

Haines Borough

Haines HS Vocational Building

Haines, AK

Operations & Maintenance Data



**JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE**  
**LOCATION: HAINES, ALASKA**  
**PREMIER ELECTRIC**  
**OPERATION & MAINTENANCE COVER SHEET**

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**JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE**  
**LOCATION: HAINES, ALASKA**  
**PREMIER ELECTRIC**  
**OPERATION & MAINTENANCE COVER SHEET**

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**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

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**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

# **Tab A**

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 02 8213 1.7 ASBESTOS ABATEMENT

Submittal Number: 1

Item: POST-WORK SUBMITTALS

Manufacturer: N/A

Installing Contractor: Absolute Services, Inc  
P.O. Box 110350  
Anchorage, AK 99511  
Phone: (907) 346-4490  
Fax: (907) 346-4991

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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**POST-PROJECT HAZARDOUS MATERIALS  
ABATEMENT SUBMITTAL  
FOR**

**HAINES HS VOC BUILDING**

**PREMIER ELECTRIC, LLC**

**ASI PROJECT NO.: 2015-026**



Absolute Services, Inc  
Post-Project Submittal  
September 28, 2015

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**POST-PROJECT HAZARDOUS MATERIALS ABATEMENT  
SUBMITTAL  
FOR**

**HAINES HS VOC BUILDING**

**ASI PROJECT NO.: 2015-026**

**Owner:**

Haines Borough  
PO Box 1209  
Haines AK 99827

**General Contractor:**

Premier Electric LLC  
PO Box 874362  
Wasilla AK 99687

**Removal Contractor:**

Absolute Services, Inc.  
P.O. Box 110350  
Anchorage, Alaska 99511-0350  
Telephone: (907) 346-4490  
Fax: (907) 346-4491



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**POST-PROJECT HAZARDOUS MATERIALS ABATEMENT  
SUBMITTAL  
FOR**

**HAINES HS VOC BUILDING**

**ASI PROJECT NO.: 2015-026**

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**POST-PROJECT HAZARDOUS MATERIALS ABATEMENT  
SUBMITTAL  
FOR**

**HAINES HS VOC BUILDING**

**ASI PROJECT NO.: 2015-026**

**Section 1 Daily Logs**

Daily Logs are attached for your review and approval.

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**Absolute Services, Inc.**

Post Office Box 110350, Anchorage, Alaska 99511

Phone: (907) 346-4490 FAX: (907) 346-4491

Daily Construction Report No. 1 Date: 6/10/15  
Project Location: Haines, Alaska  
Project Number: 2015-026  
Project Name: Haines HS Voc Building

1. WORK PERFORMED TODAY: Asbestos Work  Lead Work  PCB Work

SCOTT and Jason on site at 7:30 am. In the welding shop area we cut-out the ducting around the taping (not cutting the tape) as a non-abatement operation. Once all the ducting is outside, we notice the taping is different than most ACM Tappings and different from the mechanical Room Taping. I call signid with Carlson-Dom and she confirms that the welding shop taping testing was negative for having asbestos in it. 12:00 to 1:00 we have lunch. After lunch we start setting up the mechanical room mezzanine area. Jason runs two baseline air samples. At 3:30pm Jason and Scott begin the removal of duct taping in the mezzanine. We are wearing 1/2 face respirators and Tyvek suits. We wet the taping and then scrape it off the metal ducting and clean the ducting of any residual ACM Taping. At 5:00pm we decont-out for the night.

2. INSPECTION/TESTS PERFORMED:

Two Baseline Air samples.

SIGNED: [Signature] DATE: 6/10/15  
Project Supervisor

**Absolute Services, Inc.**

Post Office Box 110350, Anchorage, Alaska 99511

Phone: (907) 346-4490 FAX: (907) 346-4491

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Labor Classification	No.	Hours	Equipment	# of Units	Type	Total Hours
Supervisors	1	10	Trucks	1	crew cab	Day
Carpenters			Neg.Air			
Abatement Techs	1	10	Shower			
Air Monitors			Vacuum	1	HEPA	Day
Laborers			Airless			
Travel Time						

**4. INSTRUCTIONS RECEIVED OR GIVEN:**

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**5. VISITOR(S) - NAME, COMPANY, TITLE, REASON FOR VISIT, CONVERSATION:**

see 1<sup>st</sup> page for conversation with signal of carson-Dann

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**6. REMARKS - INCLUDE DEFICIENCIES DEFICIENCY CORRECTIONS & NOTES:**

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**7. JOB SAFETY EVALUATION:**

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**8. CONTRACTOR'S VERIFICATION:** The above report is complete and correct, and all material and equipment used and work performed during this reporting period is in compliance with the contract plans and specifications except as noted above.

SIGNED: John A. Peterson  
Project Supervisor

DATE: 6/10/15



## DAILY ASBESTOS PROJECT CHECKLIST

Date 6/10/15

Project Name: Haines HS Voc Building

Project #: 2015-026

**RECORDS**

YES	NO	N/A	ITEM/ TASK	COMMENT
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SUPERVISOR CARDS	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ASBESTOS WORKER CARDS	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	RESPIRATOR FIT TEST RECORDS	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	EPA NOTIFICATION	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ALASKA DOL NOTIFICATION	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SAFETY MEETING HELD	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	BULLETIN BOARD	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	CONTRACTOR'S LICENSE	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	FILL OUT VISUAL INSPECTION CHECKLIST	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	FILL OUT ALL INFORMATION ON RADIOACTIVE EXIT SIGNS	

**GENERAL SAFETY EQUIPMENT/SIGNAGE**

YES	NO	N/A	ITEM/ TASK	COMMENT
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ADEQUATE WARNING SIGNS POSTED	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	HAZARD COMMUNICATION PROGRAM	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	MSDSs ON SITE	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FIRST AID KIT (S)	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FIRE EXTINGUISHER (S)	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	CHEMICALS STORED PROPERLY	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	CHEMICALS LABELED PROPERLY	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	GFCI USED AND IN GOOD REPAIR	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EXTENTION CORDS IN GOOD CONDITION	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	CORDS SECURED / NOT IN PATHWAY	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	WORK AREA FREE OF WATER / DEBRIS	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	LADDERS IN GOOD REPAIR	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	SCAFFOLDING SET UP PROPERLY	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PORTABLE LIGHTING SUFFICIENT / SAFE	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	POSTED "NO SMOKING / EATING" SIGNS	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

**WORK AREA AND DECON**

YES	NO	N/A	ITEM/ TASK	COMMENTS
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	JOB SITE CLEAN AND FREE OF DEBRIS	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	HOUSEKEEPING PRACTICES ACCEPTABLE	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	CONTAINMENT PROPERLY SECURED	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	FULL DECON	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	WASTE LOAD OUT	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ENTRY CONTROL	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	WASTE STORAGE AREA ADEQUATE	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	SHOWER PUMP & FILTER SYSTEM WORKING	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	WATER HOSES SECURED / NOT LEAKING	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	HOT AND COLD WATER	



## DAILY ASBESTOS PROJECT CHECKLIST (CONTINUED)

### AIR MONITORING

YES	NO	N/A	ITEM/ TASK	COMMENT
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		DAILY AIR MONITORING	
			PREABATEMENT	
		<input checked="" type="checkbox"/>	AREA (HEPA, DECON, INSIDE, OUTSIDE)	
		<input checked="" type="checkbox"/>	PERSONAL (INITIAL, 30 MIN. STEL, 8 HR TWA)	
		<input checked="" type="checkbox"/>	CLEARANCE	
		<input checked="" type="checkbox"/>	POSTED DAILY	
		<input checked="" type="checkbox"/>	APPROVED LAB	
	<input checked="" type="checkbox"/>		INDEPENDENT AIR MONITORING FIRM	

### DIFFERENTIAL SYSTEMS

YES	NO	N/A	ITEM/ TASK	COMMENT
		<input checked="" type="checkbox"/>	SUFFICIENT NUMBER OF MACHINES	
		<input checked="" type="checkbox"/>	BACK-UP MACHINES	
		<input checked="" type="checkbox"/>	EQUIPMENT IN GOOD REPAIR	
		<input checked="" type="checkbox"/>	HEPA FILTER LOG ON MACHINE	
		<input checked="" type="checkbox"/>	PRE AND SECONDARY FILTERS CHANGED	
		<input checked="" type="checkbox"/>	EXHAUSTED OUTSIDE	
		<input checked="" type="checkbox"/>	MANOMETER IN USE	
		<input checked="" type="checkbox"/>	CHECK INTEGRITY OF ENCLOSURE	
		<input checked="" type="checkbox"/>	SMOKE TEST ENCLOSURE	

### PERSONAL PROTECTIVE EQUIPMENT

YES	NO	N/A	ITEM/ TASK	COMMENTS
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		TYVEK OR EQUIVALENT	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		STREET CLOTHES WORN UNDER TYVEKS	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		PROPER RESPIRATORY PROTECTION	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		RESPIRATORS APPROVED BY NIOSH / MSHA	
		<input checked="" type="checkbox"/>	BREATHING AIR MACHINE SUFFICIENT	
		<input checked="" type="checkbox"/>	300 FEET OR LESS OF AIRLINE	
		<input checked="" type="checkbox"/>	CO ALARM OPERATIONAL	
		<input checked="" type="checkbox"/>	CO ALARM CALIBRATION RECORDS	
		<input checked="" type="checkbox"/>	TRAVEL PANEL PLACED PROPERLY	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		PROPER FOOTWEAR	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		HARD HATS (IF REQUIRED)	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		EYE PROTECTION (IF REQUIRED)	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		HEARING PROTECTION (IF REQUIRED)	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		PERSONAL PROTECTIVE EQUIP. PROG. DOCS	

THIS CHECKLIST IS LIMITED IN SCOPE AND DOES NOT IMPLY APPROVAL OR WARRANTY OF SITE CONDITIONS. THE PURPOSE OF THIS CHECKLIST IS TO ASSIST IN OBSERVATION OF GENERAL WORK PRACTICES.

SIGNATURE: \_\_\_\_\_

*[Handwritten Signature]*

DATE \_\_\_\_\_

*6/10/15*

**Absolute Services, Inc.**

Post Office Box 110350, Anchorage, Alaska 99511

Phone: (907) 346-4490 FAX: (907) 346-4491

Daily Construction Report No. 2 Date: 6/11/15

Project Location: \_\_\_\_\_

Project Number: 2015-026

Project Name: Haines HS Voc Building

1. WORK PERFORMED TODAY: Asbestos Work  Lead Work  PCB Work

7:30am Scott + Jason on site. we put on PPE and re-enter the ~~mezzanine~~ mezzanine work area and continue removing duct taping using wet methods. At 11:00am we finish the tape removal and begin the fine cleaning. At 11:55 we decan-out for lunch. 1:00pm back on site. we continue the fine cleaning (HEPA vacuuming/wet wiping) until 2:30 when we finished the cleaning. we decan-out for the night.

2. INSPECTION/TESTS PERFORMED:

Personal sampling on Jason Peterson  
inside and outside work area sampling.

SIGNED: Jason Peterson  
Project Supervisor

DATE: 6/11/15



# Absolute Services, Inc.

Post Office Box 110350, Anchorage, Alaska 99511

Phone: (907) 346-4490 FAX: (907) 346-4491

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Labor Classification	No.	Hours	Equipment	# of Units	Type	Total Hours
Supervisors	1	10	Trucks	1	crew cab	Day
Carpenters			Neg. Air			
Abatement Techs	1	10	Shower			
Air Monitors			Vacuum	1	HEPA	Day
Laborers			Airless	1	Titan	Day
Travel Time						

#### 4. INSTRUCTIONS RECEIVED OR GIVEN:

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#### 5. VISITOR(S) - NAME, COMPANY, TITLE, REASON FOR VISIT, CONVERSATION:

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#### 6. REMARKS - INCLUDE DEFICIENCIES DEFICIENCY CORRECTIONS & NOTES:

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#### 7. JOB SAFETY EVALUATION:

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**8. CONTRACTOR'S VERIFICATION:** The above report is complete and correct, and all material and equipment used and work performed during this reporting period is in compliance with the contract plans and specifications except as noted above.

SIGNED:

  
Project Supervisor

DATE:

8/11/15

## DAILY ASBESTOS PROJECT CHECKLIST

Date 6/11/15

Project Name: Haines HS Voc Building

Project #: 2015-026

**RECORDS**

YES	NO	N/A	ITEM/ TASK	COMMENT
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SUPERVISOR CARDS	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ASBESTOS WORKER CARDS	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	RESPIRATOR FIT TEST RECORDS	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	EPA NOTIFICATION	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ALASKA DOL NOTIFICATION	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	SAFETY MEETING HELD	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	BULLETIN BOARD	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	CONTRACTOR'S LICENSE	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	FILL OUT VISUAL INSPECTION CHECKLIST	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	FILL OUT ALL INFORMATION ON RADIOACTIVE EXIT SIGNS	

**GENERAL SAFETY EQUIPMENT/SIGNAGE**

YES	NO	N/A	ITEM/ TASK	COMMENT
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ADEQUATE WARNING SIGNS POSTED	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	HAZARD COMMUNICATION PROGRAM	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	MSDSs ON SITE	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FIRST AID KIT (S)	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FIRE EXTINGUISHER (S)	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	CHEMICALS STORED PROPERLY	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	CHEMICALS LABELED PROPERLY	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	GFCI USED AND IN GOOD REPAIR	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EXTENTION CORDS IN GOOD CONDITION	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	CORDS SECURED / NOT IN PATHWAY	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	WORK AREA FREE OF WATER / DEBRIS	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	LADDERS IN GOOD REPAIR	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	SCAFFOLDING SET UP PROPERLY	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PORTABLE LIGHTING SUFFICIENT / SAFE	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	POSTED "NO SMOKING / EATING" SIGNS	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

**WORK AREA AND DECON**

YES	NO	N/A	ITEM/ TASK	COMMENTS
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	JOB SITE CLEAN AND FREE OF DEBRIS	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	HOUSEKEEPING PRACTICES ACCEPTABLE	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	CONTAINMENT PROPERLY SECURED	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	FULL DECON	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	WASTE LOAD OUT	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ENTRY CONTROL	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	WASTE STORAGE AREA ADEQUATE	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	SHOWER PUMP & FILTER SYSTEM WORKING	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	WATER HOSES SECURED / NOT LEAKING	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	HOT AND COLD WATER	



## DAILY ASBESTOS PROJECT CHECKLIST (CONTINUED)

### AIR MONITORING

YES	NO	N/A	ITEM/ TASK	COMMENT
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	DAILY AIR MONITORING	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	PREABATEMENT	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	AREA (HEPA, DECON, INSIDE, OUTSIDE)	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PERSONAL (INITIAL, 30 MIN. STEL, 8 HR TWA)	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	CLEARANCE	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	POSTED DAILY	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	APPROVED LAB	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	INDEPENDENT AIR MONITORING FIRM	

### DIFFERENTIAL SYSTEMS

YES	NO	N/A	ITEM/ TASK	COMMENT
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	SUFFICIENT NUMBER OF MACHINES	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	BACK-UP MACHINES	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	EQUIPMENT IN GOOD REPAIR	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	HEPA FILTER LOG ON MACHINE	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	PRE AND SECONDARY FILTERS CHANGED	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	EXHAUSTED OUTSIDE	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	MANOMETER IN USE	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	CHECK INTEGRITY OF ENCLOSURE	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	SMOKE TEST ENCLOSURE	

### PERSONAL PROTECTIVE EQUIPMENT

YES	NO	N/A	ITEM/ TASK	COMMENTS
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	TYVEK OR EQUIVALENT	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	STREET CLOTHES WORN UNDER TYVEKS	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PROPER RESPIRATORY PROTECTION	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	RESPIRATORS APPROVED BY NIOSH / MSHA	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	BREATHING AIR MACHINE SUFFICIENT	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	300 FEET OR LESS OF AIRLINE	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	CO ALARM OPERATIONAL	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	CO ALARM CALIBRATION RECORDS	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	TRAVEL PANEL PLACED PROPERLY	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PROPER FOOTWEAR	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	HARD HATS (IF REQUIRED)	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EYE PROTECTION (IF REQUIRED)	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	HEARING PROTECTION (IF REQUIRED)	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PERSONAL PROTECTIVE EQUIP. PROG. DOCS	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

THIS CHECKLIST IS LIMITED IN SCOPE AND DOES NOT IMPLY APPROVAL OR WARRANTY OF SITE CONDITIONS. THE PURPOSE OF THIS CHECKLIST IS TO ASSIST IN OBSERVATION OF GENERAL WORK PRACTICES.

SIGNATURE: \_\_\_\_\_

*[Handwritten Signature]*

DATE \_\_\_\_\_

*6/10/15*

**Absolute Services, Inc.**

Post Office Box 110350, Anchorage, Alaska 99511

Phone: (907) 346-4490 FAX: (907) 346-4491

Daily Construction Report No. 3 Date: 6/12/15

Project Location: \_\_\_\_\_

Project Number: 2015-026


Project Name: Haines HS Voc Building

**1. WORK PERFORMED TODAY:** Asbestos Work  Lead Work  PCB Work

Jason + SCOTT on site at 7:30am. We HEPA vacuum the mezzanine area again and package Bulbs and Light ballasts. At 9:00am signed Dahlberg with Carson-Dorn Fly's in from Juneau to do the visual inspection and clearance sampling. We do the inspection and then encapsulate the area. At 11:30 Final A/E sampling is started.

**2. INSPECTION/TESTS PERFORMED:**

visual inspection and clearance sampling by signed with Carson-Dorn

SIGNED:   
Project Supervisor

DATE: 6/12/15



**Absolute Services, Inc.**

Post Office Box 110350, Anchorage, Alaska 99511

Phone: (907) 346-4490 FAX: (907) 346-4491

3

Labor Classification	No.	Hours	Equipment	# of Units	Type	Total Hours
Supervisors	1	10	Trucks	1	crew cab	
Carpenters			Neg.Air			
Abatement Techs	1	10	Shower			
Air Monitors	1		Vacuum	1	HEPA	
Laborers			Airless	1	TITON	
Travel Time						

**4. INSTRUCTIONS RECEIVED OR GIVEN:**

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**5. VISITOR(S) - NAME, COMPANY, TITLE, REASON FOR VISIT, CONVERSATION:**

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**6. REMARKS - INCLUDE DEFICIENCIES DEFICIENCY CORRECTIONS & NOTES:**

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**7. JOB SAFETY EVALUATION:**

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**8. CONTRACTOR'S VERIFICATION:** The above report is complete and correct, and all material and equipment used and work performed during this reporting period is in compliance with the contract plans and specifications except as noted above.

SIGNED: James Peterson  
Project Supervisor

DATE: 6/12/15

## DAILY ASBESTOS PROJECT CHECKLIST

Date 6/12/15

Project Name: Haines HS Voc Building

Project #: 2015-026

**RECORDS**

YES	NO	N/A	ITEM/ TASK	COMMENT
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		SUPERVISOR CARDS	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		ASBESTOS WORKER CARDS	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		RESPIRATOR FIT TEST RECORDS	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	EPA NOTIFICATION	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ALASKA DOL NOTIFICATION	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	SAFETY MEETING HELD	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	BULLETIN BOARD	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	CONTRACTOR'S LICENSE	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		FILL OUT VISUAL INSPECTION CHECKLIST	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		FILL OUT ALL INFORMATION ON RADIOACTIVE EXIT SIGNS	

**GENERAL SAFETY EQUIPMENT/SIGNAGE**

YES	NO	N/A	ITEM/ TASK	COMMENT
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		ADEQUATE WARNING SIGNS POSTED	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		HAZARD COMMUNICATION PROGRAM	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		MSDSs ON SITE	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		FIRST AID KIT (S)	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		FIRE EXTINGUISHER (S)	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	CHEMICALS STORED PROPERLY	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	CHEMICALS LABELED PROPERLY	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		GFCI USED AND IN GOOD REPAIR	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		EXTENTION CORDS IN GOOD CONDITION	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		CORDS SECURED / NOT IN PATHWAY	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		WORK AREA FREE OF WATER / DEBRIS	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	LADDERS IN GOOD REPAIR	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	SCAFFOLDING SET UP PROPERLY	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		PORTABLE LIGHTING SUFFICIENT / SAFE	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	POSTED "NO SMOKING / EATING" SIGNS	

**WORK AREA AND DECON**

YES	NO	N/A	ITEM/ TASK	COMMENTS
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		JOB SITE CLEAN AND FREE OF DEBRIS	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		HOUSEKEEPING PRACTICES ACCEPTABLE	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		CONTAINMENT PROPERLY SECURED	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FULL DECON	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	WASTE LOAD OUT	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		ENTRY CONTROL	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		WASTE STORAGE AREA ADEQUATE	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	SHOWER PUMP & FILTER SYSTEM WORKING	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	WATER HOSES SECURED / NOT LEAKING	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	HOT AND COLD WATER	



## DAILY ASBESTOS PROJECT CHECKLIST (CONTINUED)

### AIR MONITORING

YES	NO	N/A	ITEM/ TASK	COMMENT
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	DAILY AIR MONITORING	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	PREABATEMENT	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	AREA (HEPA, DECON, INSIDE, OUTSIDE)	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	PERSONAL (INITIAL, 30 MIN. STEL, 8 HR TWA)	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	CLEARANCE	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	POSTED DAILY	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	APPROVED LAB	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	INDEPENDENT AIR MONITORING FIRM	

### DIFFERENTIAL SYSTEMS

YES	NO	N/A	ITEM/ TASK	COMMENT
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	SUFFICIENT NUMBER OF MACHINES	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	BACK-UP MACHINES	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	EQUIPMENT IN GOOD REPAIR	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	HEPA FILTER LOG ON MACHINE	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	PRE AND SECONDARY FILTERS CHANGED	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	EXHAUSTED OUTSIDE	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	MANOMETER IN USE	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	CHECK INTEGRITY OF ENCLOSURE	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	SMOKE TEST ENCLOSURE	

### PERSONAL PROTECTIVE EQUIPMENT

YES	NO	N/A	ITEM/ TASK	COMMENTS
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	TYVEK OR EQUIVALENT	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	STREET CLOTHES WORN UNDER TYVEKS	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PROPER RESPIRATORY PROTECTION	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	RESPIRATORS APPROVED BY NIOSH / MSHA	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	BREATHING AIR MACHINE SUFFICIENT	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	300 FEET OR LESS OF AIRLINE	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	CO ALARM OPERATIONAL	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	CO ALARM CALIBRATION RECORDS	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	TRAVEL PANEL PLACED PROPERLY	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PROPER FOOTWEAR	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	HARD HATS (IF REQUIRED)	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EYE PROTECTION (IF REQUIRED)	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	HEARING PROTECTION (IF REQUIRED)	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PERSONAL PROTECTIVE EQUIP. PROG. DOCS	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

THIS CHECKLIST IS LIMITED IN SCOPE AND DOES NOT IMPLY APPROVAL OR WARRANTY OF SITE CONDITIONS. THE PURPOSE OF THIS CHECKLIST IS TO ASSIST IN OBSERVATION OF GENERAL WORK PRACTICES.

SIGNATURE: \_\_\_\_\_

*[Handwritten Signature]*

DATE \_\_\_\_\_

*6/12/15*

**ABSOLUTE SERVICES, Inc.**

Post Office Box 110350, Anchorage, Alaska 99511 Phone: (907) 346-4490, Fax: (907) 346-4491

**Regulated Area Sign In/Out Sheet**

Project Name: Haines HS Voc Building Project No.: 2015-026 Date: 6/10/15

Regulated Area Location: mechanical room "mezzanine" Page: \_\_\_\_\_ of \_\_\_\_\_

Task Breakdown Codes

- 3160-Supervision                      3190-Pre-Cleaning                      3230-Glovebagging                      3270-Demo to Access                      3310-Clearance/Tear Down
- 3170-Mobilization                      3200-Pipe Demo                      3240-CAB Removal                      3280-PACM Debris Removal                      3320-De-Mobilization
- 3180-Set-Up/Decon Unit                      3210-VAT Removal                      3250-Fireproofing Removal                      3290-Sheetrock Demolition                      3330-Lead Disturbance Work
- 3190-Hanging Poly                      3220-Mastic Removal                      3260-Contaminated Soil Removal                      3300-Final Cleaning                      3340-Other Non-Abatement

PRINT NAME	SIGNATURE	Certification Number	TIME IN/OUT		RESP. PROT.	PROT. CLOTH.	TASK
Jason Peterson	<i>Jason Peterson</i>	5705	In: 3:30	Out: 5:00	1/2 FACE	Tyvek	Duct Taping
SCOTT mills	<i>Scott R Mills</i>	1603B	In: 3:30	Out: 5:00	1/2 FACE	Tyvek	
			In:	Out:			
			In:	Out:			
			In:	Out:			
			In:	Out:			
			In:	Out:			
			In:	Out:			
			In:	Out:			
			In:	Out:			
			In:	Out:			
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			In:	Out:			
			In:	Out:			
			In:	Out:			
			In:	Out:			
			In:	Out:			

Project Supervisor: Jason Peterson Supervisor Signature: *Jason Peterson* Date: 6/10/15



# ABSOLUTE SERVICES, Inc.

Post Office Box 110350, Anchorage, Alaska 99511 Phone: (907) 346-4490, Fax: (907) 346-4491


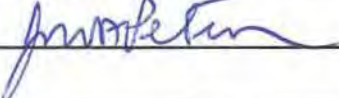
## Regulated Area Sign In/Out Sheet

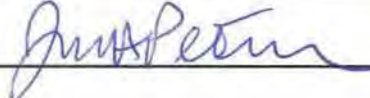
Project Name: Haines HS Voc Building Project No.: 2015-026 Date: 6/11/15

Regulated Area Location: Mechanical Room "Mezzanine" Page: \_\_\_\_\_ of \_\_\_\_\_

Task Breakdown Codes

3160-Supervision	3190-Pre-Cleaning	3230-Glovebagging	3270-Demo to Access	3310-Clearance/Tear Down
3170-Mobilization	3200-Pipe Demo	3240-CAB Removal	3280-PACM Debris Removal	3320-De-Mobilization
3180-Set-Up/Decon Unit	3210-VAT Removal	3250-Fireproofing Removal	3290-Sheetrock Demolition	3330-Lead Disturbance Work
3190-Hanging Poly	3220-Mastic Removal	3260-Contaminated Soil Removal	3300-Final Cleaning	3340-Other Non-Abatement

PRINT NAME	SIGNATURE	Certification Number	TIME IN/OUT		RESP. PROT.	PROT. CLOTH.	TASK
SCOTT MILLS		5808	In: 8:00	Out: 11:50	1/2 FACE	Tyvek	Duct Taping
			In: 1:35	Out: 2:07			
Jason Peterson		1603	In: 8:05	Out: 11:58	1/2 FACE	Tyvek	
			In: 1:35	Out: 2:30			
			In:	Out:			
			In:	Out:			
			In:	Out:			
			In:	Out:			
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			In:	Out:			

Project Supervisor: Jason Peterson Supervisor Signature:  Date: 6/11/15

**ABSOLUTE SERVICES, Inc.**

Post Office Box 110350, Anchorage, Alaska 99511 Phone: (907) 346-4490, Fax: (907) 346-4491

**Regulated Area Sign In/Out Sheet**

Project Name: Haines HS Voc Building Project No.: 2015-026 Date: \_\_\_\_\_

Regulated Area Location: Mechanical Room - Mezzanine Page: \_\_\_\_\_ of \_\_\_\_\_

Task Breakdown Codes

- |                        |                     |                                |                           |                            |
|------------------------|---------------------|--------------------------------|---------------------------|----------------------------|
| 3160-Supervision       | 3190-Pre-Cleaning   | 3230-Glovebagging              | 3270-Demo to Access       | 3310-Clearance/Tear Down   |
| 3170-Mobilization      | 3200-Pipe Demo      | 3240-CAB Removal               | 3280-PACM Debris Removal  | 3320-De-Mobilization       |
| 3180-Set-Up/Decon Unit | 3210-VAT Removal    | 3250-Fireproofing Removal      | 3290-Sheetrock Demolition | 3330-Lead Disturbance Work |
| 3190-Hanging Poly      | 3220-Mastic Removal | 3260-Contaminated Soil Removal | 3300-Final Cleaning       | 3340-Other Non-Abatement   |

PRINT NAME	SIGNATURE	Certification Number	TIME IN/OUT		RESP. PROT.	PROT. CLOTH.	TASK
SCOTT mills			In: _____	Out: _____	1/2 FACE	Tyvek	
Jason Peterson			In: _____	Out: _____			
			In: _____	Out: _____			
			In: _____	Out: _____			
			In: _____	Out: _____			
			In: _____	Out: _____			
			In: _____	Out: _____			
			In: _____	Out: _____			
			In: _____	Out: _____			
			In: _____	Out: _____			
			In: _____	Out: _____			
			In: _____	Out: _____			
			In: _____	Out: _____			
			In: _____	Out: _____			
			In: _____	Out: _____			
			In: _____	Out: _____			
			In: _____	Out: _____			
			In: _____	Out: _____			
			In: _____	Out: _____			
			In: _____	Out: _____			

Project Supervisor: \_\_\_\_\_ Supervisor Signature: Jason Peterson Date: \_\_\_\_\_





**POST-PROJECT HAZARDOUS MATERIALS ABATEMENT  
SUBMITTAL  
FOR**

**HAINES HS VOC BUILDING**

**ASI PROJECT NO.: 2015-026**

**Section 2 Notifications**

Notifications are attached for your review and approval.

**Absolute Services, Inc.**  
P.O. Box 110350, Anchorage, Alaska 99511  
(907) 346-4490 Facsimile (907) 346-4491

June 4, 2015

**State of Alaska Department of Labor**  
ATTN: Ms. Patty Gall  
3301 Eagle Street, Suite 301  
Anchorage, Alaska 99510-7020

Re: Original Notification      Worker Notification

Ms. Gall:  
Absolute Services, Inc. is submitting the name(s) of the following personnel to be utilized for asbestos abatement on the below mentioned project:


**Project Name & Location:** Haines HS Voc Building (604 Haines Hwy, Haines AK 99827)  
**ASI Project Number:** 2015-033  
**General Contractor:** Premier Electric, LLC  
**Removal Contractor:** Absolute Services, Inc.  
**Project Duration:** June 10- June 13  
**Changes:** N/A

Name	Cert. Card #	Exp. Date		Name	Cert. Card #	Exp. Date
Jason Peterson	00001683	2/6/16		Scott Mills	00005808	1/6/16

Item Number	Material Description	Type of Removal	Quantity of Material	Location of Material
1	Ducting with Asbestos-Containing taping	Class II	Approx 20 locations at 8 ft per location	Per drawing HAZ103
2	Mercury Bulbs and PCB Ballast	Class II	100 fixtures	Per drawing E103

If you have any questions, please contact me at (907) 346-4490

Sincerely,



Office Manager  
Absolute Services Inc.

INITIAL ASBESTOS PLAN APPROVAL

DATE: 6/4/15

APPROVED BY: Preston B

STATE OF ALASKA - DOL/OSH  
MAINTAIN AT WORKSITE

**POST-PROJECT HAZARDOUS MATERIALS ABATEMENT  
SUBMITTAL  
FOR**

**HAINES HS VOC BUILDING**

**ASI PROJECT NO.: 2015-026**

**Section 3 Air Monitoring**

Air Monitoring documents are attached for your review and approval.



# Platt Environmental Inc.

6731 East 99<sup>th</sup> Avenue  
Anchorage, Alaska 99507  
Telephone (907) 222-2974, Fax: (907) 222-2974

**Air Monitoring Data Sheet  
for Asbestos  
7400 Method**

Project Name: Haines Voc Ed Building  
ASI Project # 2015-026  
Client Name: Absolute Services, Inc.  
Abatement Contractor: Absolute Services, Inc.  
Samples Collected by: Jason Peterson  
Analyzed By: Ben Woods

Date Sampled: June 10-11, 2015  
Date Received: July 01, 2015  
Date Analyzed: July 03, 2015

**AIHA Lab # 173900**

Comments: Air samples collected by Jason Peterson of ASI and Analyzed by Platt Environmental.

Indoor/outdoor Temp (F) am: 0 pm: 0  
Blank #1 Count Fiber/mm2:0 Blank #2 Count Fiber/mm2:0 Filter Diameter: 25mm  
Microscope Field Area: 0.00785 Blank Count Ave.= 0

Sample ID: BL-01 Sample Type: Pre Abate Protection: Decon Equip: Pump#: Rotometer #: Cal date:	Location: Mechanical room Work Performed: Pre abate sample  Time Start: 1330 Flow Start 10 L/M Stop Time: 1530 Flow Stop 10 L/M Liters: 1200 Fiber/Field: 0/100 F/mm: 00.000  Total Minutes: 120 #of samples included: 1 <b>f/cc: OVERLOAD</b> <b>LOD: 0.000</b>
Sample ID: BL-02 Sample Type: Pre Abate Protection: Decon Equip: Pump#: Rotometer #: Cal date:	Location: Mechanical room at ladder going up Work Performed: Pre abate sample  Time Start: 1332 Flow Start 10 L/M Stop Time: 1532 Flow Stop 10 L/M Liters: 1200 Fiber/Field: 58/100 F/mm: 73.885  Total Minutes: 120 #of samples included: 1 <b>f/cc: 0.024</b> <b>LOD: 0.002</b>
Sample ID: OA-01 Sample Type: OWA Protection: Decon Equip: Pump#: Rotometer #: Cal date:	Location: Below mezzanine at ladder Work Performed: Duct tape removal  Time Start: 0800 Flow Start 10 L/M Stop Time: 1215 Flow Stop 10 L/M Liters: 2550 Fiber/Field: 50/100 F/mm: 63.694  Total Minutes: 255 #of samples included: 1 <b>f/cc: 0.010</b> <b>LOD: 0.001</b>
Sample ID: OA-02 Sample Type: OWA Protection: Decon Equip: Pump#: Rotometer #: Cal date:	Location: Outside area sample Work Performed: Duct tape removal  Time Start: 1310 Flow Start 10 L/M Stop Time: 1440 Flow Stop 10 L/M Liters: 900 Fiber/Field: 0/100 F/mm: 00.000  Total Minutes: 90 #of samples included: 1 <b>f/cc: OVERLOAD</b> <b>LOD: 0.000</b>
Sample ID: IA-01 Sample Type: IWA Protection: Decon Equip: Pump#: Rotometer #: Cal date:	Location: Inside area sample Work Performed: Duct tape removal  Time Start: 0805 Flow Start 10 L/M Stop Time: 1155 Flow Stop 10 L/M Liters: 2300 Fiber/Field: 0/100 F/mm: 00.000  Total Minutes: 230 #of samples included: 1 <b>f/cc: OVERLOAD</b> <b>LOD: 0.000</b>

Sample ID: IA-02 Sample Type: IWA Protection: Decon Equip: Pump#: Rotometer #: Cal date:	Location: Inside area sample Work Performed: Duct tape removal  Time Start: 1315      Flow Start 10 L/M Stop Time: 1428      Flow Stop 10 L/M Liters: 730    Fiber/Field: 0/100    F/mm: 00.000  <b>Total Minutes: 73</b> <b>#of samples included: 1</b> <b>f/cc: OVERLOAD</b> <b>LOD: 0.000</b>
Sample ID: EL-01 Sample Type: Exc Protection: Half face Decon Equip: Pump#:LV9 Rotometer #: Cal date:	Location: Work area Work Performed: Duct tape removal  Time Start: 0815      Flow Start 2 L/M Stop Time: 0845      Flow Stop 2 L/M Liters: 60    Fiber/Field: 9.5/100    F/mm: 12.102 <b>Jason Peterson Cert#038-42-3299</b>  <b>Total Minutes: 30</b> <b>#of samples included: 1</b> <b>f/cc 0.078</b> <b>LOD: 0.045</b>
Sample ID: P-01 Sample Type: BZ Protection: Half face Decon Equip: Pump#:LV9 Rotometer #: Cal date:	Location: Work area Work Performed: Duct tape removal  Time Start: 0848      Flow Start 2 L/M Stop Time: 1210      Flow Stop 2 L/M Liters: 60    Fiber/Field: 33.5/100    F/mm: 42.675 <b>Jason Peterson Cert#038-42-3299</b>  <b>Total Minutes: 202</b> <b>#of samples included: 1</b> <b>f/cc 0.041</b> <b>LOD: 0.007</b>
Sample ID: P-02 Sample Type: BZ Protection: Half face Decon Equip: Pump#:LV9 Rotometer #: Cal date:	Location: Work area Work Performed: Duct tape removal  Time Start: 1335      Flow Start 2 L/M Stop Time: 1435      Flow Stop 2 L/M Liters: 120    Fiber/Field: 11.5/100    F/mm: 14.650 <b>Jason Peterson Cert#038-42-3299</b> <b>TWA: 0.028</b>  <b>Total Minutes: 60</b> <b>#of samples included: 1</b> <b>f/cc 0.047</b> <b>LOD: 0.022</b>
Sample ID: CB-1 <sup>st</sup> FB1 Sample Type: BLK	Location: Field Blank Work Performed: Duct tape removal Fiber/Field: 0/100      F/mm: 0  <b>#of samples included: 1</b> <b>cc: 0.00</b>
Sample ID: CB-1 <sup>st</sup> FB2 Sample Type: BLK	Location: Field Blank Work Performed: Duct tape removal Fiber/Field: 0/100      F/mm: 0  <b>#of samples included: 1</b> <b>cc: 0.00</b>

Sample Types

EL- Excursion , CL- Clearance, B - Breathing Zone, H- Hepa Exhaust , N- Neg. Air Exhaust, XCL- Aggressive Clearance, O- Outside Work Area, PRE- Pre-abatement, IWA -Inside Work Area, BL – Field Blank, ENV - Environmental

Respiratory Protection

PD Pressure Demand, S- Supplied Air, CF- Continuous Flow, BH- Breathing Hood, PAPR- Powered Air Purifier, F- Full Face Negative Air Pressure, H- Half Face Negative Air Pressure

Decontamination


DS-Decon w/shower, D-Decon w/o Shower, DBS –double stuff, HEPA- 3 stage Station

Environmental

H- Hepa Vacuum, N-Negative Pressure Enclosure, O-No containment, C-Controlled area

This analysis was carried out to the approved 7400 method. This laboratory is in compliance with the quality specified by the method

Analysts Signature:





# Platt Environmental Inc.

Office 907-222-2974 Cell 230-5736 Email: [jbw@ak.net](mailto:jbw@ak.net) or [plattenv@gci.net](mailto:plattenv@gci.net)

## Chain of Custody

*PAGET*

Date: 6/10/15 P.O.#: \_\_\_\_\_

Client Name: Absolute Services Inc Project #: 2015-026

Project Name: Aaines AS VOC-ED BIDg

Billing Address: PO Box 110350 Anchorage AK 99511

Phone: 907-346-4400 Cell: \_\_\_\_\_

Reports to be e-mailed to: jasonp@absolutenw.com / Tracy@absolutenw.com

Samples Relinquished by: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_

Samples Received by: Ben Woods Date: 7/1/15 Time: 10 Am

Turn-Around Time: Same Day Next Day 2-Day 3-Day 5-Day

Sample #	Collection Date	TAT	Analysis	Volum e (L)	Start Time (Air)	Stop Time (Air)	Total Time (min)	Flow Rate
BL-01	6/10		PCM		1:30	3:30		10
BL-02	6/10		PCM		1:32	3:32		10
OA-01	6/10		PCM		8:00	12:05		10
EL-01	6/11		PCM		8:15	8:45		2
P-01	6/11		PCM		8:48	12:10		2
OA-02	6/11		PCM		1:10	2:40		10





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# Platt Environmental Inc.

Office 907-222-2974 Cell 230-5736 Email: [jbw@ak.net](mailto:jbw@ak.net) or [plattenv@gci.net](mailto:plattenv@gci.net)

## Chain of Custody

Date: \_\_\_\_\_ P.O.#: \_\_\_\_\_

Client Name: Absolute Services Inc Project #: \_\_\_\_\_

Project Name: \_\_\_\_\_

Billing Address: PO Box 110350 Anchorage AK 99511

Phone: 907-346-4400 Cell: \_\_\_\_\_

Reports to be e-mailed to: jasonj@absoluteenv.com / Tracy@absoluteenv.com

Samples Relinquished by: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_

Samples Received by: Ben Woods Date: 7/1/15 Time: 10 AM

Turn-Around Time: Same Day Next Day 2-Day 3-Day 5-Day

Sample #	Collection Date	TAT	Analysis	Volume (L)	Start Time (Air)	Stop Time (Air)	Total Time (min)	Flow Rate
IA-01	6/11	1	PCM		8:05	11:55		10
IA-02	6/11		PCM		1:15	2:28		10
<del>IA-03</del>								
P-02	6/11		PCM		1:35	2:35		2



PROJECT NAME _____
LOCATION _____ PROJECT NO. _____
CLIENT <u>ABSOLUTE SERVICES INC.</u> DATE _____
CLIENT PROJECT# _____ SHEET 1.0 OF _____

### FIELD DATA SHEET - ASBESTOS AIR MONITORING

ANALYSIS REQUESTED (circle) PCM	TURNAROUND REQUESTED	NUMBER OF SAMPLES	ROTOMETER IDENTIFICATION
COLLECTED BY (signature)	COLLECTION DATE	SELECTED LABORATORY <b>PEI</b>	ANALYST SIGNATURE
RELINQUISHED BY	DATE/TIME	SAMPLES RECEIVED BY	DATE/TIME

Lab ID#	Sample ID#	Location/Name of Worker	Cert #	START TIME	FLOW (l/min)	FIBERS/FIELDS	RESULTS Fibers/cc
	BL-01	Baseline in mechanical room		1:30	10	1200	0 LD
	Sample Type	Task		STOP TIME 3:30	FLOW (l/min)	VOLUME (L)	
	Pump ID#	SSN # and PPE		TOTAL TIME 120	AVG. FLOW		
		<b>OVERLOAD</b>					
	BL-02	Baseline below mechanical room at ladder going up		1:32	10	1200	.024
	Sample Type	Task		STOP TIME 3:32	FLOW (l/min)	VOLUME (L)	
	Pump ID#	SSN # and PPE		TOTAL TIME 120	AVG. FLOW		
	OA-01	Below mezzanine at ladder		8:00	10	2550	.010
	Sample Type	Task		STOP TIME 12:15	FLOW (l/min)	VOLUME (L)	
	Pump ID#	SSN # and PPE		TOTAL TIME 255	AVG. FLOW		
	EL-01	Jason Peterson	1603	8:15	2	600	.077
	Sample Type	Task		STOP TIME 8:45	FLOW (l/min)	VOLUME (L)	
	Pump ID#	SSN # and PPE		TOTAL TIME 30	AVG. FLOW		
		<b>Excursion</b> Duct taping removal 1/2 FACE/Tyvek					
	P-01	Jason Peterson		8:48	2	404	.041
	Sample Type	Task		STOP TIME 12:10	FLOW (l/min)	VOLUME (L)	
	Pump ID#	SSN # and PPE		TOTAL TIME 202	AVG. FLOW		
		<b>Personal</b> 1/2 FACE/Tyvek					
	OA-02	Outside area sample		1:10	10	900	0 LD
	Sample Type	Task		STOP TIME 2:40	FLOW (l/min)	VOLUME (L)	
	Pump ID#	SSN # and PPE		TOTAL TIME 90	AVG. FLOW		
		<b>OVERLOAD</b>					
	IA-01	Inside work area		8:05	10	2300	0 LD
	Sample Type	Task		STOP TIME 11:55	FLOW (l/min)	VOLUME (L)	
	Pump ID#	SSN # and PPE		TOTAL TIME 230	AVG. FLOW		
		<b>OVERLOAD</b>					
	IA-02	Inside work area		1:15	10	730	0 LD
	Sample Type	Task		STOP TIME 2:28	FLOW (l/min)	VOLUME (L)	
	Pump ID#	SSN # and PPE		TOTAL TIME 73	AVG. FLOW		
		<b>OVERLOAD</b>					
	P-02	Jason Peterson		1:35	2	120	.046
	Sample Type	Task		STOP TIME 2:35	FLOW (l/min)	VOLUME (L)	
	Pump ID#	SSN # and PPE		TOTAL TIME 60	AVG. FLOW		
		<b>Fine cleaning</b> 1/2 FACE/Tyvek					

**POST-PROJECT HAZARDOUS MATERIALS ABATEMENT  
SUBMITTAL  
FOR**

**HAINES HS VOC BUILDING**

**ASI PROJECT NO.: 2015-026**

**Section 4 Disposal**

Disposal documents are attached for your review and approval.

**A. Generator Information**

EPA ID CESQG Generator ABS1000-54 Generator Status CESQG

Generator Name HAINES BOROUGH Phone (907) 766-2231  
 Site Address 604 HAINES HIGHWAY City ST Zip HAINES, AK 99827 Fax \_\_\_\_\_  
 Contact/Title KRISTA KIELSMEIER Sulfide Producing Industry: N

**B. Shipping Information**

Proper Shipping Name MERCURY  
 DOT ID UN2809 Hazard Class 8 Packing Group III ERG 172 RQ \_\_\_\_\_

**C. Regulatory Information**

Name of Material FLUORESCENT LIGHT TUBES (STRAIGHT) Generating Proces OUT OF SERVICE  
 Form Code W320 Source Code G15 Origin Code 1 System Code H141  
 EPA Codes \_\_\_\_\_ State Codes \_\_\_\_\_  
 Container Type \_\_\_\_\_ Number of Units \_\_\_\_\_ Frequency \_\_\_\_\_

**D. Chemical / Constituent Composition**

Constituent	PPM	% Volume
FLUORESCENT LIGHT TUBES		100

Constituent	PPM	% Volume
Mercury	>0.2	

**E. Physical Characteristics**

Physical State (Including Range) % Liquid \_\_\_\_\_ % Sludges/Solid \_\_\_\_\_ / 100 Bi-Layer Liqui N Color VARIES  
 Odor / Describe NONE Specific Gravity N/A BTUs / Lb N/A pH:  <= 2  >2 and <12.5  >=12.5  N/A  
 FlashPt:  <100F (38C)  100-140F (38-60C)  141-200F (61-93C)  >200F (93C)  None

**F. Comments**

- \*UNIVERSAL WASTE INTACT BULBS - ALL LENGTHS - STRAIGHT BULBS.
- \*PACKAGED TO DOT SPECIFICATIONS.
- \*ADD'L CHARGES FOR TUBES WITH SHATTER SHIELDS.

**Generator's Certification**

HAINES BOROUGH  
 604 HAINES HIGHWAY  
 HAINES, AK 99827

I hereby certify that the above and attached description is complete and accurate to the best of my knowledge and ability to determine that no deliberate or willful omissions of composition properties exist and that all known or suspected hazards have been disclosed. I certify that the materials tested are representative of all material described by this profile.

Generator's Authorized Signature: \_\_\_\_\_ Date \_\_\_\_\_

Name (Print) \_\_\_\_\_ Title \_\_\_\_\_

**TSDF's Certification**

TOTAL RECLAIM  
 12050 INDUSTRY WAY  
 ANCHORAGE, AK 99515

As an authorized representative of Emerald Services, Inc. I certify, by my signature below, that Emerald Services, Inc. has the necessary permits to accept and properly manage the waste stream identified above.

TSDF's Authorized Signature: \_\_\_\_\_ Date \_\_\_\_\_

Reviewer Information Only VOC Level 1  < 11.1 psia  >= 11.1 psia  NA At Risk Waste Steam \_\_\_\_\_  
 Process  Storage  FB  OB  RY  RR  AF  UW  RY150  MT Initials \_\_\_\_\_



Purchase Order 34990

**NON-HAZARDOUS WASTE MANIFEST**

2015-026

Please print or type (Form designed for use on elite (12 pitch) typewriter)

<b>NON-HAZARDOUS WASTE MANIFEST</b>		1. Generator's US EPA ID No. C E S Q G		Manifest Document No. 9 4 0 7 2	2. Page 1 of 2	
3. Generator's Name and Address HAINES BOROUGH PO BOX 1209 HAINES, AK 99827		Site Address HAINES BOROUGH 604 HAINES HIGHWAY HAINES, AK 99827		KRISTA KIELSMEIER		
4. Generator's Phone (907) 766-2231		6. US EPA ID Number E X E M P T		A. State Transporter's ID		
5. Transporter 1 Company Name WINGS OF ALASKA		8. US EPA ID Number A K R 0 0 0 2 0 0 2 9 5		B. Transporter 1 Phone (907) 790-3100		
7. Transporter 2 Company Name ACE AIR CARGO		10. US EPA ID Number		C. State Transporter's ID		
9. Designated Facility Name and Site Address TOTAL RECLAIM 12050 INDUSTRY WAY ANCHORAGE, AK 99515				D. Transporter 2 Phone (907) 334-5100		
				E. State Facility's ID		
				F. Facility's Phone (907) 561-0544		
11. WASTE DESCRIPTION		Containers		13. Total Quantity		14. Unit Wt./Vol.
HM		No.	Type			
a. UN2809, MERCURY, 8, PGIII, ERG#172 X		2	CF	Drum 160 Box 76		113 50 P *
b.						
c.						
d.						
G. Additional Descriptions for Materials Listed Above		H. Handling Codes for Wastes Listed Above				
1) TR0001 FLUORESCENT LIGHT TUBES (STRAIGHT)						
15. Special Handling Instructions and Additional Information Shipper's Certification: This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.						
16. GENERATOR'S CERTIFICATION: I hereby certify that the contents of this shipment are fully and accurately described and are in all respects in proper condition for transport. The materials described on this manifest are not subject to federal hazardous waste regulations.						
Printed/Typed Name Duncan Barry		Signature <i>[Signature]</i>		Date 6   15   15		
17. Transporter 1 Acknowledgement of Receipt of Materials		Printed/Typed Name Jesse Ashda		Signature <i>[Signature]</i>		Date 06   15   15
18. Transporter 2 Acknowledgement of Receipt of Materials		Printed/Typed Name SIMONE		Signature <i>[Signature]</i>		Date 06   18   15
19. Discrepancy Indication Space						
20. Facility Owner or Operator: Certification of receipt of the waste materials covered by this manifest, except as noted in item 19.						
Printed/Typed Name Jake Sneddon		Signature <i>[Signature]</i>		Date 6   22   15		

NON-HAZARDOUS WASTE GENERATOR

TRANSPORTER FACILITY



Purchase Order 34990

**NON-HAZARDOUS WASTE MANIFEST**

2015-026

Please print or type (Form designed for use on elite (12 pitch) typewriter)

<b>NON-HAZARDOUS WASTE MANIFEST</b>		1. Generator's US EPA ID No. C E S Q G		Manifest Document No. 94072		2. Page 1 of 2	
3. Generator's Name and Mailing Address HAINES BOROUGH PO BOX 1209 HAINES, AK 99827		Site Address HAINES BOROUGH 604 HAINES HIGHWAY HAINES, AK 99827		KRISTA KIELSMEIER			
4. Generator's Phone (907) 766-2231							
5. Transporter 1 Company Name WINGS OF ALASKA		6. US EPA ID Number E X E M P T		A. State Transporter's ID		B. Transporter 1 Phone (907) 790-3100	
7. Transporter 2 Company Name ACE AIR CARGO		8. US EPA ID Number A K R 0 0 0 2 0 0 2 9 5		C. State Transporter's ID		D. Transporter 2 Phone (907) 334-5100	
9. Designated Facility Name and Site Address TOTAL RECLAIM 12050 INDUSTRY WAY ANCHORAGE, AK 99515		10. US EPA ID Number		E. State Facility's ID		F. Facility's Phone (907) 561-0544	
11. WASTE DESCRIPTION				Containers		13. Total Quantity	14. Unit Wt./Vol.
a. UN2809, MERCURY, 8, PGIII, ERG#172				No. 2		Type CF	165 113 50P
b.							
c.							
d.							
G. Additional Descriptions for Materials Listed Above 1) TR001 FLUORESCENT LIGHT TUBES (STRAIGHT)				H. Handling Codes for Wastes Listed Above			
15. Special Handling Instructions and Additional Information Shipper's Certification: This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.							
16. GENERATOR'S CERTIFICATION: I hereby certify that the contents of this shipment are fully and accurately described and are in all respects in proper condition for transport. The materials described on this manifest are not subject to federal hazardous waste regulations.							
Printed/Typed Name Duncan Barry				Signature <i>[Signature]</i>		Date 6   15   15	
17. Transporter 1 Acknowledgement of Receipt of Materials				Signature <i>[Signature]</i>		Date 06   15   15	
18. Transporter 2 Acknowledgement of Receipt of Materials				Signature <i>[Signature]</i>		Date 06   18   15	
19. Discrepancy Indication Space							
20. Facility Owner or Operator: Certification of receipt of the waste materials covered by this manifest, except as noted in item 19.				Signature <i>[Signature]</i>		Date 6   22   15	

NON-HAZARDOUS WASTE

GENERATOR

TRANSPORTER

FACILITY



## Certificate of Disposal / Recycle

Prepared by NRCC Alaska  
On behalf of Total Reclaim, Inc.

**GENERATOR:** Haines Borough  
604 Haines Highway  
Haines, AK 99827

**DISPOSAL FACILITY:** TOTAL RECLAIM  
12101 INDUSTRY WAY  
ANCHORAGE, ALASKA

**EPA ID NUMBER:** CESQG

**MANIFEST/DOCUMENT #:** 94072  
**DATE OF DISPOSAL/RECYCLE:** 6/22/2015

<u>LINE</u>	<u>WASTE DESCRIPTION</u>	<u>CONTAINERS</u>	<u>TYPE</u>	<u>QUANTITY</u>	<u>UOM</u>
1	Fluorescent Light Tubes	2	CF	163	P

*I certify on behalf of the above listed recycling facility, that to the best of my knowledge the above described wastes were managed in compliance with all applicable laws, regulations, permits and licenses.*

**PREPARED BY:** Roxanne Pedersen / Senior Project Manager / NRC Alaska

**SIGNATURE:** Roxanne Pedersen **DATE:** 7/1/2015

*Your Local Partner for Recycling and Environmental Services.*

**A. Generator Information**

EPA ID CESQG Generator ABS1000-54 Generator Status CESQG

Generator Name HAINES BOROUGH Phone (907) 766-2231  
 Site Address 604 HAINES HIGHWAY City ST Zip HAINES, AK 99827 Fax \_\_\_\_\_  
 Contact/Title KRISTA KIELSMEIER Sulfide Producing Industry: N

**B. Shipping Information**

Proper Shipping Name POLYCHLORINATED BIPHENYLS, SOLID  
(MARINE POLLUTANT)  
 DOT ID UN3432 Hazard Class 9 Packing Group II ERG 171 RQ 1

**C. Regulatory Information**

Name of Material PCB LIGHT BALLAST Generating Proces OUT OF SERVICE  
 Form Code W309 Source Code G15 Origin Code 2 System Code \_\_\_\_\_  
 EPA Codes ISCA State Codes \_\_\_\_\_  
 Container Type \_\_\_\_\_ Number of Units \_\_\_\_\_ Frequency \_\_\_\_\_

**D. Chemical / Constituent Composition**

Constituent	PPM	% Volume
BALLAST		100

Constituent	PPM	% Volume
POLYCHLORINATED BIPHENYLS	>500	

**E. Physical Characteristics**

Physical State (Including Range) % Liquid \_\_\_\_\_ % Sludges/Solid \_\_\_\_\_ / 100 Bi-Layer Liqui N Color VARIES  
 Odor / Describe NONE Specific Gravity N/A BTUs / Lb N/A pH:  <= 2  >2 and <12.5  >=12.5  N/A  
 FlashPt:  <100F (38C)  100-140F (38-60C)  141-200F (61-93C)  >200F (93C)  None

**F. Comments**

**Generator's Certification**

HAINES BOROUGH  
 604 HAINES HIGHWAY  
 HAINES, AK 99827

I hereby certify that the above and attached description is complete and accurate to the best of my knowledge and ability to determine that no deliberate or willful omissions of composition properties exist and that all known or suspected hazards have been disclosed. I certify that the materials tested are representative of all material described by this profile.

Generator's Authorized Signature: \_\_\_\_\_ Date \_\_\_\_\_

Name (Print) \_\_\_\_\_ Title \_\_\_\_\_

**TSDF's Certification**

US ECOLOGY IDAHO, INC.  
 20400 LEMLEY RD  
 GRAND VIEW, ID 83624

As an authorized representative of Emerald Services, Inc. I certify, by my signature below, that Emerald Services, Inc. has the necessary permits to accept and properly manage the waste stream identified above.

TSDF's Authorized Signature: \_\_\_\_\_ Date \_\_\_\_\_

Reviewer Information Only VOC Level 1  < 11.1 psia  >= 11.1 psia  NA At Risk Waste Steam \_\_\_\_\_  
 Process  Storage  FB  OB  RY  RR  AF  UW  RY150  MT Initials \_\_\_\_\_



PCB CONTROL SHEET

MANIFEST # 004786321FLE

Generator: HAINES BOROUGH  
 Site Address: 604 HAINES HIGHWAY, HAINES, AK 99827  
 EPA ID#: 40CFRPART761 Page 1 of 1

For US Ecology Use Only													
Load #:											Received:		

1	2	3	4	5	6	7	8	9	10	11	12	13	14
WSID# <small>Required</small>	QTY <small>Required</small>	PKG <small>Required</small>	TYPE OF MATERIAL <small>Required</small>	D/F <small>Required</small>	MANUF <small>Required</small>	MANIFEST LINE # <small>Required</small>	SERIAL # / UNIQUE # <small>Required</small>	KVA	WEIGHT K <small>Required</small>	DIELECT VOL	PPM <small>Required</small>	OSD <small>Required</small>	ABSORBENTS ADDED
15593-1	1	55DM	BALLAST	X	X	1	94072-01	X	<del>145 KG</del> 145 KG	X	>500	6/15/15	NO

**Explanation:**

<p>1. <b>WSID #:</b> US Ecology approved waste stream ID#.</p> <p>2. <b>QTY:</b> Enter quantity.</p> <p>3. <b>PKG:</b> Enter packaging type-same as container type.</p> <p>4. <b>Type of Material:</b> Enter description of material. Be specific.</p> <p>5. <b>D/F:</b> Specify if the transformer or article is full (F), drained (D), or drained &amp; flushed (D/F).</p> <p>6. <b>Manuf:</b> Enter manufacturer.</p> <p>7. <b>Manifest Line#:</b> For each item, indicate which line # of the manifest it is shipped on.</p> <p>8. <b>Serial # / Unique#:</b> Enter the nameplate serial number for transformers or articles or a unique number for each container. (Note: If there is no name plate serial #, you must assign a unique number to each container.)</p>	<p>9. <b>KVA:</b> Enter the nameplate KVA rating of the transformer or article.</p> <p>10. <b>Weight K:</b> Enter the weight in kilograms.</p> <p>11. <b>Dielect Vol.:</b> Enter the nameplate dielectric volume of the transformer or article.</p> <p>12. <b>PPM:</b> Enter the parts per million PCB contained in the material.</p> <p>13. <b>OSD:</b> Enter the date the material was removed from service and designated for disposal [761.65(a), 761.180(a), 761.207(a)].</p> <p>14. <b>Absorbents Added:</b> Specify non-biodegradable absorbents added.</p>
--	--

**REQUIRED CERTIFICATION:** In order for US Ecology to accept the waste material specified at the US Ecology – Grand View, Idaho or Beatty, Nevada facility the undersigned, as an authorized employee of the generating company, hereby warrants and certifies to US Ecology that the waste material listed above, delivered to and accepted for disposal by US Ecology shall conform to the above description and that all waste material and packaging shall comply with all current state and federal regulations.

Name: Douglas Barry Signature: [Signature] Title: Project Supervisor Date: 6-15-15

Note: A Completed PCB Control Sheet, including generator's signature, must accompany each shipment of regulated PCB waste.

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

004786321 FLE

Contract# 7619

Form Approved. OMB No. 2050-0039

<b>UNIFORM HAZARDOUS WASTE MANIFEST</b>		1. Generator ID Number CESQG / 40CFRPart761	2. Page 1 of 4	3. Emergency Response Phone 1-800-424-9300	4. Manifest Tracking Number <b>004786321 FLE</b>					
5. Generator's Name and Mailing Address HAINES BOROUGH PO BOX 1209 HAINES, AK 99827 (907) 766-2231			Generator's Site Address (if different than mailing address) HAINES BOROUGH 604 HAINES HIGHWAY HAINES, AK 99827							
6. Transporter 1 Company Name WINGS OF ALASKA				U.S. EPA ID Number EXEMPT						
7. Transporter 2 Company Name ACE AIR CARGO				U.S. EPA ID Number AKR000200295						
8. Designated Facility Name and Site Address US ECOLOGY IDAHO, INC. 20400 LEMLEY RD GRAND VIEW, ID 83624 (208) 834-2275				U.S. EPA ID Number IDD073114654						
GENERATOR	9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))		10. Containers No.	Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes		
	X	1. RQ, UN3432, POLYCHLORINATED BIPHENYLS, SOLID, 9, PGII, RQ=1, (MARINE POLLUTANT), ERG#171		1	DM	*TN 91 146	*TN 115 146	TSCA		
		2.								
		3.								
		4.								
14. Special Handling Instructions and Additional Information 1)USE15593-1 PCB LIGHT BALLAST Drum # 94072-01 Out-of-Service <u>6/10/15</u>										
15. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent. I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.										
* Generator's/Offoror's Printed/Typed Name Duncan Barry		Signature 				Month Day Year 16   15   15				
16. International Shipments <input type="checkbox"/> Import to U.S. <input type="checkbox"/> Export from U.S. Port of entry/exit: _____ Transporter signature (for exports only): _____ Date leaving U.S.: _____										
TRANSPORTER	17. Transporter Acknowledgment of Receipt of Materials		Transporter 1 Printed/Typed Name Jessie Ashton		Signature 		Month Day Year 16   15   15			
			Transporter 2 Printed/Typed Name Simone		Signature 		Month Day Year 16   18   15			
DESIGNATED FACILITY	18. Discrepancy									
	18a. Discrepancy Indication Space <input type="checkbox"/> Quantity <input type="checkbox"/> Type <input type="checkbox"/> Residue <input type="checkbox"/> Partial Rejection <input type="checkbox"/> Full Rejection									
	18b. Alternate Facility (or Generator) Manifest Reference Number: _____ U.S. EPA ID Number _____									
	18c. Signature of Alternate Facility (or Generator) _____ Month Day Year _____									
19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)										
1.		2.		3.		4.				
20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a										
Printed/Typed Name				Signature				Month Day Year		



Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST (Continuation Sheet)		21. Generator ID Number C E S Q G	22. Page 2 / 4	23. Manifest Tracking Number 004786321FLE		
24. Generator's Name  (907) 766-2231		HAINES BOROUGH 604 HAINES HIGHWAY HAINES, AK 99827				
25. Transporter <u>3</u>	Company Name NRC ALASKA LLC	U.S. EPA ID Number AKR000004184				
26. Transporter <u>4</u>	Company Name WEAVER BROTHERS	U.S. EPA ID Number AKD002848372				
27a. HM	27b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	28. Containers		29. Total Quantity	30. Unit Wt./Vol.	31. Waste Codes
		No.	Type			
32. Special Handling Instructions and Additional Information						
33. Transporter <u>3</u> Acknowledgment of Receipt of Materials						
Printed/Typed Name Tawni Neeser		Signature Tawni Neeser			Month Day Year 16   18   15	
34. Transporter <u>4</u> Acknowledgment of Receipt of Materials						
Printed/Typed Name H WORTH		Signature H Worth			Month Day Year 16   26   15	
35. Discrepancy						
36. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)						

GENERATOR

TRANSPORTER

DESIGNATED FACILITY



Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST (Continuation Sheet)		21. Generator ID Number C E S Q G		22. Page 3 / 4		23. Manifest Tracking Number 004786321FLE				
24. Generator's Name HAINES BOROUGH 604 HAINES HIGHWAY (907) 766-2231 HAINES, AK 99827										
25. Transporter <u>5</u> Company Name TOTEM OCEAN TRAILER EXPRESS							U.S. EPA ID Number WAD070397955			
26. Transporter <u>6</u> Company Name EMERALD SERVICES, INC.							U.S. EPA ID Number WAD058364647			
27a. HM	27b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))			28. Containers		29. Total Quantity	30. Unit Wt./Vol.	31. Waste Codes		
				No.	Type					
32. Special Handling Instructions and Additional Information										
TRANSPORTER	33. Transporter <u>5</u> Acknowledgment of Receipt of Materials									
	Printed/Typed Name				Signature			Month Day Year		
TRANSPORTER	34. Transporter <u>6</u> Acknowledgment of Receipt of Materials									
	Printed/Typed Name				Signature			Month Day Year		
DESIGNATED FACILITY	35. Discrepancy									
DESIGNATED FACILITY	36. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)									

24072 (REV)

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved. OMB No. 2050-0039

<b>UNIFORM HAZARDOUS WASTE MANIFEST</b> (Continuation Sheet)	21. Generator ID Number <b>C E S Q G</b>	22. Page 4 / 4	23. Manifest Tracking Number <b>004786321FLE</b>
---	---	-------------------	---

24. Generator's Name  (907) 766-2231	HAINES BOROUGH 604 HAINES HIGHWAY HAINES, AK 99827
--	--

25. Transporter <u>7</u> Company Name <b>STEVE FORLER TRUCKING</b>	U.S. EPA ID Number <b>IDR000205625</b>
---	---

26. Transporter <u>8</u> Company Name	U.S. EPA ID Number
---------------------------------------	--------------------

27a. HM	27b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	28. Containers		29. Total Quantity	30. Unit Wt./Vol.	31. Waste Codes			
		No.	Type						

32. Special Handling Instructions and Additional Information
--

33. Transporter <u>7</u> Acknowledgment of Receipt of Materials	Signature	Month	Day	Year
Printed/Typed Name				

34. Transporter <u>8</u> Acknowledgment of Receipt of Materials	Signature	Month	Day	Year
Printed/Typed Name				

35. Discrepancy

36. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

GENERATOR

TRANSPORTER

DESIGNATED FACILITY

Previous editions are obsolete.

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 02 8213 1.7 ASBESTOS ABATEMENT

Submittal Number: 1

Item: POST-WORK SUBMITTALS

Manufacturer: N/A

Installing Contractor: Absolute Services, Inc  
P.O. Box 110350  
Anchorage, AK 99511  
Phone: (907) 346-4490  
Fax: (907) 346-4991

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

# **Tab B**



**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 21 1300 1.4 D FIRE SUPPRESSION SPRINKLERS

Submittal Number: 1

Item: Product Information

Manufacturer: Ames & Tyco

Installing Contractor: 907 Fire Protection, Inc.  
3060 N. Lazy Eight Ct. Ste. 2-179  
Wasilla, AK 99654  
Phone: (907) 223-4381  
Fax: (907) 745-5507

Supplier/Parts Source: Ferguson Fire & Fab  
1702 Ship Ave..  
Anchorage, AK 99501  
Phone: (907) 929-7782  
Fax: (907) 929-1745

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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# Haines High School

## Vocational Building Upgrades 2015

### Operations & Maintenance Instructions

### Fire Suppression System

#### Service Company

#### **907 Fire Protection, Inc.**

3060 N. Lazy Eight Ct. Ste 2-179

Wasilla, AK 99654

907.223.4381

[907fireprotection@gmail.com](mailto:907fireprotection@gmail.com)

#### Suppliers

#### **Ferguson Fire & Fab**

1702 Ship Ave.

Anchorage, AK 99501

Phone 907.929.7782

Fax 907.929.1745

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# **Table of Contents**

<b>Ames C200 Double Check Valve Assembly</b>	<b>3</b>
<b>Tyco TY-L Horizontal Sidewall Sprinkler</b>	<b>11</b>
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<b>Backflow Test Report - Annual</b>	<b>27</b>

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# Colt™ Series C200, C200N

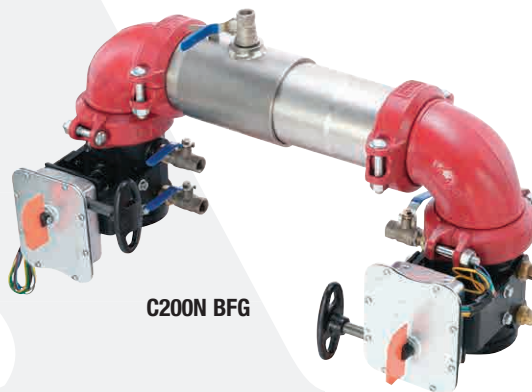
## Double Check Valve Assemblies

Sizes: 2½" – 10" (65 – 250mm)

**LEAD FREE\***



C200 OSY



C200N BFG

### Features

- Extremely Compact Design
- 70% Lighter than Traditional Designs
- 304 (Schedule 40) Stainless Steel Housing & Sleeve
- Groove Fittings Allow Integral Pipeline Adjustment
- Patented Tri-Link Check Provides Lowest Pressure Loss
- Unmatched Ease of Serviceability
- Available with Grooved Butterfly Valve Shutoffs
- Available for Horizontal, Vertical or N Pattern Installations
- Replaceable Check Disc Rubber

The Colt C200, C200N Double Check Valve Assemblies are used to prevent backflow of pollutants, that are objectionable but not toxic, from entering the potable water supply system. The Colt C200, C200N may be installed under continuous pressure service and may be subjected to backpressure. The Colt C200, C200N consists of two independently operating check valves, two shutoff valves, and four test cocks. For use in non-health hazard applications. The Colt C200, C200N features Lead Free\* construction to comply with Lead Free\* installation requirements.

### Specifications

The Colt C200, C200N Double Check Valve Assembly shall consist of two independent Tri-Link Check modules within a single housing, sleeve access port, four test cocks and two drip tight shutoff valves. Tri-Link Checks shall be removable and serviceable, without the use of special tools. The housing shall be constructed of 304 (Schedule 40) stainless steel pipe with groove end connections. Tri-Link checks shall have reversible elastomer discs and in operation shall produce drip tight closure against the reverse flow of liquid caused by backpressure or backsiphonage. Lead Free\* Double Check Valve Assembly shall be constructed using Lead Free\* materials. It shall comply with state codes and standards, where applicable, requiring reduced lead content. Assembly shall be a Colt C200, C200N as manufactured by the Ames Company.

**NOTICE**

The information contained herein is not intended to replace the full product installation and safety information available or the experience of a trained product installer. You are required to thoroughly read all installation instructions and product safety information before beginning the installation of this product.

\*The wetted surface of this product contacted by consumable water contains less than 0.25% of lead by weight.

Job Name \_\_\_\_\_ Contractor \_\_\_\_\_

Job Location \_\_\_\_\_ Approval \_\_\_\_\_

Engineer \_\_\_\_\_ Contractor's P.O. No. \_\_\_\_\_

Approval \_\_\_\_\_ Representative \_\_\_\_\_

Ames Fire & Waterworks product specifications in U.S. customary units and metric are approximate and are provided for reference only. For precise measurements, please contact Ames Fire & Waterworks Technical Service. Ames Fire & Waterworks reserves the right to change or modify product design, construction, specifications, or materials without prior notice and without incurring any obligation to make such changes and modifications on Ames Fire & Waterworks products previously or subsequently sold.

## Configurations

- Horizontal
- Vertical up
- “N” pattern horizontal

## Materials

- Housing & Sleeve: 304 (Schedule 40) Stainless Steel
- Elastomers: EPDM, Silicone and Buna ‘N’
- Tri-Link Checks: Noryl®, Stainless Steel
- Check Discs: Reversible Silicone or EPDM
- Test Cocks: Bronze Body Nickel Plated
- Pins & Fasteners: 300 Series Stainless Steel
- Springs: Stainless Steel

## Available Models

Suffix:

NRS - non-rising stem resilient seated gate valves

OSY - UL/FM outside stem and yoke, resilient seated gate valves

BFG - UL/FM grooved gear operated butterfly valves with tamper switch

\*OSY FxG - Flanged inlet gate connection and grooved outlet gate connection

\*OSY GxF - Grooved inlet gate connection and flanged outlet gate connection

\*OSY GxG - Grooved inlet gate connection and grooved outlet gate connection

Available with grooved NRS gate valves - consult factory\*

Post indicator plate and operating nut available - consult factory\*

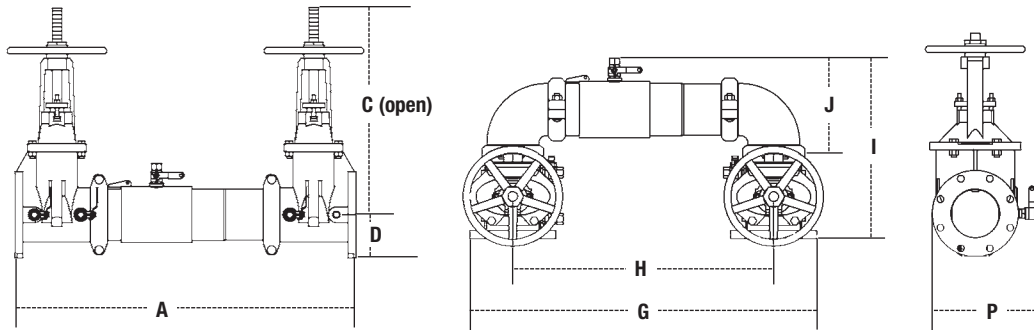
\*Consult factory for dimensions

## Pressure — Temperature

Temperature Range: 33°F – 140°F (0.5°C – 60°C)

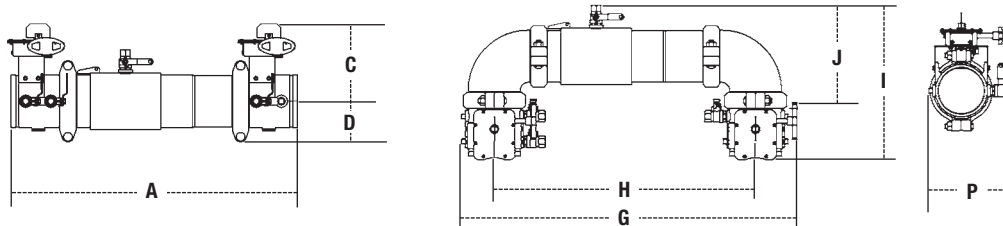
Maximum Working Pressure: 175psi (12.1 bar)

## Dimensions — Weights



**C200, C200N**

SIZE (DN)		DIMENSIONS										WEIGHT															
in.	mm	A	C (OSY)	C (NRS)	D	G	H	I	J	P	C200NRS	C200OSY	C200NRS	C200OSY													
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	lbs.	kgs.	lbs.	kgs.	lbs.	kgs.						
2½	65	30¾	781	16¾	416	9¾	238	3½	89	29⅞	738	21½	546	15½	393	8⅜	223	9½	234	115	52	125	57	123	56	133	60
3	80	31¾	806	18¾	479	10¼	260	3⅞	94	30¼	768	22¼	565	17⅞	435	9⅞	233	10½	267	131	59	145	66	144	65	158	72
4	100	33¾	857	22¾	578	12¾	310	4	102	33	838	23½	597	18½	470	9⅞	252	11¾	284	161	73	161	73	184	83	184	83
6	150	43½	1105	30¾	765	16	406	5½	140	44¾	1137	33¼	845	23¾	589	13⅞	332	15	381	273	124	295	134	314	142	336	152
8	200	49¾	1264	37¾	959	19⅞	506	6⅞	170	54¾	1375	40¾	1019	27⅞	697	15⅞	399	17¾	437	438	199	480	218	513	233	555	252
10	250	57¾	1467	45¾	1162	23⅞	605	8¾	208	66	1676	49½	1257	32½	826	17¾	440	20	508	721	327	781	354	891	404	951	431



**C200BFG, C200NBFG**

SIZE (DN)		DIMENSIONS										WEIGHT									
in.	mm	A	C	D	G	H	I	J	P	C200BFG	C200NBFG										
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	lbs.	kgs.	lbs.	kgs.						
2½	65	27¾	705	8	203	3½	89	29⅞	759	21½	546	14⅞	379	8⅜	223	9	229	56	25	64	29
3	80	28¾	718	8⅞	211	3⅞	94	30⅞	779	22¼	565	15⅞	392	9⅞	233	9½	241	54	24	67	30
4	100	29	737	8⅞	227	3⅞	94	31⅞	811	23½	597	16¼	412	9⅞	252	10	254	61	28	84	38
6	150	36½	927	10	254	5	127	43⅞	1097	33¼	845	19⅞	500	13⅞	332	10½	267	117	53	157	71
8	200	42¾	1086	12¼	311	6½	165	51⅞	1297	40⅞	1019	23¾	592	15⅞	399	14¾	361	261	118	337	153



# Approvals

- Approved by the Foundation for Cross-Connection Control and Hydraulic Research at The University of Southern California (FCCCHR-USC)

For additional approval information please contact the factory or visit our website at [www.amesfirewater.com](http://www.amesfirewater.com)



1015



B64.5



(\*\*BFG & OSY Only)



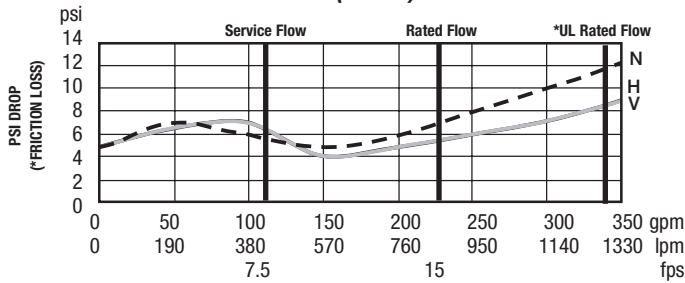
Approved



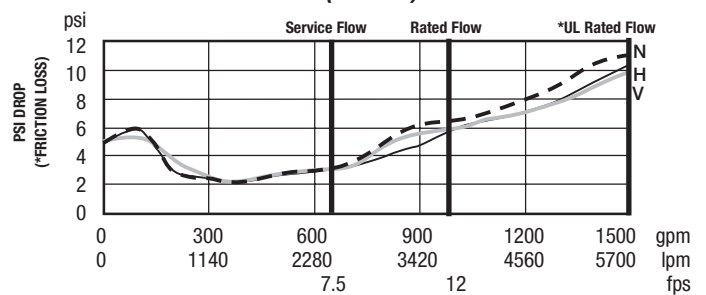
Certified to NSF/ANSI 61-G

\_\_\_\_\_ Horizontal    \_\_\_\_\_ Vertical    - - - - - N - Pattern

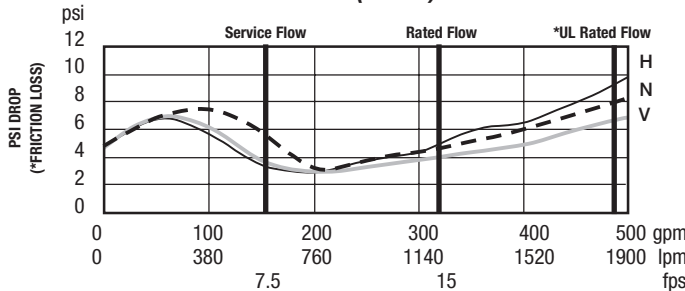
**2 1/2" (65mm)**



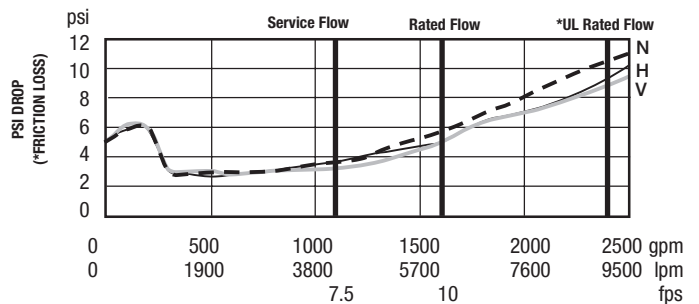
**6" (150mm)**



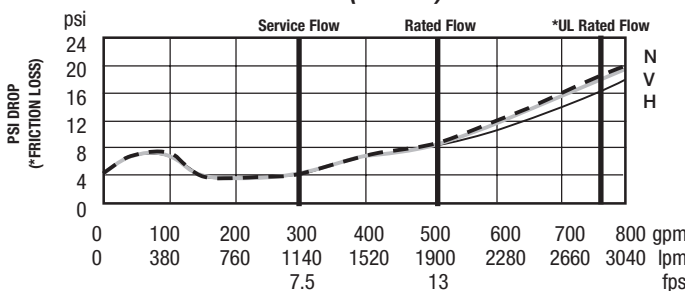
**3" (80mm)**



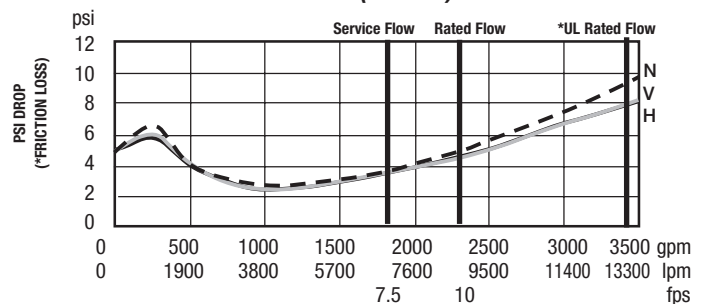
**8" (200mm)**



**4" (100mm)**



**10" (250mm)**



# Capacity

UL/FM Certified Flow Characteristics

Flow characteristics collected using butterfly shutoff valves.

**Flow capacity chart identifies valve performance based upon rated water velocity up to 25fps**

- Service Flow is typically determined by a rated velocity of 7.5fps based upon schedule 40 pipe.
- Rated Flow identifies maximum continuous duty performance determined by AWWA.
- UL Flow Rate is 150% of Rated Flow and is not recommended for continuous duty.
- AWWA Manual M22 [Appendix C] recommends that the maximum water velocity in services be not more than 10fps.

**NOTICE**

Inquire with governing authorities for local installation requirements



*A Watts Water Technologies Company*

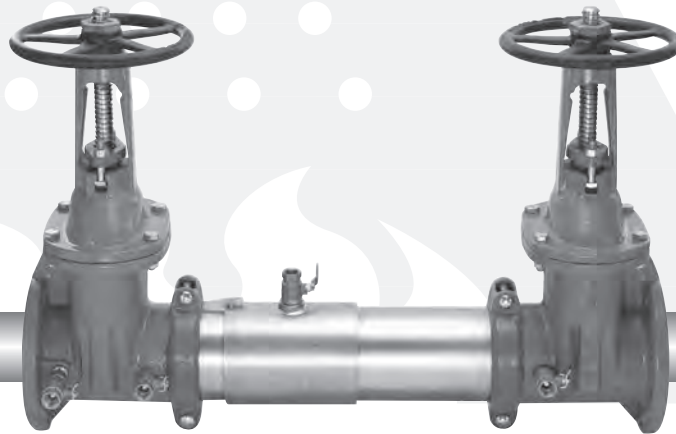
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**USA: Backflow** Tel: (978) 689-6066 • Fax: (978) 975-8350 • [AmesFireWater.com](http://AmesFireWater.com)  
**USA: Control Valves** Tel: (713) 943-0688 • Fax: (713) 944-9445 • [AmesFireWater.com](http://AmesFireWater.com)  
**Canada:** Tel: (905) 332-4090 • Fax: (905) 332-7068 • [AmesFireWater.ca](http://AmesFireWater.ca)  
**Latin America:** Tel: (52) 81-1001-8600 • Fax: (52) 81-8000-7091 • [AmesFireWater.com](http://AmesFireWater.com)

# Installation, Maintenance, & Repair Colt™ Series C200, C300

Double Check Valve Assemblies  
Double Check Detector Assemblies

Sizes: 2½" – 10" (65 – 250mm)



C200 OSY

## ⚠ WARNING



Read this Manual **BEFORE** using this equipment.  
Failure to read and follow all safety and use information  
can result in death, serious personal injury, property  
damage, or damage to the equipment.  
Keep this Manual for future reference.



Local building or plumbing codes may require modifications to the information provided. You are required to consult the local building and plumbing codes prior to installation. If this information is not consistent with local building or plumbing codes, the local codes should be followed.

**Need for Periodic Inspection/Maintenance:** This product must be tested periodically in compliance with local codes, but at least once per year or more as service conditions warrant. Corrosive water conditions, and/or unauthorized adjustments or repair could render the product ineffective for the service intended. Regular checking and cleaning of the product's internal components helps assure maximum life and proper product function.

## Testing

For field testing procedure, refer to Ames installation sheets IS-A-ATG-1 found on [www.amesfirewater.com](http://www.amesfirewater.com).

For other repair kits and service parts, refer to our Backflow Prevention Products Repair Kits & Service Parts price list PL-A-RP-BPD found on [www.amesfirewater.com](http://www.amesfirewater.com).

For technical assistance, contact your local Ames representative.

## NOTICE

Inquire with governing authorities for local installation requirements

## NOTICE

For Australia and New Zealand, line strainers should be installed between the upstream shutoff valve and the inlet of the backflow preventer.

It's important that this device be tested periodically in compliance with local codes, but at least once per year or more as service conditions warrant. If installed on a fire sprinkler system, all mechanical checks, such as alarm checks and backflow preventers, should be flow tested and inspected internally in accordance with NFPA 13 and NFPA 25.

## NOTICE

Due to shipping, storage, and general handling, the Victaulic Coupling for the shutoff valves may have loosened and should be retightened during installation.

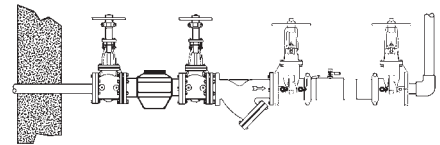
**WARNING:** This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.  
**For more information:** [www.watts.com/prop65](http://www.watts.com/prop65)

# Basic Installation Instructions

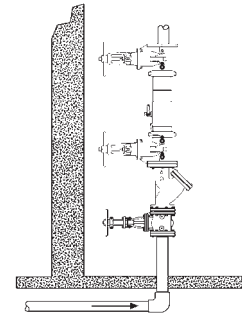
## Guidelines

Most field problems occur because dirt and debris present in the system at the time of installation becomes trapped in the check valves. **The system should be flushed before the valve is installed.** If the system is not flushed until after the valve is installed, remove both check modules from the valve and open the inlet shutoff to allow water to flow for a sufficient time to flush debris from the water line. If debris in the water system continues to cause fouling, a strainer can be installed upstream of the backflow assembly.

The Series C200 and C300 may be installed in either horizontal or vertical position as long as the backflow assembly is installed in accordance with the direction of the flow arrow on the assembly and the local water authority approves the installation. The assembly should be installed with adequate clearance around the valve to allow for inspection, testing and servicing. 12" (300mm) should be the minimum clearance between the lower portion of the assembly and the floor or grade.



Horizontal Installation



Vertical Installation

### NOTICE

Assembly body should not be painted.

## Maintenance Instructions 2<sup>1</sup>/<sub>2</sub>" – 6" (65 – 150mm)



Figure A

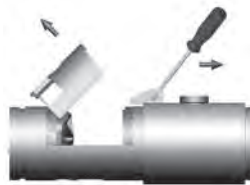


Figure B



Figure C



Figure D



Figure E



Figure F

## Instructions

### ⚠ WARNING

Prior to servicing any Ames valve, it is mandatory to shut down the water system by closing both the inlet and outlet shutoff valves. After shutoff valves are closed, open test cock #2, #3 & #4 to relieve pressure within the backflow assembly.

- After #3 test cock has been opened to relieve pressure, remove #3 test cock from housing. (Figure A)
- Insert a #3 screwdriver through the hole on the top of the cover sleeve and using both hands rotate the cover sleeve approximately 1/4-turn clockwise and 1/4-turn counter-clockwise to break the sleeve O-ring seals. Using the screwdriver, slowly slide the cover sleeve to the downstream side of the housing. (Figure B)
- Remove the stainless steel check retainer from the housing. (Figure B)
- Remove the #1 check module (Figure C) by inserting two flat blade screwdrivers into the slots on either side of the check module and gently pry the check module toward the open zone.
- Remove #2 check module with the same instructions as in #4 above. For servicing 6" (150mm) checks see 8" – 10" (200 – 250mm) instructions on p.3.
- To clean or inspect either check module, insert a #3 screwdriver through the downstream side of the check module as shown in Figure D & E. When the screwdriver is in place, remove the "E"-clip (Figure F) and pin connecting the structural members and the check clapper will open with no tension.
- Thoroughly clean the seating area. The sealing disc may be removed, if necessary, by removing the screws connecting the keeper plate to the clapper. The sealing disc may be reversed and reinstalled if the elastomer is cut or damaged.
- Wash check module and O-ring and inspect for any damage. If damaged, reinstall new parts.
- After thorough cleaning, lubricate O-ring w/FDA approved lubricant, replace pin and "E"-clip in structural members, remove screw driver and reinstall check modules and assemble housing in reverse order of these instructions.



# Maintenance Instructions 8" – 10" (200 – 250mm)

## Material/Tool Requirements:

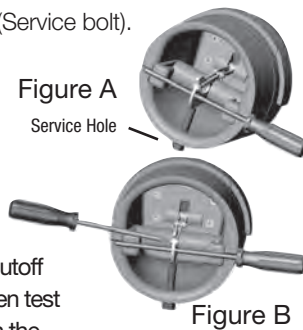
- #4 Phillips screwdriver or  $\frac{3}{8}$ " diameter rod, length sufficient to span diameter of check, see Figures A and B.
- $\frac{1}{2}$  – 13" x 5" fully threaded hex bolt (Service bolt).
- $\frac{3}{4}$ " open end or socket wrench.

## Instructions:

### ⚠ WARNING

Prior to servicing any Ames valve, it is mandatory to shut down the water system by closing both the inlet and outlet shutoff valves. After shutoff valves are closed, open test cock #2, #3 & #4 to relieve pressure within the backflow assembly.

1. After #3 test cock has been opened to relieve pressure, remove #3 test cock from housing. When repairing an 8" or 10" (200 or 250mm) device, remove both Victaulic couplers from body. Slide the downstream Victaulic coupler gasket to the downstream side of the housing. The upstream Victaulic coupler gasket stays in place.



2. Remove checks to be maintained.
3. Locate the service hole and thread in the service bolt by hand until it contacts the linkage. (Figure A)
4. Continue to thread in service bolt with the wrench until the service hole in the linkage is aligned with the service notches on the spring arbors. (Figure A)
5. Insert the Phillips screwdriver through the arbors and service hole of the linkage making sure that the tip of the screwdriver extends past the ends of the arbors by a minimum of  $\frac{1}{4}$ " (6mm). (Figure B)
6. Back out the service bolt until load is transferred to the screwdriver. Continue to back out the service bolt until sufficient clearance is achieved to remove the complete spring mechanism.
7. To disconnect linkage, remove retaining clip and pin (store in a safe location for reinstallation).
8. To remove spring mechanism, grasp the screwdriver at the center and pull complete assembly straight out and store in a safe place.
9. Reinstall in reverse.

### ⚠ WARNING

While the spring mechanism is removed for check servicing; never pull the screwdriver out or off the support notches on the arbors. Doing so may cause bodily injuries.

## Testing — Double Check Valve Assemblies

### Test Check Valve No. 1

- Step 1: Ensure shutoff #1 is open, shutoff #2 is closed.
- Step 2: Connect high side hose to test cock #3, low side to test cock #2 and open both test cock #2 and test cock #3.
- Step 3: Open valve C, then open A to bleed air from the high side. Close valve A, then open B to bleed low side. Close valve B.
- Step 4: Connect vent hose loosely to test cock #1. Open valve A to vent air from vent hose, Tighten vent hose at test cock #1, open test cock #1.
- Step 5: Close shutoff #1. Slowly loosen hose at test cock #2 until differential gauge rises to 2psi and retighten hose. If the differential reading does not decrease, record check valves as "tight".

### Test Check Valve No. 2

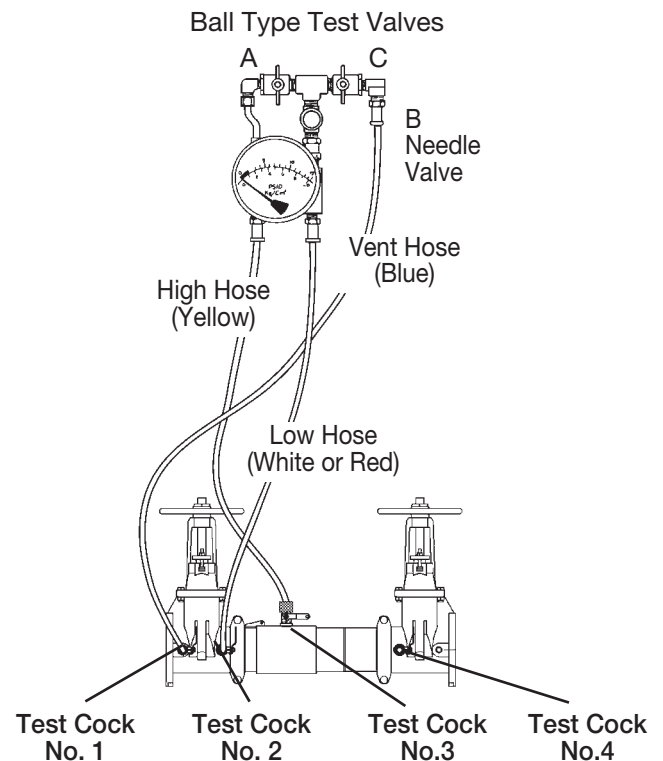
- Step 1: Move the high side hose to test cock #4, low side to test cock #3 and open both test cock #3 and test cock #4. Remove vent hose from test cock #1, open shutoff #1.
- Step 2: Open valve C, then open valve A to bleed air from the high side. Close valve A, then open valve B to bleed low side. Close valve B.
- Step 3: Connect vent hose loosely to test cock #1. Open valve A to vent air from the vent hose. Tighten vent hose at test cock #1, open test cock #1.
- Step 4: Close shutoff #1, and then slowly loosen hose at test cock #3 until differential gauge rises to 2psi and retighten hose. If the differential reading does not decrease, record check as tight. Remove all hoses and restore valve to original working condition.

### NOTICE

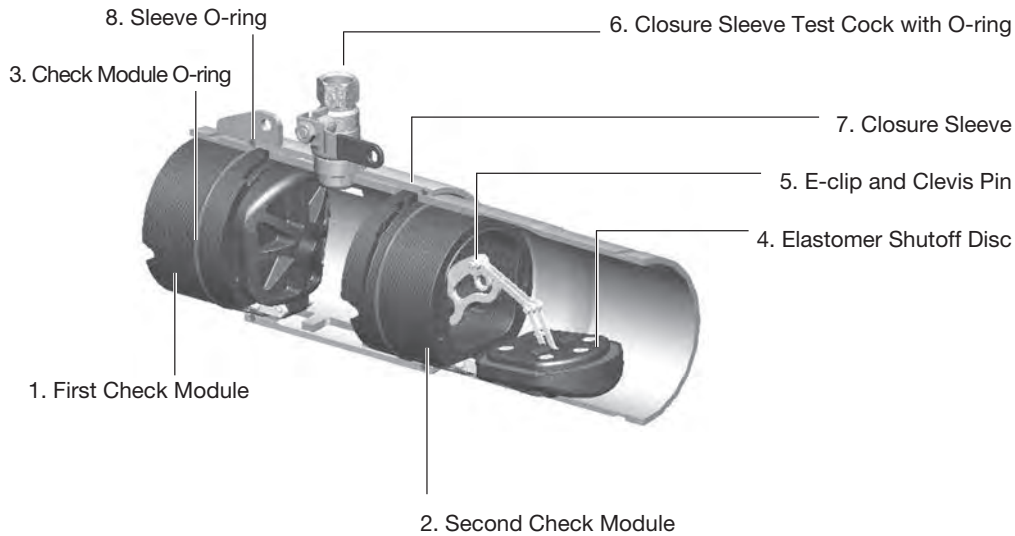
The assembly will fail both the first and second check valve tests above, if shutoff #2 leaks excessively. To test for a leaky #2 shutoff, use the following procedure.

### Test for Leaky No. 2 shutoff

- Step 1: Connect the high side to test cock #1, low side to test cock #4. Open test cock #1 and test cock #4. Close shutoffs #1 and #2.
- Step 2: Close valve C. Open valve A, then open valve B  $\frac{1}{2}$  turn, loosen hose at test cock #4 to remove air. Retighten hose.
- Step 3: If the differential gauge rises above 0, there is excessive leakage at shutoff #2 and it must be replaced to test the assembly.



# Parts



For repair kits and parts, refer to our Backflow Prevention Products Repair Kits & Service Parts price list PL-A-RP-BPD found on [www.amesfirewater.com](http://www.amesfirewater.com).

**Limited Warranty:** Ames Fire & Waterworks (the "Company") warrants each product to be free from defects in material and workmanship under normal usage for a period of one year from the date of original shipment. In the event of such defects within the warranty period, the Company will, at its option, replace or recondition the product without charge.

**THE WARRANTY SET FORTH HEREIN IS GIVEN EXPRESSLY AND IS THE ONLY WARRANTY GIVEN BY THE COMPANY WITH RESPECT TO THE PRODUCT. THE COMPANY MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED. THE COMPANY HEREBY SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

The remedy described in the first paragraph of this warranty shall constitute the sole and exclusive remedy for breach of warranty, and the Company shall not be responsible for any incidental, special or consequential damages, including without limitation, lost profits or the cost of repairing or replacing other property which is damaged if this product does not work properly, other costs resulting from labor charges, delays, vandalism, negligence, fouling caused by foreign material, damage from adverse water conditions, chemical, or any other circumstances over which the Company has no control. This warranty shall be invalidated by any abuse, misuse, misapplication, improper installation or improper maintenance or alteration of the product.

Some States do not allow limitations on how long an implied warranty lasts, and some States do not allow the exclusion or limitation of incidental or consequential damages. Therefore the above limitations may not apply to you. This Limited Warranty gives you specific legal rights, and you may have other rights that vary from State to State. You should consult applicable state laws to determine your rights. **SO FAR AS IS CONSISTENT WITH APPLICABLE STATE LAW, ANY IMPLIED WARRANTIES THAT MAY NOT BE DISCLAIMED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO ONE YEAR FROM THE DATE OF ORIGINAL SHIPMENT.**



[www.amesfirewater.com](http://www.amesfirewater.com)



A Watts Water Technologies Company

USA: Backflow- Tel: (916) 928-0123 • Fax: (916) 928-9333

Control Valves- Tel: (713) 943-0688 • Fax: (713) 944-9445

Canada: Tel: (905) 332-4090 • Fax: (905) 332-7068

# Series TY-L – 5.6 K-factor Horizontal Sidewall Sprinkler Standard Response, Standard Coverage

## General Description

TYCO Series TY-L 5.6K Standard Response, Standard Coverage, Horizontal Sidewall (HSW) Sprinklers are solder-type spray sprinklers designed for use in light and ordinary hazard, commercial occupancies such as banks, hotels, shopping malls, offices, etc. They are designed for installation along a wall or the side of a beam and just beneath a smooth ceiling. Horizontal sidewall sprinklers are commonly used instead of pendent or upright sprinklers due to aesthetics or building construction considerations where piping across the ceiling is not desirable.

Corrosion-resistant coatings, where applicable, are utilized to extend the life of copper alloy sprinklers beyond that which would otherwise be obtained when exposed to corrosive atmospheres. Although corrosion resistant coated sprinklers have passed the standard corrosion tests of the applicable approval agencies, the testing is not representative of all possible corrosive atmospheres. Consequently, it is recommended that the end user be consulted with respect to the suitability of these coatings for any given corrosive environment. The effects of ambient temperature, concentration of chemicals, and gas/chemical velocity, should be considered, as a minimum, along with the corrosive nature of the chemical to which the sprinklers will be exposed.

### IMPORTANT

Always refer to Technical Data Sheet TFP700 for the "INSTALLER WARNING" that provides cautions with respect to handling and installation of sprinkler systems and components. Improper handling and installation can permanently damage a sprinkler system or its components and cause the sprinkler to fail to operate in a fire situation or cause it to operate prematurely.

### NOTICE

The Series TY-L Sprinklers described herein must be installed and maintained in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (NFPA), in addition to the standards of any other authorities having jurisdiction. Failure to do so may impair the performance of these devices.

The owner is responsible for maintaining their fire protection system and devices in proper operating condition. Contact the installing contractor or product manufacturer with any questions.

## Sprinkler Identification Numbers (SINs)

TY3311 – HSW 5.6K, 1/2" NPT

TY3311 is a redesignation for Star SIN S1803 and Gem SIN G3113.

## Technical Data

### Approvals

UL and C-UL Listed  
FM Approved

(Refer to Table A for complete approval information.)

### Maximum Working Pressure

175 psi (12,1 bar)

### Discharge Coefficient

K=5.6 gpm/psi<sup>1/2</sup> (80,6 lpm/bar<sup>1/2</sup>)

### Temperature Ratings

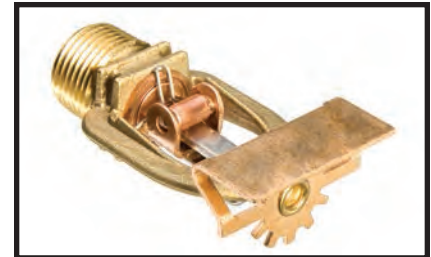
Refer to Table A.

### Finishes

Sprinkler: Refer to Table A.

### Physical Characteristics

Frame	Brass
Strut	MONEL
Deflector	Bronze
Hook	Bronze/MONEL
Fusible Element	Solder, Copper, Stainless Steel
Ejection Spring	Stainless Steel
Sealing Button	Bronze w/TEFLON

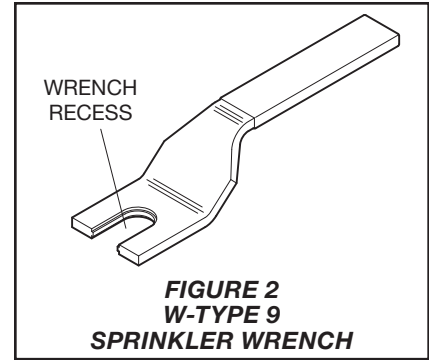
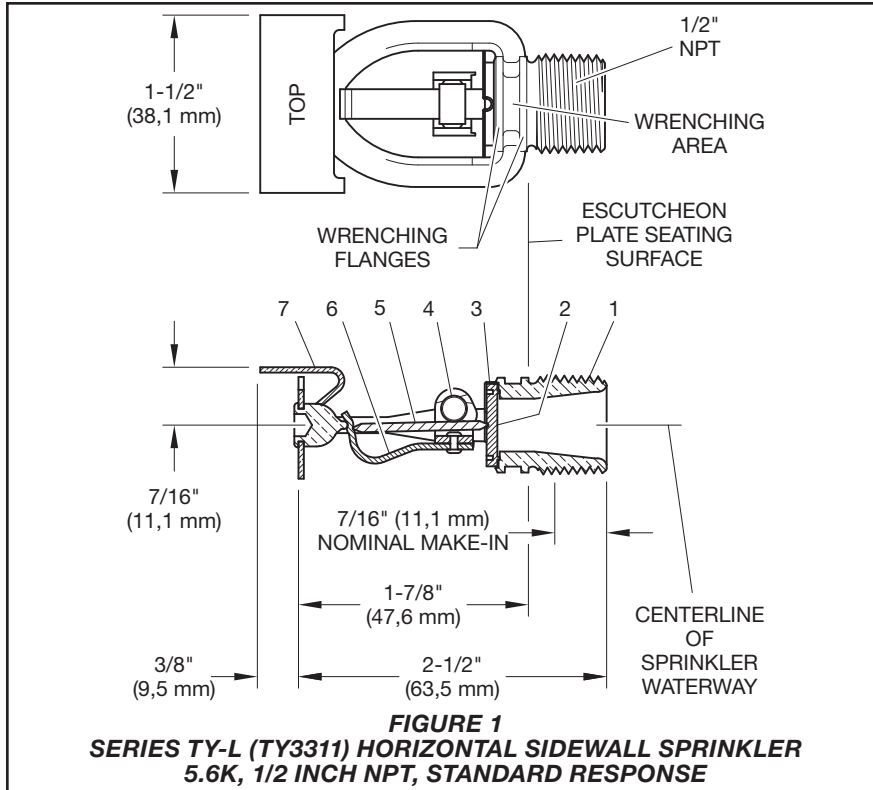


## Operation

A copper tube sealed by two stainless steel balls holds a fusible alloy. When the rated temperature is reached, the alloy melts, the balls are forced toward each other releasing the tension mechanism, allowing the sprinkler to operate.

## Design Criteria

TYCO Series TY-L 5.6K Standard Response, Standard Coverage, Horizontal Sidewall (HSW) Sprinklers are intended for fire protection systems designed in accordance with the standard installation rules recognized by the applicable listing or approval agency (e.g., UL Listing is based on NFPA 13 requirements). The Series TY-L HSW Sprinklers must be installed with a deflector-to-ceiling distance of 4 to 6 inches (100 to 150 mm). To meet this requirement, the centerline of the sprinkler waterway must be located 4-5/16 to 6-5/16 inches (110 to 160 mm) below the ceiling. Installation of the Series TY-L HSW Sprinklers in recessed escutcheons will void all manufacturer's warranties, as well as possibly void the sprinkler's approvals and/or listings.



After installation, the sprinkler wrench flats and frame arms must be inspected and the wax coating retouched (repaired) whenever the coating has been damaged and bare metal is exposed. The wax coating on the wrench flats can be retouched by gently applying a heated 1/8 inch diameter steel rod to the areas of wax that have been damaged, to smooth it back over areas where bare metal is exposed.

**NOTICE**

*Only retouching of the wax coating applied to the wrench flats and frame arms is permitted, and the retouching is to be performed only at the time of the initial sprinkler installation.*

*The steel rod should be heated only to the point at which it can begin to melt the wax, and appropriate precautions need to be taken, when handling the heated rod, in order to prevent the installer from being burned.*

If attempts to retouch the wax coating with complete coverage are unsuccessful, additional wax can be ordered in the form of a wax stick (the end of which is color-coded). Only the correct color-coded wax is to be used, and retouching of wrench flats and frame arms is only permitted at the time of initial sprinkler installation. With the steel rod heated as previously described, touch the rod to the area requiring additional wax with the rod angled downward, and then touch the wax stick to the rod approximately 1/2 inch away from the area requiring retouching. The wax will melt and run down onto the sprinkler.

**Installation**

TYCO Series TY-L 5.6K Standard Response, Standard Coverage, Horizontal Sidewall (HSW) Sprinklers must be installed in accordance with this section.

**General Instructions**

A leak-tight 1/2 inch NPT sprinkler joint should be obtained with a torque of 7 to 14 lb-ft. (9,5 to 19,0 Nm). A maximum of 21 lb-ft. (28,5 Nm) of torque may be used to install sprinklers with 1/2 NPT connections. Higher levels of torque may distort the sprinkler inlet and cause leakage or impairment of the sprinkler.

Do not attempt to make up for insufficient adjustment in the escutcheon plate by under- or over-tightening the sprinkler. Readjust the position of the sprinkler fitting to suit.

**Horizontal Sidewall Sprinklers**

The Series TY-L HSW Sprinklers must be installed in accordance with the following instructions:

**Note:** *Series TY-L HSW Sprinklers must be installed with their centerline of waterway parallel to the ceiling and perpendicular to the back wall surface. The word "TOP" on the deflector must face upwards toward the ceiling.*

**Step 1.** After installing an escutcheon (as applicable) over the sprinkler pipe threads and with pipe thread sealant applied to the pipe threads, hand-tighten the sprinkler into the sprinkler fitting.

**Step 2.** Tighten the sprinkler into the sprinkler fitting using only the W-Type 9 Sprinkler Wrench (Ref. Figure 2), except that an 8 or 10 inch adjustable crescent wrench is to be used for wax coated sprinklers. With reference to Figure 1, the W-Type 9 Sprinkler Wrench is to be applied to the wrench area, or as applicable, an adjustable wrench is to be applied to the wrenching flanges.

When installing wax coated sprinklers with an adjustable wrench, additional care needs to be exercised to prevent damage to the wax coating on the sprinkler wrench flats or frame arms and, consequently, exposure of bare metal to the corrosive environment. The jaws of the wrench should be opened sufficiently wide to pass over the wrench flats without damaging the wax coating.

Before wrench-tightening the sprinkler, the jaws of the wrench are to be adjusted to just contact the sprinkler wrench flats. After wrench-tightening the sprinkler, loosen the wrench jaws before removing the wrench.



K FACTOR	SPRINKLER TYPE	TEMPERATURE RATING	FRAME COLOR CODE	SPRINKLER FINISH				
				NATURAL BRASS	CHROME PLATED	LEAD COATED	WAX COATED	WAX-OVER-LEAD COATED
5.6 1/2" NPT	HORIZONTAL SIDEWALL (TY3311)	165°F (74°C)	Unpainted	1, 2, 3				1, 2
		212°F (100°C)	White					N/A
		280°F (138°C)	Blue					

**Notes:**

1. Listed by Underwriters Laboratories, Inc. (UL) for light or ordinary hazard occupancies
2. Listed by Underwriters Laboratories, Inc. for use in Canada (C-UL) for light or ordinary hazard occupancies
3. Approved by FM Global (FM Approvals) for light hazard occupancies

N/A – Not Applicable

**TABLE A**  
**5.6K SERIES TY-L (TY3311) HORIZONTAL SIDEWALL SPRINKLER**  
**LABORATORY LISTINGS AND APPROVALS**

## Care and Maintenance

TYCO Series TY-L 5.6K Standard Response, Standard Coverage, Horizontal Sidewall (HSW) Sprinklers must be maintained and serviced in accordance with this section.

Before closing a fire protection system main control valve for maintenance work on the fire protection system that it controls, permission to shut down the affected fire protection system must be obtained from the proper authorities and all personnel who may be affected by this action must be notified.

Absence of an escutcheon, which is used to cover a clearance hole, may delay the time to sprinkler operation in a fire situation.

Sprinklers that are found to be leaking or exhibiting visible signs of corrosion must be replaced.

Automatic sprinklers must never be painted, plated, coated or otherwise altered after leaving the factory. Modified or over-heated sprinklers must be replaced.

Care must be exercised to avoid damage to the sprinklers before, during, and after installation. Sprinklers damaged by dropping, striking, wrench twist/slippage, or the like, must be replaced.

Frequent visual inspections are recommended to be initially performed for corrosion resistant coated sprinklers, after the installation has been completed, to verify the integrity of the corrosion-resistant coating. Thereafter, annual inspections per NFPA 25 should suffice; however, instead of inspecting from the floor level, a random sampling of close-up visual inspections should be made, so as to better determine the exact sprinkler condition and the long

term integrity of the corrosion-resistant coating, as it may be affected by the corrosive conditions present.

The owner is responsible for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (e.g., NFPA 25), in addition to the standards of any other authorities having jurisdiction. Contact the installing contractor or product manufacturer with any questions.

It is recommended that automatic sprinkler systems be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.

P/N 53 — XXX — X — XXX																							
113	5.6K HSW (1/2" NPT)	SIN TY3311																					
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;"></th> <th style="width: 45%;">SPRINKLER FINISH</th> <th style="width: 50%;">TEMPERATURE RATING</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">NATURAL BRASS</td> <td style="text-align: center;">165    165°F (74°C)</td> </tr> <tr> <td style="text-align: center;">6</td> <td style="text-align: center;">WAX COATED *</td> <td style="text-align: center;">212    212°F (100°C)</td> </tr> <tr> <td style="text-align: center;">7</td> <td style="text-align: center;">LEAD COATED</td> <td style="text-align: center;">280    280°F (138°C)</td> </tr> <tr> <td style="text-align: center;">8</td> <td style="text-align: center;">WAX-OVER-LEAD COATED *</td> <td style="text-align: center;">200    200°F (93°C)</td> </tr> <tr> <td style="text-align: center;">9</td> <td style="text-align: center;">CHROME PLATED</td> <td style="text-align: center;">286    286°F (141°C)</td> </tr> <tr> <td colspan="2"></td> <td style="text-align: center;">000    OPEN***</td> </tr> </tbody> </table>				SPRINKLER FINISH	TEMPERATURE RATING	1	NATURAL BRASS	165    165°F (74°C)	6	WAX COATED *	212    212°F (100°C)	7	LEAD COATED	280    280°F (138°C)	8	WAX-OVER-LEAD COATED *	200    200°F (93°C)	9	CHROME PLATED	286    286°F (141°C)			000    OPEN***
	SPRINKLER FINISH	TEMPERATURE RATING																					
1	NATURAL BRASS	165    165°F (74°C)																					
6	WAX COATED *	212    212°F (100°C)																					
7	LEAD COATED	280    280°F (138°C)																					
8	WAX-OVER-LEAD COATED *	200    200°F (93°C)																					
9	CHROME PLATED	286    286°F (141°C)																					
		000    OPEN***																					
<small>* 165°F and 212°F only</small>																							
<p><b>TABLE B</b>  <b>SERIES TY-L HORIZONTAL SIDEWALL SPRINKLERS, STANDARD RESPONSE</b>  <b>PART NUMBER SELECTION</b></p>																							

## Limited Warranty

For warranty terms and conditions, visit [www.tyco-fire.com](http://www.tyco-fire.com).

## Ordering Procedure

Contact your local distributor for availability. When placing an order, indicate the full product name and part number (P/N).

### Sprinkler Assemblies with NPT Thread Connections

Specify: Series TY-L 5.6K Horizontal Sidewall Standard Response Sprinklers, SIN TY3311, Temperature Rating (specify), Finish (specify), and P/N (specify from Table B)

### Sprinkler Wrenches

Specify: W-Type 9 Sprinkler Wrench, P/N 56-000-1-849

Specify: W-Type 7 Sprinkler Wrench, P/N 56-850-4-001

### Wax Sticks (for retouching wrench-damaged wax coating)

Specify: (specify color) Color-coded Wax Sticks for retouching (specify temperature rating) temperature-rated Series TY-L Sprinklers, P/N (specify):

Red for 165°F . . . . . P/N 56-065-1-155  
 Blue for 212°F and 280°F . . . . . P/N 56-065-1-286

### Notes:

- Each wax stick is suitable for retouching up to 25 sprinklers.
- The wax used for 280°F sprinklers is the same as for 212°F sprinklers, and, therefore, the 280°F sprinkler is limited to the same maximum ceiling temperature as the 212°F sprinkler (i.e., 150°F).

## Series TY-L — 5.6 and 8.0 K-factor Upright, Pendent, and Recessed Pendent Sprinklers Standard Response, Standard Coverage

### General Description

The TYCO Series TY-L, 5.6 and 8.0 K-factor, Upright and Pendent Sprinklers described in this data sheet are standard response -standard coverage, solder type spray sprinklers designed for use in light, ordinary, and extra hazard, commercial occupancies such as banks, hotels, shopping malls, factories, refineries, chemical plants, etc.

The recessed version of the Series TY-L Pendent Sprinkler, where applicable, is intended for use in areas with a finished ceiling. It uses a two-piece Style 20 (1/2 inch NPT) or Style 30 (3/4 inch NPT) Recessed Escutcheon. The Recessed Escutcheon provides 1/4 in. (6,4 mm) of recessed adjustment or up to 1/2 in. (12,7 mm) of total adjustment from the flush pendent position. The adjustment provided by the Recessed Escutcheon reduces the accuracy to which the fixed pipe drops to the sprinklers must be cut.

Corrosion resistant coatings, where applicable, are utilized to extend the life of copper alloy sprinklers beyond that which would otherwise be obtained when exposed to corrosive atmospheres. Although corrosion resistant coated sprinklers have passed the standard corrosion tests of the applicable approval agencies, the testing is not representative of all possible corrosive atmospheres. Consequently, it is recommended that the end user be consulted with respect to the suitability of these coatings for any given cor-

#### IMPORTANT

Always refer to Technical Data Sheet TFP700 for the "INSTALLER WARNING" that provides cautions with respect to handling and installation of sprinkler systems and components. Improper handling and installation can permanently damage a sprinkler system or its components and cause the sprinkler to fail to operate in a fire situation or cause it to operate prematurely.

rosive environment. The effects of ambient temperature, concentration of chemicals, and gas/chemical velocity, should be considered, as a minimum, along with the corrosive nature of the chemical to which the sprinklers will be exposed.

An intermediate level version of the Series TY-L Pendent Sprinkler can be obtained by utilizing the Series TY-L Pendent Sprinkler in combination with the Model S Shield.

#### NOTICE

The TYCO Series TY-L, 5.6 and 8.0 K-factor, Upright and Pendent Sprinklers described herein must be installed and maintained in compliance with this document, as well as with the applicable standards of the National Fire Protection Association, in addition to the standards of any other authorities having jurisdiction. Failure to do so may impair the performance of these devices.

The owner is responsible for maintaining their fire protection system and devices in proper operating condition. The installing contractor or sprinkler manufacturer should be contacted with any questions.

### Sprinkler Identification Number (SIN)

TY3111 . . . . .Upright 5.6K, 1/2" NPT  
TY3211 . . . . .Pendent 5.6K, 1/2" NPT  
TY4111 . . . . . Upright 8.0K, 3/4" NPT  
TY4211 . . . . .Pendent 8.0K, 3/4" NPT  
TY4811 . . . . .Upright 8.0K, 1/2" NPT  
TY4911 . . . . .Pendent 8.0K, 1/2" NPT

TY3111 is a re-designation for S1800 and G3111.

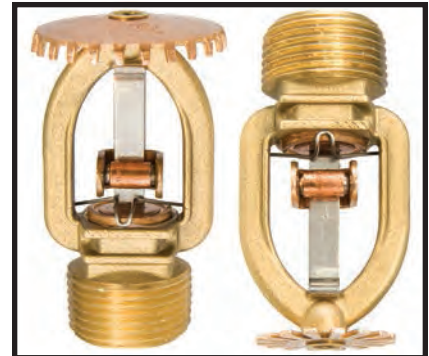
TY3211 is a re-designation for S1801 and G3112.

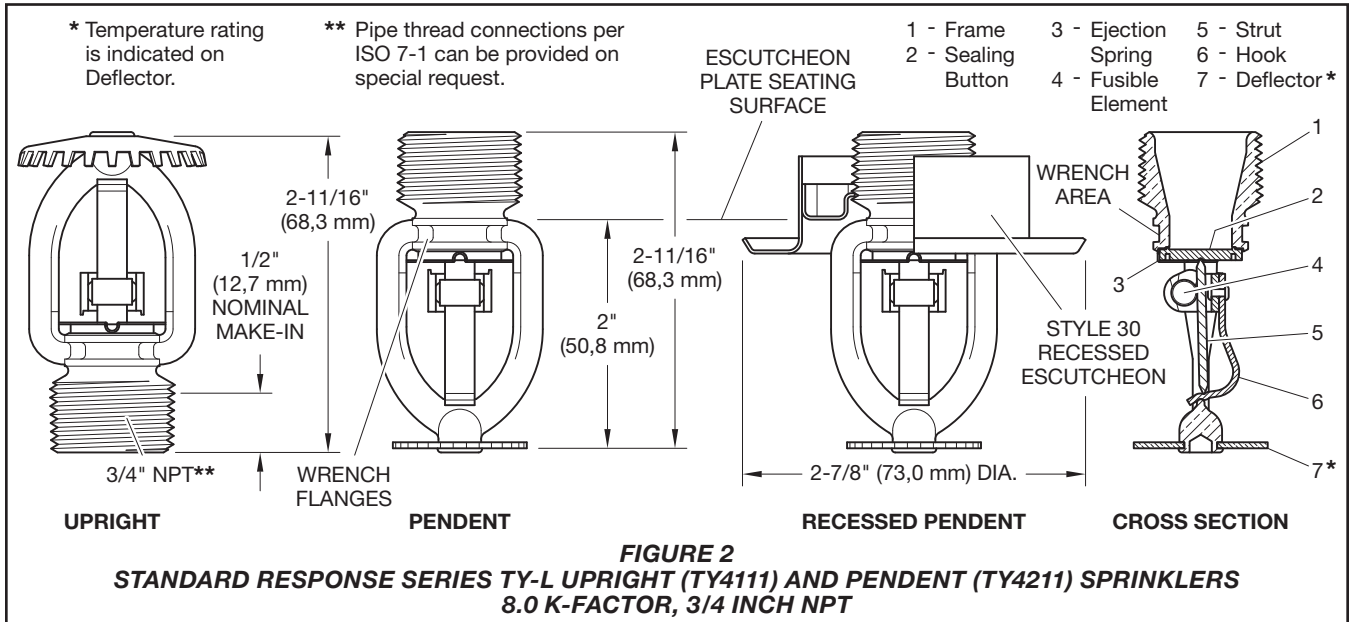
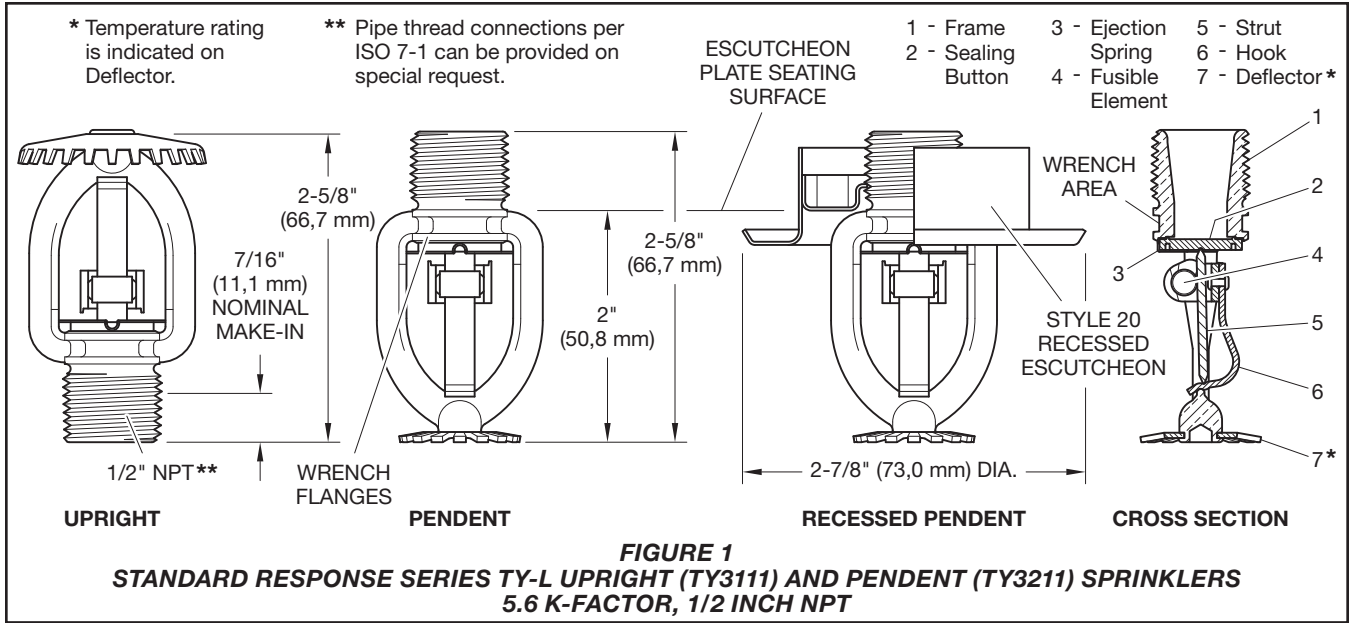
TY4111 is a re-designation for S1810 and G3101.

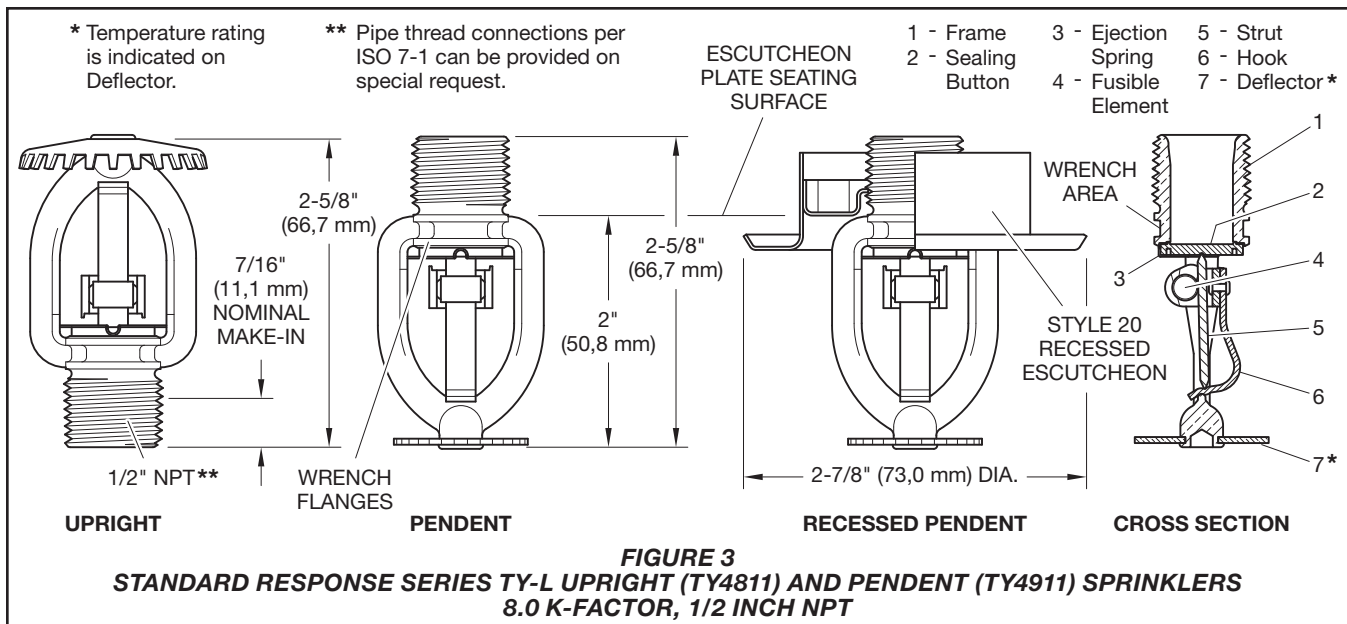
TY4211 is a re-designation for S1811 and G3102.

TY4811 is a re-designation for S1805.

TY4911 is a re-designation for S1806.







## Technical Data

### Approvals

UL and C-UL Listed. FM, and LPCB Approved. (Refer to Table A for complete approval information including corrosion resistant status.)

### Maximum Working Pressure

175 psi (12,1 bar)

### Discharge Coefficient

K=5.6 GPM/psi<sup>1/2</sup> (80,6 LPM/bar<sup>1/2</sup>)  
K=8.0 GPM/psi<sup>1/2</sup> (115,2 LPM/bar<sup>1/2</sup>)

### Temperature Ratings

Refer to Table A

### Finishes

Sprinkler: Refer to Table A Recessed

Escutcheon: White Coated, Chrome Plated, or Brass Plated

### Physical Characteristics

Frame	Brass
Sealing Button	Bronze w/TEFLON
Ejection Spring	Stainless Steel
Fusible Element	Solder, Copper, Stainless Steel
Strut	Monel
Hook	Bronze/Monel
Deflector	Bronze

## Operation

A copper tube sealed by two stainless steel balls holds a fusible alloy. When the rated temperature is reached, the alloy melts, the balls are forced toward each other releasing the tension mechanism, allowing the sprinkler to operate.

## Design Criteria

The TYCO Series TY-L, 5.6 and 8.0 K-factor, Upright and Pendent Sprinklers are intended for fire protection systems designed in accordance with the standard installation rules recognized by the applicable Listing or Approval agency (e.g., UL Listing is based on the requirements of NFPA 13, and FM Approval is based on the requirements of FM's Loss Prevention Data Sheets). Only the Style 20 or 30 Recessed Escutcheon, as applicable, are to be used for recessed pendent installations.

## Installation

The TYCO Series TY-L, 5.6 and 8.0 K-factor, Upright and Pendent Sprinklers must be installed in accordance with this section:

A leak tight 1/2 inch NPT sprinkler joint should be obtained with a torque of 7 to 14 ft.-lbs. (9,5 to 19,0 Nm). A leak tight 3/4 inch NPT sprinkler joint should be obtained with a torque of 10 to 20 ft.-lbs. (13,4 to 26,8 Nm). Higher levels of torque may distort the sprinkler inlet and cause leakage or impairment of the sprinkler.

Do not attempt to make-up for insufficient adjustment in the escutcheon plate by under- or over-tightening the sprinkler. Readjust the position of the sprinkler fitting to suit.

### Series TY-L Pendent and Upright Sprinkler Installation

The Series TY-L Pendent and Upright Sprinklers must be installed in accordance with this section.

**Step 1.** Pendent sprinklers are to be installed in the pendent position, and

**Step 2.** With pipe thread sealant applied to the pipe threads, hand tighten the sprinkler into the sprinkler fitting.

**Step 3.** Tighten the sprinkler into the sprinkler fitting using only the W-Type 9 Sprinkler Wrench (Ref. Figure 7), except that an 8 or 10 inch adjustable Crescent wrench is to be used for wax coated sprinklers. With reference to Figures 1, 2, and 3, the W-Type 9 Sprinkler Wrench is to be applied to the wrench area, or as applicable, the adjustable Crescent wrench is to be applied to the wrenching flanges.

When installing wax coated sprinklers with the adjustable Crescent wrench, additional care needs to be exercised to prevent damage to the wax coating on the sprinkler wrench flats or frame arms and, consequently, exposure of bare metal to the corrosive environment. The jaws of the wrench should be opened sufficiently wide to pass over the wrench flats without damaging the wax coating. Before wrench tightening the sprinkler, the jaws of the wrench are to be adjusted to just contact the sprinkler wrench flats. After wrench tightening the sprinkler, loosen the wrench jaws before removing the wrench.

After installation, the sprinkler wrench flats and frame arms must be inspected and the wax coating retouched (repaired) whenever the coating has



K	Type	Temp. Rating	Frame Color Code	Sprinkler Finish				
				Natural Brass	Chrome Plated	Lead Coated	Wax Coated	Wax Over Lead Coated
5.6 1/2" NPT	Pendent (TY3211) and Upright (TY3111)	165°F (74°C)	Unpainted	1, 2, 3, 5	1, 2, 3			
		212°F (100°C)	White					
		280°F (138°C)	Blue		1, 2	4	N/A	
	Recessed Pendent (TY3211 w/Style 20)	165°F (74°C)	Unpainted	1, 2, 3, 5	N/A			
212°F (100°C)		White	1, 2, 3, 5					
8.0 3/4" NPT	Pendent (TY4211)	165°F (74°C)	Unpainted	1, 2, 3	1, 2, 3			
		212°F (100°C)	White					
		280°F (138°C)	Blue		1, 2	4	N/A	
	Upright (TY4111)	165°F (74°C)	Unpainted	1, 2, 3, 5	1, 2, 3			
		212°F (100°C)	White					
		280°F (138°C)	Blue		1, 2	4	N/A	
Recessed Pendent (TY4211 w/Style 30)	165°F (74°C)	Unpainted	1, 2, 5	N/A				
	212°F (100°C)	White						
8.0 1/2" NPT	Pendent (TY4911) and Upright (TY4811)	165°F (74°C)	Unpainted	1, 2, 3, 5	1, 2, 3			
		212°F (100°C)	White					
		280°F (138°C)	Blue		1, 2	N/A		
	Recessed Pendent (TY4911 w/Style 20)	165°F (74°C)	Unpainted	1, 2	N/A			
212°F (100°C)		White						

**NOTES:**  
1. UL Listed  
2. C-UL Listed  
3. FM Approved  
4. FM Approved for maximum 150°F (68°C) ambient temperatures  
5. LPCB Approved (LPCB Ref. No. 094a/03)  
N/A: Not Available

**TABLE A**  
**LABORATORY LISTINGS AND APPROVALS**

been damaged and bare metal is exposed. The wax coating on the wrench flats can be retouched by gently applying a heated 1/8 in. diameter steel rod to the areas of wax that have been damaged, to smooth it back over areas where bare metal is exposed.

**NOTICE**

Only retouching of the wax coating applied to the wrench flats and frame arms is permitted, and the retouching is to be performed only at the time of the initial sprinkler installation.

The steel rod should be heated only to the point at which it can begin to melt the wax, and appropriate precautions need to be taken, when handling the heated rod, in order to prevent the installer from being burned.

If attempts to retouch the wax coating with complete coverage are unsuccessful, additional wax can be ordered in the form of a wax stick (the end of which is color coded). Only the correct color coded wax is to be used, and retouching of wrench flats and frame arms is only permitted at

the time of initial sprinkler installation. With the steel rod heated as previously described, touch the rod to the area requiring additional wax with the rod angled downward, and then touch the wax stick to the rod approximately one-half inch away from the area requiring retouching. The wax will melt and run down onto the sprinkler.

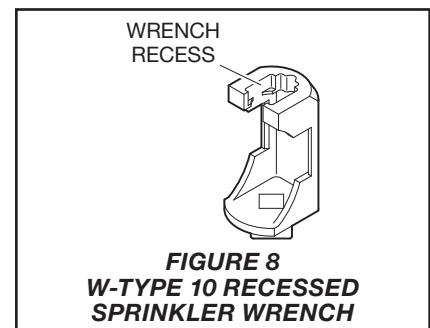
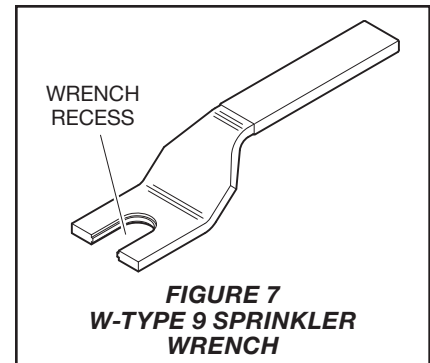
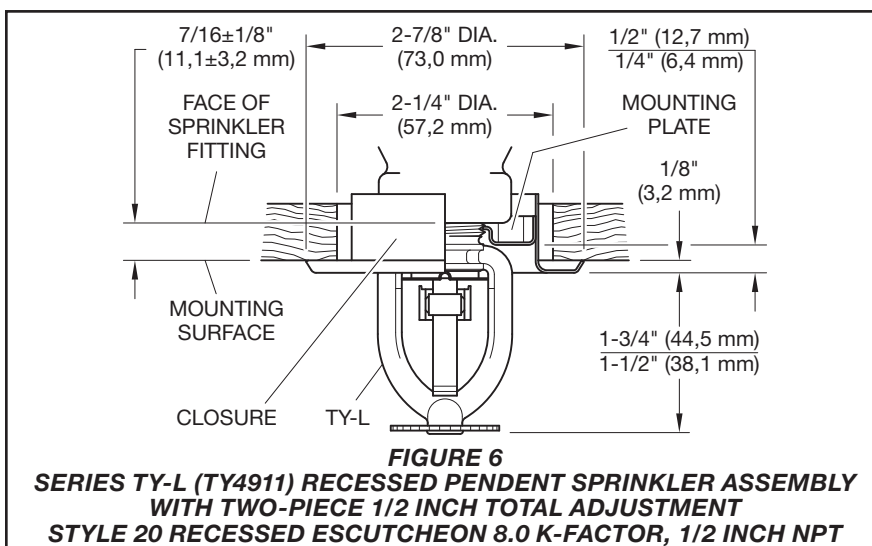
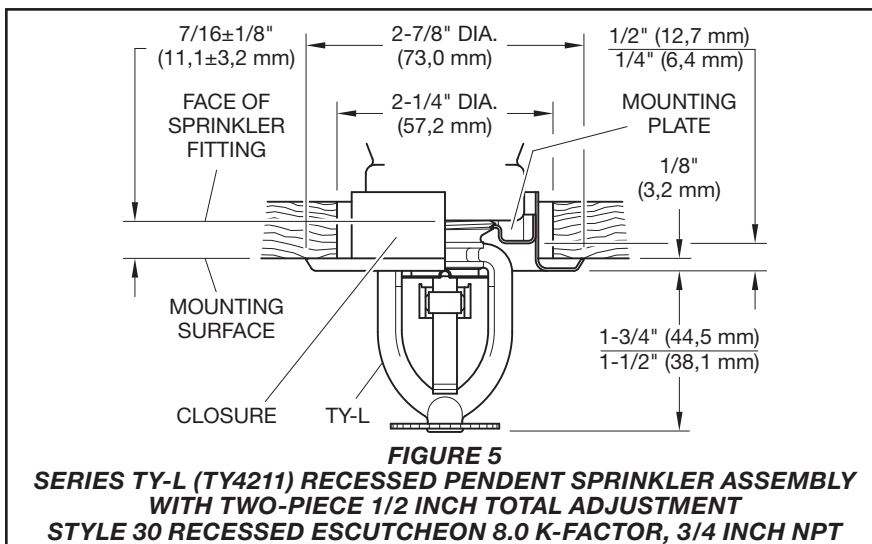
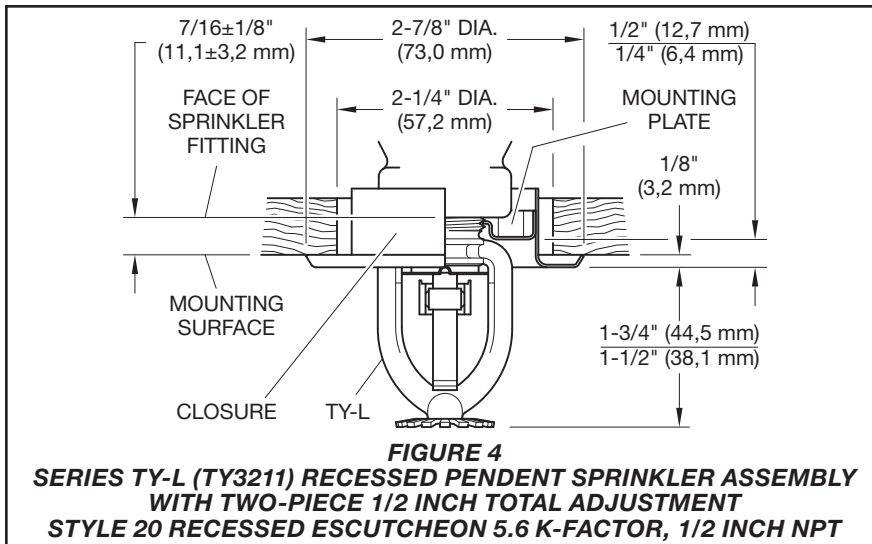
**Series TY-L Recessed Pendent Sprinklers Installation**

The Series TY-L Recessed Pendent Sprinklers must be installed in accordance with this section.

**Step A.** After installing the Style 20 or 30 Mounting Plate, as applicable, over the sprinkler threads and with pipe thread sealant applied to the pipe threads, hand tighten the sprinkler into the sprinkler fitting.

**Step B.** Tighten the sprinkler into the sprinkler fitting using only the W-Type 10 Recessed Sprinkler Wrench (Ref. Figure 8). With reference to Figure 1, 2, or 3, the W-Type 10 Recessed Sprinkler Wrench is to be applied to the sprinkler wrenching flanges.

**Step C.** After the ceiling has been installed or the finish coat has been applied, slide on the Style 20 or 30 Closure over the Series TY-L Sprinkler and push the Closure over the Mounting Plate until its flange comes in contact with the ceiling.



## Care and Maintenance

The TYCO Series TY-L, 5.6 and 8.0 K-factor, Upright and Pendent Sprinklers must be maintained and serviced in accordance with this section.

Before closing a fire protection system main control valve for maintenance work on the fire protection system that it controls, permission to shut down the affected fire protection system must be obtained from the proper authorities and all personnel who may be affected by this action must be notified.

Absence of an escutcheon, which is used to cover a clearance hole, may delay the time to sprinkler operation in a fire situation.

Sprinklers that are found to be leaking or exhibiting visible signs of corrosion must be replaced.

Automatic sprinklers must never be painted, plated, coated or otherwise altered after leaving the factory. Modified or over-heated sprinklers must be replaced. Care must be exercised to avoid damage to the sprinklers -before, during, and after installation. Sprinklers damaged by dropping, striking, wrench twist/slippage, or the like, must be replaced.

Frequent visual inspections are recommended to be initially performed for corrosion resistant coated sprinklers, after the installation has been

**P/N 53 - XXX - X - XXX**

		SIN			SPRINKLER FINISH			TEMPERATURE RATING
111	5.6K UPRIGHT (1/2"NPT)	TY3111	1	NATURAL BRASS	165	165°F (74°C)		
112	5.6K PENDENT (1/2"NPT)	TY3211	6	WAX COATED 165°F TO 280°F ONLY	212	212°F (100°C)		
101	8.0K UPRIGHT (3/4"NPT)	TY4111	7	LEAD COATED	280	280°F (138°C)		
102	8.0K PENDENT (3/4"NPT)	TY4211	8	WAX OVER LEAD 165°F TO 212°F ONLY				
106	8.0K UPRIGHT (1/2"NPT)	TY4811	9	CHROME PLATED				
107	8.0K PENDENT (1/2"NPT)	TY4911						

**TABLE B**  
**SERIES TY-L PENDENT AND UPRIGHT SPRINKLERS**  
**PART NUMBER SELECTION**

completed, to verify the integrity of the corrosion resistant coating. Thereafter, annual inspections per NFPA 25 should suffice; however, instead of inspecting from the floor level, a random sampling of close-up visual inspections should be made, so as to better determine the exact sprinkler condition and the long term integrity of the corrosion resistant coating, as it may be affected by the corrosive conditions present.

The owner is responsible for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (e.g., NFPA 25), in addition to the standards of any other authorities having jurisdiction. The installing contractor or sprinkler manufacturer should be contacted relative to any questions.

It is recommended that automatic sprinkler systems be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.

## Limited Warranty

For warranty terms and conditions, visit [www.tyco-fire.com](http://www.tyco-fire.com).

## Ordering Procedure

Contact your local distributor for availability. When placing an order, indicate the full product name and Part Number (P/N).

### Sprinkler Assemblies with NPT Thread Connections

Specify: Series TY-L (specify SIN), (specify K-factor), (specify Upright, Pendent, or Recessed Pendent) Sprinkler, Standard Response, Standard Coverage, (specify) temperature rating, (specify) finish or coating, P/N (specify from Table B)

### Recessed Escutcheon

Specify: Style (specify) Recessed Escutcheon with (specify finish), P/N (specify):

- 1/2" (15 mm)  
 Style 20  
 Brass Plated . . . . . P/N 56-705-2-010
- 1/2" (15 mm)  
 Style 20  
 Signal White (RAL9003)  
 . . . . . P/N 56-705-4-010
- 1/2" (15 mm)  
 Style 20  
 Chrome Plated . . . . . P/N 56-705-9-010
- 3/4" (20 mm)  
 Style 30  
 Brass Plated . . . . . P/N 56-705-2-011
- 3/4" (20 mm)  
 Style 30  
 Signal White (RAL9003)  
 . . . . . P/N 56-705-4-011
- 3/4" (20 mm)  
 Style 30  
 Chrome Plated . . . . . P/N 56-705-9-011

### Sprinkler Wrench

Specify: W-Type 9 Sprinkler Wrench, P/N 56-000-1-849

Specify: W-Type 10 Sprinkler Wrench, P/N 56-000-1-948

### Wax Sticks (for retouching wrench damaged wax coating)

Specify: Series TY-L Sprinklers, (specify color), color coded Wax Stick for retouching, (specify) temperature rated, P/N (specify):

- Red for 165°F (74°C) . . . P/N 56-065-1-155
- Blue for 212°F (100°C) and 280°F (138°C)  
 . . . . . P/N 56-065-1-286

### NOTES:

Each wax stick is suitable for retouching up to twenty-five sprinklers.

The wax used for 280°F (138°C) sprinklers is the same as for 212°F (100°C) sprinklers, and, therefore, the 280°F (138°C) sprinkler is limited to the same maximum ceiling temperature as the 212°F (100°C) sprinkler (i.e., 150°F (65°C)).

## **Model G1, G4 Sprinkler Guards and Model G1/S1, G4/S3 Guards with Shields for Series TY-B, TY-FRB, TY-L, and TY-FRL Sprinklers**

### **General Description**

TYCO Model G1 and G4 Sprinkler Guards are designed for use with specific types of Series TY-B, TY-FRB, TY-L, and TY-FRL Sprinklers that may be located in areas that make them susceptible to mechanical or physical damage. Table A provides compatibility details.

Model G1/S1 and G4/S3 Sprinkler Guards with Shields (Figure 2), in addition to providing protection from mechanical or physical damage, protects the sprinkler from water spray of higher elevation sprinklers (for example, rack storage sprinkler installations). When the Model G1/S1 and G4/S3 are used with the Series TY-B, TY-FRB, TY-L, and TY-FRL Sprinklers shown in Table A, the assemblies form Upright Intermediate Level Sprinklers intended for use in fire sprinkler systems designed in accordance with the standard installation rules recognized by the applicable Listing agency (that is, UL Listing is based on NFPA requirements).

- Model G1 and G4 Guards are a re-designation for the Gem F938 and F937 respectively.
- Model G1/S1 and G4/S3 Guards are a re-designation for the Gem F938/Q-76 and F937/Q-75 respectively.

#### **NOTICE**

*Model G1 and G4 Sprinkler Guards and Model G1/S1 and G4/S3 Sprinkler Guards with Shields described herein must be installed and maintained in compliance with this document and with the applicable standards of the National Fire Protection Association, in addition to the standards of any Authorities Having Jurisdiction. Failure to do so may impair the performance of these devices.*

*Owners are responsible for maintaining their fire protection system and devices in proper operating condition. The installing contractor or sprinkler manufacturer should be contacted with any questions.*

### **Technical Data**

#### **Approvals**

UL and C-UL Listed  
FM Approved  
Refer to Table A.

#### **Finishes**

Red Painted and Zinc Chromate

#### **Physical Characteristics**

Welded assembly fabricated from carbon steel

### **Design Criteria**

In accordance with the requirements of the NFPA, sprinkler guards shall be listed. Guards are only listed for use with specified sprinklers; therefore, the Model G1, G4, G1/S1, and G4/S3 must only be used with the Series TY-B, TY-FRB, TY-L, and TY-FRL Sprinklers shown in Table A.



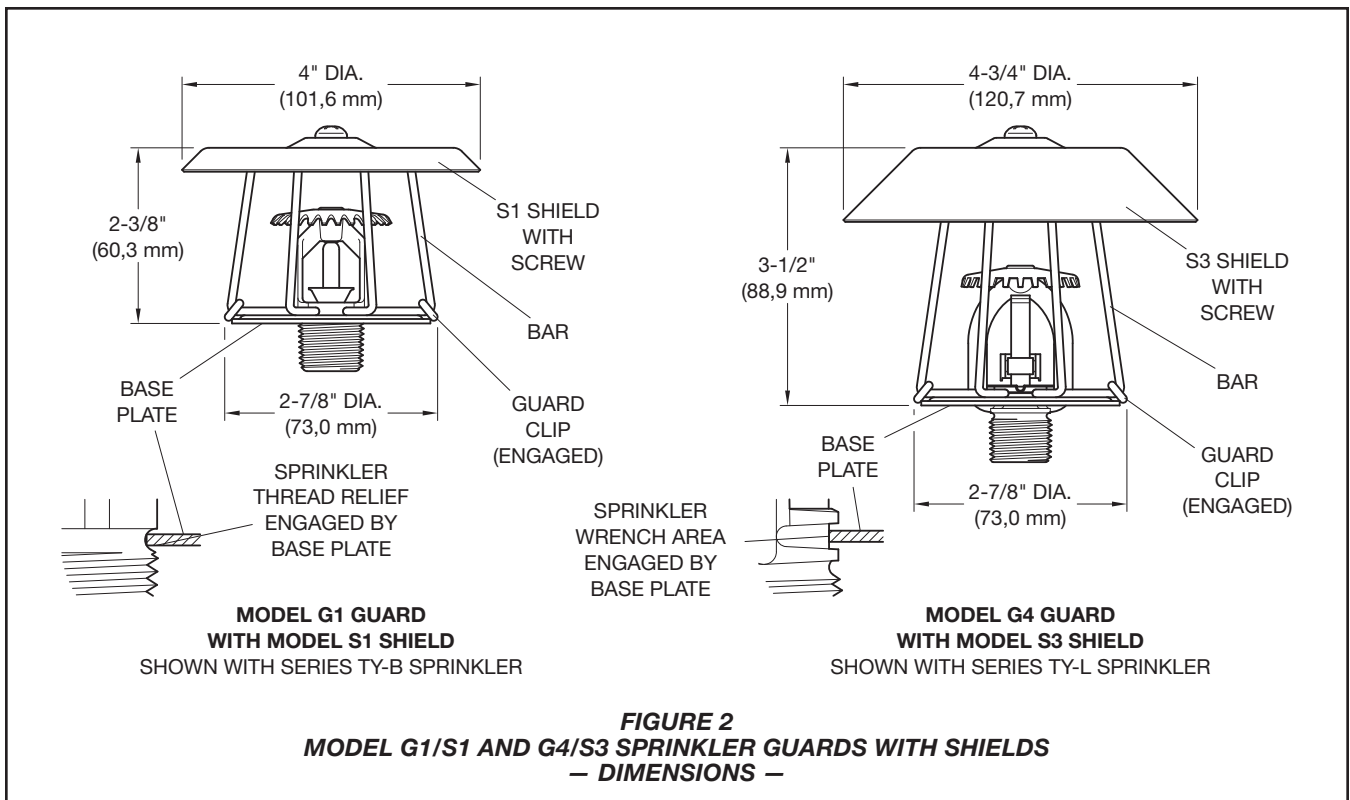
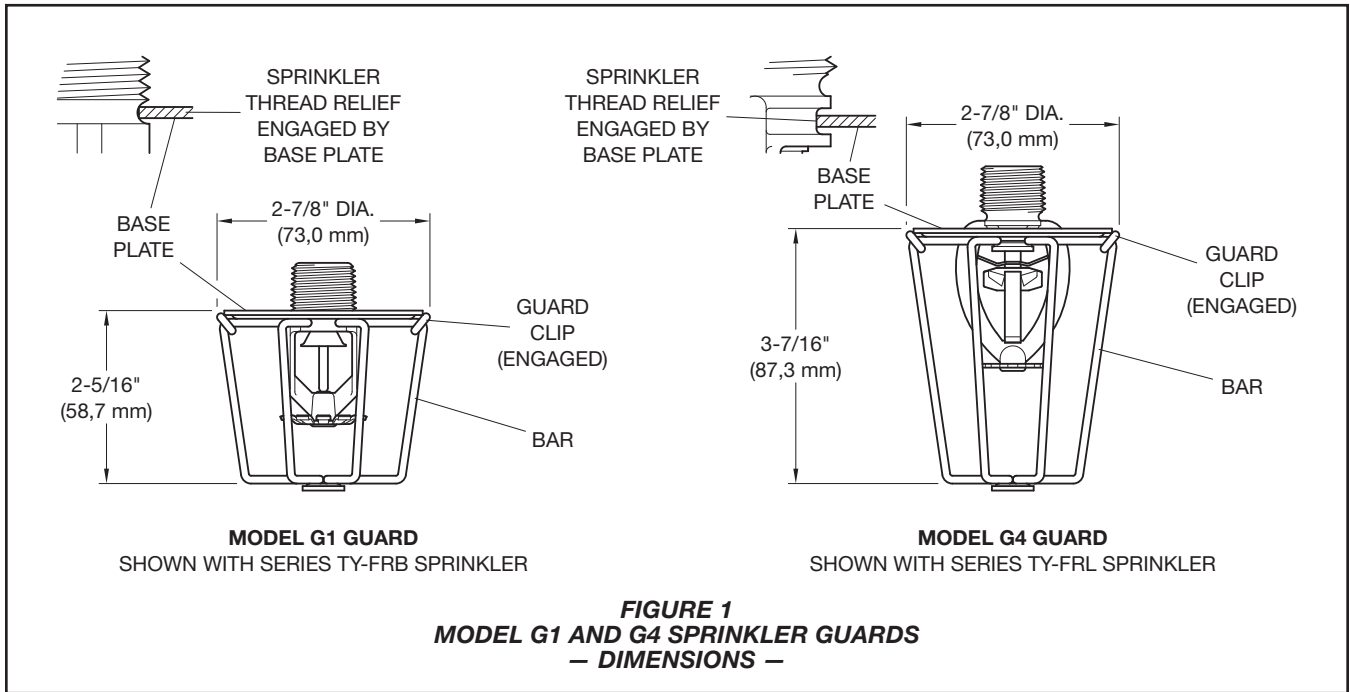
Sprinkler Series	TFP SIN	GEM SIN	STAR SIN	Sprinkler Type	Sprinkler K-Factor	Mounting Location	Guard Model Approvals	Guard with Shield Model Approvals
TY-B	TY1151	G7530	-	Upright	2.8	Thread Relief	G1 <sup>(1)</sup>	N/A
	TY1251	G7531	-	Pendent	2.8	Thread Relief	G1 <sup>(1)</sup>	N/A
	TY3151	G7570	-	Upright	5.6	Thread Relief	G1 <sup>(1, 2)</sup> , G4 <sup>(2)</sup>	G1/S1 <sup>(1, 2)</sup>
	TY3251	G7571	-	Pendent	5.6	Thread Relief	G1 <sup>(1, 2)</sup> , G4 <sup>(2)</sup>	N/A
	TY4851	G7560	-	Upright	8.0 (1/2" NPT)	Thread Relief	G1 <sup>(1, 2)</sup>	N/A
	TY4951	G7561	-	Pendent	8.0 (1/2" NPT)	Thread Relief	G1 <sup>(1, 2)</sup>	N/A
	TY4151	G7590	-	Upright	8.0 (3/4" NPT)	Thread Relief	G1 <sup>(1, 2)</sup>	G1/S1 <sup>(1, 2)</sup>
	TY4251	G7591	-	Pendent	8.0 (3/4" NPT)	Thread Relief	G1 <sup>(1, 2)</sup>	N/A
	TY3351	G7578	-	HSW	5.6	Thread Relief	G4 <sup>(1, 2)</sup>	N/A
	TY3451	G7575	-	VSW	5.6	Thread Relief	G4 <sup>(1)</sup>	N/A
TY-FRB	TY1131	G7330	-	Upright	2.8	Thread Relief	G1 <sup>(1)</sup>	N/A
	TY1231	G7331	-	Pendent	2.8	Thread Relief	G1 <sup>(1)</sup>	N/A
	TY3131	G7370	-	Upright	5.6	Thread Relief	G1 <sup>(1, 2)</sup> , G4 <sup>(2)</sup>	G1/S1 <sup>(1)</sup>
	TY3231	G7371	-	Pendent	5.6	Thread Relief	G1 <sup>(1, 2)</sup> , G4 <sup>(2)</sup>	N/A
	TY4131	G7390	-	Upright	8.0 (3/4" NPT)	Thread Relief	G1 <sup>(1, 2)</sup>	G1/S1 <sup>(1)</sup>
	TY4231	G7391	-	Pendent	8.0 (3/4" NPT)	Thread Relief	G1 <sup>(1)</sup>	N/A
	TY3331	G7378	-	HSW	5.6	Thread Relief	G4 <sup>(1)</sup>	N/A
	TY3431	G7375	-	VSW	5.6	Thread Relief	G4 <sup>(1)</sup>	N/A
TY-L	TY3111	G3111	S1800	Upright	5.6	Wrench Area	G1 <sup>(2)</sup> , G4 <sup>(1)</sup>	G4/S3 <sup>(1)</sup>
	TY3211	G3112	S1801	Pendent	5.6	Wrench Area	G1 <sup>(2)</sup> , G4 <sup>(1)</sup>	N/A
	TY3311	G3113	S1803	HSW	5.6	Wrench Area	-	N/A
	TY4811	-	S1805	Upright	8.0 (1/2" NPT)	Wrench Area	G4 <sup>(1, 2)</sup>	G4/S3 <sup>(1)</sup>
	TY4911	-	S1806	Pendent	8.0 (1/2" NPT)	Wrench Area	G4 <sup>(1)</sup>	N/A
	TY4111	G3101	S1810	Upright	8.0 (3/4" NPT)	Wrench Area	G4 <sup>(1, 2)</sup>	G4/S3 <sup>(1)</sup>
	TY4211	G3102	S1811	Pendent	8.0 (3/4" NPT)	Wrench Area	G4 <sup>(1)</sup>	N/A
TY-FRL	TY1121	G8973	S1879	Upright	2.8	Wrench Area	G4 <sup>(1)</sup>	N/A
	TY1221	G8971	S1880	Pendent	2.8	Wrench Area	G4 <sup>(1)</sup>	N/A
	TY3121	G8974	S1864	Upright	5.6	Wrench Area	G4 <sup>(1, 2)</sup>	G4/S3 <sup>(1)</sup>
	TY3221	G7375	S1865	Pendent	5.6	Wrench Area	G4 <sup>(1)</sup>	N/A
	TY3321	G8972	S1878	HSW	5.6	Wrench Area	G4 <sup>(1)</sup>	N/A
	TY4121	G8946	S1866	Upright	8.0 (3/4" NPT)	Wrench Area	G4 <sup>(1, 2)</sup>	G4/S3 <sup>(1)</sup>
	TY4221	G8174	S1867	Pendent	8.0 (3/4" NPT)	Wrench Area	G4 <sup>(1)</sup>	N/A

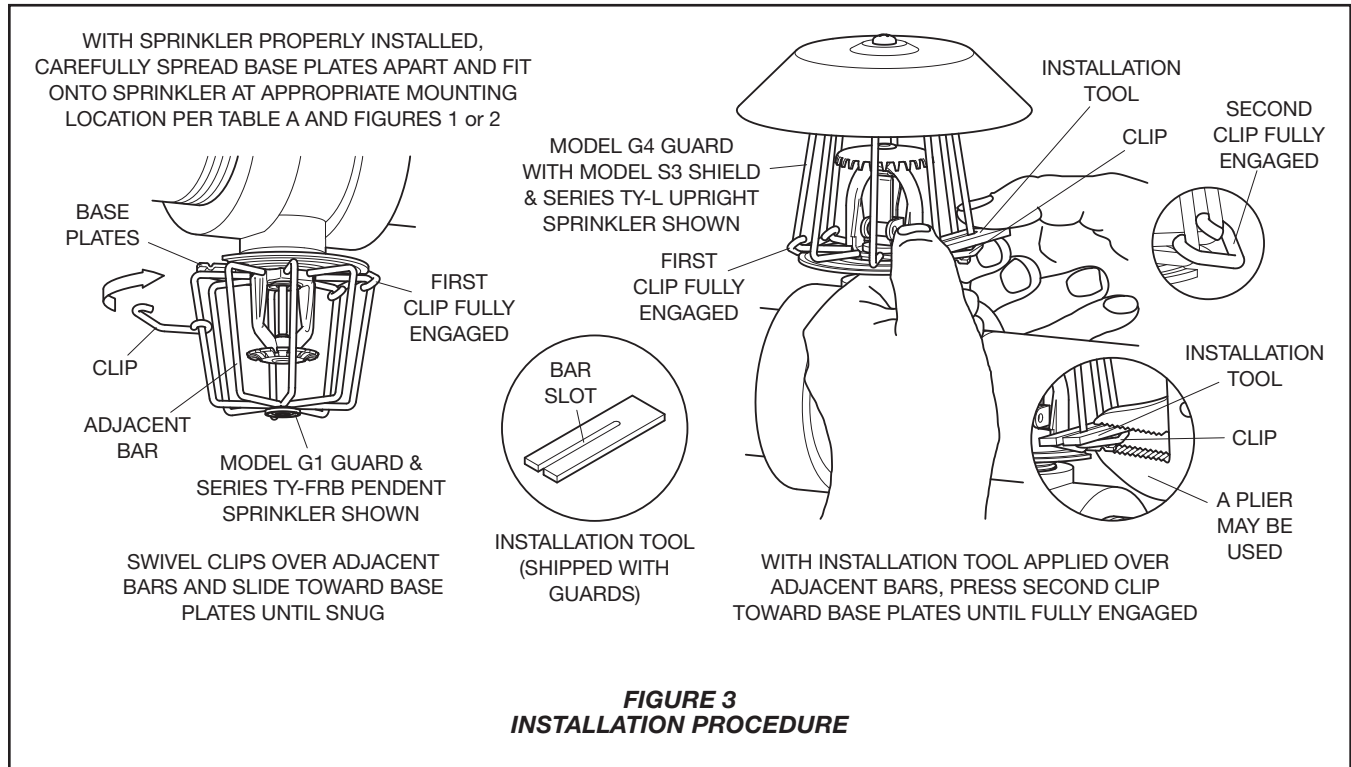
**APPROVALS & NOTES**

1. Listed by Underwriters Laboratories Inc.
  2. Approved by Factory Mutual Research Corporation.
- N/A Not Applicable for noted sprinkler.  
 — No SIN, Listing or Approval

**TABLE A**  
**LABORATORY LISTINGS AND APPROVALS**







## Installation

TYCO Models G1, G4, G1/S1, and G4/S3 Guards must be installed in accordance with the following instructions.

1. Install the sprinkler in accordance with the applicable technical data sheet.
2. Mount the Model G1, G4, G1/S1, or G4/S3 Guard on the sprinkler.
3. With the Clips loose, spread the two halves of the Sprinkler Guard enough to pass by the sprinkler deflector from the side.
4. Spread the two halves of the Sprinkler Guard enough to pass over the sprinkler “thread relief” or “wrenching area”, as applicable, portion of the sprinkler. Refer to Table A, as well as Figures 1 and 2.
5. With the Sprinkler Guard positioned on the “thread relief” or “wrenching area” portion of the sprinkler, as applicable, engage the Clips and then slide the Clips until they seat against the Base, completing the installation as shown in Figures 1 and 2.

To help assist with the sliding of the Clips, use the Guard Installation Tool as shown in Figure 3. Additionally, pliers can be used to facilitate the final seating of the Clips.

### NOTICE

*The Clips must seat against the Base to be fully seated and in order to complete the installation. The Model G1, G4, G1/S1, and G4/S3 Guards may be located in any position relative to the sprinkler frame arms.*

## Care and Maintenance

TYCO Models G1, G4, G1/S1, and G4/S3 Guards do not require any regularly scheduled maintenance; however, proper installation of the Sprinkler Guards should be verified during the annual visual inspection of the sprinklers.

### NOTICE

*Before closing a fire protection system main control valve for maintenance work on the fire protection system that it controls, obtain permission to shut down the affected fire protection system from the proper authorities and notify all personnel who may be affected by this action.*

*Responsibility lies with sprinkler owners for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (for example, NFPA 25), in addition to the standards of any other authorities having jurisdiction. Contact the installing contractor or sprinkler manufacturer regarding any questions.*

*Automatic sprinkler systems are recommended to be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.*

*Owners must assure that the sprinklers are not used for hanging of any objects and that the sprinklers are only cleaned by means of gently dusting with a feather-duster. Otherwise, non-operation in the event of a fire or inadvertent operation may result.*

## Limited Warranty

Products manufactured by Tyco Fire Suppression & Building Products (TFSBP) are warranted solely to the original Buyer for ten (10) years against defects in material and workmanship when paid for and properly installed and maintained under normal use and service. This warranty will expire ten (10) years from date of shipment by TFSBP. No warranty is given for products or components manufactured by companies not affiliated by ownership with TFSBP or for products and components which have been subject to misuse, improper installation, corrosion, or which have not been installed, maintained, modified or repaired in accordance with applicable Standards of the National Fire Protection Association, and/or the standards of any other Authorities Having Jurisdiction. Materials found by TFSBP to be defective shall be either repaired or replaced, at TFSBP's sole option. TFSBP neither assumes, nor authorizes any person to assume for it, any other obligation in connection with the sale of products or parts of products. TFSBP shall not be responsible for sprinkler system design errors or inaccurate or incomplete information supplied by Buyer or Buyer's representatives.

In no event shall TFSBP be liable, in contract, tort, strict liability or under any other legal theory, for incidental, indirect, special or consequential damages, including but not limited to labor charges, regardless of whether TFSBP was informed about the possibility of such damages, and in no event shall TFSBP's liability exceed an amount equal to the sales price.

The foregoing warranty is made in lieu of any and all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose.

This limited warranty sets forth the exclusive remedy for claims based on failure of or defect in products, materials or components, whether the claim is made in contract, tort, strict liability or any other legal theory.

This warranty will apply to the full extent permitted by law. The invalidity, in whole or part, of any portion of this warranty will not affect the remainder.

## Ordering Procedure

Contact your local distributor for availability. When placing an order, indicate the full product name and Part Number (P/N).

### Model G1 Sprinkler Guard

Specify: Model G1 Sprinkler Guard with (finish), and P/N (below).

Red Painted . . . . . P/N 56-938-1-001  
Zinc Chromate . . . . . P/N 56-938-9-001

### Model G4 Sprinkler Guard

Specify: Model G4 Sprinkler Guard with (finish) and P/N (below).

Red Painted . . . . . P/N 56-937-1-001  
Zinc Chromate . . . . . P/N 56-937-9-001

### Model G1/S1 Guard with Shield

Specify: Model G1/S1 Sprinkler Guard with Shield, (finish) and P/N (below).

Red Painted . . . . . P/N 56-938-1-066  
Zinc Chromate . . . . . P/N 56-938-9-066

### Model G4/S3 Guard with Shield

Specify: Model G4/S3 Sprinkler Guard with Shield, (finish) and P/N (below).

Red Painted . . . . . P/N 56-937-1-066  
Zinc Chromate . . . . . P/N 56-937-9-066

### Additional\* Guard Installation Tools

Specify: Guard Installation Tool for Model G1 and G4 Sprinkler Guards, P/N (56-000-8-597).

\* The Guard Installation Tool is included with orders in original carton quantities.



# **Backflow Test Reports - Annual**



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## **Test Reports to Follow**

**tyco**

*Fire &  
Security*

1901 Anka St  
Juneau, AK 99801  
Tel: (907) 789-4449  
Fax: (907) 789-4110  
granderson@simplexgrinnell.com

**SimplexGrinnell**

10/2/15

To:  
Premier Electric

From:  
Greg Anderson  
Simplex-Grinnell  
Juneau, Alaska

On this day, 10/2/15, I connected, programmed and tested one duct smoke detector, two sprinkler valve tamper switches, and one HVAC fire shutdown relay at the Haines School Vocational Education Building, in Haines, Alaska.

All devices performed perfectly, and a 10% test of unaffected devices was performed, per NFPA 72.

Any questions, feel free to call at the above numbers.

Thanks for your business!

A handwritten signature in black ink, appearing to read 'Greg Anderson', with a long horizontal line extending to the right.

Greg Anderson  
Lead Technican, Simplex Grinnell  
Alaska permit # 07-037

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

# **Tab C**

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 22 1006 2.3 Plumbing Piping Specialties

Submittal Number: 1

Item: FD-1 Floor Drain

Manufacturer: ZURN

Model #: Z415 Floor Drain

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No



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**FD-1**

ZZN4152NH5BP      ZURN

ZZN4153NH5BP      ZURN

ZZN4154NH5BP      ZURN

**FD-1 FLOOR DRAIN**

FLOOR AND SHOWER DRAIN, D.C.C.I. BODY ASSEMBLY WITH 5" ROUND POLISHED NICKEL BRONZE TOP - 2" NO HUB, TRAP PRIMER CONNECTION (SPECIFY 1/2" OR 3/4")

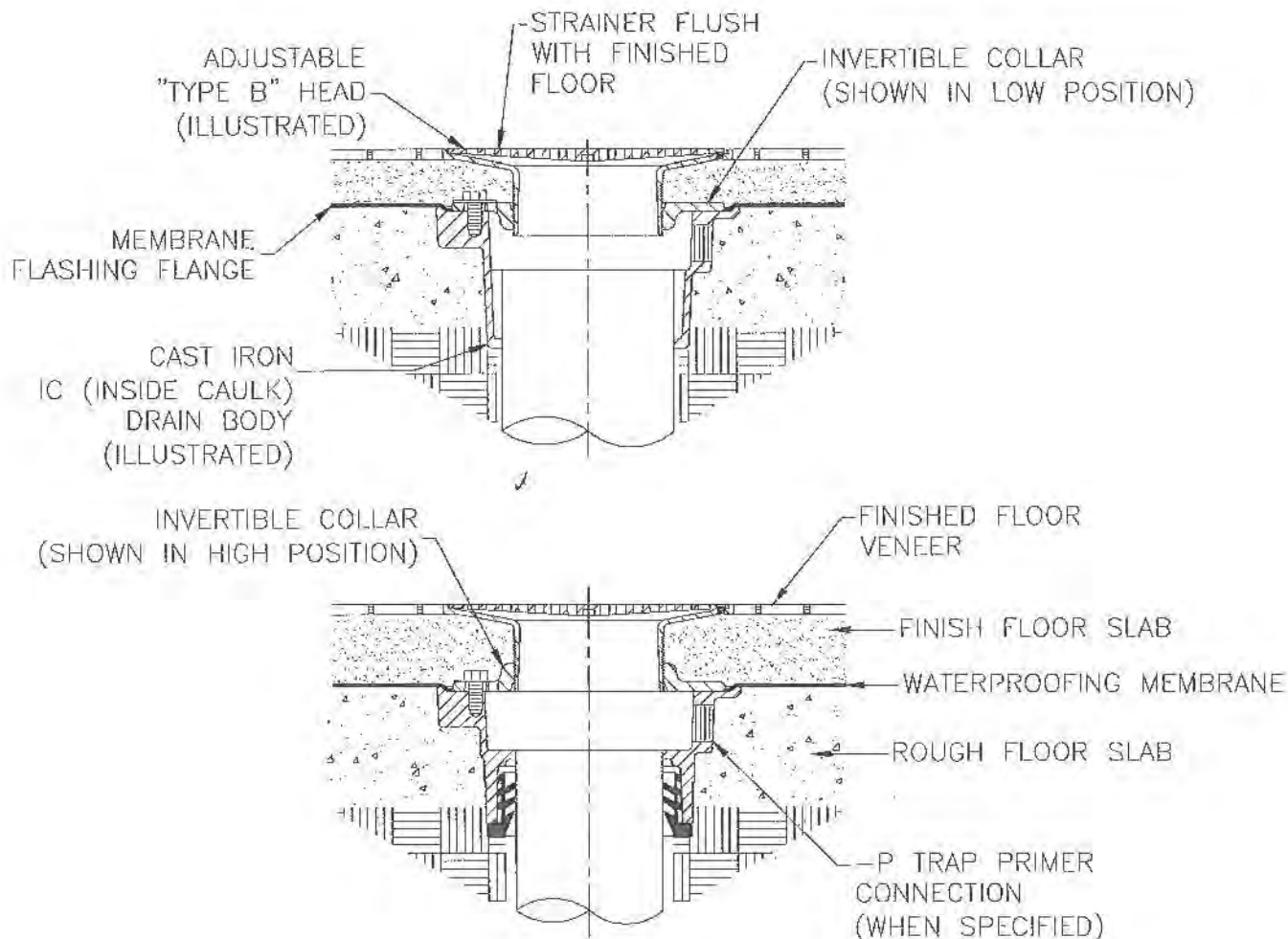
FLOOR AND SHOWER DRAIN, D.C.C.I. BODY ASSEMBLY WITH 5" ROUND POLISHED NICKEL BRONZE TOP - 3" NO HUB, TRAP PRIMER CONNECTION (SPECIFY 1/2" OR 3/4")

FLOOR AND SHOWER DRAIN, D.C.C.I. BODY ASSEMBLY WITH 5" ROUND POLISHED NICKEL BRONZE TOP - 4" NO HUB, TRAP PRIMER CONNECTION (SPECIFY 1/2" OR 3/4")



## TYPICAL INSTALLATION FOR Z415 FLOOR DRAIN

Dimensional Data (inches and [ mm ]) are Subject to Manufacturing Tolerances and Change Without Notice



### Z415 FLOOR DRAIN

The Z415 Zurn Floor Drain can be installed in most floor construction. The drain pipe is run to an elevation below the expected finished floor level, so that the drain top will be flush with (or slightly below) the finished floor. Dimensional data for all drain heights and outlet types are shown in the Engineering Handbook, and on Zurn Submittal Drawings. The drain body is secured to the pipe with any of four connections, Threaded, No-Hub, Inside Caulk or the Neo-Loc. The type of connection should be specified upon ordering any Zurn drain. Once the drain is set in place, the initial concrete sub-floor is poured to an elevation level with the top flange of the drain body. The waterproofing membrane is then run up to and over the flange. The invertible clamping collar is then placed on the drain and secured. The strainer is screwed into the invertible clamping collar and finished floor is poured to finished grade. Note the Z415 collar can be used in the high or low position to change the total adjustment of the head elevation (for example, the 5" "Type B" adjustment in the low position is 1 [25] - 1-1/2 [38] and in the high position 1-3/32 [28] - 2-1/4 [57]). Also, care should be taken to protect the top finish during installation, through the use of cardboard, tape or other protective material applied by the plumber.

Form # FD15

Date: 1/31/11

C.N. No. 120820

Rev. A

ZURN INDUSTRIES, L.L.C. ♦ SPECIFICATION DRAINAGE OPERATION ♦ 1801 Pittsburgh Ave. ♦ Erie, PA 16514

Phone: 814/455-0921 ♦ Fax: 814/454-7929 ♦ World Wide Web: [www.zurn.com](http://www.zurn.com)

In Canada: ZURN INDUSTRIES LIMITED ♦ 3544 Nashua Drive ♦ Mississauga, Ontario L4V1L2 ♦ Phone: 905/405-8272 Fax: 905/405-1292

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 22 1006 2.4 Plumbing Piping Specialties

Submittal Number: 1

Item: WCO Wall Cleanout

Manufacturer: ZURN

Model #: ZZ14412NHG, ZZ14413NHG, ZZ14414NHB

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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**WCO**

ZZ14412NHG      ZURN

ZZ14413NHG      ZURN

ZZ14414NHG      ZURN

**WCO WALL CLEANOUT**

WALL CLEANOUT WITH SMOOTH ACCESS COVER - 2" NO HUB,  
GALVANIZED BODY

WALL CLEANOUT WITH SMOOTH ACCESS COVER - 3" NO HUB,  
GALVANIZED BODY

WALL CLEANOUT WITH SMOOTH ACCESS COVER - 4" NO HUB,  
GALVANIZED BODY

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## Terms and Conditions

### Price and Terms of Payment

Terms are net, payable 30 days from date of invoice. All pricing in U.S. currency. The Buyer shall pay all sales, consumers, or other applicable taxes. A 1-1/2% monthly (18% annual) service charge will be added to the outstanding balance of all past due invoices.

Minimum invoice \$100.00. Zurn Industries, LLC ("Zurn") reserves the right to apply a minimum order charge in order to meet the \$100.00 minimum invoice requirement. All orders are subject to credit approval by the Zurn Credit Department prior to the acceptance of an order. Orders may be refused, delivery may be withheld, or shipment stopped in transit without any liability on Zurn's part at Zurn's sole discretion based upon Buyer's credit worthiness as determined by Zurn.

### Freight

Zurn is pleased to provide an industry-leading \$3,500 combined freight rate. Please see below for specific policy details.

All sales are F.O.B. seller's location. Zurn will allow full freight allowance when any of the following conditions are met: 1) any combination of Specification Drainage, Light Commercial, Commercial Brass or Wilkins orders of \$3,500 or more; 2) Linear Drainage and Chemical Drainage orders of \$5,000 or more; 3) any combination of Specification Drainage, Light Commercial, Commercial Brass, Wilkins, Linear Drainage and Chemical Drainage orders of \$5,000 or more; 4) Zurn One Systems orders of \$7,500 or more; 5) fixture only orders totaling \$10,000 or more. This full freight allowance applies when the shipment is within the continental United States and has a single destination of a buyer's standard address or job location. Routing of shipment shall be determined at the sole direction of Zurn. Shipping dates are estimates and time of delivery shall not be of the essence of this sale contract. Under no circumstances will the Seller have any responsibility on account of any delays in manufacture, transportation, or otherwise. Terms of Export Shipment on application.

NOTE: Any product dimension larger than 92" or any single item weighing more than 3,500 lbs., shall be defined as an oversized and/or overweight product and Zurn's standard FFA terms may not apply. Please contact our customer service department for guidance on potential additional shipping charges.

These charges and restrictions apply in addition to Zurn standard terms and conditions for sale unless otherwise agreed upon by the parties.

### Limited Warranty

Zurn goods sold hereunder are warranted to be free from defects in material and factory workmanship for the period of time from the date of purchase: AquaVantage® Flush Valves, AquaFlush® Flush Valves, Commercial Fixtures, Faucets, Showers, and Tubular Brass three years; Chemical Drainage, Linear Drainage, Light Commercial, Specification Drainage, Zurn Wilkins, and Flush Valve and Tubular Brass decorative finishes one year. Where permitted by law, THE IMPLIED WARRANTY OF MERCHANTABILITY IS LIMITED TO THE ABOVE IDENTIFIED PERIOD OF TIME AND SHALL BE LIMITED SOLELY TO THE REPLACEMENT OF THE DEFECTIVE GOODS. A damaged/broken test cock or ball valve is not considered defective. Please contact Zurn Customer Care for assistance.

Zurn will replace goods at no cost that prove defective provided Zurn is notified in writing of such defect and the goods are returned prepaid at the specified Zurn location with evidence that they have been properly maintained and used in accordance with instructions. ZURN SHALL NOT BE RESPONSIBLE FOR ANY LABOR CHARGES OR ANY LOSS, INJURY, OR DAMAGES WHATSOEVER, INCLUDING, BUT NOT LIMITED TO, INCIDENTAL OR CONSEQUENTIAL DAMAGES. The sole and exclusive remedy shall be limited to the replacement of the defective goods. Before installation and use, the purchaser shall determine the suitability of the product for his intended use and the purchaser assumes all risk and liability whatever in the connection therewith. All weights stated in Zurn catalogs and lists are approximate and are not guaranteed.

### Returned Goods

Standard cataloged material may be returned only with written permission of Zurn. Returned goods are subject to a 25% restocking charge of total saleable material returned, plus cost of reconditioning, if necessary, to make material sellable. Transportation charges are the responsibility of the Buyer. Credit allowance will be in the form of merchandise credit only – not cash credit. The value of the return must total at least \$100.00 to qualify for credit allowance. No credit will be allowed for parts unless originally ordered and invoiced as parts. No credit will be allowed for discontinued or made-to-order items. Items that have been specially made are not subject to return or cancellation except by special negotiation. Material must be returned within one year of invoice date for credit to be issued for Chemical Drainage, Linear Drainage, and Light Commercial. Material must be returned within two years of invoice date for credit to be issued for Commercial Fixtures, Flush Valve Products, Specification Drainage, Tubular Brass, and Zurn Wilkins. No credit is allowed for Linear Drainage products that have been cut and Specification Drainage product with auxiliary tapings. Flush Valve material over two years old will be subject to a 50% handling charge. Flush Valve material over five years old will not be accepted. Light Commercial and Specification Drainage galvanized material will be credited at value of Dura-Coated cast iron, and chrome plated at value of bronze. Zurn Wilkins damaged/broken test cocks or ball valves are not considered defective.

### Illustrations of Typical Installations

The typical installations for various products found in each product section are intended to illustrate the products and potential options for the use of these products. Under no circumstances are they to be construed as recommended installation procedures. Consult local codes and project specifications for proper installation instructions.

ZURN INDUSTRIES, LLC

1801 PITTSBURGH AVENUE, ERIE, PA, U.S.A. 16502 PHONE: 855-ONE-ZURN (855-663-9876) FAX: 814/454-7929 [www.zurn.com](http://www.zurn.com)





## Terms and Conditions

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### Shortage/Damage Claims

Notification of material shortages or incorrect filling of orders must be made to Zurn within 10 days of receipt. No claims over three months old will be honored. Buyer agrees to make all complaints for damage in transit or "short count" directly to the carrier; before the contents are unloaded have the carrier agent's acknowledgement of such damage noted on the bill of lading and to present to the carrier its agent's acknowledgement of such damaged material with formal claim covering said damage.

### General

Zurn reserves the right to make changes in design or equipment of any item or product without incurring any obligation on previously sold items, and to discontinue items at any time, without notice. Possession of this Catalog or other sales literature is not to be construed as an offer to sell. All orders are subject to acceptance by Zurn. Catalog printed in U.S.A.

Zurn flush valves are designed to comply with Army Corp of Engineers and Naval guide specifications, Military Specification MIL.V.29193 and Federal Specification WWP541.

Zurn flush valves comply with the following standards: ASME A112.18.1/CSA B125.1, A112.19.5, A112.19.2, A112.19.6, ASSE 1037 and 101 are listed by the following agencies: Canadian Standards, IAPMO/UPC/CUPC, and CSA 125.3. Zurn flush valves are manufactured from dezincification resistant alloys. For additional compliances, contact Zurn Industries, LLC, Commercial Brass Operation, or 1-800-997-3876.

**Zurn is not responsible for typographical errors. The contents of this guide are subject to revision without notice.**

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## **PEX Plumbing and Radiant Heating Systems Terms and Conditions**

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### **Price and Terms of Payment**

Terms are net, payable 30 days from date of invoice. All pricing in U.S. currency. The Buyer shall pay all sales, consumers, or other applicable taxes. A 1-1/2% per month service charge will be added to all past due invoices. Annual rate 18% of the outstanding balance due.

Minimum invoice \$150.00. Zurn reserves the right to apply a minimum order charge to equal \$150.00. All orders are subject to credit approval by the Zurn Credit Department prior to the acceptance of an order. Orders may be refused, delivery may be withheld, or shipment stopped in transit without any liability on Zurn's part if in its sole opinion, the Buyer's ability to pay for the merchandise or the terms and conditions herein are in doubt. The Credit Department of Zurn must be notified of potential pricing errors within 30 days of invoice date.

### **Freight**

All sales are F.O.B. Zurn's plant. Zurn will allow full freight allowance only on Zurn PEX® and Radiant Heating orders of \$3,000 or more. This full freight allowance is when the shipment is within the continental United States and has a destiny of a Buyer's standard address of job location. Routing of shipment shall be determined at the sole discretion of Zurn. Multi product line orders totaling \$7,500 can be combined to meet FFA guidelines. Shipping dates are estimates and time of delivery is not the essence of this sale of the contract therefore. Under no circumstances will Zurn have any responsibility on account of any delays in manufacture, transportation, or otherwise.

### **Limited Warranty**

Please refer to document ZPM10232 -- Zurn PEX®, Inc. warranty.

### **Proposition 65 Compliance**

Zurn provides certain products in compliance with the requirements of California's Proposition 65 (California Health and Safety Code 25249.5 et seq.). Any required warning materials under this statute are enclosed with these products and must be kept in their entirety with the product. Any directions included in these warning materials must be strictly followed. Customer expressly acknowledges its responsibility and obligation to ensure that any such warning materials provided by Zurn are provided to the ultimate purchaser and Zurn disclaims any express or implied liability for customer's failure to meet the requirements.

### **Returned Goods**

Standard cataloged material may be returned only with written permission of Zurn. Returned goods are subject to a 25% restocking charge of total saleable material returned, plus cost of reconditioning, if necessary, to make material sellable. Transportation charges are the responsibility of the Buyer. Credit allowance will be in the form of merchandise credit only -- not cash credit. The value of a return must total at least \$100.00 to qualify for credit allowance.

### **Shortage/Damage Claims**

Notification of material shortages or incorrect filling of orders must be made to Zurn within 5 working days of receipt. No claims over three months old will be honored. Buyer agrees to make all complaints for damage in transit or "short count" directly to the carrier; before the contents are unloaded have the carrier agent's acknowledgement of such damage noted on the bill of lading and to present to the carrier its agent's acknowledgement of such damaged material with formal claim covering said damage.

### **General**

Zurn reserves the right to make changes in design or equipment of any item or product without incurring any obligation on previously sold items, and to discontinue items at any time, without notice. Possession of this Catalog or other sales literature is not to be construed as an offer to sell. All orders are subject to acceptance by the general office of Zurn in Commerce, Texas.

Catalog printed in U.S.A.



**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 22 1006 2.6 Plumbing Piping Specialties

Submittal Number: 1

Item: Oil Inceptor

Manufacturer: ZURN

Model #: ZZ1189100

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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**OIL INTERCEPTOR**

ZZ1189100

ZURN

100 LBS CAPACITY OIL/SEDIMENT INTERCEPTOR WITH HEAVY-DUTY GRATE, ACID RESISTANT COATED FABRICATED STEEL

M

ZURN

E - EXTENSION (SPECIFY 1-6")

M

ZURN

E - ADD FOR EACH 1" OF EXTENSION GREATER THAN 6"

M

ZURN

K - ANCHOR FLANGE

M

ZURN

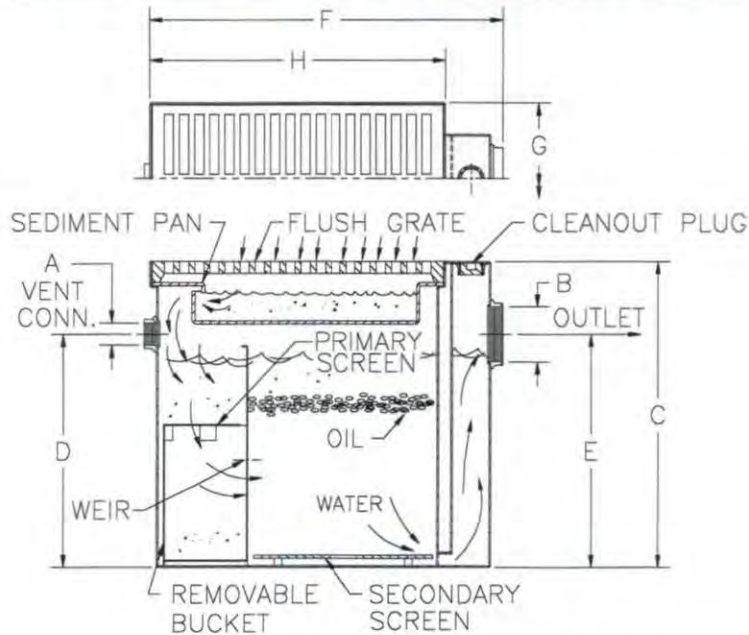
KC - ANCHOR FLANGE W/ CLAMP

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# Z-1189 OIL & SEDIMENT INTERCEPTOR

## Operation and Maintenance Instructions



Size	Sludge Capacity Lbs. [kg]	Grate Open Area [cm <sup>2</sup> ]	No. of Grates	No. of Pans	Approx. Wt. Lbs. [kg]	A Vent Size	B Pipe Size	Dimension In Inches					
								C	D	E	F	G	H
12	12 [5]	49 [316]	1	1	70 [32]	----	2 [50]	15 [381]	----	10 1/2 [267]	17 1/8 [435]	11 3/8 [289]	12 3/8 [314]
60	60 [27]	131 [845]	1	1	175 [79]	2 [51]	4 [75]	25 1/4 [641]	19 1/4 [489]	17 5/8 [448]	29 1/8 [740]	12 3/8 [314]	24 3/8 [619]
100	100 [45]	262 [1690]	2	1	280 [127]	2 [51]	4 [75]	33 [838]	27 [686]	22 [559]	29 1/8 [740]	24 3/8 [619]	24 3/8 [619]
200	200 [91]	393 [2535]	3	1	370 [168]	2 [51]	4 [75]	33 [838]	27 [686]	22 [559]	41 1/8 [1044]	24 3/8 [619]	36 3/8 [924]
300	300 [136]	524 [3380]	4	1	460 [208]	2 [51]	4 [75]	33 [838]	27 [686]	22 [559]	53 1/8 [1349]	24 3/8 [619]	48 3/8 [1229]

### SIZING

The sizing of this interceptor is generally based upon the expected amount of sediment and solid waste to be retained. (See chart above for sludge capacity). Secondly, sizing will determine the frequency for which cleaning shall be required. Larger units will handle greater volumes of waste between cleanings. All units are made with a standard pipe size outlet and are capable of handling drainage volumes standard to their respective pipe size.

### DESIGN

The Zurn Z-1189 Oil and Sediment Interceptor for garage and industrial floor drainage applications is designed to retain mud, sand, sediment, greasy sludge or any other solids entering a floor drain, in addition to any oil/grease laden waste material. This is accomplished through the principal of gravity and floatation separation. The sediment pan retains greasy sludge and solids. The removable bucket/weir will also retain solids and act to stop water turbulence so oil and grease can separate from the water, and be retained in the main separation chamber.

### OPERATION

The waste water flows through the grate into the sediment pan, then down into the removable bucket, exiting through the weir at back of the bucket into the main separating chamber, down through the secondary screen, into the cleanout chamber, then exits the interceptor to the sanitary drain system.

### MAINTENANCE

Cleaning should be done on a regular basis, either before or after sediment pan passageway becomes blocked. Remove the grate, sediment pan and bucket, and clean out all debris. Skim oil/grease from top of water or pump contents out. After cleaning all materials should be disposed of properly. Efficiency of operation is directly related to the level of maintenance. Cleaning should be done regularly to avoid oil/sludge from passing through the unit.





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NOTE: Any product dimension larger than 92" or any single item weighing more than 3,500 lbs., shall be defined as an oversized and/or overweight product and Zurn's standard FFA terms may not apply. Please contact our customer service department for guidance on potential additional shipping charges.

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### Illustrations of Typical Installations

The typical installations for various products found in each product section are intended to illustrate the products and potential options for the use of these products. Under no circumstances are they to be construed as recommended installation procedures. Consult local codes and project specifications for proper installation instructions.

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1801 PITTSBURGH AVENUE, ERIE, PA, U.S.A. 16502 PHONE: 855-ONE-ZURN (855-663-9876) FAX: 814/454-7929 [www.zurn.com](http://www.zurn.com)



## Terms and Conditions

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Zurn flush valves are designed to comply with Army Corp of Engineers and Naval guide specifications, Military Specification MIL.V.29193 and Federal Specification WWP541.

Zurn flush valves comply with the following standards: ASME A112.18.1/CSA B125.1, A112.19.5, A112.19.2, A112.19.6, ASSE 1037 and 101 are listed by the following agencies: Canadian Standards, IAPMO/UPC/CUPC, and CSA 125.3. Zurn flush valves are manufactured from dezincification resistant alloys. For additional compliances, contact Zurn Industries, LLC, Commercial Brass Operation, or 1-800-997-3876.

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**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 22 4000 2.1 Plumbing Fixtures

Submittal Number: 1

Item: Emergency Eye Wash Free Standing

Manufacturer: Speakman Company

Model #: Speakman SE-1250

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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INSTRUCTIONS FOR MODELS

**OPTIMUS™**  
SE-1200  
SE-1250  
SE-1255



STANDARD INSTALLATION  
(FOR ADA INSTALLATION SEE PAGE 6)

NEED HELP?

For additional assistance or service please contact:

**SPEAKMAN®** Company  
400 Anchor Mill Road  
New Castle, DE 19720

800-537-2107

customerservice@speakmancompany.com

www.speakmancompany.com

92-SE-1200-1255-R4

TOOLS AND SUPPLIES



**IMPORTANT**

ANSI Z358.1 requires that all safety emergency equipment shall be activated on a weekly basis to flush the line and verify proper operation. **SPEAKMAN** furnishes a testing record tag (91-0635) with each unit. On this tag, the date of inspection and the inspector's initials should be noted. ANSI Z358.1 specifies that the height of the spray heads is to be between 33" - 45" from the floor. Use Thread Locker or Sealant on all threaded connections. Be sure the Unit is level and plum.

**SAFETY TIPS**

Cover your drain to prevent loss of parts. Always wear eye protection.

**MAINTENANCE**

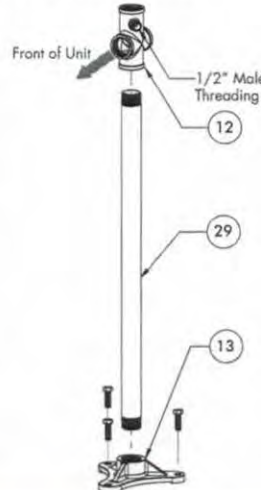
Should you need parts to repair this unit, please reference the parts listing for correct repair part number. Before any maintenance is done, be sure to shut the water supply off. Use only genuine **SPEAKMAN** parts when repairing or replacing components. To order parts, call 1-800-537-2107.

**WARRANTY**

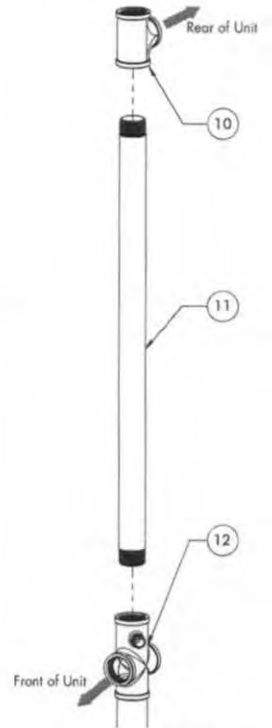
3 year limited warranty.  
Additional warranty information can be found at: [www.speakmancompany.com](http://www.speakmancompany.com)

- For ADA installation see Page 6.  
Use Thread Locker or Sealant on ALL threaded connections

- At desired location, mount Floor Flange (13) on a flat, level surface using suitable anchors, making sure that one of the three ears on the Floor Flange is positioned at what will be the front of the Stanchion.
- The Unit should be placed so that there is sufficient unobstructed area around the Stanchion.
- Assemble 1-1/4" x 32-3/8" Pipe (29) to Floor Flange (13).
- Thread 1-1/4" x 1/2" Drain/Supply Cross (12) onto Pipe (29). Side Outlets should face the front and back of the Unit, and the 1/2" male threaded outlet upward at 45° to the right side of the Unit.



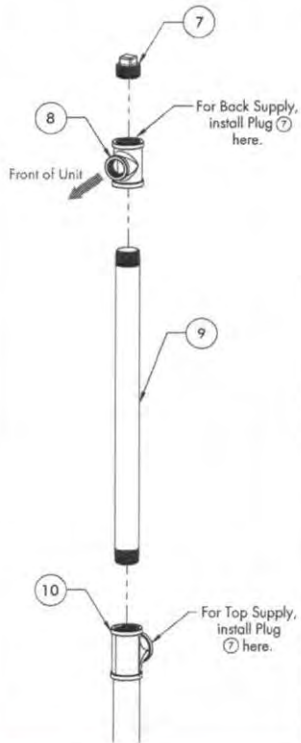
- Assemble 1-1/4" x 26-7/16" Pipe (11) to Drain/Supply Cross (12). Assemble 1-1/4" Tee (10) to Pipe (11).
- Assure the Side Outlet portion of Tee (10) is facing the rear of the Unit.





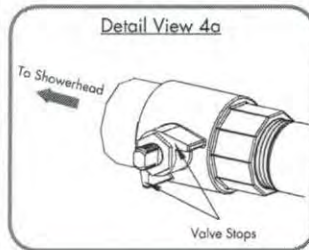
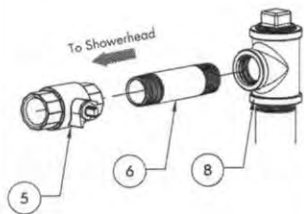
3

- If water supply is coming from above Unit, install Plug (7) into side outlet of Tee (10).
- If water supply is coming from behind Unit, install Plug (7) into top outlet of Tee (10).



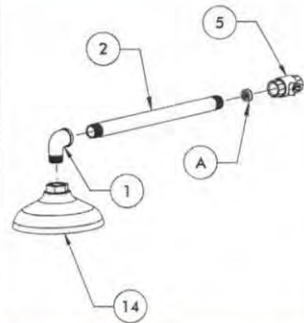
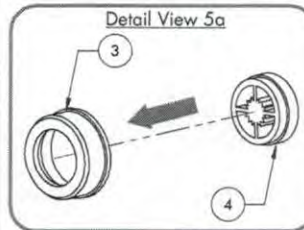
4

- Assemble 1" x 4-1/2" Pipe (2) into Side Outlet of Tee (10). Review View 4a below to understand the orientation of Ball Valve (5).
- Assemble 1" Ball Valve (5) onto Pipe (2). Valve Stops must be aligned correctly in order for the Pull Handle to operate properly.



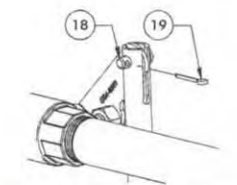
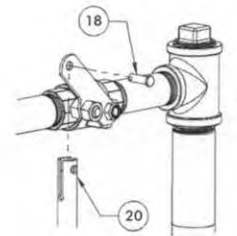
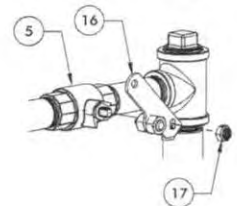
5

- Insert Flow Control (4) into Floet Housing (3), referring to Detail View 5a.
- Insert Flow Control Assembly (A) into end of 1" x 17-5/8" Pipe (2), so that the flange of Floet Housing (3) is fully seated in the end of Pipe.
- Install Pipe (2) with Flow Control Assembly (A) into Ball Valve (5).
- Assemble Elbow (1) to Pipe (2) being sure to orient Elbow (1) so that the outlet is facing down.
- Assemble Showerhead (14) to Elbow (1).



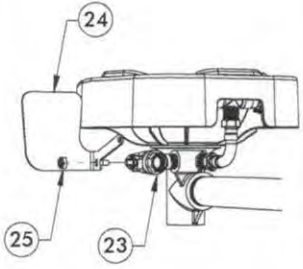
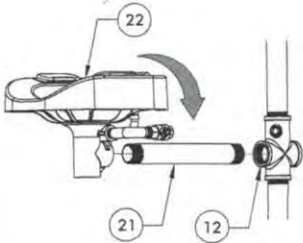
6

- Assemble the Lever Handle Assembly (18) to Ball Valve (5) using Nylo-Hex Nut (17), being sure to orient the Handle as shown below.
- Insert the slot in the Pull Rod (20) over the Lever Handle Assembly (18) and insert Pin (19).
- Secure Pin (19) with Cotter Pin (19).



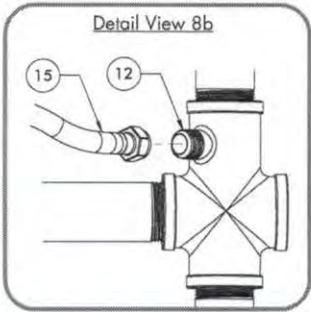
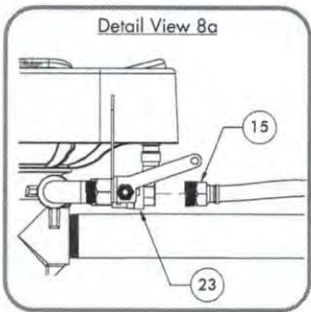
7

- Thread Pipe (21) into Drain/Supply Cross (12).
- Thread entire Bowl Assembly (22) to Pipe (21), being sure Bowl is level, plumb, and horizontal when completely secured.
- Install Paddle Handle (24) to Ball Valve (23) using Nylo-Hex Nut Nut (25).



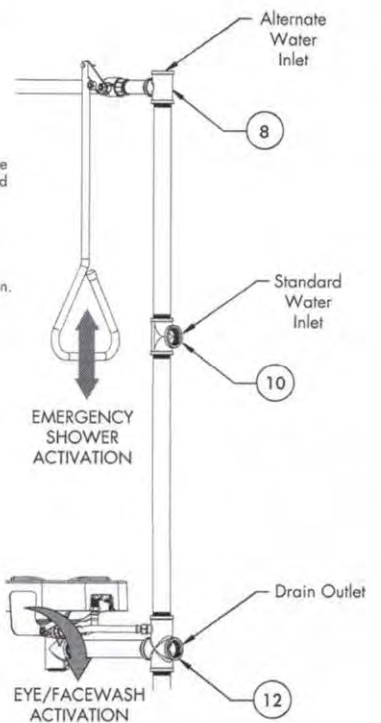
8

- Assemble male end of Flex Hose (15) to Ball Valve (23) (Detail View 8a).
- Assemble female end of Flex Hose (15) to Drain/Supply Cross (12) (Detail View 8b).

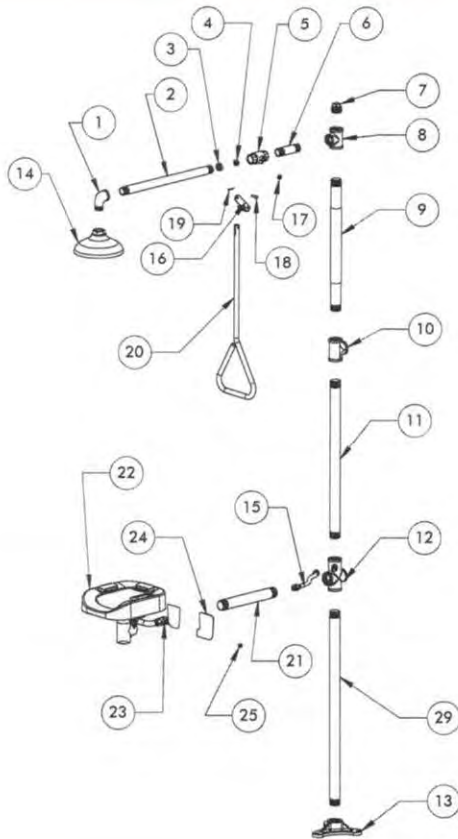


9

- Connect an uninterruptible potable water supply with a minimum of 30psi flowing pressure to Water Inlet. Failure to use potable water can result in further injury.
- Connect an adequate drain to Drain Outlet that complies with all local plumbing codes.
- Turn on water supply and check connections for leaks.
- To test the Eye/Face Wash, and for subsequent operation, push the Paddle Handle forward 90°. The unit will operate until the Paddle Handle is manually pulled back to the OFF position.
- To test the Shower, and for subsequent operation, pull the Pull Rod down. The unit will operate until the Pull Rod is manually pushed back to the OFF position.



STANDARD INSTALLATION EXPLODED VIEW / REPAIR PART GROUPS



Item No.	Description	Qty.
1	1" x 90° Galv. Street Elbow	1
2	1" x 19-3/8" Galv. Pipe, TBE	1
3	Rubber Floet Housing	1
4	20 GPM Flow Control	1
5.1	1" Chrome Plated Brass Ball Valve	1
5.2	1" Stainless Steel Ball Valve	1
6	1" 4-1/2" Galv. Pipe, TBE	1
7	1-1/4" Galv. Plug	1
8	1-1/4" x 1-1/4" x 1" Galv. Tee	1
9	1-1/4" x 22-1/4" Galv. Pipe, TBE	1
10	1-1/4" Galv. Tee	1
11	1-1/4" x 26-7/16" Galv. Pipe, TBE	1
12	1-1/4" x 1/2" Galv. Drain/Supply Cross	1
13	1-1/4" Galv. Floor Flange	1
14	8" Deluge Showerhead	1
15	Stainless Steel Flexible Supply Hose	1
16.1	Lever Handle w/Spring Plunger (SE-1200/SE-1250)	1
16.2	Lever Handle w/Spring Plunger (SE-1255)	1
17	7/16-20 UNF Stainless Steel Nylo-Hex Nut	1
18	Clevis Pin	1
19	Cotter Pin	1
20.1	29" Aluminum Pull Rod	1
20.2	29" Stainless Steel Pull Rod	1
21	1-1/4" x 11-5/8" Galv. Pipe, TBE	1
22	Eyewash Unit	1
22.1	Plastic Bowl, Chrome Plated Brass Ball Valve (SE-1	1
22.2	S/S Bowl, Chrome Plated Brass Ball Valve	1
22.3	S/S Bowl, Stainless Steel Ball Valve	1
23	1/2" Ball Valve	1
23.1	1/2" Chrome Plated Brass Ball Valve (SE-1200/1250)	1
23.2	1/2" Stainless Steel Ball Valve (SE-1255)	1
24	Paddle Handle	1
25	3/8" Stainless Steel Nylo-Hex Nut	1
29	1-1/4" x 32-3/8" Galv. Pipe, TBE	1

REPAIR PARTS

Item No.	Part No.	Description
5	SE-911	1" Ball Valve
5	SE-911-SS	1" Stainless Steel Ball Valve SE-1255 Only
14	SE-870	8" Plastic Showerhead
14	SE-880	8" Stainless Steel Showerhead
20.1	RPG47-0046	Aluminum Pull Rod (With ADA Extension)
20.2	RPG47-0044	S/S Pull Rod (With ADA Extension)
22.1	SE-1000	Plastic Bowl, Chrome Plated Brass Ball Valve
22.2	SE-1050	S/S Bowl, Chrome Plated Brass Ball Valve
22.3	SE-1055	S/S Bowl, Stainless Steel Ball Valve (SE-1255 only)
15	RPG63-0094	Stainless Steel Supply Hose



STANDARD INSTALLATION ROUGH-IN DIMENSIONS

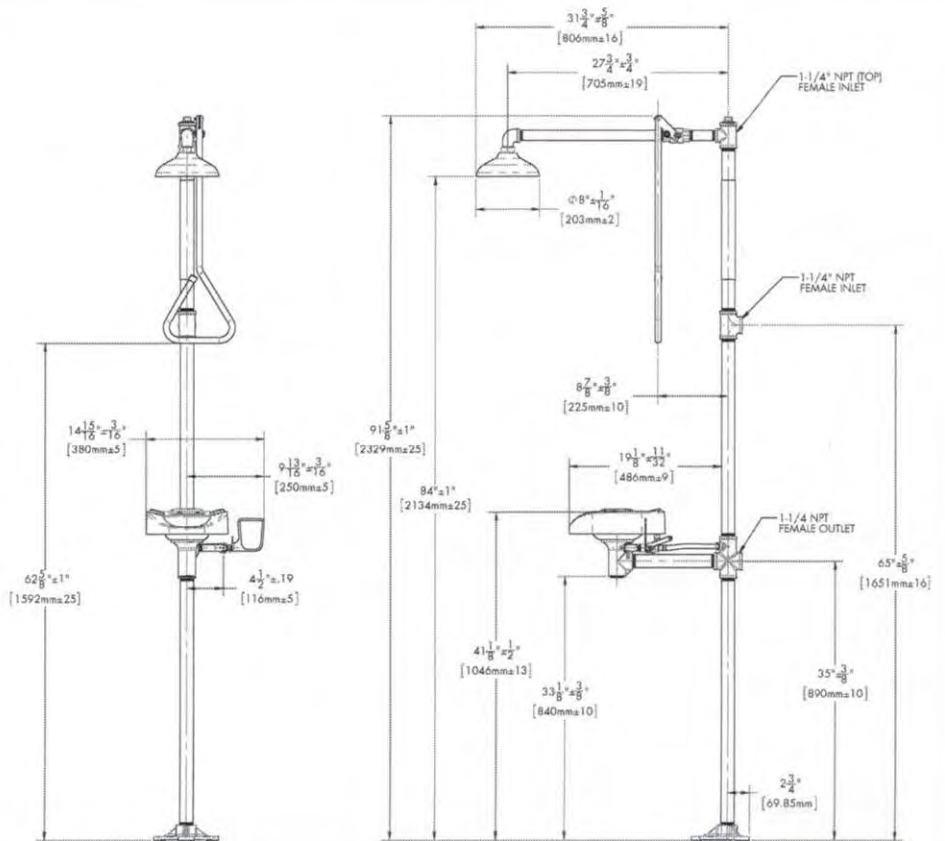
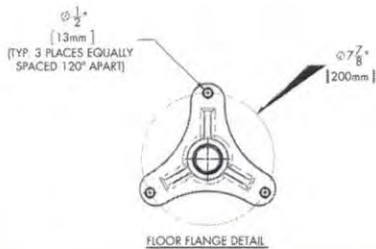
SE-1200/1250/1255  
SHOWER FLOW DATA

PRESSURE		FLOW RATE	
psi	bar	gpm	L/min
30	2.07	20	75
60	4.14	25	94

SE-1200/1250/1255  
EYE/FACEWASH FLOW DATA

PRESSURE		FLOW RATE	
psi	bar	gpm	L/min
30	2.07	4.9	18.5
60	4.14	5.0	18.9

**NOTE:** ALL UNITS MEET EXISTING ANSI Z358.1 STANDARDS AND OSHA RULES. PRODUCT IMPROVEMENTS MAY CAUSE SPECIFICATION AND DIMENSIONAL CHANGES WITHOUT NOTICE.



INSTRUCTIONS FOR MODELS

**OPTIMUS™**  
SE-1200  
SE-1250  
SE-1255



ADA INSTALLATION  
(FOR STANDARD INSTALLATION SEE PAGE 6)

NEED HELP?

For additional assistance or service please contact:

**SPEAKMAN®** Company  
400 Anchor Mill Road  
New Castle, DE 19720

800-537-2107

customerservice@speakmancompany.com

www.speakmancompany.com

92-SE-1200-1255-R2

TOOLS AND SUPPLIES



**IMPORTANT**

ANSI Z358.1 requires that all safety emergency equipment shall be activated on a weekly basis to flush the line and verify proper operation. **SPEAKMAN** furnishes a testing record tag [91-0635] with each unit. On this tag, the date of inspection and the inspector's initials should be noted. ANSI Z358.1 specifies that the height of the spray heads is to be between 33" - 45" from the floor. Use Thread Locker or Sealant on all threaded connections. Be sure the Unit is level and plum.

**SAFETY TIPS**

Cover your drain to prevent loss of parts. Always wear eye protection.

**MAINTENANCE**

Should you need parts to repair this unit, please reference the parts listing for correct repair part number. Before any maintenance is done, be sure to shut the water supply off. Use only genuine **SPEAKMAN** parts when repairing or replacing components. To order parts, call 1-800-537-2107.

**WARRANTY**

3 year limited warranty. Additional warranty information can be found at: www.speakmancompany.com

1 ⚠ For Standard installation see Page 1.

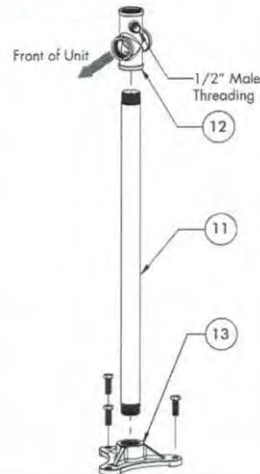
⚠ Use Thread Locker or Sealant on ALL threaded connections

- At desired location, mount Floor Flange (13) on a flat, level surface using suitable anchors, making sure that one of the three ears on the Floor Flange is positioned at what will be the front of the Stanchion.

- The Unit should be placed so that there is sufficient unobstructed area around the Stanchion.

- Assemble 1-1/4" x 26-7/16" Pipe (11) to Floor Flange (13).

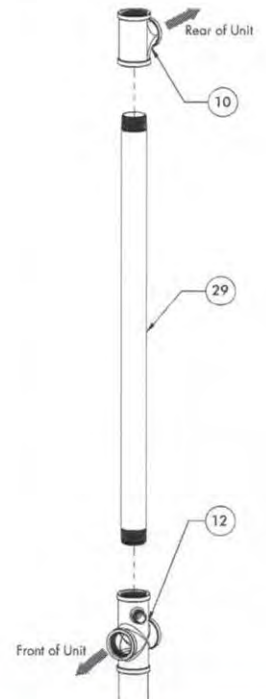
- Thread 1-1/4" x 1/2" Drain/Supply Cross (12) onto Pipe (11). Side Outlets should face the front and back of the Unit, and the 1/2" male threaded outlet upward at 45° to the right side of the Unit.



2

- Assemble 1-1/4" x 32-3/8" Pipe (29) to Drain/Supply Cross (12). Assemble 1-1/4" Tee (10) to Pipe (29).

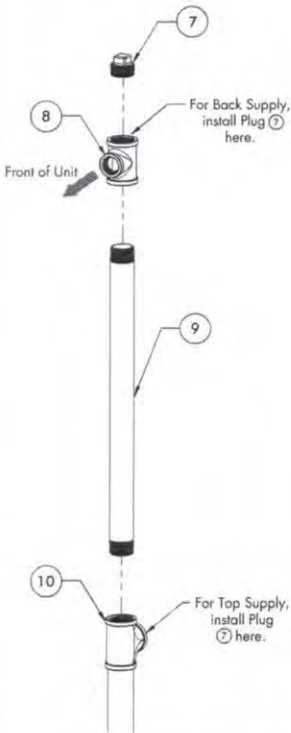
- Assure the Side Outlet portion of the Tee is facing the rear of the Unit.





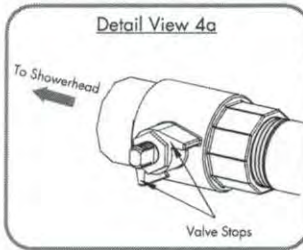
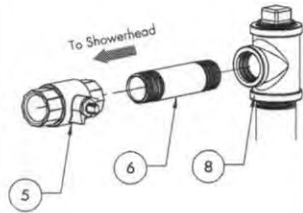
3

- If water supply is coming from above Unit, install Plug (7) into side outlet of Tee (8).
- If water supply is coming from behind Unit, install Plug (7) into top outlet of Tee (8).



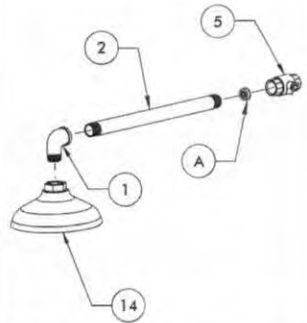
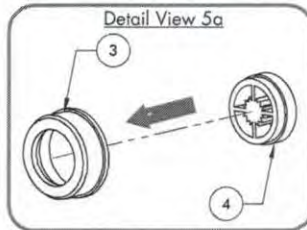
4

- Assemble 1" x 4-1/2" Pipe (4) into Side Outlet of Tee (8). Review View 4a below to understand the orientation of Ball Valve (5).
- Assemble 1" Ball Valve (5) onto Pipe (4). Valve Stops must be aligned correctly in order for the Pull Handle to operate properly.



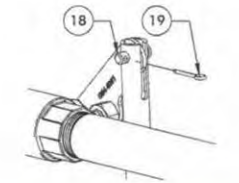
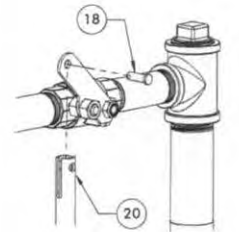
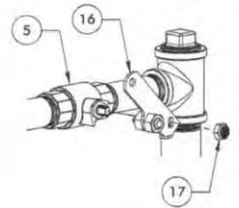
5

- Insert Flow Control (4) into Floet Housing (3), referring to Detail View 5a.
- Insert Flow Control Assembly (A) into end of 1" x 17-5/8" Pipe (2), so that the flange of Floet Housing (3) is fully seated in the end of Pipe.
- Install Pipe (2) with Flow Control Assembly (A) into Ball Valve (5).
- Assemble Elbow (1) to Pipe (2) being sure to orient Elbow (1) so that the outlet is facing down.
- Assemble Showerhead (14) to Elbow (1).



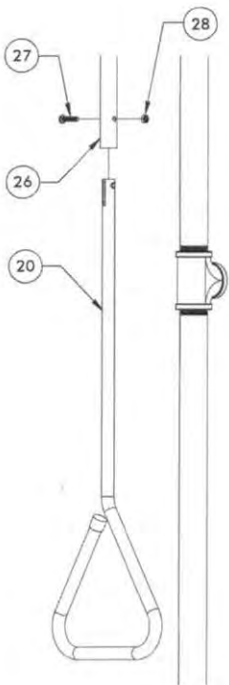
6

- Assemble the Lever Handle Assembly (18) to Ball Valve (5) using Nylo-Hex Nut (17), being sure to orient the Handle as shown below.
- Insert the slot in the Pull Rod (18) over the Lever Handle Assembly (18) and insert Pin (19).
- Secure Pin (19) with Cotter Pin (19).



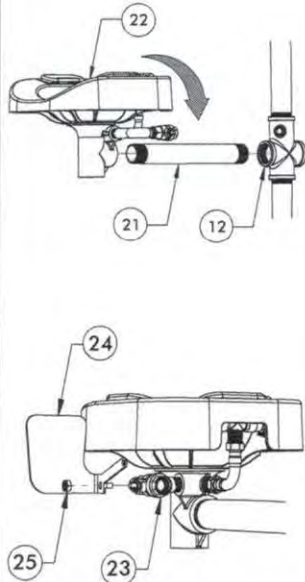
7

- Assemble Pull Rod (20) to Pull Rod Extension (26) using Machine Screw (27) and Nylo-Hex Nut (28).



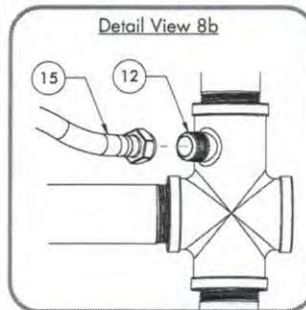
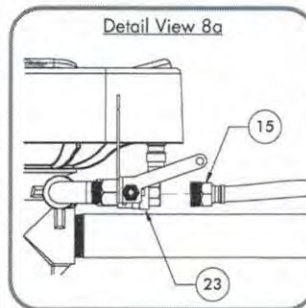
8

- Thread Pipe (21) into Drain/Supply Cross (12).
- Thread entire Bowl Assembly (22) to Pipe (21), being sure Bowl is level, plumb, and horizontal when completely secured.
- Install Paddle Handle (24) to Ball Valve (23) using Nylo-Hex Nut Nut (25).



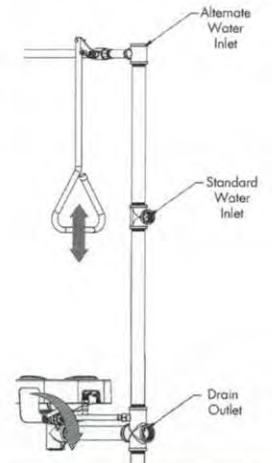
9

- Assemble male end of Flex Hose (13) to Ball Valve (23) (Detail View 8a).
- Assemble female end of Flex Hose (13) to Drain/Supply Cross (12) (Detail View 8b).

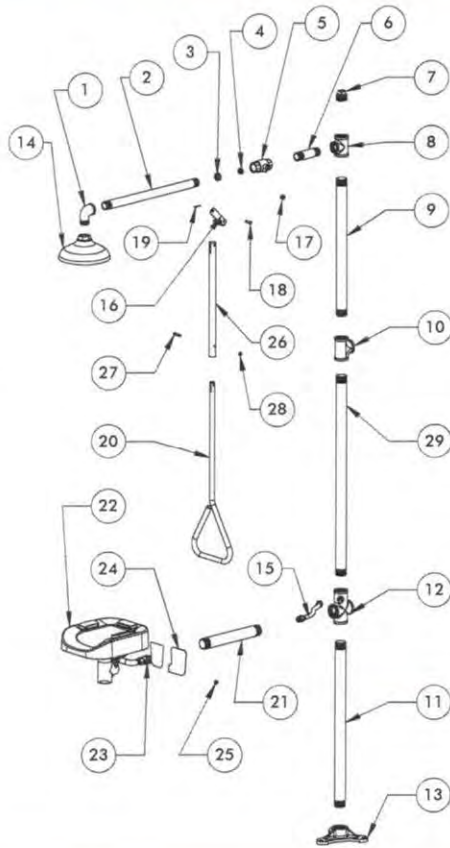


10

- Connect an uninterruptible potable water supply with a minimum of 30psi flowing pressure to Water Inlet. Failure to use potable water can result in further injury.
- Connect an adequate drain to Drain Outlet that complies with all local plumbing codes.
- Turn on water supply and check connections for leaks.
- To test the Eye/Face Wash, and for subsequent operation, push the Paddle Handle forward 90°. The unit will operate until the Paddle Handle is manually pulled back to the OFF position.
- To test the Shower, and for subsequent operation, pull the Pull Rod down. The unit will operate until the Pull Rod is manually pushed back to the OFF position.



ADA INSTALLATION EXPLODED VIEW / REPAIR PART GROUPS



Item No.	Description	Qty.
1	1" x 90" Galv. Street Elbow	1
2	1" x 19-3/8" Galv. Pipe, TBE	1
3	Rubber Floet Housing	1
4	20 GPM Flow Control	1
5.1	1" Chrome Plated Brass Ball Valve	1
5.2	1" Stainless Steel Ball Valve	1
6	1" 4-1/2" Galv. Pipe, TBE	1
7	1-1/4" Galv. Plug	1
8	1-1/4" x 1-1/4" x 1" Galv. Tee	1
9	1-1/4" x 22-1/4" Galv. Pipe, TBE	1
10	1-1/4" Galv. Tee	1
11	1-1/4" x 26-7/16" Galv. Pipe, TBE	1
12	1-1/4" x 1/2" Galv. Drain/Supply Cross	1
13	1-1/4" Galv. Floor Flange	1
14	8" Deluge Showerhead	1
15	Stainless Steel Flexible Supply Hose	1
16.1	Lever Handle w/Spring Plunger (SE-1200/SE-1250)	1
16.2	Lever Handle w/Spring Plunger (SE-1255)	1
17	7/16-20 UNF Stainless Steel Nylo-Hex Nut	1
18	Clevis Pin	1
19	Cotter Pin	1
20.1	29" Aluminum Pull Rod	1
20.2	29" Stainless Steel Pull Rod	1
21	1-1/4" x 11-5/8" Galv. Pipe, TBE	1
22	Eyewash Unit	1
22.1	Plastic Bowl, Chrome Plated Brass Ball Valve (SE-1	1
22.2	S/S Bowl, Chrome Plated Brass Ball Valve	1
22.3	S/S Bowl, Stainless Steel Ball Valve	1
23	1/2" Ball Valve	1
23.1	1/2" Chrome Plated Brass Ball Valve (SE-1200/1250)	1
23.2	1/2" Stainless Steel Ball Valve (SE-1255)	1
24	Paddle Handle	1
25	3/8" Stainless Steel Nylo-Hex Nut	1
26.1*	Aluminum Pull Rod Extension (SE-1200/SE-1250 ADA Only)	1
26.2*	Stainless Steel Pull Rod Extension (SE-1255 ADA only)	1
27*	1-1/2" Long 1/4-20 Machine Screw	1
28*	1/4-20 Stainless Steel Nylo-Hex Nut	1
29	1-1/4" x 32-3/8" Galv. Pipe, TBE	1

\*ADA Installation only

REPAIR PARTS

Item No.	Part No.	Description
5	SE-911	1" Ball Valve
5	SE-911-SS	1" Stainless Steel Ball Valve SE-1255 Only
14	SE-870	8" Plastic Showerhead
14	SE-880	8" Stainless Steel Showerhead
20.1	RPG47-0046	Aluminum Pull Rod (With ADA Extension)
20.2	RPG47-0044	S/S Pull Rod (With ADA Extension)
22.1	SE-1000	Plastic Bowl, Chrome Plated Brass Ball Valve
22.2	SE-1050	S/S Bowl, Chrome Plated Brass Ball Valve
22.3	SE-1055	S/S Bowl, Stainless Steel Ball Valve (SE-1255 only)
15	RPG63-0094	Stainless Steel Supply Hose



ADA INSTALLATION ROUGH-IN DIMENSIONS

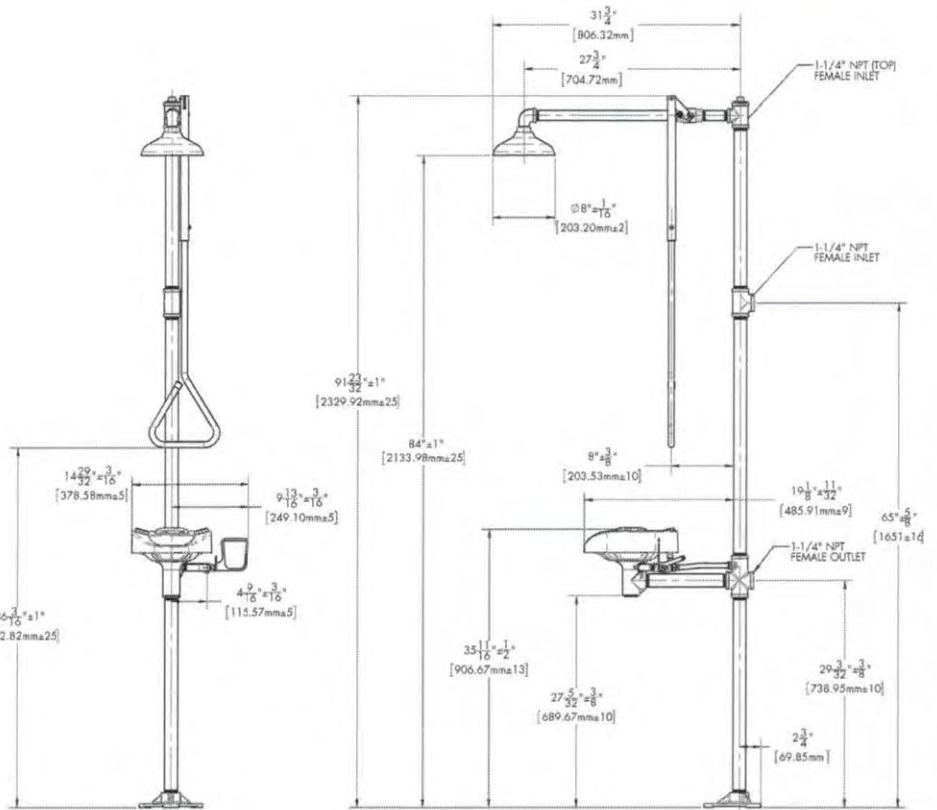
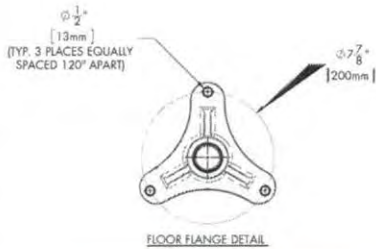
SE-1200/1250/1255  
SHOWER FLOW DATA

PRESSURE		FLOW RATE	
psi	bar	gpm	L/min
30	2.07	20	75
60	4.14	25	94

SE-1200/1250/1255  
EYE/FACEWASH FLOW DATA

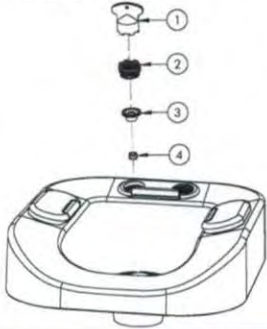
PRESSURE		FLOW RATE	
psi	bar	gpm	L/min
30	2.07	4.9	18.5
60	4.14	5.0	18.9

**NOTE:** ALL UNITS MEET EXISTING ANSI Z358.1 STANDARDS AND OSHA RULES. PRODUCT IMPROVEMENTS MAY CAUSE SPECIFICATION AND DIMENSIONAL CHANGES WITHOUT NOTICE.



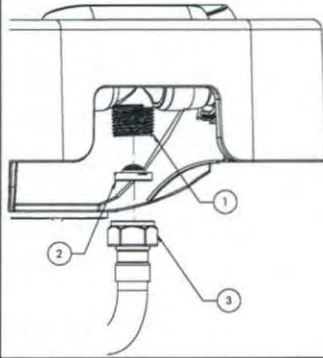
### To Clean the Aerated Outlets:

Using the Aerator Wrench (1), remove the Aerator (2). The Flow Control Housing (3) will come out next, with the Flow Control (4) inside of it. Remove the Flow Control and check for debris surrounding the o-ring. Flush with clean water. Check the mesh on the back of the Aerator for debris. Flush with clean water.



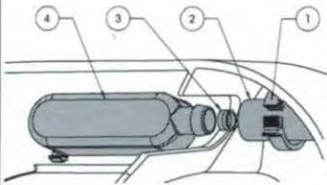
### To Clean the In-Line Strainer:

Begin by removing Supply Hose (3) from Hose Manifold Tee (1). The Strainer (2) will be located inside the threading of Supply Hose (3). Remove Strainer (2) and check for debris. Flush with clean water.



### To Clean the Non-Aerated Outlets:

Begin by removing the Hose Clamp (1), then remove Hose (2) from Housing (4). Flow Control (3) can be seen inside Housing (4) at this point. Remove Flow Control and check for debris surrounding the o-ring. Flush with clean water.







TV1

L7299911

LAWLER

TV-1 TEMP VALVE

MODEL 801 ROUGHT CHROME HIGH-LOW MASTER CONTROLLER MIXING VALVE WITH 3/4" INLET, 1" OUTLET, AND CHECK STOPS. 50GPM @ 45 PSI, ASSE 1017 APPROVED AND ASSE LEAD FREE CERTIFIED



**MANUFACTURING CO., INC.**  
5330 East 25th Street  
Indianapolis, Indiana 46218  
Phone (317) 261-1212  
Fax (317) 261-1208

www.lawlervalve.com

# Model 801

Installation &  
Maintenance Manual  
M 801 C  
PAT. NO. 5,203,496.  
PAT. NO. 5,323,960.

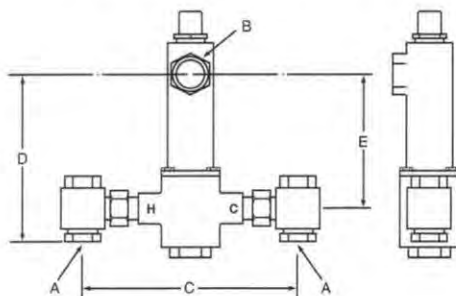


## NOTICE!

ASSE 1017 Approved

Thermostatic Water Controllers will not work satisfactorily if improperly installed. Read these instructions carefully before installing and follow directions as outlined.

Certified to  
CSA B125.3



### DIMENSIONS:

Valve Number	A N.P.T.	B N.P.T.	C	D	E
801	3/4"	1"	10"	12"	10 1/2"

### CAPACITIES - MODEL 801

Pressure Drop PSI	5	10	20	30	45	60	80
Valve Number	Capacity						
801-GPM	17	25	34	40	50	57	65
801-LPM	64	94	128	151	189	210	246

## General Description

The Model 801 water temperature controller is carefully assembled and tested at the factory to mix hot and cold water to any desired temperature within range. The temperature of the hot water should be at least 20°F higher than the maximum valve setting. The major safety features are:

1. Failure of cold water supply causes the hot water ports to reduce hot water flow.
2. Failure of hot water supply causes the cold water ports to reduce cold water flow.
3. Failure of the thermostat allows both ports to reduce flow of hot and cold water.

At each inlet of the controller is a union end stop and check valve with removable strainer. Stop and check valves are to prevent water from bypassing between hot and cold water supply lines. These valves should be fully open when in operation.

### Maximum Inlet Conditions

Pressure: 125 psi

Temperature: 200°F

## Maintenance

The controller should be checked periodically and, if needed, cleaned as outlined in "INSPECTING and CLEANING VALVE." To test for proper setting and operation - proceed as follows:

1. Turn on full hot and cold water supply to the valve. The mixing valve should deliver water at the outlet temperature stamped on the label.

Standard setting is 110°F. If the outlet temperature is different than that shown on the label, readjust valve according to "TEMPERATURE ADJUSTMENT" procedure on page 2.

2. If after adjusting the outlet temperature the water stays below the set temperature, see "CHECKING COLD WATER SHUT-OFF." If the temperature stays above the set temperature, see "CHECKING HOT WATER SHUT-OFF."

**Caution:** When maintaining and adjusting the mixing valve, all fixtures should be isolated from use. Lawler Manufacturing Co., Inc. recommends that you work safely at all times and in a manner consistent with the OSHA Lock/Tagout standard, 29 CFR 1910.147 and other applicable standards.

## Checking Cold Water Shut-Off

Turn on full hot and cold water supply to the valve and let it run for one minute. Then shut off the hot water stop and check valve only. Cold water should flow through the controller momentarily then be reduced to a negligible amount.

Failure to do so indicates that:

- a. Plunger is sticking and requires cleaning or replacement.

## Checking Cold Water Shut-Off (Cont.)

- b. Spring #13 has lost its strength and should be replaced.

**Note:** Lack of water flow can be normal on the first test if the temperature of the cold water is below 75°F. A quick test is to momentarily turn on the hot water to warm the thermostat. If flow then starts, the thermostat is good; failure to obtain flow when first starting, or when valve is cold, is a normal reaction.

## Checking Hot Water Shut-Off

Allow full hot and cold water to flow through the valve for one minute. Shut off the cold water stop and check valve only. The hot water should be reduced to a negligible amount.

Failure to do so will indicate:

- The hot water supply is not 20°F above the required maximum temperature setting.
- The plunger is sticking and requires cleaning or replacement.

## Inspection and Cleaning Valve

Shut off the hot and cold water supply to the controller. Remove bonnet #19. To replace pusher O-ring #18, remove pusher #21 from bonnet #19 and replace O-ring. Reassemble in reverse order.

With the bonnet assembly off the valve, remove thermostat #22 and check and clean (see fig. A). Unscrew bottom plug #14 and remove valve spring #13 and plunger #12 (see fig. C). If the assembly does not slide out, remove the plunger with liner #11 and gently tap plunger until it becomes free. Clean and polish the liner and plunger with very fine emery cloth until the plunger moves freely in the liner.

With the liner out of the valve, replace liner O-ring #10.

**Note:** If the piston or liner is nicked or shows signs of excessive wear, it should be replaced.

**Caution:** The liner and plunger cannot be dropped please handle carefully. The liner must be inserted correctly. Carefully examining the outside of the liner will reveal a very small difference in diameter between the upper half and the lower half. On reassembly, the smaller diameter must be inserted first through bottom plug opening.

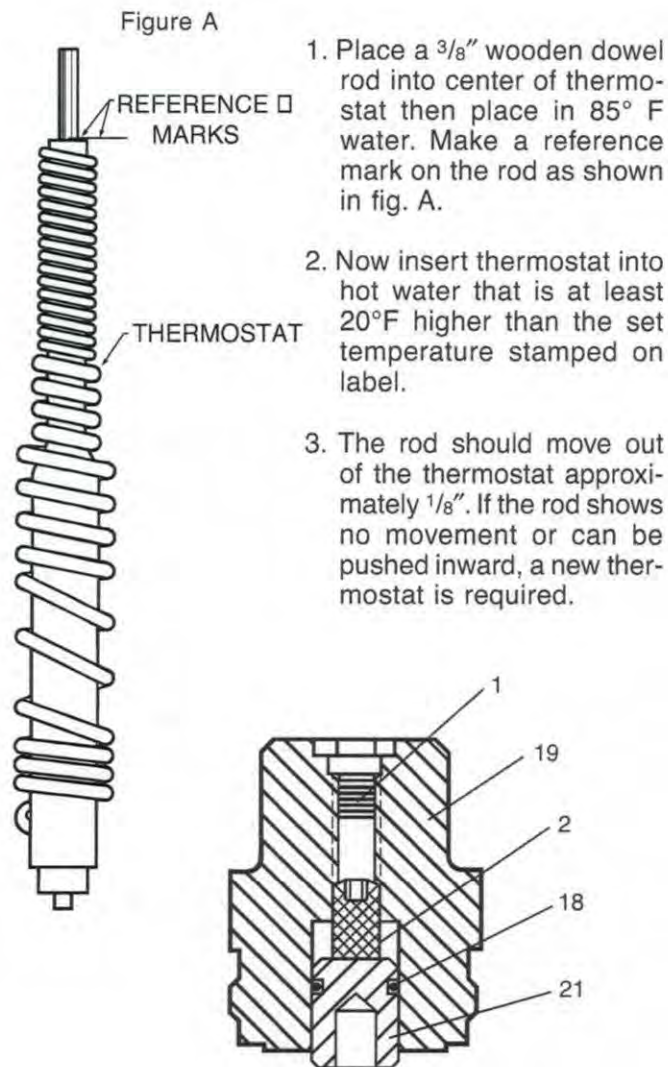


Figure B

## Temperature Adjustment

Valves are normally factory set for a maximum 110°F outlet temperature, or that stamped on the label. If it is desired to change this setting, proceed as follows:

While allowing water to flow through the controller:

1. Remove screw #1.
2. With a  $\frac{5}{32}$  allen key, turn adjusting screw #2 counterclockwise to increase temperature or clockwise to decrease temperature.
3. When temperature is correct, replace screw #1.

**Note:** If outlet temperature desired is 15°F or more higher than that stamped on the label, contact the factory or a representative for a special thermostat.



Model 801 Repair Parts

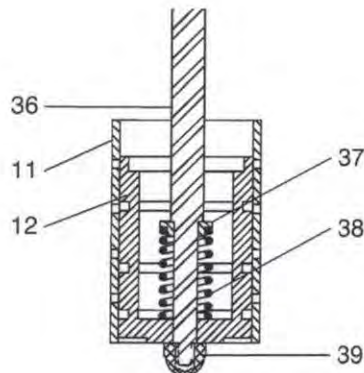
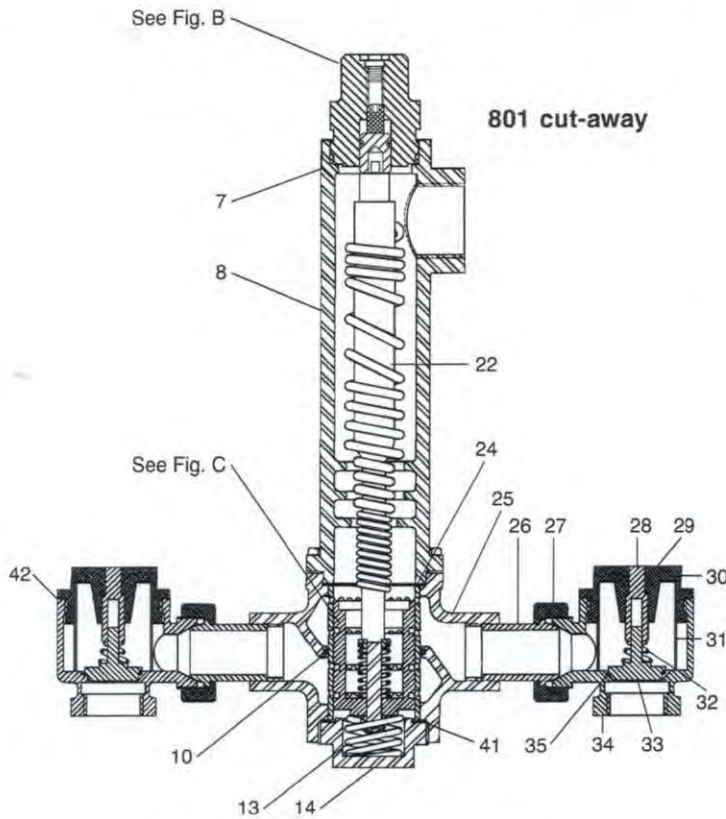


Figure C

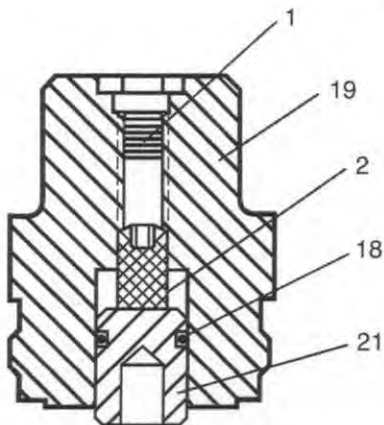


Figure B

Item	Description	Part No.
1	Screw	7628-00
2	Adjusting Screw	8237-00
7	Bonnet Gasket	
8	Dome	—
10	Liner O-Ring	
11	Liner	
12	Plunger	
12a	Piston Liner Assembly	Figure C
13	Valve Spring	—
14	Bottom Plug	—
18	Pusher O-Ring	
19	Bonnet	
21	Pusher	
22	Thermostat	
23	Body Screw (NS)	
24	Liner Gasket, Upper	
25	Valve Body	—
26	Tailpiece	—
27	Union Nut	
28	Stop & Check Stem	
29	S & C Stem O-Ring	
30	S & C Bonnet	—
31	Strainer	—
32	S & C Spring	—
33	Shutoff Disc Assembly	—
34	S & C Body	—
35	Seat O-Ring	—
36	Pushrod	—
37	Spring Retainer	—
38	Relief Spring	—
39	Acorn Nut	—
40	Nameplate (NS)	—
41	Liner Gasket, Lower	—
42	S & C Gasket	—

(NS) - Not Shown

Note: Item 42 not applicable

12a Only available in assembly

Repair Kits and Assemblies

Kit H

Kit	Description	Contains	Part No.
1	Complete Repair Kit	7-10-12a-13-18-22-24-31-32-35	79981-00
2	Piston and Liner Assy.	11-12a	71945-16
3	Stop and Check Repair Kit	28-29-31-32-33-35	79907-02
4	Thermostat Repair Kit	7-22	72911-11
5	Bonnet Assy.	1-2-18-19-21	71965-10
6	O-Ring and Gasket	7-10-18-24-29-35-41	79830-01

## Typical Installation

Install the mixing valve below the hot water tank or heater. If this is not possible, pipe in a heat trap as shown in Figure 1 with an approximate 2' drop.

Connect a tempered water return line as shown in Figure 1. This allows flow through both ports of the mixing valve during periods of no draw.

If a dual temperature system is used, a separate recirculating loop and pump are required to return high temperature hot water to the water heater. See Figure 2.

Install an aquastat at the tempered water return pump. Install the water heater per manufacturer's instructions.

## Setting The Mixing Valve To The System

1. After installations be sure to flush the system thoroughly.
2. Make sure the hot water supply is heated to normal design temperature.
3. Close and tag all fixtures to ensure they are not used during this procedure.
4. Turn off the recirculating pump.
5. Create a draw on the system greater than the minimum flow rating of the mixing valve. All open fixtures must be tagged to ensure they are not tampered with or used during this procedure.
6. Allow water to flow through the mixing valve until the water temperature is stable. If necessary, readjust the mixing valve in accordance with the TEMPERATURE ADJUSTMENT section of the installation manual.
7. Once the temperature is set, start the recirculating pump and allow the system to reach set temperature.
8. Measure the water temperature at the return pump and adjust the aquastat to shut off the pump should the return water exceed the set point by 2 degrees F. Set the low limit switch to restart the return pump when return water drops 5 degrees F below the set temperature.
9. Set the balancing valve in the full open position.
10. Shut off all fixtures and ensure there is no draw on the system. The cold inlet to the mixing valve should be warm.
11. Allow the system to run in this condition for at least 30 minutes.
12. In some cases, an increase in water temperature may occur during a no draw period. If this occurs, slowly close the balancing valve until the water temperature is back to the original set temperature.

Figure 1

## Typical Installation

When used in a single temperature recirculating system

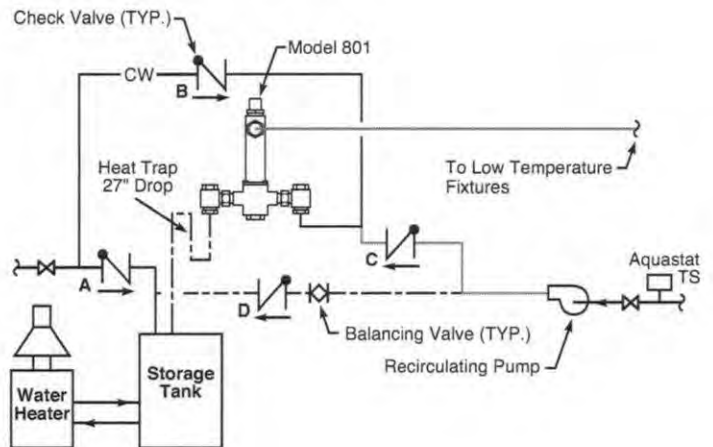
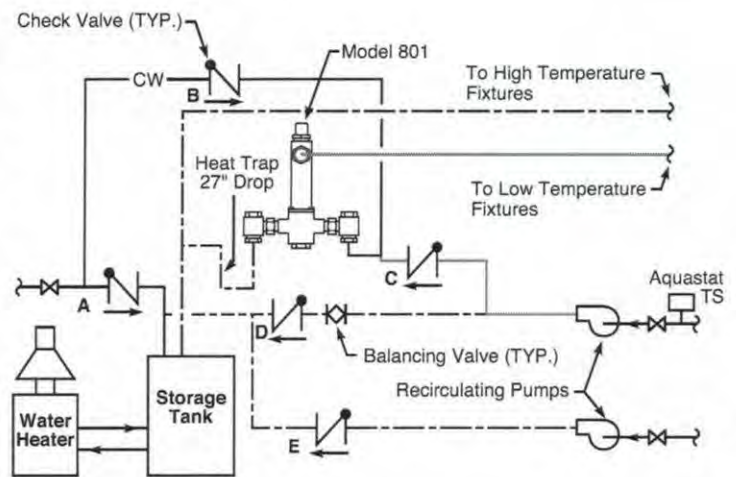


Figure 2

## Typical Installation

When used in a dual temperature recirculating system



## GUARANTEE

We guarantee the Lawler Mixing Valve to be free from defects in workmanship and material, and for a period of one year from date of purchase, will replace any parts found by us to be defective. We will not be

held responsible, however, for any labor incidental to, or for any damages caused by defective material. Each mixing valve is thoroughly inspected and tested under actual conditions at our factory.



**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 22 4000 2.2 Plumbing Fixtures

Submittal Number: 1

Item: Emergency Eye Wash Wall Mount

Manufacturer: Speakman Company

Model #: Speakman SE-1050 – SPV Wall Mounted

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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## INSTRUCTIONS FOR MODELS

**OPTIMUS™**  
SE-1000  
SE-1050  
SE-1055



### NEED HELP?

For additional assistance or service please contact:

**SPEAKMAN®** Company  
400 Anchor Mill Road  
New Castle, DE 19720

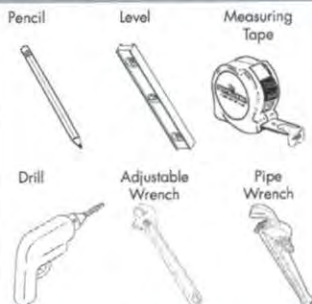
800-537-2107

customerservice@speakmancompany.com

www.speakmancompany.com

92-SE-1000-1055-R4

## TOOLS AND SUPPLIES



### IMPORTANT

ANSI Z358.1 states that weekly activation should be conducted on all plumbed emergency equipment to ensure that there is a suitable flushing fluid supply present and to clear the supply line of any sediment build-up. Also per the standard, the unit should be checked annually to ensure the unit still complies with the installation section (7.4) of the ANSI Z358.1 standard. ANSI Z358.1 specifies that the height of the spray heads is to be between 33" - 45" from the floor. The SE-1000/1050/1055 unit shall be mounted ensuring the mounting surface (wall, etc.) and mounting hardware are sufficient to carry the load. Be sure to read instructions thoroughly before beginning installation. Use thread locker on all threaded connections. Make sure Eye/Face wash is level and plumb. Do not overtighten any connections or damage may occur. **SPEAKMAN** furnishes a testing record tag (91-0635) with each unit. On this tag, the date of inspection and the inspector's initials should be noted.

### SAFETY TIPS

Be sure to wear eye protection.

### MAINTENANCE

Please reference the parts listing for the correct repair part numbers. Only use genuine **SPEAKMAN** parts when repairing or replacing components. To order parts, call 1-800-537-2107. Be sure to turn off water supplies before beginning any maintenance. See Page 2 for cleaning instructions.

### WARRANTY

3 year limited warranty.  
Additional warranty information can be found at:  
www.speakmancompany.com

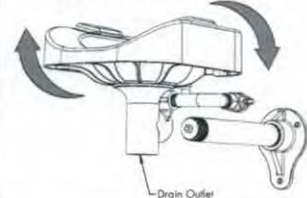
- 1 After referring to the Rough-In Diagram, select a suitable plumb mounting location for the Wall Bracket. Mark and drill holes according to hardware selection specifications. Use selected hardware to secure the Wall Bracket to the mounting surface.



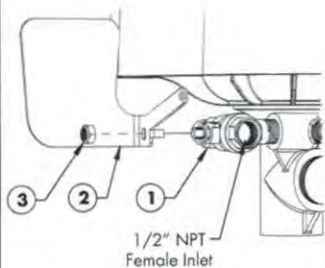
- 2 Insert 1-1/4" x 11-5/8" Pipe (opposite end with Expansion Plug) into the Wall Bracket. Tighten connection, being careful not to damage finish.



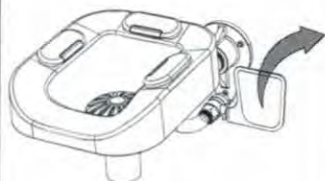
- 3 Thread entire Bowl Assembly to the plugged end of Pipe, ensuring the Bowl is level and plumb when completely secured. Connect the Drain Outlet to an adequate drain in accordance with local plumbing codes.



- 4 Install Paddle Handle (2) to Ball Valve (1) with Nut (3). Connect an uninterruptable potable water supply with a minimum flowing pressure of 30psi and a maximum static pressure of 60psi to the 1/2" NPT female water supply inlet.

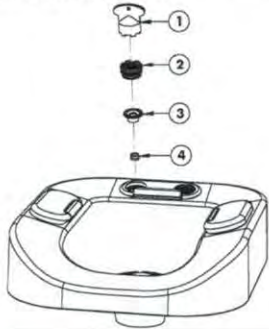


- 5 To test, and for subsequent operation, push the Paddle Handle forward 90°. The unit will operate until the Paddle Handle is manually pulled back to the OFF position.



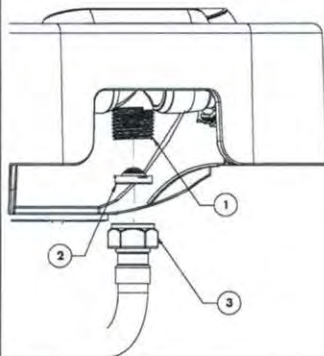
### To Clean the Aerated Outlets:

Using the Aerator Wrench (1), remove the Aerator (2). The Flow Control Housing (3) will come out next, with the Flow Control (4) inside of it. Remove the Flow Control and check for debris surrounding the o-ring. Flush with clean water. Check the mesh on the back of the Aerator for debris. Flush with clean water.



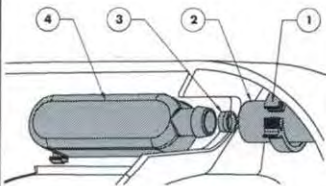
### To Clean the In-Line Strainer:

Begin by removing Supply Hose (1) from Hose Manifold Tee (1). The Strainer (2) will be located inside the threading of Supply Hose (3). Remove Strainer (2) and check for debris. Flush with clean water.



### To Clean the Non-Aerated Outlets:

Begin by removing the Hose Clamp (1), then remove Hose (2) from Housing (3). Flow Control (3) can be seen inside Housing (4) at this point. Remove Flow Control and check for debris surrounding the o-ring. Flush with clean water.

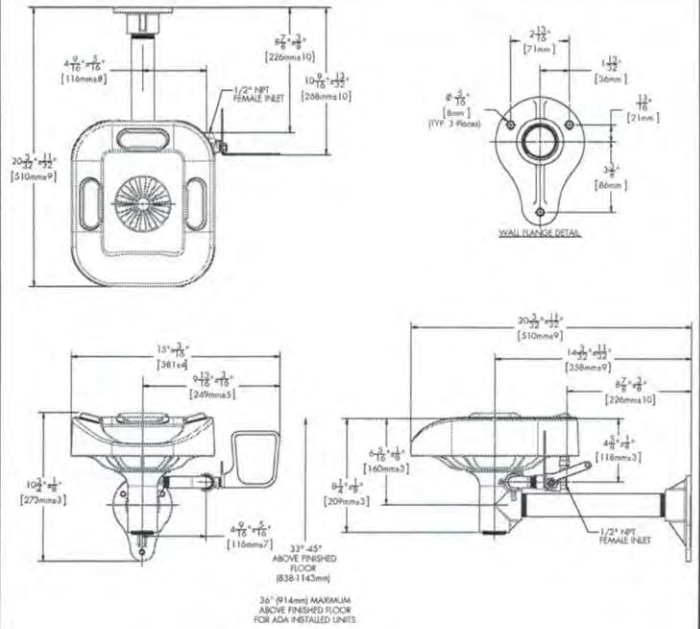


### Flow Data:

#### SE-1000 FLOW DATA

PRESSURE		FLOW RATE	
psi	bar	gpm	L/min
30	2.07	4.9	18.5
60	4.14	5.0	18.9

### ROUGH IN DIMENSIONS



### REPAIR PART GROUPS

Part No.	Description
RPG49-0010	Spray Outlet Claskets
RPG07-0023	Dust Cover Group
RPG03-0087	Stainless Steel Flex Hose
RPG05-2500	Aerators (6)
RPG05-0936	Complete Spray System Replacement Group
SE-910	1/2" Ball Valve with Paddle Handle
SE-910-SSBV	1/2" Stainless Steel Ball Valve with Paddle Handle



TV1

L7299911

LAWLER

TV-1 TEMP VALVE

MODEL 801 ROUGHT CHROME HIGH-LOW MASTER CONTROLLER  
MIXING VALVE WITH 3/4" INLET, 1" OUTLET, AND CHECK STOPS.  
50GPM @ 45 PSI, ASSE 1017 APPROVED AND ASSE LEAD FREE  
CERTIFIED



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**LAWLER**  
**MANUFACTURING CO., INC.**  
 5330 East 25th Street  
 Indianapolis, Indiana 46218  
 Phone (317) 261-1212  
 Fax (317) 261-1208

www.lawlervalve.com

# Model 801

Installation &  
 Maintenance Manual  
 M 801 C  
 PAT. NO. 5,203,496.  
 PAT. NO. 5,323,960.

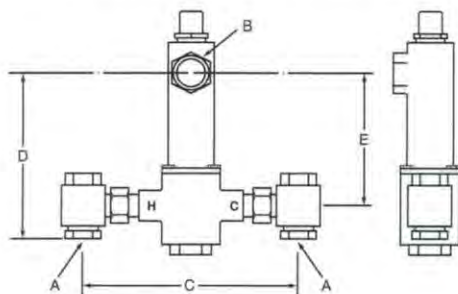


## NOTICE!

ASSE 1017 Approved

Thermostatic Water Controllers will not work satisfactorily if improperly installed. Read these instructions carefully before installing and follow directions as outlined.

Certified to  
**CSA B125.3**



### DIMENSIONS:

Valve Number	A N.P.T.	B N.P.T.	C	D	E
801	3/4"	1"	10"	12"	10 1/2"

### CAPACITIES - MODEL 801

Pressure Drop PSI	5	10	20	30	45	60	80
Valve Number	Capacity						
801-GPM	17	25	34	40	50	57	65
801-LPM	64	94	128	151	189	210	246

## General Description

The Model 801 water temperature controller is carefully assembled and tested at the factory to mix hot and cold water to any desired temperature within range. The temperature of the hot water should be at least 20°F higher than the maximum valve setting. The major safety features are:

1. Failure of cold water supply causes the hot water ports to reduce hot water flow.
2. Failure of hot water supply causes the cold water ports to reduce cold water flow.
3. Failure of the thermostat allows both ports to reduce flow of hot and cold water.

At each inlet of the controller is a union end stop and check valve with removable strainer. Stop and check valves are to prevent water from bypassing between hot and cold water supply lines. These valves should be fully open when in operation.

### Maximum Inlet Conditions

Pressure: 125 psi

Temperature: 200°F

## Maintenance

The controller should be checked periodically and, if needed, cleaned as outlined in "INSPECTING and CLEANING VALVE." To test for proper setting and operation - proceed as follows:

1. Turn on full hot and cold water supply to the valve. The mixing valve should deliver water at the outlet temperature stamped on the label.

Standard setting is 110°F. If the outlet temperature is different than that shown on the label, readjust valve according to "TEMPERATURE ADJUSTMENT" procedure on page 2.

2. If after adjusting the outlet temperature the water stays below the set temperature, see "CHECKING COLD WATER SHUT-OFF." If the temperature stays above the set temperature, see "CHECKING HOT WATER SHUT-OFF."

**Caution:** When maintaining and adjusting the mixing valve, all fixtures should be isolated from use. Lawler Manufacturing Co., Inc. recommends that you work safely at all times and in a manner consistent with the OSHA Lock/Tagout standard, 29 CFR 1910.147 and other applicable standards.

## Checking Cold Water Shut-Off

Turn on full hot and cold water supply to the valve and let it run for one minute. Then shut off the hot water stop and check valve only. Cold water should flow through the controller momentarily then be reduced to a negligible amount.

Failure to do so indicates that:

- a. Plunger is sticking and requires cleaning or replacement.



## Checking Cold Water Shut-Off (Cont.)

- b. Spring #13 has lost its strength and should be replaced.

**Note:** Lack of water flow can be normal on the first test if the temperature of the cold water is below 75°F. A quick test is to momentarily turn on the hot water to warm the thermostat. If flow then starts, the thermostat is good; failure to obtain flow when first starting, or when valve is cold, is a normal reaction.

## Checking Hot Water Shut-Off

Allow full hot and cold water to flow through the valve for one minute. Shut off the cold water stop and check valve only. The hot water should be reduced to a negligible amount.

Failure to do so will indicate:

- The hot water supply is not 20°F above the required maximum temperature setting.
- The plunger is sticking and requires cleaning or replacement.

## Inspection and Cleaning Valve

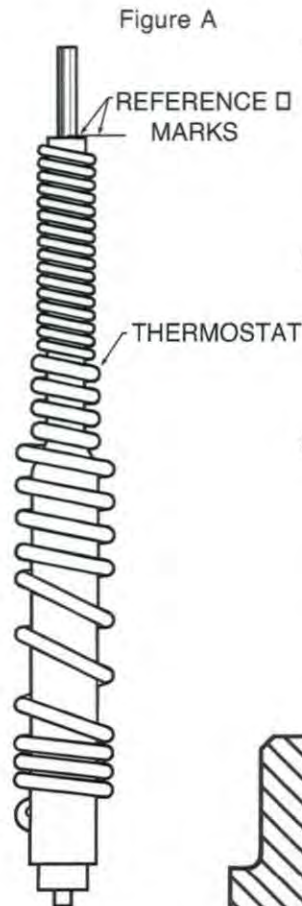
Shut off the hot and cold water supply to the controller. Remove bonnet #19. To replace pusher O-ring #18, remove pusher #21 from bonnet #19 and replace O-ring. Reassemble in reverse order.

With the bonnet assembly off the valve, remove thermostat #22 and check and clean (see fig. A). Unscrew bottom plug #14 and remove valve spring #13 and plunger #12 (see fig. C). If the assembly does not slide out, remove the plunger with liner #11 and gently tap plunger until it becomes free. Clean and polish the liner and plunger with very fine emery cloth until the plunger moves freely in the liner.

With the liner out of the valve, replace liner O-ring #10.

**Note:** If the piston or liner is nicked or shows signs of excessive wear, it should be replaced.

**Caution:** The liner and plunger cannot be dropped please handle carefully. The liner must be inserted correctly. Carefully examining the outside of the liner will reveal a very small difference in diameter between the upper half and the lower half. On reassembly, the smaller diameter must be inserted first through bottom plug opening.



- Place a  $\frac{3}{8}$ " wooden dowel rod into center of thermostat then place in 85° F water. Make a reference mark on the rod as shown in fig. A.

- Now insert thermostat into hot water that is at least 20°F higher than the set temperature stamped on label.

- The rod should move out of the thermostat approximately  $\frac{1}{8}$ ". If the rod shows no movement or can be pushed inward, a new thermostat is required.

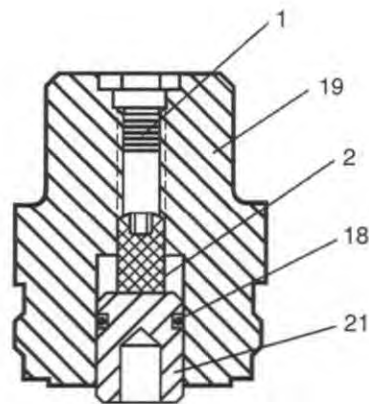


Figure B

## Temperature Adjustment

Valves are normally factory set for a maximum 110°F outlet temperature, or that stamped on the label. If it is desired to change this setting, proceed as follows:

While allowing water to flow through the controller:

- Remove screw #1.
- With a  $\frac{5}{32}$  allen key, turn adjusting screw #2 counterclockwise to increase temperature or clockwise to decrease temperature.
- When temperature is correct, replace screw #1.

**Note:** If outlet temperature desired is 15°F or more higher than that stamped on the label, contact the factory or a representative for a special thermostat.

Model 801 Repair Parts

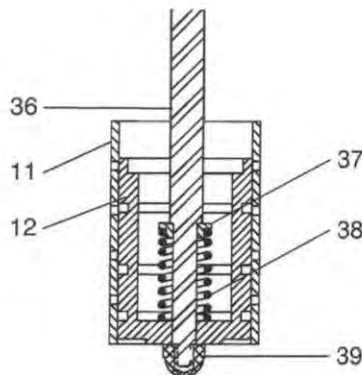
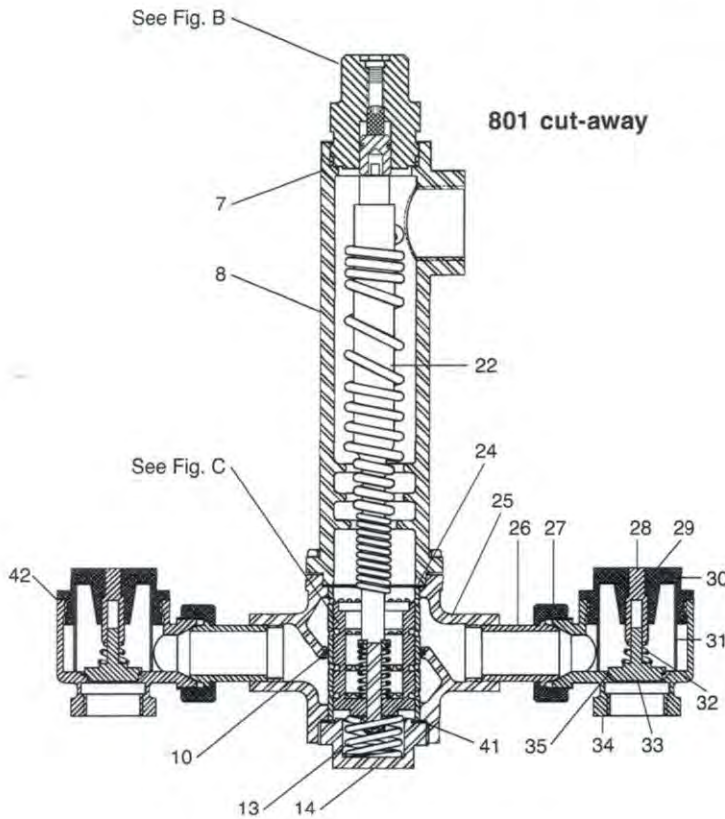


Figure C

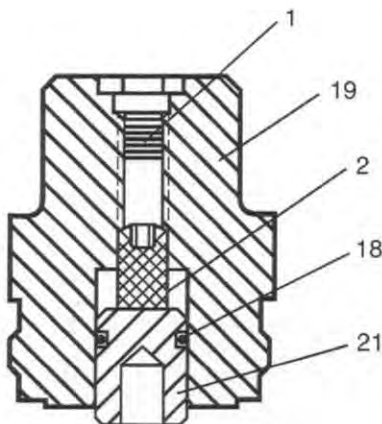


Figure B

Item	Description	Part No.
1	Screw	7628-00
2	Adjusting Screw	8237-00
7	Bonnet Gasket	
8	Dome	—
10	Liner O-Ring	
11	Liner	
12	Plunger	
12a	Piston Liner Assembly	Figure C
13	Valve Spring	—
14	Bottom Plug	—
18	Pusher O-Ring	
19	Bonnet	
21	Pusher	
22	Thermostat	
23	Body Screw (NS)	
24	Liner Gasket, Upper	
25	Valve Body	—
26	Tailpiece	—
27	Union Nut	
28	Stop & Check Stem	
29	S & C Stem O-Ring	
30	S & C Bonnet	—
31	Strainer	—
32	S & C Spring	—
33	Shutoff Disc Assembly	—
34	S & C Body	—
35	Seat O-Ring	—
36	Pushrod	—
37	Spring Retainer	—
38	Relief Spring	—
39	Acorn Nut	—
40	Nameplate (NS)	—
41	Liner Gasket, Lower	—
42	S & C Gasket	—

(NS) - Not Shown

Note: Item 42 not applicable

12a Only available in assembly

Repair Kits and Assemblies

Kit H

Kit	Description	Contains	Part No.
1	Complete Repair Kit	7-10-12a-13-18-22-24-31-32-35	79981-00
2	Piston and Liner Assy.	11-12a	71945-16
3	Stop and Check Repair Kit	28-29-31-32-33-35	79907-02
4	Thermostat Repair Kit	7-22	72911-11
5	Bonnet Assy.	1-2-18-19-21	71965-10
6	O-Ring and Gasket	7-10-18-24-29-35-41	79830-01



## Typical Installation

Install the mixing valve below the hot water tank or heater. If this is not possible, pipe in a heat trap as shown in Figure 1 with an approximate 2' drop.

Connect a tempered water return line as shown in Figure 1. This allows flow through both ports of the mixing valve during periods of no draw.

If a dual temperature system is used, a separate recirculating loop and pump are required to return high temperature hot water to the water heater. See Figure 2.

Install an aquastat at the tempered water return pump. Install the water heater per manufacturer's instructions.

## Setting The Mixing Valve To The System

1. After installations be sure to flush the system thoroughly.
2. Make sure the hot water supply is heated to normal design temperature.
3. Close and tag all fixtures to ensure they are not used during this procedure.
4. Turn off the recirculating pump.
5. Create a draw on the system greater than the minimum flow rating of the mixing valve. All open fixtures must be tagged to ensure they are not tampered with or used during this procedure.
6. Allow water to flow through the mixing valve until the water temperature is stable. If necessary, readjust the mixing valve in accordance with the TEMPERATURE ADJUSTMENT section of the installation manual.
7. Once the temperature is set, start the recirculating pump and allow the system to reach set temperature.
8. Measure the water temperature at the return pump and adjust the aquastat to shut off the pump should the return water exceed the set point by 2 degrees F. Set the low limit switch to restart the return pump when return water drops 5 degrees F below the set temperature.
9. Set the balancing valve in the full open position.
10. Shut off all fixtures and ensure there is no draw on the system. The cold inlet to the mixing valve should be warm.
11. Allow the system to run in this condition for at least 30 minutes.
12. In some cases, an increase in water temperature may occur during a no draw period. If this occurs, slowly close the balancing valve until the water temperature is back to the original set temperature.

Figure 1

## Typical Installation

### When used in a single temperature recirculating system

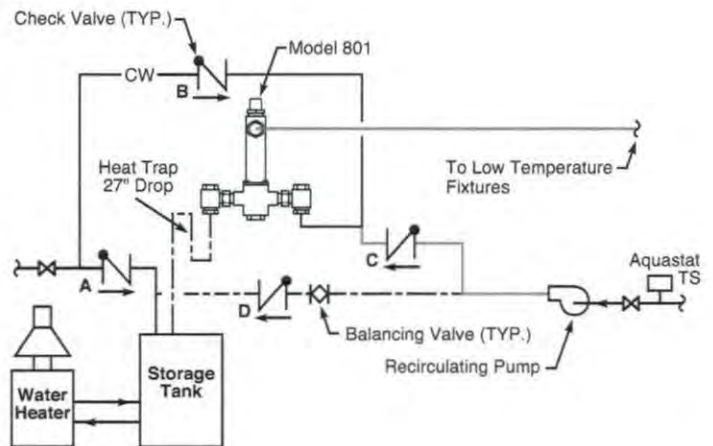
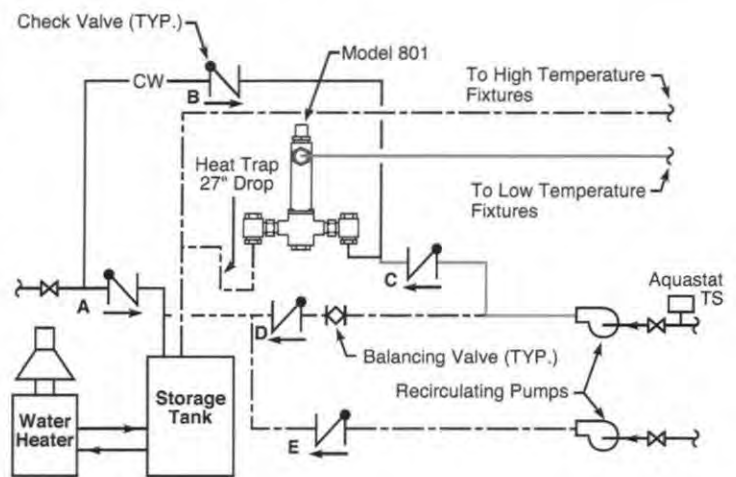


Figure 2

## Typical Installation

### When used in a dual temperature recirculating system



## GUARANTEE

We guarantee the Lawler Mixing Valve to be free from defects in workmanship and material, and for a period of one year from date of purchase, will replace any parts found by us to be defective. We will not be

held responsible, however, for any labor incidental to, or for any damages caused by defective material. Each mixing valve is thoroughly inspected and tested under actual conditions at our factory.



**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

# **Tab D**

## **DESCRIPTON OF MECHANICAL SYSTEMS AND OPERTATING INSTRUCTIONS**

The mechanical ventilation and heating system upgrades in the Haines Vocational Technology Building consists of two main pieces of equipment the Boiler and the Air Handling Unit VU-1.

### **BOILER**

The Weil-McLain Model H-680 Boiler is located in the boiler room in the north back corner of the wood shop. The boiler is an oil fired boiler, which requires combustion air and make up air which is provided into the room through two separate openings to the outside and controlled by mechanical dampers. The primary job of the Boiler is to heat the glycol that is pumped through it to go out to the four unit heaters, cabinet unit heater and Air Handling Unit VU-1. The system utilizes glycol to prevent the system from freezing. The glycol make up tank is provided to keep the system charged with pressure. The system operating pressure is 12 to 15 psi.

The system has two circulating pumps. P-1 circulates from the boiler to the heating main pipe system. P-2 circulates the main heating piping with branch lines to all the heating appliances.

Maintenance for the Weil-McLain Model H-680 Oil Fired Boiler can be found in the boiler operations and maintenance manual under Tab I – Specification Section 23 5223 2.2. Page 41-44.

### **AIR HANDLING UNIT VU-1**

The Air Handling Unit VU-1 Daikin Applied Model CAH 003-090C VU-1 is the ventilation unit or air handler unit located up in the mezzanine area. The Air Handling Unit VU-1 is used to ventilate the building. It brings in outside air and mixes it with the return air from the building and sends it back in to the building. Depending on the outside air temperature and the mixed air temperature, it also heats the discharge air to a set temperature before being discharged into the building. The air is heated as it passes through a heating coil which is heated by the boiler. There are three ducts and plenums coming off the return end of the Air Handling Unit VU-1, one return duct from each shop and one outside air from the outside. Each duct has a control damper and a volume damper that controls the amount of air passing through the unit and into the building. Also found in the two return air ducts, where they pass through the mezzanine walls, are fire dampers which are designed to close if a fire were to occur. There are access doors located at each fire damper to provide damper access for inspection and cleaning.

On the other side of Air Handling Unit VU-1 referred to as the discharge side of the unit is the discharge for supply air plenums and ducting. There are two supply air ducts, one for each shop. Off each of them are a smaller 6x6 ducts that supply air to the office and to the storage room through diffuser registers, each have adjustable louvers for balancing built in to them.

Both of the discharge or supply ducts have control dampers and fire dampers which also have access doors for inspection and cleaning. (All equipment controls are controlled by a separate DDC system)

Maintenance for Air Handler Unit VU-1 should be as manufacturer suggests located under Tab J – Specification Section 23 7913 2.2 Periodic Maintenance Pages 37-46.

### **TERMINAL HEAT TRANSFER UNITS (UNIT HEATERS (UH) & CABINET UNIT HEATERS (CUH))**

The other pieces of heating equipment mentioned earlier with the boiler are the Terminal Heat Transfer Units referred to as unit heaters (UH-1 through UH-4), one in each of the four outer corners of the building and the cabinet unit heater (CUH) located in the east entrance of the building by the restrooms. These units all have set temperatures controlled by the DDC System. Also, each unit has supply and return piping and an isolation valve on each line to the unit. There is also an auto air vent on each unit with its own isolation valve. Access to the cabinet unit heater (CUH) is either from below through a removable access panel or from above in the mezzanine.

Maintenance for should be as manufacture suggests located under Tab K Specification Section 23 8101 Sub Section 2.1 Unit Heaters (UH1-4), Page 5 Maintenance.  
Sub Section 2.4 Cabinet Unit Heaters (CUH) Page 2 of 2 Operation and maintenance.

### **EXHAUST FANS (EF-1, EF-2, EF-3, EF-4 & EF-5) & (TEF-1 and TEF-2)**

Other equipment installed was the 5 exhaust fans. (EF-1, EF-2, EF-3, EF-4 & EF-5)

**EF-1** is a centrifugal fan located in the mezzanine, used to exhaust air from the auto shop area through duct and a grill located at the east wall of the auto shop above the auto lift to the outside. It is controlled by an on off switch located in the office.

Maintenance for EF-1 should be as manufacturer suggests located under Tab G Specification Section 23 3516 Sub Section 2.2 (EF-1) Page 8 and 9

**EF-2** is the exhaust fan that exhausts air from the four welding booths at the south end of the auto shop to the outside and is also located in the mezzanine and controlled by a switch in the office.

Maintenance for EF-2 should be as manufacturer suggests located under Tab G Specification Section 23 3516 Sub Section 2.2 (EF-2 & 3) Page 8

**EF-3** is the same as EF-2 and exhaust air from the two new welding booths in the auto shop to the outside. EF-3 is also located in the mezzanine and is controlled with a switch in the office.

Maintenance for EF-3 should be as manufacturer suggest located under Tab G Specification Section 23 3516 Sub Section 2.2 (EF- 2- 3 Page 8

**EF-4** is a centrifugal low pressure blower type exhaust fan. It exhausts air from the two exhaust hose reels or VER-1 and VE-2 located at the west end of the auto lift. EF-4 is also located in the mezzanine. It is switched on and off automatically as the hoses are extracted and retracted from and to the reels.

Maintenance for EF-4 should be as manufacturer suggests located under Tab G Specification Section 233516 Sub Section 2.2 (EF-4) Page 24

**EF-5** is a direct drive centrifugal sidewall exhaust fan. It exhausts air from the laser cutter to the outside. It is located outside next to the overhead door in the auto shop. It is controlled by a switch next to the laser cutter.

Maintenance for EF-5 should be as the manufacturer suggests located under Tab G Specification Section 23 3516 Sub Section 2.2(E-5) Page 6 -7

**TEF-1** and **TEF-2** were also installed during the upgrades. They are the exhaust fans in the two restrooms. They turn on and off with motion detection.

Maintenance for TEF-1 and TEF-2 should be as the manufacture suggest which consist of turning off the power and removing the 4 screws that hold the grill on. Then wiping out the fan housing and the grill then replacing the grill.

More information on any and all of the equipment and all the suggested maintenance and maintenance schedules can be found in the O&M manuals with each piece of equipment.

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 0926 Building Automated System & Controls - 1.7 DDC O&M's

Submittal Number: 1

Item: DDC O&M's

Manufacturer: Envision for BACtalk

Installing Contractor: ATS Alaska  
139 E 51<sup>st</sup> Ave. #100  
Anchorage, AK 99503  
Phone: (907) 868-5100  
Fax: (907) 868-5123

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No



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# HSD Vocational Tech Building M & E Upgrades

Controls O&M

by



139 E. 51st Ave Suite 100  
Anchorage, Alaska 99503  
Phone: 907-868-5100  
Fax: 907-868-5123

**ATS Project #**

3115003

**Project Manager**

Robby Bray

**Project Engineer**

Robby Bray

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*Mechanical Engineer*

Company Name:

Murray & Assoc.

Contact:

Doug Murray

907-780-6151

*Mechanical Contractor:*

Company Name:

Premier Electric

Contact:

Steve Linden

907-745-4200

**HSD Vocational Tech  
Building M & E Upgrades  
Controls O&M**

ATS Job Number:

**3115003**

**ATS Contact:**

*Project Manager:*

Robby Bray

Phone: 907-868-5100

Fax: 907-868-5123

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**HSD Vocational Tech  
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Envision for BACtalk



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# Before you begin

# 1

Envision for BACtalk is an operator workstation software package for BACnet-compliant systems. Envision, which runs on a Windows personal computer, enables BACtalk operators and developers to monitor and control BACnet-compliant devices in their building automation system (BAS). The Envision for BACtalk operator workstation communicates with BACnet-compliant field equipment using BACnet over local area networks (LANs) and wide area networks (WANs).

From the Envision for BACtalk operator workstation, operators can access any BAS data made available on the network using the BACnet protocol standard—even if it originates in another manufacturer's device. Developers can use the Envision for BACtalk operator workstation to program custom direct digital control (DDC) sequences that run locally in BACtalk controllers. They can also configure other site operational details.

In addition to the Envision for BACtalk operator workstation, Alerton offers a complete line of BACnet-compliant equipment controllers (VLCs) and global controllers (BTI, BTI-100, and BACtalk control modules). All BACtalk products exchange messages in compliance with the BACnet protocol and communicate on LANs as specified in ASHRAE Standard 135-2001, BACnet.



## Using the Envision for BACtalk documentation set

Documentation for Envision for BACtalk is provided in several forms and formats. It is designed to meet the needs of different users who work with the system in a variety of contexts. This section describes the documentation set and the audience and purpose of each piece.

### Envision for BACtalk Operator's Manual (this manual)

This guide focuses on information for BACtalk system users who use the operator workstation to monitor and command their building automation and control system. It provides conceptual information about working with features: zones, schedules, tenant activity, optimum start, demand limiting, alarms, trendlogs, and other features likely to be used in building operations.

The operator's manual uses a sample job, located on a campus setting at State University, to illustrate how you can incorporate these features into your own BACtalk job. Use this manual when you want the "big picture" about how a feature works and runs or when you need reference information for the best way to set up a feature.

#### How chapters are organized

Chapters in this operator's manual are organized as follows:

- **Feature overview** Describes the feature and its benefits in broad terms.
- **Quick start** A step-by-step overview of feature setup with cross-references to other locations where you can find information.
- **How the feature works and runs** Detailed information about how setup parameters work together and how the system carries out the feature.
- **Setting up the feature** Guidelines and instructions for setting up the feature, with screen shots of feature configuration and in-depth information about settings.
- **Maintaining or monitoring operation** Instructions and tips for working with the feature after it is set up.

#### Using "examples"

Throughout this manual, you will find information under the heading "Example." These sections typically include sample values to help reinforce your understanding of the concepts discussed. For example, if a feature uses a particular equation, the "example" would demonstrate how the equation works using specific values.

#### Using "practical applications"

You will also find a number of sections with the heading "Practical application." These sections illustrate how a feature might be implemented and used in the context of the State University sample job. The practical applications are designed to put features in a "real-world" context that you can leverage for your own site.

**Note** Use the Envision for BACtalk online Help while using the software to find detailed information and procedural instructions related to setting up and using BACtalk features.

## Readme file

This file, Readme.rtf, displays during Envision for BACtalk installation and is saved in the installation under the System folder and on the DVD. It addresses late-breaking operational and installation issues that could not be included in other documentation.

## Online Help

Online Help in Envision for BACtalk provides detailed information and procedural steps for setting up and using BACtalk features. Help is designed to answer your questions while you are working with the Envision for BACtalk software.

## Installation and Startup Guide (LTBT-TM-ADMIN)

This guide provides critical information and step-by-step instructions for those responsible for installing or upgrading an Envision for BACtalk system. In addition to detailed installation information, it provides guidelines and instructions for job setup and engineering.

## Display Developer's Guide (LTBT-TM-DSPDV)

This guide provides information for those responsible for designing and developing data displays for a particular site. It provides guidelines for good design and tips on display strategies. The guide also provides detailed instructions about using display and template editors.

## BACtalk Systems Programmer's Guide and Reference (LTBT-TM-PRGRMR)

This guide is intended for those responsible for programming Envision for BACtalk systems. It provides an introduction to the VisualLogic development tool and offers guidelines for effective programming techniques and strategies. This guide also includes a reference for all available DDC functions.

## BACtalk Systems Design Guide (LTBT-TM-SYSDSGN)

This guide provides information for those responsible for planning and installing a building automation system (BAS) with Alerton's BACnet-compliant BACtalk products. This guide provides essential information to use as a reference when planning, designing, and configuring a BAS internetwork with BACtalk products.

This guide focuses on strategies for interconnecting BACtalk products. See specific documentation for the product of interest to find installation and LAN configuration instructions.

## Your site documentation

Site documentation typically includes job-specific information, including controller device numbers, equipment device numbers, network types and numbers, riser diagrams, and point lists. The site documentation is a critical information resource used for the ongoing operation, maintenance, and upgrading of the building automation system.

## Version information

Information in this manual applies to Envision for BACtalk 3.0. VLCs, building controllers, and global controllers may have operating characteristics specific to firmware or real-time operating code (ROC) version. See the device documentation for details.

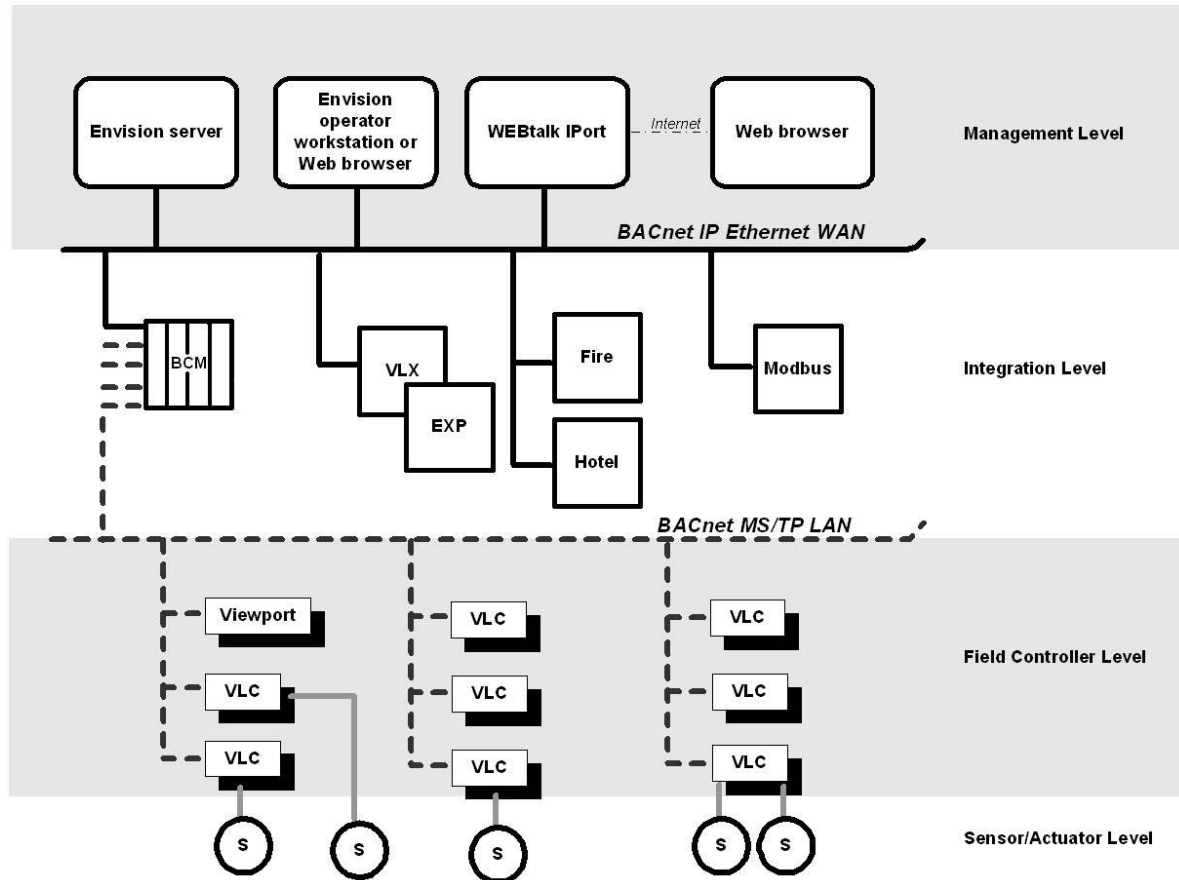
## What you need to know

Those who work with Envision for BACtalk should have a thorough understanding of the following topics before they start using the software:

- Working with a Windows personal computer (see your computer's documentation for more information)
- Your site's building automation system (BAS) configuration: its equipment, setup, maintenance, and capabilities
- A basic understanding of how your BAS represents data and control points as BACnet objects and properties

## BACtalk BAS architecture and components

To understand the BACtalk system architecture, it is helpful to describe it using the four levels of components shown in the following illustration.



**Figure 1.1** BACtalk system architecture. Note: The global controller can be a BTI, BTI-100, or group of BACtalk control modules (BCMs).

### Management level

The Envision for BACtalk software and operator workstations are representative of the management level. These easy-to-use, graphical tools provide access to real-time data and energy management features. The management level is where you set up, monitor, and control how your building works.

**Integration level**

Components such as global controllers and building controllers reside at this level. These intelligent BACnet programmable devices work with the components at the management level to implement control strategies for an entire facility or multiple sites.

**Field controller level**

Alerton field controllers (VLCs) are native BACnet logic controllers. These programmable devices support a range of applications to control equipment such as air handling units, terminal units such as VAV boxes, heat pumps, and air conditioning units.

**Sensor/actuator level**

This level includes devices, such as sensors, which can serve as both tenant control centers and field service tools. Alerton's Microset is one example of this type of device. The BACtalk system also supports traditional sensors and actuators commonly used in building automation.

## About the BACnet Standard

BACnet is the common term for a communication protocol standard created by the American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE). BACnet stands for Building Automation and Control Network, a non-proprietary protocol standard for the building automation industry, which enables devices to communicate and exchange information regardless of manufacturer.

BACnet prescribes a set of rules for representing and transmitting data between building automation and control devices on a network. The protocol specifies a common "language" that computer-based devices can use to communicate.

The standard prescribes an object-oriented method of representing system data and processes. It also prescribes the physical method of data transmission, relying on existing standards (Ethernet, for example) and standards created with the special needs of a control system in mind.

**History**

A committee of industry experts, vendors, designers, and users working under the auspices of ASHRAE, first published the standard in 1995. It was adopted by the American National Standards Institute (ANSI) later that year. The standard was updated and then republished as ASHRAE Standard 135-2001 in 2001. It was adopted by the International Standards Organization (ISO) in 2003 as ISO Standard 16484-5. In 2004 the standard was updated and republished as Standard 135-2004.



**From ASHRAE Standard 135-2001, BACnet**

*"This standard defines data communication services and protocol for computer equipment used for monitoring and control of HVAC & R and other building systems. [It defines], in addition, an abstract, object-oriented representation of information communicated between such equipment, thereby facilitating the application and use of digital control technology in buildings ...*

*This protocol models each building automation and control computer as a collection of data structures called "objects," the properties of which represent various aspects of the hardware, software, and operation of the device. These objects provide a means of identifying and accessing information without requiring knowledge of the details of the device's internal design or configuration."*

A standard, open protocol such as BACnet enables building owners, facility managers, and specifying engineers to choose from a broader range of products and design options. Past systems were often confined to a single manufacturer's products, or developers had to invest in expensive gateways to exchange information between systems. With BACnet, products can be individually evaluated and compared for cost, features, performance, and function.

If you want more detailed information about the BACnet standard, see the following publications and resources:

- The Alerton website—[www.alerton.com](http://www.alerton.com)
- The BACnet website—[www.bacnet.org](http://www.bacnet.org)
- The ASHRAE website—[www.ashrae.org](http://www.ashrae.org)
- The BACnet Standard—ASHRAE STD 135-2001  
(Available from ASHRAE in print or on CD, this is the standard itself. Intended for programmers and system developers, this document includes highly technical information about the data structures and architectures that comprise the standard.)

## About BACnet objects, properties, and services

If you are familiar with BACnet and how it represents system data, you can skip this section.

### BACnet objects

BACnet identifies all information in terms of properties and objects. An object might represent a physical input or output, or it may represent something more abstract, such as a setpoint. And each property of the object provides data to describe something about it. All data in a BACnet system is identified in this way. The most important property of almost all objects is the present-value.

The property of an object is equivalent to what is traditionally known in control systems as a *data point*.

Three elements identify the source of a data point in a BACnet system:

- Device instance
- Object ID
- Property

Each object has an instance number that, along with its type, forms the object ID. For example, AI-1, represents Analog Input 1. This object ID, together with the device instance, allows the BACnet system to identify and use data. For example, in a VAV-SD (a VAV box controller), AI-1 is a physical input. Its most important property is the present-value, which represents the room temperature because AI-1 connects to the physical sensor. Other properties of the object convey more information: the units property tells the system that the value is in degrees F; the device-type property indicates that the hardware is a 10k ohm thermistor; and the description property shows that it is space temperature. All objects have some required properties and some that are optional. You can examine the device's protocol information conformance statement (PICS) to determine which objects a device supports.

### BACnet properties

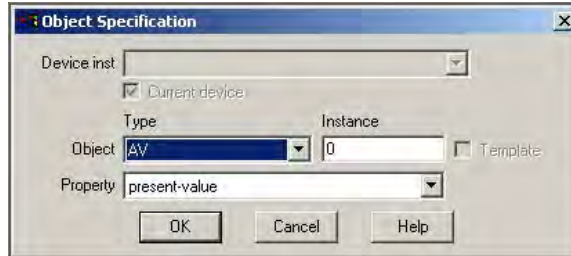
Objects are monitored and controlled only through their properties. BACnet specifies 123 properties of objects. Three properties—object-identifier, object-name, and object-type—must be present in every object. BACnet may also require that certain objects support specific additional properties. The type of object and the type of device in which that object resides determine which properties are present. Some properties can accept writes and others can only be read.

### BACnet services

When a property is read or written to, that act is known as a *service*. Services are how one BACnet device gets information from another device, commands a device to perform certain actions (through its objects and properties), or lets other devices know that something has happened. The only service that all devices must support is the read-property service. There are a total of 32 standard services.

## Specifying an ID for a property

The Object Specification dialog box appears in Envision for BACtalk whenever you need to specify a data point.



**Figure 1.2** Object Specification dialog box

BACnet identifies data points in a control system by object and property. The following elements uniquely identify each property.

**Table 1.1** Guidelines for setting up data points

Item	Description
Device Instance	The numerical identifier of a physical device where the property originates.
Template check boxes	The Template check box for Device ID is available when you place an item on a template. Select this check box if you want the pushbutton that summons the template to specify the device instance.  Similarly, the Template check box for Object Type and Instance is available only for object templates. Select this check box if you want the pushbutton that summons the template to specify the object type and instance.
Object Type and Instance	Select an object type from the list. See section 12 of ASHRAE SPC-135P for a listing of object types and their properties. Also see the object and properties table for the device referenced in Device ID.
Property	Select a property of the object from the list. Only properties relevant to the selected object type appear.

## Binary objects (BIs, BOs, BVs)

The present-value of binary object types is one of two states: ACTIVE (ON) or INACTIVE (OFF). You will find that the most often used and referenced binary data are the present-value properties of binary inputs (BIs), binary outputs (BOs), and binary values (BVs).

## Analog objects (AIs, AOs, AVs)

Analog objects in BACtalk devices have present-value properties representing real numbers, depending on the type of object. Analog values (AVs) store data, analog inputs (AIs) are directly associated with physical inputs, and analog outputs (AOs) are directly associated with physical outputs. The following are BACnet-defined ranges for AIs, AOs, and AVs.

**AI** An unsigned real number in the range 0–4095

**AO** An unsigned real number in the range 0–100

**AV** A real number in the range  $\pm 3.4 \times 10^{38}$

## Inputs and outputs (AIs, AOs, BIs, and BOs)

Inputs (AIs and BIs) are directly associated with physical electrical input connections to the VLC. As such, they will never have values written to them and will appear only on the input side of a DDC function.

Outputs (AOs and BOs) are directly associated with physical electrical output connections to the VLC. Outputs can appear on the input or the output side of a DDC function.

## Values (AVs and BVs)

AVs and BVs in a VLC or global controller are used for calculated values, setpoints, timers, and lockouts—virtually any value not directly associated with a physical input or output.

## Multistate objects (MIs, MOs, MVs)

Multistate objects in BACtalk have present-value properties representing different states of operation. For example, a fan may have four (or more) states of operation: low, medium, high, and NULL.

## New in Envision for BACtalk

Envision for BACtalk v3.0 supports the following added features and functionality:

- **New Energy Dashboard** Energy awareness dashboard Visually provides energy consumption data on an easy-to-understand dashboard display using a web browser. This educational dashboard shows energy consumption compared to historical or other building data and visually displays it. Studies show visually presenting this information can reduce energy use by more than 5%. It integrates real-time building resource data with Envision for BACtalk. The user-friendly design meets site needs with customizable displays. Dashboard controls can be easily navigated using a touchscreen monitor. This dashboard is ideal for displaying in a lobby or other high-traffic area so visitors and other occupants can see how energy is being used in the building.
- **BACtalk Software License Key** Eliminates the hardware key.
- **Energy Logs** Energy log meter data is now updated at 15-minute intervals. Envision for BACtalk polls trendlogs assigned as meters every 15 minutes to display real-time data on the new energy dashboard.
- **Enhanced Reporting** New reports easily gather site data to be used as site documentation. Device settings can also be exported in report format for future use during troubleshooting. Now supports Crystal Reports 2008 RPT file format. When a file is saved, the generated report uses a system-specified filename. Enhanced Reporting is a mechanism



that allows the installation of new reports without a new release of BACtalk. Version 3.0 ships with the new Trendlog List Report.

- **Multiple Trendlog Viewer** Now supports wild card searches for improved search results.
- **VisualLogic v3.0** Enhanced user interface and toolkit. Compatible with existing DDC drawings. Use with Visio 2007 or later. Visio 2010\* recommended. New features include:
  - New Toolkit combines all tools into a dockable window that supports auto-hide and is available on every drawing page—reduces DDC development and testing time.
  - New Compare feature allows you to compare two DDC drawings and print a report of the differences—saving critical time for troubleshooting warranty issues and service calls.
  - New Auto Sequence DDC feature automatically sequences DDC as you place functions on the drawing—saving DDC development time
  - New Auto Connect DDC feature automatically connects functions as you place functions on the drawing —saving time in developing DDC
  - New Auto Edit DDC feature automatically opens function for editing parameters when you place functions on the drawing—saving DDC development time
  - New Auto Propagate DDC feature automatically propagates parameters when you connect DDC functions on a drawing—saving DDC development time
  - New Find and Replace feature saves DDC editing time
  - Cross Reference Table can be sorted by columns—saving DDC editing and troubleshooting time
  - Cross Reference Table supports Object Name property —saving DDC editing and troubleshooting time (BD6 DDC file only)
  - Cross Reference Table object description column displays the point description and the point type-instance. The format is <BACnet point description property> (<point type-instance>). For example, Space

Temp (AI-0)—saving DDC editing and troubleshooting time (BD4 DDC file only)

- Cross-Reference Table automatically updates after editing a DDC function—saving DDC development time
- Send DDC and Save DDC Options can now be saved for each drawing—saving DDC development and commissioning time
- Error checking now delineates between warnings and errors—saving DDC development time and providing an option to report multiple writes in the Options dialog box
- Statistics displays the size of DDC comments separately from geometric info (BD6 DDC only)—saving DDC development time
- **New enhanced VLC/VLCA Device Settings dialog box**
- Propagate and update all drawing tabs with I/O references from connected DDC functions page—saving DDC development and editing time
- Collect point descriptors from drawing I/O tabs and populate Point Setup descriptions page—saving DDC development and editing time
- Send point descriptors from Point Setup and populate drawing I/O tabs page—saving DDC development and editing time
- Export all point setup parameters to Excel spreadsheet—saves time in maintaining a library of applications
- Import all point setup parameters from Excel spreadsheet—saving DDC development time
- Export and Import Microset Field Service Setup data (BD6 DDC Only)
- **Visio 2010\***
- Ribbon toolbar buttons repeat all menu functionality for convenience.
- Customize the ribbon toolbar to align tabs and save time during device configuration.

As with all upgrades, reading and following these instructions will substantially ease the upgrade.



# Data displays

# 2

Your site's data displays are unique. These data displays were customized for your job so that you can easily access site data. Data displays in Envision for BACtalk are very similar to Web pages. You use push buttons on a data display to navigate from one display to another within Envision for BACtalk, just as you would use links on a Web page. The *top display* is the display that first appears when you start Envision for BACtalk. This is like a home page. The top display provides access to all other data displays.

Use data displays to control and monitor BACtalk system parameters and equipment. You can point and click to start equipment, adjust a setpoint, set up a schedule, launch an application, and so on.

## About data displays

Data displays are fairly straightforward—items on a display graphically depict equipment operation, provide user feedback and control of operating parameters, or provide access to other data displays or templates. Data displays are typically used to depict campus layouts, risers, floor plans, and central systems.

All displays consist of a background, which can be either a solid color or a graphics file, and the items placed on the background. Displays function in two distinct modes: user mode and edit mode. Displays cannot be altered in user mode. However, you can change values and command parameters for which you have sufficient privileges. For information about editing or creating a custom data display, see your *Envision for BACtalk Display Developer's Guide* (LTBT-TM-DSPDV).

Envision for BACtalk displays are saved in the rep/job folder specified in General System Setup. For information about defining this folder, see “System Administration” on page 315.

**IMPORTANT!** A rep/job name cannot start with a number. Use letters when creating a rep name.

## Viewing and navigating displays

When you start Envision for BACtalk, the top display appears in a window that you can move, size, and minimize. Pushbuttons on the display enable you to view other displays and navigate site information. The top display generally serves as a gateway to other displays. You use this network of data displays to manage your site's equipment and view status.

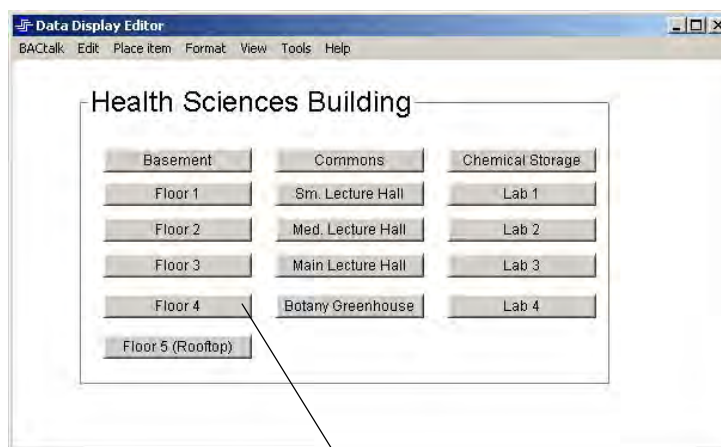
**CAUTION** When you finish working with data displays, close the display windows. This will help your system performance. Data displays poll the system frequently to update dynamic items, and leaving displays open can cause system performance to degrade because of network usage.

## Using pushbuttons to navigate displays

You navigate displays by clicking pushbuttons that the system developer added to the display. Pushbuttons typically have labels that tell you what type of data or what zone they lead to. If you do not have a security level sufficient to use a pushbutton, the pushbutton does not appear on the display.

Usually, a Previous push button enables you to quickly backtrack to the display you last viewed. If a Previous push button does not appear, use the Alt+left arrow keys to backtrack through displays.

You can also navigate between displays by clicking a data display pushbutton once.



Click a pushbutton once to view a different display

Use a Launch Application pushbutton to start other software applications from within Envision for BACtalk software. This pushbutton works like a Windows shortcut on your desktop. You can start another software program or a specific file with just a mouse click.

See your *Envision for BACtalk Display Developer's Guide* (LTBT-TM-DSPDV) and *Envision for BACtalk Help* for more information about setting up pushbuttons.

## Using the View menu to navigate displays

You can use commands on the View menu to quickly view the top display or the display viewed just previously to the current one.



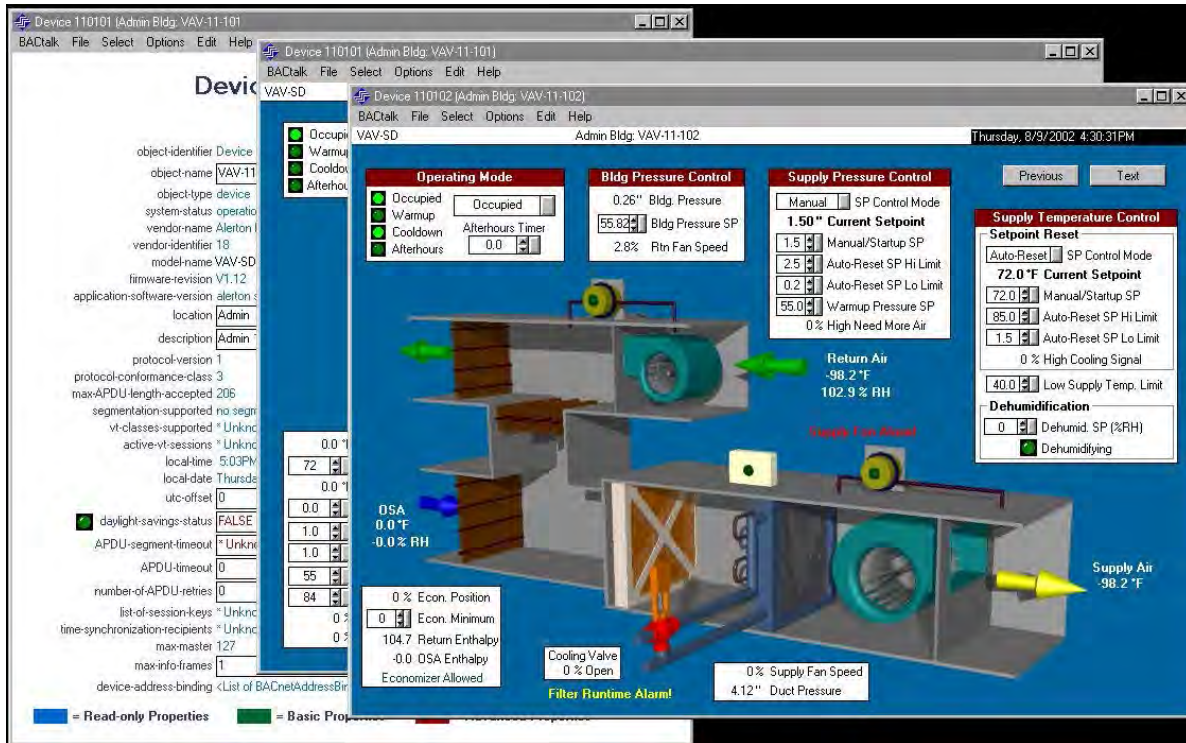
## Working with multiple display windows

Envision for BACTalk enables you to have multiple display windows open at once. This can be useful for simultaneously checking the status of related pieces of equipment, or for checking a piece of equipment along with a related zone or some other status information.

You can open as many display windows as your computer's memory will allow.



When you open additional displays (View>Display>New Display), a new instance of the top display appears.



**Figure 2.1** Envision for BACtalk with three displays open simultaneously. To switch between displays, click the title bar of an inactive window.

## Identifying and working with items on a display

In addition to push buttons and text labels to help you navigate and understand what you are viewing, Envision for BACtalk presents site data with feedback and control items. These items have special features and are the real power of your BACtalk system. Identifying them will help you take advantage of your system's capabilities.

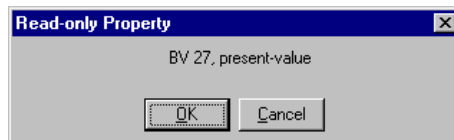
In most cases, the only difference between a control item and a feedback item is the setup when the system was programmed. A pilot light, for example, can be set up as read-only (feedback) or commandable (control).

## Improved graphics editing

Starting with v2.5, Envision for BACtalk has an improved graphics editing environment to save on design time. Display items can be copied and then instantly lined up and centered using the new Align menu (Edit> Format>Align). For example, create a push button, copy it 20 times, select all 20 items, align them all along the left side and space them all evenly and simultaneously. The result is twenty new push-button created in seconds. Display items can be created, copied, modified and perfectly positioned with greater ease and efficiency. Development time is drastically reduced and the overall look of data displays is more professional.

## Feedback items

Feedback items can appear as graphical simulations of equipment operation or as text. When you double-click a feedback item, Envision for BACtalk shows a dialog box with the device, object, and property where the data originates. Feedback items are also referred to as "read-only" items because you can not use them to command equipment operation or change parameters.



A spinning fan, a value that tells you the fan is operating at 30% of maximum speed, a half open valve, a modulating thermometer, and a temperature reading

are all examples of feedback items. The following data display demonstrates several different types of feedback and control items.

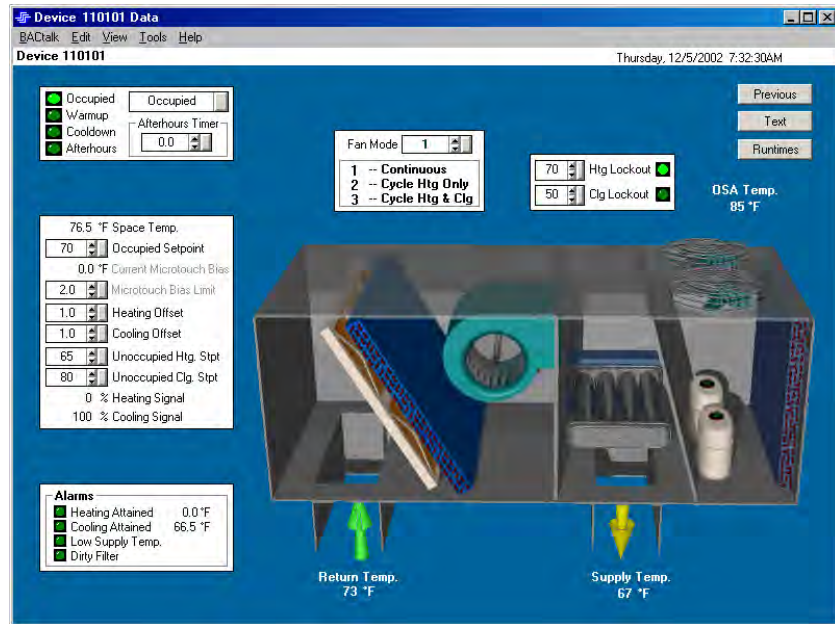


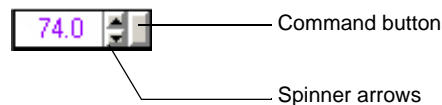
Figure 2.2 Data display for device 110101

## Commanding system parameters with control items

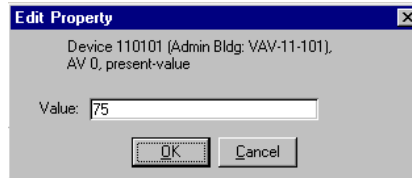
Control items appear as virtual, on-screen controls for starting equipment or setting system parameters. Switches, pilot lights, prompted items, and check boxes are all examples of control items.

### Prompted items

*Prompted items* are the most common type of control on a data display. You use prompted items to enter system values. They can affect the status of either analog or binary values. Each has a command button, which you click to change the value. When you click the command button, the Edit Property dialog box appears, where you can type a new value or select a different status. Click a prompted item's command button or use the spinner arrows to change a value in the Edit Property dialog box.



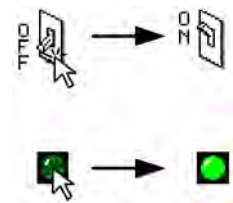
If you click the command button, the Edit Property dialog box opens. You can use this dialog box to type a new value or select an appropriate value from a list. Options depend on the controlled data point.



**Note** BACtalk controllers use floating point math to calculate values, giving them the ability to handle very large and very small numbers. For these numbers, the value in the Edit Property dialog box is represented in scientific notation. The number appears on the display in traditional notation and you can enter values without using scientific notation.

### Graphical control items

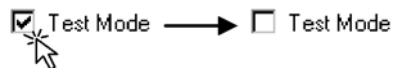
Graphical control items, such as switches and pilot lights, are set up to affect binary property types. You click the graphical control to toggle the status from OFF to ON or vice versa. Graphical items may be set up for you to confirm a change after you make it. Click a graphical item once to toggle its status.



### Check boxes

Check boxes on a data display also affect binary data points. Usually, the data point assigned to a check box controls an operating mode.

Like a graphical control item, you click a check box once to toggle the status of the data point. A check mark appears in the box when the data point is ACTIVE (ON). Click a check box once to toggle its status.



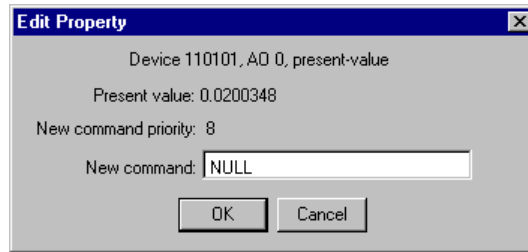
### Commanding AOs, BOs, BVs from a data display

Because a number of commands may be issued simultaneously for a present-value property—for instance, an operator may command a fan ON while a schedule calls for it to be OFF—a scheme for prioritizing commands is necessary. This is achieved with the priority-array property.

The present-value of AOs and BOs in VLCs and building controllers results from the object's priority-array. The same is true of BVs in a global controller. BACtalk uses the priority-array to prioritize commands for these objects.

When you command one of these items from a data display, you actually write a value to the object's priority-array at a particular index, rather than writing directly to the present-value. The value displayed for the AO, BO, or BV, however, is the present-value. If a control item is in effect with a higher priority level, you may issue a command with a prompted item and see no effect on the value.

Your developer chose a priority-array index when your displays were created. The priority for each item can be customized. When you open the Edit Property dialog box for an AO, BO, or global controller BV, Envision for BACtalk lists the priority-array index written from the display as the New command priority.

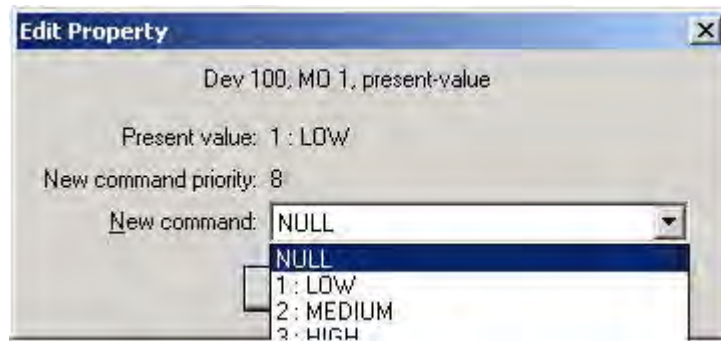


**Note** For AO items, you can type NULL for the AO value in the Edit Property dialog box to relinquish command to lower priority items. For BOs and BVs, you can select NULL as an option.

### Commanding MOs, MIs, and MVs from a data display

Multistate objects in BACtalk have present-value properties representing different states of operation. For example, a fan may have three (or more) states of operation: low, medium, and high. The NULL value is used to relinquish command to lower priority items of the same property. When the present-value of a multistate object is combined with a state-text property, the special multistate Edit Property dialog box displays a number value with the text label for each state of operation.

If you click the command button, the Edit Property dialog box opens. You can use this dialog box to type a new value or select an appropriate value from a list. Options depend on the controlled data point.



**Figure 2.3** The present-value property 1 combined with the state-text property LOW can be used for a fan operating in low mode. The present-value property 3 combined with the state-text property HIGH can be used for a fan operating in high mode.

When the present-value property has a priority array, NULL is displayed at the top of the New command drop down list.

If an MI, MO, or MV object is not associated with a state-text property, only the number values are displayed in the Edit Property dialog box. For example, LOW, MEDIUM, and HIGH would not be displayed.

Menu items for MI, MO, and MV properties are displayed in context menus when you right-click a data display item that has a multistate object associated with it. Selecting the Properties item will open the properties data display.



## Using shortcut menus to access automation features

Depending on how your data displays are set up, you may be able to right-click a feedback or control item to access alarms, schedules, trendlogs, or operator activity for the property that the item references. You may also be able to view a property status sheet for the device where the property originates.

When you right-click an item set up with the feature enabled, a shortcut menu appears. The shortcut menu and available commands are set up on an item-by-item basis. Not all menu items may appear.

**Note** For details about setting up and using alarms, schedules, trendlogs, operator activity, and input, output, value, or device properties, see the appropriate chapter in this manual.

## Setting up an alarm, schedule, or trendlog for an item from a data display

Right-click an item to see a context or pop-up menu of all the features you can set up for it through the data display. Only the available options for the selected item are shown. Click the menu command you want to start setting up the option.



**Note** The Zone option only appears for data points associated with a zone controller. See “Zones” on page 29 for more information.

## Interpreting status messages and alarms on displays

In addition to giving you control and visibility of your site data, feedback and control items provide messages that reveal the status of communications. Also, graphical items may be set up to show an alarm image if the referenced property is set up with an alarm and enters an alarm state. See “Alarms” on page 47 for more information about alarms.

**Table 2.1** Status and alarm messages on data displays

Message	Description
75... ACTIVE... [ellipsis after value]	Prompted items only. Ellipses indicate that the command is being written to the data point (or to its priority-array). When the ellipses disappear, the value has been read back from the device.
NR	No response from unit. Communications with the device could not be established.
NR<val>	No response from unit, with <val> equal to the last known value of the property, which is buffered at the operator workstation.
NR NULL	No response from unit, with no known value in the buffer.
(waiting)	Attempting to establish communications with the unit.
Unsupported character set	Appears only for properties that return text string values. Indicates that the character string contains unrecognizable characters.
Unknown property	The property referenced does not exist in the object referenced.
*Unknown object*	The object does not exist in the device.
*no datum*	Indicates that the device referenced does not support the read-property-multiple service. To correct this, disable the service in the Advanced Network Settings dialog box (click <b>General System Setup</b> on the Tools menu, click the Network tab, click <b>Advanced</b> , and then select <b>Disable Read/Write Property Multiple</b> ).
*no entry*	Indicates that the device associated with the requested property is not defined in the Device Manager table.
*Communications error*	Indicates that BACTalk could not establish communications to obtain the property status referenced.
*Err(services, other)*	Miscellaneous error condition.



# Zones

# 3

A *zone* is a defined space in a building that is controlled by the BACtalk system. Zones provide a convenient mechanism to monitor, manage, and arbitrate multiple Envision features, such as schedules, optimum start, and tenant activity. The optimum start and tenant activity features (see “Optimum start” on page 119 and “Tenant activity” on page 141) require a zone setup.

You can define zones to accommodate the specific needs of a building. For example, a zone may represent one floor of a building, multiple floors, a particular room or area within a floor, a hallway, foyer, or stairwell. How you define and use zones depends on how space is used and how you want to control the environment or equipment in a space. Typically, a zone is an area serviced by a single terminal unit, such as a variable air volume (VAV) box or a fan-coil unit.

Look at the areas of the building and how they are used before you define your zones. Consider how you want to control each zone. Is this an area that will be controlled by schedules? Is this an area where you want to use optimum start to warm or cool the space before it is occupied? Will you monitor and bill tenants for after-hours energy use in this zone? Like all Envision features and functionality, careful evaluation and planning will help ensure more effective results.

## Benefits

**Convenient** Set up a zone and then assign it to other Envision features: schedules, tenant activity, and optimum start. A zone simplifies operation.

**Efficient** Set up a zone once and forget it. Copy the zone to set up scheduling, optimum start, and tenant activity for any number of similar controllers.

**Reliable** Set up a zone and system operation will remain reliable over time.



## Practical application

---

George, the Facilities Manager at State University, wants to use optimum start in the Health Sciences building. This will help ensure that classrooms are comfortable when the first class of the day arrives, no matter how early or late that is. The administration is also thinking about charging individual department budgets for after-hours energy use in their respective buildings. George has suggested using the Health Sciences building as a trial run for the tenant activity feature. Both of these features require that the space be set up in zones.

Health Sciences is a four-story building with 30 VAV controllers on each floor, controlling the conditioning in classrooms, labs, and offices. George will use these VAV controllers to define 120 zones in the Health Sciences building. He can then set up schedules for each zone based on the expected occupancy. For example, standard classroom schedules are Monday, Wednesday, and Friday from 8:00 AM to 2:00 PM. Labs are typically in use on Tuesdays and Thursdays from 8:00 to 10:00 AM and 1:00 to 3:00 PM. Office hours are Monday through Friday from 8:00 AM to 5:00 PM. Defining these zones and schedules are the first steps in setting up optimum start and tenant activity.

---

## Quick start–zone setup

Use the following table to help you set up zones in Envision for BACtalk. The key steps for creating a zone are listed in order.

**Table 3.1** Tasks for setting up a zone

Task		See
1	Identify the areas of your building you want to set up as zones.	• Site documentation
2	Identify the device instance of the field controller that controls the zone's equipment.	• Site documentation
3	Identify the control point that reliably represents the occupied command for that zone. Typically BV-40 for Alerton standard applications.	• Site documentation
4	Identify the global controller or BCM that you want to host the zone.	• Site documentation
5	Use the information you have gathered to set up information on the General tab for the zone. Specify the Advanced Output Settings if the zone device uses multistate objects.	• page 37
6	If you will use optimum start and you will use Celsius, specify this on the Advanced tab.	• page 39
7	If you will use optimum start, on the Optimum Start References tab, set up optimum start data point references for warmup and cooldown commands, heating and cooling setpoints, outside air temperature, and zone space temperature.	• page 41
8	If you will use tenant activity, on the Tenants tab, specify the data point that indicates after-hours override in the zone.	• page 42
9	Save the zone.	• page 33
10	If you will use optimum start or tenant activity, set up a schedule set for the zone.	• page 44
11	Identify similar zones that you want to have the same setup. Use Copy to create multiple zone setups quickly and easily.	• page 44



## How zones work

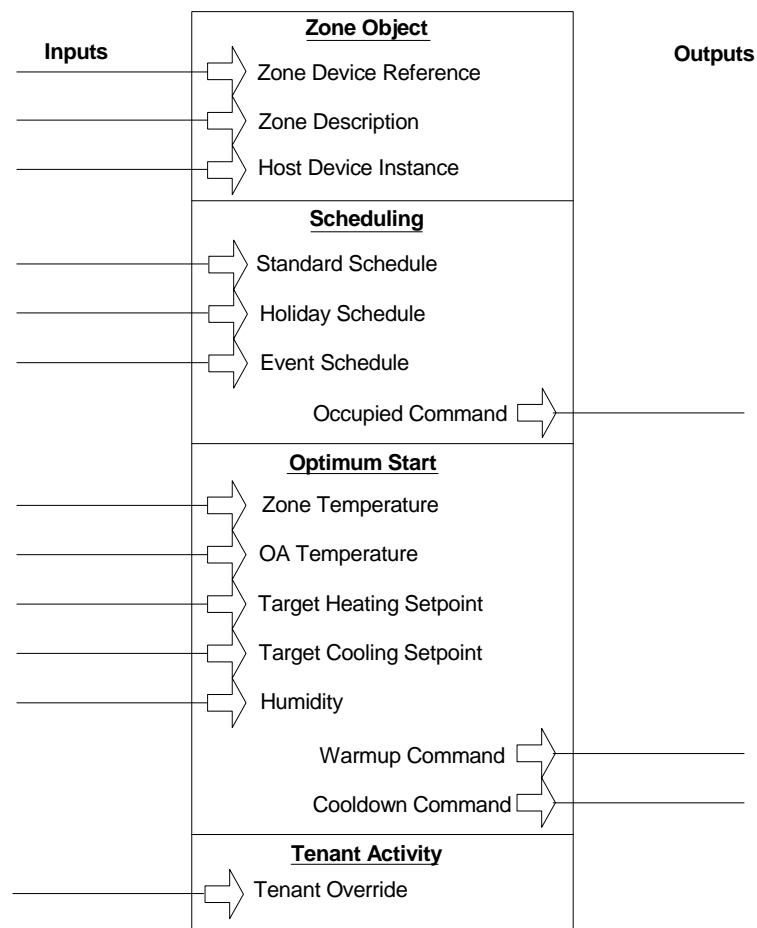
Facilities are typically divided into manageable areas called *zones*. A zone is associated with a single field controller and terminal unit device. In a BACtalk system, each zone must have an occupied command point in that controller.

## Why use zones?

Envision for BACtalk specifically requires zones for the optimum start and tenant activity features. You can also assign a schedule set to a zone to control device operations based on the time of day, holidays, and special events.

In the context of a building, a zone is any area you want to control. Within the context of a BACtalk system, a zone is an Alerton-defined object with an associated set of properties. See the *BACtalk Systems Programmer's Guide and Reference* (LTBT-TM-PRGRMR) for more information about objects and properties.

A zone object pulls together the individual properties and references required to support optimum start or tenant activity in a single object. It handles the user-defined inputs specified during the zone setup to monitor and control schedules, optimum start, and tenant activity.



**Figure 3.1** Zone object inputs and outputs

## What makes a zone?

Each zone is defined by a *zone device reference* and an *occupied command reference*. The zone device reference identifies the field controller for the equipment that conditions the zone. The occupied command reference indicates whether the zone is occupied or unoccupied; this reference must be a data point within the zone device.

## How zones work with schedules and optimum start

When you set up a zone and assign a schedule set to it, the schedules write to properties on the zone object, instead of the command points of the BACnet device controlling the actual hardware. See Figure 3.1 on page 32.

A point may be controlled by one zone or by one schedule, but not both. If you assign a schedule to a zone, do not schedule any of the points that the zone writes to. For example, warmup and cooldown command references are points of control, so they have this restriction.

When you assign a schedule set to control a zone, it writes to the individual properties of the zone, such as the occupied command. This allows Envision for BACtalk to determine which schedule (standard, holiday, or event) controls the zone. In other words, the occupied command is not scheduled directly; the zone controls the occupied command, which in turn is used to help calculate optimum start times.

## How zones work with tenant activity

In much the same way that the occupied command associates a zone with optimum start, the tenant override command associates a zone with the tenant activity feature. When you define a zone, you can identify a tenant-override property. The host device detects when this property indicates after-hours activity in a zone and records these events. You can then view or generate bills based on this information.

Zones are a component of the tenant profile. When you define a tenant profile, you assign one or more zones to a tenant. For example, a tenant may occupy two floors of a building and each floor may be divided into several zones. See “Tenant activity” on page 141 for more information about setting up and using the tenant activity feature.

## How zones are saved and run

Zones are Alerton objects that are saved in global controllers. This allows features that rely on zones, such as schedules and optimum start, to run even if the operator workstation is offline.

**Note** The tenant activity feature requires that the Envision for BACtalk server be running to log tenant activity events.

The zone object incorporates all the information that defines a zone, including references to the physical BACnet device controlling the zone and references to the schedules controlling the zone. The zone object manages the various schedule inputs (standard, holiday, and event) that control the physical device. See the *BACtalk Systems Programmer’s Guide and Reference* (LTBT-TM-PRGRMR) for information about the objects and properties.

### Synchronizing zone data

When you add or edit a zone definition and click **OK**, the settings are saved to the BACtalk server and to the host device if it is online. You can also send zone settings to devices from Device Manager. When you use the Send feature, Envision for BACtalk displays an option to resynchronize and verify all zone and schedule dependencies. To ensure a complete resynchronization, it is good practice to send all schedules and zones at the same time.

**Note** If you view the User Request Monitor after choosing to synchronize zone data, you will see that Envision for BACtalk automatically sends all schedules before sending zone data.

Because a point cannot be controlled by both a zone and a schedule set, conflicts may occur. Envision displays an error message if you try to assign a zone to a point that is already controlled by a schedule or vice versa. However, other advanced Envision features can inadvertently create conflicts. For example, conflicts will occur if you back up a job and restore it to a job that does not have exactly the same objects stored in the controller. You will also experience errors if you dial-up a non-server based site without first performing reverse engineering upon connection. Use the Status information in the Zones dialog box to help you identify the devices where conflicts exist. See “Working with zone status information” on page 43 for more information.

**CAUTION** Be careful when assigning a point to a zone. If DDC is trying to write to a point that the zone is trying to control, no conflict will be apparent.



---

### Example

Health Sciences is a four-story building, which has 30 VAV controllers per floor. These are the field controllers for each of 120 zones in this building. The zones use the same standard application and same data points (for example, BV-40 is the occupied command reference). They also use the same schedule set. You can set up one of the zones, and then copy that setup to the other 119 zone objects in the other zones' global controllers to automatically create the rest of the zones. See “Copying a zone setup” on page 44 for more information.



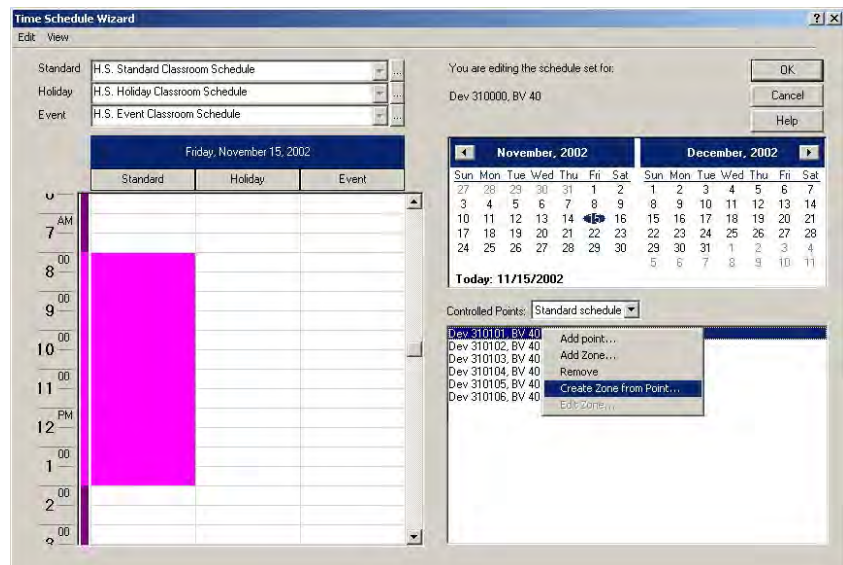
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### Practical application

George, the Facilities Manager, has identified all the zones in the Health Sciences building where he wants to use optimum start. For now, he is limiting it to the classrooms and labs because that is where the most people are affected if the room is too warm or too cold for the first class or lab of the day.

Currently, all of the classrooms are controlled by data points and occupied commands. George wants to convert the classrooms to zones so he can enable optimum start. After reviewing the data displays for several of the classrooms, George realizes that they are all engineered in the same way—they use the same schedule set, the same occupied command reference in each device, and so on. George opens the schedule used for the classrooms in the Time Schedule Wizard and selects a data point from the Controlled Points list for a Health Sciences classroom, Dev 310101, BV-40. He right-clicks the point, and then uses the

Create Zone from Point option on the shortcut menu to quickly create a zone based on the current data point settings.



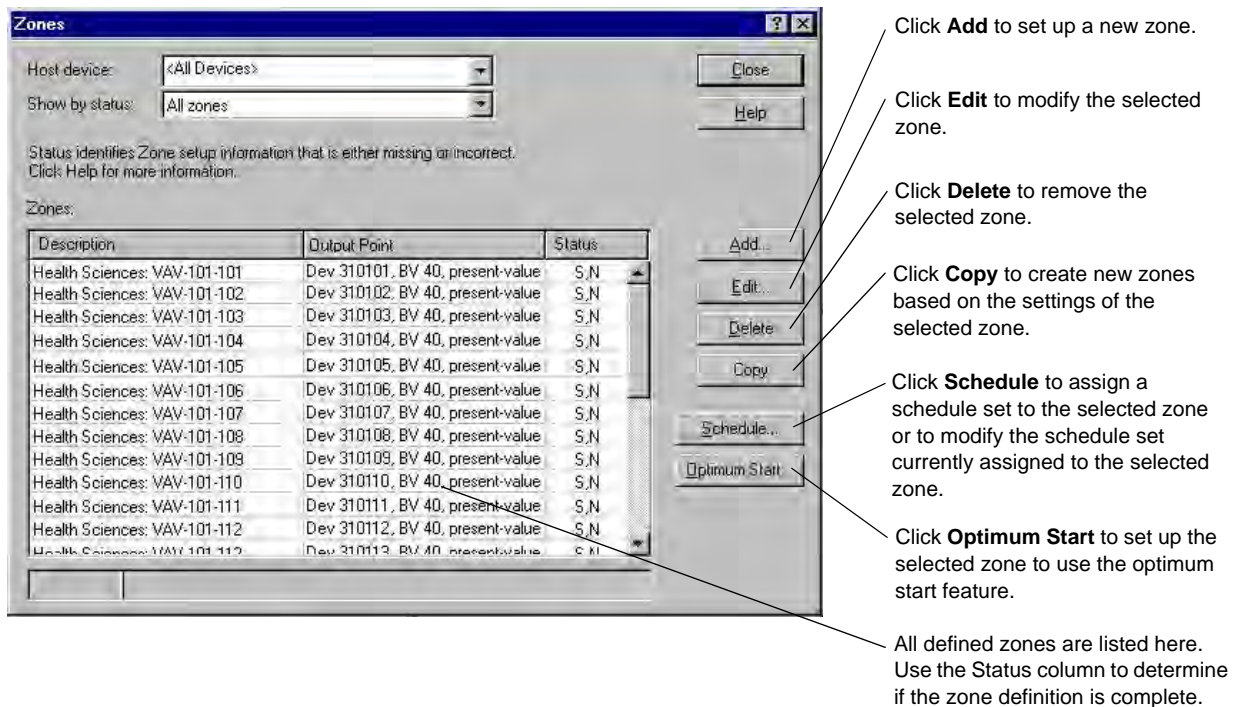
George deletes all the other points to be converted from the Time Schedule Wizard's Controlled Points list (Dev 310102, BV 40 - Dev 310106, BV 40). He clicks **OK** to save the new schedule and synchronize the zone with the schedule. He then goes to the Zones list (BACtalk>Zones) and selects the new zone controlling Dev 310101. George uses the Copy button to create zones for the rest of the points (Dev 310102, BV 40 - Dev 310106, BV 40), using the same settings.

## Setting up a zone

Zones enable you to monitor and control environmental conditions within specified areas in a facility. Once you have defined a zone, you may not have to modify the zone setup again. You can assign tenants to existing zones and generate tenant bills for after-hours energy use through tenant activity. You can also link schedules and optimum start functionality to existing zones so that Envision calculates when to start HVAC equipment to reach a zone's desired setpoint temperature by scheduled occupancy.

See the Schedules, Tenant Activity, and Optimum Start chapters in this manual or Envision for BACtalk Help for more information about using these features with zones.

When you select the **Zones** option, Envision displays a list of the zones that have been created. The Zones dialog box displays the zone description, the associated output point, and the status of the zone definition. See “Working with zone status information” on page 43 for more information.



**Figure 3.2** Use the Zones dialog box to add, edit, delete, or copy the selected zone's properties. You can also set up schedules and optimum start for the selected zone from this dialog box.

There are a number of ways you can define zones, depending on how you work with Envision for BACtalk and your objectives. The following lists various strategies you can use:

- Define all zones, then define schedules, optimum start, and tenant activity settings for each different zone as appropriate.
- Define a single zone and all features that you want to use with the zone, such as optimum start and tenant activity. Copy the zone setup for all similar controllers and edit those setups as needed.
- The optimum start and tenant activity features both allow you to define a zone when you define the settings for the feature. For example, if you select **Energy Management** and then **Optimum Start** from the BACtalk menu, the Select Zone for Optimum Start dialog box appears. You can select a zone from the list or create a new zone.
- You can also create a zone from the Time Schedule Wizard. Right-click the Controlled Points list and click **Add Zone** to define a new zone, or select a point from the list and click **Create Zone from Point** to create a zone based on a scheduled point.

**Note** In the User Setup dialog box, Add, Delete, and Configure Zones must be selected privileges in your user profile to allow you to create or edit zones.

## Defining a zone

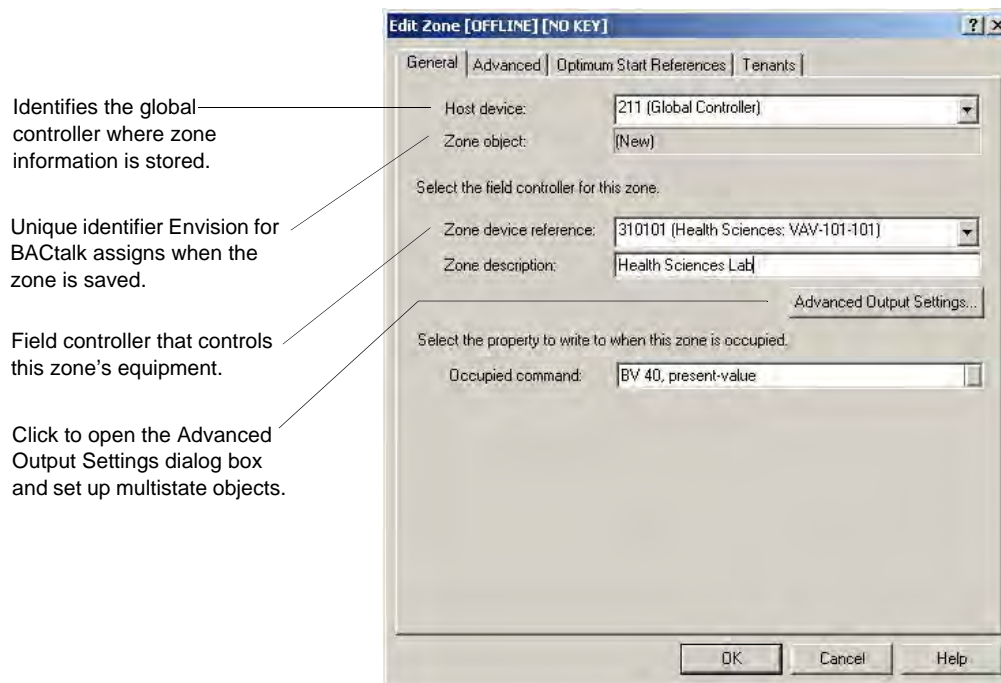
When you click **Add on** the Zones dialog box, the Edit Zone dialog box is displayed.

**Note** Zone references automatically update to Alerton Standard applications. That is why certain AVs are always automatically assigned during the zone setup process. These default values are fixed and are not based on device type. For example, outside air temperature default reference is AV-103, present-value. For more information about zone references or Alerton Standard applications, see the *BACtalk Systems Programmer's Guide and Reference* (LTBT-TM-PRGRMR).

### General tab

Use the General tab to specify the host where the zone information will be stored, the field controller that controls the zone equipment, and the occupied command property. These references on the General tab define the zone.





**Figure 3.3** Specify controllers, zone location, and the occupied command property on the General tab of the Edit Zone dialog box for a new zone. Use the Advanced Output Settings dialog box to set up multistate objects.

**Host device** Specify the device instance of the global controller that will store the zone settings and carry out features associated with the zone, such as optimum start. The Host device box lists only devices that are capable of hosting a zone. Once you create and save a zone definition, you cannot change the host device.

**Note** Device capabilities are set in the device profile using Device Manager. To host a zone, a controller must have “Supports Alerton zone objects with external points” selected on the Capabilities tab in the Add/Edit Device Profile dialog box.

**Zone object** When you save this zone definition, Envision for BACtalk automatically creates a unique identifier for the zone object, which includes the host device number, a zone number, and the zone description. For example, “Dev 31010, aler-zone 11 (Health Sciences: VAV-101-101).”

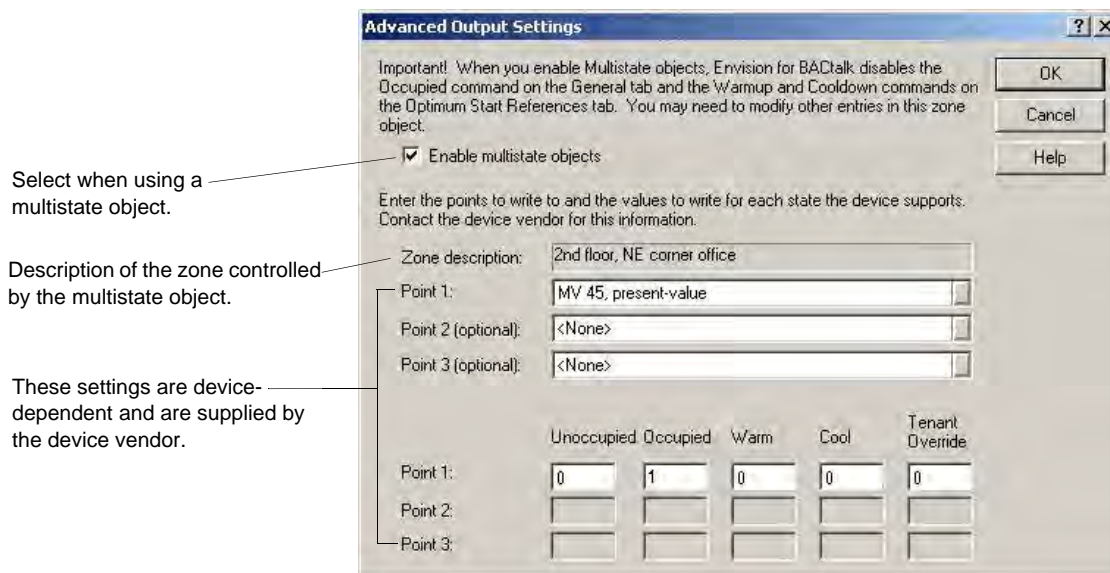
**Zone device reference** This entry identifies the field controller for the equipment that conditions the zone. For example, the device instance of a VLC controller for a fan coil unit. The occupied command is written to this device.

**Zone description** Enter a meaningful description for this zone, for example, a description of the zone's location (Health Sciences: VAV-101-101). This description is displayed as part of the zone object in lists and displays. It is also the default device description displayed in Device Manager.

**Advanced Output Settings** Click to open the Advanced Output Settings dialog box and then enable and define a multistate object, such as a fan with low, med, high, and off settings. Select **Enable** box to activate the rest of the fields and

then select points to write to and values to write for each state (for example, low, medium, and high) that the device supports. Contact the device vendor to obtain the specific points and values to use. Clear the Enable check box to disable the advanced output settings.

**Note** Saved changes on the Advanced Output Settings dialog box affect settings in the Edit Zone dialog box. For example, the Occupied command field on all tabs is disabled and displays “Advanced output mode.” All other fields on the Edit Zone tabs display the current settings until the user changes them. The Warmup command and Cooldown command fields on the Optimum Start References tab are also disabled (see Figure 3.6 on page 41).



**Figure 3.4** Enable multistate objects and define the points to write to and the values to write for multistate objects on the Advanced Output Settings dialog box.

**Occupied command** The occupied-command property indicates when the zone is occupied or unoccupied. This must be a property on the zone device.

**Note** The Occupied command field is dimmed and reads “Advanced output mode” when multistate object support is enabled. See “Advanced Output Settings” on page 38 for more information.

**WARNING** By default, the zone object uses BV-40 for the occupied command and BV-41 and BV-42 for the warmup and cooldown functions used in optimum start calculations whether your system uses the optimum start feature or not.

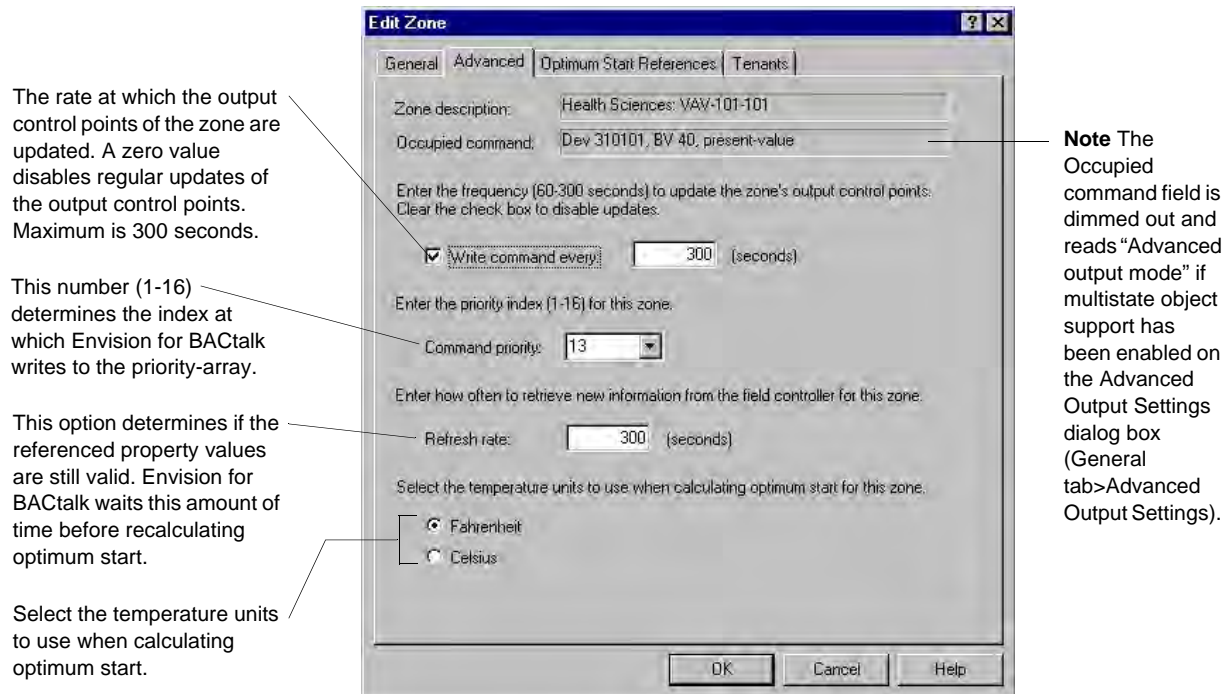
## Defining advanced zone settings

### Advanced tab

The settings on the Advanced tab determine how the BACtalk system processes zone data. These settings seldom need to be changed.

**WARNING** Only change the default Advanced tab settings if you have a specific need to do so. While changing the Write Command Every rate and the Refresh rate values from the default to a lower value will increase accuracy and

response times of zones, it will also have a negative effect on BACtalk network traffic due to the increased number of property reads and writes.



**Figure 3.5** Use the Advanced tab of the Edit Zone dialog box to specify how BACtalk will process zone data.

**Write command every** This setting determines how often, in seconds, the host controller updates the zone's output control points (for example, occupied command and optimum start references, if enabled). The minimum setting is 60 seconds; the maximum is 300 seconds. When the check box is cleared, outputs are updated when conditions change instead of regular intervals.

**Command priority** This setting assigns a priority to the zone. This is the priority-array index that the zone object writes to in commandable BACtalk properties, such as occupied command, warmup command, and cooldown command. Valid index values are 1-16. See your *BACtalk Systems Programmer's Guide and Reference* (LTBT-TM-PRGRMR) for more information.

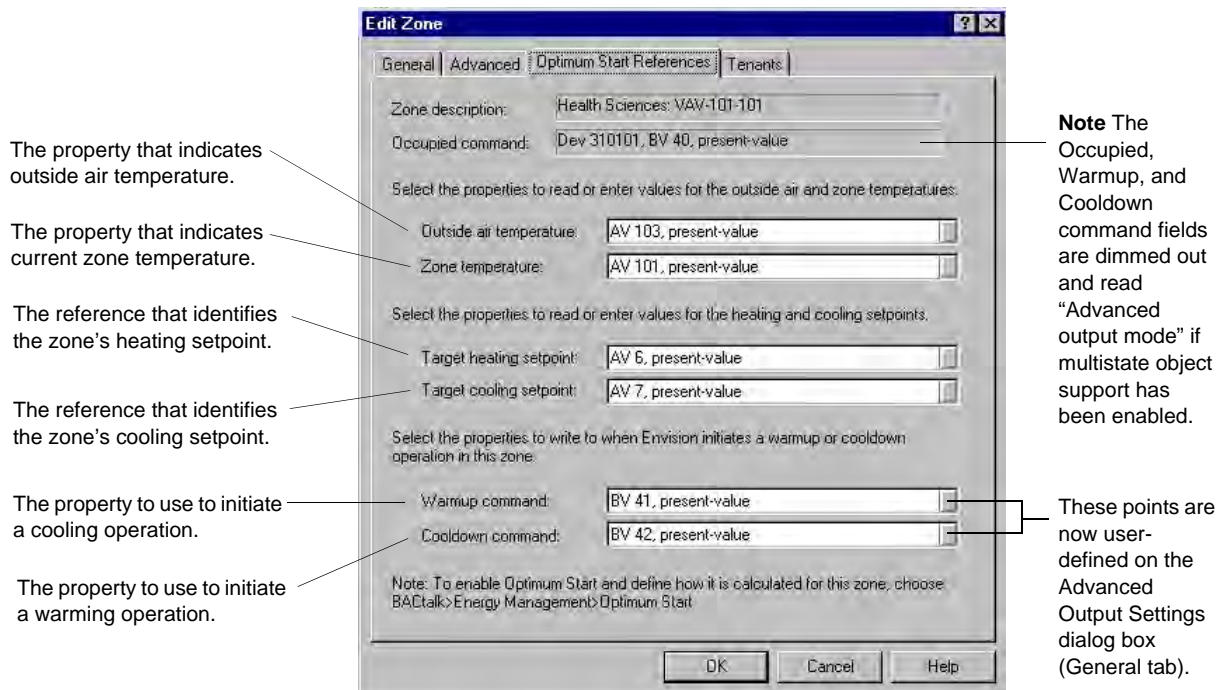
**Refresh rate** This setting determines how frequently, in seconds, that Envision for BACtalk polls the field controller for data about this zone (space temperature, outside air temperature, target heating and cooling setpoints, and humidity, if defined). Data is refreshed at least every 15 minutes by default. Users can set this rate anywhere between 10 and 900 seconds.

**Fahrenheit/Celsius** Specify whether your system uses Fahrenheit or Celsius for temperature calculations and references. Changing this setting automatically converts the Outside air limit value on the Optimum Start dialog box to the same units.

## Setting optimum start references

### Optimum Start References tab

Use the Optimum Start References tab to define the reference points or values used for optimum start calculations for this zone. For more information about how optimum start calculations work, see “Optimum start” on page 119. You do not need to change the default settings if optimum start is disabled.



**Figure 3.6** Use the Optimum Start References tab to specify the data points and values that this zone uses for optimum start calculations.

Optimum start is a self-tuning feature that uses a set of calculations to determine when to begin heating or cooling operations to reach the desired setpoint by the time the zone is occupied. As a result, the calculations and daily adjustments are more accurate when data point references are used. However, if they are unavailable, you can specify values for each of the references. For more information about how these values are used in optimum start calculations, see “Optimum start” on page 119.

**Outside air temperature** Select the data point to monitor or enter a value for the temperature of the air outside the facility.

**Zone temperature** Select the data point to monitor or enter a value for the space temperature for the zone.

**Target heating setpoint** Select the data point that provides the target heating setpoint for this zone. This is the temperature you want the zone warmed to by the next scheduled occupancy. Typically, this is set to a data point that represents the zone's occupied heating setpoint. Alternately, this may be set to a data value.

**Target cooling setpoint** Select the data point that provides the target cooling setpoint for this zone. This is the temperature you want the zone cooled to by the

next scheduled occupancy. Typically, this is set to a data point that represents the zone's occupied cooling setpoint. Alternately, this may be set to a data value.

**Warmup command** Select the data point that optimum start writes to when heating is called for in preparation for scheduled occupancy. Envision assumes heating is required when the zone temperature is less than the target heating setpoint - 0.5 degrees Fahrenheit. If a data point is not specified (None is selected), optimum start will not begin warming the zone prior to scheduled occupancy.

**Cooldown command** Select the data point that optimum start writes to when cooling is called for in preparation for scheduled occupancy. Envision assumes cooling is required when the zone temperature is greater than the target cooling setpoint + 0.5 degrees Fahrenheit. If a data point is not specified (None is selected), optimum start will not begin cooling the zone prior to scheduled occupancy.

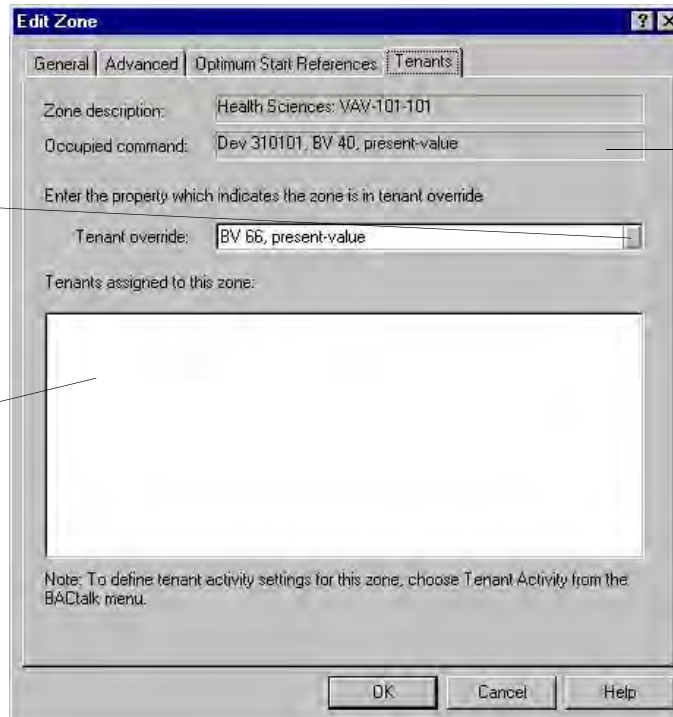
## Setting the tenant override reference

### Tenants tab

Use the Tenants tab if you will be setting up the tenant activity feature for the selected zone.

The property that will indicate tenant override activity in this zone. For example, in Alerton Standard applications, this is the present-value property of BV-66.

Displays a list of all tenants assigned to this zone.



**Note** The Occupied command field is dimmed out and reads "Advanced output mode" if multistate object support has been enabled on the Advanced Output Settings dialog box (General tab).

**Figure 3.7** Specify the data point that BACtalk will monitor to determine if a zone is in tenant override mode.

**Tenant override** Select the data point to monitor to determine when the zone is in tenant override mode. If you are not using tenant activity in this zone, you can select None for this property.

See the "Tenant Activity" chapter in this manual or Envision for BACtalk Help for more information about setting up and using Tenant Activity.

## Working with zones

After you have set up a zone, you can adjust the settings, if necessary, or use an existing zone to set up another zone with similar settings. From the Zones dialog box, you can also edit, copy, add, or modify schedules, or enable or adjust optimum start settings for the selected zone. See page 36 for an example of the Zones dialog box.

### Editing a zone setup

The zone setup is basically a set-and-forget task, but over time you may want to adjust zone settings. For example, the building where the zone is located may be remodeled and the zone's description may no longer be accurate. You may decide at a later time that you want to use the optimum start feature in a zone and need to set up the references used in optimum start calculations.

**Note** Once you save a zone definition, you cannot edit the host device. If you need to edit a zone's host device, you must delete the zone and recreate it using the new host device.

### Working with zone status information

The Zones dialog box provides useful information about the status of a zone definition. This information can help you determine if additional edits or settings need to be defined for the zone.

The Status column in the Zones dialog box provides the following information.

**Table 3.2** Zone status information

Status	Description	Recommended action
C	Conflict with another zone or schedule. Only one zone or schedule can control a single command point.	Check other zones and schedules to make sure that only this zone is controlling the data point for a given device.
I	Incomplete control point information.	Check to make sure all data points are defined for this zone. This status may occur if a point has been removed from a zone.
S	Incomplete schedule information.	Check the schedule set for this zone and verify that standard, holiday, and event schedules are assigned to it.
N	No tenants assigned to this zone.	Optional: Ignore this status code if you are not monitoring tenant activity. To use the tenant activity feature in this zone, you must assign a tenant to the zone on the Zones tab of the Edit Tenant Profile dialog box.
O	Tenants assigned, but no tenant override property.	Optional: Ignore this status code if you are not monitoring tenant activity. To use the tenant activity feature, you must specify a tenant override property for this zone on the Tenants tab of the Edit Zone dialog box.



## Deleting a zone

You may decide that a zone is no longer needed or that a particular zone setup is inaccurate and you would like to set it up all over again. Select the unwanted zone from the Zones list in the Zones dialog box, and then click **Delete**.

**WARNING** Deleting a zone permanently removes that zone from Envision for BACtalk. Make certain the zone is no longer needed, for example, no tenants are assigned to the zone, before deleting it.

## Copying a zone setup

If you are setting up zones for a large site, using the copy feature can save a lot of time. For example, you can define all the settings for one zone, and then copy those settings to create zone definitions for areas with similar controllers. When you create zones using the copy feature, keep these guidelines in mind:

- Set up the first zone according to how you want all other zones to be set up, including schedules and optimum start settings.
- If you will be using tenant activity or optimum start, configure those options and enable optimum start before you copy the zone. Note: Tenant assignments are not copied.
- When you click **Copy** in the Zones dialog box, select all the devices that you want to copy the zone setup to. The devices you select should be the field controllers for each zone. Their device instances will appear as the zone device reference in the zone definition.
- Verify that all devices have descriptions in Device Manager.
- All the data references for the zone are copied to the new zones. For example, if the original zone uses BV-40 in the field controller for its occupied command, the new zones will each use BV-40 in their respective field controllers as the occupied command reference. If you entered fixed values, those values are copied to the new zones.
- The copied zones use the same schedule set as the original zone.

## Options for scheduling a zone

Zones use schedules to determine when to begin and end operations in the zone. When you link schedules to a zone, you select a standard schedule, a holiday schedule, and an event schedule. Features, such as optimum start, use these schedules to calculate when to begin warming or cooling operations in the zone. See “Schedules” on page 101.

There are several ways to schedule a zone in Envision for BACtalk:

- In the Zones dialog box, select the zone you want to schedule, and then click **Schedule**.
- From a data display, right-click a data point and, from the shortcut menu, click **Zone**, and then click **Schedule**.
- In the Time Schedule Wizard, right-click under Controlled Points, and then click **Add Zone**.

## Setting up and adjusting a zone's optimum start settings

You can set up or edit optimum start settings from the Zones dialog box. Select the zone you want to work with, and then click **Optimum Start** to open the Edit Optimum Start dialog box. For details on configuring optimum start, see “Optimum start” on page 119.



# Alarms

# 4

Envision for BACtalk *alarms* help you efficiently manage your buildings. Alarms monitor data points in the BACtalk system for conditions you specify, and then generate alarm messages when the condition is met. For example, you might monitor the temperature of a zone, the status (ON/OFF) of a piece of equipment, or compare a command to an actual operating status.

When you set up an alarm, you also set up or select an *alarm handler*, which tells the system where and how to annunciate the alarm. The system can annunciate the alarm in a number of ways:

- Data display items referencing the data point in alarm can show alarm status
- Operator workstations can email an alarm
- Operator workstations can display a popup alarm message indicating the alarm
- The alarm can display a link to a specified URL or a BACtalk display or template when it is annunciated
- The alarm can dial out information to a pager
- The alarm can dial out information to be logged at a remote site
- The Envision for BACtalk server can record an entry in the Alarm History file

See “Reading BACtalk alarm messages” on page 90 for more information about reading and working with alarm messages.

## Benefits

**Efficient** Get critical information about your system while at an operator workstation or on the road.

**Customizable** Set up your own alarm messages for different alarms. Have alarms sent to pagers, operator workstations, remote systems, or email.

**Flexible** Use alarm handlers to change alarm recipients without having to edit individual alarms.



## Practical application

---

Marc is the lead facilities engineer for the Administration building at State University and responsible for the regular maintenance of all equipment in the facility. For example, he ensures filters are changed, equipment is tuned, and air ducts are cleaned. Marc also is the “first line of defense” if there is a problem with mechanical equipment. He is usually on site from 8:00 AM to 7:00 PM Monday through Thursday and on-call for emergencies during off-hours. He has a pager so that his night crew, and the system, can contact him for emergencies.

Many alarms were set up for the system when it was turned over to the facilities staff, but Marc quickly learned that alarms help him keep tabs on his building. He occasionally sets up new alarms to annunciate at operator workstations, pagers, remote sites, or email when equipment requires some sort of maintenance.

---

## Quick start–alarm setup

Use the following table to help you set up an alarm in Envision for BACtalk. The key steps for defining an alarm are listed in order.

**Table 4.1** Tasks for setting up an alarm

Task	See
1 Identify the foundation of the alarm setup: <ul style="list-style-type: none"> <li>• What kind of conditions do you want to define alarms for?</li> <li>• Who should receive the alarms and how should they receive them?</li> <li>• What kinds of alarm conditions require acknowledgement?</li> <li>• What kinds of messages do you want to use for alarms?</li> <li>• Which data points (present-value of AI, AV, AO, BI, BV, BO) do you want to monitor for an alarm state?</li> <li>• What alarm type best suits the objective of each alarm condition?</li> <li>• What global controller do you want to host the alarm setup?</li> </ul>	<ul style="list-style-type: none"> <li>• Site documentation</li> <li>• page 54</li> <li>• page 55</li> </ul>
2 Select the data point you want to monitor for an alarm. Use the Alarm Wizard, Point Alarm Setup, or right-click an item on a display.	<ul style="list-style-type: none"> <li>• page 62</li> </ul>
3 Define alarm setup parameters based on the type of alarm and your decisions from step 1.	<ul style="list-style-type: none"> <li>• page 69 (fixed limit)</li> <li>• page 72 (floating limit)</li> <li>• page 74 (binary)</li> <li>• page 76 (command fail)</li> </ul>
4 Do you want to pop up a data display, template, or Web page?	<ul style="list-style-type: none"> <li>• page 71</li> </ul>
5 Do you want to email an alarm?	<ul style="list-style-type: none"> <li>• page 84</li> </ul>
6 Select an alarm handler for the alarm, or set up a new alarm handler. Verify the recipients of the alarm or set up new recipients.	<ul style="list-style-type: none"> <li>• page 77</li> </ul>
7 Define global alarm settings.	<ul style="list-style-type: none"> <li>• page 87</li> </ul>

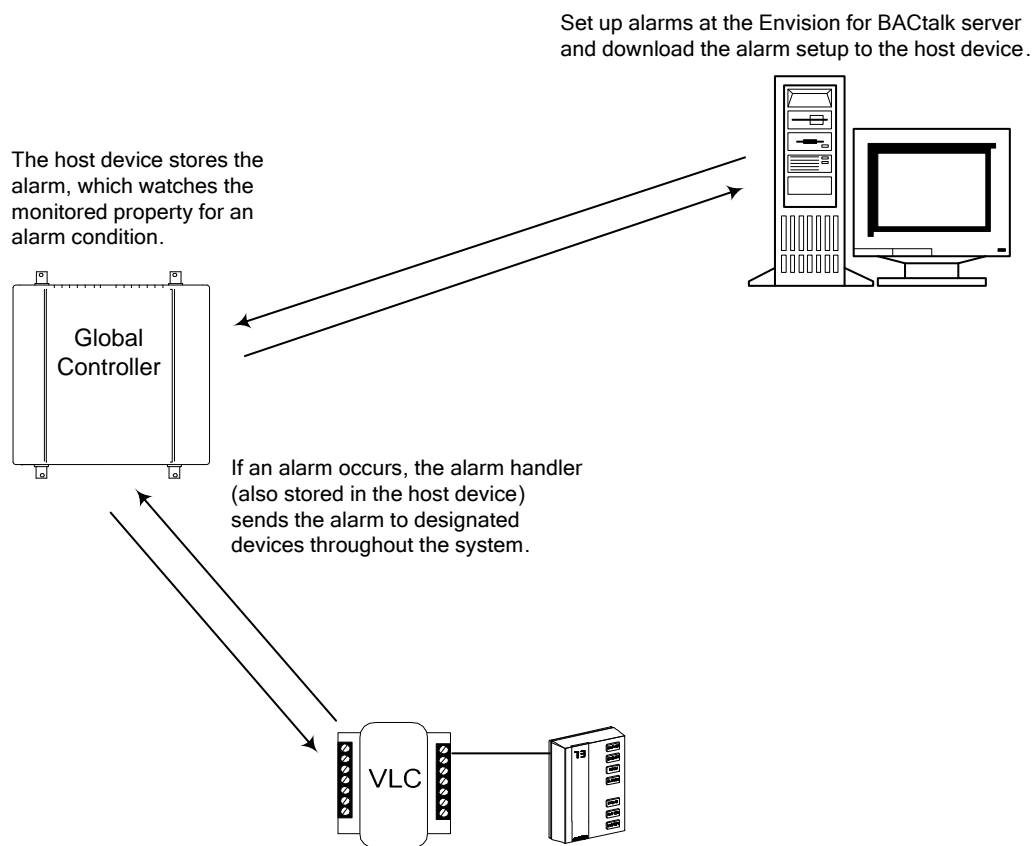


## How alarms work

There are three items at the core of any alarm in Envision for BACtalk:

- The *monitored property*, which is the status or value that the alarm watches for an alarm state.
- The *alarm setup* (in BACnet, technically known as an *event-enrollment object*), which is saved in a global or building controller. It watches the monitored point to generate an alarm.
- The *alarm handler* (in BACnet, technically known as a *notification-class object*), which determines what operator workstations, pagers, remote sites, and email accounts are notified when an alarm occurs.

This method of generating alarms—with three components working in tandem—is efficient and flexible.



**Figure 4.1** BACtalk components work together to generate alarms. Global controllers include: BTI, BTI-100, and BCMS (which act like global controllers in the BACtalk system).

## About the monitored property

The monitored property is usually the present-value of an AV, BV, AI, BI, AO, or BO. Although an alarm can monitor any property of any object, these data points are most likely to indicate an alarm condition in your system. The monitored property can originate anywhere in the system, but it is good practice to have the global controller closest to the monitored property host the alarm setup.

## About the alarm setup

The alarm setup is saved in the host device (see “How alarms are saved and run” on page 61). The alarm setup stores a reference to the monitored property and stores the parameters that determine when the property is in alarm. When the alarm setup finds an alarm condition in the monitored property, it changes state. There are three possible states, and each one can have a separate set of rules for alarm handling. These states can be individually enabled or disabled for each alarm. The alarm handler uses these event states to determine where alarm notifications are sent and whether the notification needs to be acknowledged.

The three alarm states are:

- **Alarm (also, off-normal)** This is the most common alarm state. An *off-normal alarm* indicates that the monitored point does not conform to the alarm parameters set up for it. For example, the present-value of an AV is out of range or a BV has changed state.
- **Fault** Currently supported in the VLX and the VLCP only. This alarm state is related to the reliability property of BACnet objects. Although the monitored point is a BACnet object and property combination, this alarm state keys on the reliability property of the object alone. A fault alarm occurs when the reliability property of the monitored object is other than No Fault Detected.
- **Normal** This state indicates that the referenced property returned from off-normal to normal status. A property must return to normal before it can alarm, so this selection does not appear in the alarm setup and is always enabled.

## About the alarm handler

Each alarm in Envision for BACtalk has an alarm handler assigned to it. The alarm handler determines which devices are notified when an alarm occurs. These devices are called *alarm recipients*. Alarm recipients can include one or more of the following:

- An operator workstation
- A pager
- A remote BACtalk system
- An email account

The alarm handler maintains a list of *recipient profiles*. Each recipient profile determines the type (off-normal, fault, normal) of alarm the recipient accepts and the actions the recipient carries out. When you set up an alarm handler, you can select existing recipient profiles or set up new ones. Once you create a profile, any alarm handler can use it, and multiple profiles can be set up for a single recipient. Alarm handlers are saved to the Envision for BACtalk server and to the host device.

See “Setting up alarm handlers” on page 77 or Envision for BACtalk Help for information about setting up alarm handlers.



## Practical application

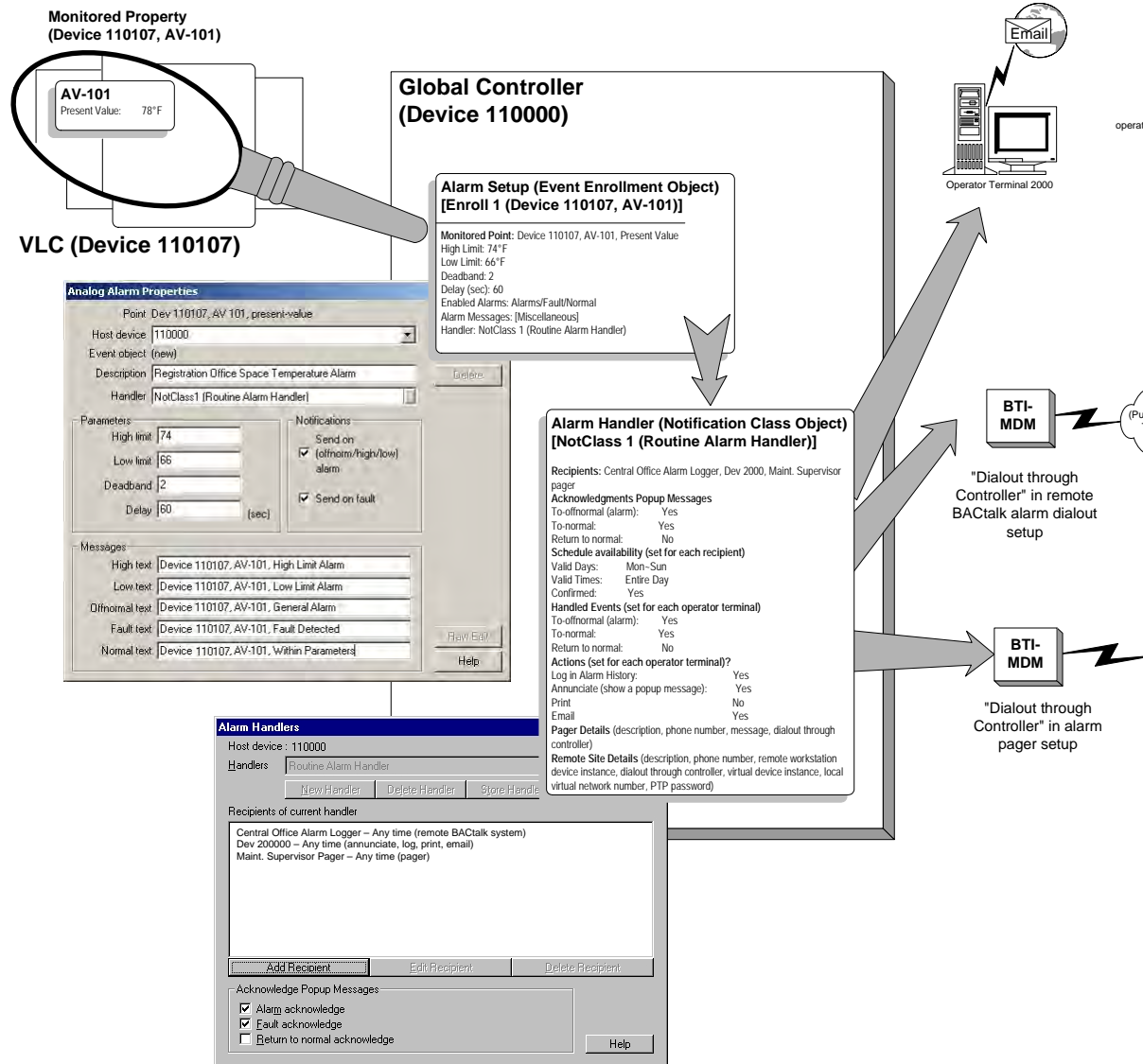
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As the lead facilities engineer in the Administration building, Marc has four technicians working for him. Marc himself is on site four 10-hour days, 8 AM to 7 PM, with Friday through Sunday off, and he is on call the rest of the time. Marc's daytime technicians work five days a week, 8 AM to 5 PM, Monday through Friday. Night crew technicians work 9 PM to 6 AM Wednesday through Sunday.

Marc has an on-call pager he uses off site. Marc also has his own operator workstation, which also functions as the Envision for BACtalk server. The technicians share two operator workstations, one in the facilities offices and the other in the central plant. There is also a roaming pager, which Marc carries when he is on site, and the shift lead carries otherwise.

Marc uses the alarm handlers and recipient profiles he sets up for all these devices to manage alarm annunciation and ensure that alarms get appropriate coverage.

---



**Figure 4.2** The alarm setup and alarm handler work together to monitor alarms and send out notifications.

## The importance of alarm descriptions and alarm messages

An alarm description is the name for the alarm setup and the alarm message is the text that is transmitted along with this description when an alarm occurs. Understanding the difference between these items and how to use them is an important aspect of alarm setup.

### Alarm descriptions

The alarm description appears in parentheses in listings of alarms, in alarm history records, and in Envision for BACtalk alarm messages.

In every case, the alarm description should include a pointer to the device and object where the alarm originates (for example, "Device 110114, AI 1"). In certain circumstances, the alarm description may be the only way to find the true source of the alarm.

**Note** In the Alarm Wizard, Envision for BACtalk calls this the Event Enroll Object Description. Because of the importance of the alarm source information, the Alarm Wizard allows you to use variables for the device instance and object ID. See "Using variables for alarm descriptions and messages" on page 67 for more information.

### Alarm messages

Alarm messages appear in alarm histories, BACnet Alarm Message dialog boxes, and email alarm notifications. Use alarm messages to characterize the alarm and to indicate in plain language where the alarm is coming from. Different alarm types have different messages you can set up for them. For example, analog alarms include high and low alarm text, and binary alarms have off-normal, fault, and normal alarm text.

**Note** The Alarm Wizard also lets you use variables for alarm messages. See "Using variables for alarm descriptions and messages" on page 67.

## About alarm delays

Each alarm setup includes the option for an alarm delay in seconds. When you set up an alarm delay, the alarm condition must exist for this period of time for an alarm to occur. If the alarm returns to normal within the delay time, no alarm occurs. For more information about using alarm delays, see "Use a Delay" on page 67.

## Types of alarms

There are five types of BACtalk alarms. The type of alarm you use depends on whether the monitored property is analog or binary.

- **Communications alarms**, which the BACtalk system automatically generates if a controller goes off-line
- **Binary alarms**, which occur on a simple change of state (ON-to-OFF, for example)
- **Command fail alarms**, which occur when two binary point values do not match
- **Fixed limit alarms**, which occur when an analog value is above or below fixed high or low limits
- **Floating limit alarms**, which occur when an analog value varies from a setpoint value by a certain amount

### About communications alarms

Communications alarms in Envision for BACtalk occur when the operator workstation attempts to communicate with a BACtalk device and the device does not respond.

**Note** See “Enabling device communication failure alarms” on page 317 for information about alarm annunciation when communication is lost between the operator workstation and a device.

The communications alarm returns to normal when another communication attempt with the device is successful.

**Note** Normal display update operations do not cause communications alarms. Activities such as background trendlog processing, saving and sending objects, and other processing operations prompt communications alarms if the device of interest is offline.

Alarm descriptions for communications errors in Envision for BACtalk use the following syntax:

**Dev** <HostDev>, **device** <OfflineDI> [<DevDesc>] (**Communications Error**)

Where:

<HostDev>	The alarm monitoring host device.
<OfflineDI>	The device instance for the device that was offline and caused the communications alarm.
<DevDesc>	The device description (from Device Manager) for the offline device.





## Example

---

Operator workstation 200000 reports a communications error with Device 110000, a BTI, with the description “BTI 110000 - Admin Bldg 11” set in Device Manager:

Dev 200000, device 110000 BTI 110000 - Admin Bldg 11  
(Communications Error)

Operator workstation 200000 reports a communications error with Device 110101, a VLC, with the description “Admin Bldg: VAV-11-101” set in Device Manager:

Dev 200000, device 110101 Admin Bldg: VAV-11-101  
(Communications Error)

---

### About binary alarms

For binary properties, the most common alarm condition to monitor is a change of state from active (ON) to inactive (OFF) or vice versa. You select the transition state that causes the alarm. This is listed as Type in the Alarm Wizard and as Alarm under Parameters in the Binary Alarm Properties dialog box.



## Practical application

---

Each air handling unit controller on campus has DDC associated with a differential pressure transducer. If the differential pressure across a filter is too great, a change filter alarm, BV-201, turns ON in DDC.

Marc has set up an alarm for each BV-201 to annunciate to the operator workstations when they occur. Because this is not a critical alarm, he does not assign his pager to the alarm handler for this alarm.

---

### About command fail alarms

A command fail alarm checks if a monitored property matches a command reference property. The reference property is called a Command reference property in the Alarm Wizard and Cmd point in the Command Fail Alarm Properties dialog box.

The properties to compare must originate from the same device.



### Practical application

The main parking garage at State U is located under the Administration building. It has 10 single-speed exhaust fans. Each fan is controlled by a VLC-550, numbered 110001 through 110010. A scheduled or manual fan ON command turns BO-1 on the VLC-550 ON. Each fan has a proof switch wired to input BI-1, and the proof switch is ON as long as the fan is actually operating.

Using the Alarm Wizard, Marc sets up a command fail alarm for each of the 10 BI-1s, and sets the command reference for each as BO-1. He sets up a delay of 60 seconds, and assigns a high-priority alarm handler to them so that he and the on-site technician get paged when the alarm occurs.

Figure 4.3 Command Fail Alarm Parameters dialog box

### About fixed limit analog alarms

For analog properties, the most commonly configured alarm type is an analog (fixed limit) alarm. For example, an alarm can occur if a space temperature goes above 74 degrees F (high limit) or below 66 (low limit) degrees F. An alarm occurs when the value of the monitored property exceeds the high limit or drops below the low limit.

Two factors further affect when the alarm is generated: a delay and a deadband. The monitored property must be in an alarm condition for the time indicated by the Delay setting before an alarm is generated. The deadband is subtracted from

the high limit and added to the low limit to control when the alarm returns to normal.



### Practical application

Marc showed his technician how the space temperature for the Registration Office within the Administration building might be set up as a fixed limit alarm and how the deadband setting worked for that type of alarm. He used a diagram to help explain the relationship between alarm settings and system performance.

Marc's diagram is shown in Figure 4.4. It shows a deadband setting of 2 with high and low limits of 74 degrees F and 66 degrees F, respectively. Marc also mentioned that this alarm had a delay of 60 seconds. When the temperature exceeds 74 degrees F, an alarm occurs (provided it remains there for at least 60 seconds). Because of the deadband, the alarm remains until the temperature is less than 72 degrees F. The same applies to the low limit: the alarm occurs at less than 66 and will return to normal only when the temperature is greater than 68. Marc stepped through the diagram from left to right, discussing each of the points called out in the diagram, to show the tech how the alarm generation was based on the monitored property and whether the temperature was moving up or down.

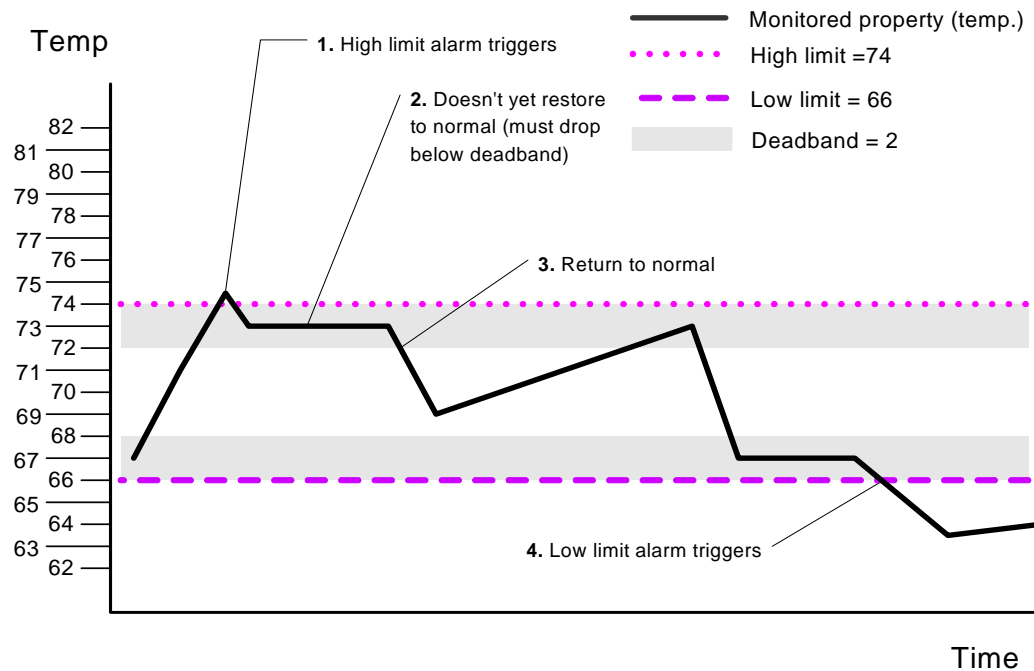


Figure 4.4 Understanding fixed limit analog alarms

### About floating limit analog alarms

A floating limit alarm compares a monitored analog property to an analog reference property, which is called the Setpoint reference property in the Alarm Wizard (SP Reference in the Analog Alarm Properties dialog box). If the

monitored property varies above or below the setpoint-reference property by the high limit offset or low limit offset values you specify, an alarm occurs.

The high limit offset is added to the value of the setpoint-reference property; the low limit offset is subtracted from it. A deadband value determines when the alarm returns to normal. The deadband value is added to the low limit equation and subtracted from the high limit equation.

The following equations describe offset and deadband logic.

Where:

**MP** = Monitored property

**SP** = Setpoint

**HL** = High limit offset

**LL** = Low limit offset

**DB** = Deadband

- If  $MP > SP + HL$ , a high limit alarm occurs.
- If  $MP < SP - LL$ , a low limit alarm occurs.
- If a high limit alarm has occurred and the value of **MP** subsequently changes such that  $MP < SP + HL - DB$ , the alarm returns to normal.
- If a low limit alarm has occurred and the value of **MP** subsequently changes such that  $MP > SP - LL + DB$ , the alarm returns to normal.

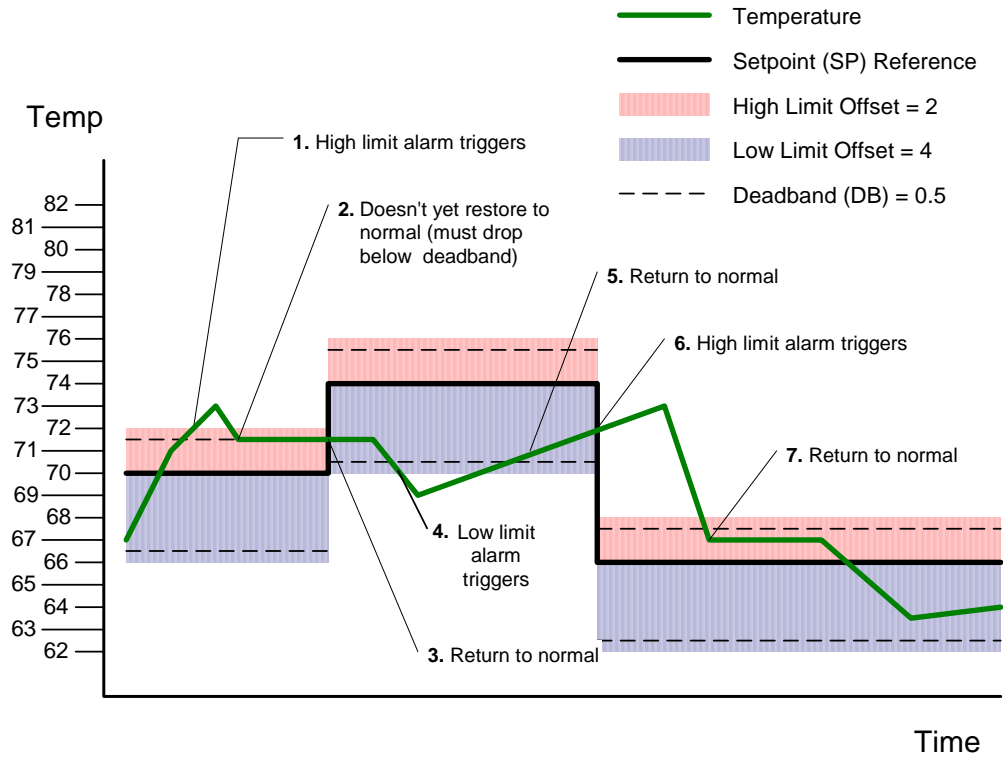


## Practical application

For the five biggest zones located in the Administration building, Marc has floating limit alarms set up that compare the actual space temperature in each zone to the setpoint. When showing one of his technicians how to set up a floating limit alarm, he found it hard to explain the high limit offset, low limit offset, and deadband and how they affect when an alarm occurs and when it returns to normal. The changing of the temperature and the setpoint were even getting him confused.

Once Marc created another diagram based on the equations, it became clear to him, and his tech got it right away. Marc's diagram is presented in Figure 4.5. He used the alarm setup for the space temperature in the Registration Office as his example.

The monitored property is set up as the space temperature for the Registration Office (Dev 110107, AV-101, present-value) and the setpoint reference property represents the space temperature setpoint (Dev 110107, AV-90, present-value). In the alarm setup, the high limit offset is set to 2 and the low limit offset is set to 4. The deadband is set to 0.5. Marc stepped through the diagram from left to right, discussing each of the points called out in the diagram, to show the tech how the alarm generation was based on the setpoint and whether the temperature was moving up or down.



**Figure 4.5** Understanding floating limit analog alarms

## How alarms are saved and run

When you create an alarm, the setup is saved to the Envision for BACTalk server and to the global controller that you select to host the alarm. Technically, BACnet identifies the alarm setup as an event-enrollment object. So when you see the alarm listed, its entry appears as Enroll <num> (<desc>), where <num> is a sequential number that the system automatically assigns and <desc> is the description you enter for the alarm.

When you create a new alarm, you select a global controller or building controller as the *host device*. The host device saves the event-enrollment object (the alarm setup) and the notification-class object (alarm handler) associated with it.

**Note** Envision for BACTalk can automatically assign a host device to a controller when you set up an alarm from a data display. Use the Preferences tab in Device Manager (BACTalk>Device Manager>[select device]>Edit>Preferences) to assign a default host for alarms to the selected controller.



## Setting up alarms

Envision for BACTalk offers three ways to set up an alarm:

- Right-click a dynamic item on a data display, and click **Alarms** on the shortcut menu. Use this when you are working with data displays.
- Click **Point Alarms** on the BACTalk >Alarms menu. Use this when you know the point whose alarm you want to set up or edit, but do not necessarily know where it is.
- Click **New Alarm Wizard** on the BACTalk >Alarms menu. Use this when you want to set up a range of alarms that are identical except for their addresses. This is usually used during initial system setup.

### Using the shortcut menu on a data display

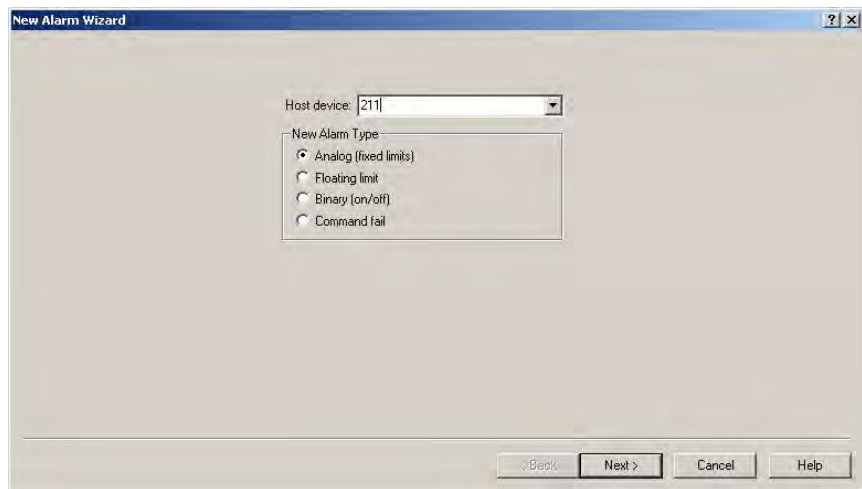
This is the most common way to set up an alarm in Envision for BACTalk. You do not need to know the ID of the object and property you want to monitor to set it up. All you need to do is right-click the item on a data display.

**Note** Right-click functionality for a display item must be enabled when the data display is edited and the item placed on it. If the Alarms selection does not appear on the shortcut menu when you right-click an item, this feature is not enabled for the item. see “Using shortcut menus to access automation features” on page 26 for more information on right-click functionality.



**Figure 4.6** Right-click an item to display the shortcut menu.

Only the types of alarms appropriate for the property's data type (analog or binary) are available.



**Figure 4.7** New Alarm Wizard dialog box

Select the type of alarm you want to set up, and then set alarm parameters. See the topics on specific alarm setups later in this section.

## Using Point Alarms on the BACtalk menu

Use Point Alarms (BACtalk>Alarms>Point Alarms) when you want to edit the parameters of an existing alarm and you know the alarm description. For example, you want to change the recipients of an alarm.

You can also use this feature to set up a new alarm for the present-value of an object when you know the device instance and object that you want to monitor (for example, Device 110107, AI-1), but you do not necessarily know where to find it on a data display.

When you open the Point Alarms dialog box, Envision for BACtalk lists the alarms set up for a host device in your system. Alarms are listed by the device instance and object where the monitored property originates (for example, Dev 110107, AI-1).

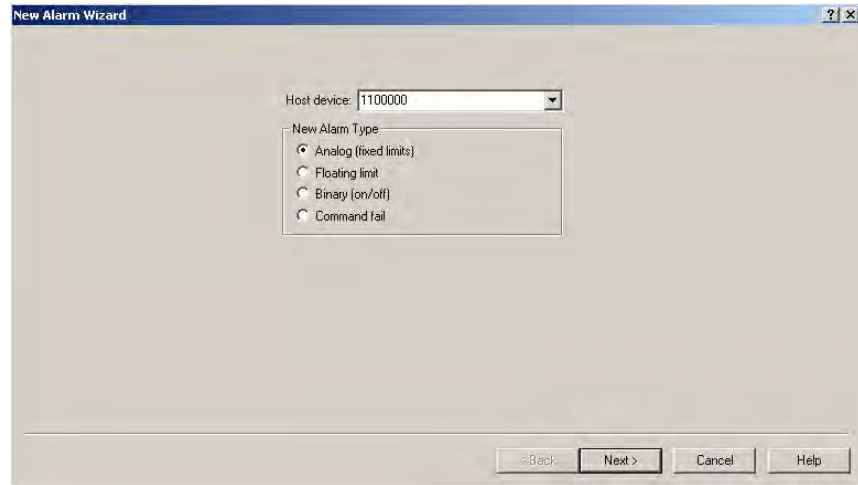
## Using the New Alarm Wizard

Use the New Alarm Wizard to conveniently set up alarms for the same properties in a range of devices with the same I/O and application configuration. The Alarm Wizard creates an alarm setup for each of the properties and saves them in a host device.

**Note** If the system includes a BCM-WEB, follow these naming conventions for alarm handlers:

- the alarm handler object name must begin with “Alarm Handler”
- the default alarm handler object name must begin with “Default Alarm Handler”

**Select the host device where alarm setups will be saved** The host device is the global controller where you want the alarm setups saved when you finish. For Marc, this is the BTI with device instance 110000. If the controller appears in Device Manager, its device instance appears in the list (see Figure 4.9 on page 65); otherwise, you can type the device instance directly in the box.



**Figure 4.8** Specify the host device and the type of alarm you want to set up on the New Alarm Wizard dialog box.

See “How alarms are saved and run” on page 61 for more information.

If a host device does not appear in the list of available devices, the capabilities in Device Manager may not be set up correctly. For more information about device capabilities, see Help and the *Envision for BACtalk Installation and Startup Guide* (LTBT-TM-ADMIN26).

The following practical application illustrates how to use the New Alarm Wizard to create alarms for several devices at once.



### Practical application

State U’s Administration building has 90 identical VAV boxes. Each has a controller set up with the same I/O and application configuration. Marc needs to create alarms for each of them so that an alarm triggers if the current (actual) airflow varies from the desired airflow by more than 40 cfm. This tells him that the VAV damper is not performing to expectations. He wants these alarms sent to his operator workstation and logged in Alarm History. Setting up each alarm in

the Point Alarms dialog box or through data displays takes time so Marc uses the New Alarm Wizard. Marc gathers the following information before he begins:

- Each floor has 30 VAV box controllers (floors 1 through 3).
- VAV box controllers have device instances in the range 110101-110130 (floor 1), 110201-110230 (floor 2), and 110301-110330 (floor 3). Device instances increment by ones (110101, 110102, . . . , 110130).
- All VAV boxes have a global controller with device instance 110000 as their host device.
- In all VAV boxes, the current airflow is read as the present-value of AI-10.
- In all VAV boxes, the desired airflow is written in the application as AV-4.

When Marc starts the New Alarm Wizard, he first selects the type of alarm to set up. Because he needs to compare one analog value to another, he selects **Floating limit** under New Alarm Type (Figure 4.7 on page 63).

**Select the range of devices to monitor** The Floating Limit Alarm Parameters dialog box appears. In the Starting device instance and Ending device instance boxes, Marc types the range of devices that he wants to monitor for an alarm condition. For the Starting Device Instance, he types 110101. For the Ending Device Instance, he types 110130 (floor 1 only). The Spacing value is the number by which the device instances increment, in this case, 1. (The default is 1.)

The host device where the alarm setups are saved.

Type the range of devices that you want to monitor for an alarm condition.

Select the monitored property and the setpoint reference property.

Select the alarm handler to use for alarms of this type.

Starting device instance: 110101		Host device: Dev 110000	
Ending device instance: 110130		Alarm handler: Dev 110000, NotClass 2 (Routine Alarm Handler)	
Spacing: 1			
Monitored property		Setpoint reference	
Property	< Delete	Property	Spacing
1 AI 10	< Delete	Dev 110000, AV 4	0
2	< Delete		0
3	< Delete		0
4	< Delete		0
5	< Delete		0
6	< Delete		0
7	< Delete		0
8	< Delete		0

**Figure 4.9** Floating Limit Alarm Parameters dialog box of the New Alarm Wizard

**Select an alarm handler that sends an alarm message to the operator workstation** Marc wants the alarms sent to his operator workstation. He clicks the small button beside the Alarm Handler box to select an alarm handler that is stored in the host device (see Figure 4.9).

If an alarm handler already exists that sends a message to Marc's operator workstation, he can select it from the Handlers list, and the operator workstation will appear under Recipients of the current handler. If one does not exist, he can create a new alarm handler. See "Setting up alarm handlers" on page 77 for more information.

**Select the monitored property and the setpoint-reference property** The monitored property is the current airflow, which is AI-10. The setpoint reference is the desired airflow, which is AV-4. Marc clicks the small button beside each box, and then selects the properties in the Object Specification dialog box (see Figure 4.9 on page 65).

**Select offset values** Offsets determine how far the monitored property must vary from the setpoint reference for an alarm to occur. This is 40 cfm both above and below the desired airflow, so Marc types 40 in each of the boxes, leaving the deadband at 0.

	Monitored property	High limit offset	Low limit offset	Deadband
1	AI-10	40	40	0
2				
3				
4				
5				
6				
7				
8				

**Deadband** Determines when the alarm returns to normal. The deadband is subtracted from the high limit and added to the low limit.

**Low limit offset** The monitored property must be less than the value of the setpoint reference minus this number for a low limit alarm to occur.

**High limit offset** The monitored property must be greater than the value of the setpoint reference plus this number for a high limit alarm to occur.

**Figure 4.10** Select offset values for the alarm.

**Use variables for the description** The Event enroll object description is the alarm description. This is what will appear in alarm listings for each of the alarms. The Alarm Wizard allows variables to represent the device instance and property because these references may not be static ("Device 110101," for example, will not apply to all 90 devices). Marc leaves the default of %3, %4. See "Using variables for alarm descriptions and messages" on page 67 for a description of variables you can use. See Figure 4.11 on page 67.

**Use a Delay** The alarm condition must exist for a minimum number of seconds (called the *delay*) before an alarm occurs. Marc types a delay of 60 seconds to prevent nuisance alarms when airflow anomalies exist. He leaves Notify on alarm and Notify on fault checked. Clearing Notify on alarm effectively disables the alarm.

Monitored property	Event enroll object description	Delay [sec]	Notify on alarm	Notify on fault
1 AI 10	%3, %4	60	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	%3, %4	0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3	%3, %4	0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4	%3, %4	0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
5	%3, %4	0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6	%3, %4	0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
7	%3, %4	0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
8	%3, %4	0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

**Notify on fault** Enables fault alarms.

**Notify on alarm** Enables off-normal alarms.

**Delay** Time delay in seconds. If an alarm condition occurs and returns to normal within this delay time, no alarm occurs.

**Event-enrollment object description** Each alarm needs a unique description. You can use variables to represent device and property specifics. Click **Help** for more information. Make sure the alarm description includes information about the property that caused the alarm.

**Figure 4.11** Type alarm description (or variables) and set a delay for your alarm.

**Type alarm text** Marc types the alarm text to appear under alarm (off-normal) conditions. He also types the high and low limit alarm text. Like the description, he can use variables in these alarm messages. See the following section for more information.

When Envision for BACtalk creates the alarm setups, it also saves them in the host device (BTI global controller 110000 in this case). Marc can use the Point Alarms dialog box to confirm creation of the alarms. They are named according to the monitored device instances and objects.

## Using variables for alarm descriptions and messages

The Alarm Wizard can build multiple alarms for multiple objects and properties in multiple devices. For this reason, static alarm descriptions and alarm messages that include a device instance or property will not apply. For example, if you use the Alarm Wizard to set up a return air alarm for seven fan-coil controllers numbered 110001 through 110007, and type an alarm description of “Device 110001, AI-3, Return Air Alarm,” it will not be accurate for devices 110002 through 110007.



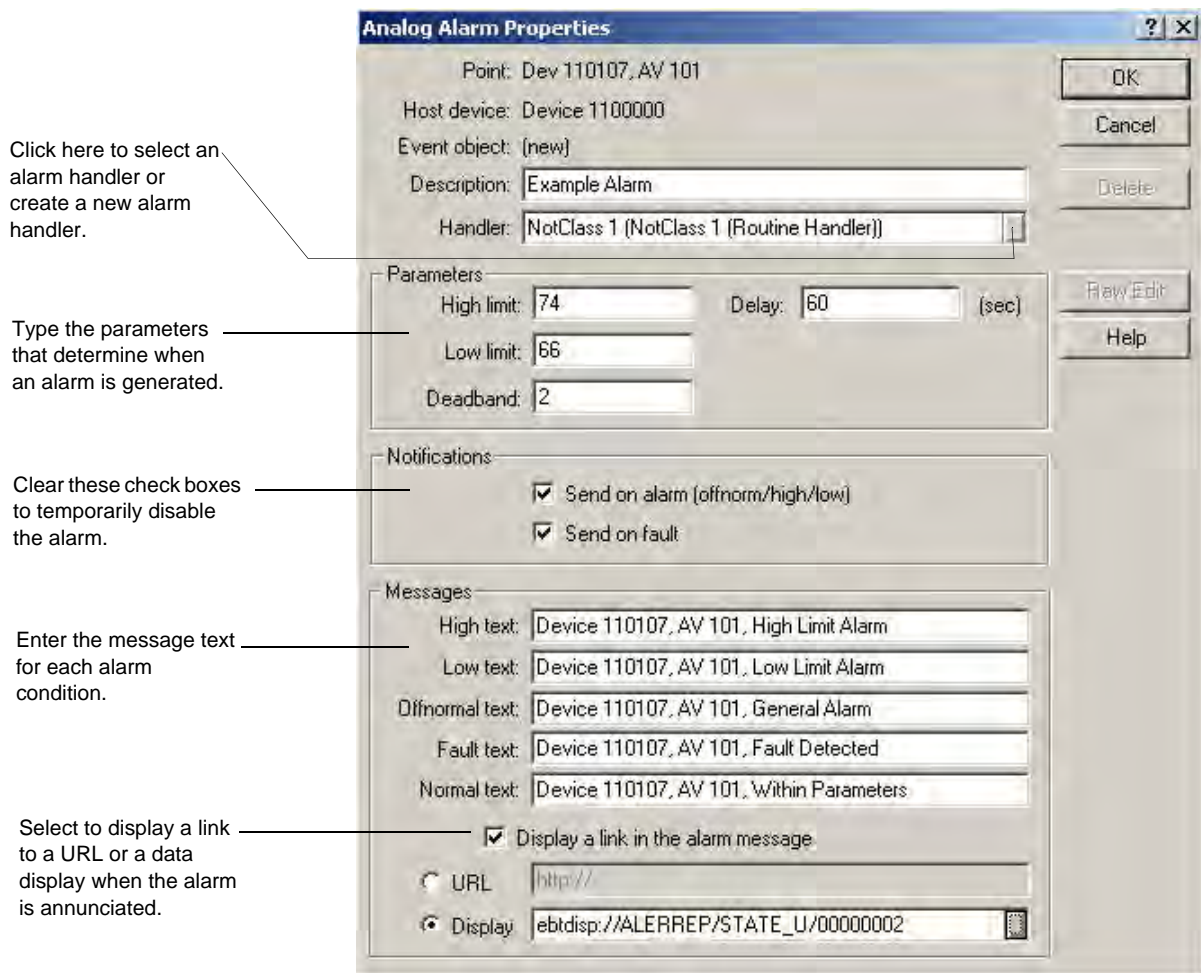
To help you set up multiple alarms, the Alarm Wizard provides variables you can use in alarm descriptions and alarm messages. By using these variables, you can write a description or message for a range of alarms and include vital information about the origin of the alarm, without having to edit each alarm setup individually. You can mix variables and plain text.

**Table 4.2** Variables for use in alarm descriptions and messages

Variable	Adds this to each alarm description or message
%1	The device instance of the monitored property. Example: 110006.
%2	The monitored object, property, and the description of the property in parentheses. Example: AI 3, present-value (return air temp).
%3	The device instance of the monitored property, preceded by the word "Device" and followed by the device's description in parentheses. Example: Device 110006 (Fan-Coil 6 Controller). Included in the default description.
%4	The monitored property without the property's description. Example: AI 4, present-value. Included in the default description.
%5	The device description of the monitored property. Example: Fan-Coil 6 Controller. If the description is empty, returns Device <device instance>. For example, Device 110006.
%6	The description of the object containing the monitored property. Example: return air temp. If the description is empty, returns the monitored object and property. Example: AI 5, present-value.

## Setting up fixed limit analog alarms

Set up a fixed limit alarm to ensure that the value of a monitored property stays within a defined range. If the monitored property exceeds the high limit or drops below the low limit, an alarm occurs. See page 58 for an example of how fixed limit alarms can be used.



**Figure 4.12** Analog (fixed limit) Alarm Properties dialog box set up so the alarm will display a link to a STATE\_U job data display.

### Point

The monitored point is the status or value that the alarm watches for an alarm state. This is the point you selected from a data display or from the Point Alarms dialog box.

### Event object

Envision for BACtalk automatically assigns this description of the event-enrollment object when a new alarm setup is saved. See “How alarms work” on page 50 for more information about the event-enrollment object.

### Description

The alarm description you type here appears in lists and alarm messages. See “The importance of alarm descriptions and alarm messages” on page 54 for more information.

### Handler

Every alarm must be assigned an alarm handler. The alarm handler controls where the alarm is sent, for example, to an operator workstation or a pager. See “Setting up alarm handlers” on page 77 for more information about alarm handlers and recipients.

### Parameters

These parameters determine when the alarm occurs. See “About fixed limit analog alarms” on page 57 for details.

**High limit** If the monitored point value goes above this limit, a high limit alarm occurs. If a delay is set, the alarm does not occur until the delay time has passed and only then if the alarm condition still exists.

**Low limit** If the monitored point value goes below this limit, a low limit alarm occurs. If a delay is set, the alarm does not occur until the delay time has passed and only then if the alarm condition still exists.

**Deadband** Type a deadband value here to establish a range in which no change occurs. The deadband value is subtracted from the high limit and added to the low limit to determine when the alarm returns to normal. For example, if the high limit is 85 and the deadband is 5, the alarm returns to normal at 79. Between 80 and 85, no change occurs.

**Delay** This setting represents the number of seconds an alarm condition must exist before an alarm occurs. Use the delay to prevent alarms from occurring too frequently due to operating anomalies.

### Alarm notifications

As a general rule, leave both of these check boxes enabled. To temporarily disable an alarm, you can clear both check boxes.

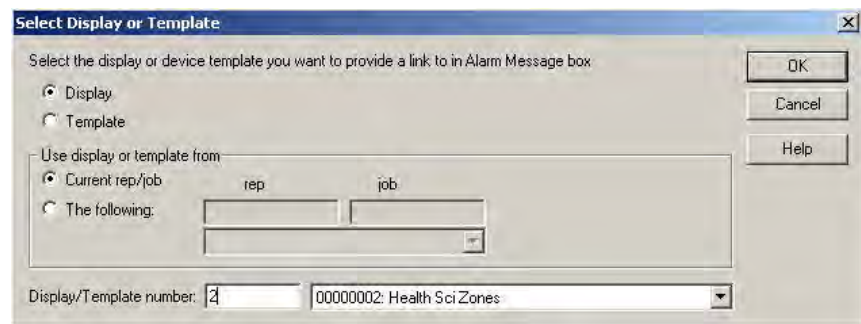
### Alarm messages

Type the alarm messages you want to appear when an off-normal alarm occurs, when a fault alarm occurs, and when the alarm returns to normal. Use high- and low-limit alarm text for analog alarms. See “The importance of alarm descriptions and alarm messages” on page 54 for details.

## Setting up a URL notified or display linked alarm

Set up alarms (global feature in the Alarm Setup and in each alarm) to display a link to a specified URL or BACtalk display or template when the alarm is annunciated. For example, display a URL to a camera view of a door or zone that is in an alarm state to visually check out the alarm condition before travelling to the location. Use the Alarm Properties dialog box (BACtalk>Alarms>Point Alarms) to select either a URL link or a link to a data display (this option is cleared by default). Then use the Select Display or Template dialog box to set up

the link that will display when the alarm is annunciated at an operator workstation.



**Figure 4.13** This alarm will display a link to the Health Sci Zones data display when it is annunciated at the BACTalk operator workstation.

**Note** URL notified alarms can also be set up using the New Alarm Wizard (BACTalk>Alarms>New Alarm Wizard) or the Event Enrollment Editor (Tools>Advanced >Event Enrollment>General tab).

### Working with URL notified alarms

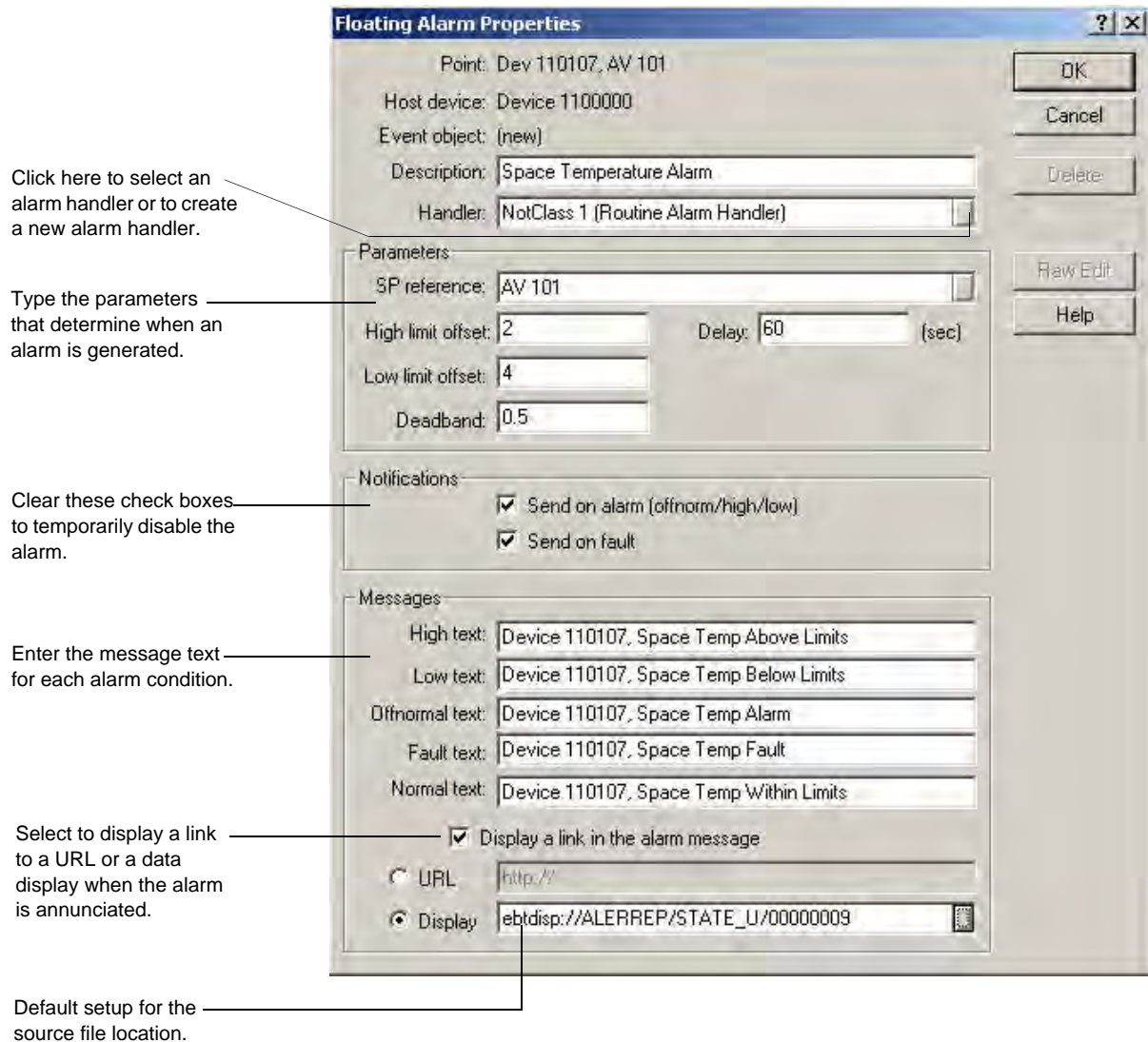
Envision for BACTalk processes URLs with an http prefix only until you select an option in the Alarm Setup dialog box (BACTalk>Alarms>Alarm Setup) that instructs the system to process all URLs. You can also select an option to automatically open the specified URL associated with an alarm when it is annunciated, instead of just displaying the link.

**Note** Selecting “Automatically open URL links when alarm messages are processed” on the Alarm Setup dialog box opens alarms in a browser window outside the control of Envision for BACTalk. Therefore, you must explicitly close the browser window when you are done viewing it.

**Note** See page 87 for more information about using the Alarm Setup dialog box.

## Setting up floating limit analog alarms

Set up a floating limit alarm to compare a monitored analog property to a setpoint reference property. See page 59 for an example of how floating limit alarms can be used.



**Figure 4.14** Analog (floating limit) Alarm Properties dialog box set up so the alarm will display a link to a STATE\_U job data display.

### Point

The monitored point is the status or value that the alarm watches for an alarm state. This is the point you selected from a data display or from the Point Alarms dialog box.

### Event object

Envision for BACtalk automatically assigns the description of the event-enrollment object when a new alarm setup is saved. See “How alarms work” on page 50 for more information about the event-enrollment object.

## Description

The alarm description you type here appears in lists and alarm messages. See “The importance of alarm descriptions and alarm messages” on page 54 for more information.

## Handler

Every alarm must be assigned an alarm handler. The alarm handler controls where the alarm is sent, for example, to an operator workstation or a pager. See “Setting up alarm handlers” on page 77 for more information about alarm handlers and recipients.

## Parameters

These parameters determine when the alarm occurs. See “About floating limit analog alarms” on page 58 for details.

**Setpoint (SP) reference** Select the setpoint-reference property you want to compare to the monitored analog property. If the monitored property varies above or below this setpoint reference by the values specified for the high limit or low limit offsets, an alarm occurs. You can specify an external device point for SP reference when the alarm host supports BACnet event-enrollment objects.

**High limit offset** Type the value to add to the setpoint-reference property to determine if the monitored property is out of the desired range. If the monitored point value goes above this limit, a high limit alarm occurs. If a delay is set, the alarm does not occur until the delay time has passed and only then if the alarm condition still exists.

**Low limit offset** Type the value to subtract from the setpoint-reference property to determine if the monitored property is out of the desired range. If the monitored point value goes below this limit, a low limit alarm occurs. If a delay is set, the alarm does not occur until the delay time has passed and only then if the alarm condition still exists.

**Deadband** The deadband value establishes a range in which no change occurs. The deadband value is added to the low limit equation and subtracted from the high limit equation to determine when the alarm returns to normal.

**Delay** This setting represents the number of seconds an alarm condition must exist before an alarm occurs. Use the delay to prevent alarms from occurring too frequently due to operating anomalies.

## Alarm notifications

As a general rule, leave both of these check boxes enabled. To temporarily disable an alarm, you can clear both check boxes.

## Alarm messages

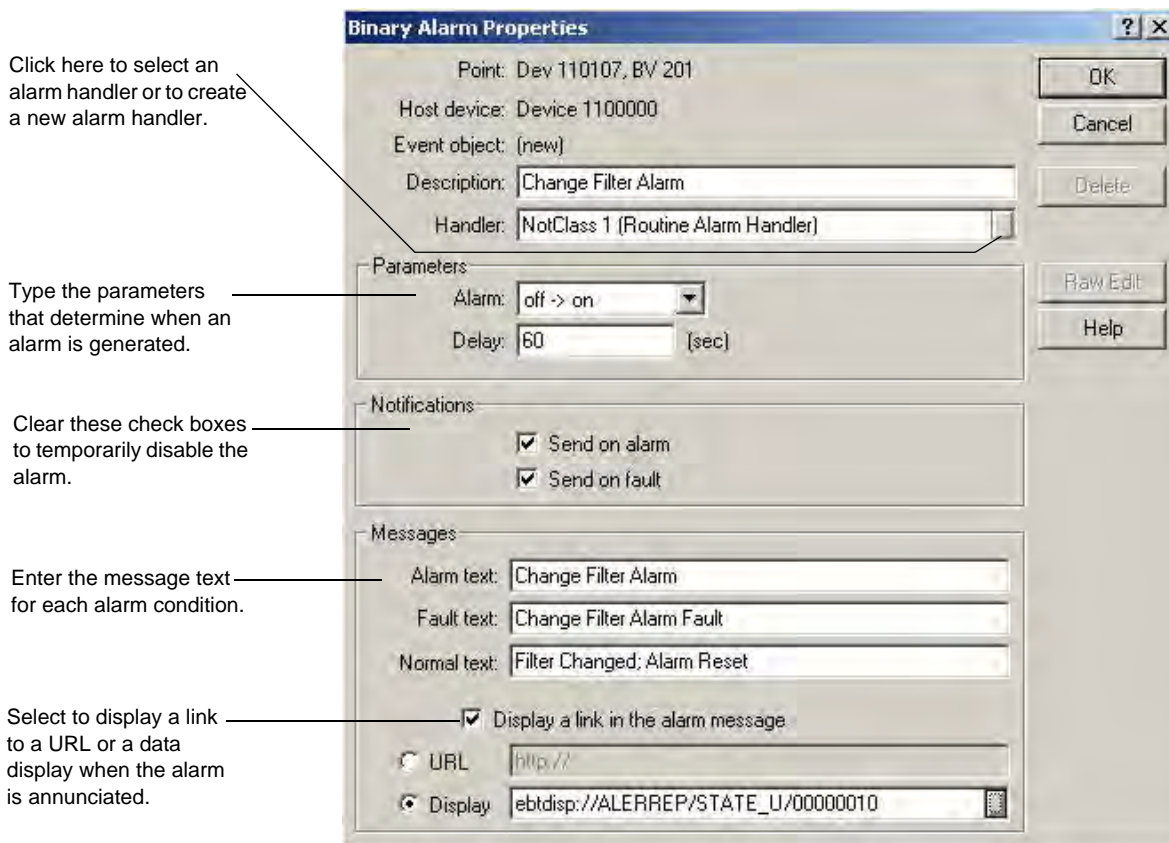
Type the alarm messages you want to appear when an off-normal alarm occurs, when a fault alarm occurs, and when the alarm returns to normal.

**Note** See “Working with URL notified alarms” on page 71 for more information about setting up a URL-notified or display linked alarm.



## Setting up binary (on/off) alarms

Set up a binary alarm to monitor the status of a binary point. See page 56 for an example of how this type of alarm might be used.



**Figure 4.15** Binary Alarm Properties dialog box set up so the alarm will display a link to a STATE\_U job data display.

### Point

The monitored point is the status or value that the alarm watches for an alarm state. This is the point you selected from a data display or from the Point Alarms dialog box.

### Event object

Envision for BACtalk automatically assigns the description of the event-enrollment object when a new alarm setup is saved. See “How alarms work” on page 50 for more information about the event-enrollment object.

### Description

The alarm description you type here appears in lists and alarm messages. See “The importance of alarm descriptions and alarm messages” on page 54 for more information.

### Handler

Every alarm must be assigned an alarm handler. The alarm handler controls where the alarm is sent, for example, to an operator workstation or a pager. See

“Setting up alarm handlers” on page 77 for more information about alarm handlers and recipients.

### **Parameters**

These parameters determine when the alarm occurs. See “About binary alarms” on page 56 for details.

**Alarm** Select the change of state that causes an alarm. Options are OFF (inactive) to ON (active) or ON to OFF.

**Delay** This setting represents the number of seconds an alarm condition must exist before an alarm occurs. Use the delay to prevent alarms from occurring too frequently due to operating anomalies.

### **Alarm notifications**

As a general rule, leave both of these check boxes enabled. To temporarily disable an alarm, you can clear both check boxes.

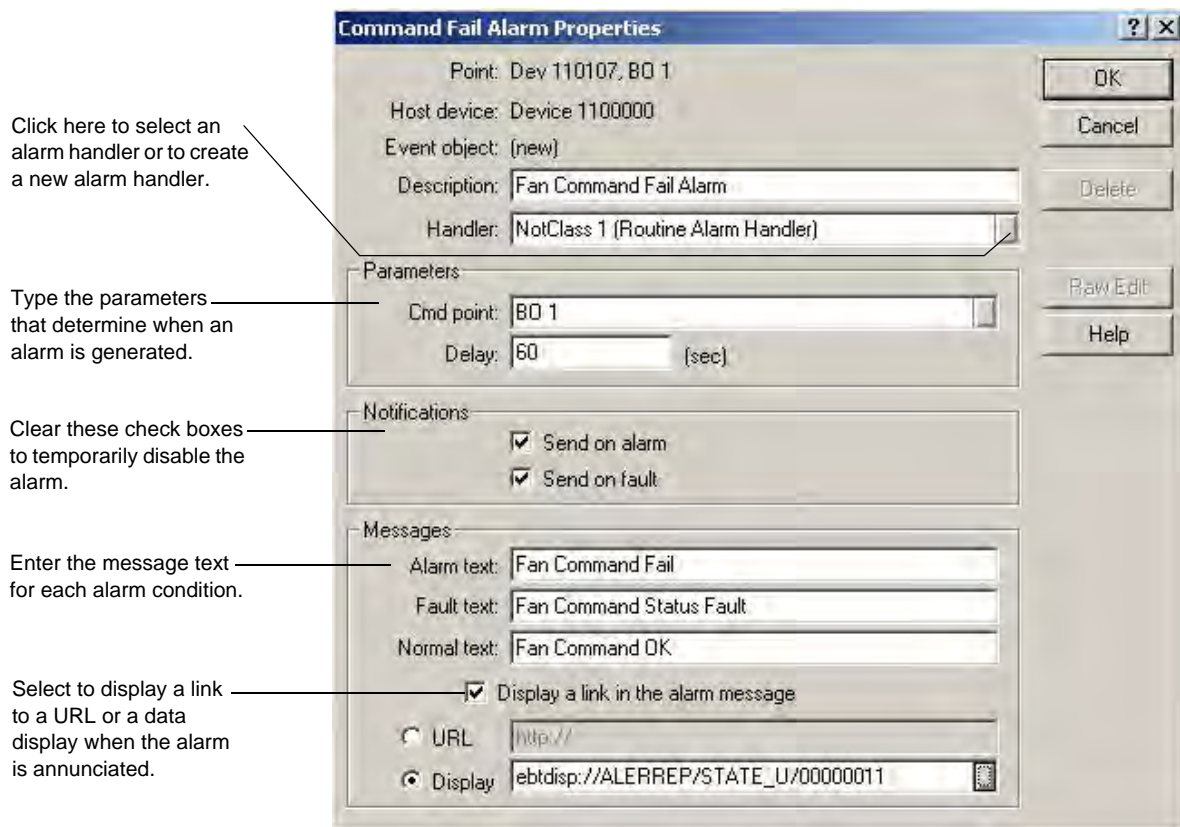
### **Alarm messages**

Type the alarm messages you want to appear when an off-normal alarm occurs, when a fault alarm occurs, and when the alarm returns to normal. See “The importance of alarm descriptions and alarm messages” on page 54.

**Note** See “Working with URL notified alarms” on page 71 for more information about setting up a URL-notified or display linked alarm.

## Setting up a command fail alarm for binary points

Set up a command fail alarm to compare the value of the monitored property (point) to a command-reference property value. If they don't match, an alarm occurs. See page 57 for an example of how this type of alarm might be used.



**Figure 4.16** Command Fail Alarm Properties dialog box set up so the alarm will display a link to a STATE\_U job data display.

### Point

The monitored point is the status or value that the alarm watches for an alarm state. This is the point you selected from a data display or from the Point Alarms dialog box.

### Event object

Envision for BACtalk automatically assigns the description of the event-enrollment object when a new alarm setup is saved. See “How alarms work” on page 50 for more information about the event-enrollment object.

### Description

The alarm description you type here appears in lists and alarm messages. See “The importance of alarm descriptions and alarm messages” on page 54 for more information.

## Handler

Every alarm must be assigned an alarm handler. The alarm handler controls where the alarm is sent, for example, to an operator workstation or a pager. See the next section for more information about alarm handlers and recipients.

## Parameters

These parameters determine when the alarm occurs. See “About command fail alarms” on page 57 for details.

**Cmd point** Select the command point to which you want to compare the value of the monitored point. When they do not match, an alarm occurs. You can specify an external device point for Cmd points when the alarm host supports BACnet event-enrollment objects.

**Delay** This setting represents the number of seconds an alarm condition must exist before an alarm occurs. Use the delay to prevent alarms from occurring too frequently due to operating anomalies.

## Alarm notifications

As a general rule, leave both of these check boxes enabled. To temporarily disable an alarm, you can clear both check boxes. Currently, the Fault setting is inconsequential. See “About the alarm setup” on page 51 for details.

## Alarm messages

Type the alarm messages you want to appear when an off-normal alarm occurs, when a fault alarm occurs, and when the alarm returns to normal. See “The importance of alarm descriptions and alarm messages” on page 54 for details.

## Setting up alarm handlers

Alarm handlers maintain a list of recipient profiles and provide a centralized method of setting up and configuring alarm recipients. Alarm handlers determine how alarm messages are broadcast, how alarm printing happens, and how alarm logging happens.

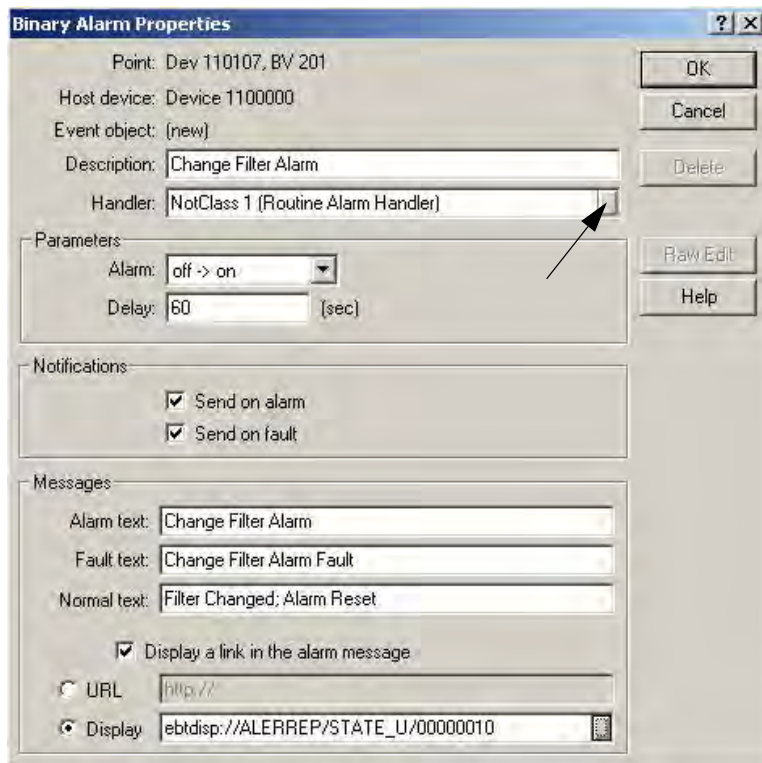
**Note** Because you can assign an alarm handler to any number of alarms, it makes sense to set up a limited number of alarm handlers for different classes of alarms.

There are three ways you can start the Alarm Handlers module to edit alarm recipients:

- On the BACtalk menu, point to **Alarms**, and then click **Alarm Handlers**. Select or type the device instance of the controller where the alarm handler is saved. You can create a new alarm handler or select an existing handler to edit.

**CAUTION** If you edit alarm handlers this way, make sure you know which alarms the alarm handler is assigned to. Otherwise, you may inadvertently change how an alarm is handled.

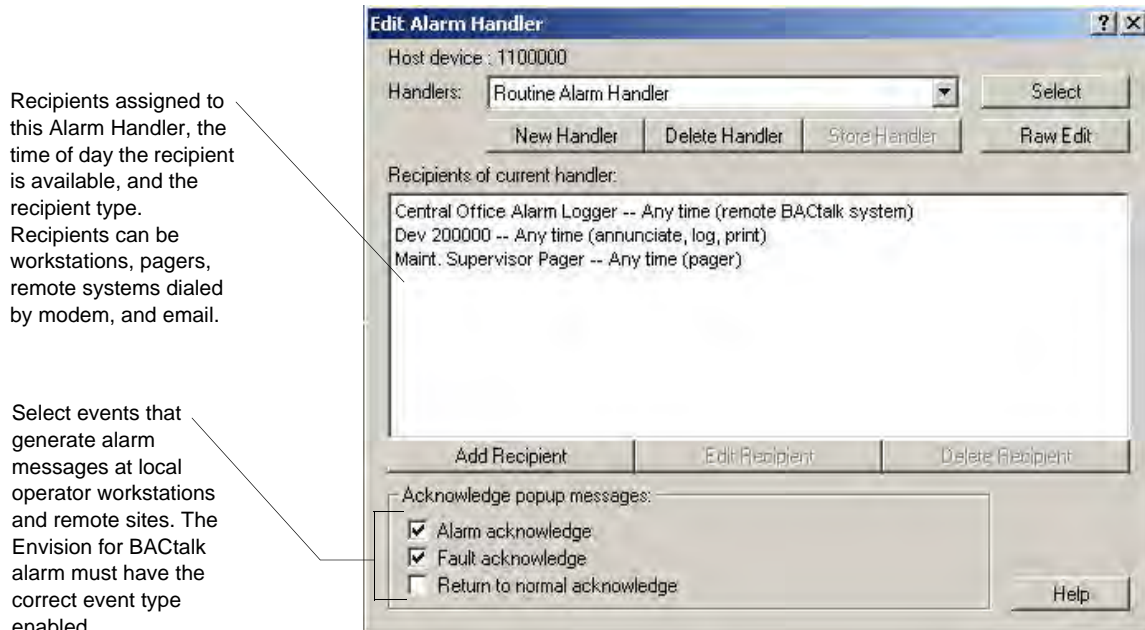
- In the Alarm Properties dialog box, click **Handlers**, and then select an existing alarm or set up a new binary alarm from the Point Alarms dialog box (BACtalk>Alarms>Point Alarms).



**Figure 4.17** Binary Alarm Properties dialog box

- Create or edit alarm handlers as a step in the Alarm Wizard. For more information, see “Using the New Alarm Wizard” on page 63.

Use the Edit Alarm Handler dialog box to edit an alarm handler and its recipients.



**Figure 4.18** Edit Alarm Handler dialog box

The Handlers list shows available alarm handlers; the New Handler and Delete Handler buttons enable you to manage alarm handler setups. This list and these buttons are available only if you edit alarm handlers using the New Alarm Wizard or Point Alarms dialog box (a Select button also appears instead of a Done button). Otherwise, use the Alarm Handler Editor dialog box to manage alarm recipients and popup message acknowledgments.

### Reading an alarm handler's recipient list

After you select an alarm handler to work with, its recipients appear in the Recipients of current handler list. You can select a recipient profile from the list and edit its setup. You can also create new profiles.

The recipient listing shows:

- The type of recipient (pager, operator workstation, remote BACTalk system, or email).
- The description of the recipient profile. For operator workstations, this is the description assigned in the Device Manager. For pagers, remote systems, and email, this description is assigned in the recipient setup.
- The availability of the recipient (for example: any time or Mon...Fri, 8:00AM...5:00PM).
- For Envision for BACTalk front ends, the actions performed at the operator workstation (annunciate, log, or print).



### Choosing alarm messaging options for an alarm handler

Select these check boxes if you want Envision for BACtalk alarm messages to appear at recipient operator workstations and remote operator workstations. (You must also enable the acknowledge action in the recipient profile.) By default, the Return to normal acknowledge check box is cleared so no alarm messages appear when an alarm returns to normal.

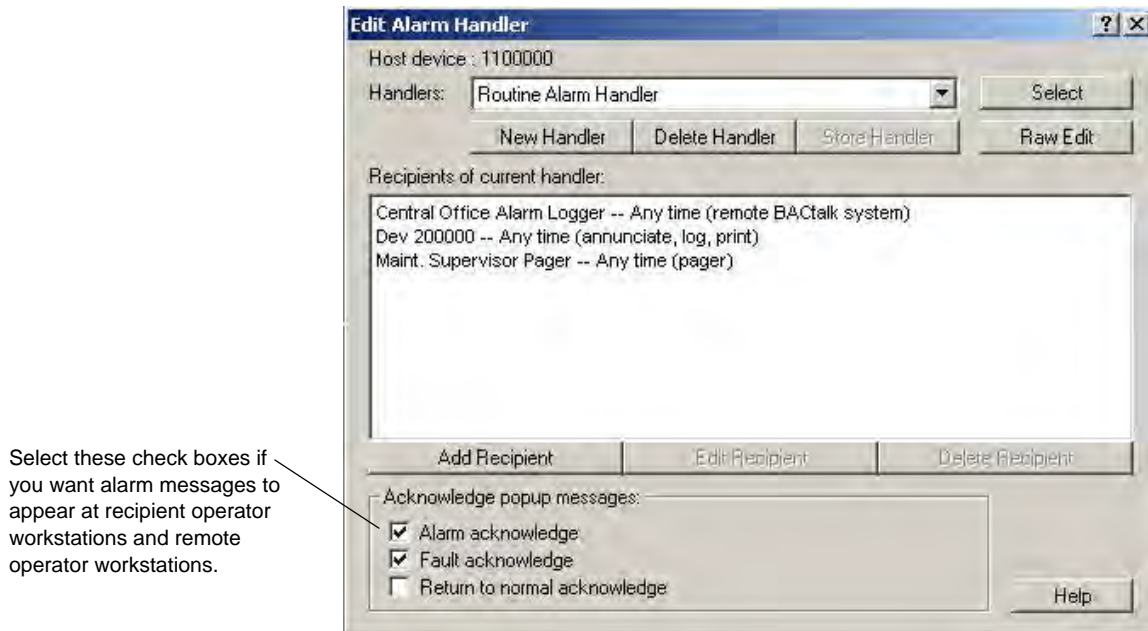


Figure 4.19 Edit Alarm Handler dialog box

### Setting a single recipient to be available at different times

To make a single recipient available on different days or at different times of the day, you create multiple recipient profiles for the same alarm recipient. For each recipient profile, you set a unique schedule. You can also set up different handling details.

### Setting a recipient to be available at different times for different types of alarms

To create different handling for different alarm states, you create multiple recipient profiles. Within each profile, you set up the types of events the recipient handles. You can combine schedules and handled events to create powerful alarm strategies.

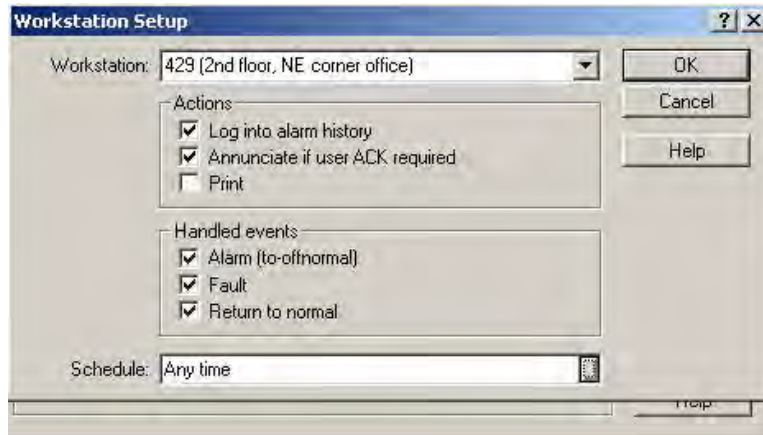
### Setting up operator workstation recipients

Use the recipient profile for an operator workstation to set up how an onsite operator workstation treats alarms (BACtalk>Alarms>Alarm Handlers>Add/Edit>Add Recipient>Local workstation). You set up the alarm states and notifications that the operator workstation receives, the actions the operator workstation takes upon receipt, and its scheduled availability.

For operator workstations, each profile for each alarm handler is unique. Edits to one profile do not affect others. You can set up multiple recipient profiles for a single operator workstation (even within a single alarm handler) depending on

how you want the operator workstation to handle different alarms. Handled events include: alarm (to-offnormal), fault, and return to normal.

On the Workstation Setup dialog box under Actions, select the actions you want the operator workstation to perform when it receives an alarm.



**Figure 4.20** Workstation Setup dialog box with default options selected.

**Table 4.3** Possible workstation responses to an alarm

Select	To
Log into alarm history	Log the alarm in the operator workstation's alarm history database. See "Working with alarm histories" on page 93 for details about the contents of a log entry.
Annunciate if user ACK required	Display an alarm message at the operator workstation. Make sure you also select the types of alarms (off-normal, fault, or return to normal) for which you want an alarm message to appear (see "Setting up alarm handlers" on page 77). See "How alarms work" on page 50 for details about the elements of an Envision for BACtalk alarm message.
Print	Prints the contents of the alarm message. The same information that appears on an Envision for BACtalk alarm message is printed.  The Main Alarm Setup at the recipient operator workstation (see "Using Alarm Setup at an operator workstation" on page 87) must have printing enabled and a printer selected.

### Setting up pager recipients

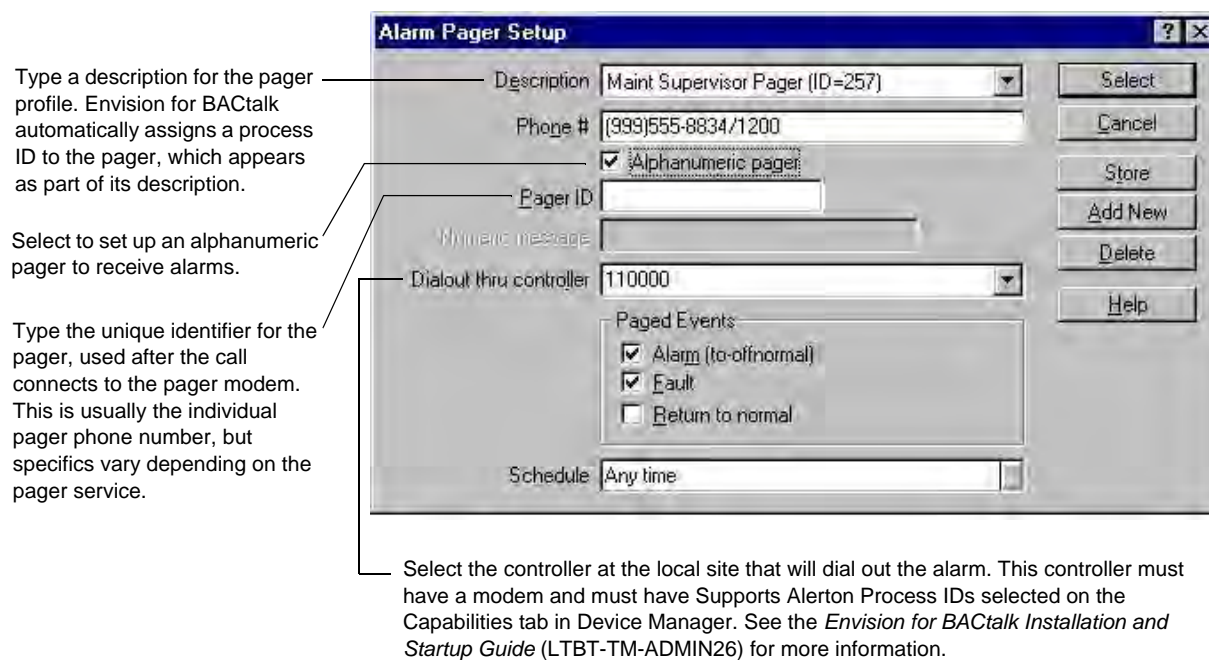
The recipient profile for a pager enables you to set up an alphanumeric or digital pager to receive alarms (Alarm Handlers>Add/Edit>Add Recipient>Pager). Each recipient profile is unique. You can set up multiple profiles for a single device (even within a single alarm handler) depending on how you want the device to handle different alarms. Edits to one profile do not affect others.

**Note** If you set up two or more pagers in the Alarm Pager Setup dialog box to dial out through two or more different controllers, and then switch between the

two pager setups, the dial out through controller information will not automatically update.

**Alphanumeric pagers** Envision for BACtalk can send alarm messages, which are typed under Messages in the Alarm Wizard or Point Alarms dialog box, along with other alarm information, to alphanumeric pagers. Alphanumeric pagers display all information that appears in an Envision for BACtalk alarm message at the operator workstation.

**Note** Alphanumeric pagers are dialed only once for each recipient profile.

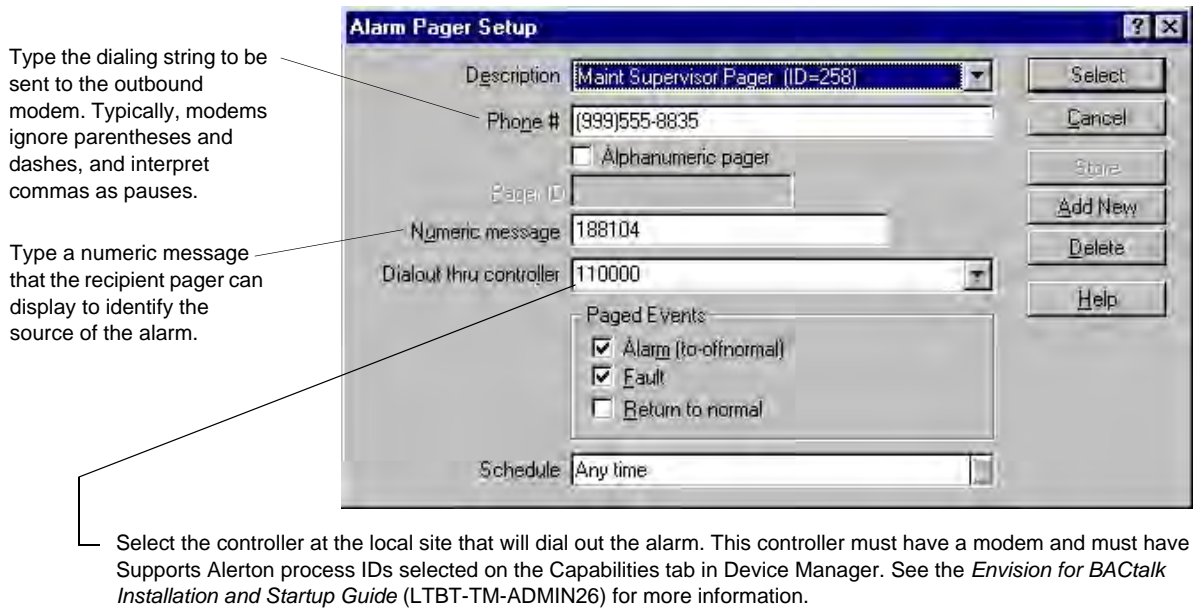


**Figure 4.21** Setting up a pager recipient profile in the Alarm Pager Setup dialog box

If an extended period of handshaking (the audible squealing a modem emits) occurs but the paging service never receives the alarm, add a /NNNN to the end of the “Phone # string” (where NNNN is the baud rate supported by the paging service—this value can be either /300, /1200, or /2400) in the Alarm Handler’s “Alarm Pager Setup” dialog box. This forces the global controller’s modem to communicate at NNNN baud rate when connecting to the paging system. For example, if the phone number to the paging service is 18002223333, and the service supports 2400 baud rate connections, the amended phone number string should read 18002223333/2400.

**Standard (digital) pagers** Standard pagers require a single phone number, which rings the pager directly. Optionally, you can specify a numeric message, which is passed to the pager. This enables you to assign a specific code to an alarm, so the pager recipient can learn the source of the alarm from the numeric message.

**Note** Digital pagers are dialed only once for each recipient profile.



**Figure 4.22** Alarm Pager Setup dialog box

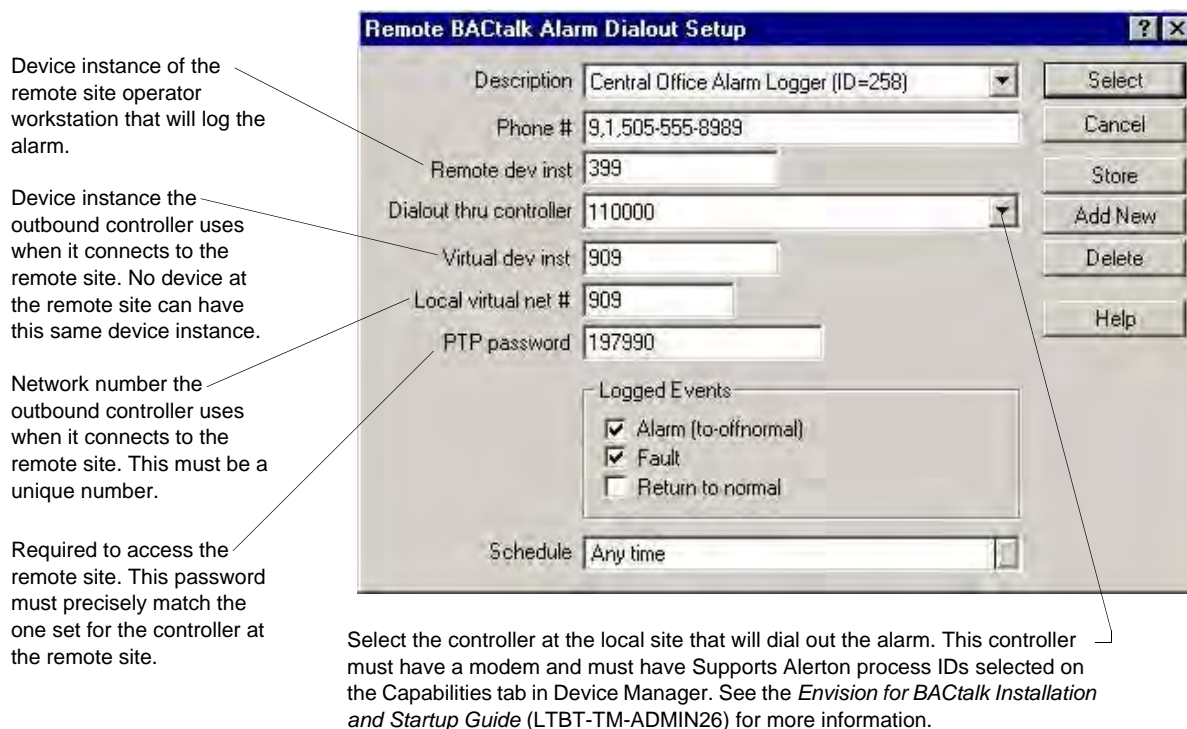
### Setting up remote site recipients

You can set up an alarm to dial out from a global controller modem at an originating BACTalk site to a global controller modem at a recipient site (BACTalk>Alarms>Alarm Handlers>Edit>Add Recipient>Remote BACTalk system thru controller modem). An operator workstation at the remote site logs alarm messages to the remote alarm history. You can print alarms from within the alarm history. The remote operator workstation cannot annunciate or print the alarm on receipt.

This arrangement enables a single operator workstation at a centralized, remote location to log alarms from a number of geographically dispersed sites. The operator workstation at the remote site must be on and running Envision for BACTalk.

**Note** Envision for BACTalk supports such connections only between global controller modems—a global controller at the originating site dials a global controller modem at the remote site, which then forwards the alarm to the operator workstation at the remote site.

Each recipient profile is unique. You can set up multiple profiles for a single device (even within a single alarm handler) depending on how you want the device to handle different alarms. Edits to one profile do not affect others.



**Figure 4.23** Remote BACTalk Alarm Dialout Setup dialog box

### Setting up email recipients

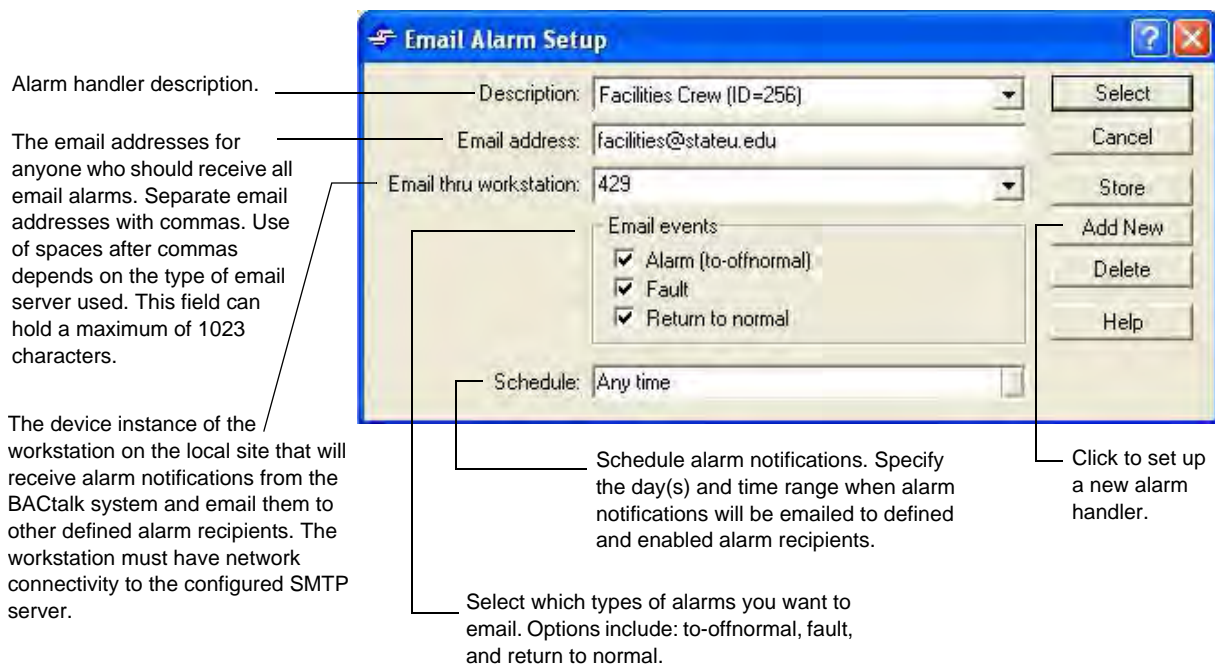
You can set up a BACTalk workstation to email an alarm notification to one or more email recipients. Emailed alarm messages include the type of alarm and other text that appears in pop-up alarm notifications. Setting up email alarm notifications involves setting up the alarm, configuring the alarm handler, and specifying an email server.

**Setting up an alarm** To configure an alarm for email notifications, on the Alarm Setup page (BACTalk>Alarms>Alarm Setup), select **Send email** to email recipients. Click **Email Settings...** and then specify the From, CC, and BCC email addresses. Use commas between email addresses when setting up multiple recipients. The From email address appears as the sender of alarm notifications. CC and BCC recipients will receive copies of all email notifications. BCC recipients' email addresses will not be visible to other recipients.

**Configuring an alarm handler** To configure the alarm handler, open the Edit Alarm Handler dialog box (see "Setting up alarm handlers" on page 77), click **Add Recipient**, and then select **Email**. The Email Alarm Setup dialog box appears. Type the recipient email address(es) separated by commas. Define the BACTalk workstation that will send out email alarms. Select a workstation with



network connectivity to an SMTP email server. Select the events for which alarms will be generated. Specify the schedule for alarm notifications.



**Figure 4.24** Set up for sending email alarms to the facilities group at State U

**Specifying an email server** To specify an email server, click **General System Setup** on the **Tools** menu and then select the **Email Setup** tab. Type a server host name or IP address and then specify a time-out. You may need to consult with site IT professionals to get these settings. Specify authentication settings and test the connection. See the associated online Help for more detail.



## Practical application

Marc has three alarm handlers set up for the State University Administration building. One of these handlers is assigned to each alarm. He is organized them by severity and named the alarm handlers accordingly:

- Emergency alarm handler
- High-priority alarm handler
- Routine alarm handler

By doing this, Marc can change assignments within an alarm handler and have it carried out for all alarms of that type. This is handy if something in the system changes. For example, Marc got a new pager, and he now has to update the system to dial it. He also just installed a new technician's operator workstation in the mechanical room, and he needs to set it up to receive high-priority and routine alarms.

For **emergency alarms**, Marc wants his pager dialed during off hours. He also wants the on-site pager dialed at all times, an alarm message to pop up on all



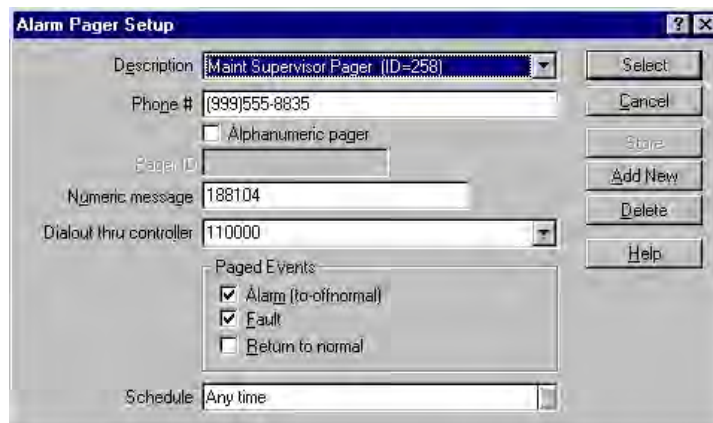
operator workstations, the server to send out email alarm notifications, and the alarm logged to the alarm history file on the server.

For **high-priority alarms**, Marc wants the on-site pager dialed at all times, an alarm message to pop up on all operator workstations, the server to send out email alarm notifications, and the alarm logged to the alarm history file.

For **routine alarms**, Marc wants alarm messages to appear at the two technician operator terminals and the alarm logged to the alarm history file so he can follow up at the end of the week.

To do this, Marc sets up the following recipient profiles:

- A recipient profile for his pager
- A recipient profile for the on-site pager
- A recipient profile for the server (Device Instance 200000)
- A recipient profile for the office tech workstation (Device Instance 200001)
- A recipient profile for the mechanical tech workstation (Device Instance 200002).



**Figure 4.25** Alarm Pager Setup dialog box

### About alarm dialout

For each pager or remote site recipient to be dialed, the BACtalk system dials only once. The system pauses two minutes before dialing the next recipient on the list. All recipients on the list are dialed each time an alarm occurs until the alarm is acknowledged.

## Using Alarm Setup at an operator workstation

You use the Alarm Setup dialog box (BACtalk>Alarms>Alarm Setup) to set up the following alarm items for an operator workstation. These are global settings that apply to all alarms as appropriate.

- The site description passed to alarm pagers and remote-site alarm loggers (if alarm dialout is set up)
- Alarm printing specifics (if the operator workstation will host alarm printing)
- Order for alarm display on the operator workstation: oldest on top or newest on top
- Default handling for inbound alarms that have no handling specified
- Alarm set up for displaying a link to a URL or a data display

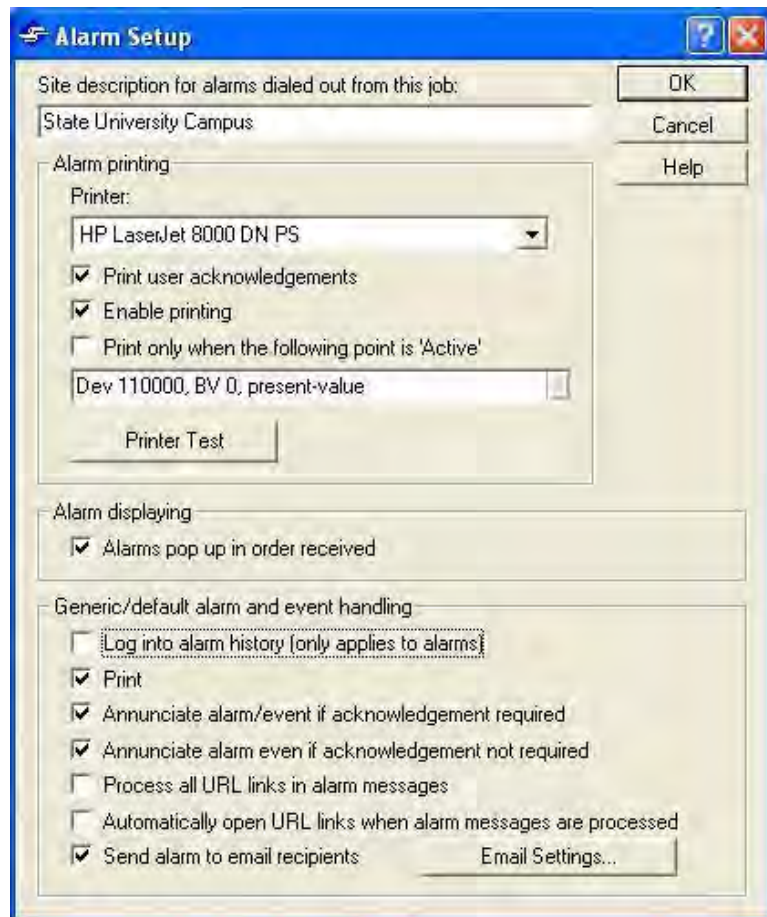


Figure 4.26 Alarm Setup dialog box

### Site description

The site description is sent along with alarm information when BACtalk dials an alarm to an alphanumeric pager or a remote BACtalk system. Make sure you choose a description that uniquely identifies the site for transmitted alarms. If no alarms dial out, you can leave the site description blank.

## Alarm printing

Use the items under Alarm Printing to designate the printer that Envision for BACtalk uses to print alarms.

**Printer** Click the arrow and then select a printer from the list. Only printers set up through the Printers utility in the Windows Control Panel are available (see Microsoft Windows documentation for more information).

**Print user acknowledgements** Select this check box if you want Envision for BACtalk to print alarm messages when they are acknowledged by the user (see “Reading BACtalk alarm messages” on page 90). The recipient profile and type of alarm are irrelevant in this case.

**Enable printing** Select this check box if you want Envision for BACtalk to print alarms received at this operator workstation upon receipt. The recipient profile used to transmit the alarm must have printing enabled as well.

**Print only when the following point is active** Select this check box to use a data point to control printer availability. Click the command button to select the point, typically a BV. This point can be scheduled or manually controlled. Alarms print when the point is active (ON) or when the point cannot be read.

**Printer test** Be sure your printer is connected and online, and then click this button to test your printer options and setup.

## Alarm displaying

Use this check box to set the stacking order of alarm popup windows. When the box is selected, the most recent alarm is displayed behind older alarms that have not yet been acknowledged. If the box is cleared, the most recent alarms are displayed on top. After selecting an option, the active alarm messages are resorted accordingly.

## Generic/default alarm and event handling

Most alarms and events broadcast with some sort of handling specified (using a BACnet notification class). However, alarms and events occasionally may arrive without handling instructions. Specify what you want the operator workstation to do when this happens.

**Table 4.4** Alarm Setup dialog box—user-specified alarm handling options

Item	Remarks
Log into alarm history (only applies to alarms)	Select to log all alarms with no handling specified into alarm history
Print	Select to print all alarms that have no handling specified.
Annunciate alarm/event if acknowledgement required	Select to annunciate events that have the “ack required” flag set.

**Table 4.4** Alarm Setup dialog box—user-specified alarm handling options

Item	Remarks
Annunciate alarm even if acknowledgement not required	Select to annunciate all events even if the “ack required” flag is not set. Applies only to alarms that do not use a BACtalk alarm handler (that is, with process IDs in the range 0-7 or 10-127).
Process all URL links in alarm messages	Select to translate URL text into live links.
Automatically open URL links when alarm messages are processed	Select to go to a URL when the alarm is processed.
Send alarm to email recipients	Select to email an alarm message to specified and configured recipients.

**Note** See “Working with URL notified alarms” on page 71 for more information about setting up URL-notified or data display linked alarms.

**Enable email alarms** Select **Send Alarm to Email Recipients**, and then click **Email Settings** to open the Email Setup for Alarms dialog box. Specify how the alarm origination information should be displayed, and then specify the email addresses where you want alarm notifications to be emailed. Note that the email recipients entered here are in addition to recipients set up in the Alarm Handler setup (

Specify the To: email addresses of all the users you want to receive the emailed alarm. Specify the From: email address, and email that will always be carbon copied (cc:). Blind copy (bcc:) users you want to receive alarms but whose email information you do not want displayed. Use commas between email addresses when setting up multiple recipients.

Email settings for alarms must be configured (BACtalk>Alarms>Alarm Setup), email must be added as an alarm recipient (BACtalk>Alarms>Alarm Handlers>Add/Edit>Add Recipient>Email) before alarms can be successfully emailed.

## Working with alarms

Alarms are an important component of your BACtalk system. You need to be able to recognize and read alarms to use this powerful feature effectively.

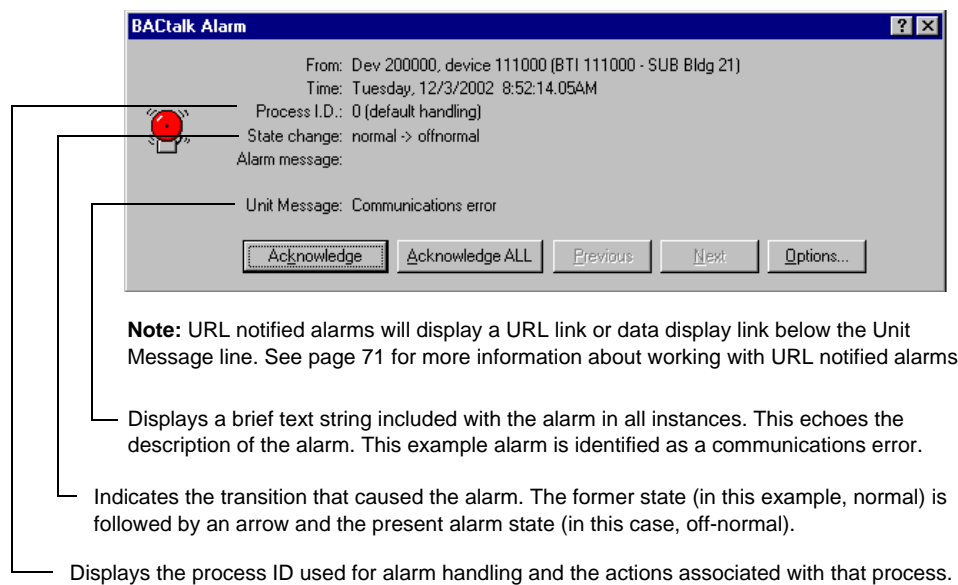
### Reading BACtalk alarm messages

Most alarms are set up to require a user acknowledgment at an operator workstation through an alarm message. The alarm message can appear when an alarm or fault occurs, or when an alarm returns to normal.

The following conditions must be met for an alarm message to appear at an operator workstation:

- The monitored property must go into a state that triggers an alarm, as determined by the alarm setup. See “How alarms work” on page 50 for more information about alarm components.
- The alarm setup must have the corresponding alarm state enabled: Off-normal, Fault, or Normal.
- The alarm handler must be set up to require a user acknowledgment for the alarm state that occurs.
- The alarm handler for the alarm must have the operator workstation listed as a recipient.
- The operator workstation’s recipient profile must be set up to handle the alarm state that occurs and to annunciate it.

An alarm message conveys substantial information about when, where, and why an alarm occurred.



**Figure 4.27** BACtalk alarm message

Buttons along the bottom of the alarm message allow you to manage active alarm messages.

**Table 4.5** Alarm message buttons

Button	Function
Acknowledge	Acknowledges the present alarm. This can be either the most recent or least recent alarm, depending on how the alarm display feature is set up. see “Using Alarm Setup at an operator workstation” on page 87 for more information. This acknowledges the alarm at this operator workstation only.
Acknowledge All	Acknowledges all alarms at once. This closes all alarm messages without allowing the user to read the message.
Previous	Scrolls back through the alarm messages. This can be an earlier or later alarm, depending on how the alarm display feature is set up. see “Using Alarm Setup at an operator workstation” on page 87 for more information.
Next	Scrolls forward through the alarm messages. This can be a later alarm or earlier alarm, depending on how the alarm display feature is set up. see “Using Alarm Setup at an operator workstation” on page 87 for more information.
Options	Opens the Main Alarm Setup dialog box. You can set the printing, display, logging, and annunciation of alarms and events here. see “Using Alarm Setup at an operator workstation” on page 87 for more information.

**WARNING** Acknowledging an alarm in no way ensures that the alarm condition has returned to normal. Use alarm history to check if an alarm condition still exists. If the alarm has not returned to normal, no entry appears in the “End” column. See Figure 4.29 on page 93.

### Alarm notices on data displays

In addition to the alarm message at an operator workstation, alarm notices appear on your site displays for properties that are in alarm. The alarm message appears enclosed in asterisks after the current (or last obtained) value or status of the data point. By default, most alarm notices appear in red; however, the system developer selects the color when setting up the item.

Analog data point alarms on a data display



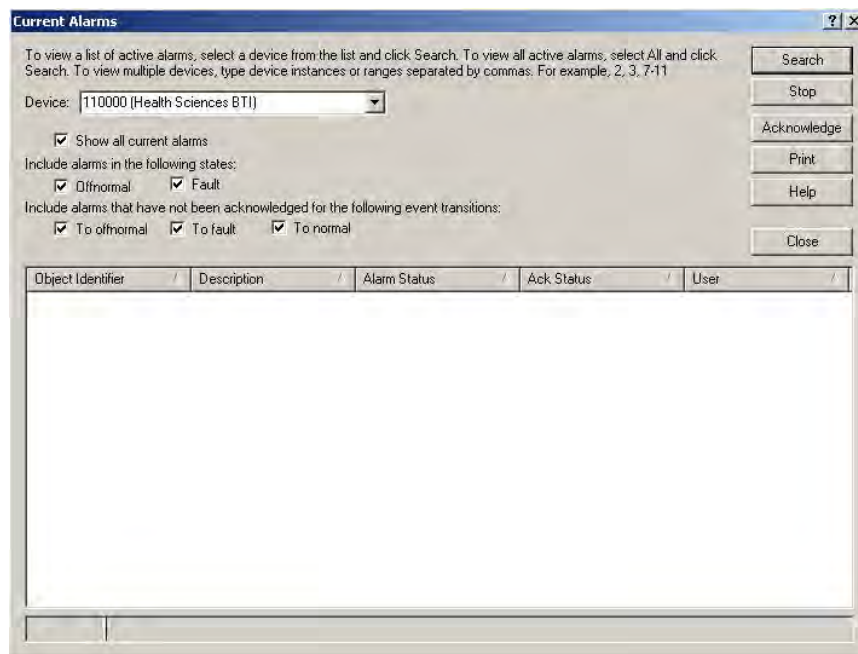
Binary data point alarms on a data display





## Working with Current Alarms view

Current Alarms view allows you to view a list of alarms that are not currently in a normal state and alarms that have returned to a normal state but have not been acknowledged (BACtalk>Alarms>Current Alarms). This view enables you to select one or multiple alarms at once and acknowledge them.



**Figure 4.28** View a list of alarms not in normal state and alarms that have returned to normal state without being acknowledged in Current Alarms view.

Select a device from the drop down list and then click **Search** to view a list of current alarms stored in that device. Or, select **All devices** and then click **Search** to view a list of all alarms and all alarms that have returned to normal without having been acknowledged.

**Note** Click **Search** to refresh displayed data after acknowledging an alarm. Check the Alarm History window for a complete list of alarms that have been logged. These include both entries that have and have not been acknowledged.

**Note** In order for a device to be scanned, the appropriate capabilities must be selected on the device's Capabilities tab in Device Manager.

Use the check box options on the Current Alarms dialog box to specify the types of alarms to view (all current alarms, offnormal, fault, and unacknowledged alarms).

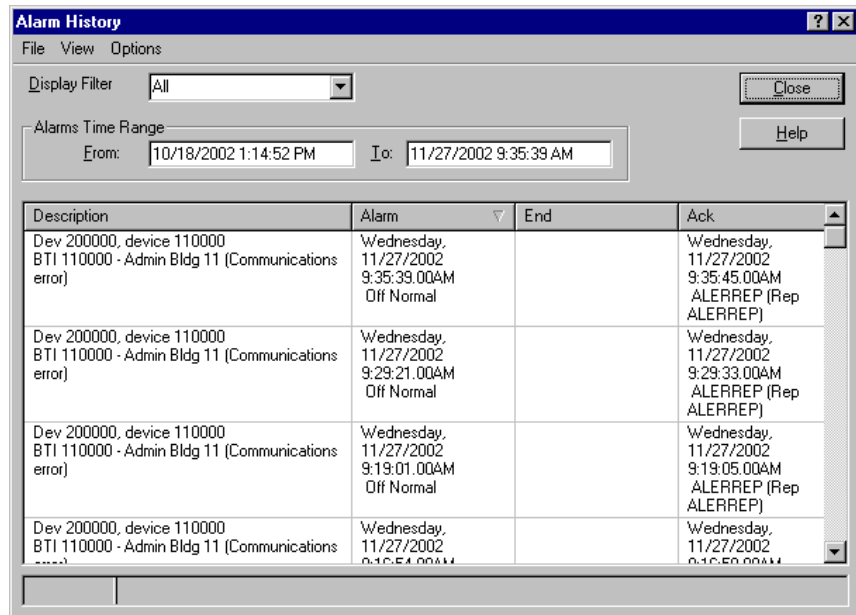
The Current Alarms list includes informative data columns about each alarm: object identifier, alarm description, alarm state, whether or not the alarm was acknowledged, and the name of the user that acknowledged the alarm if it was acknowledged and has been logged at the Envision for BACtalk server. These columns have "clickable" headings so you can sort and customize the Current Alarms view to better serve your needs.

Use the Print button to send a list of current alarms to a printer.

## Working with alarm histories

Alarm history records (BACtalk>Alarms>Alarm History) show critical information about the alarms that have occurred in your system. To refresh alarm history records, press F5. Select the alarm types you want to view from the Display Filter list, and then select the date range to view under Alarms Time Range. To clear records or print the history, use the File menu.

To be logged in alarm history, the alarm handler for the alarm must be set up to broadcast to this operator workstation. Select **Log Into Alarm History** under **Actions**. See Figure 4.20 on page 81 for more information.



**Figure 4.29** The Alarm History dialog box displays a description of the device in alarm, the date and time the alarm occurred, when it returned to a normal state, and when and by whom the alarm was acknowledged.

### Display filter

Select the types of alarms to view. Only the selected types will be displayed.

### Viewing Current or Archived Data

View current alarm data or select an archive record from the drop-down menu to display it.

**Note** Archived files are saved to the server.

### Alarm history view time interval

Type in a new date and time range to view other archived data. Refresh the window to update the display window.

### Description

This column lists both the device instance (usually a global controller) where the alarm is stored, and the alarm description set up when the alarm was created. For communications alarms, the origin and logging device are recorded.

## Alarm

This column lists the date and time the alarm occurred with the alarm type immediately below it. This same information appears in the Envision for BACtalk Alarm Message box (if applicable). See Table 4.6 on page 94 for more information.

**Table 4.6** Alarm types and when they occur

Alarm Type	Remarks
Off-normal	The most common type of alarm. Generated when an alarm status changes from normal to off-normal (called an event transition).
Fault	Generated when the alarm finds the monitored data point's reliability property to be in a fault state (other than No Fault Detected).
High/Low Limit	Applies to analog values. High limit indicates the present-value of the object has exceeded its assigned high limit. Low limit indicates the present-value of the object dropped below its assigned low limit.

## End

The time that the original event state that caused the alarm changed—either returned to normal or to some other state.

**Note** If the End field is blank, the original alarm condition still exists.

## Ack (Local alarm history only)

The time that the operator clicked **Acknowledge** on the Envision for BACtalk alarm message box and the user ID of the operator. If blank, the alarm was either set up with no acknowledgment or has yet to be acknowledged.

## Site: rep/job, description (Remote alarm history only)

These fields identify the source of the alarm. The site description is established in the Main Alarm Setup at the remote site, and the rep and job further pinpoint the source.



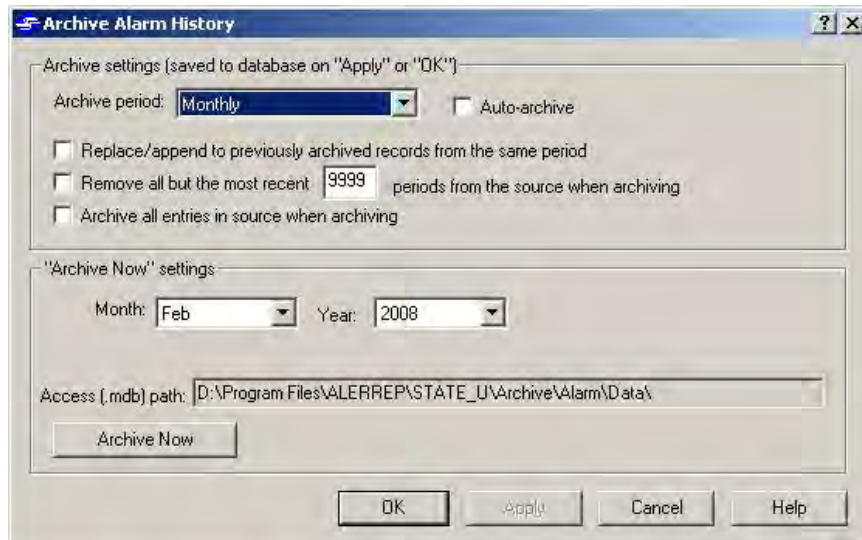
## Practical application

Marc uses the alarm history each Thursday to check alarms that have been acknowledged and to ensure that no alarms remain unresolved. He sorts on the “End” column to look at alarms by status. He knows that any alarms that have nothing listed in the “End” column have not been resolved and may still be active alarms. He uses this as a convenient checklist to follow up.

Marc could also have used the Current Alarms View to quickly check alarm status.

## Auto-archiving alarm history data

Use the auto-archive feature to set BACTalk to automatically archive alarm history records (BACTalk> Alarms> Alarm History> File> Archive Data). Records can be archived daily, weekly, twice a month, monthly, quarterly, twice a year, and yearly. Archived files are saved to the server.



**Figure 4.30** Archive Alarm History dialog box set to auto-archive every month

## Using remote alarm history

Remote Alarm History entries (BACTalk>Alarms>Remote Alarm History) appear only if this operator workstation is set up to receive alarms from a remote site using a modem. BACTalk creates a record of alarm information in the file Remote Alarm Log.mdb, which is saved in the current rep/job folder.

**Note** Do not attempt to open an MDB file that is already in use by BACTalk. For example, do not click **Archive Now** for a selected file when BACTalk is already using that file.

### Display filter

Select the types of alarms to view. Only the selected types will be displayed.

### Viewing Current or Archived Data

View current remote alarm data or select an archive record from the drop-down menu to display it.

### Remote alarm history view time interval

Type in a new date and time range to view other archived data. Refresh the window to update the display window.

### Site rep/job

Identifies the rep/job of the operator workstation at the remote site where the alarm originated.

**Description**

The alarm description set up when the alarm was created. Usually, this includes the device, object, and property that generated the alarm. For communications alarms, the origin and logging device are recorded.

**Alarm**

Lists the date and time the alarm occurred, followed by the event state that caused the alarm to occur, typically off-normal or fault.

**End**

The date and time that the alarm returned to normal or to some other state, and the state it returned to. If blank, the alarm condition still exists, except for communication alarms.

## Auto-archiving remote alarm history data

Use the auto-archive feature to set BACtalk to automatically archive remote alarm history records (BACtalk> Alarms> Remote Alarm History> File> Archive Data). Records can be archived daily, weekly, twice a month, monthly, quarterly, twice a year, and yearly. Archived files are saved to the server.

**Note** Do not attempt to open an MDB file that is already in use by BACtalk. For example, do not click **Archive Now** for a selected file when BACtalk is already using that file.

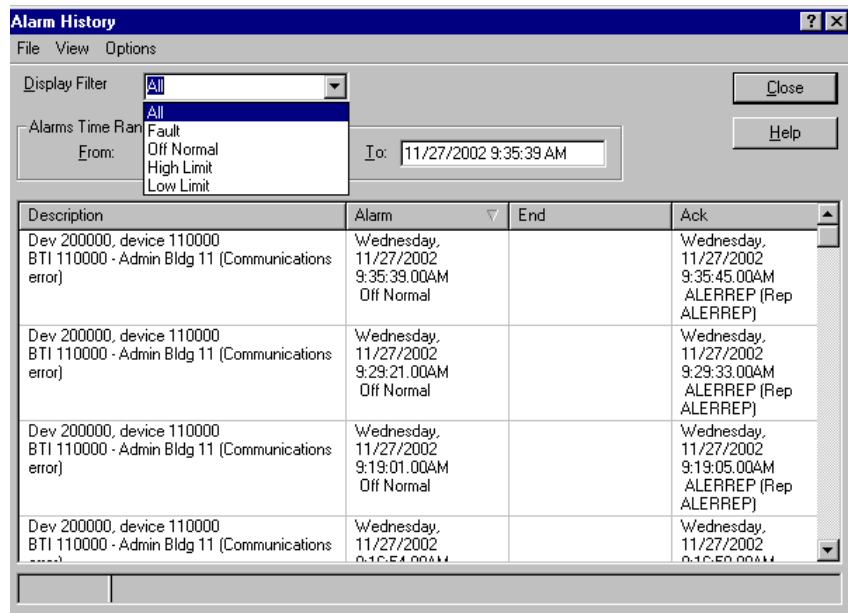
## Alarm history database files

Alarm history records are saved in databases in the appropriate rep/job folder of the Envision for BACtalk root directory.

The database file for alarm history records is Alarms.mdb and the database file for the Remote Alarm History module is Remote Alarm Log.mdb.

## Sorting records and printing

You can use the Display Filter control to change how you view and print data. Only the records that match the criteria you select display.

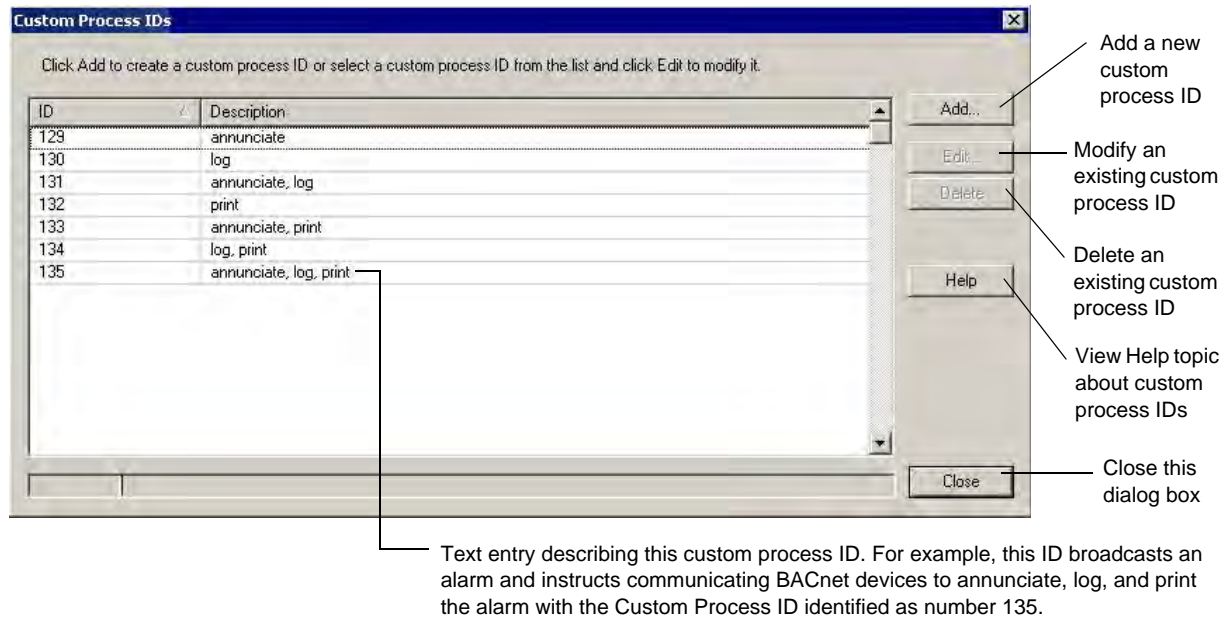


**Figure 4.31** Alarm History dialog box using a display filter

## Working with Custom Process IDs

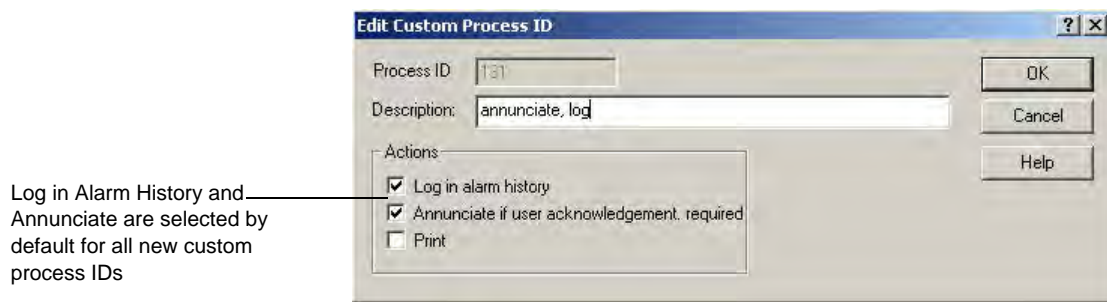
When an alarm is broadcast to all devices, every device must handle it the same way. For example, you can not configure some devices to print the alarm and other devices to annunciate the alarm with a URL link displayed. Set up a

custom process ID to broadcast an alarm to all BACnet devices, including those that are not Alerton devices (BACtalk>Alarms>Custom Process IDs).



**Figure 4.32** The Custom Process ID dialog box where new process IDs can be added and existing ones can be selected and then edited or deleted.

Use the Custom Process ID dialog box to add, edit, and delete process IDs. The Edit Custom Process ID dialog box opens when you click **Add** or **Edit**.



The Process ID is a numerical value assigned to a process ID that identifies it from other process IDs. Default custom process IDs are predefined in the range 129-135. Each predefined ID has a unique combination of annunciation, logging, and printing enabled. These custom process IDs can be user-edited.

Specify how you want the alarm to be handled once this custom process ID is broadcast to all communicating BACnet devices on the network for an alarm. The Log in Alarm History and Annunciate options are selected by default.

You can delete one or multiple custom process IDs at a time. When multiple IDs are selected for deletion, a confirmation message prompts you to verify that you want to delete more than one ID. This is a security measure to prevent the loss of



wanted data. Only one ID can be modified at a time so the Edit button is disabled when multiple IDs are selected.

### **Custom process ID versus a non-custom process ID**

When Envision for BACTalk processes an event that is configured as an unconfirmed event notification, it processes the ID based on the definition for a matching custom process ID. Otherwise, Envision for BACTalk uses a specific process ID.



# Schedules

# 5

Envision for BACtalk schedules enable you to plan building operations based on the time of day, holidays, and special events. Schedules can control zones and binary objects (ON or OFF) that support the priority-array property.

A *schedule set*, which you assign to a point or zone, consists of a *standard schedule*, a *holiday schedule*, and an *event schedule*. This scheduling structure allows you to control day-to-day zone operations with the standard schedule. The holiday schedule controls days or times when a facility is typically unoccupied. The events schedule controls time periods outside normal occupied times. The holiday schedule overrides the standard schedule, and the event schedule overrides the holiday and standard schedules within a schedule set.

## Benefits

**Efficient** Scheduling data points and relying on the BACtalk system to turn equipment ON and OFF frees you to focus your attention on other areas of system operation.

**Convenient** Set up a schedule and then share it to control any number of points. Use the Time Schedule Wizard to view scheduled status at a glance.

**Easy** Right-click an item on a data display, and then click **Schedules** to edit the schedules or set up a new schedule set if the point is not yet scheduled.

**Fast** Set up times for one day of the week and then copy the settings to other days.



## Practical application

The Administration building at State University is open Monday through Friday from 8:00 AM until 5:00 PM. This building is closed on state and federal holidays. Occasionally, special events in the conference room of the Administration building require a special schedule. For instance, on Monday, January 20, 2003 from noon to 3 PM, the building will be open for a special luncheon honoring Martin Luther King, Jr.

Marc is responsible for scheduling operations in the Administration building. He will use schedules in Envision for BACtalk to do it.

## Quick start–schedule setup

Use the following table to help you set up schedules. The key steps for creating schedules are listed in order.

**Table 5.1** Tasks for setting up a schedule

Task	See
1 Identify the zone or data point in your system that you want to schedule. Must be a BV in a global controller, a BO in a VLC, or BV-40 in VLC 2.04 and later.	<ul style="list-style-type: none"> <li>• Site documentation</li> <li>• “Zones” on page 29</li> <li>• “How schedules work” on page 103</li> </ul>
2 If working with a data point, add a new scheduled point to the Point List in the Schedules dialog box (BACtalk>Schedule Points).  If working with a zone, select the zone from the Zones list (BACtalk>Zones), and then click <b>Schedule</b> . Or, use the Schedule List (BACtalk> Schedules> Schedule List).	<ul style="list-style-type: none"> <li>• “Zones” on page 29</li> </ul>
3 Specify the host device that will store and run the schedules	<ul style="list-style-type: none"> <li>• Site documentation</li> </ul>
4 For each of the three schedules–standard, holiday, and event–that control the point or zone, specify whether you want to create a new schedule, copy an existing schedule, or share an existing schedule.	<ul style="list-style-type: none"> <li>• “Using the New Schedule Wizard” on page 107</li> <li>• Refer to this year’s holiday and event schedules to help you plan next year’s holiday and event schedules.</li> </ul>
5 Set up time blocks for ON and OFF commands.	<ul style="list-style-type: none"> <li>• “Setting the schedule date and hours of operation” on page 110</li> </ul>

**Note** It is good practice to name schedules according to their hours of operation (for example, M-F, 7AM-5PM, ON) rather than by the controlled equipment or zone so that the schedule remains flexible.

See “Zones” on page 29 and “Optimum start” on page 119 or Envision for BACtalk Help for more information about setting up and working with these features.

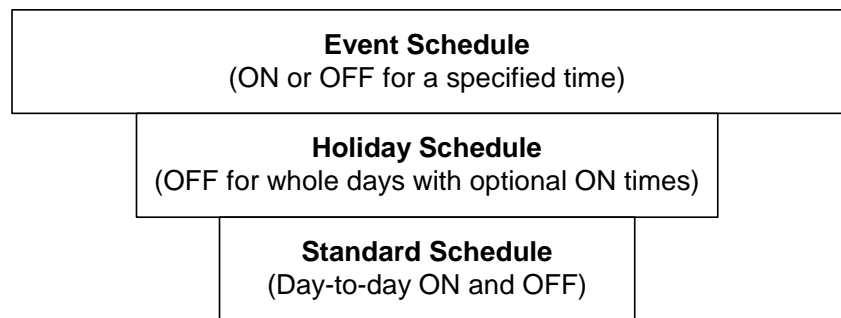
## How schedules work

When you set up schedules to control a data point or zone, it is important to understand the relationship of the schedules in the schedule set and how to use each one.

- **Standard schedule** Use standard schedules to control equipment with ON and OFF commands during routine hours of operation. This schedule may contain ON commands for operating hours or an all day ON command.
- **Holiday schedule** Use holiday schedules to override standard schedules for an entire day, usually with an all day OFF command. You can then schedule ON times within the holiday. This schedule overrides the standard schedule for the entire day.

**Note** Holiday schedules automatically write a 12:00 AM OFF time, which is in effect until the first scheduled ON command of the day occurs.

- **Event schedule** Use event schedules to override standard and holiday schedules with ON and OFF commands for time blocks in a day. Event time blocks are only in effect for the duration of the scheduled event and can not run through midnight.



**Figure 5.1** The schedule set hierarchy—event schedules override holiday and standard schedules, holiday schedules override standard schedules.

## How schedules write to zones and points

If you use zones in your system, you do not need to be as concerned about the technical details of how the system arbitrates for control of the point. The zone object resolves commands from the standard, holiday, and event schedules. The only concern: ensure that the occupied command you specify in the zone setup is not being written to by DDC. The occupied command data point is usually BV-40 in a VLC.

To fully understand how schedules operate with data points, it helps to understand the BACnet priority array. The BACtalk system uses the BACnet priority-array to manage the hierarchy of schedules.

**CAUTION** A data point must support the priority-array property to be scheduled. BVs in Alerton global and building controllers support the priority array. VLC versions 2.04 and later support the priority array. BOs in VLCs support the priority array.

See “Zones” on page 29 or Envision for BACtalk Help for information about using zones.

See the *BACtalk Systems Programmer's Guide and Reference* (LTBT-TM-PRGRMR) for information about the priority array.

- Standard schedules write to data points at priority-array index 16. If the standard schedule is not writing an ON or OFF command, it is NULL.
- Holiday schedules write to data points at priority-array index 15. For days when a holiday schedule is in effect, an OFF command is written from 12:00 AM to 11:59:99.99 PM. On non-holiday days, the holiday schedule is NULL.
- Event schedules write to data points at priority-array index 13. If the event schedule is not writing an ON or OFF command for a time block, it is NULL.

Usually, the data points that schedules write to are reserved for scheduling. When a schedule set is assigned to a zone, the schedules write to the occupied command referenced for the zone (see “Zones” on page 29). Be careful that nothing else (such as DDC applications) writes to points that are scheduled.

There are essentially three methods for scheduling data points:

- BV-40 method
- Global controller BV method
- Direct BO control method

### **BV-40 method**

Schedules control the occupied command in a VLC directly through BV-40. This enables you to directly schedule the occupied command in the VLC by assigning schedules to BV-40.

**CAUTION** Use this method only with VLC versions 2.04 because they support a priority-array for BV-40. Do not use this method for earlier VLC versions.

### **Global controller BV method**

With this method, a schedule set controls the present-value of a global controller BV. DDC in the global controller then transfers the present-value to a VLC BV. Each global controller typically has a BV devoted to scheduling. Likewise, each zone controller has a BV in DDC assigned for scheduling (BV-40 in most applications). Most system developers write subroutine DDC in the global controller to transfer the scheduled global controller BV to each respective zone controller BV. Subroutine DDC is usually already present to transfer other data, such as outside air temperature.

This scheduling method has a couple of advantages. Alerton Standard applications do not need to be edited for schedules. Also, VLC and building controller BOs can have the out-of-service property set to true, and schedules will still control the BO using DDC. One disadvantage is that global controller DDC must transfer the scheduled global controller BV to the appropriate VLC or building controller BVs.

### **Direct BO control method**

You can directly control a BO in a VLC or VLX by assigning a schedule set to it. Right-click a prompted item on a data display that is set up as the present-value of a VLC BO, and then click **Schedules**. The schedule set then commands the priority-array of the BO. When you use this scheduling method, the most important consideration is that internal DDC running in the VLC writes commands at priority-array index 14, and will override the standard and holiday schedules.

One advantage of this approach is that there is no global controller DDC to write or maintain for schedules. Another advantage is the ease of scheduling a BO (right-click an item on a display).

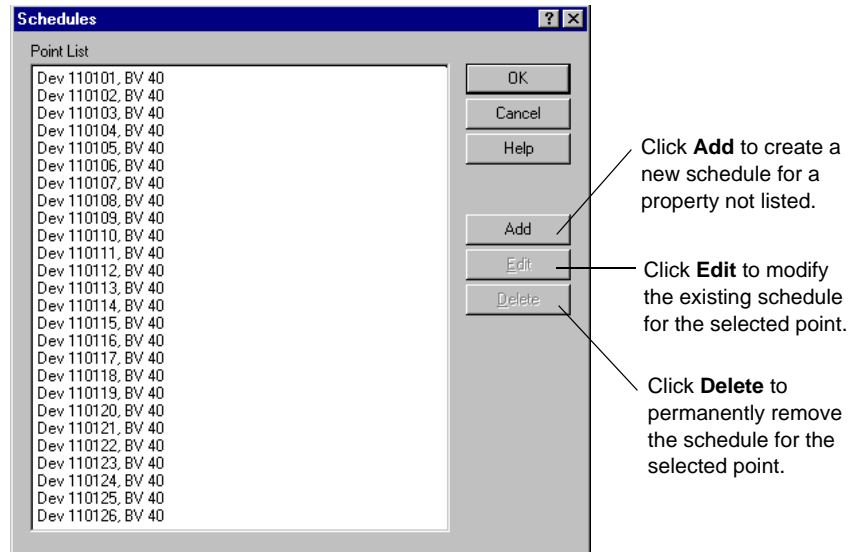
The greatest disadvantage of this approach is that you must edit and monitor VLC DDC so that it does not conflict with schedules. If you do not modify DDC, conflicts may occur, and the data point will appear to not respond to schedule control.



## Setting up schedules with the schedule wizards

The New Schedule Wizard and the Time Schedule Wizard enable you to efficiently set up reliable schedules for BACtalk data points and zones.

You can access both schedule wizards from the Schedules dialog box. The Schedules dialog box includes a Point List of all properties that have a schedule set assigned to them. If you click **Add** to create a schedule set for a data point not listed, the New Schedule Wizard appears. If you click **Edit** to modify an existing schedule set for a selected point, the Time Schedule Wizard is displayed.



**Figure 5.2** Schedules dialog box

You can also access both schedule wizards from the Zones dialog box. If you select a zone with an “S” in the status column, and then click **Schedules**, the New Schedule Wizard appears. (S in the Status column indicates that the zone does not have a complete schedule set.) If you select a zone that does have a schedule set assigned, and then click **Schedules**, the Time Schedule Wizard appears.

See “Zones” on page 29 for more information about using the Zones dialog box.

## Using the New Schedule Wizard

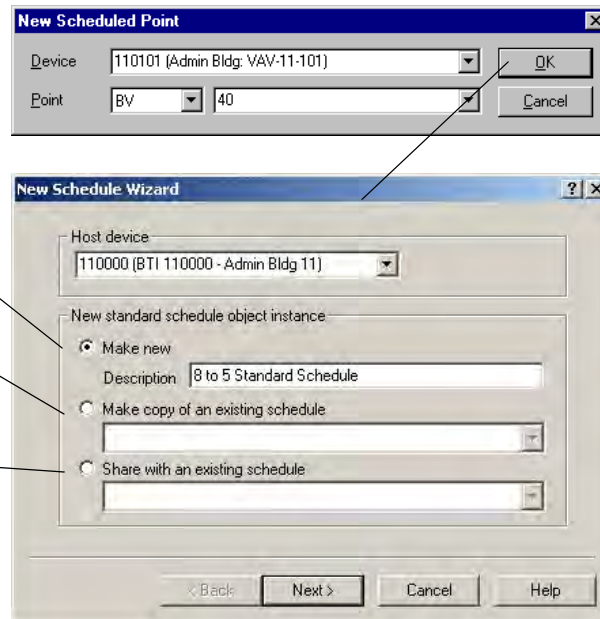
The New Schedule Wizard enables you to schedule a data point or zone. For the standard, holiday, and event schedules, you can choose to create a new schedule, copy an existing schedule, or share an existing schedule with other zones or points.

**Note** The New Scheduled Point dialog box only appears when you select **Schedules** from the BACtalk menu.

**Make New** Create a new schedule set to control this point.

**Make a copy...** Make a copy of an existing schedule set, give it a unique name, and use it to control this point.

**Share...** Use an existing schedule to control this point.



**Figure 5.3** Use the New Schedule Wizard to set up schedule control for a data point or zone.

## Using the Time Schedule Wizard

The Time Schedule Wizard provides a calendar-based tool where you can create, edit, and delete schedules. The majority of BACtalk schedules are edited and configured using the Time Schedule Wizard. The wizard's easy-to-use format graphically displays the standard, holiday, and event schedules—the schedule set—that combine to control a point.

When you work with the wizard, you start with the property you want to schedule. BACtalk assigns a standard schedule, holiday schedule, and event schedule to the data point according to your instructions. You use a calendar and timetable to edit commands, and BACtalk sets up the appropriate schedules for you. The schedules are saved to the global controller and to your workstation hard disk when you save your work.

There are three ways to start the Time Schedule Wizard:

- **Data points** Select **Schedules** from the BACtalk menu, select a data point, and then click **Edit**.
- **Zones** Select **Zones** from the BACtalk menu, select a zone, and then click **Schedule**. (If the Zone has not been scheduled, the New Schedule Wizard appears first, followed by the Time Schedule Wizard.)
- **Data display access** Right-click a data display item and click **Point Schedules**. If the data point belongs to a zone, point to **Zones** first and then click **Schedule**.

Time blocks on the Time Schedule Wizard timetable represent ON or OFF commands by hour of the day. Blocks are color coded for easy identification. Each column shows time blocks for the corresponding schedule.

The Time Schedule Wizard's interactive calendar and timetable make it easy to add and remove scheduled commands. Use the timetable to edit a scheduled command, edit schedule properties, or delete a schedule command. Use the calendar to jump to existing holiday and event schedules.

**About the example shown** This is a common setup for a holiday, Martin Luther King Jr. day, on which a special luncheon will be held from 12-3 PM. The standard schedule is set up for Monday through Friday (using the recurrence feature) 8 AM to 5 PM ON. An OFF command for the entire day is set up in the holiday schedule. From 12 to 3, the event schedule issues an ON command for the luncheon event.

The data point you are working with.

**The calendar** Shows dates, with holidays and events assigned in bold. Click a day on the calendar to set up scheduled times on that day. The active day appears highlighted. To quickly jump to a different month or year, click the month or year in the header and then select the one you want.

**The schedules listing** Shows the description of the schedules in this schedule set and enables you to change assignments and descriptions.

**The timetable** Graphically shows ON and OFF times for each schedule for the selected day. It also lets you easily edit and add scheduled commands. Double-click a time slot in the appropriate column to set up a new scheduled time block. To delete a scheduled event, right-click anywhere on the command block and click **Delete**. To edit a time, click the block and drag its edges until it occupies the appropriate time slots.

**The timeline** Right-click anywhere along the timeline to change displayed increments (60 min, 30 min, 15 min, or 10 min).

**The point status bar** Shows the resulting status of the point based on the combination of standard, holiday, and event schedules. (Colors are configurable. Right-click the status bar to change the ON and OFF colors.)

Click to jump to today's schedule.

**The Controlled Points list** Shows the points and zones the selected schedule controls. Right-click a point or zone to delete it (and remove schedule control) or to add a new point or zone.

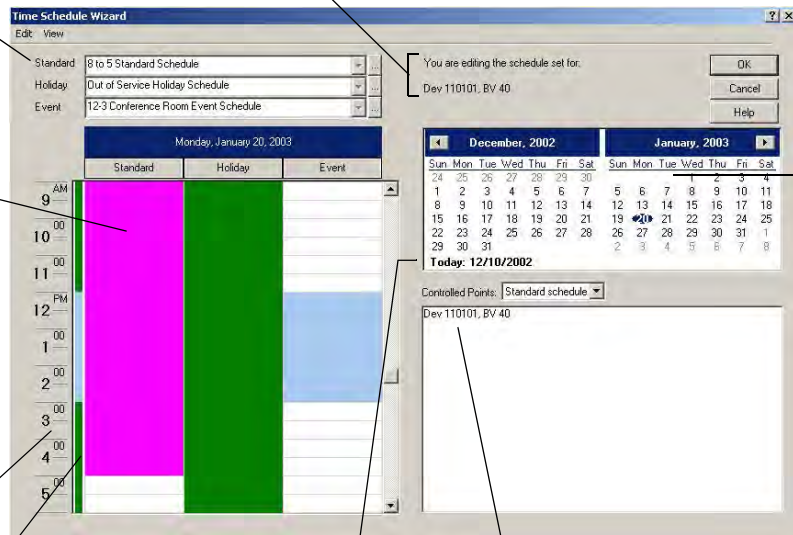
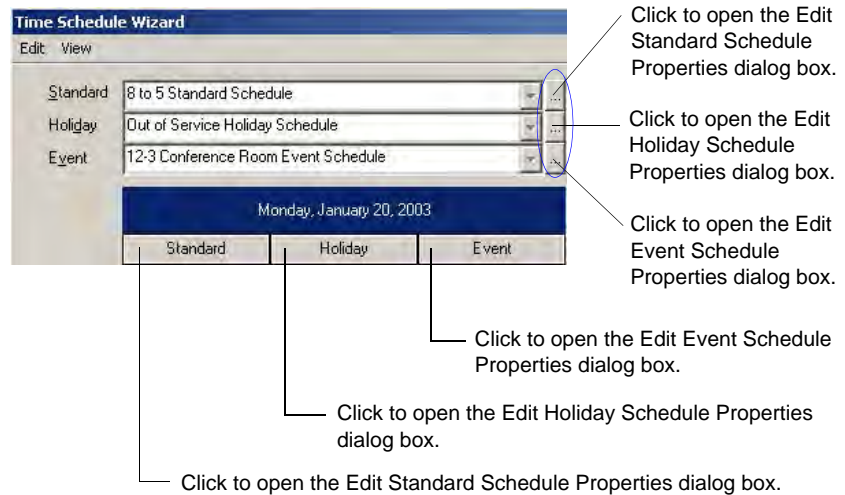


Figure 5.4 The Time Schedule Wizard

## Setting the schedule effective period and properties

In rare cases, you may want to change the description of a schedule in a schedule set. Envision for BACtalk also enables you to change the period of time that a schedule in a schedule set is effective. This feature enables you to have a schedule control the assigned points only during a certain period that you specify. Because of the complexity using this feature introduces, it is rarely used and not recommended.

Click the command button to the right of each schedule type field, click the schedule header, or from the Edit menu, point to Properties and then click the Schedule you want to change to open the Edit Standard (Holiday, Event) Schedule Properties dialog box.



Use the Edit Standard (Holiday, Event) Schedule Properties dialog box to specify the time period that this standard (holiday, event) schedule will be in effect during the year. Specify the month, day, and year or the day of the week that this schedule will start and stop controlling the data point. Leave the date fields blank if you want this schedule to always be enabled.

Leave blank for this schedule component to be enabled at all times. Otherwise, type a date range. The schedule component only sends commands during that date range.

**Figure 5.5** This 8 to 5 Standard Schedule will be effective from January 1, 2003 through December 31, 2003.

## Setting the schedule date and hours of operation

### Standard schedule

Use the Edit Schedule Wizard to set the days of the week and the hours your standard schedule will be enabled.


**Figure 5.6** This standard schedule will be enabled on Fridays from 8:00 AM to 5:00 PM.

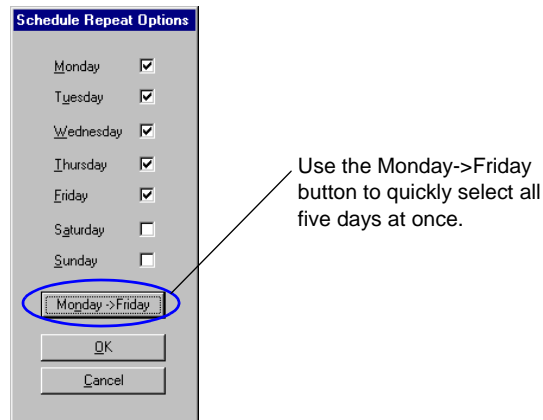
**Note** Envision for BACTalk recognizes many date formats to suit your preferences. For example, typing 5 = 5:00 AM, 17 = 5:00 PM, 6P = 6:00 PM, and 5:20P = 5:20 PM.

There are two ways to open the Edit Schedule Wizard:

- Select a time slot, right-click the selection, and then click **New**.
- Double-click a time slot.

**Note** BACTalk applies the schedule command to the next occurrence of the scheduled day. For example, if you select a start time of Monday at 8:00 AM and then subsequently choose a Tuesday start, the command appears on the next occurring Monday.

To make the schedule command recur on a range of dates, click the  **Recurrence** button and then select the days you want the command to occur.



**Figure 5.7** This schedule will be in effect Monday through Friday.

There is no “clear all” feature on the Schedule Repeats Options dialog box. Individually clear the check box in front of each day of the week for which you do not want to schedule an event.

### Holiday schedule

Use the Edit Holiday Wizard to set a day or time block when the holiday schedule will be in effect.



**Figure 5.8** This holiday schedule will command the equipment OFF all day for Martin Luther King, Jr. Day, January 20, 2003.

There are two ways to open the Edit Holiday Wizard:

- Select a time slot, right-click the selection, and then click **New**.
- Double-click a time slot and navigate through the calendar until you locate the date you want to schedule.

**IMPORTANT!** If you clear the All Day check box, remember that holiday schedules always start with a 12 AM OFF time. So, if you schedule a 2:00 PM to 3:00 PM ON time for a holiday, all other times on that day will be OFF.

## Event schedule

Use the Edit Event Wizard to set a day or time block when the event schedule will be in effect.



**Figure 5.9** This event schedule will command equipment ON from 12:00 PM to 3PM for the luncheon honoring Martin Luther King, Jr. **Note** Event schedules override holiday schedules.

There are two ways to open the Edit Event Wizard:

- Select a time slot, right-click the selection, and then click **New**.
- Double-click a time slot.

## Editing a scheduled command

Once you have created a schedule, it is easy to go back and modify its command parameters. Click anywhere on the time block to select the time period for editing. Position the mouse pointer on the edge of the time block you want to change so it appears as a double-headed arrow and drag it to the new starting or ending time.



**Note** You can also right-click anywhere in the time block and then click **Open** on the shortcut menu to edit a scheduled command.

## Deleting a scheduled command

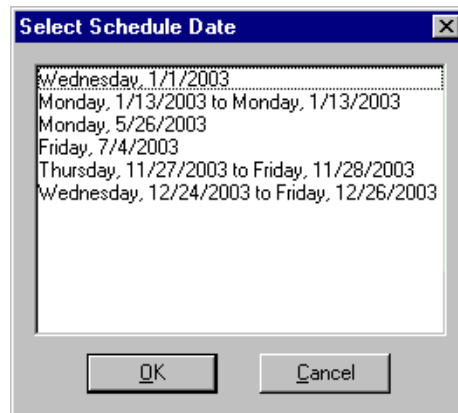
Select a scheduled point from the Schedules dialog box, and then click **Delete** to permanently remove a schedule from the data point. If you are already working with the Time Schedule Wizard, right-click anywhere on the time block and then click **Delete**.

## Jumping to an existing holiday or event schedule

Use the View menu in the Time Schedule Wizard to quickly move to an existing holiday or event schedule. Click **Dates** from the View menu, and then click



**Holiday or Event** schedule. A list of dates for which holidays or events are scheduled is displayed (depending on your selection). Select the date you want to open and click **OK**.



**Figure 5.10** This is a list of existing holiday schedules assigned to the selected point.



### Practical application

The Administration building at State U has a single global controller, a BTI with device instance 110000. There are numerous zones within the building, such as: university administrative staff offices, the university president's office and conference room, the provost's office, Academic Records, Student Registration, Cashier, Academic Scholarships, faculty payroll, university accounting, Alumni Services, Graduation Services, small conference room, medium conference room, large conference room, and restrooms and lobby.

Regularly scheduled operating hours are from 8 AM to 5 PM every weekday. Marc has the Administration building zones set up to share the same standard schedule, which he named "8 to 5 Standard Schedule." When the university administration changed hours from the old 7 AM to 4 PM schedule last year, it was easy for Marc to update the schedule. He simply changed the time block and the schedule object description on a standard schedule for one of the zones and all zones that use this schedule were updated to the new operating hours.

Each year around late November, the provost releases the business holidays for the following year. Because the business holidays are different from the school holidays, the Administration building needs its own holiday schedule, "Business Holiday Schedule." Holidays are set up on this schedule to be OFF all day.

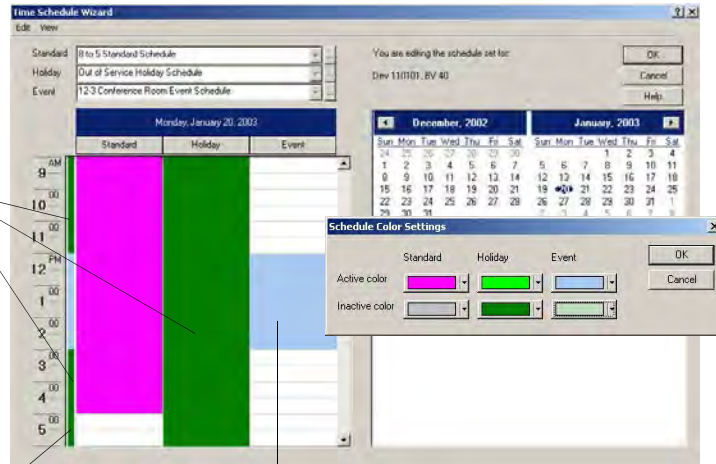
Marc set up each zone in the Administration building with its own event schedule. This way, an event in one of the zones does not cause equipment in the other zones to come ON.

Early tomorrow, a disciplinary hearing is being held in the university president's conference room, from 7:00 AM to 8:00 AM. Marc adds a 7:00 AM ON time block to the event schedule for the following day. Because the zones have different event schedules, it affects only the university president's conference room.

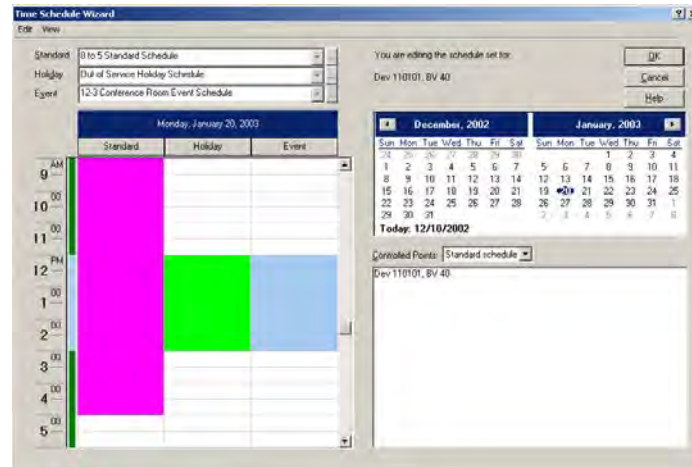
For the luncheon on Martin Luther King Jr. day, Marc modifies the holiday schedule. This way, he can affect all zones in the building. MLK day is already selected as an All Day OFF holiday. Marc navigates to the calendar, right-clicks the Holiday column, and selects Open. He then clears the All Day check box. Marc then adds an event schedule for 12:00 PM to 3:00 PM and clicks the ON option button. The holiday schedule still issues an 12:00 AM off command, but there is now a single ON command for the luncheon.

Shows that the holiday schedule is in effect so Administration building equipment is scheduled OFF. Use the color settings to help you understand which schedules are active or inactive. This image shows the Holiday column and the point status bar are the same color.

Right-click the point status bar to view/edit schedule status colors.



Shows that the event schedule is in effect from 12 PM to 3 PM. **Note** Event schedules override holiday schedules.



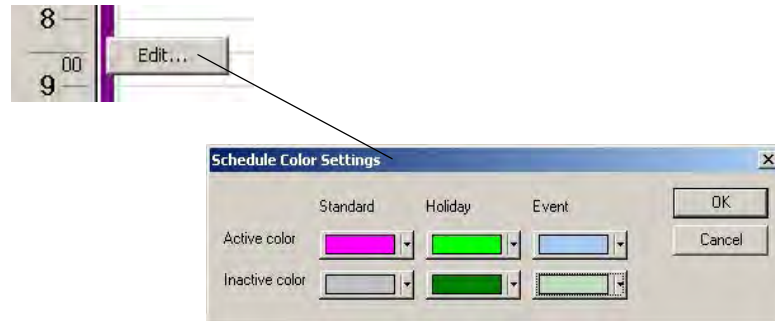
Notice how the point status bar in the image above still indicates that the entire day is set to OFF, except 12 PM to 3 PM. When Marc sets up the single time for the ON holiday, the building is set to ON for the specified event and remains set to OFF for the rest of the day. If he wants to add a second ON time for the holiday, Marc can add the ON time to the holiday schedule or use the event schedule.

## Customizing the appearance of the timetable

You can customize the appearance of the timetable in the Time Schedule Wizard to better meet your needs.

### Changing schedule color settings

You can change the color associated with each of three types of schedules for easy recognition while setting up and working with schedules. Right-click the point status bar, and then click **Edit**.



A color box appears in the Schedule Color Settings dialog box for each schedule type and command state—Active (ON) or Inactive (OFF). Use the arrow next to the schedule and command state you want to change, and then select a color from the palette.

### Changing the time increments displayed on the timeline

By default, the timeline along the left side of the timetable is displayed in 1-hour increments. Right-click anywhere on the timeline and then select the time increment you want. A check mark appears next to the selected increment.



You can change the time increments in the timeline to either 60, 30, 15, or 10 minutes. Default is 30 minutes.

### Changing the Time Schedule Wizard dialog box size

You can adjust the size of the Time Schedule Wizard dialog box to suit your needs. Click **Size** on the **View** menu, and then click either **Large** or **Small**. By default, the size of the Time Schedule Wizard dialog box is set to **Small**. Selecting **Large** allows you to view more hours in the timetable and enlarges the Controlled Points list area.

## Editing schedule sets and point assignments

You can easily change the operation of a schedule set once it is defined. You can add and remove data points and zones, exchange a standard, holiday, or event schedule for another one, and change the description and effective date of a schedule component.

### Changing the points or zones that a schedule set controls

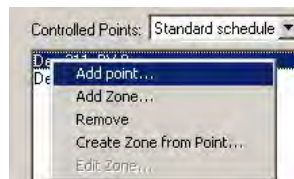
You may need a schedule set to control a different property as time passes. For example, a tenant may expand their operations to another floor and they have a different work schedule than the previous tenant. With the occupied mode for the zone specified, BACtalk makes it easy to remove the properties from the old schedule set and assign them to a new one.

#### Removing a property from a schedule set

Either through the BACtalk menu or by right-clicking a data display, select the scheduled point that you want to work with from the Point List in the Schedules dialog box. To permanently remove the assigned schedule set from the selected point, click **Delete**.

#### Assigning additional points to a schedule set

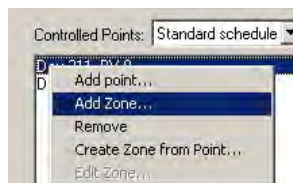
You may also want to assign the same schedule set to additional points. Open the Time Schedule Wizard for the schedule set you want to use, and then right-click anywhere on the Controlled Points list to display the shortcut menu.



Click **Add point** and specify the device instance of the global controller and point information.

#### Assigning additional zones to a schedule set

You may also want to assign the same schedule set to additional zones. Open the Time Schedule Wizard for the schedule set you want to use, and then right-click anywhere on the Controlled Points list to display the shortcut menu.



Click **Add Zone** and select an existing zone or create a new one to assign to this schedule set.

See “Zones” on page 29 or Envision for BACtalk Help for more information about working with zones.

## Replacing a schedule in a schedule set

Occasionally, you may need to replace a schedule in one schedule set with a schedule from another schedule set. For example, you may find that a holiday or event schedule for one zone may not be appropriate for another zone.

**CAUTION** When you edit a schedule set in this way, all properties assigned to the schedule set are affected. Check the Controlled Points list in the Time Schedule Wizard for a schedule set to confirm that you want to make the change.

Replace a standard, holiday, or event schedule in a schedule set with another by opening the Time Schedule Wizard for the point whose schedule you want to edit. To avoid changing the wrong schedule set, verify that only the points you want to edit appear in the Controlled Points list. Use the arrow to select the schedule you want to work with.



**Note** The drop-down arrow is only available when more than one schedule has been created.



# Optimum start

# 6

How do you decide when to start equipment to prepare a zone for occupancy? Start too late, and occupants might be too hot or too cold for a while when they are first in the zone. Start too early, and you waste energy conditioning unoccupied zones. You may also need to frequently adjust the start schedule for seasonal and building factors. Instead, use *optimum start* to do the work for you. With optimum start, you schedule only the occupied time for the zone. Your BACtalk system reliably calculates how far in advance to start equipment to meet the desired temperature by scheduled occupancy.

## Benefits

**Efficient** Equipment only works when necessary to condition the space and keep occupants comfortable.

**Saves labor** You schedule occupied times and the system calculates when equipment actually needs to start. No additional programming or manual adjustments are required.

**Intelligent** Optimum start learns every time it runs, self-adjusting to ensure maximum efficiency and comfort.





## Practical application

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Joe, a facilities engineer at the State University Health Sciences building, is getting complaints again that the main lecture hall is too cold in the morning. The first class of the day arrives at 8:00 AM, and the lecture hall is scheduled for occupancy at the same time. This schedule is set up every November. Joe suspects that the hall does not actually warm up to the occupied setpoint until about a half hour later now that the weather is colder. So he checks trendlogs to confirm this. After evaluating the trendlogs, he decides to adjust the schedule to start equipment a half-hour earlier for every occupied time. It works, but he knows he may have to adjust again when the weather gets even colder, then again in spring, and again in summer as the weather gets warmer.

The main lecture hall is a good candidate to use optimum start. Optimum start will look at the lecture hall's scheduled occupied time and then calculate how much earlier equipment needs to start. The feature then monitors how well it did and adjusts the next start time, continuously improving and optimizing. The system will find the optimum time to start equipment based on many factors, including the temperature outside and its past performance.

Joe sets up a zone for the main lecture hall (see "Zones" on page 29) and then sets up optimum start for the zone. The BACtalk system now automatically warms up or cools down the space for its occupied times. From time to time, Joe checks trendlogs of key points to ensure the feature is functioning as expected.

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## Quick start–optimum start setup and adjustment

Use the table to determine the order of tasks to perform when you set up optimum start. The table also lists references in this document and elsewhere where you can get more information.

**CAUTION** Adjusting optimum start settings without sufficient knowledge can cause undesirable results and may inadvertently overwrite BACtalk’s self-tuning operations. Before adjusting automatic mode settings, it is recommended that you take values and run them through the equations to try to predict their effect.

**Table 6.1** Tasks for setting up optimum start

Task	See
1 Identify the zone you need to work with or set up a new zone.	<ul style="list-style-type: none"> <li>• “Optimum start” on page 119</li> <li>• Site documentation</li> </ul>
2 Confirm that the zone has a schedule set assigned to it and that the occupied times are correct. Edit the schedule set if necessary.	<ul style="list-style-type: none"> <li>• “Zones” on page 29</li> <li>• “Schedules” on page 101</li> </ul>
3 Confirm that the zone has optimum start references. If necessary, verify that the references are correct.	<ul style="list-style-type: none"> <li>• “Zones” on page 29</li> <li>• “Setting or confirming optimum start references for the zone” on page 132</li> </ul>
4 For zones with existing optimum start, make sure to update the data.	<ul style="list-style-type: none"> <li>• “Saving data from the controller to the Envision for BACtalk server” on page 128</li> </ul>
5 Select the optimum start mode.	<ul style="list-style-type: none"> <li>• “Choosing manual or automatic mode” on page 135</li> </ul>
6 Set your parameters.	<ul style="list-style-type: none"> <li>• “Editing optimum start settings” on page 133</li> <li>• Site documentation</li> </ul>

## How optimum start works

This section first provides the equations and logic that optimum start uses to calculate equipment *advance time*. Advance time is the amount of time before occupancy that the BACtalk system begins warmup or cooldown to get a zone to target heating and cooling setpoints for occupancy. This chapter then provides information about how an optimum start program is saved, how it runs, and the other BACtalk features it interacts with.

This information may be helpful if you are setting up optimum start for a zone (See “Zones” on page 29) or if you need to determine if optimum start is doing its job as expected. (Also, see “Strategies and tips for checking optimum start operation” on page 139.) Most readers can skip this section.

## About automatic and manual modes of operation

Optimum start has two modes of operation: manual mode and automatic mode. The mode is selected when optimum start is set up.

### Manual mode

Manual mode offers a simple method to implement optimum start for zones where heating and cooling operations are very predictable, regardless of the time of day, the temperature outside, or other building factors. You simply specify how many degrees per hour you expect equipment to heat up or cool down a zone prior to occupancy. You also specify the maximum advance time for equipment. Use the maximum advance time as a fail-safe of sorts. The maximum advance ensures that the system will not start warmup or cooldown operations too early under error conditions (for example, if a sensor fails or a unit is offline).

The calculations in manual mode are straightforward.

**Warmup calculation**  $\text{AdvanceMinutes} = (\text{HtgSP} - \text{Temp}) \times 60 / \text{HtgRate}$

Where:

AdvanceMinutes = The amount of warmup time optimum start calculates to be necessary before occupancy

HtgSP = The occupied heating setpoint for the zone

HtgRate = The heating rate set up for optimum start (degrees per hour)

**Cooldown calculation**  $\text{AdvanceMinutes} = (\text{Temp} - \text{ClgSP}) \times 60 / \text{ClgRate}$

Where:

AdvanceMinutes = The amount of cooldown time optimum start calculates to be necessary before occupancy

ClgSP = The occupied cooling setpoint for the zone

ClgRate = The cooling rate set up for optimum start (degrees per hour)



## Example

A manual optimum start program is set up for a zone with a heating rate of 5 degrees F, a cooling rate of 4 degrees F, and a maximum advance time of 120 minutes. The zone is scheduled for two occupied times during the weekday, one at 8:00 AM and the other at 4:30 PM. The zone has an occupied heating setpoint of 68 degrees F and an occupied cooling setpoint of 74 degrees F.

The BACtalk system monitors the zone space temperature and sees it holding at 63 degrees. Optimum start calculates an advance time of 60 minutes [ $60 = (68 - 63) * 60/5$ ], and will start warmup at 7:00 AM. At 1:30 PM the space temperature is 84 degrees F. Optimum start calculates an advance time of 150 minutes, but does not start equipment [ $150 = (84 - 74) * 60/4$ ] until 2:30 because 120 minutes is the maximum advance time allowed.



## Practical application

The basement classrooms in the Health Sciences building heat and cool at a very predictable rate. In warmup mode, the HVAC system heats the classrooms at a rate of 5 degrees F per hour and cools at a rate of 10 degrees F per hour. It does not matter if it is August or November, 100 degrees F or 10 degrees F outside, 3:00 AM or 3:00 PM. Also, they have never needed more than 10 degrees heating or cooling.

Because this zone of classrooms is so predictable, Joe, the facilities engineer, has set up manual mode optimum start for it. The heating rate is set to 5 degrees per hour and the cooling rate is set to 4 degrees per hour. Because it never varies from the setpoint by more than about 10 degrees, Joe sets the maximum advance time to 240 minutes. This ensures that the system never starts warmup or cooldown more than 2 hours before scheduled occupancy.

### Automatic mode

Automatic mode offers an intelligent and adaptive algorithm to control warmup and cooldown operations for a zone. Setup is more complex for automatic mode responding to environmental and historical conditions dynamically, but its behavior is also much more advanced and adaptive than manual mode.

**CAUTION** Adjusting automatic mode settings requires a solid understanding of their effect on the optimum start calculations. Adjusting these settings without sufficient knowledge can cause undesirable results and may inadvertently overwrite BACtalk's self-tuning operations. Before adjusting automatic mode settings, it is recommended that you take values and run them through the equations to try to predict their effect.

Use automatic mode when you want warmup and cooling operations to intelligently adapt to changing conditions.

**Initial warmup calculation**  $\text{AdvanceMinutes} = \text{WrmFctr} \times (\text{OADelta} + \text{BldgMass} \times (\text{HtgSP} - \text{Temp})) \times 2$

Where:

**AdvanceMinutes** = The amount of warmup time optimum start calculates to be necessary before occupancy.

**WrmFctr** = An automatically adjusted warmup factor. Maximum value is 10. Minimum is 0. The greater the warmup factor, the greater the advance time.

**OADelta** = The difference between the outside air limit—a value that you specify in the optimum start setup—and the actual outside air temperature. If the result is less than zero, optimum start uses zero.

**BldgMass** = A value that you specify in the optimum start setup that can be equal to 3, 4, or 5. Larger numbers correspond to greater interior building mass (including heavy bookcases, thick walls, glass walls, and lots of oversized office equipment), increasing the effect of zone temperature within the equation. Smaller numbers correspond to less interior building mass, increasing the effect of outside air temperature within the equation.

**HtgSP** = The occupied heating setpoint for the zone.

**Temp** = The zone space temperature.

**Initial cooldown calculation**  $\text{AdvanceMinutes} = \text{ClFctr} \times (\text{Temp} - \text{ClgSP}) \times \text{BldgMass} \times 2$

Where:

**ClFctr** = An automatically adjusted cooldown factor. Maximum value is 10. Minimum is 0. The greater the cooling factor, the greater the advance time.

**Temp** = The zone space temperature.

**ClgSP** = The occupied cooling setpoint for the zone.

**BldgMass** = A value that you specify in the optimum start setup that can be equal to 3, 4, or 5. Larger numbers correspond to greater interior building mass, increasing the effect of zone temperature within the equation. Smaller numbers correspond to less interior building mass, increasing the effect of outside air temperature within the equation.

**Heating and cooling factor adjustments** Optimum start adjusts warmup and cooldown factors based on the performance of optimum start. Adjustments occur at the end of an optimum start operation (that is, after scheduled occupancy).

When adjusting warmup and cooldown factors, optimum start uses a self-tuning factor that you specify. This value ranges from 0.0 to 1.0. Use the self-tuning factor to adjust how aggressively optimum start tunes. When the factor is set to 1, the most recent optimum start performance has the maximum effect on the adjustment. When set to 0.1 it has the minimum effect. When set to 0, automatic adjustment is disabled.

**Note** If the previously calculated advance time exceeded the maximum advance time defined in the Optimum Start dialog box, optimum start does not further adjust the heating and cooling factors.

If optimum start fails to reach the setpoint by the scheduled occupied time, optimum start compares the ratio of desired temperature change to actual temperature change to calculate an adjustment to the heating or cooling factor.

$$\text{FctrAdjustment} = (\text{SP} - \text{StartTemp}) / (\text{ResultTemp} - \text{StartTemp})$$

Where:

SP = The occupied heating or cooling setpoint as appropriate.

StartTemp = The zone space temperature measured at the time optimum start began warmup or cooldown (the scheduled occupied time less the advance time).

ResultTemp = The zone space temperature measured at the scheduled occupied time.

If the zone reached the setpoint too early, optimum start uses the ratio of actual time to achieve desired temperature to planned time to achieve the temperature to calculate an adjustment to the heating or cooling factor.

$$\text{FctrAdjustment} = (\text{ActualMinutesToSP} / \text{CalculatedAdvanceMinutes})$$

After optimum start calculates the adjustment to the heating or cooling factor, it uses the adjustment to calculate a new heating or cooling factor as follows.

$$\text{NewFctr} = \text{OldFctr} + \text{OldFctr} \times (\text{FctrAdjustment} - 1.0) \times \text{TuningFactor}$$

Where:

NewFctr = The new heating or cooling factor as appropriate.

OldFctr = The previously used heating or cooling factor.

FctrAdjustment = The factor adjustment that optimum start calculated (see earlier equations). The greater the adjustment, the greater the difference between the old factor and the new factor.

TuningFactor = The tuning factor, which you specify in the optimum start setup, varies from 0.1 to 1.0. The greater the tuning factor, the greater the difference between the old factor and the new factor. A tuning factor of 1.0 causes heating and cooling factors to tune the most aggressively. A tuning factor of 0.1 causes them to adjust least aggressively. A tuning factor of 0 disables factor adjustments.



## Example

An automatic optimum start program is set up for a zone with the following settings:

Self-tuning factor: 0.5

Outside air limit: 65 degrees F

Building mass: 4.0

Warmup factor: 1

Maximum advance: 120 minutes

The zone is scheduled for occupancy at 9:00 AM and has an occupied heating setpoint of 68 degrees F. When the BACtalk system monitors the zone to calculate optimum start, the space temperature is 58 degrees F. The outside air temperature is 50 degrees F.

Optimum start calculates an advance time of 110 minutes and will start warmup at 7:10 AM, using the initial warmup equation (see “Initial warmup calculation” on page 124 for more information):

$$\text{AdvanceMinutes} = \text{WrmFctr} \times (\text{OADelta} + \text{BldgMass} \times (\text{HtgSP} - \text{Temp})) \times 2$$

$$110 = 1 \times (15 + 4 \times (68 - 58)) \times 2$$

At 9:00 AM, the zone temperature has reached only 65 degrees F, so optimum start makes the necessary adjustments to reach the heating setpoint earlier next time. First, a factor adjustment of 1.4 is calculated, using the following equation:

$$\text{FctrAdjustment} = (\text{SP} - \text{StartTemp}) / (\text{ResultTemp} - \text{StartTemp})$$

$$1.4 = (68 - 58) / (65 - 58)$$

Next, the factor adjustment is used to determine a new warmup factor of 1.2:

$$\text{NewFctr} = \text{OldFctr} + \text{OldFctr} \times (\text{FctrAdjustment} - 1.0) \times \text{TuningFactor}$$

$$1.2 = 1 + 1 \times (1.4 - 1.0) \times 0.5$$

Finally, a new advance time of 132 minutes is calculated for the next day:

$$132 = 1.2 \times (15 + 4 \times (68 - 58)) \times 2$$



## Practical application

The main lecture hall in the Health Sciences building has lots of windows so Joe, a facilities engineer, sets up optimum start for this zone with a light building mass of 3. This zone is located on the third floor where the windows are not shaded by trees or other buildings so it gets lots of sunshine and is very susceptible to time-of-day and seasonal temperature changes. Joe raises the self-tuning factor for this zone to 0.8 to account for its physical location. He also sets up and checks trendlogs to help him verify that optimum start is performing as expected and to help him determine when he needs to tweak optimum start factors as environmental conditions change.



### Automatic mode with humidity

Humidity can play a significant role in cooling a zone because it takes longer to cool a space with higher humidity. If the optimum start mode is set to automatic, and the relative humidity is known, the following algorithm is used to calculate advance minutes when the zone requires cooling:

$$\text{AdvanceMinutes} = \text{Cooling\_Factor} \times (\text{Enthalpy}(\text{ZoneTemp}, \text{ZoneHumidity}) - \text{Enthalpy}(\text{CoolingSP}, 50)) \times 12$$

Where ZoneHumidity has a minimum of 30% and the ZoneTemp is limited between 40°F and 100°F for the Enthalpy calculations. If the humidity is below 30%, then the value 30% is used. If the temperature is outside the range 40°F through 100°F, the nearest value inside the range is used.

Enthalpy can be approximated by the following:

Td= dry bulb temp in degrees F

RH= the relative humidity, 0 through 100, in percent

Partial pressure of water vapor at saturation

$$P_{ws} = -0.104 + 0.00869 \times Td - 0.0001395 \times Td^2 + 0.000001581 \times Td^3$$

Partial pressure Pw at humidity RH

$$P_w = RH \times P_{ws} / 100$$

Humidity Ratio

$$W = 0.622 \times P_w / (p - P_w) \quad (p = \text{atmospheric pressure} = 14.7 \text{ at sea level})$$

Enthalpy

$$h = 0.24 \times Td + W \times (1061 + 0.444 \times Td)$$

## How an optimum start program is saved and runs

Optimum start is a feature associated directly with a zone. When you set up an optimum start program, the information, configuration, and settings are stored and run as part of a zone object. Optimum start then works along with the schedule assigned to the zone.

For this reason, before you set up optimum start, you must set up a zone and assign a schedule to that zone. Data for optimum start is available as properties of the zone object. For a reference of properties related to optimum start, see the *BACtalk Systems Programmer's Guide and Reference* (LTBT-TM-PRGRMR).

See the Zones chapter or Envision for BACtalk Help for more information about setting up and working with zones.

### Saving and restoring optimum start settings, and automatically calculated values

Optimum start settings and standard optimum start calculation values are stored in a database on the Envision for BACtalk server. They are also saved in the global controller. When the BACtalk system self-tunes the values used in optimum start calculations, those values are saved in the global controller. Also, if you adjust values from a data display, the values are adjusted in the global controller.

**WARNING** Although values in the global controller update dynamically, they are not automatically updated in the Envision for BACtalk database. This would have an unacceptable impact on system performance.

Selecting the Show data from device check box in the Edit Optimum Start dialog box causes Envision for BACtalk to get the most recent data stored in the global controller. When working with optimum start, it is highly recommended that you select this check box so that data in Envision is synchronized with data in the controller when you click **OK**.

Select this option to update this dialog box with data from the device. When this option is cleared, the dialog box reflects the data that is saved on the local disk.

**CAUTION** If you make changes to optimum start settings here without the Show data from device check box selected and then click **OK**, you risk overwriting calculated values in the global controller. This is of particular concern when you use automatic mode and when you use a data display to adjust values.

**Saving data from the controller to the Envision for BACtalk server** You may want to save optimum start self-tuning data to the Envision for BACtalk server, especially if you have found the settings that enable your system to meet setpoint at scheduled occupancy.

There are two ways to save current settings in the controller to the Envision for BACtalk server:

- Select the device record for the zone's host controller in Device Manager, click **Save**, and then select **Zones and Point Data**. This also allows you to select multiple global controllers to save at once.
- Open the Edit Optimum Start dialog box, select **Show data from device** to update values, and then click **OK** to write the values. This saves one zone at a time.

**Restoring data from Envision for BACtalk to the controller** You may need to restore optimum start settings if a user has changed descriptions or values through a data display or conditions have changed such that the values stored in the controller are no longer acceptable.

To restore current settings from Envision for BACtalk to the global controller, you have two options:

- Select the device record for the zone's host controller in Device Manager, click **Send**, and then select **Zones and Point Data**.
- Open the Edit Optimum Start dialog box, clear the **Show data from device** check box to show only values in the Envision for BACtalk database, and then click **OK**. This overwrites the values in the controller.

## Setting up and adjusting optimum start values

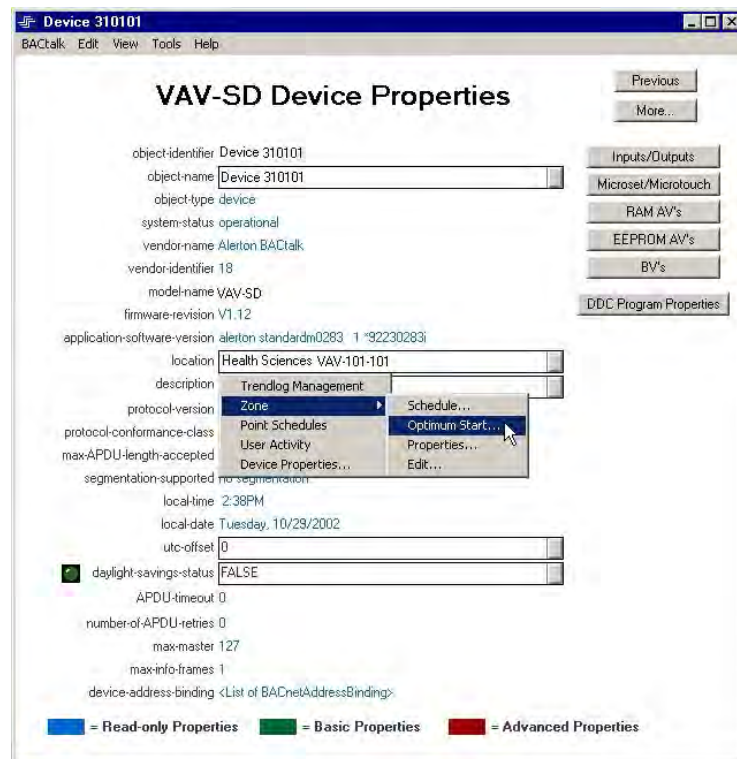
Optimum start uses both zone and scheduled occupancy during the optimum start calculation to determine the best time to start operating in warmup or cool-down mode. It monitors when a zone is scheduled to be occupied, uses building and environmental factors to estimate how far in advance to start heating or cooling, examines how well optimum start performed the last time, and then adjusts to do better the next time.

Once you have zones and schedules set up and the optimum start feature pointing to the right data, you typically do not have to modify the optimum start setup again.

See the Zones and Schedules chapters in this manual or Envision for BACtalk Help for more information about setting up and using these features.

**CAUTION** Do not adjust optimum start settings unless you have a thorough understanding of both the feature and the operation of your system. Adjusting optimum start settings without sufficient knowledge can cause undesirable results and may inadvertently overwrite BACtalk's self-tuning operations.

You can access zone and optimum start configuration through a data display. Open a device data display and right-click a field. Point to **Zone**, and then click **Optimum Start** to access data for the selected zone.



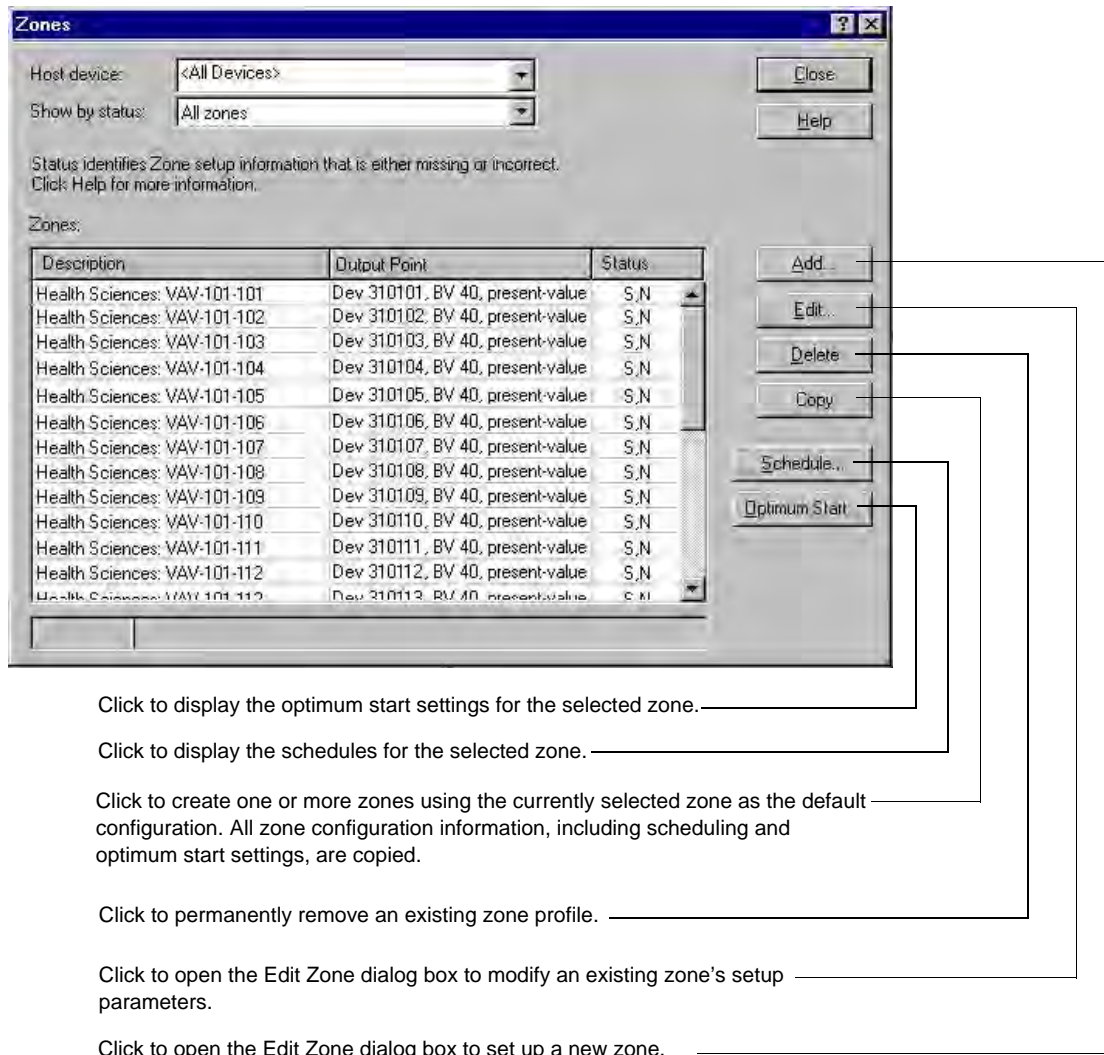
**Figure 6.1** Access optimum start for the 1st floor main lecture hall by right-clicking the location field.

## Selecting the zone you want to work with

Optimum start works hand-in-hand with schedules to determine when to start equipment to achieve the setpoint temperature by the time occupants are scheduled to arrive. When setting up optimum start, make sure the zone you are working with has a schedule assigned to it. Do not select a zone with an “S” in the status column because these zones do not have schedules assigned to them. Zones may be set up differently depending on your site’s design and needs.

See the Zones chapter or Envision for BACtalk Help for more information about setting up zones.

It is very important to use a meaningful and unique description for each zone you set up so that users can easily locate the zone. You may want to describe the physical location of the zone in relation to the rest of your job or describe the type of equipment located in the zone. For example, if the job has only one big chiller, you may decide to describe the zone where it is located as “Big Chiller Zone.” The State University job has been set up so that the zone description depicts the building (Health Sciences), device type (VAV) building number (101), floor number (1), and device instance (01).

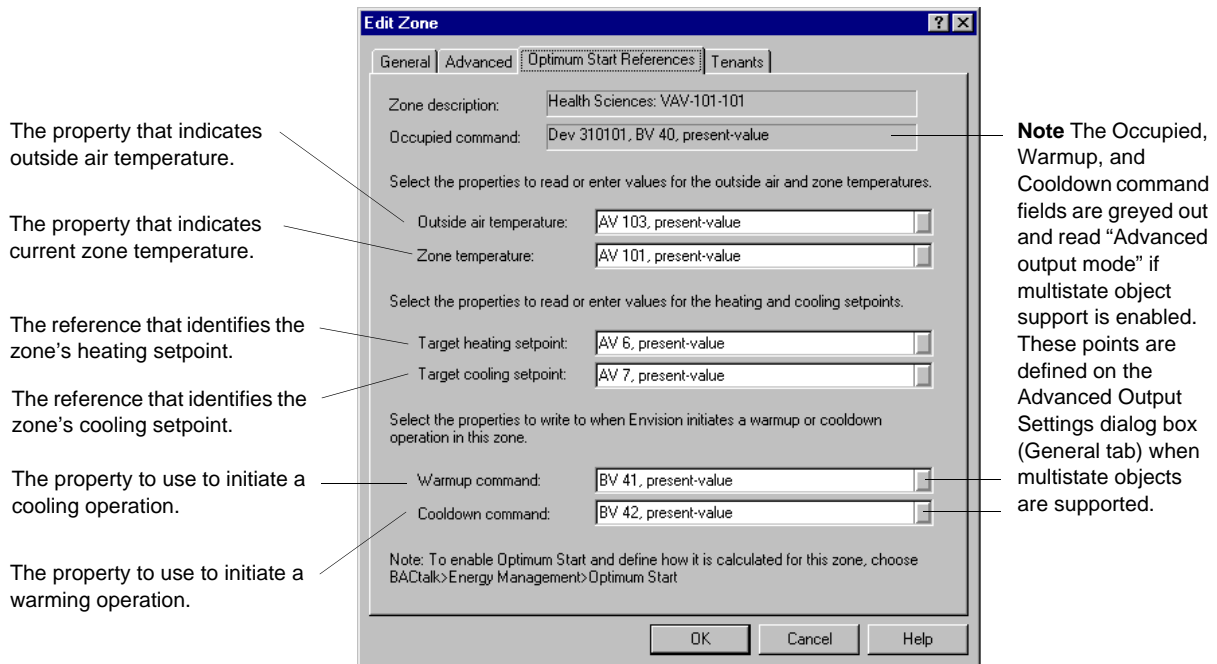


**Figure 6.2** Use the Zones dialog box to add, edit, delete, or copy a zone. You can also set up optimum start settings and schedules through the Zones dialog box.

## Setting or confirming optimum start references for the zone

Use the Optimum Start References tab on the Edit Zone dialog box to set up how optimum start will be used in the selected zone. The selected zone and the occupied command for the selected zone appear at the top of the tab. Envision for BACtalk automatically fills in this data from the information you provided on the General tab.

There are three areas on the Optimum Start References tab that you must fill in to complete the optimum start setup. Specify the properties you want BACtalk to use for each of the following: outside air and zone temperature, target heating and cooling setpoints, and warmup and cooldown operation initialization.



**Figure 6.3** Setting optimum start references for Health Sciences

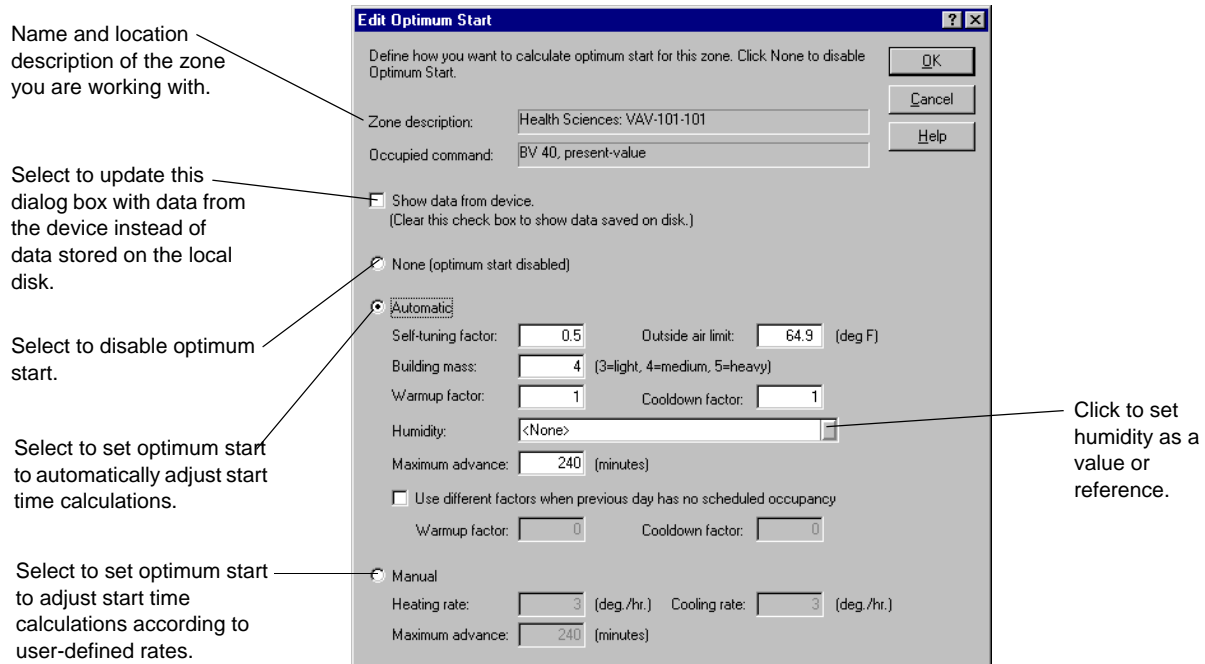
See the Zones chapter or Envision for BACtalk Help for more information about using zones.

## Editing optimum start settings

The Edit Optimum Start dialog box gives you access to all the optimum start settings for the selected zone. Use the Edit Optimum Start dialog box to display data from the device or the local hard disk, to enable or disable optimum start, and to specify whether optimum start will run in automatic or manual mode. See "About automatic and manual modes of operation" on page 122 for more information about optimum start modes and how BACtalk calculates optimum start.

Open the Edit Optimum Start dialog box from a data display by right-clicking an item, pointing to **Zones**, and then clicking **Optimum Start**. You can also open the Edit Optimum Start dialog box from the BACtalk menu. Point to **Energy Management** on the BACtalk menu, and then click **Optimum Start**. Double-click the zone to display the Edit Optimum Start dialog box.





**Figure 6.4** Use the Edit Optimum Start dialog box to enable optimum start and to set either automatic or manual operational mode.

**CAUTION** Be careful not to overwrite warmup and cooldown factors automatically calculated by optimum start. Self-tuning calculations are stored at the local device and the optimum start object is stored in a database at the Envision for BACtalk server. Before clearing the Show data from device check box, it is recommended that you back up self-tuning values to the server database to prevent overwriting them.

See “Temporarily disabling optimum start” on page 138 for more information about saving changes made to optimum start settings and recovering if optimum start settings are lost.

**Zone description** BACtalk automatically updates the zone description from the user-defined information provided on the General tab of the Edit Zone dialog box (BACtalk>Zones>Edit). Use a meaningful and unique description for this zone so that users know exactly where this zone is located or what type of equipment is controlled in it. For example, “Health Sciences: VAV-101-301.” Health Sciences and 101 describe the physical building where this zone is located. VAV is the device type, and 301 is the first device instance on the 3rd floor.

**Occupied command** BACtalk automatically updates the occupied command for the selected zone from the user-defined information provided on the General tab of the Edit Zone dialog box. The occupied command is the property you want BACtalk to write to when the zone is occupied.

**Show data from device** By default, the Edit Optimum Start dialog box displays the data currently saved on the local hard disk. If you select the Show data from device check box, Envision for BACtalk will update the optimum start feature with data saved at the device instead. The data on the device may be different due to the self-tuning capability.

### **Choosing manual or automatic mode**

BACtalk uses optimum start settings to calculate what time of day it has to start equipment to meet a zone's temperature setpoint by the time occupants are scheduled to arrive. If equipment is started too early, money and energy is wasted. If equipment is started too late, occupants arrive to a cold zone. You specify whether you want BACtalk to make this calculation automatically based on previous performance, or manually based on values you calculate and provide.

Use automatic mode when you want warmup and cooling operations to intelligently adapt to changing conditions. Automatic mode is very powerful, but the setup is a bit more complex. Use automatic mode to get the most from the optimum start feature's ability to adapt.

Use manual mode when equipment operation has a very predictable effect on a zone—essentially, when you know the zone heats up or cools down at the same rate regardless of other factors. You can also use manual mode if you do not have access to outside air temperature, you do not want the system to self-tune, or you prefer to keep your system very simple.

See “How optimum start works” on page 122 for more information about using optimum start.

### **Automatic mode settings**

It is important to understand that the BACtalk system automatically adjusts automatic mode settings. In nearly all cases, manually changing these settings will not be necessary. Also, before you change these settings, make sure that they are up-to-date. See “Temporarily disabling optimum start” on page 138.

**Table 6.2** Automatic mode settings

Item	Remarks
Self-tuning factor	Use the self-tuning factor to control how aggressively optimum start adjusts based on previous warmup and cooldown efforts. Range is 0.0 to 1.0. 1.0 is most aggressive. 0.1 is least aggressive. 0 disables adjustment. Adjusting the self-tuning factor rather than warmup and cooldown factors directly is recommended.
Outside air limit	Used only in warmup calculations. Set this to approximate the average space temperature of the zone when warmup begins. The greater the difference between this and the outside air temperature, the greater the advance time.
Building mass	A number that corresponds to interior building mass. 3.0 corresponds to the lightest interior mass. 5.0 corresponds to the heaviest interior mass. Larger numbers increase the effect of zone temperature on the advance time. Smaller numbers increase the effect of outside air temperature on advance time.
Warmup factor	Important! Automatically adjusted by optimum start.
Cooldown factor	Important! Automatically adjusted by optimum start.
Humidity	Usually left to <none>. Type a value corresponding to the relative humidity commonly experienced in the space or reference a data point that reports humidity in the zone. If humidity is specified, optimum start uses it in the advance time calculation. Increased humidity will increase the advance time.
Maximum advance	The maximum number of minutes allowed before the next scheduled occupied time to begin an optimum start operation.
Use different factors check box (warmup or cooldown)	Optional. Set different warmup and cooldown factors when the zone was scheduled to be unoccupied the previous day. These factors are independent of the primary warmup and cooldown factors.

### Manual mode setting

Select manual mode when you do not have a way to read outside air temperature or do not want your system to self-tune. You might also select manual mode when you have set fixed warming and cooling rates and want to implement them. Manual mode is easier to set up, but automatic mode is recommended because you will need to tweak manual mode settings yourself as operational and environmental conditions change. Automatic mode implements adjustments to optimum start calculations for you.

**Table 6.3** Manual mode settings

Item	Remarks
Heating/cooling rate	Type the rate (in degrees per hour) that you want to change the temperature of the zone. For example, if you set the heating rate to 3.0, the temperature in the zone cannot increase by more than 3.0 degrees per hour. Valid entries are in the range of 0 through 20.0. Default value is 3.0.
Maximum advance	The maximum number of minutes allowed before the next scheduled occupied time to begin an optimum start operation.

## Temporarily disabling optimum start

You can temporarily disable the optimum start feature for a zone whenever necessary. When you do this, the most recent optimum start settings for automatic or manual mode are retained. Only optimum start calculations are disabled. Schedules are not affected, so the assigned schedule still controls heating and cooling operations in the zone.

### ► To disable optimum start for a zone

1. From the BACtalk menu, select **Energy Management** and then click **Optimum Start**.

The Select Zone for Optimum Start dialog box opens.

2. Select the zone you want from the list and then click **Optimum Start**.
3. Select **None** (optimum start disabled) and then click **OK**.

Click to turn off Optimum Start in this zone.

Define how you want to calculate optimum start for this zone. Click None to disable Optimum Start.

Zone description: Health Sciences: VAV-101-101

Occupied command: BV 40, present-value

Show data from device.  
(Clear this check box to show data saved on disk.)

None (optimum start disabled)

Automatic

Self-tuning factor: 0.5      Outside air limit: 64.9 (deg F)

Building mass: 4 (3=light, 4=medium, 5=heavy)

Warmup factor: 1      Cooldown factor: 1

Humidity: <None>

Maximum advance: 240 (minutes)

Use different factors when previous day has no scheduled occupancy

Warmup factor: 0      Cooldown factor: 0

Manual

Heating rate: 3 (deg./hr.)      Cooling rate: 3 (deg./hr.)

Maximum advance: 240 (minutes)

## Strategies and tips for checking optimum start operation

Periodically you may need to check optimum start performance. You may want to verify that the current advance time setting is bringing space temperature to setpoint at the time of occupancy—not too early or too late. Setting up trendlogs for optimum start data points can tell you if a tenant has a valid complaint due to a system operational issue or if they just need to adjust their personal work space or put on a sweater. Trendlogs can also help you decide how to adjust current optimum start settings to accommodate for seasonal changes occurring outside the building.

You can also adjust raw optimum start values and manually calculate how your changes will affect optimum start performance. It is recommended that you manually calculate the outcome of your changes before actually making changes to the optimum start settings in the software to prevent an adverse outcome to your system. See “How optimum start works” on page 122 for more information about calculating optimum start.

For example, set up trendlogs for your system for time periods when optimum start is first enabled, and then disable optimum start and trend system performance the next day. Compare the separate trendlogs to get a clear picture of the operational differences of your system with and without optimum start enabled. If you have set up optimum start correctly, the trendlog for the time period when this feature was enabled should show that your system came within 2 degrees, for example, of the zone setpoint by scheduled occupancy time. See “Trendlogs” on page 163.

See Envision for BACtalk Help for more detailed information about setting up and working with optimum start.





# Tenant activity

# 7

Envision for BACtalk allows you to monitor when tenants use facilities after hours. *After-hours activity* occurs when a tenant initiates a *tenant override*, causing equipment in the zone to return to occupied mode when the space would otherwise be unoccupied. A tenant override is usually a manual process—for example, the tenant presses a button on the Microset in a room.

Because conditioning a zone for occupancy typically requires more energy resources than conditioning when the space is unoccupied, you may want to track this after-hours activity or bill the tenant for it. The tenant activity feature in Envision for BACtalk enables you to do this.

Envision for BACtalk relies on zone setups for tenant activity. See “Zones” on page 29 for more information.

## Benefits

**Automated** Automatically detect and log after-hours override activity in a zone. Use these logged events to generate tenant bills.

**Flexible** Review events and billing amounts before bills are generated. Modify or delete events. Change the billing rate. Add surcharges or seasonal billing factors.

**Convenient** Define how you want to send bills to each tenant. You can print and mail bills. You can generate files and print bills from another program, such as Excel or Word. You can generate files and email them to tenants.

**Powerful** For large sites, this feature makes it easy to set up multiple tenants and multiple zones and quickly generate bills. You can create one tenant profile and copy it to define multiple tenants. Once you have set up billing rates and other parameters, Envision for BACtalk automatically calculates billing amounts, making it easy to generate bills each month.

**Tighter facility management** You can control who is billed for what type of after-hours activity. Tenant activity shows you where after-hours usage is occurring—whether you bill for it or not. You can also modify bills before they are generated to ensure that tenants are not billed inappropriately.



## Practical application

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The State University administration wants to charge individual department budgets for after-hours use of classrooms and labs. Before instituting this practice campus-wide, they have decided to conduct a trial run in the Health Sciences building, using Envision for BACtalk's tenant activity feature.

George, the Facilities Manager, has already defined zones in the Health Sciences building. So to begin tracking after-hours activities in this building, he needs to set up a tenant profile for the Health Sciences department and assign zones to that tenant.

Once tenant activity is set up and running, George can use the tenant activity log to see which classrooms and labs are used after-hours, when they are used, and for how long. He can also generate monthly bills that go to the Accounting office to charge against the department budget and to the head of Health Sciences for information.

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## Quick start–tenant activity setup

Use the following table to help you set up tenant activity in Envision for BACtalk. The key steps for defining tenant activity are listed in order.

**Table 7.1** Tasks for setting up tenant activity

Task		See
1	Set up zones for the areas where you want to track after-hours tenant activity. In doing so, identify (on the Tenants tab) the data point that reliably indicates a tenant override in the zone.	<ul style="list-style-type: none"> <li>• “Setting up zones” on page 148</li> <li>• Site documentation</li> <li>• “Zones” on page 29</li> </ul>
2	Define the property manager contact information.	<ul style="list-style-type: none"> <li>• “Setting up property manager profiles” on page 149</li> </ul>
3	Create a new tenant and define the tenant contact information.	<ul style="list-style-type: none"> <li>• “Setting up tenant contact information” on page 152</li> </ul>
4	Define tenant billing information.	<ul style="list-style-type: none"> <li>• “Setting up billing parameters” on page 153</li> </ul>
5	Assign zones to tenants.	<ul style="list-style-type: none"> <li>• “Linking zones to a tenant” on page 155</li> </ul>

## How tenant activity works

To set up and use tenant activity in Envision for BACtalk, you create a *tenant profile*, which includes contact and billing information for the tenant, and identifies the *zones* the tenant occupies. You also define the billing party, or *property manager*, whose name will appear on all bills you generate. Envision uses the *tenant-override property* associated with a particular zone to determine if the zone is operating in after-hours mode.

For more information about zones, see “Zones” on page 29.

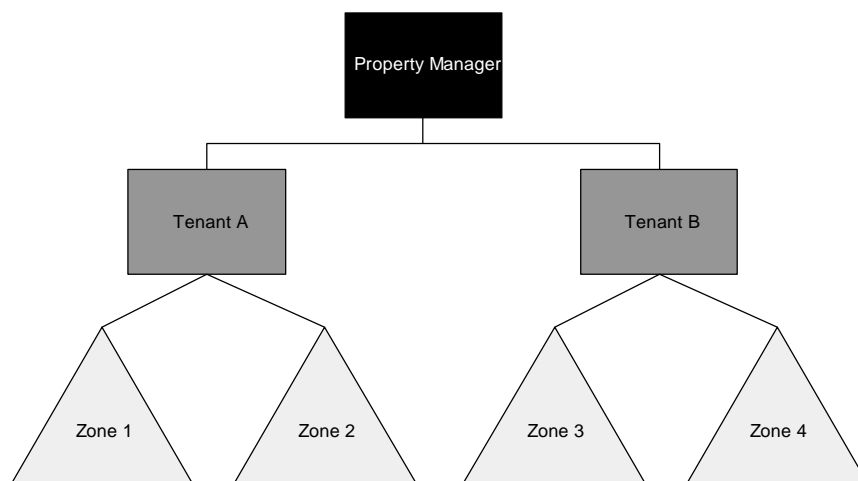
All after-hours activity for a tenant is recorded in the *tenant activity log*. You can use this log to view which zones are used after-hours, when they are used, and for how long. You can also generate bills using the information in the tenant activity log. You can edit events listed in the tenant activity log before generating the bill. You can also use seasonal multipliers or surcharges to make adjustments to calculated billing amounts.

## Tenants and property managers

A tenant is any occupant whose after-hours activity in a zone you may want to monitor. You can log tenant activity in any zone with one or more tenants assigned to it. You can log this activity without billing for it. For example, you may simply want to track how much an area or its equipment is used outside of its scheduled occupied hours.

The tenant profile identifies all the relevant information about a tenant, including contact information, billing information, and the zones that the tenant occupies. See “Setting up tenant profiles” on page 150 for more information.

A key component of the tenant profile is the property manager. This is the person or company who appears as the entity sending the bill to the tenant. Most buildings typically have only one property manager. Each tenant must be assigned a property manager to generate a bill.



**Note** It is possible for multiple tenants to share the same zone. For example, tenants A and B share the medium conference room in the Health Sciences building. Tenant A uses it from 8 AM to 12 PM and tenant B uses it from 1 PM to 5 PM.

## Tenant override in a zone

A manual action by the tenant, such as pressing a Microset override button, usually triggers a tenant override. It is also possible to have an automatic action initiate a tenant override, such as a motion detector or feedback from an access control system.

To use tenant activity in a zone, there must be a system data point that is ACTIVE (ON) for as long as the tenant zone is in override and that is INACTIVE (OFF) when the zone is no longer in override. Envision for BACtalk references this data point to calculate override time. As long as the point is ACTIVE, override time accrues.

The data point that indicates an after-hours tenant override is assigned on the Tenants tab of the Edit Zone dialog box (BACtalk>Zones>Edit). For Alerton field controllers, this data point is usually the present-value of BV-66.

Tenant override operation depends on the operating mode set up for the controller and the requirements of the space. See your site documentation to determine if a data point such as BV-66 is available to indicate override status.

### What causes a tenant override to end?

Again, the programming of the field controller for the zone is critical. The following events are likely to cause the tenant override reference to turn OFF.

- The tenant cancels the override
- The override timer expires
- The space reaches a scheduled occupied time
- Optimum start begins conditioning the space



### Example

A room is scheduled for occupancy from 8:00 AM to 5:00 PM. Based on this schedule, heating and cooling equipment operate to maintain a temperature between 69 and 73 degrees F. During unoccupied hours (5:00 PM to 8:00 AM), the setpoint is maintained between 55 and 80 degrees F.

The field controller for the zone has device instance 310101. Programming in the field controller uses the present-value of BV-66 as an override status. This data point is ACTIVE whenever a tenant override is in effect.

The room is set up as a zone in Envision for BACtalk. The zone device reference is set up as device instance 310101. In the zone setup, BV-66, present-value is referenced as the tenant override property on the Tenants tab. BV-40, present-value is referenced as the occupied command. A schedule set is assigned to the zone so that during the week it is scheduled for 8:00 AM to 5:00 PM occupancy.



## Practical application

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Professor Wang has a lecture in his classroom on Tuesday morning at 9:00 AM. He arrives around 7:00 AM to prepare. Since the lecture hall is not scheduled to be occupied at that time, it is a little bit too warm and stuffy when he arrives—78 degrees F, in fact. He pushes the right up button on the Microset II in the classroom until 2:00 appears to get 2 hours of override. He then presses the left down button to drive the setpoint down as low as it will go, to 69 degrees F.

The HVAC equipment in the classroom starts cooling and ventilating the space almost right away to achieve the 69 degree F setpoint.

As soon as Professor Wang pressed the override button on the Microset, programming in the field controller turned the present-value of BV-66 ON. Because BV-66 is referenced as the tenant override data point, this started an override event. The override event ended at 9:00 AM when the zone was scheduled for occupancy. The override event was entered into the tenant activity log at 9 AM when it ended.

---

## The tenant activity log versus the tenant bill

The tenant activity log displays each override event. This display lets you monitor when tenants are using zones after hours. You can view events and manually change override times. You can also choose to include or exclude events from the bill. This gives you control over what the tenant is billed for.

From the tenant activity log, you can access the tenant bill. The tenant bill lists the billing amounts for each override event. You cannot edit events from the tenant bill, but you can change the seasonal multiplier or surcharge amounts (if selected on the Billing tab in the Edit Tenant Profile dialog box), and then recalculate the total. You generate bills from this display.

### Override time versus billed time

Depending on how tenant activity *billing rules* are set up, the actual override time may not be the same as the billed time. Based on these rules, you may see an override event in the log that is greater or less than the billed time in the tenant bill.

In the tenant profile, you define the minimum amount of time that a zone must be in override mode before the tenant is billed for override activity. For example, you may not want to track or bill for override events of only a few minutes. In addition, the tenant profile defines the minimum amount of time the tenant is billed for when an after-hours activity “qualifies” as an override event. And finally, you define the maximum amount of time a tenant will be charged for a single override event.



## Example

On the Billing tab in the Tenant Profile dialog box, billing rules are set up as follows. The resulting billed time is shown in Table 7.2.

- Minimum billable override event = 10 minutes. This means that override events of less than 10 minutes are ignored.
- Charge tenant for a minimum of = 30 minutes. This means that any override events longer than 10 minutes and less than 30 minutes are billed as though they were 30 minutes in length.
- Charge tenant for a maximum of = 10 hours. Any override events longer than 10 hours are billed as though they ended at 10 hours.

With these settings, the following table shows examples of what the tenant would be billed for in various scenarios.

**Table 7.2** Sample override events and billing amounts

Override event	Billed time
5 minutes	0 minutes
18 minutes	30 minutes
52 minutes	52 minutes
3 hours	3 hours
11 hours	10 hours

## Where tenant activity information is stored and how tenant activity runs

Tenant activity information is stored in databases on the Envision for BACtalk server. For example, all the tenant profile setup information is saved on the Envision for BACtalk server. The zone setup information resides in both the server and the global controller. The global controller uses that information to reference the tenant override property in the field controller.

Tenant activity is monitored only in zones with one or more tenants assigned. When override events occur, the global controller sends each event to the Envision for BACtalk server where it is actually logged.

**CAUTION** The tenant activity feature requires that the Envision for BACtalk server is running to monitor and log override events.



## Setting up tenant activity

The first step when you set up tenant activity in Envision for BACTalk is to set up the zones that represent the areas in a facility where you want to track after-hours override activity. Then set up a tenant profile for each tenant occupying those zones. Finally, link zones to tenants and set up Envision for BACTalk to monitor zones for after-hours use.

## Setting up zones

Use your site documentation to determine which device controls equipment in each zone, and then use this information to define each zone.

Use the Zones dialog box (BACTalk>Zones) to view the zones set up for your system, edit zones, or set up new zones. The Zones dialog box also provides information about the status of tenant activity for the zone.

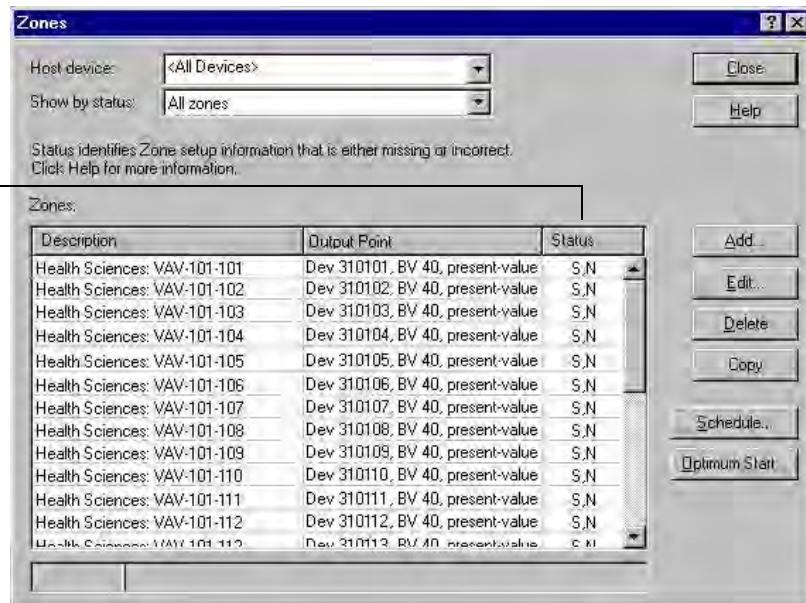
See “Zones” on page 29 or Envision for BACTalk Help for more information about setting up zones.

**Note** You can also set up zones when you create the tenant profile, using the Zones tab on the Tenant Profile dialog box. See “Linking zones to a tenant” on page 155 for more information.

The “S” in the Status column indicates the zone does not have a complete schedule set.

The “N” in the Status column indicates the zone is not linked to a tenant profile.

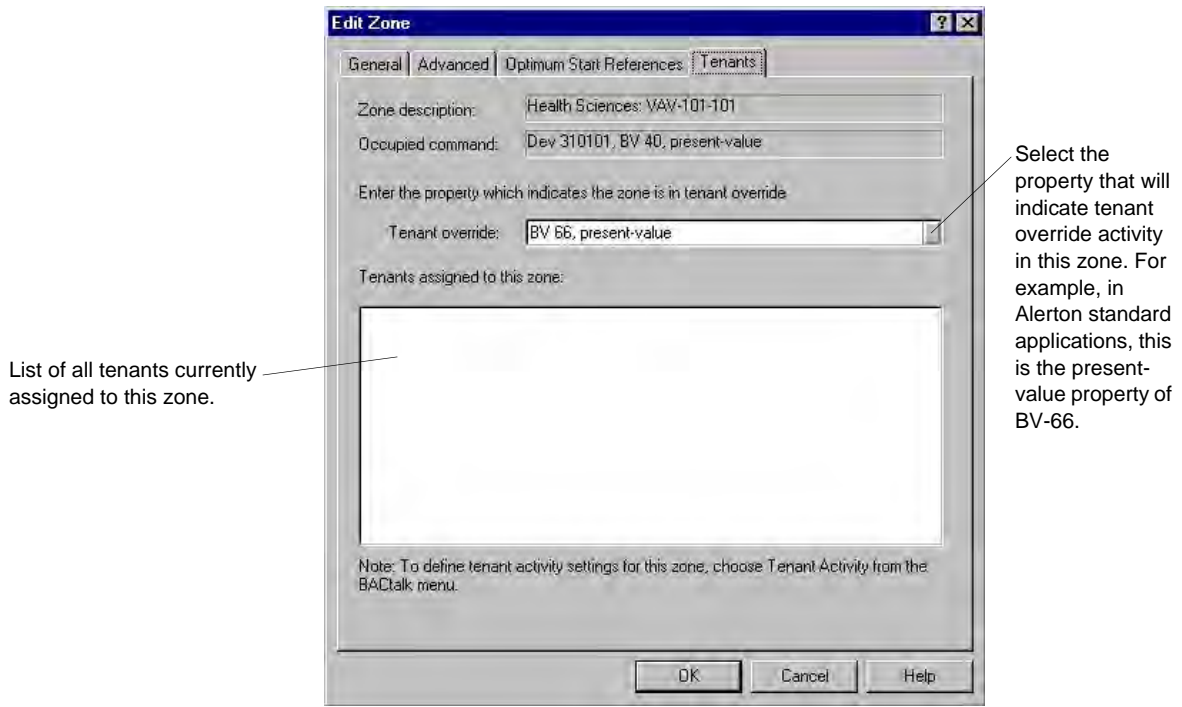
An “O” in the Status column indicates that the zone is linked to a tenant profile, but a tenant override property has not been defined.



**Figure 7.1** Use the Zones dialog box to set up new or edit existing zones, and to view the status of the zone setup.

**CAUTION** If the host device you select does not have UTC set up correctly, tenant activity start and stop times may be off; however, durations will still be correct. Ensure that the host device has Send UTC offset properties selected on the Capabilities tab in Device Manager. Then ensure that the UTC offset for the device is correct on the Preferences tab in Device Manager. Click **Help** in the Preferences tab of Device Manager for more information about determining the correct UTC for the device location.

Tenant information is set up on the Tenants tab in the Edit Zone dialog box. Use the Tenants tab to see the tenants assigned to this zone and to view and assign the tenant override data point.



**Figure 7.2** Use the Tenant tab on the Edit zone dialog box to assign a tenant override and view tenant assignments for a zone.

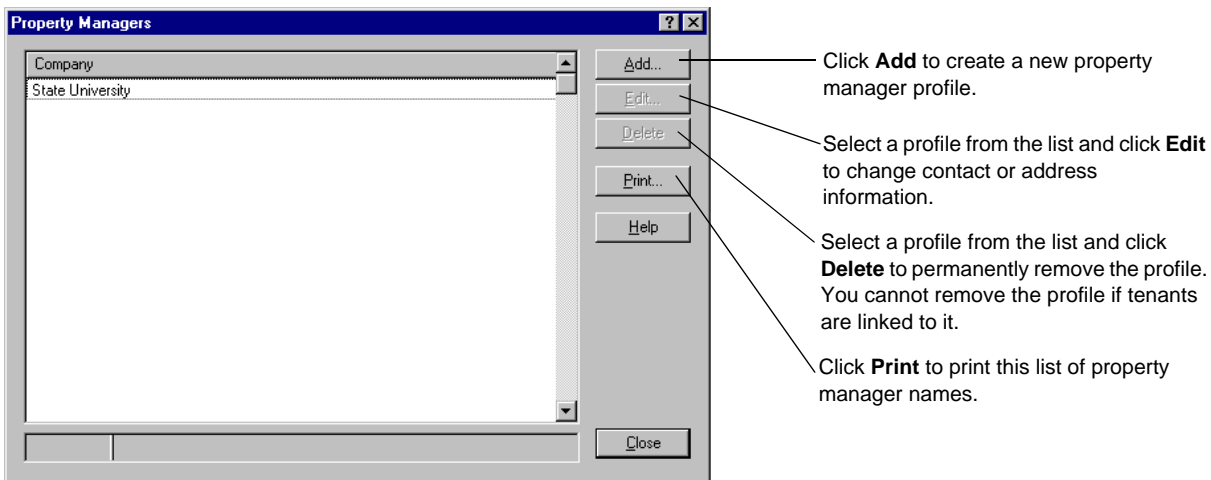
## Setting up property manager profiles

The property manager is identified on each tenant's bill as the originator of the bill. Property managers are essential to tenants. Before you save a tenant profile, you must first link it to a property manager. You must assign a property manager to a tenant to generate the tenant's bill.

A property manager can, and usually does, have more than one tenant assigned to it, but a tenant can have only one property manager.

**Note** Emailed bills originate from only one billing email address. Therefore, if you will email a tenant their bill, it is recommended that you set up only one property manager profile on each Envision for BACTalk server and use that property manager's email address in the tenant activity email setup. For more information, see "Setting up email billing" on page 161.

Use the Property Managers dialog box (BACTalk>Tenant Activity>Property Managers) to define new property manager profiles or edit an existing profile.



**Figure 7.3** Use the Property Managers dialog box to set up new and work with existing property manager profiles.

### Deleting and editing property manager profiles

You can edit any information in a property manager profile at any time. However, Envision for BACTalk does not allow you to delete a property manager profile if that property manager has assigned tenants. This is to avoid “orphaned” tenants in your system.

If a property management change occurs, and a new property manager takes over for another, you have a couple of options.

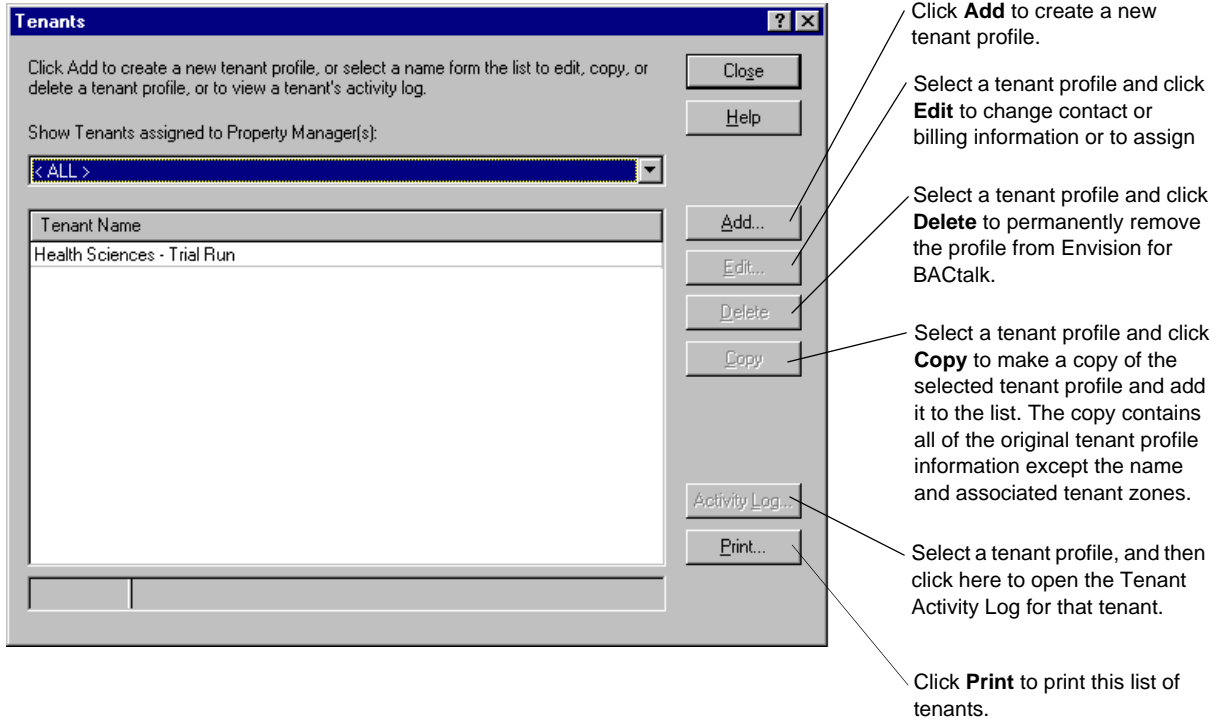
- The simplest way is to update the old property manager profile with the new property manager’s information. Existing zones will remain linked to the updated information. Use this method if a new property management company takes over for another entirely.
- Create a new property manager profile. Edit the contact information for the affected zones to reference the new property manager. See “Setting up tenant contact information” on page 152. Use this method if the number of affected zones is relatively small.

## Setting up tenant profiles

Tenant profiles store contact, billing, and zone assignments. When you set up a tenant profile, you provide:

- Contact information for the tenant, including the property manager
- Billing details about the tenant, including rules about the events you want to record and how much you want to charge for those events
- Links to the zones the tenant occupies

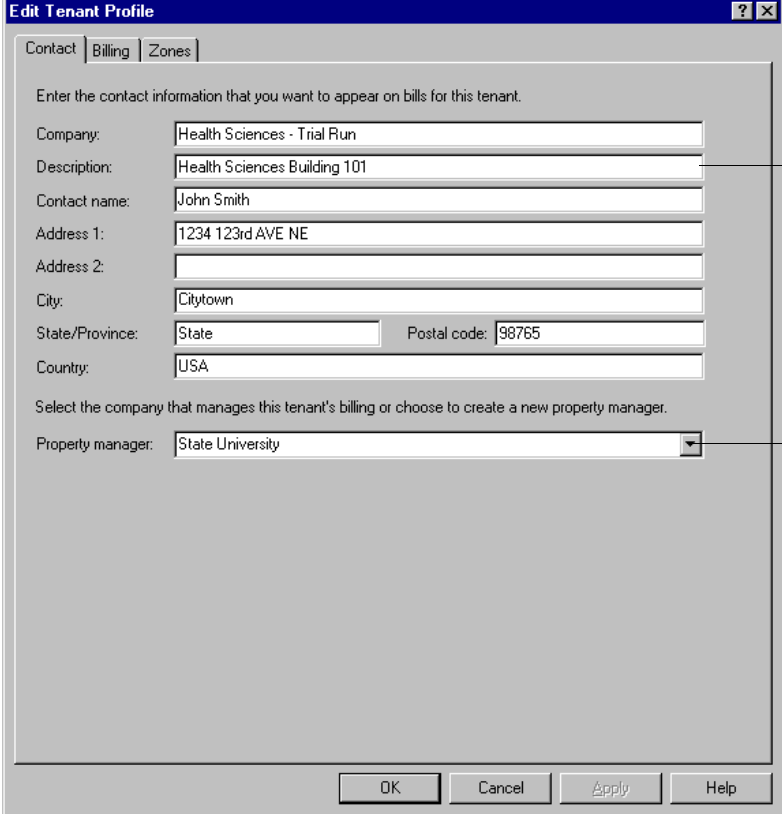
Use the Tenants dialog box (BACtalk>Tenant Activity>Tenants) to add or edit tenant profiles.



**Figure 7.4** Use the Tenants dialog box to add, edit, delete, or copy tenant profiles and to view the activity log for a selected tenant.

## Setting up tenant contact information

The tenant contact information enables you to effectively communicate with the tenant, handle billing inquiries in a timely fashion, and ensure that tenant bills are sent to the correct location. Both the company name and address appear on all bills, as does the property manager from whom the bill originates.



The screenshot shows the "Edit Tenant Profile" dialog box with the "Contact" tab selected. The dialog contains the following fields and options:

- Company:** Health Sciences - Trial Run
- Description:** Health Sciences Building 101
- Contact name:** John Smith
- Address 1:** 1234 123rd AVE NE
- Address 2:** (empty)
- City:** Citytown
- State/Province:** State
- Postal code:** 98765
- Country:** USA
- Property manager:** State University (dropdown menu)

Annotations on the right side of the dialog provide instructions:

- An arrow points to the "Description" field with the text: "Type a description that quickly identifies the tenant. For example, describe the tenant by the zone they occupy in the building."
- An arrow points to the "Property manager" dropdown with the text: "Select the property manager responsible for this tenant. Select <new> to set up a new property manager from here."

At the bottom of the dialog are buttons for "OK", "Cancel", "Apply", and "Help".

**Figure 7.5** Set up tenant contact information in the Edit Tenant Profile dialog box.

## Setting up billing parameters

Tenant bills are generated according to the method of delivery and billing parameters you set up on the Billing tab of the tenant profile.

The screenshot shows the 'Edit Tenant Profile' dialog box with the 'Billing' tab selected. The 'Company' field contains 'G. I. Tenant Joe'. The 'Billing template' dropdown is set to 'Tenant Report - Default'. The 'Billing Rate' is '1.00 (\$/hr.)'. Under 'Billing adjustments', 'Seasonal multiplier' is '1' and 'Surcharge Amount' is '0.30 (\$)'. The 'Billing rules' section includes 'Minimum billable override event' (00:10 hr:min), 'Charge tenant for a minimum of' (00:30 hr:min), and 'Charge tenant for a maximum of' (10:00 hr:min). The 'Billing notification' section has 'Print' checked with '(Default Printer)', 'File' checked with 'Tenant1-Bill.rtf', 'Type' set to 'RTF', and 'Email address' unchecked.

**Figure 7.6** The Billing tab of the Edit Tenant Profile dialog box

**Billing template** This specifies the report template that Envision uses to create the tenant bill. Unless you create additional custom templates, only the default template appears in this list. The template file (Bttenactdef.rpt) is located in <BACTalk root>\<rep>\<job>\Reports\. In most circumstances, the default template will fulfill your billing needs. If you need to customize the default template or create different ones, you can use Crystal Reports 8. If you create additional \*.rpt files and place them in the Reports folder, you may need to type the custom template name the first time you reference it in a tenant profile.

**Billing rate** The *billing rate* is the amount per hour the tenant is charged for after-hours activity. You can charge a different rate for different tenants, if appropriate. Typically, the billing rate is based on utility rates, size of the space, amount of equipment, and any special fees the property manager wants to include for after-hours usage.

**Billing adjustments** The Billing Adjustments area enables you to add a seasonal multiplier and a surcharge amount to the tenant bill if necessary.

- **Seasonal multiplier** This allows a property manager to adjust tenant billing for seasonally-variant costs, such as the cost of a kilowatt hour of electrical energy, which may be more expensive during peak seasons. The seasonal multiplier is only applied when computing the billing amount and is listed on the bill itself. The subtotal is multiplied by the seasonal multiplier.
- **Surcharge** This enables you to add a fixed cost to a bill that is not dependent on a tenant's energy usage. For example, a tenant might pay a surcharge to cover the monthly rental fee for the vending machines in the break room or the equipment in the exercise room. A surcharge may also be a monthly processing fee, a late payment penalty, or a credit to the customer. Use a negative number to apply a credit to the customer's bill. The surcharge is applied after the seasonal multiplier.



## Example

Because October through May is not a peak electrical use season, after-hours usage is billed from the electrical provider at \$8. The bill is set up with a billing rate of \$8. A tenant has 50 hours of after-hours usage during May and the tenant bill shows \$8 x 50. During the peak electrical use season, June through September, kWh rates increase by 20%. The seasonal multiplier in the tenant profile is modified to 1.2 in June. The tenant also uses 50 hours in August, peak cooling, and thus electrical use, season. In August, after-hours usage is billed at \$8 x 1.2, or \$9.60 per hour.

**Billing rules** Use the options in the Billing Rules area to specify event billing parameters.

- **Minimum billable override event** Set this to the amount of time that must accrue before the tenant is billed. For example, a setting of 00:10 prevents tenant activity from billing for events less than 10 minutes. Though not billed for these events, the event still appears in the tenant activity log.
- **Charge tenant for a minimum of** Set this to a value that indicates the least amount of time the tenant is billed for. For example, setting this to 00:15 means that the tenant is billed for no less than 15 minutes for any valid override event.
- **Charge tenant for a maximum of** Set this value to the maximum time that a tenant can be billed for an override event. You can use this value as a system overflow check of sorts to prevent billing a tenant for more after-hours use than is possible. For example, if you know that occupied hours are 6 am to 6 pm seven days a week, you know that more than 12 hours of override billing will never occur, so you could set this value to 12:00.
- **Consolidate zones in bill** If a tenant has more than one zone in override, the billing rate will be the highest of the zone billing rates.



When this option is not selected, the rate will be the sum of the zone billing rates for the zones in override.

**Billing notification** Select how you want to generate a tenant bill. These settings determine what happens when you click **Bill Tenant** in the Tenant Billing dialog box. You can select any or all of the three billing options: print, file, or email.

- **Print** Select this option if you want to print this tenant bill on the default printer. The bill will print at the default printer for the operator workstation where the billing operation was initiated. To change printers, change the default printer in the Windows control panel. See your Windows operating system documentation for more information.
- **File** Select this option if you want to always save the tenant bill to a file in either RTF (rich text format, for word processors) or XLS (Excel spreadsheet format, for spreadsheets). Send the saved RTF or XLS file as an email attachment or print the saved file and mail the bill to the tenant for payment. Selecting this option is required if you will email the bill.
- **Email address** This option is available only after you select File and the format type (RTF or XLS) you want. You then type an email address for the tenant. With this option selected, when you bill, the file is included as an attachment to an email sent to the tenant. You must first provide a valid email address, define the SMTP server, and specify an email template. For more information, see “Setting up email billing” on page 161.

**Note** Starting with v2.5, Envision for BACtalk supports SMTP authentication for increased security and compatibility with SMTP servers such as Gmail and other email providers.

### Linking zones to a tenant

To log tenant activity in a particular area, Envision for BACtalk requires a defined zone with a tenant override property assigned. The zone must be linked to a tenant profile.

You can define all your zones, starting at the Zones dialog box (BACtalk>Zones>Add). Then assign zones to tenants using the Edit Tenant Profile dialog box (BACtalk>Tenant Activity>Tenants>Add or Edit). Alternatively, you can create the tenant profile, and then define the zones from the Zones tab on the Edit Tenant Profile dialog box.

Use the Zones tab on the Edit Tenant Profile dialog box to view all the zones currently linked to the tenant. Each zone in the list includes a description (typically the zone location defined when the zone was set up), the device instance of the host controller for the zone, and this tenant’s billing rate for each zone (defined on the Billing tab in the tenant profile).

Company: Health Sciences - Trial Run

Click Assign Zones to add zones to the list. To edit the billing rate for a zone, select the zone in the list and click Edit Rate.

Tenant zones:

Description	Host Device	Rate for this Zone
Health Sciences: VAV-101-101	310000	(Default) 8.00
Health Sciences: VAV-101-102	310000	(Default) 8.00
Health Sciences: VAV-101-103	310000	(Default) 8.00
Health Sciences: VAV-101-104	310000	(Default) 8.00
Health Sciences: VAV-101-105	310000	(Default) 8.00
Health Sciences: VAV-101-106	310000	(Default) 8.00

Buttons: Assign Zones..., Edit Rate..., Remove, Print...

Callouts:

- Displays all zones that are currently linked to this tenant profile.
- Displays the Select Zones to Assign to Tenant Profile dialog box. From the Zones list, select existing zones to link to this tenant and then click **OK**. Or click **Add** to create a new zone.
- Select a zone and then click **Edit Rate** to override the tenant's default billing rate.
- (Default) is shown when the rate used for the zone matches the default billing rate defined in the tenant's profile.
- Select a zone and click **Remove** to delete the link to the tenant profile.
- Click here to print a list of all the zones that are currently linked to this tenant profile.

Bottom buttons: OK, Cancel, Apply, Help

**Figure 7.7** Use the Zones tab on the Edit Tenant Profile dialog box to link the tenant to the zones they occupy.



## Practical application

The Health Sciences building is being used for the trial run of tenant activity at State U. So, in this case, there is only one tenant for all zones of the building. However, the Facilities Manager wants to monitor after-hours activity only in classrooms and labs, not in the offices or other areas. George has already defined the zones for all the spaces in the Health Sciences building. Now he sets up the tenant profile for the Health Sciences department. On the **Zones** tab, he clicks **Assign Zones** to display a list of all defined zones. He can select all the zones associated with classrooms and labs in the Health Sciences building and link them to the tenant profile in one operation.

## Viewing tenant activity and billing tenants

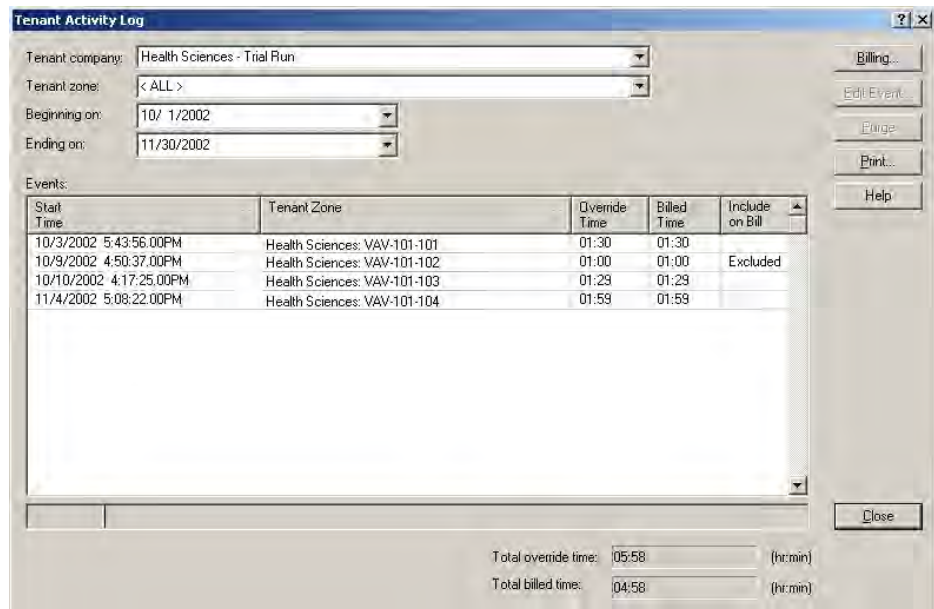
Use the Tenant Activity Log and the Tenant Billing dialog boxes to review billing information, make adjustments if necessary, and generate tenant bills.

You can review override events by tenant to determine whether or not you want to change or delete them.

### Using the Tenant Activity Log

The Tenant Activity Log is a detailed list of all recorded override events that took place in the selected zone for the specified billing period. You can use it to view events before you generate a bill and to edit events, if necessary.

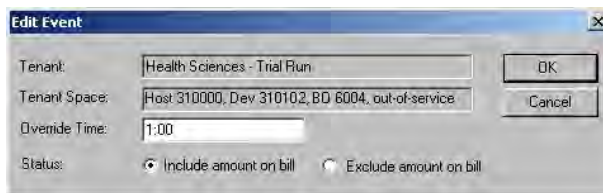
The log includes the start time of the event, the zone where the event occurred, the duration of the event, and the billed time. The duration and billed time may be different depending on how the billing rules were set up. See “Override time versus billed time” on page 146 for more information.



**Figure 7.8** Use the Tenant Activity Log to view, edit, delete, or print tenant events.

### Manually editing an event or excluding it from the bill

When you select an event from the Tenant Activity Log and click **Edit Event**, you have the option to change the override time or exclude the override from the bill. If you select **Exclude amount on bill**, the word “Excluded” appears in the Status column of the Tenant Activity Log. See Figure 7.9 on page 158 for more information.



**Figure 7.9** Edit an event in the Tenant Activity Log to manually change the override time of an event or to exclude it from the bill.



### Example

After-hours maintenance occurred during the billing period and you want to adjust the corresponding event in the tenant activity log. You can view the log for the appropriate tenant, locate the event, and modify or delete it. After you make all necessary adjustments in the tenant activity log, you can generate and send the tenant bill.



### Practical application

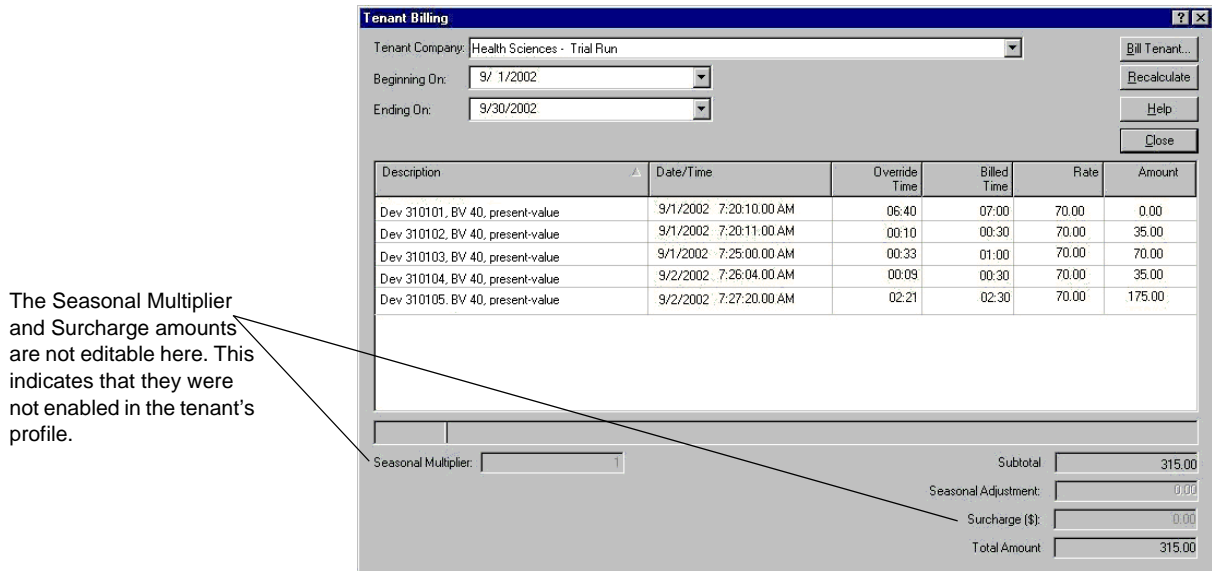
The Health Sciences department logged 9 hours and 10 minutes of override time in all zones. However, their bill is for only 4 hours.

George manually excluded a 5 hour, 30 minute event from the bill because he knows this event was the night that a maintenance crew was in the referenced zone, and the override event can be attributed to them, not the Health Sciences department. He opened the tenant activity log, edited the event, and then chose Exclude amount on bill. In addition, a 10-minute override event was logged as 30 minutes of billed time based on the billing rules in the tenant profile.

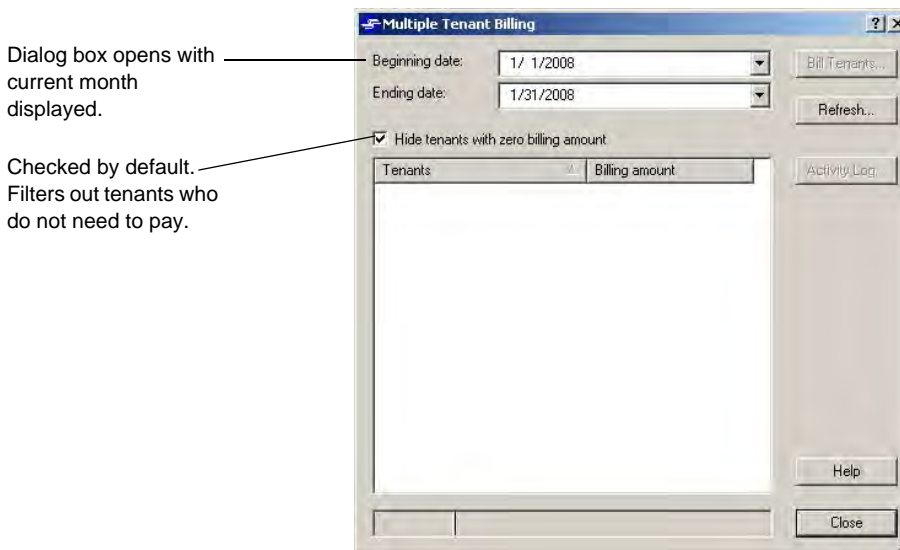
## Generating tenant bills

After you have reviewed the Tenant Activity Log and made any necessary adjustments to tenant events, you can use the Tenant Billing dialog box to generate bills for single tenants. Or, use the Multiple Tenant Billing dialog box to set up billing for multiple tenants at once (BACTalk> Tenant Activity> Multiple Tenant Billing). Use the Beginning On and Ending On dates to set the billing period if necessary.

**Note** Starting with Envision for BACTalk v2.5, the Tenant Billing dialog box opens in the current month for convenience.



**Figure 7.10** Use the Tenant Billing dialog box to view and adjust tenant activity event records and billing information.



**Figure 7.11** Use the Multiple Tenant Billing dialog box to set up bills for multiple tenants at once



## Practical application

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The head of the Health Sciences department contacted the Accounting office three months ago and arranged for a special billing rate for a charity event that just took place in the current billing period. Accounting agreed to charge only half for any override time for this event.

Accounting did not contact Facilities about this arrangement, and the Health Sciences department complained about the 4-hour charge on their bill at full cost.

George opens the tenant activity log, locates the event, and edits the event, adjusting the override time to 2:00. When he displays the Tenant Billing dialog box, next month's bill already appears. He changes the Beginning on and Ending on dates for last month's bill. The corrected amount appears on the bill, so he re-bills the Health Sciences department for the correct amount.

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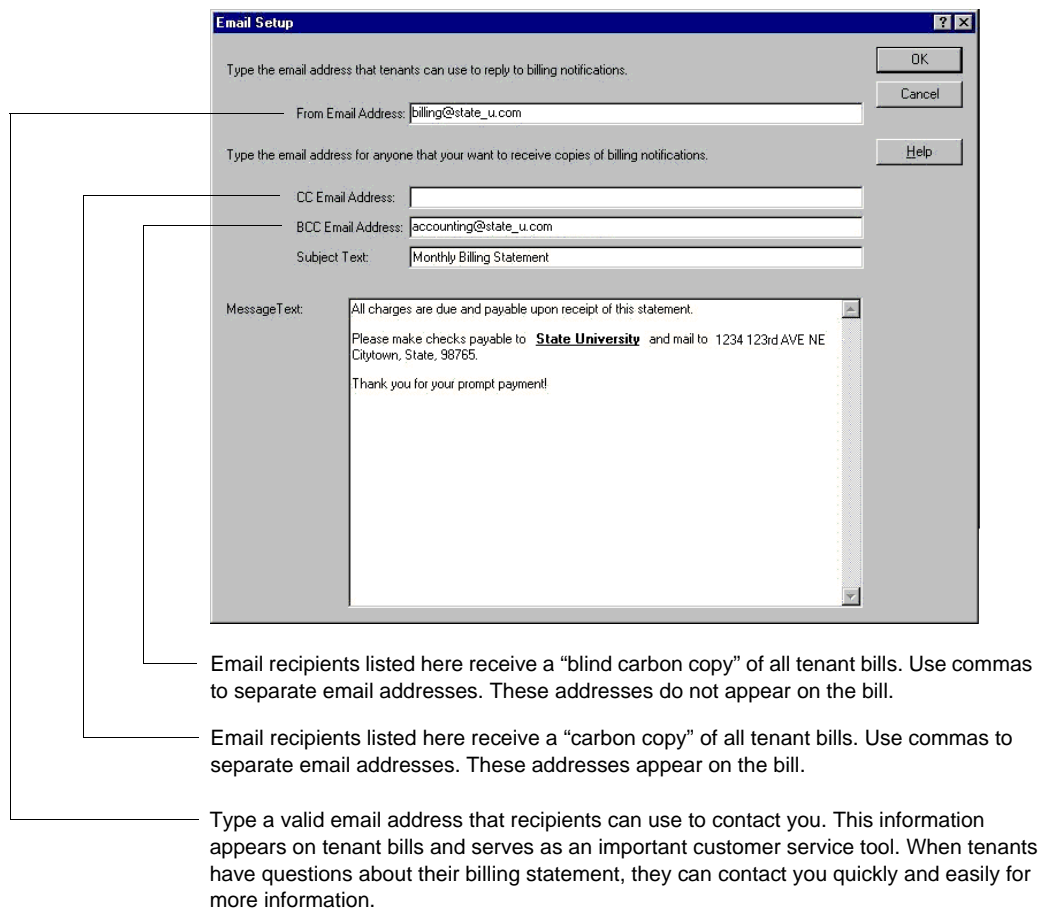
## Setting up email billing

Tenant bills are emailed to tenants if you specify the email billing method in the Tenant Profile dialog box (for more information, see “Setting up tenant profiles” on page 150). You must set up the email notification to enable Envision for BACTalk to email bills to your tenants. Use the Tenant Activity Email Setup dialog box to set up email delivery for tenant bills.

The information you provide on the Email Setup dialog box applies to all emailed tenant bills. This means that each tenant that is set up to receive bills through email sees the same subject and message text. See “Setting up billing parameters” on page 153 for more information about billing tenants.

You also need to have the Email tab in the General System Setup dialog box (Tools>General System Setup) set correctly for your network environment.

**Note** The SMTP server must be addressed and set up correctly in General System Setup to send bills by email. Envision for BACTalk v2.5 and later supports SMTP authentication for increased security and compatibility with SMTP servers like Gmail and other email providers. Contact your IT department if you need assistance.



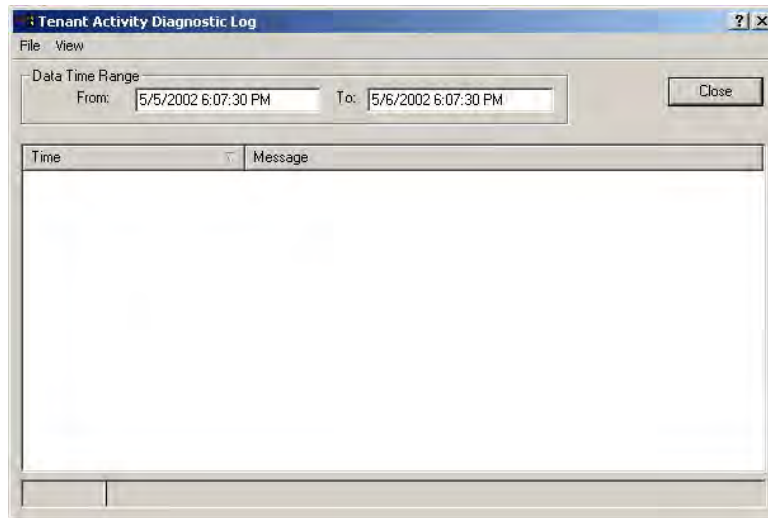
**Figure 7.12** You must complete the tenant activity Email Setup before you can email bills to tenants.



## Viewing the Tenant Activity Diagnostic Log

The Tenant Activity Diagnostic Log (BACtalk>Tenant Activity>Diagnostic Log) displays an historical record that shows how tenant activity itself is functioning. This log includes any errors that occur while generating bills at the server.

If the tenant activity log lists override events that do not seem to make sense, you can use the information in the diagnostic log to help troubleshoot the problem.



**Figure 7.13** Use the Tenant Activity diagnostic log if the tenant activity feature is not working as expected.

# Trendlogs

# 8

Trendlogs help you troubleshoot problem areas and identify critical operating trends in your system. BACtalk *trendlogs* sample data values from any data point at a regular interval. The Envision for BACtalk server saves sampled values in records that you can view, print, and export. You can view historical data as a list or graph, and choose to view one trendlog side-by-side with another. Global and building controllers buffer samples in memory so that if the server is offline, samples are still gathered.

Trendlog data can also be analyzed using the Enhanced Trendlog Viewer application. Enhanced Trendlog Viewer provides a dynamic graphic display of trendlog data. See “Using the Enhanced Trendlog Viewer” on page 190.

Trendlogs are an essential component of *energy logs*, which provide historical energy demand and consumption data. See “Energy Logs” on page 201 or Envision for BACtalk online Help for more information about using energy logs.

**Note** If an Envision for BACtalk v1.2 or later client attempts to access trendlog data from a server running Envision for BACtalk v1.1 or earlier, a communications error will occur. If an Envision for BACtalk v1.1 or earlier client attempts to access trendlog data from an Envision for BACtalk v1.2 or later server, unsupported data types (bitstring and null) are filtered out of the display data. As a general rule, when the server and client are running different versions of Envision for BACtalk, avoid operations that impact databases (creating or editing schedules, trendlogs, or alarms, for example).

## Benefits

**Easy to use** View trendlogs in table or graph format to easily spot trends and analyze information. Display trendlog data in order by time stamp or in the order recorded.

**Powerful** You can set up trendlogs for virtually any data point in your system, and use this information to troubleshoot problems or find opportunities to improve system performance.

**Flexible** Define trendlogs based on what you need to know. Specify start and end times for collecting trendlog samples. Compare trendlogs side-by-side. Modify existing trendlog setups to get a different view of system performance or problem areas. Work with archived trendlogs.



## Practical application

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As part of a statewide initiative to reduce energy expenditures by 30%, State University needs to cut its energy bill. To do this, the Facilities Department is considering a demand limiting program. They have decided a good candidate for a pilot program is the Student Union Building (SUB).

Before they implement demand limiting, they need to understand their energy demand and consumption profile in the SUB. Jacob, the SUB's lead engineer, will use energy logs to compile the historical data he needs to inform the demand limiting effort.

Jacob needs to set up a trendlog for the kWh meter in the SUB, which is Device 111101, AI-1, present-value. This trendlog will then be used as the meter reference in the energy log setup.

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## Quick start–trendlog setup

Use the following table as a guide when setting up trendlogs. The key steps for defining trendlogs are listed in order.

**Table 8.1** Tasks for setting up trendlogs

Task		See
1	Identify the devices and data points that you want to track with a trendlog.	• Site documentation
2	Set up a trendlog handler, if necessary.	• page 170
3	Select a host device for the trendlog.	• page 170
4	Customize trendlog setup, if necessary.	• page 178

**IMPORTANT!** You must correctly set UTC offset for your BACtalk system in order to time sync trendlogs and graph trendlog data accurately for your time zone. See the *Envision for BACtalk Installation and Startup Guide* (LTBT-TM-ADMIN) for more information about setting the UTC offset.

## How trendlog samples are gathered and saved

When you set up a trendlog, you create an Alerton-log object in a global controller or building controller. Trendlogs in global controllers can track values from any manufacturer's BACnet-compliant device. However, the Alerton-log object is a proprietary object that can only be created or modified by Alerton software. For global controllers, the monitored property can be local to the global controller or can be a property from other controllers. For building controllers, only local properties can be trendlogged. For example, you cannot use a trendlog in a VLX to monitor a property in a VLC.

The host device stores information about the log—the device instance, object type and instance, and the property of the *trended point*; the name of the trendlog; and the description of the trendlog.

In addition, each trendlog sample record contains:

- The time the sample was gathered (time stamp)
- Data value of the sample, if available
- An event state returned in lieu of datum (for example, NR—no response from unit or device error code.)

When you set up a trendlog, you select a *trend interval*. This determines how frequently the host device gathers information from, or “polls,” the device where the trended data point is.

After the host device gathers trend samples, it stores them in a memory buffer until the trend samples can be sent to an Envision for BACtalk server. You can specify this *buffer size* when you set up the trendlog. See “Advanced trendlog options” on page 178 for more information about setting the buffer size.

Two things cause the Envision for BACtalk server to gather samples from the controller:

- An operator chooses to view a trendlog or updates a trendlog while viewing it.
- The Envision for BACtalk server is running and receives a notification from a log handler that it should gather data.

Whenever the server gets samples to update its database, it looks in its records for the most recent sample in the trendlog. It then retrieves recent records from the controller, adding the samples to its database.

The host device uses a log handler (technically, a notification-class object in BACnet) to tell selected operator workstations when to gather a trendlog's records. When the host device has gathered the number of samples that you define in the trendlog setup as the *notification threshold*, it sends a notification to the operator workstation to get samples.

**CAUTION** In most cases, the default settings for buffer size and notification threshold are appropriate. Setting the size of the notification threshold relative to the buffer size is a critical consideration when you set up a trendlog. Correct settings will help ensure that samples are not lost. For more information, see “Advanced trendlog options” on page 178.

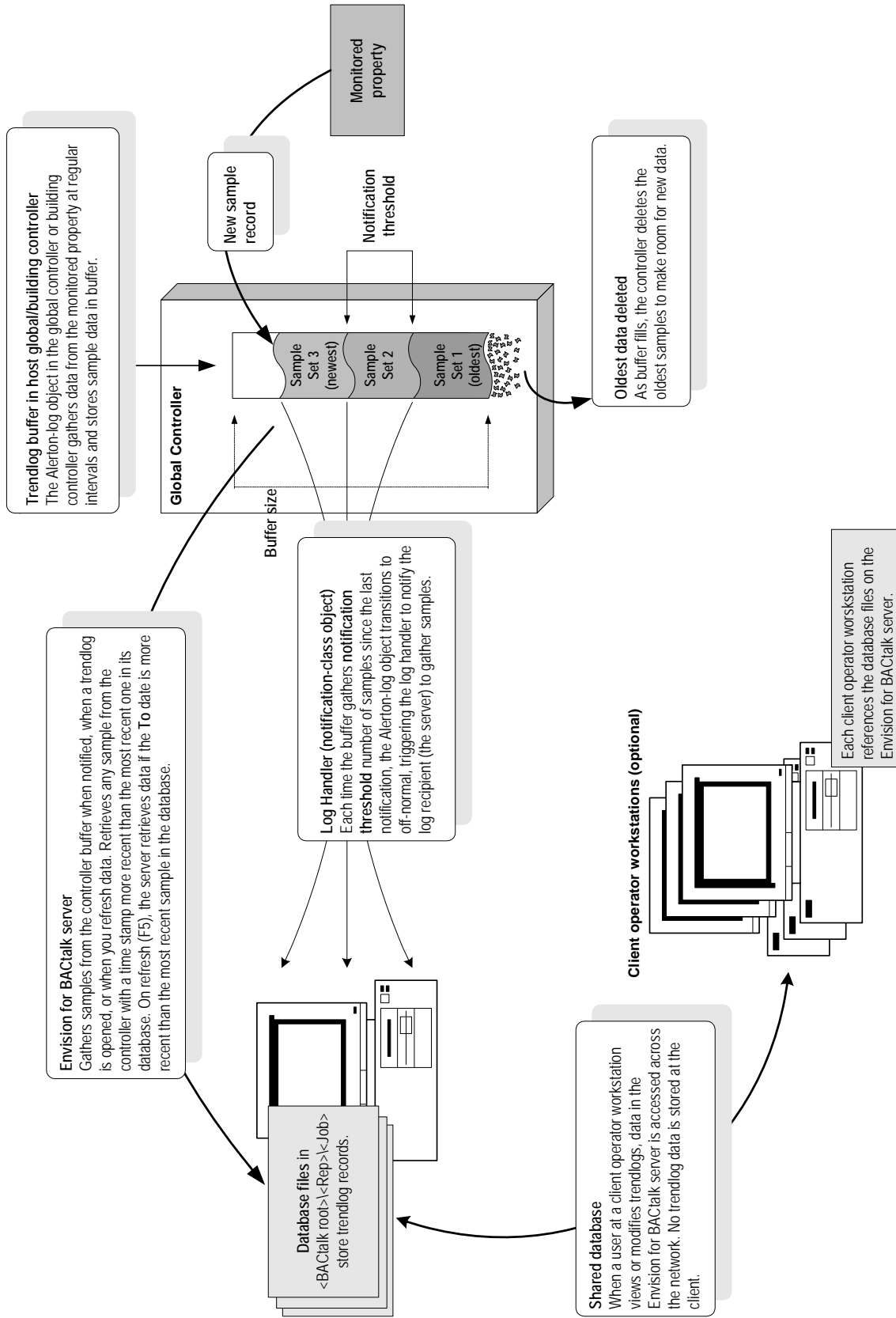


Figure 8.1 Trendlog data flow

## Trendlog database files

The database files for a trendlog are saved in the job folder on the Envision for BACtalk server, this is usually a folder on the operator workstation hard disk (<bactalk root>\Alerton\ BACtalk\<version>\ <repname>\<jobname>).

**Table 8.2** Trendlog database files

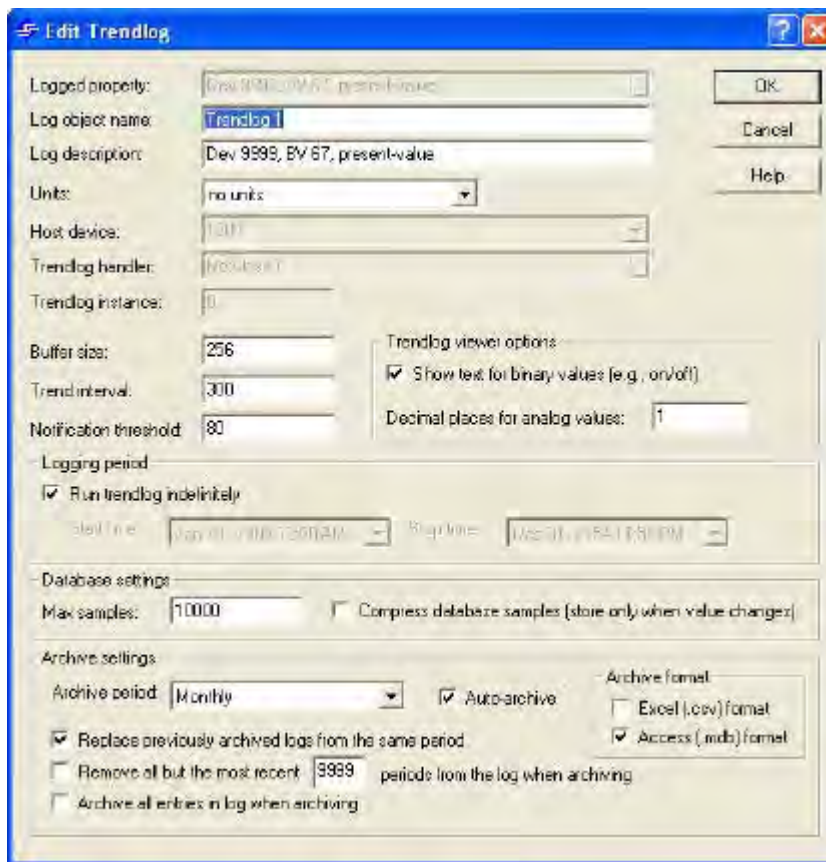
File Name	Description
Bactalk.mdb	Contains a single table that stores general information about each trendlog. This is the master list of trendlogs. This file stores no sample records.
Trendlog_<device instance>_<trendlog instance>.mdb	These files store the sample records for trendlogs. Each trendlog has an associated database file. Device Instance is 7 characters long and Trendlog Instance is 10 characters long. Both are 0 padded.  For example, the filename for Device 9999's trendlog 37 would be <i>Trendlog_0009999_0000000037.mdb</i> .



## Setting up a trendlog

If an item on a data display is set up with the right-click trendlog option, you can right-click the item to work with trendlogs. If no trendlog is set up for the referenced property, Envision for BACtalk displays the Edit Trendlog dialog box. If a trendlog is already set up, you immediately view log data for that property.

If you know the object and property ID of the data value you want to trend, you can select **Trendlog Management>Trendlogs** from the BACtalk menu. This displays the Trendlogs dialog box, which lists any trendlogs that have been defined. From here, you can add new trendlogs and edit, print, or view existing trendlogs. To create one trendlog, click Add, and then click **Single Trendlog**. To create several similar trendlogs, click **Multiple Trendlogs** to display the Multiple Trendlog Builder. See “Using the multiple trendlog builder” on page 173 for more information.



**Figure 8.2** Use the Edit Trendlog dialog box to set up a single trendlog.

Use the guidelines in the following table to set up a single trendlog.

**Table 8.3** Trendlog properties

Item	Description
Logged property	The property whose value you want to log. After initial setup, the selection is fixed and cannot be changed. This is usually the present-value of an AV, BV, AO, BO, AI, or BI.
Log object name	Envision for BACtalk assigns a default log object name based on the logged property. We recommended that you do not change this object name. Valid names are 1–40 characters.
Log description	Type text that further identifies the trendlog. This text appears as the sample data heading in the trendlog view window. An example is "VAV-5 Room Temp." Valid descriptions are 1–40 characters.  You can save time by using variables in the Log Description field. See "Using variables for trendlog descriptions" on page 177.
Units	If desired, select a unit of measure to display when viewing trendlog data and to use if an energy log uses this trendlog (see "Setting up meters" on page 207).
Host device	On initial setup, select a global or building controller where the trendlog setup is stored. After you select a host device on initial setup, the selection cannot be changed.  Building controllers can host trendlogs only for their local properties. The host device defaults to the host defined in Device Manager for the device where the logged property originates.
Trendlog handler	On initial setup, select a trendlog handler, which determines the operator workstation that gathers trendlog data from the controller. After initial setup, this selection cannot be changed.  Typically, one trendlog handler is set up for each controller. The recipient is the Envision for BACtalk server, and it is assigned by default.  If a trendlog handler does not exist in the host device, Envision for BACtalk automatically creates one during the trendlog setup.  If the system includes a BCM-WEB, the trendlog handler object name must begin with "Log Handler".
Trendlog instance	The trendlog instance is a unique number that identifies the trendlog in the BACtalk system. By default, Envision for BACtalk auto-generates the trendlog instance using the next available trendlog instance for the selected host device.  If you need to enter a custom trendlog instance, clear the Auto-generate trendlog instance check box and type a number between 0 and 4,194,302.  Note: You cannot change an existing trendlog instance.
Auto-generate trendlog instance	Selected by default so that Envision for BACtalk automatically creates the trendlog instance using the next available trendlog instance for the selected host device.  Clear this check box to activate the Trendlog Instance field and customize the trendlog instance.
<b>Change of value (COV) options (VLCA-1688 only)</b>	
Use COV sampling	Logs samples when the value of the monitored property changes.  NOTE: If the selected device or property do not support COV trendlogs, the <b>Change of value (COV) options</b> area does not appear.

**Table 8.3** Trendlog properties

Item	Description
COV increment (deadband)	<p>The degree of change required to cause a sample to be logged. For example, if you are monitoring a temperature in degrees Fahrenheit and want to log only changes of one degree or more, you would set this to 1. Type a positive number.</p> <p>Use caution when setting the increment. Small increments can dramatically increase the amount of data gathered and slow system performance.</p>
Log on COV and every <i>n</i> seconds	In addition to logging samples when the value has changed, samples are also logged at regular intervals. Select the check box and type a number between 1 and 86,400 (inclusive). This sets the trendlog resubscription interval. Each time the log resubscribes, it logs a sample, so the value entered here in effect becomes the Trend interval.
Buffer size	Determines the total number of samples that the host device can retain before samples are lost. See “Advanced trendlog options” on page 178.
Trend interval	<p>The frequency, in seconds, with which the logged property is sampled. The trendlog records a sample for the logged property at each interval. Default is 60 seconds. Use a 60-second trend interval when trending an energy log.</p> <p>Use the maximum interval that meets your trendlog objectives. Stated minimum is 10 seconds, but this assumes best-case network conditions, which rarely exist. The practical minimum depends on network and site-specific conditions. A greater number of logged points, more network traffic, a slower network connection, or a greater physical distance between the property and the host device require less-frequent trend intervals.</p> <p>Begin with the least frequent trend interval that is reasonable for your application, and then check your trendlogs for gaps and “Sample Interval Too Frequent” messages. Adjust your trend interval upwards if gaps or errors appear. There is no applicable maximum for trend interval.</p>
Notification threshold	Type a notification threshold value in number of samples. When the host device gathers this many samples, it sends notification to the Envision for BACtalk server to gather the sampled data. This value should be significantly less than the buffer size to minimize the possibility of data loss. See “Advanced trendlog options” on page 178.
<b>Trendlog view options</b>	
Show text for binary values	Select this check box if you want the trendlog view window to display text, such as ACTIVE and INACTIVE, for binary values. Clear the check box to display 1s and 0s.
Decimal Places for analog values	Enter the number of digits you want to appear to the right of the decimal point for analog values in the trendlog view window.
Max samples	The number of samples the database at the Envision for BACtalk server saves before it deletes the oldest data. Allowable range is 5,000 to 50,000 samples. The default is 10,000 samples. Smaller values help performance—Envision for BACtalk will read the database more quickly, but you must archive data more frequently.
<b>Sample times</b>	

**Table 8.3** Trendlog properties

Item	Description
Run trendlog indefinitely	Clear this check box to enter the date and time that trendlog sampling should begin and end. These fields are disabled if the "Supports BACnet Trendlog" capability is not selected in the Device Profile for the host device. Default is to run trendlogs indefinitely.
<b>Database settings</b>	
Max samples	The maximum number of samples to be stored in the database. A large number here may impact system performance.
Compress database samples	Logs samples only when the sample is different from the previous sample. This differs from COV logging because it samples at regular intervals and only records variations. COV logging logs a sample each time the value changes.  Samples gathered before this feature is activated will be unaffected.
<b>Archive Settings</b>	
Archive period	Daily, weekly, twice a month, monthly, quarterly, twice a year, yearly.
Auto archive	Select the check box to enable auto-archive. Otherwise, a user must manually click <b>Archive Now</b> to archive trendlog data. Archived files are saved to the server.  <b>Note:</b> Do not attempt to open an MDB file that is already in use by BACTalk. For example, do not click <b>Archive Now</b> for a selected file when BACTalk is already using that file.
Archive format	Save archived data as an Excel (.csv) file or an Access (.mdb) file.
Replace previously archived logs from the same period	Overwrites Excel (.csv) trendlog data files for the same period to save database space. Or, appends Access (.mdb) files for the same period.
Remove all but the most recent periods from the log when archiving	Purge old data from the database and specify the maximum periods of data that should be stored in the database.
Archive all entries in log when archiving	To avoid any data loss, archive all trendlog data in the database.



## Practical application

Jacob can not remember the device instance of the controller for the SUB kWh meter (it has a bunch of 1s in it) but he knows how to get to it on his site data displays. He navigates to the consumption meter value on a display, and then right-clicks to bring up the shortcut menu. He selects Trendlog Management. Because no trendlog already exists for this point, the Edit Trendlog dialog box appears.

Jacob confirms that it is the correct data point, Device 111101, AI-1. A trendlog host has been assigned to Device 111101, a VLC-550, in Device Manager. So the correct BTI, device instance 111000, appears as the host device in the trendlog setup. Also, the trendlog handler selection defaults to "NotClass 1," which was

already set up for another trendlog. Jacob clicks **Trendlog Handler** and verifies that the server is designated as the trendlog recipient.

He knows this trendlog will eventually be used as a meter input to an energy log, so he makes sure he selects the right units: kW or kWh? it is a consumption meter so he selects kWh. (See “Setting up meters” on page 207.)

He leaves the log object name the same, but types in a description, “SUB kWh meter,” so that he will know what the trendlog is when he sees it in listings.

He does not adjust the buffer size or the notification threshold. He also decides to leave the trend interval at the default 60 seconds because he will be using it later with energy logs.

Jacob thinks about the maximum samples setting. He knows there are 1440 minutes in a day. So to keep a month’s worth of samples in the database, he needs to set Max Samples to at least 44,640 (31 days X 1440). He sets it to the maximum, 50,000, knowing that there is plenty of hard disk space on the server. He knows that such a big database will slow the performance in BACtalk, but since he will mostly be using the data in Excel anyway, it does not matter.

He leaves the decimal places displayed to 1, and he ignores the setting for showing text for binary values.

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## Using the multiple trendlog builder

Envision for BACtalk enables you to quickly set up a number of similar trendlogs for a range of controllers at one time. This is useful for sites with a large number of VLCs or other unitary devices performing essentially the same application task with the same I/O configuration—VAV controllers, for example.

You can set up trendlogs for space temperature and supply air temperature all at the same time for all the controllers. The device instance of controllers must be sequential (110101, 110102, 110103...for example), and it is best that the controllers have the same I/O configuration—for example, AI-0 is space temperature in all controllers.

The Multiple Trendlog Builder is also useful if you have more than one trendlog to set up in a single device.

In the global controller defined as the host device, Envision for BACtalk creates a trendlog for each of the properties in each device. For example, you can build identical logs for the present-value of AI-0 and AI-2 in controllers 110101 through 110130.

Set the Trendlog interval to 60 seconds if the job uses energy logs.

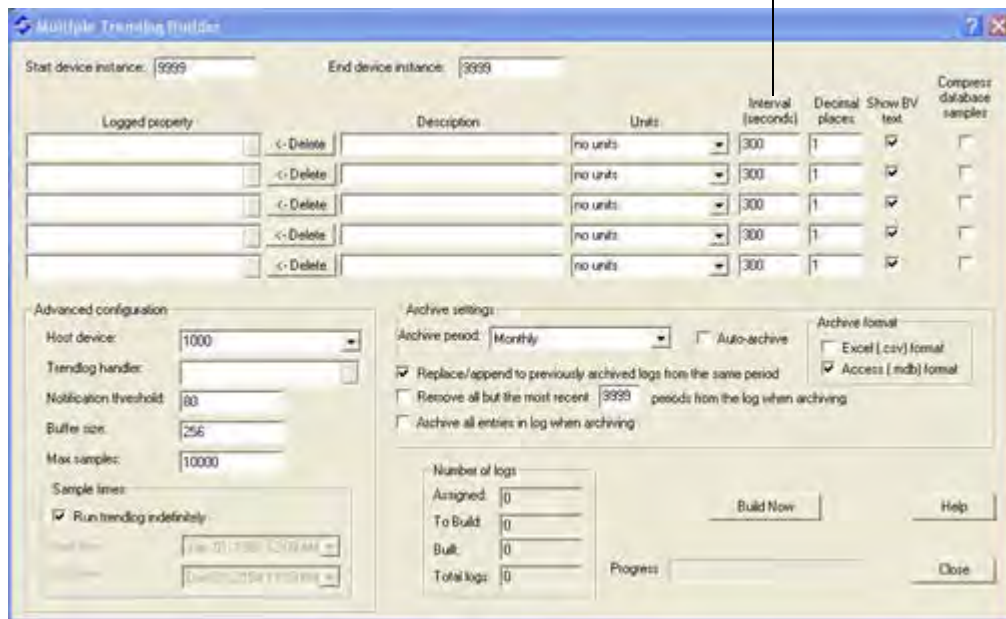


Figure 8.3 Multiple Trendlog Builder dialog box

Use the following guidelines to set up multiple trendlogs.

Table 8.4 Parameters for setting up multiple trendlogs

Item	Description
Start/End Device Instance	Type the device instance of the first and last device in which you want to log data. Trendlogs are built for properties in devices from the Start Device Instance to the End Device Instance.
Logged Property	The property whose value you want to log. After initial setup, the selection cannot be changed. This is usually the present-value of an AV, BV, AO, BO, AI, or BI.
Description	Type text that further identifies the trendlog and appears as the sample data heading in the trendlog view window. An example is "Room Temp." Valid descriptions are 1–40 characters.  You can save time by using variables in the Description field. See "Using variables for trendlog descriptions" on page 177.
Units	If desired, select a unit of measure to display when viewing trendlog data and to use if an energy log uses this trendlog (see "Setting up meters" on page 207).

**Table 8.4** Parameters for setting up multiple trendlogs

Item	Description
Interval (seconds)	<p>The frequency, in seconds, that the logged property is sampled. The trendlog records a sample for the logged property at each interval. Default is 60 seconds.</p> <p>Always use the maximum interval that meets your trendlog objectives. Stated minimum is 10 seconds, but this assumes best-case network conditions, which rarely exist. The practical minimum depends on network and site-specific conditions. A greater number of logged points, more network traffic, a slower network connection, or a greater physical distance between the property and the host device requires a less frequent trend interval.</p> <p>Begin with the least frequent trend interval that is reasonable for your application, and then check your trendlogs for gaps and “Sample Interval Too Frequent” messages. Adjust your trend interval upwards if gaps or errors appear. There is no applicable maximum for trend interval.</p>
Decimal Places	<p>Enter the number of digits you want to appear to the right of the decimal point for analog values in the trendlog view window.</p>
Show BV Text	<p>Select this check box if you want the trendlog viewer to display text, such as ACTIVE and INACTIVE, for binary values. Clear the check box to display 1s and 0s.</p>
Compress database samples	<p>Select this check box to filter out trendlog samples so that only samples that are different from the previous sample get logged. Database records that exist before Log on COV is activated remain in the database and do not get altered. All logged records in the database are displayed.</p>
Host Device	<p>On initial setup, select a global or building controller where the trendlog setup is stored. After you select a host device on initial setup, the selection cannot be changed.</p> <p>Building controllers can host trendlogs only for their local properties. The host device defaults to the host established in Device Manager for the device where the logged property originates.</p>
Trendlog Handler	<p>On initial setup, click the command button, and then select a trendlog handler, which determines the operator workstation that gathers trendlog data from the controller. After initial setup, this selection cannot be changed. Typically, one trendlog handler is set up for each controller and the recipient is the Envision for BACTalk server. If a trendlog handler does not exist in the host device, Envision for BACTalk prompts you to create one.</p>
Notification Threshold	<p>Type a value in number of samples. When the host device gathers this many samples, it sends notification to the operator workstation to gather the sampled data. This value should be significantly less than the buffer size to minimize the possibility of data loss. See “Advanced trendlog options” on page 178 for more information.</p>
Buffer Size	<p>Determines the total number of samples that the host device can retain before samples are lost. See “How trendlog samples are gathered and saved” on page 166 for more information.</p>



**Table 8.4** Parameters for setting up multiple trendlogs

Item	Description
Max Samples	The number of samples the database at the operator workstation saves before it deletes the oldest data. Allowable range is 5,000 to 50,000 samples. The default is 10,000 samples. Smaller values help performance—Envision for BACtalk will read the database more quickly, but you must archive data more frequently.
Run trendlog indefinitely	Select to enter the date and time that trendlog sampling should begin and end. These fields are disabled if the “Supports BACnet Trendlog” capability is not selected in the Device Profile for the host device.
Archive period	Daily, weekly, twice a month, monthly, quarterly, twice a year, yearly.
Auto archive	Select the check box to enable auto-archive. Otherwise, a user must manually click <b>Archive Now</b> to archive trendlog data.
Archive format	Save archived data as an Excel (.csv) file or an Access (.mdb) file.
Replace previously archived logs from the same period	Overwrites Excel (.csv) trendlog data files for the same period to save database space. Or, appends Access (.mdb) files for the same period.
Remove all but the most recent periods from the log when archiving	Purge old data from the database and specify the maximum periods of data that should be stored in the database.
Number of logs	Assigned = number of logs already in the host device To Build = number of additional logs this build will create Built = number of logs built so far for the current build request Total logs = sum of existing and new trendlogs in host device



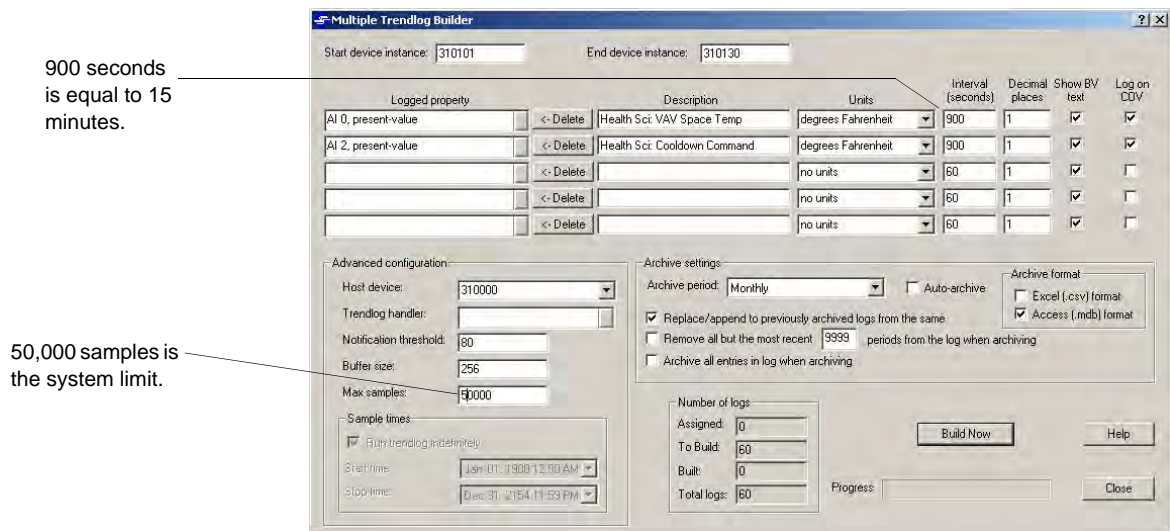
## Practical application

Mario, the lead engineer in the Health Sciences building, wants a weekly report showing space temperature trends, in graph format for every 24 hours in 15-minute increments, for every zone in the Health Sciences building as part of an evaluation of the optimum start program there. Joe, a facilities engineer, is responsible for setting up the trendlogs. Mario wants the graphs shown alongside the cooldown command status for the zone.

After looking at the site documentation, Joe sees that all the VAV boxes in the Health Sciences building are set up with sequential device instances, 310101-310130 (floor 1), 310201-310230 (floor 2), 310301-310330 (floor 3), and all have the same references for space temperature, AI-0. Fortunately, all of these VAV controllers also have the same cooldown command, BV-42.

Joe decides this is a great application for the multiple trendlog builder. He opens up the Trendlogs dialog box from the BACtalk menu and clicks **Add** to create multiple trendlogs for the Health Sciences building. He specifies the starting device instance for the Health Sciences VAV on the first floor that he wants to set up a trendlog for; it is a VLC with device instance 310101. The ending device instance is VLC 310130. Then Joe sets the logged properties that he wants to trend, AI-0, present-value. He types in a description that can be used for all these trendlogs. Joe uses “Heath Sci: VAV Space Temp.” He sets up the cooldown command for BV-42 and labels it “Health Sci: Cooldown Command.” Joe also

changes the Interval setting to 900 seconds. Like Jacob over in the SUB, Joe sets the Max Samples value to the maximum limit of 50,000.



**Figure 8.4** Multiple Trendlog Builder dialog box setup for the first floor of the Health Sciences building

When Joe finishes setting up both series of trendlogs, he views each of the space temperature logs, right-clicks the column heading for each one, selects **Add companion log**, selects the corresponding BV from the list, and then clicks **Select**. Joe can now see the two trendlogs side by side in the Trendlog View dialog box.

## Using variables for trendlog descriptions

When setting up trendlogs, typing descriptions can be time consuming - especially when creating multiple trendlogs. Variables streamline this task by retrieving information from the Envision for BACtalk server and placing it in the description field of the trendlog(s).

To use variables, type the variable in the description field. When you build the trendlog(s), the returned values will be shown in the description field. In Multiple Trendlog Builder, two variables (%3 and %4) are placed in the description field by default. Table 8.5 lists all of the variables.

**Table 8.5** Trendlog description variables

Variable	Description	Example
%1	The device instance of the device that hosts the monitored property.	"702"
%2	The monitored object, property, and the description of the property in parentheses.	"AI 3, present-value (return air temp)"

**Table 8.5** Trendlog description variables

Variable	Description	Example
%3	The device instance of the monitored property, preceded by the word "Device" and followed by the device's description in parentheses. Included in the default description.	"Device 110006 (Fan-Coil 6 Controller)"
%4	The monitored property without the property's description. Included in the default description.	"AI 4, present-value"
%5	The device description of the monitored property. Fan-Coil 6 Controller. If the description is empty, returns "Device <device instance>".	"Fan-Coil 6 Controller" or "Device 702"
%6	The description of the object containing the monitored property. If the description is empty, returns the monitored object and property.	"return air temp" or "AI 5, present-value"

## Advanced trendlog options

For most trendlogs, the defaults in the trendlog setup dialog boxes (Edit Trendlog and Multiple Trendlog Builder) are adequate. This topic is intended for advanced users. This information is useful if you experience gaps in trendlog data or if you have unusual trendlog or site circumstances.

### Calculating the buffer size

When you set a buffer size for a trendlog, consider how many trendlogs the controller hosts, or is planned to host, and the number of other objects (such as schedules and calendars) the controller hosts. The amount of memory a trendlog occupies depends on the buffer size, expressed in samples, that you select for a trendlog. For example, each BTI has approximately 6.2 MB reserved for object memory, and the BCM-ETH has about 2.5 MB reserved for object memory. Leaving ten percent of available memory free is a good rule of thumb for all controllers.

When you set a large buffer size for a trendlog and combine it with a relatively small notification threshold, you are less likely to lose data if the operator workstation can not gather samples for some reason (for example, it is shut off or Envision for BACtalk is not running). However, your global controller will not be able to support as many trendlogs.

Use the following equation to calculate how much host controller memory a trendlog will occupy based on buffer size:

$$n + 194 + ([1 + \text{int}(s/128)] \times 1160) = \text{Bytes for Trendlog}$$

s = value of buffer size in samples

n = number of characters in object name and object description

**Note**  $\text{int}(s/128)$  indicates to use the integer portion of  $s/128$ . For example, if  $s/128 = 8.59$ ,  $\text{int}(8.59) = 8$ . If  $s/128 = 0.78$ ,  $\text{int}(0.78) = 0$ . This portion of the equation accounts for the controller's assigning of trendlog memory in 128-byte blocks.



## Example

Buffer Size (s) = 288

Object Name = *Alerton Log Object 54* (21 characters)

Object Description = *Outside Air Temp.* (17 characters)

(n) = 21 + 17 = 38.

$38 + 194 + ([1 + \text{int}(288/128)] \times 1160) = 3712$  bytes

### Choosing a notification threshold

The notification threshold determines when the notification-class object alerts an operator workstation to gather trendlog data. The smaller your notification threshold relative to your buffer size, the more secure your data is—there is more room to store data in the buffer if a notification is not effective. The buffer size minus the notification threshold is called *slack*.

An excessively small notification threshold (especially for a number of trendlogs) might burden your network with rapidly repeating notifications. A good notification threshold value for critical trendlogs is approximately 30% of the buffer size, which allows for three notifications before data begins to drop out of the buffer. Also consider the trend interval when you set the buffer size and notification threshold. A smaller trend interval might warrant a larger buffer size and a smaller notification threshold, and a larger interval just the opposite.

### Calculating slack time

An important calculation is *slack time*. This is the amount of time that the recipient operator workstation can be offline before the oldest samples in the trendlog are deleted. If slack time is exceeded, gaps in trendlog data appear.

#### Equation for determining slack time in minutes

$$(\text{Buffer Size} - \text{Notification Threshold}) \times (\text{Trend Interval}/60) = \text{Slack Time}$$

This equation can be useful for:

- Stand-alone applications, when determining how often to connect to gather log data.
- For applications where the recipient operator workstation may be offline for some time.



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### Example

Trend Interval = 30 sec.  
Buffer Size = 256  
Notification Threshold = 80

$$(256 - 80) \times (30/60) \cong 88$$

Using this example, the notification threshold is reached roughly every 40 minutes  $(\text{Trend Interval} \times \text{Notification Threshold})/60$ , and then the Envision for BACtalk server is notified to gather data. The server has roughly 88 minutes to gather data before samples are lost. This process is just a way of converting the number of samples to a time value.

**Note** The global controller only notifies the Envision for BACtalk server when the notification threshold, or a multiple of the threshold, is reached (80 samples, 160 samples, 240 samples, for example). If the Envision for BACtalk server is offline when the 80, 160, and 240 notifications are sent, and it comes back online at 250 samples, it will not process the log until it receives the 320 sample notification. If the buffer size was set to 256 samples, 64 samples will have been lost by the time the Envision for BACtalk server receives the 320 sample notification  $(320 - 256 = 64)$ .

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## Viewing trendlogs

The trendlog view function enables you to view trendlog samples in tabular or chart format. This topic provides instructions for viewing trendlog data, updating trendlog data while you are viewing, and customizing how you view trendlog data.

An advanced viewer is available. See “Using the Enhanced Trendlog Viewer” on page 190.

**Note** If you do not update the From and To settings or there are no samples for the most recent day, no data appears in the trendlog viewer. Change the From and To dates, and then press F5 to update data. See “Updating trendlog data while viewing” on page 184 for information.

When you open a trendlog to view (BACtalk>Trendlog Management>Trendlogs>[select a trendlog]>View), Envision for BACtalk displays the data in table view by default. You can also view data in graph view, which plots the data visually for you, or event view, which is useful mostly for trendlog and system troubleshooting.

**Note** It is good practice to close the trendlog window when you are finished working with trendlog data. Leaving the trendlog window open, especially if you have Auto Update selected from the Options menu, can increase network traffic.

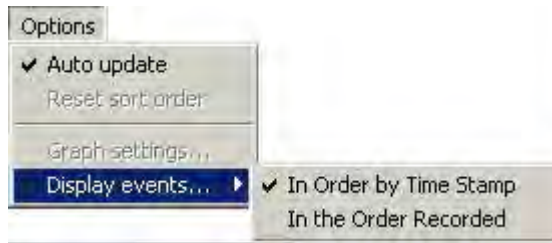
### Table view

This view appears by default with the default sort order being by Time. For the Time column, you can select ascending or descending order and the last ascending/descending sort order selected is retained the next time Trendlog View is opened. Use table view to display trendlog data side-by-side.

Time	Heat indoor air (no units)
2/24/2012 10:19:57 AM	71.0
2/24/2012 9:29:57 AM	71.0
2/24/2012 8:39:57 AM	71.0
2/24/2012 7:49:57 AM	71.0
2/24/2012 6:59:57 AM	71.0
2/24/2012 6:10:00 AM	71.0
2/24/2012 5:20:00 AM	71.0
2/24/2012 4:30:00 AM	71.0
2/24/2012 3:40:00 AM	71.0
2/24/2012 2:50:00 AM	71.0
2/24/2012 2:00:00 AM	71.0
2/24/2012 1:10:00 AM	71.0
2/24/2012 12:20:00 AM	71.0
2/23/2012 11:30:00 PM	71.0
2/23/2012 10:40:00 PM	71.0
2/23/2012 9:50:00 PM	71.0

Figure 8.5 Trendlog viewer—table view

Change the order in which trendlogs are displayed using the Options menu.



**Figure 8.6** Display trendlogs in Table View in order by time stamp or in the order recorded

**Note** Sort orders are not retained when you switch between Trendlog views (Table View, Graph View, and Event View). Time is always the primary sort order when Trendlog Table View opens.

By default, trendlog samples are displayed In Order by Time Stamp. If the view is changed to In the Order Recorded, this becomes the default view the next time the trendlog viewer is opened.

The Reset Sort Order option restores trendlogs to sorted by Time. This option is disabled if Auto Update is selected or if the view is already in the default sort order.

**Note** When viewing trendlogs In the Order Recorded, companion logs are not displayed and companion log configuration is not available.

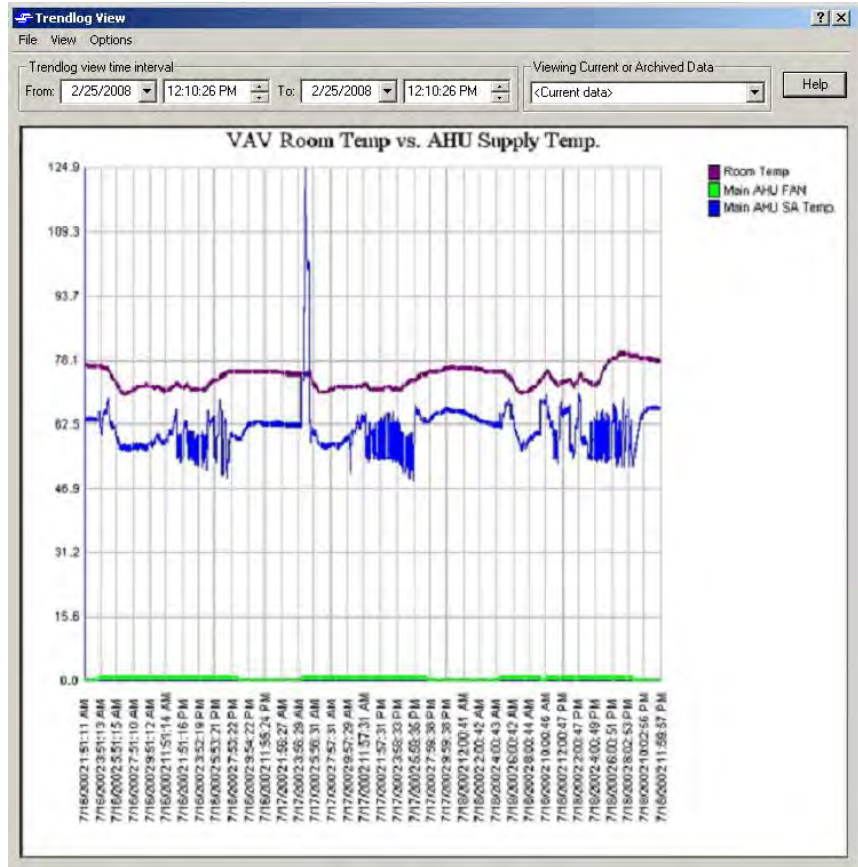
There are several ways to refresh trendlog data while working in Trendlog Table View:

- Click **Reset Sort Order** on the Options menu
- Add or delete a companion trendlog
- Click **Display Events** on the Options menu, and then select a different sort order
- Switch to a different trendlog view (Table View, Graph View, or Event View)
- Resort the Table View by the Time column



## Graph view

Use this view to display trendlog data graphically. Drag the mouse across the graph to zoom in on a specific portion of the graph.

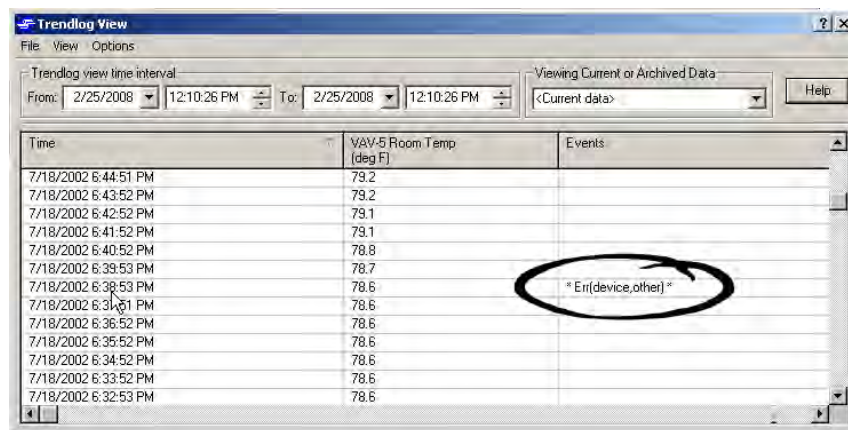


**Figure 8.7** Trendlog viewer—graph view

**Note** When you view data as a line graph, Envision for BACTalk compresses the X axis to view all the samples in the date/time range you specify in the From and To boxes. In bar graph view, the display is limited to approximately 45 samples at a time, and Envision for BACTalk displays samples beginning with the From date. If you switch back to line graph mode, only those first samples are displayed. Right-click anywhere on the graph and then click **Zoom Out** on the shortcut menu to return to the compressed view.

## Event view

The event view can be useful when troubleshooting to see if any error events were transmitted along with the data sample. If you see a strange data sample or group of samples, you may want to check event view to see if Envision for BACtalk recorded an error event.



**Figure 8.8** Trendlog viewer—event view

**Note** If companion logs are included, they are hidden while event view is active.

## Adding companion logs

Companion logs enable you to view multiple data sets together. Data from the logs appear side-by-side with the primary log. You can view up to 10 data sets at once. You set up companion logs in table view. Once you set up companion logs, you can switch to graph view. Until companion logs are deleted, they are displayed when their primary logs are displayed.

**Note** When viewing trendlogs In the Order Recorded, companion logs are not displayed and companion log configuration is not available.

### ► To add a companion log to table view

1. On the BACtalk menu, click **Trendlog Management** and then click **Trendlogs**.
2. Select the trendlog you want to view, and then click **View**.
3. Right-click the heading for the trendlog, and then click **Add Companion Log**.
4. In the list of trendlogs, click the companion logs you want to view, and then click **Select**.

The companion log appears to the right of the currently selected trendlog.

## Updating trendlog data while viewing

When you view trendlog data, you view samples from the database at the Envision for BACtalk server. When you first open a trendlog, Envision for

BACtalk retrieves the most recent samples from the global controller or building controller.

Select **Auto Update** on the **Options** menu (BACtalk>Trendlog Management>Trendlogs>View) to ensure that the data in the trendlog viewer updates whenever the server retrieves samples from the controller. See “How trendlog samples are gathered and saved” on page 166 for more information.

There are essentially three ways that the trendlog database can be updated with samples from the controller while you are viewing a trendlog:

- Change the To date and time to a time more recent than the most recent sample in the database and then press F5.
- Close the trendlog viewer and re-open it.
- With Auto Update selected, wait for the Envision for BACtalk server to receive log data at the interval established in the log handler.

## Archiving trendlog data

Envision for BACtalk enables you to archive trendlog data as a comma-separated values (\*.csv) file or an Access (\*.mdb) file. These files are saved on the Envision for BACtalk server in the server’s Archive directory. Specify the Archive directory using the Site Configuration dialog box (General System Setup>Network>Site Configuration).

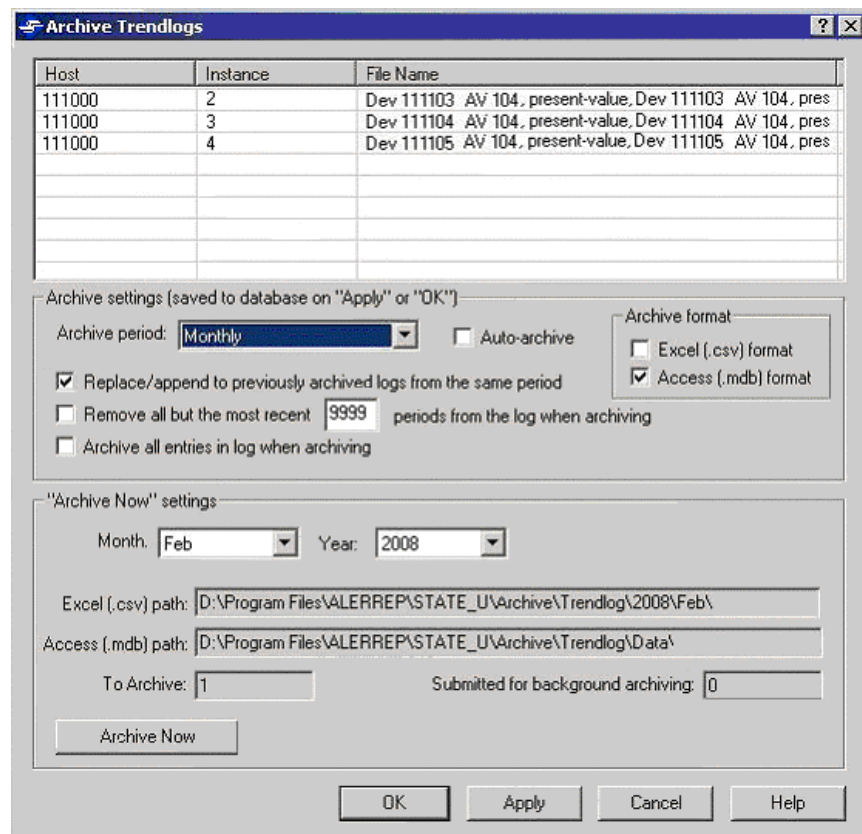
Most spreadsheet and database programs can read .csv files. This is useful for exploring trendlog data for sophisticated analysis.

The Access (\*.mdb) file format supports viewing archived data in the trendlog viewer. This is the option selected by default.

From the list of trendlogs (BACtalk>Trendlog Management>Trendlogs), select the trendlogs you want to archive. Use Shift+click to select a range and then Ctrl+click to add or remove a trendlog. Click Archive to archive your selected trendlogs.

Use the auto-archive feature to set the BACtalk server to automatically archive trendlog data (BACtalk>Trendlog Management>Trendlogs). You can archive records daily, weekly, twice a month, monthly, quarterly, twice a year, and yearly.

Archive trendlog data from the BACTalk server or client workstations. However, archived data is always stored on the server.



**Figure 8.9** Archive Trendlogs dialog box

Envision for BACTalk displays the trendlog list you have selected.

The current archive settings for the displayed trendlogs are also shown. Where settings are different between trendlogs, the setting is blank or gray. Changing a setting forces that setting to be used by all the selected trendlogs.

The Archive Now area controls the actual date range to be used when manually archiving trendlogs. Select the date range you want and then click Archive Now to immediately send the data to the server for archiving in the Archive directory. View the archive operation's progress in the User Request Monitor.

**Note** If you change the archive settings to do Archive Now but do not want to permanently change the settings used for auto-archiving, click Cancel after the Archive Now operation is complete. Otherwise, the updated archive settings you last used for Archive Now are saved to the database and they will be used for all subsequent auto-archive operations.

## Auto-archive

Selecting the "Auto-archive" check box causes the selected trendlogs to automatically archive starting at midnight following the selected archive period. For example, a log that is archived Monthly will archive the previous month's data at midnight on the first of each month. As part of the auto-archive operation,

the latest trendlog data from the host device is gathered and stored in the database prior to archiving.

Auto-archiving occurs according to the following schedule. Weeks are defined as Sunday through Saturday. Therefore, weekly auto-archiving happens on Sunday morning at midnight for the previous week ending Sunday night at 23:59:59. All times are local time.

**Table 8.6** Auto-archive scheduling

Auto-archive period	Scheduled start time
Daily	At 12:00:00 midnight for the previous day
Weekly	Sunday at midnight for the previous week
Semi-monthly	The 1st and 16th of each month at midnight for the previous period
Monthly	The 1st of each month at midnight for the previous month
Quarterly	The 1st of January, April, July, October at midnight for the previous quarter
Semi-annual	The 1st of January and July at midnight for the previous half-year
Annual	The 1st of January at midnight for the previous year

## Replacing or appending to previously archived data

If you create an archive file using “Archive Now” and then decide to set up a log for auto-archiving, perform auto-archiving and BACtalk will add new data to your existing archive file. If the default “Replace/append to previously archived logs from the same period” setting is checked, .csv files get overwritten if they exist and .mdb files get appended if they exist.

If this check box is not checked and the archive file for the selected period already exists, then the archive operation is skipped.

Data for each archive period is saved with a unique file name. For example, monthly archive data for February 2008 is saved in a different file than monthly archive data for Mar 2008. File names are also different based on the archive period. For example, weekly archive data will have different file names than monthly archive data.

## Removing old log entries

The “Remove all but the most recent \_\_\_ periods from the log when archiving” option allows you to clear out old data from the current database during an archive operation. Data from the selected period is archived, and then any old data is removed from the current database. The age of data to be removed is controlled by the number of periods entered. The default number of periods is 9999 to prevent inadvertent loss of data in case the check box is accidentally checked. For example, if you have “Monthly” selected and check the “Remove all but the most recent \_\_\_ periods from the log when archiving” option with the number of periods set to 12, all but the most recent 12 months’ worth of data will be removed from the current database once the archive operation completes.

If you have “Daily” selected and check the “Remove” check box with the number of periods set to 365, all but the most recent 365 day’s worth of data gets removed from the current database after the archive operation completes.

**Note** If an error occurs during the archive operation, no data will be removed. This prevents inadvertent data loss.

## Archiving all entries

If you check “Archive all entries in the log when archiving” check box, all data in the current database gets copied to the appropriate archive file when archiving, regardless of the selected archive period. However, the file name(s) for the archived data will be based on the selected archive time period.

This option is especially useful for “Archive Now” operations the first time you set up your system for auto-archiving. By selecting those trendlogs you want to auto-archive and performing an “Archive Now” operation with the “Archive all entries in the log when archiving” check box checked, you will essentially create an on-line backup copy of all of your old trendlog data to which you can refer once you start removing old data (using the “Remove all but the most recent \_\_\_\_\_ periods from the log when archiving” option) as a part of the auto-archiving operation.

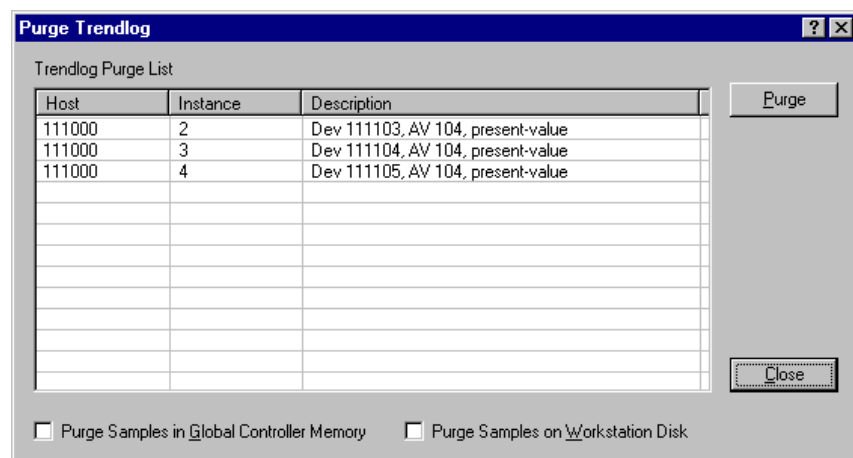
You probably do NOT want to check this option for auto-archiving, since you will end up with additional copies of the entire database on the server disk each time auto-archive runs. This can fill up the disk rapidly, especially for frequent archives, such as Daily or Weekly.

## Purging trendlog data

Purging trendlog data clears all samples from the Envision for BACtalk server and from the controller, at your discretion, but retains the trendlog setup.

From the list of trendlogs (BACtalk>Trendlog Management>Trendlogs), select the trendlogs you want to purge. Use Shift+click to select a range and Ctrl+click to add or remove a trendlog from a selection. Then click the Purge button.

The options to purge from global controller memory or from workstation hard disk apply to all selected trendlogs.



**Figure 8.10** Purge Trendlog dialog box

## Printing a trendlog view or list

Once you have trendlog samples sorted and displayed the way you want in table, graph, or event view, click **Print** on the File menu. You can then select a printer connected to the local operator workstation from the Windows print manager.

If you need to print a listing of all the trendlogs set up in your system, click the Print button in the Trendlogs dialog box.

## Using the Enhanced Trendlog Viewer

### About Enhanced Trendlog Viewer

Enhanced Trendlog Viewer extends Envision for BACtalk's built-in trendlog viewing functionality. It helps you troubleshoot the behavior of a building control system and allows you to see how data from one trendlog relates to other trendlog data. It shows data from as many as ten trendlogs on an interactive line graph.

See the Enhanced Trendlog Viewer Installation Instructions (LTBT-TM-TLVINST) for information about installing Enhanced Trendlog Viewer.

### Configuring Enhanced Trendlog Viewer

Before you begin using Enhanced Trendlog Viewer, consider limiting the size of search results. If your network includes a NAT firewall, you must add an entry to `bactalk.ini` to enable communication across the firewall.

#### Limiting the size of search results

Large search results can consume network bandwidth and take a long time to process. Limiting the number of trendlogs returned by a search can minimize network traffic and reduce the time required to display results.

The **Max Trendlogs to Display** text box on the **Trendlog Selection** dialog box allows the user to set the maximum number of trendlogs returned. If the number of trendlogs that meet the search criteria exceeds the limit, Enhanced Trendlog Viewer shows an error message.

You can limit the number the user can enter in **Max Trendlogs to Display** by setting the **MaxTrendlogSearchResults** entry in the `bactalk.ini` file.

#### ► To set **MaxTrendlogSearchResults**

1. Open `bactalk.ini` in a text editor such as Notepad. The default location of `bactalk.ini` is `C:\Alerton\BACtalk\3.0`.
2. In the `TrendlogViewer` section, set **MaxTrendlogSearchResults** to the desired value. The default value is 5000.
3. Save your changes and close `bactalk.ini`.
4. Refresh the Enhanced Trendlog Viewer page.

#### NAT firewall issues

If there is a NAT firewall between the Envision for BACtalk server and an Envision for BACtalk client, you must edit the client's `bactalk.ini` file to ensure the client can communicate with the server.

#### ► To configure clients in a NAT environment

1. On the client computer, open the `bactalk.ini` file. The default location is `C:\Alerton\BACtalk\3.0`.
2. In the `[Niagara]` section, add two entries - `PublicHostName` and `PublicHttpPort`.



3. If the client is separated from the server by a NAT firewall, use the server's public hostname and port (as assigned by the network administrator) to populate the PublicHostName and PublicHttpPort entries in the bactalk.ini file.

**Note** If the client is not separated from the server, it uses the server's local hostname and port to populate the PublicHostName and PublicHttpPort entries in the bactalk.ini file. You do not need to change these entries.

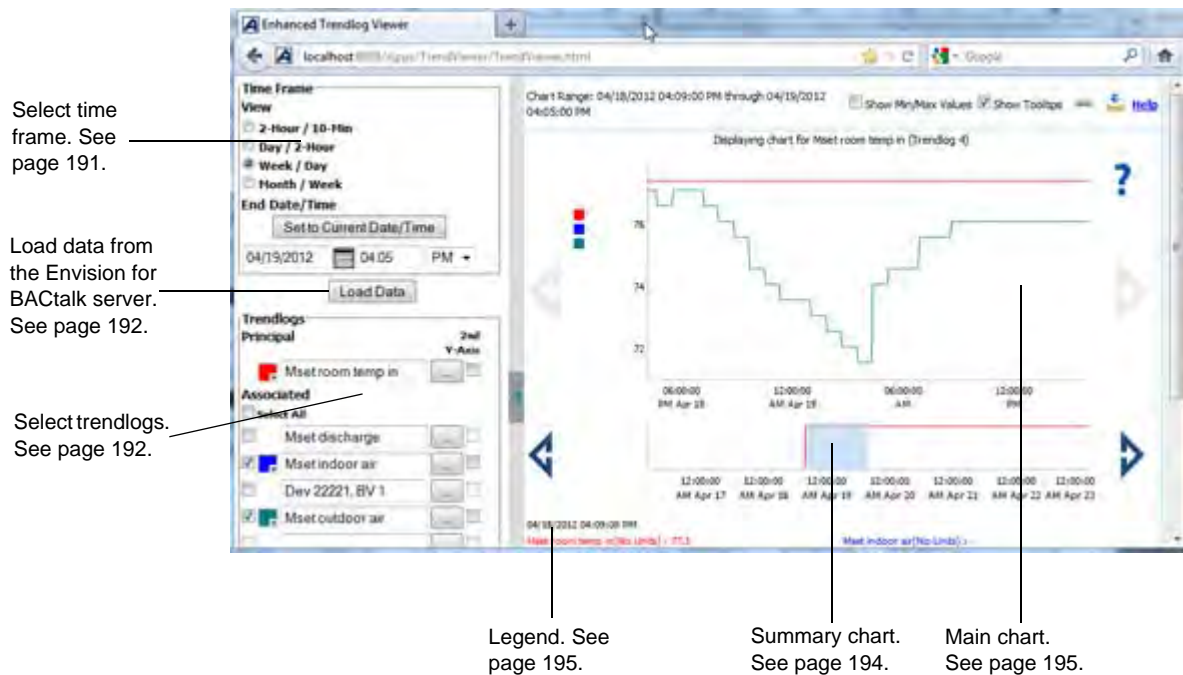
4. Save the changed bactalk.ini file and then refresh the Enhanced Trendlog Viewer page.

## Starting Enhanced Trendlog Viewer

Starting Enhanced Trendlog Viewer requires a valid Envision for BACtalk user profile. When you start Enhanced Trendlog Viewer, it opens in the default web browser.

### ► To start Enhanced Trendlog Viewer from a server

1. Log in to Envision for BACtalk.
2. On the BACtalk menu, select **Trendlog Management** and then click **Enhanced Trendlog Viewer**.



**Figure 8.11** Enhanced Trendlog Viewer user interface

## Setting the time frame

This is where you select the time frame for the data that is retrieved and how much of that data is displayed on the charts. The range is shown just above the main chart.

## Views

Trendlog data is shown in one of four views - 2-Hour/10-Minute, Day/2-Hour, Week/Day, and Week/Month. Views are named to reflect the date/time ranges shown in the summary and main charts.

When you select a view, the application retrieves more data than it shows on the charts. You can view the additional data by panning. You can also view a subset of the displayed data by zooming.

**2 Hour/10 Minutes** When you select 2-Hour/10-Minute view, Enhanced Trendlog Viewer retrieves data for the 24 hours preceding the End date/time. It displays two hours of data in the summary chart and ten minutes of data in the main chart.

**1 Day/2 Hour** When you select Day/2-Hour view, Enhanced Trendlog Viewer retrieves data for the two days preceding the End date/time. It displays one day of data in the summary chart and two hours of data in the main chart.

**1 Week/1 Day** When you select Week/Day view, Enhanced Trendlog Viewer retrieves data for the two weeks preceding the End date/time. It displays one week of data in the summary chart and one day of data in the main chart.

**1 Month/1 Week** When you select Month/Week view, Enhanced Trendlog Viewer retrieves data for one month preceding the End date/time. It displays one month of data in the summary chart and one week of data in the main chart.

## Set to Current Date/Time

This button sets the End Date and End Time to the present date/time on the Envision for BACtalk server and then retrieves data based on the view selected.

## End Date/Time

Use the date picker or type the date of the latest data you want to retrieve from the server. Type an end time and then click Load.

## Loading data

When you select a principal trendlog, Enhanced Trendlog Viewer loads data for that trendlog and up to three associated trendlogs. When you select a new view or click **Set to Current Date/Time**, Enhanced Trendlog Viewer loads data. If you change the date or time, or if you change the associated trendlog selections, you must click **Load Data** to load data from the server.


## Selecting trendlogs

Select a principal trendlog and, optionally, associated trendlogs to show in the charts.

### Principal trendlog

The principal trendlog will appear in the summary chart and the main chart.

#### ► To select a principal trendlog

1. Click the selection button.   
The **Trendlog Selection** dialog box appears.

2. Type part of a trendlog name or description and then click **Search**. You can search without typing search criteria, but this will return all trendlogs and the list may be difficult to sort through.
3. If the search returns more trendlogs than the number set in the Max Trendlogs to Display field, a message appears. Refine your search criteria or increase the **Max Trendlogs to Display**.
4. If you are using a touchscreen device, click the selector arrow to display the list of trendlogs.
5. Select a trendlog and then click **OK**.  
Enhanced Trendlog Viewer retrieves data for the trendlog and displays it in the charts.



If the principal trendlog has companion logs configured in Envision for BACTalk, Enhanced Trendlog Viewer shows up to nine of them as associated trendlogs and displays data for the first three.

### Associated trendlogs

Associated trendlogs appear only in the main chart and can be toggled ON or OFF.

Do not confuse associated trendlogs with companion logs. Associated trendlogs are associated with a principal trendlog only for the duration of the Enhanced Trendlog Viewer session. See Envision for BACTalk online Help for information about companion logs.

#### ► To select associated trendlogs

1. Click the selection button.   
The Trendlog Selection dialog box appears.
2. Type part of a trendlog name or description and then click **Search**. You can search without typing search criteria, but this will return all trendlogs and the list may be large.
3. If the search returns more trendlogs than the number set in the **Max Trendlogs to Display** field, a message appears. Refine your search criteria or increase the **Max Trendlogs to Display**.
4. If you are using a touchscreen device, tap the selector arrow  to display the list of trendlogs.
5. Select a trendlog and then click **OK**.  
Enhanced Trendlog Viewer retrieves data for the trendlog and displays it in the main chart.

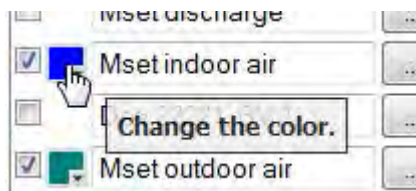
To remove an associated trendlog from the main chart, clear the check box next to it. The associated line disappears from the chart and the trendlog name and description appear dimmed.

### Color selection

When Enhanced Trendlog Viewer loads trendlog data, each trendlog is represented in a different color. If a color is associated with the trendlog in Envision for BACTalk, that color is used. Otherwise, Enhanced Trendlog Viewer assigns a color.

► **To select a new color**

1. Click the colored button to the left of the trendlog name.



The Color Selection dialog box appears.

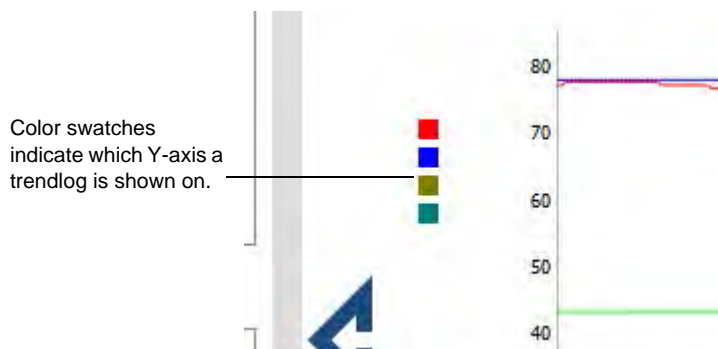
2. Select a color and then click **OK**.
3. Click **Load Data**.

### Secondary Y-axis

If an associated trendlog is measured on a scale or in units different from the principal trendlog, you can display the associated trendlog data on a secondary Y-axis. The secondary Y-axis appears on the right side of the main chart.

To show a secondary Y-axis for an associated trendlog, click the check box button to the right of the trendlog description and then click **Load Data**.

When data for a trendlog is shown on the secondary Y-axis, a corresponding color swatch appears next to the axis. This helps you know which axis a trendlog is shown on each axis.



## Viewing data on the charts

Enhanced Trendlog Viewer shows data in two charts - the summary chart and the main chart.

Trendlog data is represented on the charts by colored lines. The amount of data shown on the charts depends on which view you have selected.

### Summary chart

The summary chart shows all of the data retrieved from the Envision for BACTalk server.

Only the principal trendlog is represented on the summary chart. Use the panning arrows to pan forward and back.

A shaded area on the summary chart indicates the time frame of the data shown in the main chart. You can click and drag this highlighted area to pan through data.

### Main chart

The main chart shows a subset of the data shown on the summary chart in greater detail.

You can zoom in on specific areas of the chart and then pan forward and backward through the data (see “Panning and zooming” on page 197). Each selected trendlog is represented on the main chart.

**Chart range** Shows the date/time range of the data displayed in the main chart.



**Figure 8.12** Enhanced Trendlog Viewer chart range

**Legend** The chart legend, located below the summary chart, shows the date/time and trendlog values based on the location of the cursor in the main chart. Trendlog names/descriptions and values are shown in their associated colors.



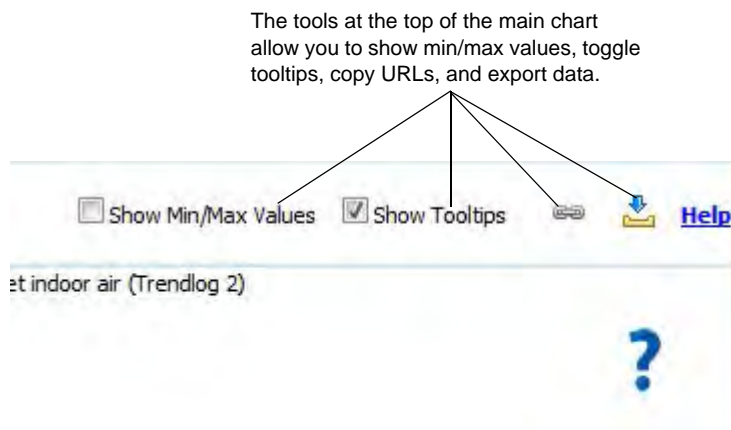
**Figure 8.13** Enhanced Trendlog Viewer legend

The legend shows blank values until the cursor moves onto the main chart. Then it shows the date/time and values as the cursor moves across the chart. Small dots appear on the lines in the main chart to indicate the date/time being shown.

When the cursor is moved off of the main chart, the legend shows the values that were shown at the time the cursor was moved off.

## Tools

Use the tools above the main chart to enable or disable min/max values, copy URLs, toggle tooltips, and to export data.



**Figure 8.14** Enhanced Trendlog Viewer tools

**Show Min-Max Values** The line that represents trendlog data on the main chart is an averaged value. When Show Min-Max Values is selected, the minimum and maximum values are displaced as shadows below and above the trendlog line. Not selected by default.

**Show Tooltips** When this option is selected and you hover the mouse cursor over a button or check box, a tooltip is displayed that explains the function of that button or check box. Show Tooltips is selected by default.

NOTE: Tooltips are not supported on touchscreen devices.


**Copying URLs** If you want to link to a particular trendlog view, you can copy the URL to your computer's clipboard. Then you can paste it into an email, create a link on a graphic display, or paste the URL into a web browser and bookmark it.

When you copy an Enhanced Trendlog Viewer URL, the URL includes information about the view and the trendlogs you have selected. It also includes any secondary Y-axis selections and whether secondary trendlogs are selected for display on the main chart.


URLs do not include end date/time data.

Users must have view privileges for the trendlogs or Enhanced Trendlog Viewer will not display the data.

### ► To copy a URL

1. Click the Copy URL icon  at the top of the main chart area.  
The **Copy URL** dialog box opens.
2. Ensure the URL is selected (highlighted).
3. Press **Ctrl+C**.
4. Click **OK**.

5. Navigate to where you want to use the URL and then press **Ctrl+V** to paste the URL.

**Exporting to CSV** If you want to view trendlog data in another program, you can export the data to a comma separated value (CSV) file. Select the trendlogs and time frame you want to export and click the export icon. 

If you select a large data set that will takes a long time to export, Enhanced Trendlog Viewer will ask you to confirm the operation.


**Note** The Export to CSV function is not available on touchscreen devices.

## Panning and zooming

Navigate the data by panning through the summary and main charts and by zooming in on the main chart.

### Panning



Use the panning arrows  to move backward and forward through the data. You can also pan by clicking and dragging the shaded area in the summary chart

**Main chart panning** You can only pan across the main chart after you have zoomed in. See “Zooming” on page 197.

When you click a panning arrow next to the main chart, Enhanced Trendlog Viewer moves the selected data by 25% of the selected date/time range. Selected data is shown as a shaded area in the summary chart. When you are zoomed in, the date/time range shown in the main chart is represented as a darker shaded area within the shaded area on the summary chart.

### Summary chart panning

When you click a panning arrow next to the summary chart, Enhanced Trendlog Viewer moves the selected date/time range according to the view you have selected.


**Table 8.7** Panning behavior of Enhanced Trendlog Viewer

If you are in this view:	Enhanced Trendlog Viewer will move:
2-Hour / 10-Min	10 minutes
Day / 2-Hour	2 hours
Week / Day	One day
Month / Week	One week

### Zooming

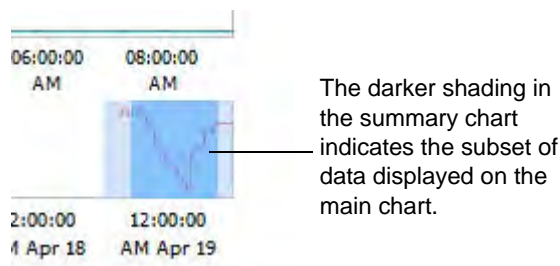
Select a subset of data to view by clicking and dragging in the main chart. The main chart will refresh to show the range of data selected. The axis labels on the chart will reflect the values of the zoomed view.

**Horizontal zooming** Zoom in on a date/time range by clicking and dragging in the main chart.

You can zoom in multiple times. To return to the un-zoomed view, double-click the main chart or click the zoom out icon. 


On a touchscreen device, use standard touchscreen actions to zoom.

When you zoom in horizontally, the summary chart shows the zoomed-in time frame as a dark area in the context of the currently selected view.



**Figure 8.15** Summary chart showing zoomed-in view

**Vertical zooming** Zoom in on a subset of data by clicking the desired starting point and dragging your mouse up or down to the desired end point.

You can zoom in multiple times. To return to the un-zoomed view, double-click the main chart or click the zoom out icon. 

On a touchscreen device, use standard touchscreen actions to zoom.

## Copying URLs

If you want to link to a particular trendlog view, you can copy the URL to your computer's clipboard. Then you can paste it into an email, create a link on a graphic display, or paste the URL into a web browser and bookmark it.

When you copy an Enhanced Trendlog Viewer URL, the URL includes information about the view and the trendlogs you have selected. It also includes any secondary Y-axis selections and whether secondary trendlogs are selected for display on the main chart. URLs do not include end date/time data.

Users must have view privileges for the trendlogs or Enhanced Trendlog Viewer will not display the data.


### ► To copy a URL

1. Click the Copy URL icon at the top of the main chart area.
2. The Copy URL dialog box opens.
3. Ensure the URL is selected (highlighted).
4. Press Ctrl+C.
5. Click OK.
6. Navigate to where you want to use the URL and then press Ctrl+V to paste the URL.



## For touchscreen users

When viewed on a touchscreen device, the Enhanced Trendlog Viewer interface has a few differences from the PC interface:

- To start Enhanced Trendlog Viewer, you must type the URL in a web browser.
- Tooltips are not supported on touchscreen devices.
- CSV export is not supported on touchscreen devices.
- In the trendlog selection dialog box, after you search for trendlogs you must click the down arrow  to see the trendlog list. On a PC the list is populated automatically.



# Energy Logs

# 9

An energy log calculates energy demand and consumption based on a trendlog of *meter* data. Each energy log reports *consumption* and *peak demand* by hour, day, week, month, and year according to the units of measure in the trendlog setup, the meter setup, and the report setup.

## Benefits

**Flexible** Energy logs read trendlogs to calculate energy usage and peak demand by hour, day, week, month, and year. You can view energy logs in table format and export to comma-separated values (.csv) files for further analysis.

**Easy to set up** Set up trendlogs on the fly as you set up a meter. Then create an energy log to read the trendlog.

**Powerful** Set up meters to gather demand or consumption data in energy logs. Use a single meter or combine data from multiple meters into a single energy log. Work with archived energy log data. Energy log data is also used to build the displays in the Alerton Energy Dashboard.



## Practical application

Jacob has already set up the trendlog for the meter (see “Trendlogs” on page 163) that he wants to use for the SUB. All he needs to do now is reference that trendlog as the meter input and set up the energy log.

After the energy logs are set up, Jacob can analyze the data along with the energy bills, to determine the best way to implement a demand limiting program in the SUB.

## Quick start–energy log setup

Use the following table as a guide when setting up energy logs. The key steps for defining energy logs are listed in order.

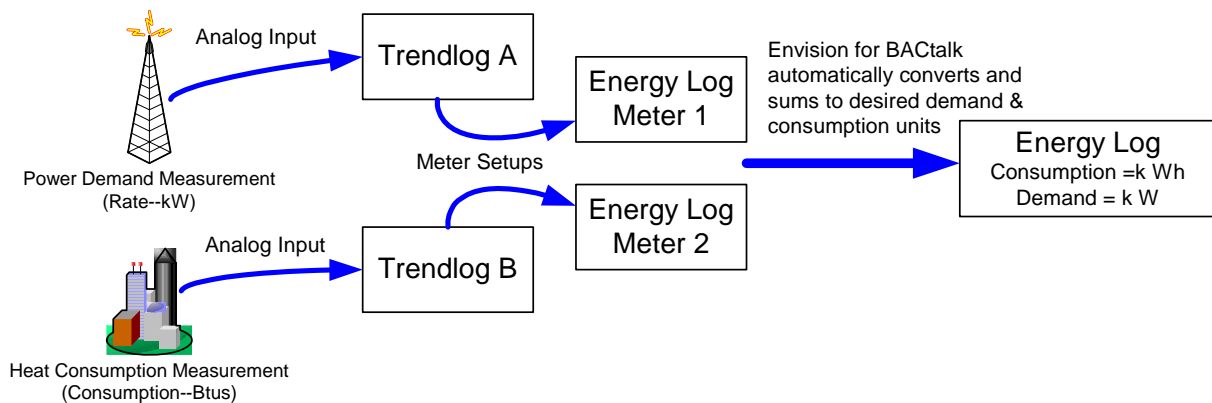
**Table 9.1** Tasks for setting up energy logs

Task		See
1	Set up a trendlog for the energy meters you will use.	• “Trendlogs” on page 163
2	Know the units of measure for the meter and if you need to convert its counts to units.	• Site documentation
3	Know the demand window size you want Envision for BACtalk to use to calculate peak demand.	• “Demand Limiting” on page 213
4	Set up your energy log.	• “Setting up an energy log” on page 205
5	(Optional) Set up an Alerton Energy Dashboard using energy log data.	• “Setting up a dashboard” on page 256

## How energy logs work

When you set up an energy log, you first set up trendlogs for the objects and properties that represent an energy meter input. The energy log then reads the trendlogs you assign and calculates energy usage and peak demand by hour, day, week, month, and year according to the units of measure in the trendlog setup, the meter setup, and the report setup.

You can set up trendlogs on the fly as you set up the meter. Trended properties can report energy consumption or demand data, and they can be regular energy meters or fluid energy meters. You can combine data from multiple meters to create a single energy log.



**Note** There is often much confusion around the difference between energy and demand. Demand is the rate at which energy is used. In the case of electricity, energy is typically measured in kWh and demand is measured in kW, which could be thought of as kWh per hour. For example, if you have a piece of equipment that is rated at 17 kW, it uses 34 kWh of energy if you leave it running for two hours ( $2 \times 17 = 34$ ). Most commercial electrical meters record both the total energy (kWh) used and the highest demand or rate of energy use (kW) since the last time the meter was read.

The *demand window* is a period of time over which demand is averaged to calculate peak demand for a sample period.

See “Demand Limiting” on page 213 or Envision for BACtalk Help for more information about demand windows.

You can enable an *energy index calculation* for your energy log. The energy index is a widely recognized method for normalizing energy use into common units. This enables you to compare energy use in different buildings or spaces. For index calculations, total energy use for a month or year is divided by the square footage to yield energy use per square foot.

## About meters

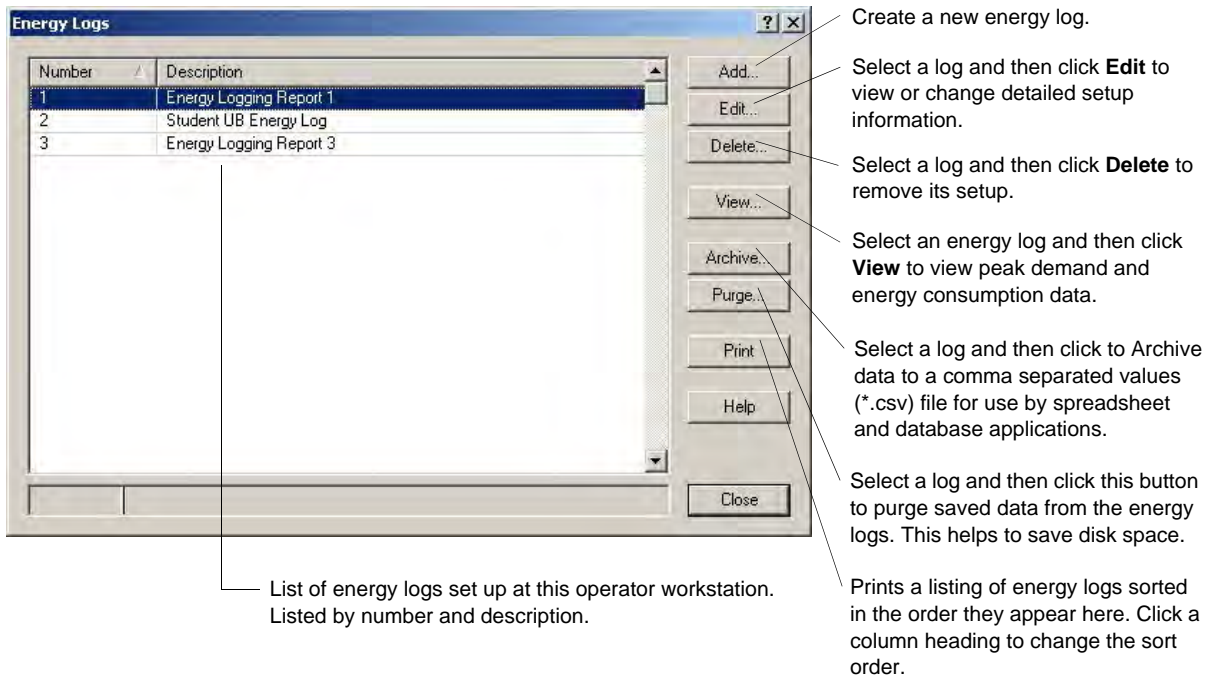
Energy logs use *meters* to gather demand or consumption data. An energy log can use a single meter or the sum of a number of meters. Each meter references a trendlog, and each meter has a unique setup, or profile. A unique *meter number* identifies the meter setup. For example, you might set up one meter to measure power consumption in your building and another to measure heat consumption.

When you set up a meter for an energy log, in addition to the meter name, you specify:

- The trendlog that monitors the meter input.
- The type of meter, which is either demand (rate) or consumption.
- The desired meter units and a conversion factor, if necessary, which is applied to the trendlog sample value to determine a meter reading. (For example, trendlog sample value X conversion factor = meter reading.)
- The trend interval. It is highly recommended that you specify a 60-second trend interval for energy logs.

## Where an energy log is saved

Energy log calculations and data are saved only to the Envision for BACtalk server.



**Figure 9.1** Set up and work with energy log setups from the Energy Logs dialog box.

## Setting up an energy log

When you set up an energy log, you define the meters that measure the energy being used. Any number of trendlogs can use the same meter setups.

The screenshot shows the 'Energy Logging Setup' dialog box with the following fields and options:

- Report number:** 1
- Description:** SUB: ACU-21-501 Kitchen
- Meters:** A table with columns 'Meter', 'Demand', and 'Consum.'. One row shows 'kW Hrs' under 'Meter' and 'kW' under 'Demand'.
- Demand window size:** 15 (min)
- Report units:** A list of units for 'Demand' (kW, Btu/hr, kBtu/hr, ton) and 'Consum.' (kWh, them, kBtu, ton-hr).
- Custom units:** Fields for 'Demand:' and 'Consumption:'.
- Decimal places:** 1
- Energy index units:** A dropdown menu.
- Enable energy index calculation:** A checkbox.
- Total floor area:** 0
- Archive settings:**
  - Report types for Excel (.csv) format: Access (.mdb) format (if selected) archives all report types.
  - Frequency:  Hourly,  Daily,  Weekly,  Monthly,  Yearly.
  - Archive period: Monthly
  - Auto-archive:
  - Archive format:  Excel (.csv) format,  Access (.mdb) format.
  - Replace/append to previously archived logs from the same period
  - Remove all but the most recent 9999 periods from the log when archiving
  - Archive all entries in log when archiving

Annotations on the left side of the dialog box:

- Text that identifies the energy log in listings and reports. (points to Report number)
- Meter list assigned to this log. If the meter is a rate meter, a unit of measure appears under Demand. For consumption meters, units appear in the Consum. column. (points to Meters table)
- Envision for BACtalk calculates peak demand using a sliding window with this time span. Default is 15 minutes. The window with the highest average within a period (hour/day/month/year) is that period's peak demand. (points to Demand window size)
- Demand and consumption units used on reports and when converting and summing meter data. Select <custom> from the list and then type demand and consumption units under Custom Units. Custom units require custom meter units, and all must precisely match. (points to Report units and Custom units)
- The number of significant digits to appear to the right of the decimal in energy log samples. (points to Decimal places)
- The floor area in square feet to be used for the energy index calculation. (points to Total floor area)

Annotations at the bottom of the dialog box:

- Set up BACtalk to automatically archive energy log data, (points to the Archive settings section)
- Click to enable energy index calculation and then select energy index units from the list and type the total floor area in square feet. Not used with custom units. (points to the Energy index units and Total floor area fields)

**Figure 9.2** Energy Logging Setup dialog box

Select options according to the following guidelines.

**Table 9.2** Guidelines for setting up energy logs

Item	Description
Description	Type a description for the energy log. For example, "SUB: ACU-21-501 Kitchen."
Meters	Shows meters assigned to this log. Each meter is identified by description. If a rate meter, a unit of measure is displayed in the Demand column. If a consumption meter, units are displayed in the Consum. column.
Demand Window Size	Type a demand window value in minutes. Envision for BACtalk calculates peak demand using a sliding window with this time span. The default is 15 minutes. The window with the highest average within a period (hour/day/month/year) is that period's peak demand. See "Demand Limiting" on page 213.
Report Units	Lists demand and consumption units that appear on the report and that are used in converting and summing meter data. Click to select the report units you want to use from the list.
Custom Units	This option is only available if you select <custom units> from the Report Units list. For more information, see "Using custom energy log units" on page 207.
Decimal Places	Type the number of digits to appear to the right of the decimal in energy log samples.
Energy Index Units	Select the check box to enable energy index calculation and then select Energy Index Units from the list. Not available when custom units are used. See page 203 for more information about the energy index calculation.
Total Floor Area	Type the floor area in square feet to be used for the energy index calculation. See page 203 for more information about the energy index calculation.
Report types	Excel (.csv) or Access (.mdb)
Archive period	Daily, weekly, twice a month, monthly, quarterly, twice a year, yearly.
Auto archive	Select the check box to enable auto-archive. Otherwise, a user must manually click <b>Archive Now</b> to archive trendlog data. Archived files are saved to the server. <b>NOTE:</b> Do not attempt to open an MDB file that is already in use by BACtalk. For example, do not click <b>Archive Now</b> for a selected file when BACtalk is already using that file.
Archive format	Save archived data as an Excel (.csv) file or an Access (.mdb) file.
Replace/append to previously archived logs from the same period	Overwrites Excel (.csv) trendlog data files for the same period to save database space. Or, appends Access (.mdb) files for the same period.
Remove all but the most recent periods from the log when archiving	Purge old data from the database and specify the maximum periods of data that should be stored in the database.
Archive all entries in log when archiving	Archive all data to prevent any loss of energy log data.



## Using custom energy log units

If you select custom units when you set up an energy log or an energy log meter, follow these rules:

- Set up all meters with the same custom units for rate or consumption as appropriate.
- Energy log custom units must precisely match the meter's custom units.
- The relationship between demand and consumption units must always be <units>/hour and <units>.

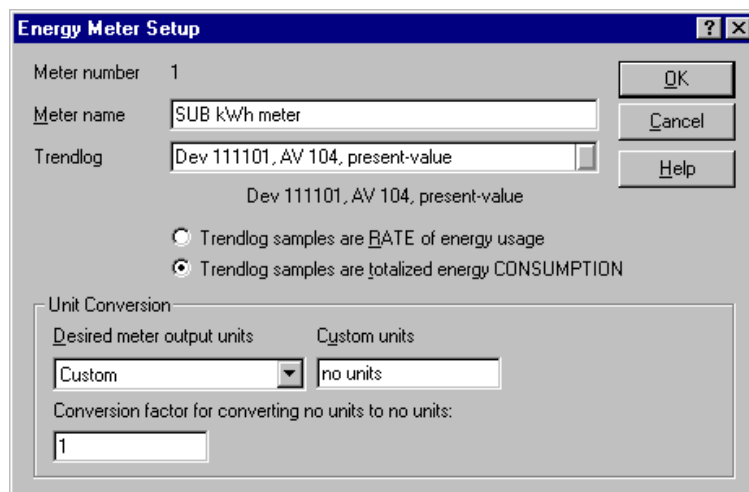
## Setting up meters

Energy logs use meters to gather demand or consumption data. An energy log can use a single meter or the sum of a number of meters. Each meter references a trendlog, and each meter has a unique setup. A unique meter number identifies the meter setup.

### Setting up an energy meter

When you set up a meter for an energy log, in addition to the meter name, you specify:

- The trendlog that monitors the meter input
- The type of meter, which is either demand (rate) or consumption
- The desired meter units and a conversion factor, if necessary, which is applied to the trendlog sample value to determine a meter reading (trendlog sample value X conversion factor = meter reading)



The screenshot shows the 'Energy Meter Setup' dialog box. It includes the following elements:

- Meter number:** 1
- Meter name:** SUB kWh meter
- Trendlog:** Dev 111101, AV 104, present-value
- Buttons:** OK, Cancel, Help
- Radio buttons:**
  - Trendlog samples are RATE of energy usage
  - Trendlog samples are totalized energy CONSUMPTION
- Unit Conversion section:**
  - Desired meter output units:** Custom
  - Custom units:** no units
  - Conversion factor for converting no units to no units:** 1

**Figure 9.3** Energy Meter Setup dialog box

**CAUTION** If you choose a meter unit different from the trendlog unit, Envision for BACtalk warns you that you have not chosen a valid meter factor. See “Using custom energy log units” on page 207. When a trendlog is used as an energy log meter, it is important that the trendlog have a unit of measure

assigned. Envision for BACtalk uses this unit of measure, along with the report units in the Energy Logging Setup dialog box, to calculate demand and consumption data.

You can set up trendlogs on the fly as you set up a meter. Trended properties can report energy consumption or demand data, and they can be regular energy meters or fluid energy meters. You can combine data from multiple meters to create a single energy log. If meter units are mixed (say Btus and kWh), Envision for BACtalk resolves them to the energy log report units.



## Practical application

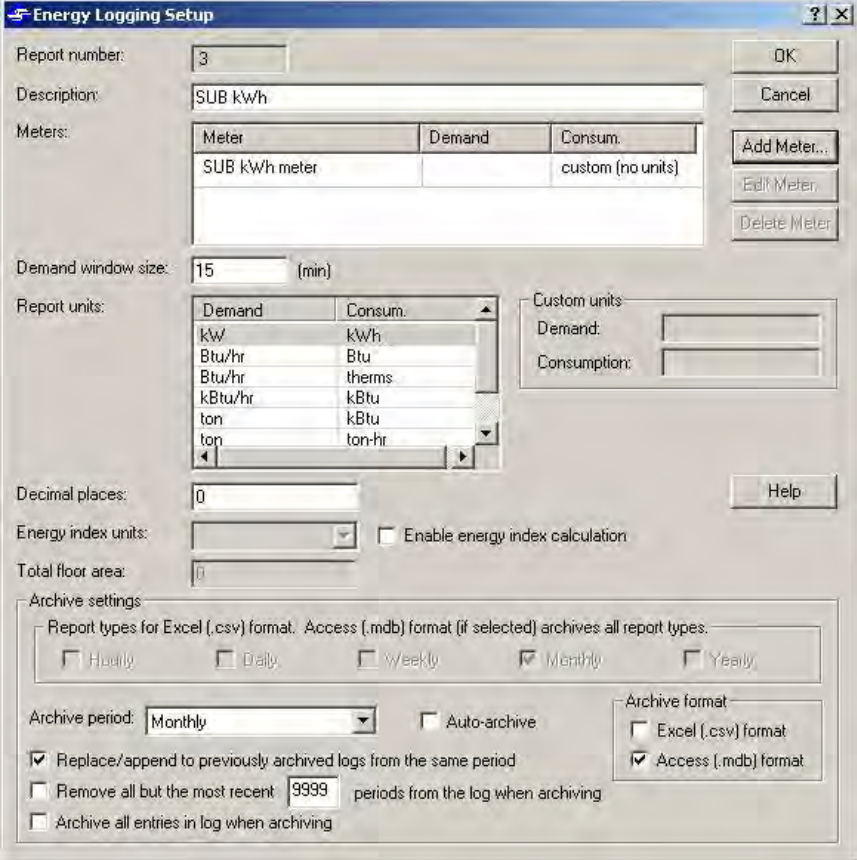
---

Jacob has already set up his trendlog for the SUB energy meter (see “Setting up a trendlog” on page 169). He also knows that this meter is set up at the source, the VLC, to report kWh, so no conversion factor is necessary (see “Scaling factor” on page 230).

When he sets up the energy log, he names the energy log, SUB kWh. He then clicks **Add Meter** and sees that his kWh meter is not set up yet, so he needs to set up the meter.

He clicks **Add** again, and then selects Energy Meter to create a meter from the trendlog setup. He types a description, SUB kWh meter, and then selects the trendlog he wants this meter to reference. He knows it is a kWh meter so he selects the Consumption option (see “Working with demand limiters” on page 227). Because the trendlog units are set to kWh, the desired meter output units read the same. Jacob also knows that the 0.5 kWh per pulse is converted at the VLC, so he leaves the conversion factor to 1. When he is finished, he clicks **OK** and then clicks **Select**. The meter is now in the meters list for the energy log.

He leaves the demand window set to 15 minutes, since that is what All State Electric uses to calculate peak demand, and leaves all other settings to their defaults.



The Energy Logging Setup dialog box is shown with the following settings:

- Report number: 3
- Description: SUB kWh
- Meters:
 

Meter	Demand	Consum.
SUB kWh meter		custom (no units)
- Demand window size: 15 (min)
- Report units:
 

Demand	Consum.
kW	kWh
Btu/hr	Btu
Btu/hr	therms
kBtu/hr	kBtu
ton	kBtu
ton	ton-hr
- Custom units: Demand: [ ], Consumption: [ ]
- Decimal places: 0
- Energy index units: [ ]  Enable energy index calculation
- Total floor area: 0
- Archive settings:
  - Report types for Excel (.csv) format: Access (.mdb) format (if selected) archives all report types.
  - Hourly  Daily  Weekly  Monthly  Yearly
  - Archive period: Monthly  Auto-archive
  - Replace/append to previously archived logs from the same period
  - Remove all but the most recent 9999 periods from the log when archiving
  - Archive all entries in log when archiving
  - Archive format:
    - Excel (.csv) format
    - Access (.mdb) format

**Figure 9.4** Energy Logging Setup dialog box

## Setting up a fluid energy meter

A fluid energy meter relies on three trendlogs: one for flow and two for temperature. Based on the measurement of flow and the temperature difference in the inflow and outflow fluid, Envision for BACtalk calculates how much energy the fluid has absorbed (cooling) or expended (heating). You can also provide a value for the *Specific Heat (Cp)* and the *Specific Gravity* of the fluid substance measured.

**Figure 9.5** Fluid Energy Meter Setup dialog box

The three trendlogs used are:

- Trendlog under Fluid Measurement, which establishes the rate of fluid flow for the fluid measured. You choose whether the meter provides rate-of-flow or consumption data and the units the data represents. You can also provide a conversion factor that Envision for BACtalk uses to convert the units in the trendlog to meter units (trendlog data sample X conversion factor = meter data value).
- Temp 1, which reads the inflow fluid temperature. Trendlog units must be degrees F, degrees C, or degrees K.
- Temp 2, which reads the outflow fluid temperature. Trendlog units must be degrees F, degrees C, or degrees K.

## Printing and archiving energy logs

When you view an energy log, you can select from hourly, daily, monthly, or yearly data views. You can also select the date range you want to view. Envision for BACTalk lists demand and consumption data for the log and period you select. To print energy log data, select **Print** from the **File** menu in the Energy Peak/Consumption View dialog box.

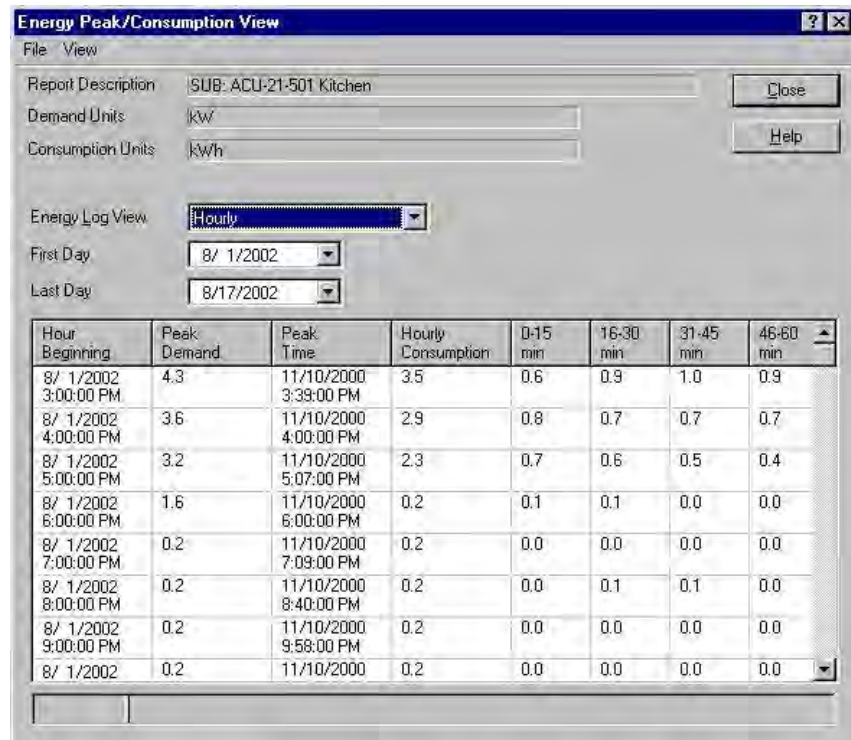


Figure 9.6 Energy Peak/Consumption View dialog box

## Archiving energy log data

Envision for BACTalk enables you to archive calculated energy log data to a comma-separated values (\*.csv) file or Access (.mdb) file. Most spreadsheet and database programs can import .csv files so you can further analyze this data, if necessary.

Use the Archive Energy Log dialog box (BACTalk>Energy Management>Energy Logs>Archive) to create the archive file. Or, specify how you want Envision for BACTalk to automatically archive energy log data when you set up the energy log on the ENergy Log Setup dialog box (BACTalk>Energy Log Management>Energy Logs>Add). You provide the type of data you want to back up (such as hourly or daily) and the range of months you want to archive. The Server Path field lists the folder where the archive file is saved. If the folder does not exist, Envision for BACTalk creates it.

Envision for BACTalk names the file for you as <elog\_desc>\_<HR|DY|WK|MO|YR>. Using the sample report in the previous section, Envision for BACTalk creates the file SUB ACU-21-501 Kitchen\_HR.csv on the Envision for BACTalk server. Files archived from a client operator workstation are saved to the appropriate location on the server.

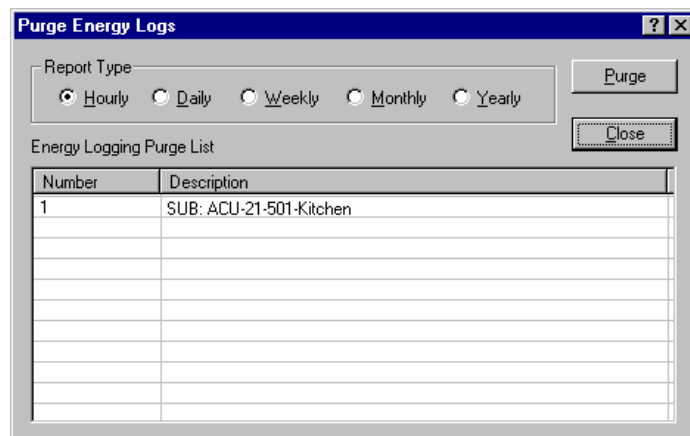
**CAUTION** Archived data cannot be restored for use in Envision for BACtalk. Make sure you do not accidentally delete energy log data or copy over an existing log. Select the options carefully. You will not be prompted to confirm.

## Purging energy log data

Purging energy log data clears all data from the Envision for BACtalk server at your discretion, but retains the energy log setup.

From the list of energy logs (BACtalk>Energy Management>Energy Logs), select the logs you want to purge. Use Shift+click to select a range and Ctrl+click to add or remove an energy log from a selection. Then click **Purge**.

**CAUTION** Purged energy log entries cannot be restored.



**Figure 9.7** Purge Energy Logs dialog box

# Demand Limiting

# 10

Envision for BACtalk enables you to monitor energy demand and then automatically adjust equipment operation to limit the demand and reduce costs. This is known as *demand limiting*. A demand limiting program can result in significant savings when applied properly.

In Envision for BACtalk, a demand limiting program is made up of any number of *demand limiters*. Each demand limiter measures energy demand through a *meter*. When demand approaches a level you assign, a *demand threshold*, the demand limiting program begins to automatically adjust equipment operation to limit energy use. This is known as *load shedding*. The goal is to remain below an energy demand level to avoid higher costs and, in some cases, avoid excessive peak billing charges. As demand tapers off and falls away from the threshold, the demand limiting program *restores* loads to normal operation.

Although flexible enough to accommodate any type of energy demand, Envision for BACtalk demand limiters are usually applied to electrical energy. But you can set up a demand limiting program for any type of energy or substance used: for example, gas or water.

As you may already know, a demand limiting program must be carefully planned and engineered before implementation. Identifying the correct metering points and the equipment to adjust is of the utmost importance.

## Benefits

**Cost-effective** Demand limiting programs can significantly reduce operating costs when applied properly.

**Full-featured** Multiple demand limiting programs can be set up for different meters. Each program can react with ON/OFF commands or with analog offsets, usually applied to setpoints.

**Flexible** The same demand limiting program can use different control parameters. This enables different responses depending on billing practices, time of day, or season.

**Interactive** Watch energy demand, monitor loads, and track the action of a demand limiting program in real time.



## Practical application

As part of a statewide initiative to reduce energy expenditures by 30%, State University needs to cut its energy bill. After analyzing their energy bills, the State University Facilities Department determines that they can save a lot by reducing the peak demand portion of their energy bill. Like many utilities, All State Energy charges State University a peak demand fee. For each month's bill, the utility looks at State University's peak demand and charges \$4.50 for each kW. The peak demand period for the month is calculated using the highest 15-minute average of demand. State University has about 14 buildings on campus. they have determined that implementing a demand limiting program could save them as much as 30% off their entire energy bill. Each building on campus has an individual kW meter.

As Phase I of the demand limiting program, the Facilities Department is going to implement a demand limiting program for the building with the highest average peak demand: the Student Union Building (SUB). Once they implement and monitor the energy limiting program there, they will phase demand limiting into other buildings on campus as well.

Figure 10.1 shows the SUB's peak demand in kW for the 2001 year and the peak demand charge. If energy demand stays on track with last year, by reducing peak demand in the SUB by only 10%, State University can save approximately \$7,000 a year.

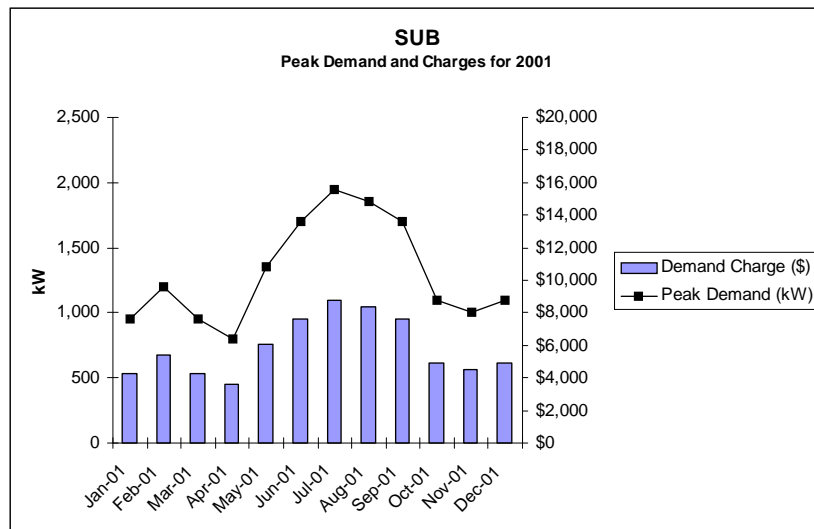


Figure 10.1 Peak demand and charges in the SUB for 2001



The SUB has 10 rooftop air conditioning units. Each services the following zones:

- Kitchen
- Bookstore
- Student government (ASB) offices
- Heroes of State ballroom-East
- Heroes of State ballroom-West
- Copy center
- Dining-North
- Dining-South
- Department offices
- Commons

The AC units are the primary loads in the summer months—April through September for State U—and account for much of the demand increase during this time. Other large loads include the electric grills, dishwashers, and other equipment in the kitchen, the electric hot water heater, and the two large copiers and other equipment in the copy center.

The Facilities Department sets up a demand limiting program with a goal to reduce peak demand charges by 10% for the upcoming year. They have decided that the best strategy is to use a combination of *setpoint spreading* and *load lockouts* as demand increases.

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## Quick start–demand limiter setup

**WARNING** You must have a thorough understanding of your building's energy demand profile and the operation of demand limiters before you set up or modify a demand limiting program.

Use the following table to help you set up a demand limiter in Envision for BACtalk. The key steps for creating a demand limiter are listed in order.

**Table 10.1** Tasks for setting up a demand limiter

Task	See
1 Analyze historical data and trends to understand your building's energy demand.	<ul style="list-style-type: none"> <li>Utility statements and site documentation</li> </ul>
2 Study your utility's billing structure and options. Do they offer different billing structures for peak demand? Do they change seasonally? How is peak demand calculated?	<ul style="list-style-type: none"> <li>Utility statements</li> </ul>
3 Analyze your building's current equipment and identify existing and potential areas where energy can be metered and energy demand limited.	<ul style="list-style-type: none"> <li>Site documentation</li> </ul>
4 Understand your energy meters, what and how they report energy demand, and how they are treated in software.	<ul style="list-style-type: none"> <li>Meter device documentation</li> <li>Site documentation</li> </ul>
5 Develop a long-term, comprehensive strategy for demand limiting.	<ul style="list-style-type: none"> <li>page 217</li> <li>Site documentation</li> </ul>
6 Identify the meter input data points you want to use and the type of meter it is (rate or consumption). You need to set up a demand limiter for each meter input.	<ul style="list-style-type: none"> <li>page 217</li> <li>Site documentation</li> </ul>
7 Identify the analog and binary loads you want to control with the demand limiter.	<ul style="list-style-type: none"> <li>Site documentation</li> </ul>
8 Organize your binary loads into shed levels.	<ul style="list-style-type: none"> <li>page 223</li> </ul>
9 Select an Alerton global controller to host the demand limiter, name the demand limiter, and give it a description.	<ul style="list-style-type: none"> <li>page 228</li> </ul>
10 Set up the meter for the demand limiter.	<ul style="list-style-type: none"> <li>page 229</li> </ul>
11 Define binary loads by shed level.	<ul style="list-style-type: none"> <li>page 231</li> </ul>
12 Define custom binary loads, if any.	<ul style="list-style-type: none"> <li>page 234</li> </ul>
13 Define analog loads.	<ul style="list-style-type: none"> <li>page 234</li> </ul>
14 Define control parameters for the demand limiter.	<ul style="list-style-type: none"> <li>page 237</li> </ul>
15 Enable the demand limiter.	<ul style="list-style-type: none"> <li>page 228</li> </ul>
16 Monitor control status and the status of binary and analog loads to ensure the demand limiter behaves as expected.	<ul style="list-style-type: none"> <li>page 239</li> </ul>

## How demand limiting works

This topic covers technical information about demand limiter operation. Understanding this information is essential if you will set up demand limiting programs.

However, understanding this information is only a part of what you need to know. You must also understand:

- Energy demand trends in your building
- Your utility's billing practices
- How energy meters are set up and report energy usage or demand

Several concepts are key to understanding the operation of a demand limiter in Envision for BACtalk: the *meter*, analog and binary *loads*, and the *control ramp*. The meter is where the demand limiter measures energy demand. Loads are equipment or processes that use the energy being measured at the meter. The demand limiter *sheds* loads to try to limit energy demand and *restores* loads to normal operation once exceeding the threshold is no longer a risk. To control load shedding and restoring in an organized way, Envision for BACtalk uses a *shed ramp* and *restore ramp*.

First, we will cover how the demand limiter measures a meter input and uses it to calculate average demand. Then we will explore how the demand limiter uses that average demand value to calculate ramp values. Finally, we will discuss how the ramp values work to shed and restore binary and analog loads (custom binary loads, by definition, are not affected by ramp values).

## About energy meters

Each demand limiter references a data point associated with an energy meter. There are two common methods for measuring energy in buildings: *demand meters* output the rate at which energy is being used, for example kW or Btu/hr, and *consumption meters* output a running total of how much energy has been used, for example kWh or Btu.

You can compare an energy demand meter to your car's speedometer, which shows how fast you are going in miles per hour. The difference between them is what each measures: speed (in miles per hour) rather than energy demand or rate of energy use (for example, kW or Btu/h). Demand meters typically output a 4–20mA or 0–5VDC signal proportional to the rate of energy use.

You can compare an energy consumption meter to your car's odometer. Again, the difference is what is measured: distance traveled (in miles) rather than energy consumed (for example, kWh or Btu). A consumption meter is almost always based on a pulse meter, which outputs a pulse each time a certain amount of energy has been used.

Regardless of its type, the meter connects to a field device where the data it outputs is recorded as a data point (for Alerton devices, this is the present-value of a VLC AI). The demand limiter then references this data point for energy demand. Ideally, the data point referenced reports the energy value in the appropriate units.



## Example

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A pulse output kWh meter measures kWh (power consumption) and is set up to output one pulse for every 0.5 kWh. The output is wired to AI-1 on a VLC-1188C3. In the VLC, the setup for the AI has the type set to pulse totalizer, and the range/pulse value setting is set to 0.5. The present-value of this VLC AI now reports kWh (power consumption). The demand limiter program references this AI. Every time it reads the AI, approximately once per minute, it automatically calculates kW. For example, at 4:00 PM, if AI-1 is equal to 10,400 and at 4:01 PM, AI-1 is equal to 10,420, 20 kWh was consumed during the minute. The demand limiter recognizes a kW demand of 1200 kW (20 X 60 minutes).



## Practical application

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The Facilities Department consults their as-built engineering documentation for the SUB. It shows that the SUB is fitted with a Veris H8050 series meter on the three-phase 208/120 power feed to the building. This unit has DIP switches to set the number of pulses per kWh, which are set to provide one pulse per 0.5kWh. The pulse output is wired to IN-1 of a VLC-1188C3 with device instance 111101, so consumption data is available as device instance 111101, AI-1, present-value.

A trendlog and energy log (see “Trendlogs” on page 163 and “Energy Logs” on page 201 for more information) are already set up for Device 111101, AI-1, present-value. The trendlog is compared to the All State bill and the Facilities Department determines that it has been accurate for at least the past year.

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## How the demand limiter calculates average demand

With a meter input referenced and appropriately set up as rate or consumption in the VLC, the demand limiter uses the demand values it reads and a *sliding demand window* to calculate *average peak demand*. Utilities generally use a sliding demand window to calculate peak demand for billing purposes as well.

The sliding demand window is an interval used to calculate a rolling average of peak demand. Rather than billing for the true peak demand, measured at any given instant, the peak demand is based on the highest average peak demand for the *demand window interval* (see the graphs on page 214). Most utilities use a 15-minute demand window interval (or period) and bill for the highest average 15-minute average peak demand for a month. You specify the demand window interval when you set up the demand limiter (see “Demand window” on page 237).

The demand limiter in Envision for BACtalk also has an option labeled *enable faster response*. This setting effectively cuts the demand window you specify into a third to calculate peak demand. This enables the system to anticipate and react to peak demand before it is actually reached. Essentially, without enable faster response selected, the demand limiter risks reacting too late, after peak demand has already occurred. If you do not use the enable faster response option, you should set your demand window interval in Envision for BACtalk to a value less than your utility’s peak demand window.



### Example

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With a demand window interval of 15 minutes, kW for each 15-minute interval is averaged. The peak demand is then the highest average from any of the 15-minute intervals. Peak demand is calculated for the intervals 6:00 to 6:15, 6:01 to 6:16, 6:02 to 6:17, and so on—a rolling average. When enable faster response is selected, the demand limiter actually calculates the peak demand for every 5-minute interval—6:00 to 6:05, 6:01 to 6:06, 6:02 to 6:07, and so on. The window does not stop at the beginning and end of an hour, day, or month but is perpetual.



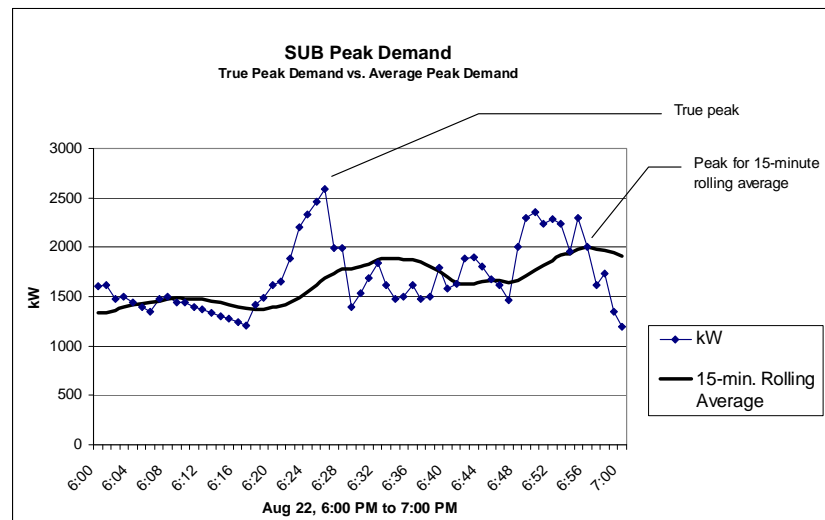
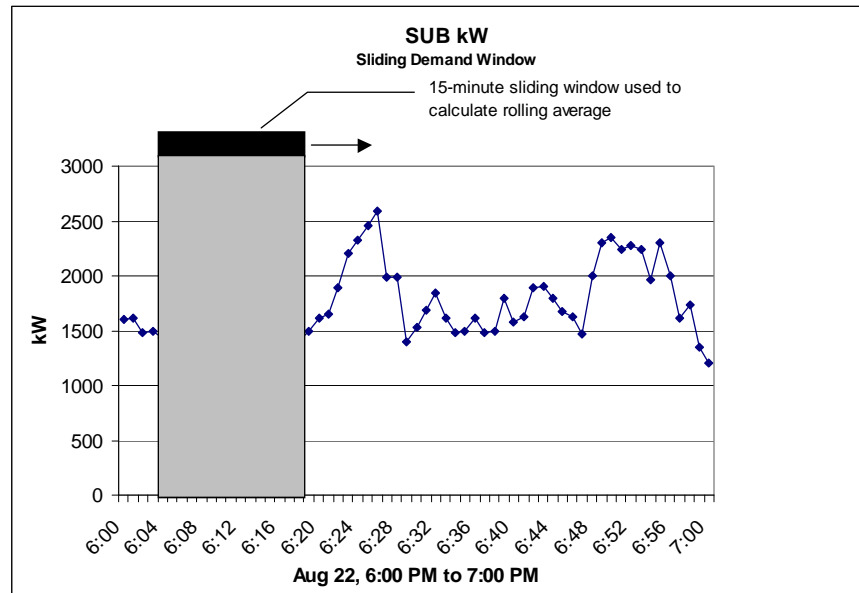
### Practical application

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The Facilities Department knows that All State Electric bills them for peak demand based on a 15-minute demand window average. Jacob, the lead engineer, had a hard time explaining to his staff about the peak demand concept and what enable faster response did. They wanted to know why they were using a 15-minute window.

To explain the concept, Jacob used a graph of the peak demand profile for the SUB for a summer day last year: August 22nd. He then super-imposed a 15-

minute window on it to demonstrate how peak demand for that day would be calculated. Jacob's work is shown in the following graphs.



**Figure 10.2** Peak demand for the hour of 6:00 PM to 7:00 PM at the State University Student Union Building on August 22. Note how the true peak (recorded minute-by-minute) is greater than the averaged peak, and the averaged peak does not necessarily correspond with the true peak.

## How the demand limiter calculates ramp values

Ramp values are percentages (0-100%) that Envision uses to shed and restore loads in an orderly way. Instead of shedding or restoring equipment all at once, the ramp values cause the demand limiter to shed and restore loads gradually. Essentially, when the ramp value = 0%, no loads are shed. When the ramp value = 100%, all loads are shed.

Ramp is the term used because the percentage value “ramps” up as demand reaches the demand threshold and loads need to be shed. Likewise, the demand value ramps down when the demand level subsequently decreases and loads need to be restored. The demand limiter uses two different ramps: a shed ramp and a restore ramp.

When you set up a demand limiter, you define the shed ramp in terms of the average demand value at which you want to start and stop shedding loads. You define the restore ramp and the value at which you start and stop restoring loads. (See “How a demand limiter sheds and restores loads” on page 223.)

**CAUTION** The demand values that define the shed and restore ramps are critical to the operation of the demand limiter. Choosing the correct values depends on your site and an understanding of how demand reacts to the loads you shed and restore.

For the shed ramp, you pick an energy demand value for start shedding or you can reference a data point. The start shedding value is the average peak demand value at which the ramp value equals 0 and starts counting up. As a general rule, you can set the start shedding value to approximately 20% less than the peak demand value you want to stay below. You also pick a value or reference a data point where the ramp value is equal to 100% and all loads are shed. As a general rule, you can set the all loads shed value equal to the peak demand value you want to stay below. The smaller the difference between the shed ramp values, the faster the value ramps up and sheds loads.

Similarly, for the restore ramp, you pick values or reference data points for start restoring and all loads restored. The start restoring value is the average peak demand value at which the ramp starts counting down and restoring loads. This is usually set to a value approximately 5 to 10% less than the all loads shed value. The all loads restored value is average peak demand value at which you want all loads to be restored and the control ramp to have returned to 0%. As a general rule, you can set the all loads restored value to approximately 5 to 10% less than the start shedding value. The smaller the difference between the restore ramp values, the faster the value ramps down and restores loads.

Start Shedding = Average Peak Demand (APD) X 0.8

All Loads Shed = APD

Start Restoring = APD X 0.9

All Loads Restored = Start Shedding X 0.9

**Figure 10.3** Guidelines for defining shed and restore values



## Example

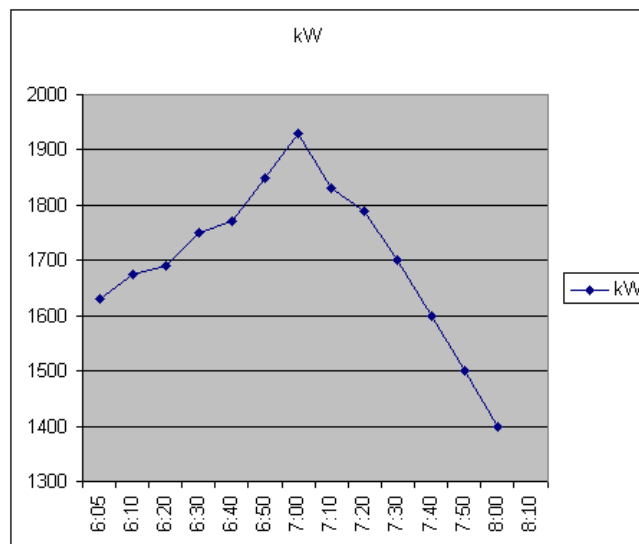
With an average peak demand threshold set to stay below 2000 kW, examine the effects of the following sets of shed and restore values.

<b>Start shedding loads</b>	1600
<b>All loads shed</b>	2000
<b>Start restoring loads</b>	1800
<b>All loads restored</b>	1450

The graphical representation of ramp value to kW demand value is shown in the following graph. The demand window value is set to 15 minutes and Enable faster response is selected. The demand limiter reads the 5-minute average and recalculates the ramp value every minute.

At 6:05, average peak demand is 1630, the demand limiter begins shedding loads. Average peak demand continues to rise and at 6:12 reaches 1680, at which time 20% of all loads have been shed. By 7:00, average peak demand has reached 1920 and, based on how the demand limiter was defined, 80% of all loads have been shed.

By 7:20, average peak demand has dropped down to 1790, so loads begin to be restored. By 8:00, average peak demand is down to 1400, so all loads have been restored.



**Figure 10.4** kW value by time of day



## How a demand limiter sheds and restores loads

Once a demand limiter is set up and enabled, it monitors average peak demand and responds to changes to keep energy demand within a desired range. As described in the preceding section, when average peak demand rises above a specified value, the demand limiter begins shedding loads to reduce demand. When the average peak demand drops below a specified value, loads are restored.

Shedding loads may consist of one or more of the following:

- Spreading setpoints—a cooling setpoint is increased from 74 to 76 degrees F, for example.
- Locking out equipment—no additional hot water is heated, for example.
- Shutting down equipment—an air conditioning unit is turned OFF, for example.

Loads are not shed all at once, but a little at a time, depending on how the demand limiter was defined. As the average peak demand reaches a certain level, certain loads are shed. If demand continues to increase, another set of loads are shed. This continues until all loads are shed or until demand falls below a desired level.

When shedding has occurred long enough to reduce demand to the level specified in the demand limiter, loads are restored—again a few at a time, depending on how the demand limiter was defined. Just like load shedding, the rate at which loads are restored depends on the average peak demand.

Demand limiting can be set up for different kinds of loads: binary, custom binary, or analog loads.

### Binary load shedding

Binary loads typically refer to equipment that can be turned ON or OFF. Use demand limiting to prioritize binary loads into five levels. Each level turns equipment OFF and ON at a different time, depending on the average peak demand. For example, all loads in shed level 1 are shed before any loads in shed level 2. Additionally, all loads in shed level 2 are restored before any loads in shed level 1 are restored. You generally want to place less critical equipment or loads that have less impact on occupants in shed level 1 and place the most critical equipment or loads with the greatest impact on occupants in shed level 5.

Within individual shed levels, you can set a first-off, first-on option. Because loads of equal importance are generally grouped within the same shed level, this option tends to even out the length of time each load is shed.

You may also want to control how quickly loads are shed and restored to avoid cycling equipment, which can cause other problems, such as wear and tear on mechanical parts. Envision for BACtalk uses *anticycle limits* for this purpose. Anticycle limits specify a minimum length of time that a load must remain shed before it can be restored and vice versa.



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## Example

If the minimum restore time is 5 minutes and demand rises to a point that would precipitate shedding after only 2 minutes (since being restored), the load would not be shed again for another three minutes (assuming the demand still dictates shedding).



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## Practical application

There are five SUB offices in shed level 3, which have their air conditioning turned OFF first as average peak demand increases. When the Facilities Department set up the demand limiter for the SUB, the first-off, first-on option was selected for this shed level. When average peak demand decreases and the restore cycle begins, the office shed first is restored first. This helps prevent any of the offices from becoming insufferably hot because the air conditioning has been turned OFF for the longest time.

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### Analog load shedding

Instead of turning equipment ON or OFF like binary loads, analog loads affect equipment operations indirectly. Analog load shedding is often used for setpoint spreading. Setpoint spreading essentially increases the deadband.

In addition, analog loads are not grouped in shed levels like binary loads. Analog loads respond to a specific range of the shed ramp. In a setpoint spreading scenario, you might increase the setpoint offset by 2 degrees when the shed ramp is at 20%, and stop increasing the offset at 4 degrees once the shed ramp reaches 40%. The cooling offset would gradually increase in proportion to the control ramp. For example, when the ramp is at 30%, the offset would be 3 degrees.



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## Example

The normal setpoint is 72 degrees F with a cooling offset of 2. If the temperature goes above 74, then the air conditioning turns ON. With demand limiting you can increase the offset when the ramp reaches a certain point. For example, when the ramp value is at 20%, you increase the cooling offset by 2. That means the air conditioning is not turned ON until the temperature gets to 76.

---

## Custom binary load shedding

Custom binary loads, by definition, are not associated with any of the shed levels. Custom binary loads are shed and restored at specific demand levels, independent of the control ramp.



### Practical application

After evaluating all the information and considerations, the Facilities Department sets up a demand limiter for the SUB. The following table shows how loads will be shed.

**Table 10.2** Shed levels and load assignments for the SUB

Shed Level	Analog loads	Binary loads
1 (0-20%)	Setpoint spreading in all areas except kitchen	
2 (20-40%)		Department offices and Electrical Room AC
3 (40-60%)		Student government offices and ballroom (East and West) AC <sup>a</sup>
4 (60-80%)		Copy Center, The Commons, Dining (North and South); hot water heater
5 (80-100%)	Setpoint spreading in cafeteria and kitchen	One of the large copiers in Copy Center

a. This shed level uses the first-off, first-on option. The air conditioning will be restored in the same order it was shed. In other shed levels, the opposite is true.

In addition, there is one custom binary load. The compressor in the basement is only turned OFF when average peak demand exceeds 1900 kW and is turned back ON as soon as average peak demand drops below 1700 kW.

## Where a demand limiter is stored and how it runs

Like schedules, trendlogs, and alarm setups, demand limiters are set up in Envision for BACtalk and then downloaded to a global controller, which is the host device. After you define the demand limiter's operating parameters and save them to a global controller, the demand limiter automatically performs the limiting function for you. The operator workstation can be disconnected and the demand limiter will continue to read meter inputs and shed or restore loads.

**Note** LSi global controllers do not support demand limiting.

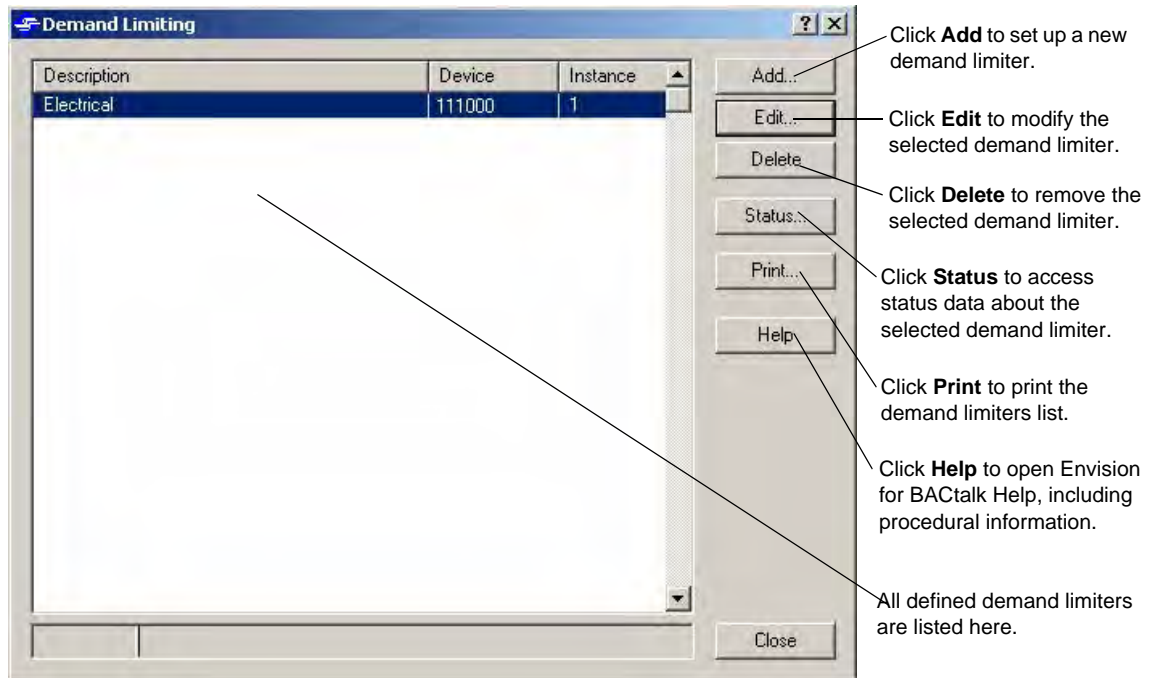
The demand limiter is an Alerton BACnet object. Envision for BACtalk automatically assigns a unique object instance to each demand limiter when you first create and save it. A demand limiter has properties like any other BACnet object. See the *BACtalk Systems Programmer's Guide and Reference (LTBT-TM-PRGRMR)* for more information about the demand limiter object. Most importantly, the demand limiter object's present-value property provides the current ramp value, which can be useful if you want to set up and view a trendlog of the ramp value for a particular period of time.

The demand limiter reads and writes values approximately once per minute. Depending on the load placed on the global controller and traffic on the network, the demand limiter may execute less frequently, but never faster than once per minute.

You can also send and save demand limiter data using Device Manager. For example, if you change demand limiter settings, you can send the new settings to the global controller. In addition, you can save the current demand limiter data stored in the global controller to the operator workstation. For example, when performing a system backup or when upgrading to a new ROC file.

## Working with demand limiters

When you select Demand Limiting (BACtalk>Energy Management>Demand Limiting), Envision for BACtalk displays a list of the demand limiters that have been created. Each one is associated with a different meter input. A demand limiter is identified by its description, host device, and object instance. The host device is the controller that stores and runs the demand limiter. Envision automatically assigns a unique object instance to each demand limiter when it is saved for the first time.



**Figure 10.5** Add or edit an Envision for BACtalk demand limiter through the Demand Limiters dialog box.

## Adding or editing demand limiters

When adding or editing a demand limiter, use the six tabs on the Edit Demand Limiter dialog box to define a demand limiter object: General, Meter, Binary Loads, Custom Binary Loads, Analog Loads, and Parameters.

- On the General tab, specify a host device and description.
- On the Meter tab, identify the meter that will monitor energy demand.
- On the Binary Loads, Custom Binary Loads, and Analog Loads tabs, identify the individual loads you want to shed to limit demand.
- On the Parameters tab, specify the average peak demand levels for your shed ramp and restore ramp.

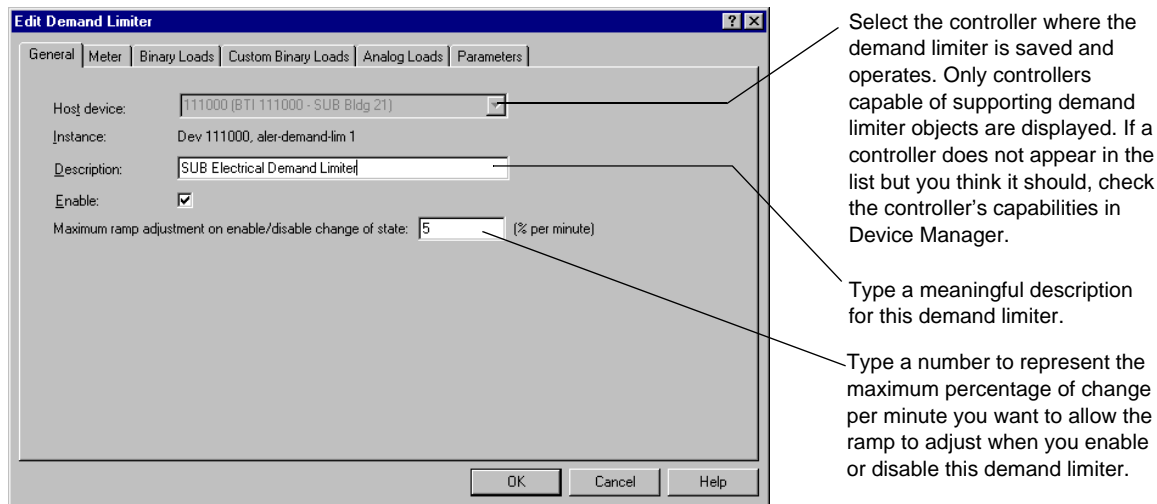
When you finish setting up a demand limiter and click **OK**, Envision automatically saves the setup to the Envision for BACtalk operator workstation and to the global controller selected as the host device. If Envision cannot save to the global controller (for example, it is offline), you can send the demand limiter setup at another time using the Device Manager Send feature (see the

*Installation and Startup Guide* (LTBT-TM-ADMIN) or Envision for BACtalk Help for more information).

## Setting the demand limiter name and description

### General tab

Use the General tab to enable or disable the demand limiter and to specify where the demand limiter is saved, its purpose (description), and how fast it will respond when it is first enabled or disabled.



**Figure 10.6** Use the General tab to select the host device and set a description for the demand limiter.

Select the global controller where you want to save and run the demand limiter. You must select a global controller, such as a BTI, that can write to points other than its own. Once you save a demand limiter, you cannot change the host device.

**Note** LSi controllers do not support demand limiting.

Give the demand limiter a meaningful description so that system operators can recognize what each demand limiter regulates. Envision automatically assigns the instance of the new demand limiter when you save it for the first time (New is the default). This number appears in the Demand Limiters dialog box once the new demand limiter is added to the system. Envision for BACtalk uses the demand limiter description in listings and references.

You can enable or disable the demand limiter using the check box on the General tab. For example, you can disable the demand limiter when you are making changes to it or during special circumstances when you do not want to limit demand. Select Enable to turn the demand limiter ON; this activates the BACtalk system to monitor and regulate energy demand based on the current ramp values. When you disable demand limiting, you set the ramp value to 0, which means that no loads need to be shed to limit energy demand.

Use the maximum ramp adjustment setting to limit how fast loads are shed or restored when a demand limiter state is changed between enable and disable. This ensures that demand limiting is performed gradually.



### Practical application

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State U disabled the demand limiter for a special Open House event at the SUB. With so many people in the building, the air conditioning was working at its maximum. When demand limiting was enabled after the event, the demand was high enough to cause the ramp value to go to 100%. However, the Facilities Department set up this demand limiter to allow a maximum adjustment of 5% per minute on an enable/disable change of state. As a result, the ramp does not go straight to 100%, but increments by a count of 5% each minute. In 20 minutes, it reaches 100% if load shedding has not begun bringing demand down.

See Envision for BACtalk Help for more detailed information and procedures about completing the General tab.

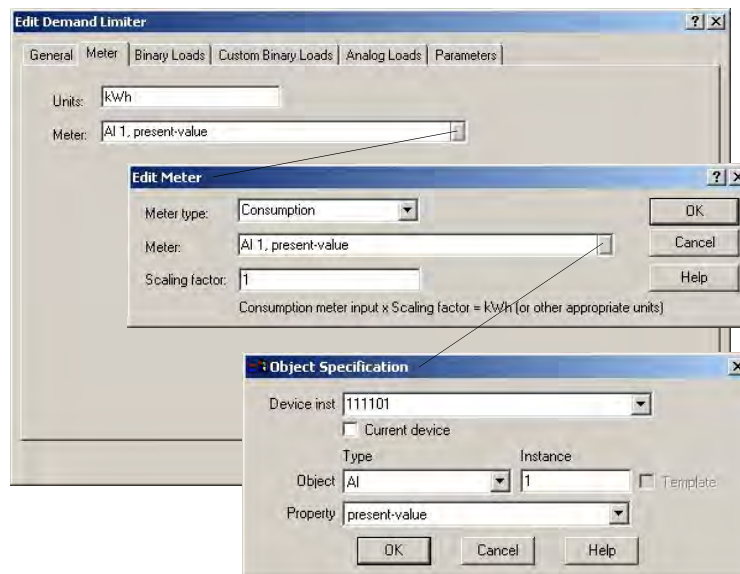
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## Setting up meters

### Meter tab

A meter is a key component of a demand limiter. Each demand limiter monitors one meter input to determine energy demand. This is the ramp value that the demand limiter uses to determine when loads are shed and restored. For more information about meters and how demand limiters use meter inputs, see “About energy meters” on page 217.

Use the Meter tab on the Edit Demand Limiter dialog box to identify the meter and units used to measure energy demand.



**Figure 10.7** The Edit Demand Limiter dialog box with the Meter tab open. Click the command buttons to open the Edit Meter and the Object Specification dialog boxes.

### Meter type

Envision for BACtalk demand limiters support two types of meters: rate and consumption. Rate meters are often 4-20 mA or 0-5VDC. If you have this type of meter, you select Rate as the meter type in the Edit Meter dialog box. Consumption meters are often pulse meters. Select Consumption as the meter type if you are using a pulse meter.

Each meter has an object instance and property, just like any other device in a BACtalk system. This identifies the input on a field controller that reads data from the meter.

**Note** Use kW for rate meter units and kWh for consumption meter units.

### Scaling factor

You can specify a scaling factor, if necessary. The scaling factor converts input units to demand units. For example, if a rate meter provides raw input in watts and demand units are kW, then the scaling factor is 0.001. If a consumption meter reads 0.072kWh per pulse, the scaling factor is 0.072 when demand units are kW.

See “About energy meters” on page 217 or Envision for BACtalk Help for more information about setting up and configuring meters used with demand limiters.



## Setting up load references

Use the Edit Demand Limiter dialog box to configure the loads you want this demand limiter to work with. You define loads based on their type: binary, custom binary, or analog. Use the Binary Loads, Custom Binary Loads, and Analog Loads tabs to identify the loads and the order you want to shed and restore them. You shed loads to limit demand and restore loads when demand limiting is no longer required.

### Binary Loads tab

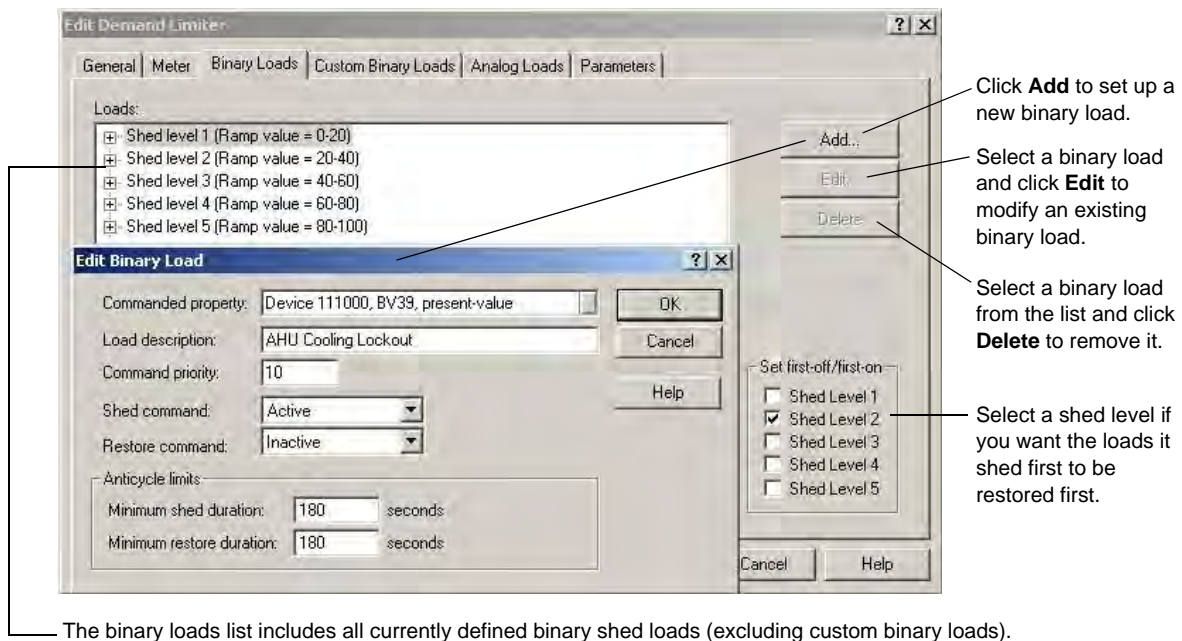
Use the Binary Loads tab on the Edit Demand Limiters dialog box to assign the binary data points that the demand limiter will shed. Binary properties (BVs and BOs) typically represent building equipment loads, such as a heat pump, building water heater, and air conditioning, that you can turn OFF to limit demand.

You specify how these loads are categorized among the five available shed levels. Place non-critical loads in the lower-numbered shed levels, which are shed first based on the ramp value. Place more critical loads in the higher-numbered shed levels, which are shed last. The higher-numbered shed levels are also restored first.



### Practical application

Demand limiting for the SUB is set up so that shed level 2 includes the copy center and storage space; shed level 3 includes the student government offices; shed level 4 includes the kitchen, dining areas, and The Commons; and shed level 5 includes the dean's office and critical equipment. As energy demand increases, after setpoints are spread at shed level 1, the first air conditioning loads shed are areas with low occupancy. These loads will also be the last restored. Loads such as the air conditioning in the dean's office and critical equipment are assigned to shed level 5 and will be shed as a "last resort."



**Figure 10.8** The Binary Loads tab with the Edit Binary Loads dialog box open.

**Binary Loads list** The binary loads list includes all currently defined binary loads. You can drag and drop a point from one shed level to another in the Loads list. Click **OK** after making changes to the shed levels list to send the updated demand limiter settings to the global controller without disrupting global controller operation.

**Shed levels** Each demand limiter provides five load levels, which correspond to the following percent ranges of the shed ramp: 0-20, 20-40, 40-60, 60-80, and 80-100. As demand increases from 0 to 20 percent of the shed ramp, binary loads in shed level 1 are shed. If demand continues to rise above 20% of the shed ramp, then loads in level 2 begin to shed, and so on until demand falls below defined restore levels.

A single shed level can have one load, several loads, or no loads assigned to it. For example, if you do not want to shed or restore binary loads at a particular ramp level, you can leave that shed level empty on the Binary Loads tab.

Just as loads in shed level 1 (at the top of the list) are shed first and restored last, the same is true of individual binary loads within a shed level. A binary load at the top of a list is shed first and restored last; the load at the bottom of the list will be shed last and restored first—unless the Set first-off/first-on option is selected for that level.

The first-off/first-on option restores individual loads within a shed level in the same order that they were shed. Typically, you select this option for a shed level to even out the amount of time each load is turned OFF.



## Practical application

In the SUB, the dining areas and The Commons are high occupancy areas. Lockouts for the air conditioning units for these areas are assigned to shed level 4. Because a lot of people are affected when the air conditioning goes OFF for demand limiting purposes, the first-off/first-on option was selected for this shed level.

When the ramp value reaches shed level 4, the air conditioning in The Commons is turned OFF before the other areas. Air conditioning in The Commons is also restored before the others when energy demand decreases adequately. This prevents having the air conditioning OFF for a disproportionately long time in one area over the others.

## Adding or editing a binary load

To add a new binary load or edit an existing load, use the Edit Binary Load dialog box.

The property that will be commanded by the demand limiter to control this load.

A meaningful description for the binary load that does not exceed 255 characters.

Type the minimum amount of time (in seconds) that this load must shed and restored.

The value you want the demand limiter to write to the object when the load is restored. Typically, this is NULL for properties that support a priority array.

The value you want the demand limiter to write to the object when the load is shed.

Type a priority level from 1-16 to set the index of the priority-array at which the demand limiter writes. Default is 10.

**Figure 10.9** Click the commanded property command button on the Edit Binary Load dialog box to open the Binary Load Property dialog box.

When you add or edit a binary load, you specify the property that controls whether demand limiting is in effect. For example, this may be an occupied command for air conditioning equipment. Air conditioning is always OFF when the room is unoccupied.

You also assign a priority to the load. The priority determines whether other commands take precedence over demand limiting. The default for demand limiting is 10. In contrast, a standard schedule typically writes with a priority of 15. So a load that was scheduled to be turned ON could be turned OFF if demand limiting is in effect.

**Note** When setting up a demand limiter, Envision for BACtalk will not allow you to enter the same property and priority combination more than once.

Part of the binary load definition is the command the demand limiter writes when the load is shed or restored. For binary loads, the shed command is typically INACTIVE because you are turning equipment OFF. The restore command is typically NULL, returning equipment control to other processes. For example, use NULL if you want the equipment restored to whatever state the current schedule would dictate.

Use the anticycle limit settings to prevent equipment from cycling ON and OFF too frequently. The minimum shed and restore duration settings depend on the equipment. If it takes one or two minutes for a machine to “warm up” and get started, you would set the anticycle limits long enough to warrant the startup time.

### **Custom Binary Loads tab**

You can use custom binary loads for equipment that you do not want to associate with a specific shed level. Instead of shedding and restoring these loads based on the control ramp, they are directly associated with a specific energy demand value.

Like other binary loads, you specify the property that controls the load, the command priority, and shed and restore commands. You can also set anticycle limits for custom binary loads. In addition, you define the demand value at which the load will be shed and the value at which it will be restored.

### **Analog Loads tab**

Use the Analog Loads tab on the Edit Demand Limiters dialog box to assign the analog points that the demand limiter will shed. Analog loads provide another way of limiting energy demand without directly turning HVAC equipment ON or OFF. You can set up analog loads that spread setpoints, for example, so that equipment does not run as often or work as hard.

Analog loads are not grouped in levels like binary loads. Analog loads respond directly to a specific shed ramp range. You select when to start and stop shedding based on a percentage of the shed ramp value.

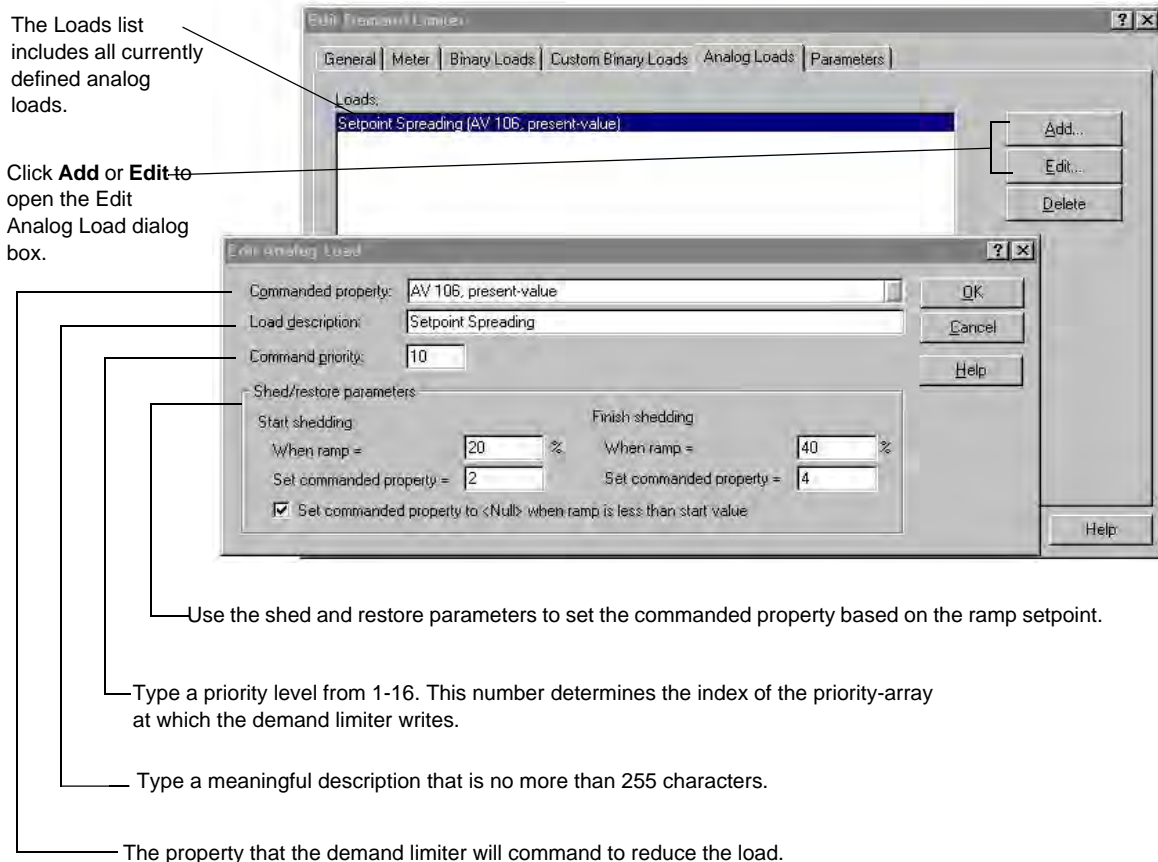


## Practical application

State U uses analog loads in its SUB demand limiter. For all student government offices, the cooling setpoint is gradually increased from 72 to 76 degrees F as the shed ramp increases from 0 to 20 percent. This reduces energy demand by delaying when the air condition is turned on. It also spreads the reductions in air conditioning use over several offices instead of just one area.

**Analog loads list** The Loads list on the Analog Loads tab includes all currently defined analog loads. You can add loads or select an existing load and edit it. Click **OK** after making changes to the analog loads list to send the updated demand limiter settings to the global controller without disrupting global controller operation.

To add a new analog load or edit an existing load, use the Edit Analog Load dialog box.



**Figure 10.10** The Analog Loads tab with the Edit Analog Load dialog box open

When you add or edit an analog load, you specify the property that the demand limiter writes to when shedding or restoring this load. For setpoint spreading, this would be the property that controls the demand offset.

You also assign a priority to the load. The priority determines whether other commands take precedence over demand limiting. The default for demand limiting is 10. In contrast, standard schedule typically has a priority of 15. So a device with scheduled setpoints could have the setpoints changed if demand limiting is in effect.

**Note** When setting up a demand limiter, Envision for BACtalk will not allow you to enter the same property and priority combination more than once.

The key settings for an analog load are the start shedding and finish shedding parameters. You define the ramp value (in percent) when you want to begin shedding this load and the ramp value when you want to stop shedding this load. You then set the values you want to write to the commanded property when you start and stop shedding.

You can also set up the demand limiter to write a NULL value to the commanded property when the ramp value is less than the value you entered for start shedding. This lets other software features, such as schedules, control the commanded property when the average peak demand is below the start shedding level.



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## Example

An analog load is set up for setpoint spreading. The shed/restore parameters are defined to start shedding when the ramp value is 20% and set the commanded property to 2. The demand limiter completes shedding this load when the ramp value is 40% and the commanded property will be set at 4. The Set commanded property to <Null> when ramp is less than start value has also been selected.

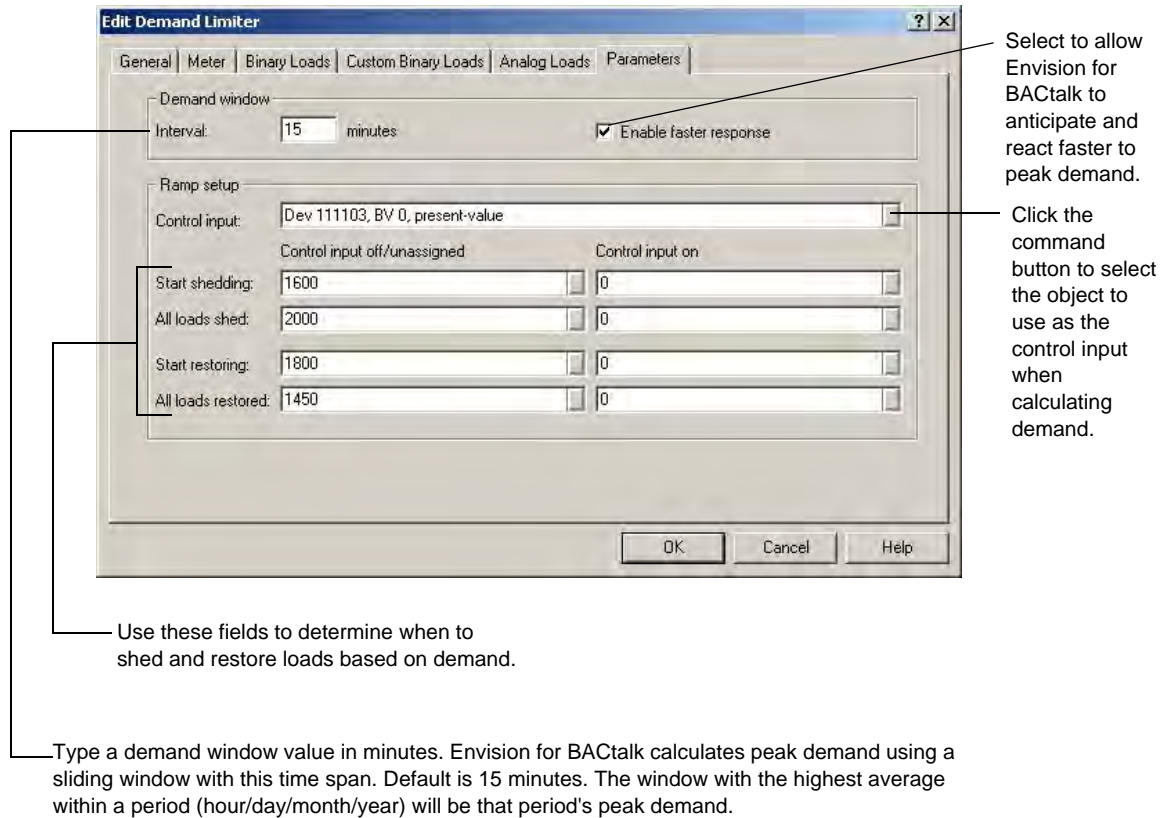
When the ramp value reaches 20%, the demand offset is increased by 2 degrees. If demand continues to increase, the demand offset is also increased up to a maximum of 4 degrees when the ramp value reaches 40% and shedding completes for this analog load. (See the Edit Analog Load dialog box in Table 10.10 on page 235.)

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## Setting ramp control parameters

### Parameters tab

Use the Parameters tab to set the demand window interval and upper and lower limits of the shed and restore ramps.



**Figure 10.11** The Parameters tab

### Demand window

The demand window interval controls how frequently the demand limiter recalculates the ramp value. By default, average peak demand is calculated using a 15-minute sliding window. (See “How the demand limiter calculates average demand” on page 218.) You can change this value, for example, if the utility company uses a different interval such as 30 or 60 minutes. If you select the Enable faster response check box on the Parameters tab, then the sample interval is reduced to one-third of the time. This allows the system to anticipate and react to peak demand before it is reached.

### Ramp setup

Envision for BACtalk uses the control ramp to shed and restore loads in an organized way. You can use the same control ramp for shedding and restoring loads. More often, users set up different values for the shed ramp and restore ramp. (See “How the demand limiter calculates ramp values” on page 221.)

You can define two sets of shed and restore ramps, and use a reference point to control which of the two sets is used. For example, if you assign a schedule to the reference point, the shed and restore ramps used can change according to the time of day. Use the Control input box on the Parameters tab to select the reference point.

The control input is optional. If no control input is selected, use the first column to set the shed and restore ramp parameters. See “How the demand limiter calculates ramp values” on page 221 for guidelines on selecting the correct ramp values for shedding and restoring.

If a control input is selected, use the first column to set the ramp parameters when the control input is OFF; use the second column to set the ramp parameters when the control input is ON. This may be useful if your utility varies its peak demand billing based on the time of day.

You can use constant values for the shed and restore settings, such as start shedding when average peak demand reaches 1600 kW. You can also reference points. This makes the ramps totally configurable using DDC or data displays.



### Practical application

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All State Energy charges State U a different peak demand fee depending on the time of day. From 2:00 PM to 7:00 PM on weekdays, State U is charged \$7.50 for each kW above 50kW. Outside of those hours, All State Energy charges \$1.50 for each kW above 50kW. To save even more money, State U wants to use more restrictive demand limiting during those peak charge hours.

When the Facilities Department sets up the demand limiter for the SUB, they schedule a reference point that is ON during the peak hours (2:00 to 7:00 PM weekdays) and OFF at all other times. This is the control point they select on the Parameters tab. Then, they set up two sets of shed and restore ramps.

During the peak hours, shedding is set up to start shedding sooner and start restoring later than during the non-peak hours. For example, at 10:00 on Tuesday morning, shedding starts when the average peak demand reaches 1600 kW. At 5:00 that same afternoon, shedding starts when average peak demand reaches 1400 kW.

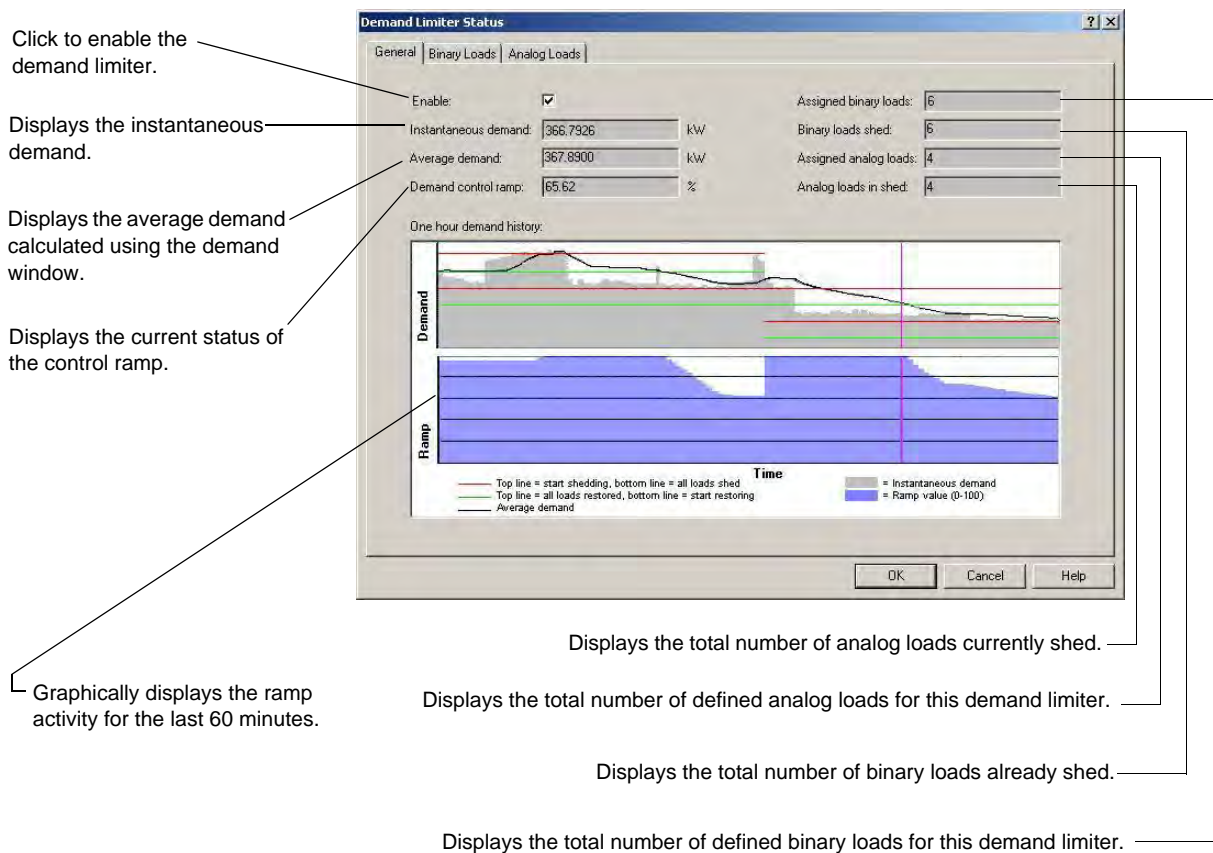
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## Working with demand limiter status

To monitor the status of a demand limiter, click **Status** in the Demand Limiters dialog box. The Demand Limiter Status dialog box provides three views of how the demand limiter is performing.

- The General tab provides statistical and graphical information, including average peak demand, current status of the control ramp, and number of loads currently shed.
- The Binary Loads tab displays the current shed status of each binary load.
- The Analog Loads tab displays the current shed status of each analog load.



**Figure 10.12** The Demand Limiter Status dialog box with the General tab open

Use the General tab to view the ramp and demand values in graphical format for the last 60 minutes. When you open the status window, a vertical magenta line indicates the beginning of the sliding window.

You can use this graph to view when shedding starts and stops and to see when the system begins restoring loads. These events are indicated using red and green lines, respectively. The legend at the bottom of the graph provides more information.



# File Transfer

# 11

The file transfer file allows you to move files from a client workstation to the server workstation, from a server workstation to any connected client workstation, or to and from any client workstations connected to the same Envision for BACtalk server. Files can be transferred over Ethernet, IP or PTP connections.

## Benefits

**Convenient** Transfer a single file or a group of files all at one time. Transfer the files now or pause and transfer them later without losing your setup.

**Secure** Allow users to access and transfer all files on the local workstation or limit their access to Envision for BACtalk files only. You determine user access to data and whether or not they can transfer data.

**Easy to set up** Quickly select and transfer the files you want to and from connected Envision for BACtalk workstations.



## Practical application

Joe can transfer energy log files, trendlog reports, and archived trendlog files from his client workstation in the Health Sciences building to his boss, George's server workstation in the Facilities Office. Joe can also transfer files from his client workstation to Marc's client workstation in the Administration building. George can transfer display .DSP files from the server to both Joe's and Marc's client workstations. They can also send report files and time sheet .XLS files to George and Accounting at the end of each pay period.

## Quick start–file transfer setup

Use the following table as a guide when setting up file transfer. The key steps for transferring files are listed in order.

**Table 11.1** Tasks for transferring files

Task		See
1	Enable the File Transfer Policy at the server.	• See page 243
	Set up user profiles with File Transfer privileges.	• See page 246
2	Open File Transfer and select the file(s) to transfer.	• See page 247
3	Specify the target destination for the selected file(s).	• See page 247
4	Specify the destination the file(s) will be stored to on the remote workstation.	• See page 247
5	Transfer the selected file(s).	• See page 247

## Setting up file transfer

The File Transfer feature is disabled by default so it must be configured before it can be used. File transfer must be set up at the server and for each user profile. For added security, the most restrictive privileges apply when there is a conflict between server and individual user privileges.



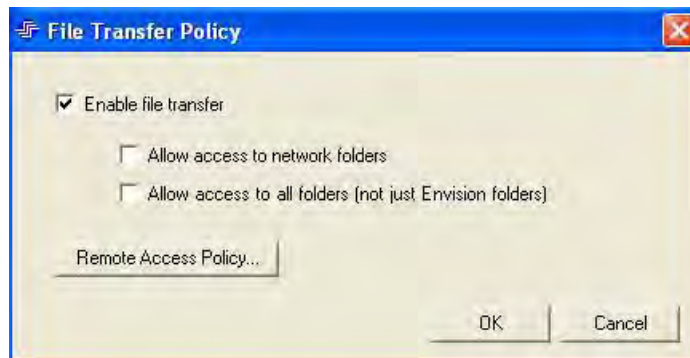
### Practical application

Joe's privileges allow him to transfer files from the workstation in the Health Sciences Building to his colleagues in other State U buildings. However, his boss, George, has disabled File Transfer on the server. Joe may open the File Transfer window but he cannot select any files for transfer. Joe can now view only the Current Transfer Status and Transfer History tabs.

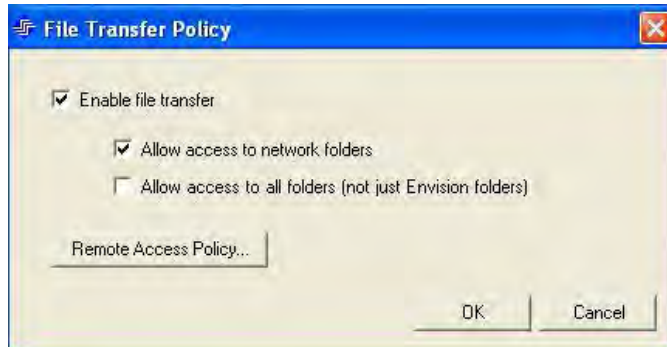
## Setting up the server

Enable File Transfer (file transfer policy) at the server (Tools>File Transfer>File Transfer Policy) and specify whether files on the local workstation can be transferred or just Envision for BACTalk files. Also, specify if users who have the Set File Transfer Policy Remotely privilege selected in their user profile will be able to remotely connect to the server and change the File Transfer Policy.

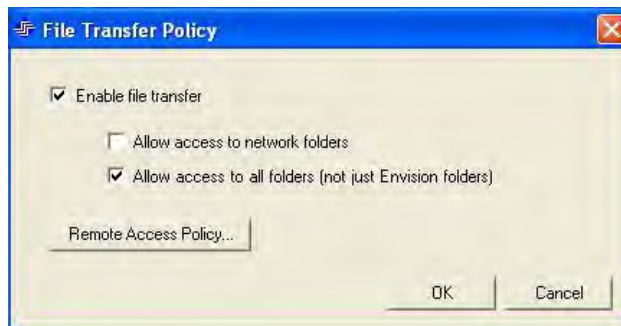
When Enable File Transfer is selected and both access check boxes are cleared, you can transfer files only to and from Envision for BACTalk folders.



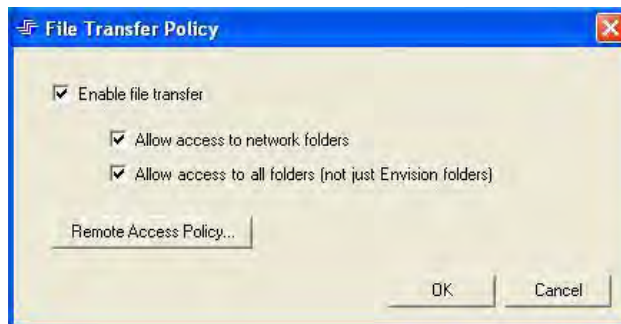
When Enable File Transfer is selected and Allow Access To Network Folders is selected, you can transfer files to and from Envision for BACtalk folders on the network or on the local workstation.



When Enable File Transfer is selected and Allow Access To All Folders is selected, you can transfer files to and from any folders on the local workstation.



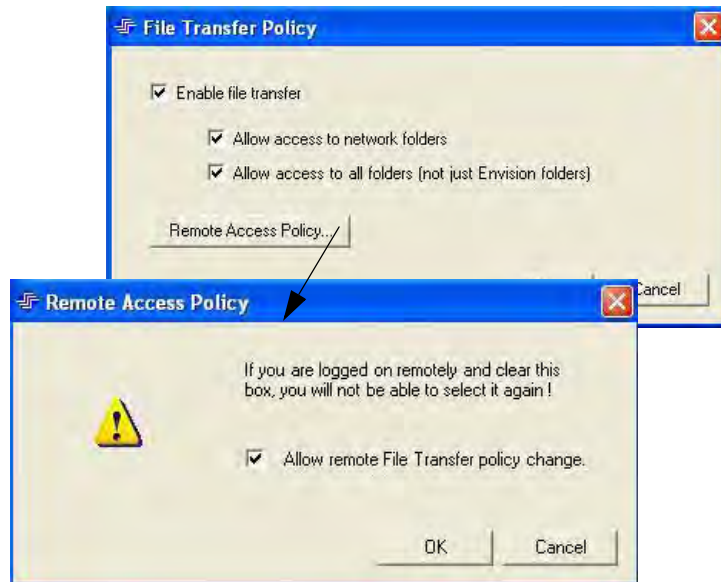
When Enable File Transfer is selected and both Allow Access To Network Folders and Allow Access To All Folders options are selected, you can transfer files to and from any folders on the network or the local workstation.



### Setting the file transfer policy remotely

You can remotely connect to the server and change the File Transfer Policy if the Set File Transfer Policy Remotely privilege is selected in your user profile. Enable the Remote Access Policy to allow privileged users to remotely change the File Transfer Policy. When the Allow Remote File Transfer Policy Change option is enabled, privileged users can change the global transfer policy from a client workstation. If this option is not enabled, users cannot remotely change the

global file transfer policy regardless of their privileges. Click **Remote Access Policy** to open the Remote Access Policy dialog box and then enable users to change the file transfer policy from a remote location.

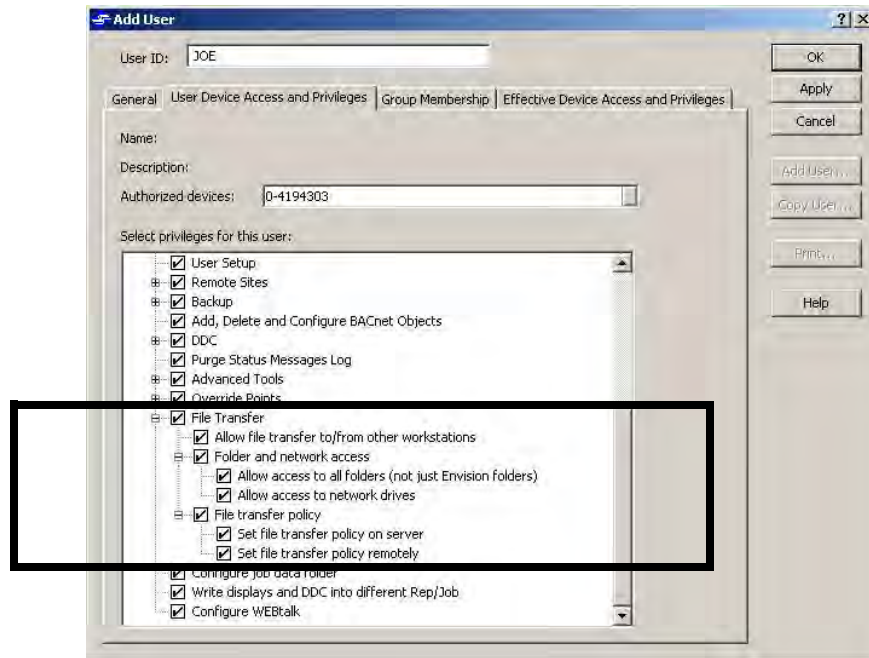


**Figure 11.1** Open the Remote Access Policy dialog box from the File Transfer Policy dialog box.

System performance may be slow when attempting to do other operations while a large file transfer is in progress over a dial-up connection. It may be a good idea to do large file transfers over a dial-up connection during off-peak hours.

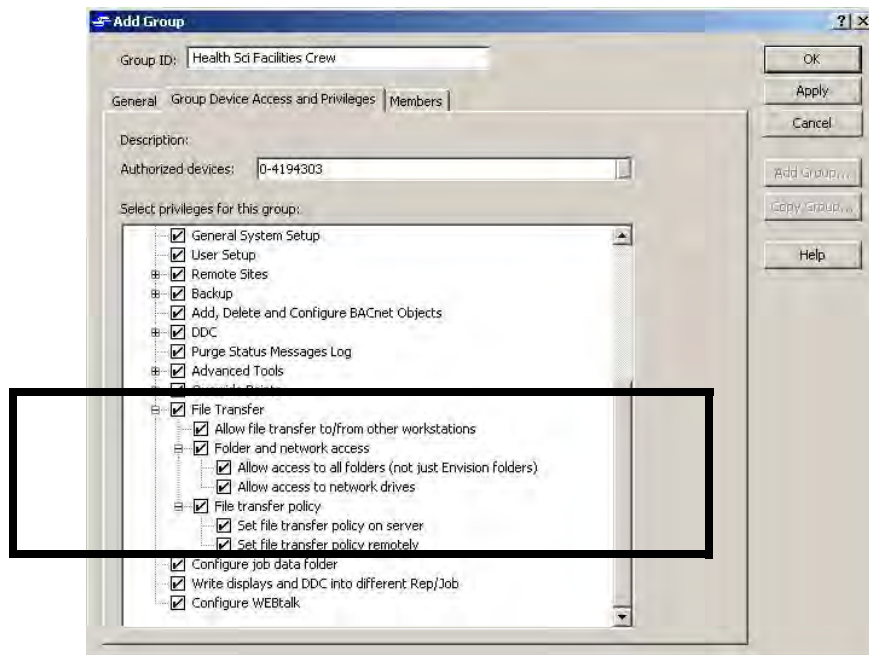
## Setting up File Transfer privileges

Set individual user privileges for File Transfer on the Add User dialog box for each user (Tools> Users and Groups> User tab> Add/Edit).



**Figure 11.2** File transfer user privileges must be enabled before the user can transfer files.

Or, give File Transfer privileges to a Group and then all members of that group will have File Transfer rights, even if their individual user profiles do not grant access to File Transfer (Tools> Users and Groups> Group tab> Add/Edit).





## Working with File Transfer

When you set up to transfer a file, you define the file to be transferred, its current location, and its target destination. Transfer one file at a time or select multiple files or folders from the same location using Shift+click and Ctrl+click operations.

Select one or more files on the local workstation and then click the right (top) arrow to move it to the specified destination in the Remote Workstation pane. Or, select a file in the right pane and click the left arrow to transfer it to the local workstation. You can also drag and drop files.

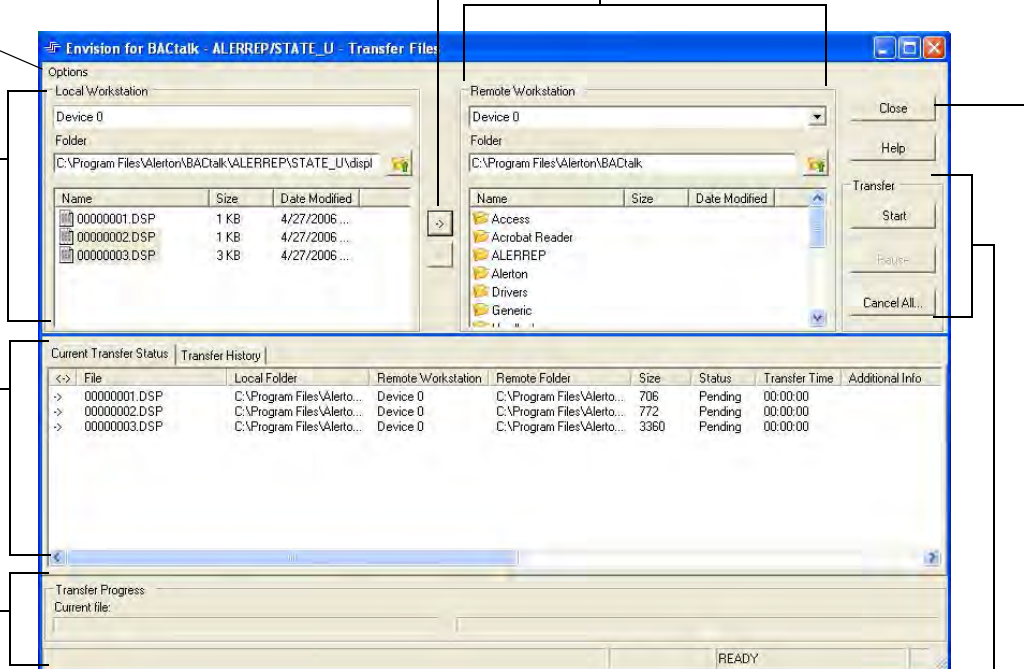
Select a file on a remote workstation to transfer, or select the destination on the remote workstation for a transferred file.

Click to Enable Auto Start or Refresh data

Select a file on the local workstation to transfer, or select the destination for a transferred file.

View the current status of a file selected for transfer or the history of all transferred files.

View transfer status



Click **Start** to transfer selected files. Start turns into Resume when a transfer operation is paused. Click **Resume** to start a paused file transfer. Click **Pause** to suspend a transfer operation already in process. Click **Cancel All** to clear the Current Transfer Status pane.

Click to close the File Transfer dialog box. Pause file transfers already in progress to resume later or cancel the selected file transfer(s) before closing. A warning displays telling you file transfer will be paused if you shut down Envision for BACtalk, log off, or close a remote dialup connection before a file transfer operation completes. NOTE: If auto-logout is enabled and the auto-logout time expires, file transfer will silently suspend. It is recommended that you disable auto-logout if you plan to do large unattended file transfers.

**Figure 11.3** The File transfer dialog box

Use the following File Transfer dialog box components when working with File Transfer.

**Table 11.2** File Transfer window components

Item	Description
Options menu	Enable Auto Start: Click to immediately start a file transfer when a file is dragged and dropped on a destination folder or when multiple files are selected and one of the To/From arrows is clicked.
	Refresh: Click to update all displayed data on the File Transfer dialog box.
Local Workstation	Manages transfers to and from the local workstation. The device number and description of the local workstation as it appears in Device Manager.
	Folder: shows the active folder. The Envision for BACtalk folder is displayed by default.
	Name: Names of files located on the local workstation.
	Size: File size in bytes.
To/From arrows	Date Modified: The date the file was last saved.
	Move selected files to and from the Local Workstation and Remote Workstation panes. These arrows are disabled until the destination and least one file is selected for transfer. Note: You can also drag and drop files instead of using the arrows.
Remote Workstation	Used for transfers to and from the remote workstation. Includes a workstation drop-down list of all available remote workstations. If the local workstation is the server, all networked client workstations are in the list. If the local workstation is a client, all networked workstations as the Envision for BACtalk server are listed.
	Folder: shows the active folder. The Envision for BACtalk folder is displayed by default.
	Name: Names of files located on the local workstation.
	Size: File size in bytes.
Transfer options	Date Modified: The date the file was last saved.
	Start: Click to start transferring the selected file(s). Start turns into Resume when a transfer operation is paused.
	Resume: Click to restart a paused file transfer.
	Pause: Click to suspend a transfer operation already in process. For example, pause a file transfer when you need to close the File Transfer dialog box or close down Envision for BACtalk. The Status column on the Current Transfer Status tab shows which files were transferred (Complete) and which files are still pending.
	Cancel All: Click to cancel all pending transfers and clear the Current Transfer Status pane. View the Transfer History tab for file transfer data.

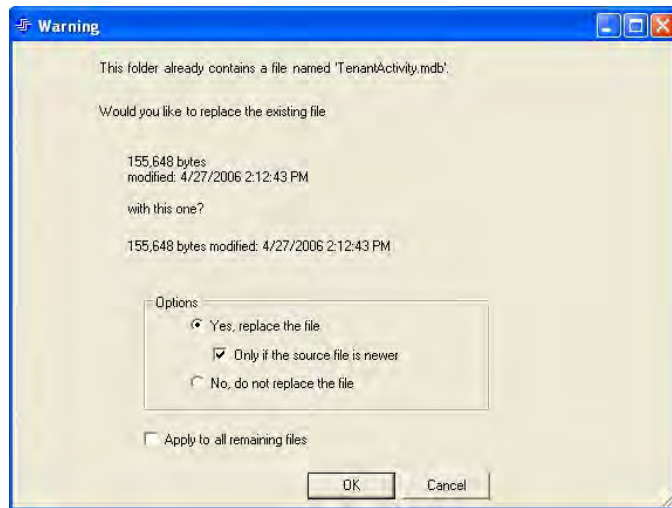
**Table 11.2** File Transfer window components

Item	Description
Current Transfer Status tab	<p>Cancel, Cancel All, and Show Details are available on the context (right-click) menu on the Current Transfer tab.</p> <p>Cancel = stops the transfer of the selected file and removes it from the list.</p> <p>Cancel All = all pending file transfers are canceled and all files are cleared from the list. Any files already transferred appear in Transfer History.</p> <p>Show Details = displays all available information about the selected file.</p>
	<->: Direction of the file transfer.
	File: List of all files selected for transfer since the dialog box was opened.
	Local Folder: The full path on the local workstation where the file is being transferred to or from.
	Remote Workstation: Lists the full path on the remote workstation where the file is being transferred to or from.
	Size: File size in bytes.
	<p>Status: Indicates the current status of the transfer operation.</p> <p>Pending = file has not yet been transferred. Pending transfers older than 30 days get automatically purged.</p> <p>Complete = file was successfully transferred. A percentage indicates the current approximate percentage completion of a transfer currently in progress.</p> <p>Canceled = a user canceled the file transfer.</p> <p>Error = a system error cancelled the file transfer. See Additional Info error details.</p>
	Transfer Time: The time it took to successfully transfer a file.
	Additional Info: For files with a status of Error, a brief description of the error is displayed.

**Table 11.2** File Transfer window components

Item	Description
Transfer History tab	Shows only files transferred by the current user. Click column headings to sort the data. Delete and Show Details are available on the context (right-click) menu on the Transfer History tab. Delete = deletes the selected file from the list. Files can only be deleted from this list manually by the user. Show Details = shows available information about the selected file.
	Source: Workstation that file was transferred from. This same information appears in Local or Remote Workstation panes.
	Destination: Workstation that the file was transferred to. This same information appears in the Local or Remote Workstation panes.
	File: List of all successfully transferred files.
	Source Folder: The full path on the workstation where the file was transferred from.
	Destination Folder: The full path on the workstation where the file was transferred to.
	Size: File size in bytes.
	Start: The date and time when the file transfer started.
	Finish: The date and time when the file transfer stopped.
	Status: Indicates the current status of the transfer operation. Complete = file was successfully transferred. Error = the file was not successfully transferred due to an error. See Additional Info.
	Additional Info: For files with a status of Error, a brief description of the error is displayed.
	Transfer Progress
Current File: File name of current file transfer in progress.	
Time Left: Estimated time left for the current file transfer in progress to complete. A graphical progress bar represents the completion status for the current file.	
All Files: Number of files selected for transfer and the number of current file in progress. For example, 3 of 6.	
Time Left: Estimated time left for all the files currently selected for transfer.	

If more than file or folder with the same name is detected, the system prompts you to acknowledge whether to overwrite the existing file.



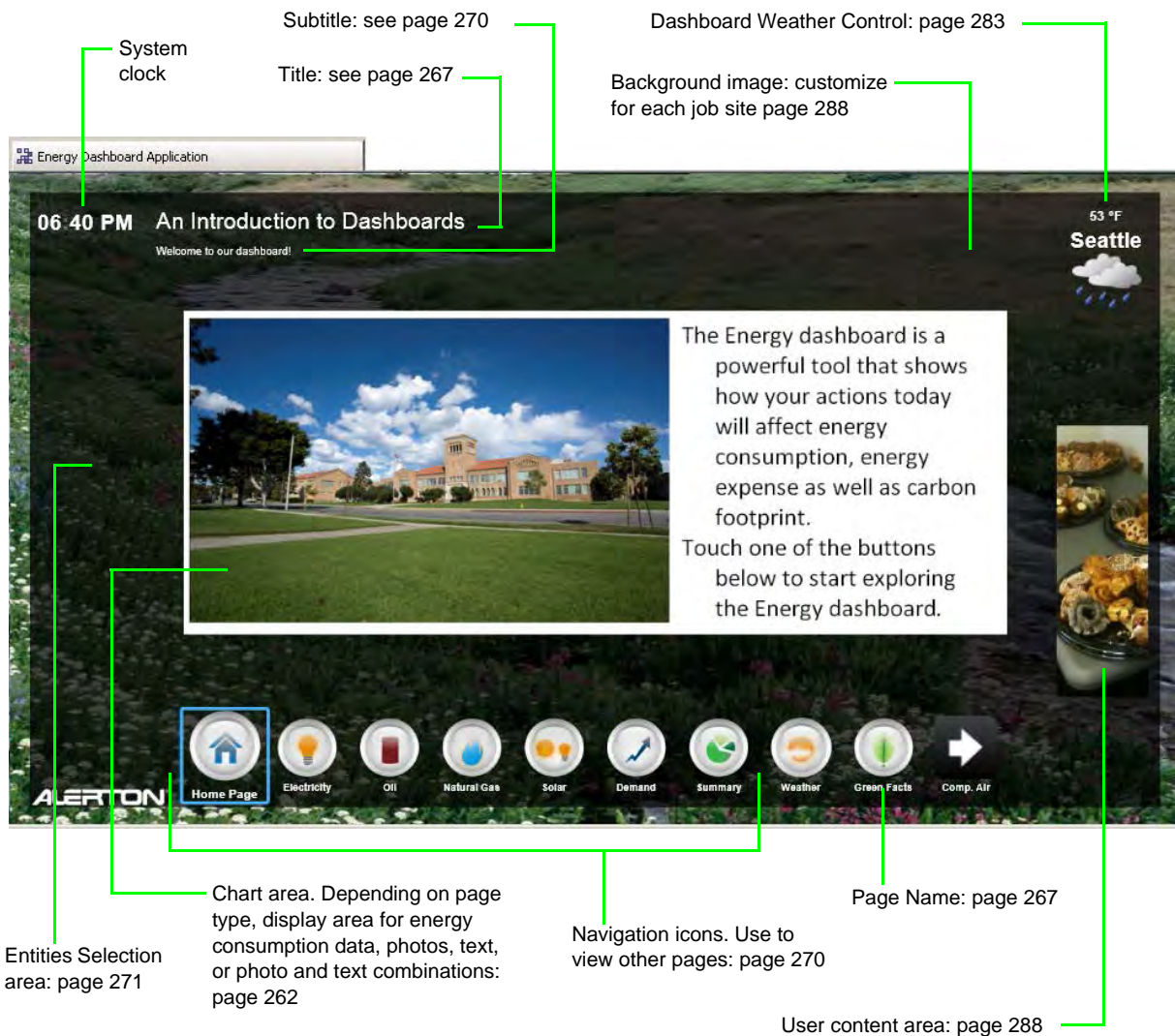
You can choose to overwrite all files, overwrite older files, or not to replace files.



# Energy Dashboards

# 12

Alerton Energy Dashboards display energy consumption for sites. They provide a visual representation of how building tenant, occupant, and visitor behaviors impact energy conservation. Dashboards work best when displayed on high-resolution computer screens. Users can interact with them using a keyboard and mouse or, optimally, on a touchscreen monitor. Configure the display screens to highlight how your BACtalk site monitors and manages energy use.



**Figure 12.1** Example Energy Dashboard: add photos, text, and weather forecast to customizable areas.

The Energy Dashboard is automatically installed with Envision for BACtalk but a software license key is required to activate the dashboard software module. Display an energy dashboard as a lobby kiosk or as a web site configured as either an intranet or internet site that supports up to 450 concurrent users.

**IMPORTANT!** Energy Dashboards use Envision for BACtalk energy log data to display energy usage information. Before you set up a Dashboard, make sure you have created energy logs for all meters installed on the system.

## Benefits

**Convenient** Display energy consumption in the lobby or other high traffic location so visitors and occupants can see how their behavior impacts a facility's energy demand.

**Accurate** Real data is pulled from the secure BACtalk system and used to generate a visual display of actual energy demand as reported by a facility's energy meters.

**Reduce consumption** Customize the dashboard to highlight energy savings in your facility. Highlight energy consumption over time to show occupants and visitors how their behavior impacts the facility's carbon footprint thus motivating them to conserve energy.



### Practical application

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State University is going green and striving to achieve LEED certification so George, the facilities manager, wants to set up energy dashboards in various high-traffic areas on campus so students, faculty, administrators, and visitors can see how their behavior on campus impacts the amount of energy consumed. Marketing messaging on the dashboard could make connections between the amount of energy used and the rate of tuition or state tax increases. Show people how much energy they currently use, advertise cost-saving alternatives, and show them comparison numbers over time so they can see how their modified behavior can make a difference in energy conservation and lower bills.

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## Quick start–dashboard setup

Use the following table as a guide when setting up a dashboard.

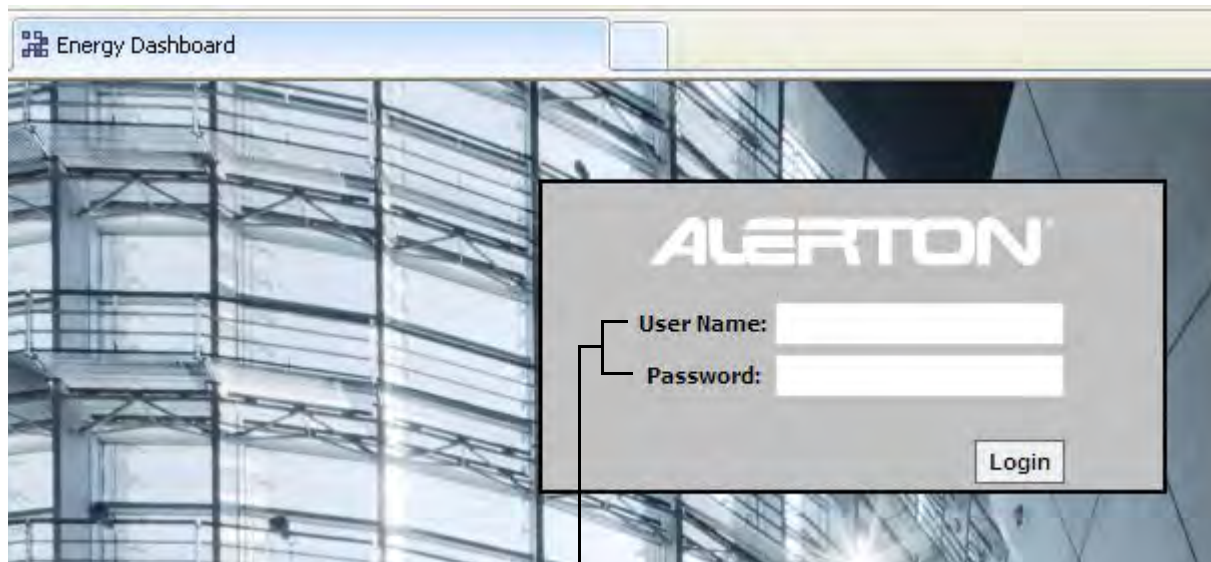
**Table 12.1** Tasks for setting up a dashboard

Task	See	
1	You must have a BACtalk software license key that supports Dashboards - ABS-3-D-MEDIUM, ABS-3-D-LARGE, or ABS-3-D-ENTERPRISE.	<ul style="list-style-type: none"> <li>See the Envision for BACtalk Installation and Startup Guide (LTBT-TM-ADMIN30) for more information.</li> </ul>
2	Gather all high-resolution images and clear and concise text to add to the dashboard so you have all you need to populate the pages. Make sure you have obtained any and all permissions required to use photos, logos, names, slogans, and any other intellectual property on the dashboard.	
3	Take precautions to securely install dashboard equipment since the monitor is intended to be mounted in a public space. For example, bolt the high-resolution monitor in place and securely cover all unused ports to prevent unauthorized connections.	
4	Set up energy logs for all meters that will report data to the dashboard.	<ul style="list-style-type: none"> <li>page 205</li> </ul>
5	Enable the Default User on the General System Setup tab. <b>NOTE:</b> The Default User must be configured in Envision for BACtalk before any user can access the Dashboard.	<ul style="list-style-type: none"> <li>page 331</li> </ul>
6	Configure users with the "General System Setup" privilege to access the Dashboard. <b>NOTE:</b> Default User should not have the General System Setup privilege nor should this user configure dashboards.	<ul style="list-style-type: none"> <li>page 328</li> </ul>
7	Users must have the "General System Setup" privilege to access the Energy Dashboard Editor.	<ul style="list-style-type: none"> <li>page 331</li> </ul>
8	Ensure your computer has an internet connection to easily access the Energy Dashboard Editor.  <b>NOTE:</b> Dashboards can run without an internet connection but the functionality will be reduced. For example, live weather data will be unavailable.	
9	If you want to run multiple dashboards, install the Alerton Multiple Building Dashboard.	<ul style="list-style-type: none"> <li>page 258</li> </ul>
10	With Envision for BACtalk running, log in to the Energy Dashboard Editor to set up Dashboards.	<ul style="list-style-type: none"> <li>page 260</li> </ul>
11	View dashboards in a standard web browser.  From the BACtalk server, type: <b>http://localhost/dashboard/&lt;dashboard+name&gt;</b>  From a client, type: <b>http://&lt;server IP address&gt;/dashboard/&lt;dashboard+name&gt;</b>	

See the following sections for an overview of each Energy Dashboard Editor page. The online Help gives more specific information about using page components.

## Setting up a dashboard

Use the Energy Dashboard Editor to set up energy dashboards that you can customize for your facility.



With Envision for BACtalk running, enter a valid Envision for BACtalk user name and password. This user must have the General System Setup privilege and should not be the Default User.

**NOTE:** Unless all dashboards require authentication, the Default User must be configured and enabled in Envision for BACtalk but the Default User should not set up dashboards.



### Practical application

In an effort to reduce energy costs in State University student housing, George wants to display how much electrical power students in the Dormitory West consume in a three month period. George asks Joe, one of the lead technicians, to set up a dashboard in the cafeteria of the dormitory to show student residents, school employees, and visitors the amount of electrical energy consumed in Dormitory West and equivalents.

## Setting up user privileges

Before you begin using dashboards, set up Envision for BACtalk to support them.

Set up a Default User profile (Tools > Users and Groups) in Envision for BACtalk and then specify the Default User on the Startup/Shutdown tab (General System Setup). Log into Envision for BACtalk and then launch the Energy Dashboard Editor to set up your dashboards.

Configure the dashboard to be used with a touchscreen display using web browser navigation, or with a mouse and high-resolution 16x9 aspect ratio monitor display. Refer to the touchscreen documentation to set up and calibrate your touchscreen monitor using a mouse and keyboard.

## Running multiple dashboards

A standard Envision for BACtalk 3.0 installation includes functionality for a single dashboard. If you want to run multiple dashboards, you can obtain additional dashboard licenses and install the Alerton Multiple Building Dashboard drop-in application. For information about drop-in applications, see “About drop-in management” on page 259.

## Acquiring additional dashboard licenses

To run multiple dashboards, you will need to purchase additional licenses. Acquire the licenses as instructed by Alerton Customer Service.

If the Envision for BACtalk server is connected to the Internet, the licenses will be loaded when you log in as LocalAdministrator and enter the license key supplied by Alerton Customer Service.

If the server is not connected to the Internet, you will get the license.lar file from Alerton Customer Service and copy it to the Envision for BACtalk server. Then, when you log in as LocalAdministrator, you can choose to load the license file from the server.

## Installing Multiple Building Dashboard

### ► To install Multiple Building Dashboard

1. Download these files from the Alerton Support Network:  
**EnableAddInManagement.exe**  
**ABS-3-Pack-1.zip**
2. In Envision for BACtalk, select Tools>General System Setup and then select the Startup/Shutdown tab.
3. Ensure that Auto-Login is not enabled.
4. Shut down Envision for BACtalk.
5. Copy **EnableAddInManagement.exe** to the Envision for BACtalk installation directory. The default installation directory is C:\Alerton\BACtalk\3.0.
6. Double-click the file to run it.
7. When prompted, ensure that the files are extracted to the installation directory.
8. If you are prompted to confirm file replacement, click **Yes**.
9. Unzip the files in **ABS-3-Pack-1.zip** to the newly created DropIns folder (<installation directory>\DropIns).
10. Start Envision for BACtalk and then log in as the LocalAdministrator.
11. If prompted for the location of the license.lar file, browse to the location where you saved it and then click **OK**.
12. To verify the installation, click **Help>About Envision...**  
Under Installed apps: the version of Energy Dashboards should be 1.1.x.0.

## About drop-in management

Drop-in management functionality is a new feature in Envision for BACTalk that checks for new or updated application files and copies them to the correct location. The drop-in management executable file (EnableDropInManagement.exe) runs only one time. Thereafter, drop-in management runs automatically.

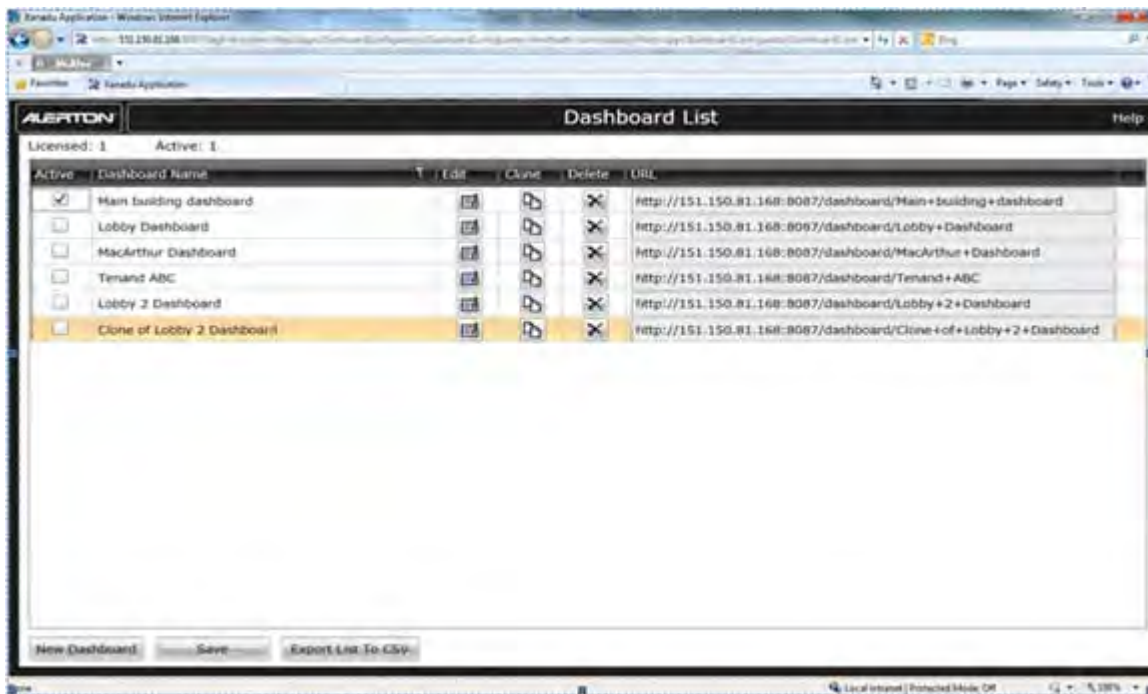
When you run EnableDropInManagement.exe, it replaces System\bactalk.exe, creates a DropIns folder, and copies two new files to the server - System\XagLoader.dll and System\DropIns\readme.html.

At startup, Envision for BACTalk scans the DropIns folder for new or updated files and installs them. It does not overwrite newer versions of any file, so it is safe to leave the installed applications in the DropIns folder. This is useful as a reminder of what you have installed. When you drop in new applications or updates, drop-in management ensures that the latest files are used by Envision for BACTalk.

## Launching Energy Dashboard Editor

- ▶ **To launch the Energy Dashboard Editor**
  1. Log in to Envision for BACtalk.
  2. From the BACtalk menu, select **Energy Management>Energy Dashboards>Energy Dashboard Editor**.
  3. The Energy Dashboard Editor login page opens.
  4. Enter a valid user name and password (defined in Envision for BACtalk, must have General System Setup privilege), and then click **Login**. The Dashboard List appears.

**IMPORTANT** The Energy Dashboard Editor session remains active until the web browser is closed.



**Figure 12.2** Energy Dashboard Editor - Dashboard List

## Using the dashboard list

After you launch the Dashboard Editor, it opens to the Dashboard List. The list shows the dashboards that have been created, shows licensing information, and allows you to create, edit, and delete dashboards.


Licensing information is shown above the list of dashboards. It shows the number of dashboard licenses associated with the Envision for BACTalk server and the number of active dashboards.

To sort the list by name, click the Dashboard Name column heading. Click the heading again to toggle between ascending and descending order.

**Active** Select dashboards to make them accessible by a web browser (active). Clear selections to make them inaccessible. Click **Save** to commit the changes. The number of active dashboards is limited to the number of licenses associated with the Envision for BACTalk server.

**Dashboard Name** The dashboard name appears in the browser title bar of the dashboard and in the URL that points users to the dashboard application. You can change a dashboard name by clicking it, typing the new name, and then clicking **Save**. Do not use apostrophes ('), ampersands (&), quotation marks (“”), greater-than symbols (>), or less-than symbols (<) in dashboard names. Dashboard names must be unique within the Envision for BACTalk installation.

To sort the list by name, click the Dashboard Name column heading. Click the heading again to toggle between ascending and descending order.

Filter the list by clicking the filter icon  in the Name column heading. Use the filter to show or hide dashboards on the list.

**Edit** Click the icon  in the Edit column to change the configuration of the associated dashboard. The Energy Dashboard Editor appears. See “Editing energy dashboards” on page 262.

**Clone** Click the icon  in the Clone column to make a copy of the dashboard.

The Dashboard Editor creates a new dashboard with the same configuration as the existing dashboard. You can replace the default name with a more meaningful name by clicking the name and then typing a new one.

**URL** The dashboard URL is used to point web browsers to the dashboard application. The URL is generated by Envision for BACTalk based on the dashboard name. Spaces in the dashboard name are converted to plus signs (+) for use in the URL. The URL is read-only.

**New Dashboard** Click **New Dashboard** to create a new dashboard and add it to the bottom of the list. You can replace the default name with a more meaningful name by clicking the name and typing a new one. Do not use

**Export List to CSV** Saves the name, active/inactive status, and URL of the listed dashboards to a comma separated value (CSV) file.

## Editing energy dashboards

The ten pages and two reports listed in the left navigation area comprise the Energy Dashboard Editor.

Resource Name	Units	Cost Per Unit	Type	Equivalent Configuration	Delete
Electricity	kilowatt hour	0.12	Consumption		
Water	gallon	0.035	Consumption		
Solar	kilowatt hour	0.34	Production		
Natural Gas	megabtu	0.4	Consumption		
Oil	megabtu	0.42	Consumption		

Navigation Menu (highlighted in red):

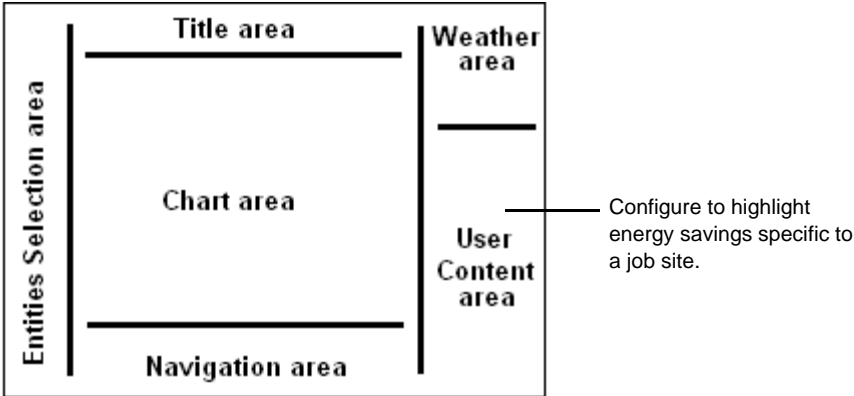
- Resources
- Pages
- Entities
- Compare To
- Equivalents
- Variable Data
- Weather Data
- Miscellaneous
- Auto Rotation
- Image Gallery
- Error Log
- User Activity

Buttons at the bottom: Add New Resource, Save, Cancel

### Page layout

Dashboards are made up of a **maximum** of 10 pages. Pages, in turn, are made up of areas, which contain one or more configurable controls.





**Figure 12.3** The dashboard page template has 6 main areas.

Use only high-resolution graphics when building dashboards. This ensures images display crisply and clearly on large monitors. Resolution: check the display where the dashboard will run and verify that the images display well. For example, verify that there are no artifacts, no pixilation, and so on.

Maintain the graphics aspect ratio to make best use of available screen space and to avoid distortion. Divide the width of each graphic by its height and verify that it matches the value provided in the table below. Use images correctly sized for the area in which they will be displayed. The supported dimensions of each area are:

Area	Pixels	Aspect Ratio
Entity Selection	100 x 480	0.21
Title	750 x 80	9.38
Weather	100 x 128	0.21
Chart	1000 x 480	2.01
User Content	100 x 480	0.21
Navigation	960 x 114	8.42

**Note** Click **Help** at the top of the Energy Dashboard Editor screen for more specific information about working with each Editor page.



## Resources page

Define the resources to display in your dashboard. Typical resources include electricity, water, solar power, natural gas, and oil. Specify which equivalent to display on the dashboard. For example, the amount of electricity used equals X number of cheeseburgers.

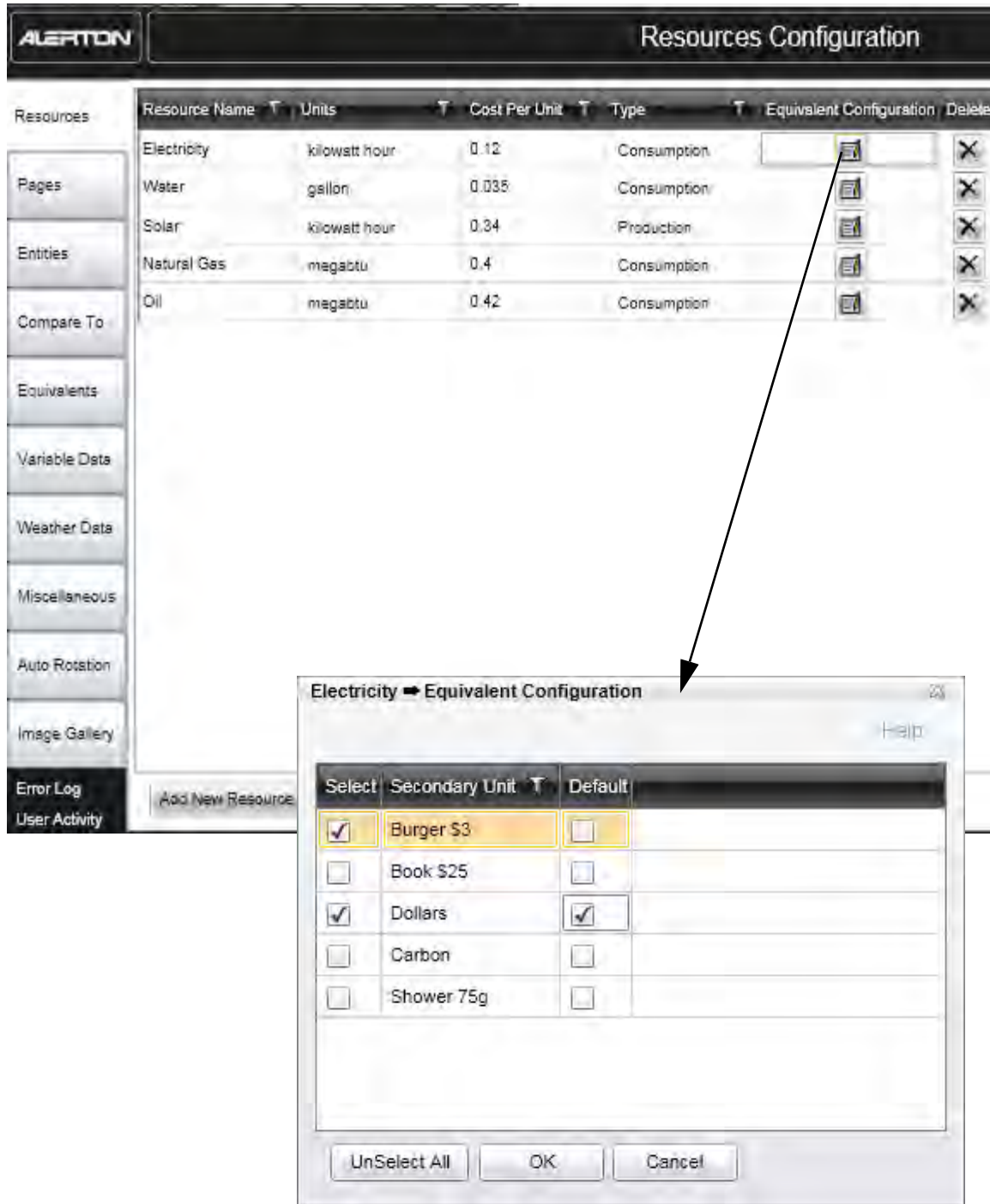


Figure 12.4 Energy Dashboard Editor - Resources page default settings




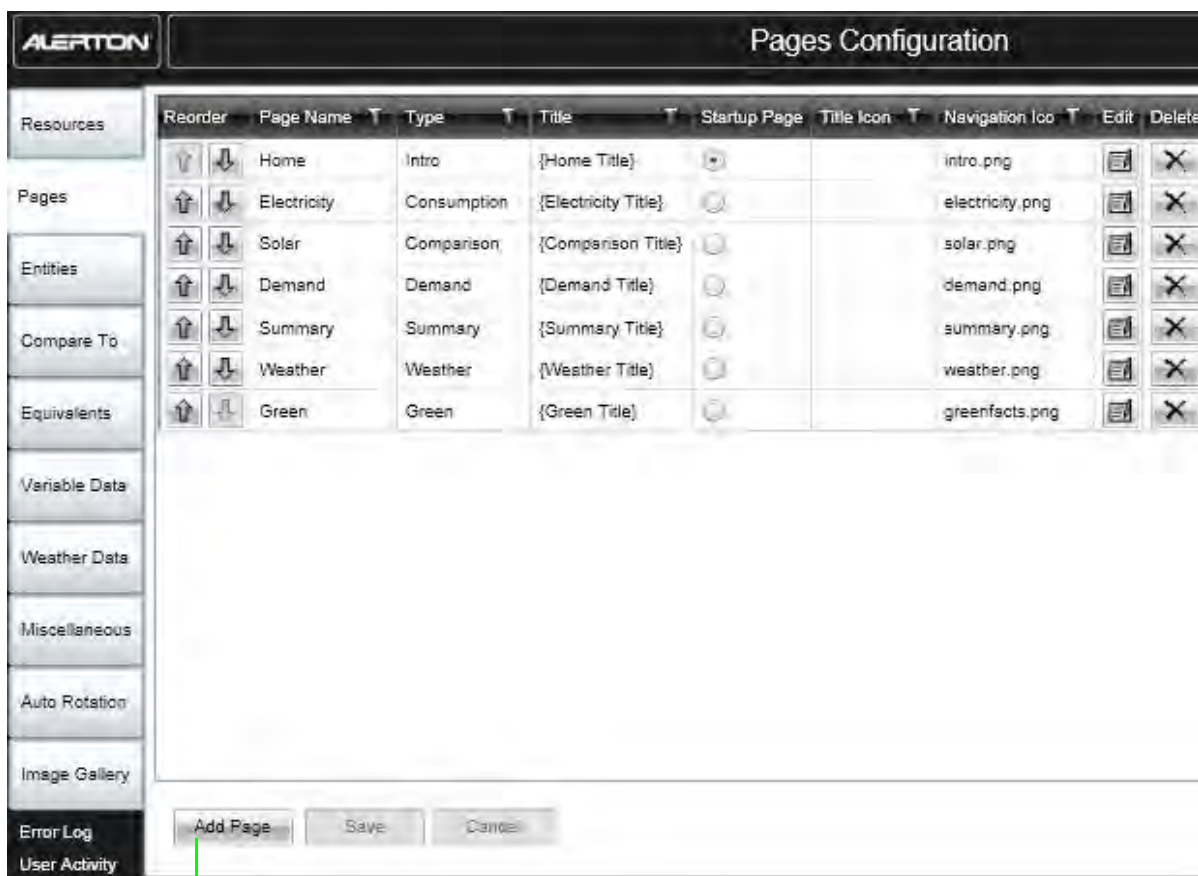
Figure 12.5 Example Resources dashboard page set up for electricity consumption



Figure 12.6 Example Resources dashboard page set up for solar vs. electrical power

## Pages page

The Pages page lists the pages in the dashboard and allows you to add, edit, and delete pages. Click the edit icon  to customize the look of each dashboard display screen.



Click to add a new page to the dashboard.

Other types of useful pages include:

**How it Works** Content that explains to building occupants how an energy management system works.

**What Can I Do** Explains what building occupants can do to reduce their energy consumption and participate in a sustainability program.

**LEED Scoreboard** Shows building occupants how their building compares to others or provides before and after facts to show the success of current sustainability efforts.

**Campus Map** Displays a campus map that provides campus-specific information to building visitors.

**Building Directory** Displays the names of building tenants.

**Figure 12.7** Energy Dashboard Editor - Pages page default settings



## Reorder

Use the arrows in the Reorder column to change the order in which pages appear in the Navigation area.

## Page Name

Modify the text in the Page Name column to specify what title appears in the bottom Navigation area of the dashboard below the navigation icon buttons. Supports a maximum of 12 characters.

## Type

The page type defines the basic function of the page. There are seven page types.

**IMPORTANT!** Page type is determined when the page is created and it cannot be changed later.

**Table 12.2** Dashboard page types


Page type	Description
Home Page	Page intended as the starting screen for a viewer. This introductory screen typically includes a photograph of the job/building/campus and some interesting descriptive text about the facility being monitored for energy consumption. Explains the purpose and uses of the dashboard.
Green Facts	Illustrates components of the major green building categories. Summary screens that describe how the job is eco-friendly. This is a good opportunity to tell your captive audience about the different ways the job respects the environment.
Consumption	Shows energy consumption for a single entity. For examples: Electricity - Graph of electricity consumption per building. Solar - Graph display of solar vs. electrical energy consumption per day per building.
Comparison	Compares data from one time period to another.
Demand	Gauge display of summarized resources per day for a single entity. Each energy type is depicted in a dedicated gauge. There is only one demand page per dashboard. If multiple demand pages are added, the content they display will be identical.
Weather	Shows current and forecast weather conditions for the configured location.
Summary	Lists the groups and entities in the system and shows energy consumption for them. When a user mouses over the chart, the entity descriptions are displayed as tool tips.  There is only one summary pager per dashboard. If multiple summary pages are added, the content they display will be identical.

## Title

Modify the text here to specify the title text that appears at the top of the dashboard page. For example, “An Introduction to Dashboards.” Supports a maximum of 55 characters.


**Edit the Demand page** (Pages > Demand) Customize calculations on the Demand page to make more complex expressions using previously defined variables such as  $\text{Var1} = x+y$  ;  $\text{Var2} = \text{Var1} + z$ . See Figure 12.8 on page 269 to see the Calculations dialog box.

► **To specify Demand calculations**

1. On the Pages page click **Edit** in the Demand row to open the Edit Demand Page dialog box.
2. Click **Add Demand Block**.
3. Click  in the Calculation column to open the Calculation dialog box.
4. Specify the operands and operator and then click **Save**.

**Edit the Summary page** (Pages page > Summary Page > Edit)

► **To specify Summary calculations**

1. On the Pages page click **Edit** in the Summary row to open the Edit Summary Page dialog box.
2. Click **Add Summary Block**.
3. Click  in the Calculation column to open the Calculation dialog box.
4. Specify the operands and operator, click **OK**, and then click **Save**.

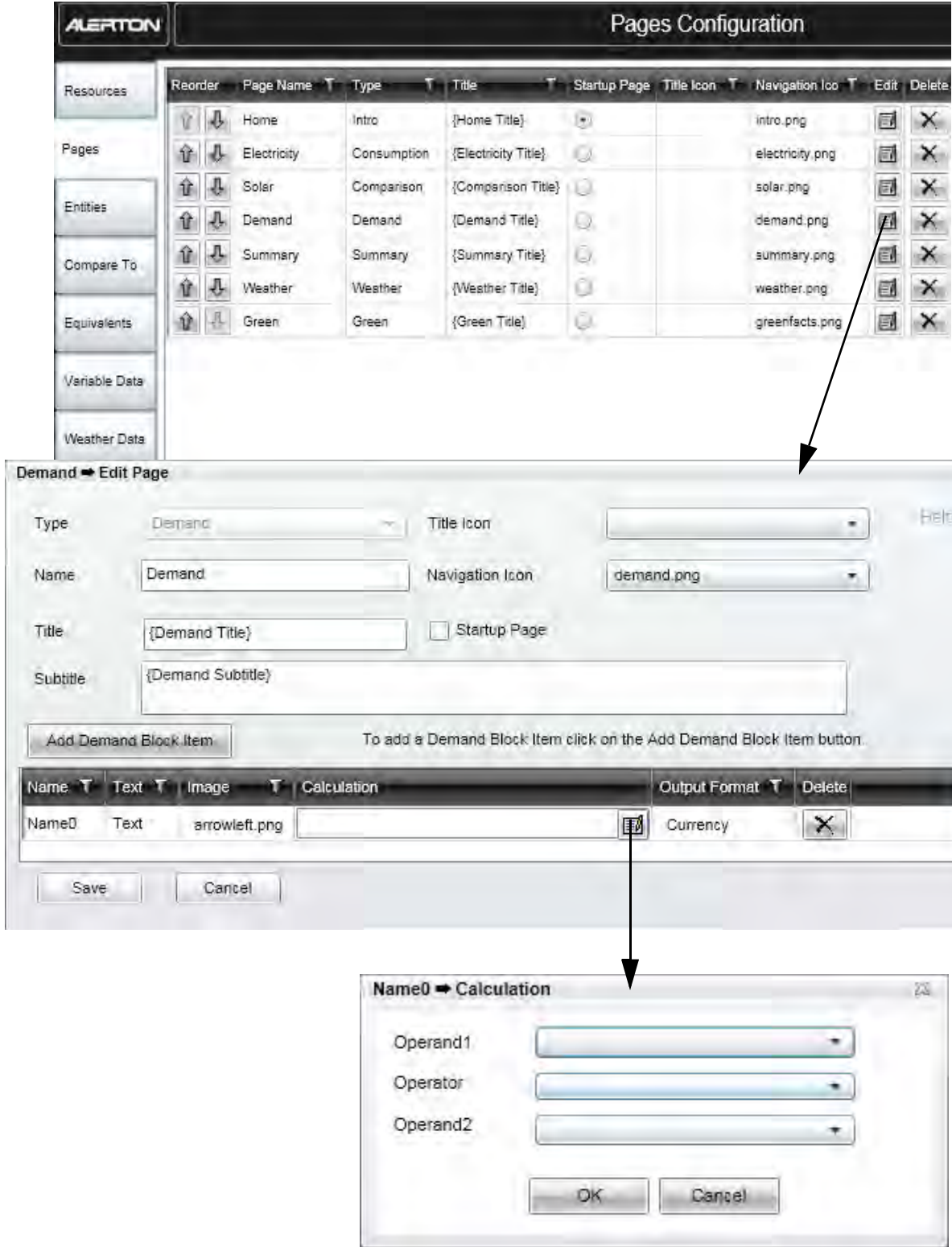


Figure 12.8 Energy Dashboard Editor - Pages page default settings

**Edit the Weather page** (Pages page > Weather > Edit)

The screenshot shows the 'Weather Edit Page' configuration window. It contains the following fields and options:

- Type:** Weather (dropdown menu)
- Title Icon:** weather.png (dropdown menu)
- Name:** Weather (text input)
- Navigation Icon:** weather.png (dropdown menu)
- Title:** Weather Forecast (text input)
- Startup Page:**  (checkbox)
- Subtitle:** This page contains current and forecasted weather for Seattle (text input)
- Forecast:** SixDayForecast (dropdown menu with a 'Save' button below it)

**Figure 12.9** Energy Dashboard Editor - Editing the Weather page

**Subtitle** Text that appears below the title in the Title area. For example, “Welcome to our dashboard!” Supports a maximum of 115 characters.

**Forecast** Select the number of days to display on the weather forecast. Select Six Day Forecast for U.S. locations and Four Day Forecast for locations outside the U.S. Forecast data for non-U.S. locations is available for four days only.

**Startup Page**

Specify the page you want to display when the dashboard opens.

**Title Icon**

Specify the icon that appears in the Title area. The list is populated with the image files defined on the Image Gallery page.

**Navigation icon**

Specify the icon that represents the page in the Navigation area. The list is populated with the image files defined on the Image Gallery page. See “Weather Data page” on page 283 for more information about how to set up weather source data.



## Entities page

Lists the basic units for displaying energy consumption. An entity is typically a group of buildings, a single building, or one floor of a building, but can be anything for which an energy log can be set up. Define the following as an entity and then compare them on the dashboard to visually show viewers where the money is being spent.

- Buildings
- Floors
- Tenants
- HVAC equipment expenses
- Occupied vs. unoccupied area expenses
- Etc.

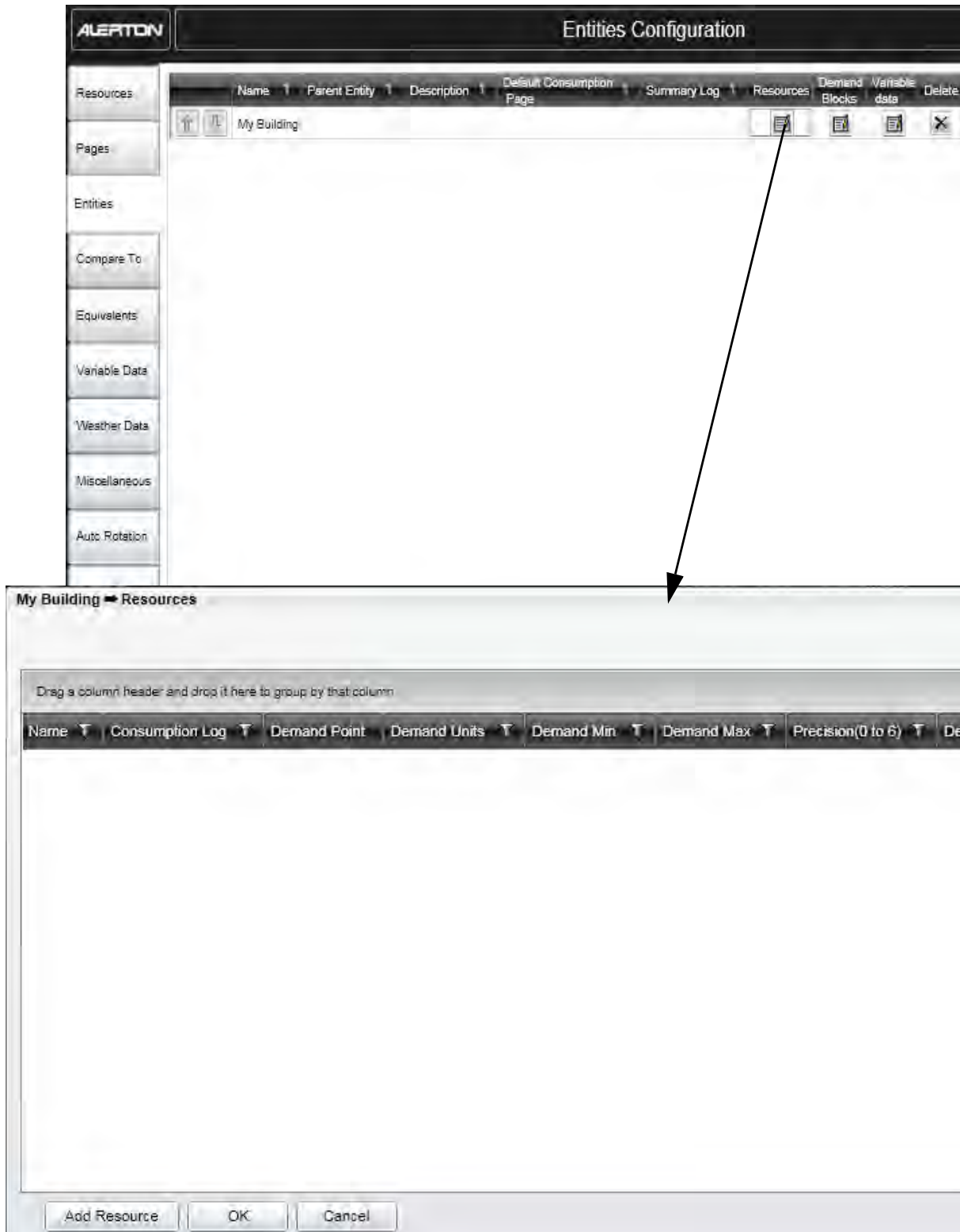
You can set up a consumption page for each resource type used for an entity. For example, you can create a consumption page that tracks electricity (resource) use in a particular building (entity).

Configure the entities and then connect each entity to a meter. Energy log data gathered from these meters become dashboard data.



**Figure 12.10** Energy Dashboard Editor - Entities page default settings

Once you create an entity, use the Resources page to associate the entity with a resource. Resources can be set up for any metered item you want to show on the dashboard.



**Figure 12.11** Click the Edit Resources icon on the Entities page to configure each building, floor, tenant, etc.

**Name**

The text that represents the resource in the Energy Dashboard Editor interface. Click **Resource Name** and then select a resource from the list.

**Consumption Log**

The energy log that shows how much of the resource is being used. Click **Consumption Log** and then select a log from the list (optional).

**Demand Point**

Shows the current value of a BACnet point. Click the edit icon in the Demand Data column, set the BACnet point, and then click **OK**.

**Demand Units**

The text displayed with the demand value. Type a value.

**Demand Min**

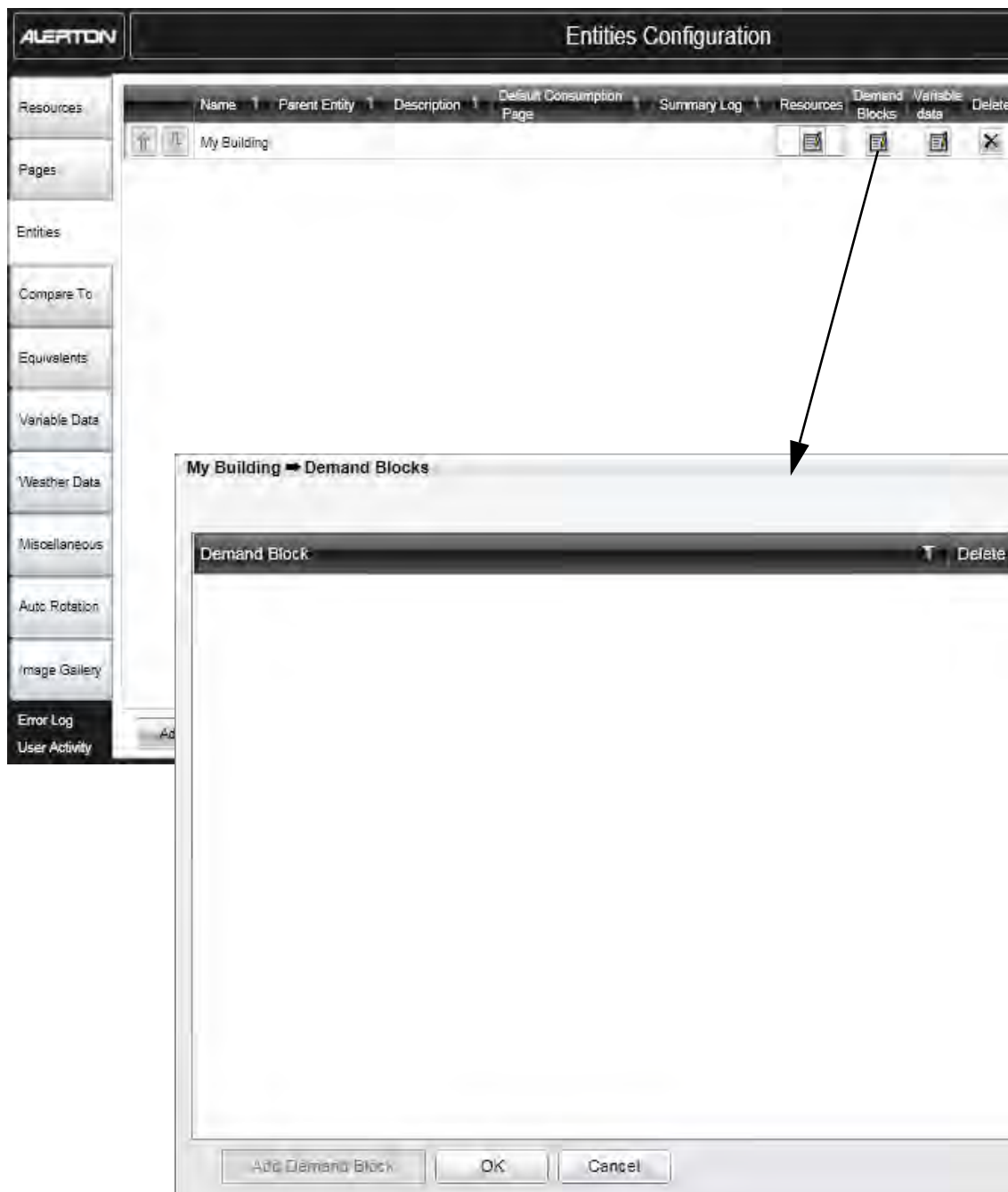
Sets the lower limit of the gauge that appears on the dashboard. Click the value and type a new one.

**Demand Max**

Sets the upper limit of the gauge that appears on the dashboard. Click the value and type a new one.

**Precision (0 to 6)**

Sets the number of decimal places displayed.



**Figure 12.12** Click the Edit Demand Block icon on the Entities page to configure data to display on the Demand page.

Demand blocks allow you to perform simple math functions on two variables and then display the result on a Demand page. Demand blocks are defined from the Pages page and assigned to an entity on the Entities page. The variables used in demand block calculations are defined on the Variable Data page.

Click **Add Demand Block** to add a new demand block. Click the name and then select a demand block from the list.



**Figure 12.13** Click the Edit Variable Data icon on the Entities page to configure BACnet data to display.

You can display BACnet point values or constant values on the dashboard. For example, show the outside air temperature as read from the BACnet system.

**Data Type**

Select Constant or BACnet.

### Value

The constant value or BACnet point you want to display. Click the edit icon to set the value.

### Variable Name

The text that represents the value in the Energy Dashboard Editor interface. Click the table cell and select a variable. Variables are created on the Variable Data tab.



Seattle Campus is an example of an entity.

Figure 12.14 Example Demand dashboard page set up for the entity “Seattle Campus”



### Practical application

Dashboard displays make it easy for student residents in Dormitory West to see how much electrical power they are excessively consuming by not paying attention to their living habits. Many students wonder what they can do to save energy and school officials wonder how to save on energy bills.

Student and school leaders start a “Reduce, Reuse, Recycle” campaign that advertises various ways individual residents can cut back on energy use and how different floors in Dormitory West can work together to see which floor team can

reduce the demand for electrical power. Joe set up the Dormitory West dashboard by setting up his entities as:

- DormWest
- Floor1
- Floor2
- Floor3

Joe assigned an electrical meter to each floor and set up energy logs in Envision for BACtalk for each meter. Dashboard viewers can now open the DormWest building and then drill down further to see energy log data displayed as electrical consumption for Floors 1 through 3. For example, viewers can now see the amount of electrical power used by Team Floor 2 versus Team Floor 3. The dashboard becomes the scoreboard, residents are motivated to conserve electrical power, and State University pays lower energy bills.

---

## Compare To page

Compare current usage to historical data. A comparison page looks similar to a consumption page except it includes a Compare To selector. First select a current time frame (current day, current week, and so on) and then select a time period to compare (same day last week, same week last year, and so on).

Each dashboard supports up to 10 comparison entities.

Note: If an entity is selected on the Compare To tab, that entity cannot be deleted.



**Figure 12.15** Energy Dashboard Editor - Compare To page default settings

Click the filter icon in the Comparator Name column to display the compare filter dialog box. Click the expansion arrows to display the filter options. See Figure 12.16.



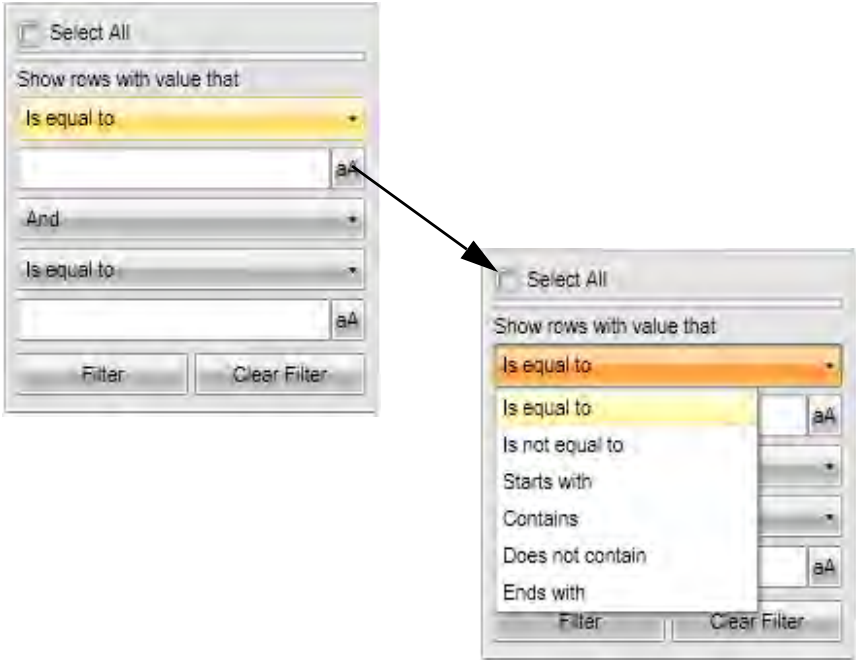


Figure 12.16 Use the expansion arrows to display filter options.

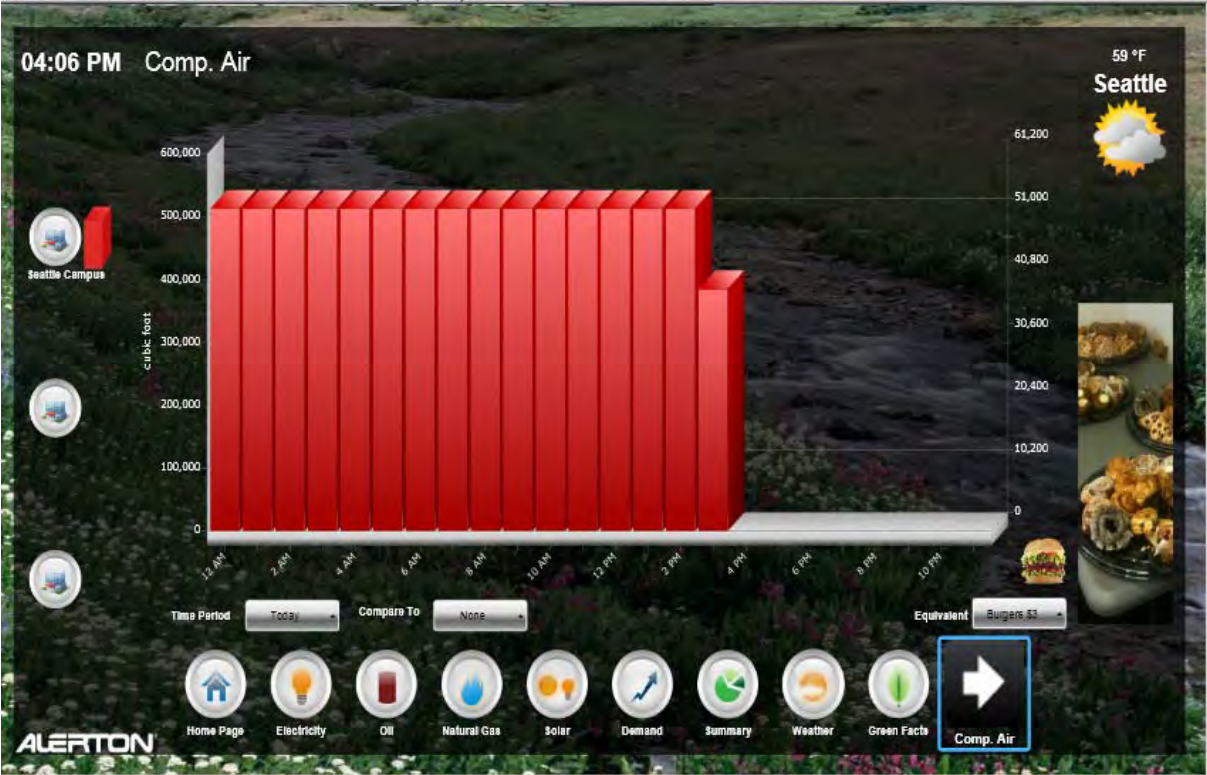


Figure 12.17 Example Compare To dashboard page set up for the entity “Seattle Campus”

## Equivalents page

Equivalents give dashboard users perspective on how much energy is being used in a building. Seeing energy values converted to values of common objects helps users understand energy consumption in real-world terms. Select a comparison item from the list and it will appear on consumption pages on the right side of the graph.



**Figure 12.18** Energy Dashboard Editor - Equivalents page default settings

### Text

The text that describes the comparison item on the dashboard page.

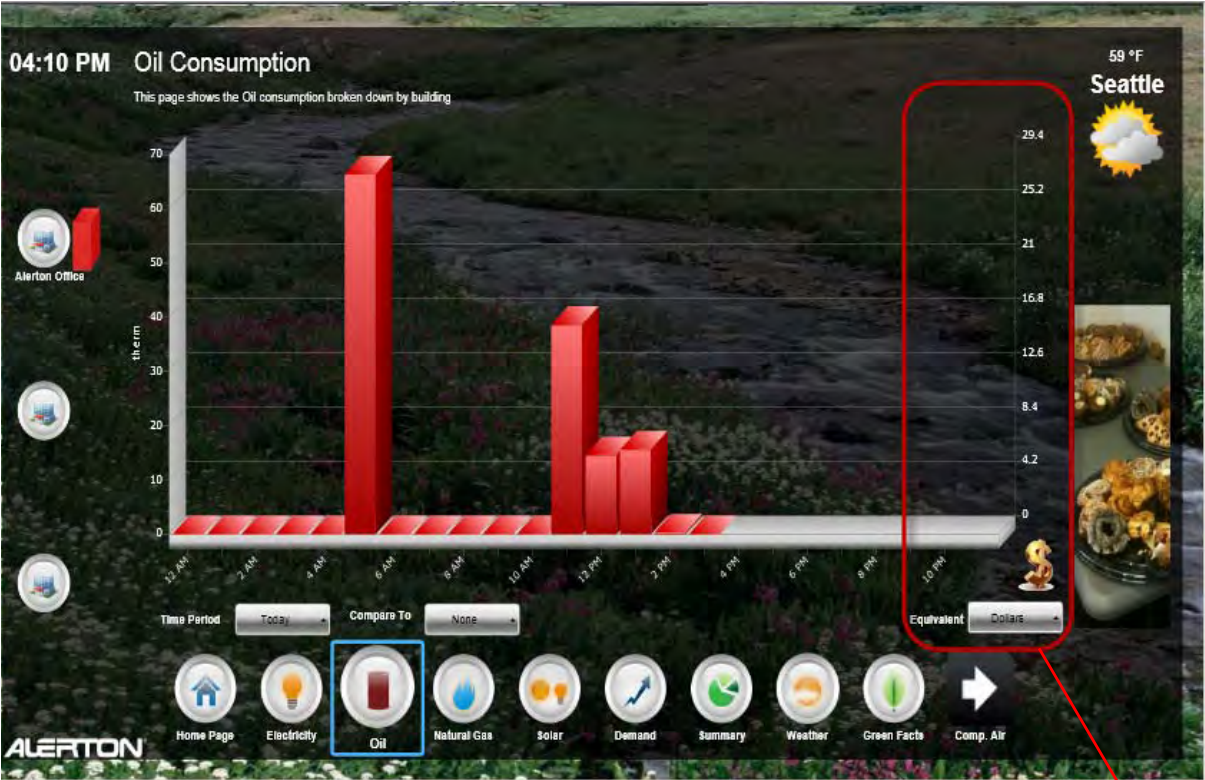
### Conversion Factor

The number of comparison items it would take to purchase one unit of energy.

**Image**

The image that represents the comparison item on the dashboard. You can add custom images to use for equivalents.

**Note** You cannot delete a comparison item if it is associated with a resource.



Example comparing oil consumption to money. Other provided equivalents: cheeseburgers, books, pollution, and showers.

**Figure 12.19** Example dashboard page using money as the equivalent to show how much oil is used

## Variable Data page

Define the variables used to calculate summary block items on Summary pages and demand block items on Demand pages. Click **Add Variable**, click the new variable, and then type a value. Use numbers and letter characters (a-z and A-Z) only in variable names. Do not type spaces or mathematical operators such as +, -, /, or \*.

**Note** A variable cannot be deleted if it is associated with an entity.



**Figure 12.20** Energy Dashboard Editor - Variable Data page default settings

## Weather Data page

Use the Weather page to select the source of weather data and to configure how data is displayed in the Weather area of each dashboard page in the top right corner and on the Weather page.

### Provider

#### NOAA (USA Only) - Station code

National Oceanic and Atmospheric Administration is a federal agency in the United States Department of Commerce that focuses on the condition of the oceans and the atmosphere. Select a weather station code (location) from the list. Envision for BACtalk retrieves current weather conditions and forecasts from the National Weather Service and displays them on the dashboard. NOAA provides 6-day weather forecasts.

If you have trouble getting weather data, refresh the browser page. If you still get no data, information from your preferred location may be temporarily unavailable; try a nearby large city.

#### Google (International and USA) - Location Code

Type a location and then click **Validate Location**. The location is tested on Google's weather service and a message is returned. If you have trouble getting a valid location, try large cities near the location you want. Google provides 4-day weather forecasts.

### BACnet Data

Select the options in the BACnet Data area to use BACnet data instead of NOAA or Google data. Click the Edit icon to select a Device Instance, Object Type, and Object Instance. Only the options you select will override data from the other sources.

**Wind Direction Override Values** The following is a list of valid MV values for wind direction. Variables are not case sensitive. The value displayed in the dashboard comes from the lexicon file, not directly from the MV.

north	southwest
northeast	west
east	northwest
southeast	variable
south	notavailable

### Appearance

Specify how display weather data on the dashboard. Customize the location, font size, and unit labels for temperature, wind speed, and barometric pressure.



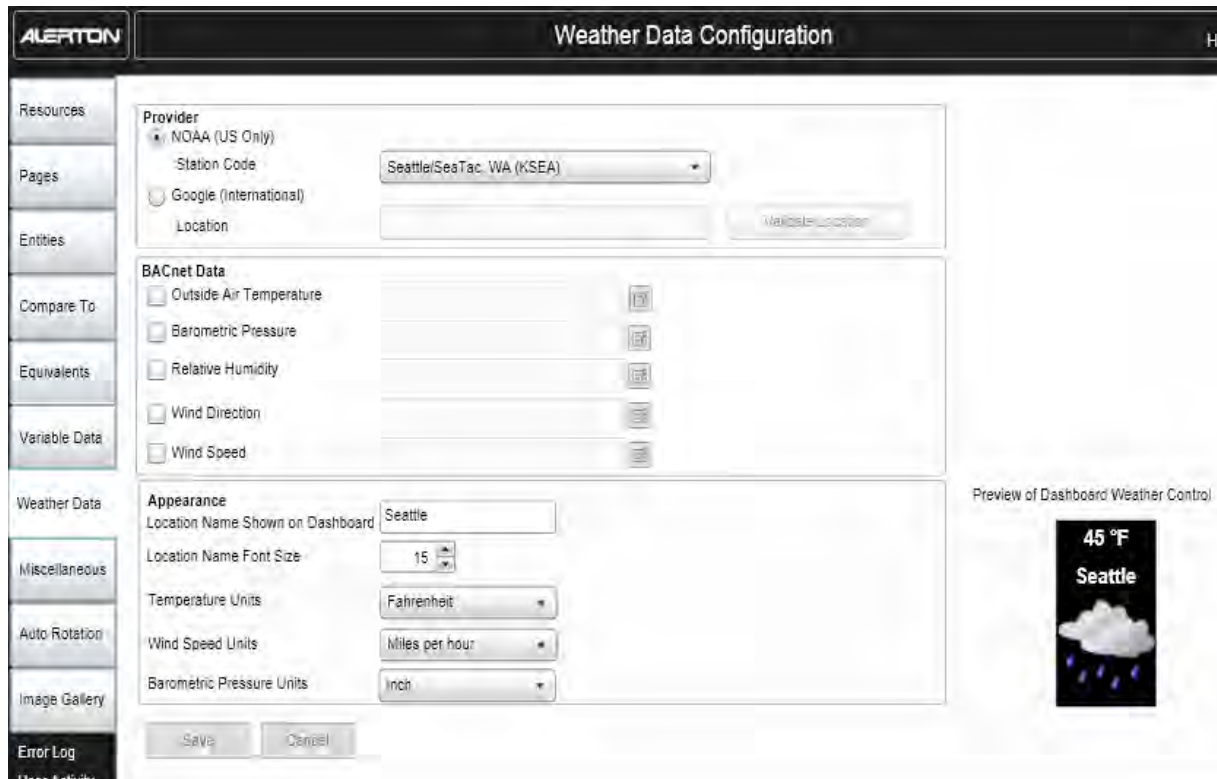


Figure 12.21 Energy Dashboard Editor - Weather Data page default settings



Figure 12.22 Example Weather page configured for Seattle, WA USA

## Miscellaneous page

Configure the appearance and behavior of some dashboard elements including color, refresh intervals, background image, and Start Day of the Week.



**Figure 12.23** Energy Dashboard Editor - Miscellaneous page default settings

### Entity Colors

Click the color blocks to select the color that will represent the entities. Blocks of these colors appear next to the entity icons in the Comparison Selection area.

### Data Refresh Rate (Demand Page)

Set the number of seconds the dashboard will wait before retrieving new data and refreshing the display.

### Auto Rotation Inactivity Interval

The dashboard will wait this long before beginning page rotation.

### User Content Request Interval

The rate at which user content is rotated in the User Content area.

### Compare To Color

Click the color block to select the color that will represent a comparator when the user selects a time period to compare with current data. The Compare To button will also be this color.

**Application Restart Interval**

This is how often the dashboard application will restart while in Kiosk mode. Restarting is necessary to pick up configuration changes, clear cache, and so on. The dashboard should be restarted at least daily.

**Leaf Color for Summary Page**

Click the color block to select the color that will represent a child entity on the Summary page.

**Auto Rotation Interval**

This is how long a page displays when the pages are being rotated.

**Branch Color for Summary Page**

Click the color block to select the color that will represent a parent entity on the Summary page.

**Display Clock**

Select to show a clock in the upper left corner of the dashboard.

**Clock shows 24Hr time format**

Select to display time in 24-hour format.

**Font Color for Summary Page**

Click the color block to select the color of the text on the Summary page.

**Background Image**

Select the image that appears behind the dashboard elements. You can copy custom background images to the Image Gallery.

**Require Authentication**

Requires users to log in with valid Envision for BACtalk credentials to access the dashboard. If this is not selected, the Energy Dashboard Editor will use the credentials of the Envision for BACtalk default user. If a default user is not configured, the user will be prompted for authentication.

**Start Day of Week**

The first day of the week displayed on graphs. Sunday is the default.

**Enable 3D Chart**

When this option is selected, charts will appear three-dimensional.

**Enable Equivalent Comparison**

Enables the secondary y-axis for equivalent comparisons.

**Show Peak Demand**

Select to enable the display of peak demand values on consumption pages. The values appear as colored bubbles on the consumption graph.

**Peak Demand Color**

Select the color of the peak demand bubbles.



### Auto Rotation page

Customize dashboards to rotate pages at a given interval. Click **Add Page**. A new page appears in the list. Click the name of the new page and then select a page from the list. Click the edit icon to edit the rotation parameters.



Figure 12.24 Energy Dashboard Editor - Auto Rotation page default settings

## Image Gallery page

Shows thumbnail images of all the images available for use in the dashboard including controls, icons, and background images. Add images to the gallery by copying your image files to

**C:\Alerton\BACtalk\<version>\<rep>\<job>\AppData\EnergyDashbaord\Resources\Images** folder. Refresh your browser window to see changes when files are added or deleted from the Images folder. See “To load images to the User Content area” on page 290 for instructions about how to add images to the User Content area.

**IMPORTANT!** Dashboards support .PNG and .JPG formats only. Use high-resolution images only.

**Image dimensions** Dashboards support the following height and width values in image areas.

Image	Height	Width	Note
Dashboard Weather Control	100	128	Image, Temperature, Location text
Weather	100	77	(128 * 0.6) Image only
Detailed weather page	150	124	--
User Content Area	480	100	--
Title	80	750	--
Entity Control	480	100	Including all 3 entity controls. The entity icon's height and width are specified as ratios of the parent control. Each entity is 100X160 (480/3). Includes image and entity name.
Navigation Control	114	960	--
Navigation Icon	88	80	Size for both image and Name

### Dashboard's Screen User Configurable Information

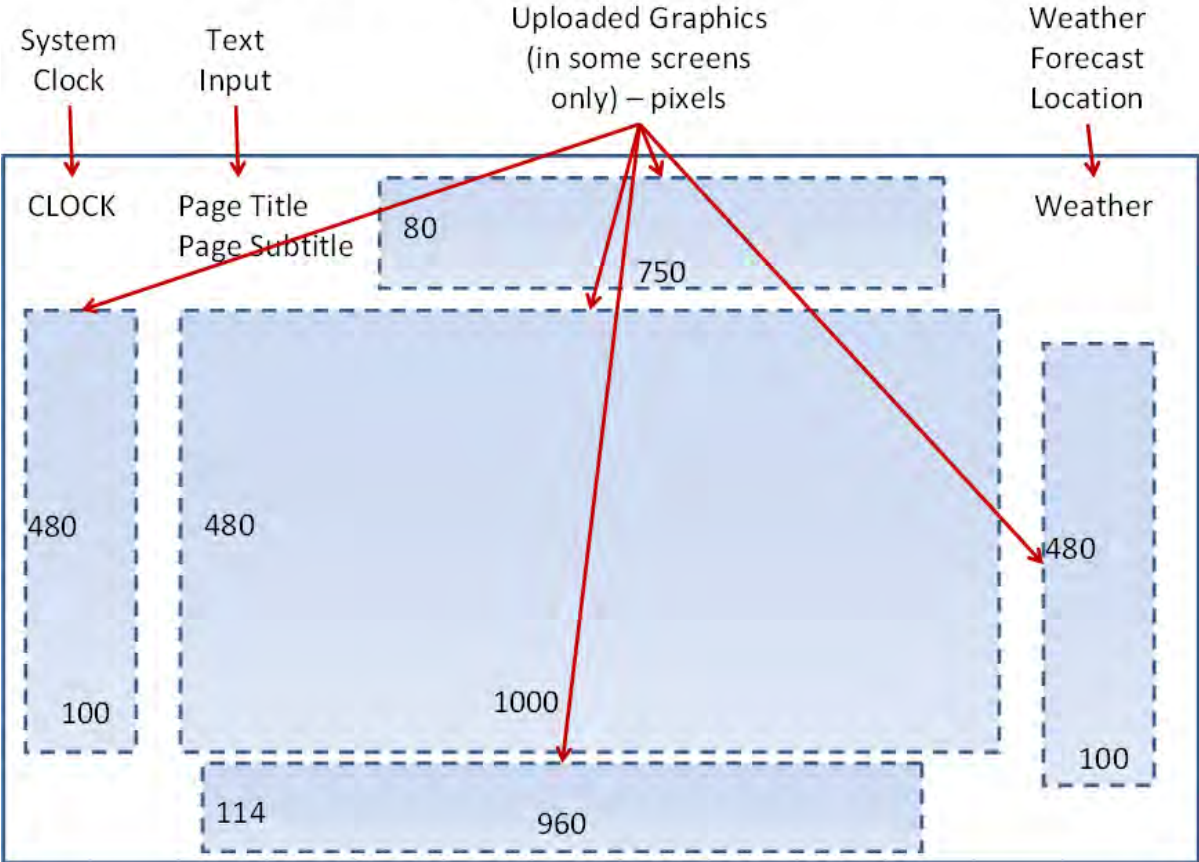


Figure 12.25 Customizable dashboard areas

#### Upload Image

- ▶ To add new images to the image gallery
  1. Click **Browse** and locate the image you want to add.
  2. Click **Open**.
  3. Click **Upload**.

#### View Images

The View Images table lists the filenames and dimensions (in pixels) of available images. It also shows a thumbnail preview.



**Figure 12.26** Energy Dashboard Editor - Image Gallery page default image files

► **To load images to the User Content area**

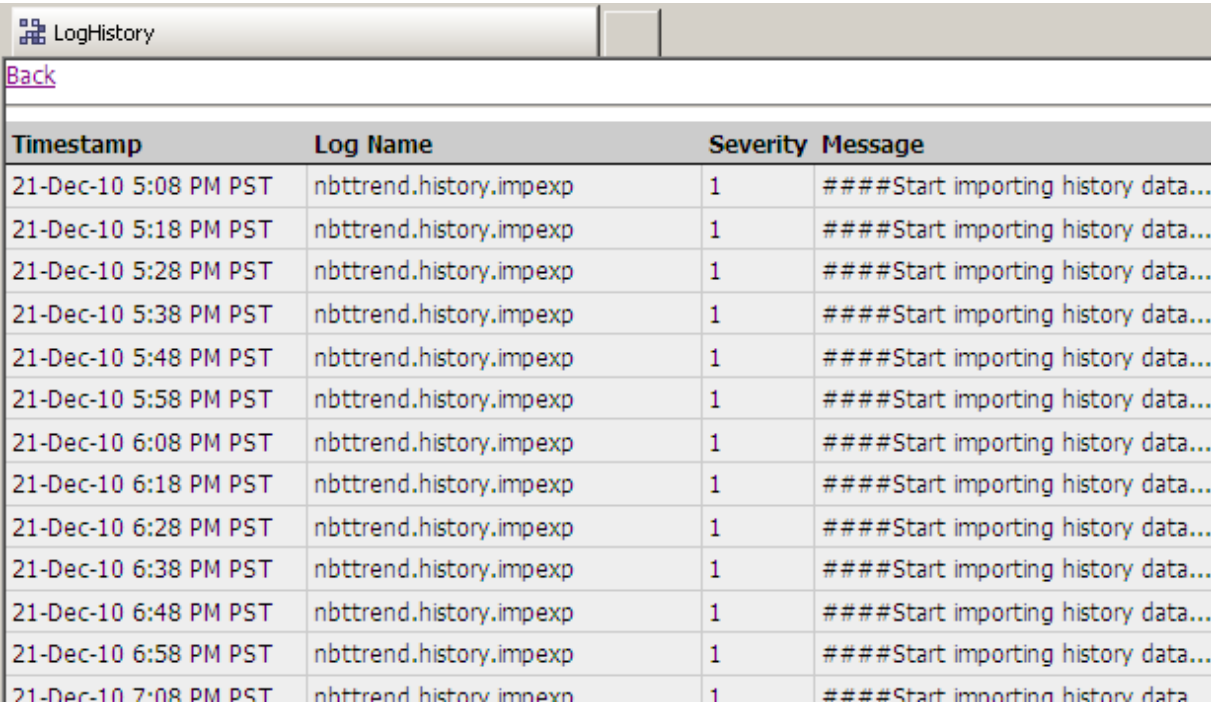
1. Generate .JPG or .PNG files.
2. Verify resolution and aspect ratio.  
See “Image dimensions” on page 288 for details.
3. Copy the file(s) to the user content folder, typically:  
C:\Alerton\BACtalk\3.0\Alerton\<project name>\  
appdata\energydashboard\usercontent.

**Note** The images will cycle approximately every 20 seconds.

## Error Log page

The Error Log page includes a timestamp, log name, severity level, and descriptive message for each error. This is a log of the 500 latest system errors related to the dashboard. It may be useful in troubleshooting.

Click **Back** to return to the Energy Dashboard Editor.



Timestamp	Log Name	Severity	Message
21-Dec-10 5:08 PM PST	nbttrend.history.impexp	1	####Start importing history data...
21-Dec-10 5:18 PM PST	nbttrend.history.impexp	1	####Start importing history data...
21-Dec-10 5:28 PM PST	nbttrend.history.impexp	1	####Start importing history data...
21-Dec-10 5:38 PM PST	nbttrend.history.impexp	1	####Start importing history data...
21-Dec-10 5:48 PM PST	nbttrend.history.impexp	1	####Start importing history data...
21-Dec-10 5:58 PM PST	nbttrend.history.impexp	1	####Start importing history data...
21-Dec-10 6:08 PM PST	nbttrend.history.impexp	1	####Start importing history data...
21-Dec-10 6:18 PM PST	nbttrend.history.impexp	1	####Start importing history data...
21-Dec-10 6:28 PM PST	nbttrend.history.impexp	1	####Start importing history data...
21-Dec-10 6:38 PM PST	nbttrend.history.impexp	1	####Start importing history data...
21-Dec-10 6:48 PM PST	nbttrend.history.impexp	1	####Start importing history data...
21-Dec-10 6:58 PM PST	nbttrend.history.impexp	1	####Start importing history data...
21-Dec-10 7:08 PM PST	nbttrend.history.impexp	1	####Start importing history data...

**Figure 12.27** Energy Dashboard Editor - Sample Error Log screen

## User Activity page

The user activity log, which can be useful in troubleshooting problems. Click **Back** to return to the previous page.

AuditHistory						
<a href="#">Back</a>						<a href="#">Help</a>
Timestamp	Operation	Target	Slot Name	Old Value	Value	User Name
17-May-11 1:13 PM PDT	Login	/Services/WebService	127.0.0.1			BRENDA
17-May-11 1:13 PM PDT	Invoked	/Services/Bactalk/DeviceManager	getBacnetUnits			BRENDA
17-May-11 1:13 PM PDT	Invoked	/Services/Bactalk/DeviceManager	getDeviceData			BRENDA
17-May-11 1:13 PM PDT	Invoked	/Services/Bactalk/WeatherReport	getNwsWeatherStations			BRENDA
17-May-11 1:13 PM PDT	Invoked	/Services/Bactalk/DashboardConfiguration	getDashboardConfigurationData		Bt Dashboard Config Req	BRENDA
17-May-11 1:13 PM PDT	Invoked	/Drivers/BactalkNetwork/EBT/energyLogs	getAllEnergyLogConfigs			BRENDA
17-May-11 1:13 PM PDT	Invoked	/Services/Bactalk/HistoryImportExport	getAllExpectedLogs			BRENDA
17-May-11 1:14 PM PDT	Invoked	/Services/Bactalk/BtLogService	addLogEntry		Bt Log Record Set	BRENDA
17-May-11 2:23 PM PDT	Login	/Services/WebService	127.0.0.1			BRENDA
17-May-11 2:23 PM PDT	Invoked	/Services/Bactalk/DashboardConfiguration	getDashboardConfigurationData		Bt Dashboard Config Req	BRENDA
17-May-11 2:23 PM PDT	Invoked	/Services/Bactalk/UserContent	getUserContent		Nbt User Content	BRENDA
17-May-11 2:23 PM PDT	Invoked	/Services/Bactalk/WeatherReport	getWeatherReport		Bt Weather Report Req	BRENDA
17-May-11 2:24 PM PDT	Invoked	/Services/Bactalk/UserContent	getUserContent		Nbt User Content	BRENDA

**Figure 12.28** Energy Dashboard Editor - Sample User Activity screen

## Importing historical data

You can view historical data into Energy Dashboards. Importing requires a data file in csv format and an accompanying xml file. Envision for BACtalk uses the xml file to process the csv file.

### Preparing historical data

To import correctly, historical data must be in .csv format and meet these requirements:

- Must be two columns.
- Column A must contain the data/time stamps.
- Using the time stamp format “M/d/yy H:mm” is recommended.
- Column B must contain the values.

**CAUTION** A known bug prevents the import of data for one hour when daylight savings time (DST) changes. Remove the rows in the data file that are between 2 AM and 3 AM on any day a DST change occurred. Failure to do so will cause the import to fail. The Dashboard error log can help you locate these fields after an unsuccessful import.

### Creating the xml file

To import historical data Envision for BACtalk requires a mapping file in addition to the historical data. This mapping file defines the time stamp format and the units you want appended to the values. It also defines the starting row in the csv file (so that header rows or other unneeded rows can be skipped).

To create the mapping file, open a text editor such as Notepad and then copy or type this text:

```
<ExpectedData>
  <header>
    <timestampFormat>M/d/yyyy HH:mm</timestampFormat>
    <units>kilowatt hour</units>
    <dataRowStart>2</dataRowStart>
  </header>
</ExpectedData>
```

Spaces, punctuation, and case are important in time stamp formats. Supported time stamp formats are:

```
d-M-yy HH:mm
M/d/yy HH:mm
```

Save the file with an .xml extension. The file name must match the csv file name except the extension (hist\_data.xml and hist\_data.csv, for example).

### Copying data to the server

Copy the csv and xml files to  
 <Envision for BACtalk root>\System\nbtwb\stations\<Rep\_job>\DataImport

The dashboard application checks this directory at 15 minute intervals and then imports new data. You may wait up to 15 minutes for the historical data to appear in the dashboard. You can restart Envision for BACtalk to force the data import.

## Viewing imported data

### ► To view imported data

1. Start Dashboard Editor.
2. If the Dashboard List appears, select the dashboard you want to view and then click **Edit**.
3. Click the **Compare To** tab.
4. Click **Add Compare To**.
5. Click the name of the new profile and then type a descriptive name. Maximum length is 10 characters.
6. Click **Save**.
7. Select the **Entities** tab.
8. Click the **Resources** icon for the entity from which the data was collected.  
The Resources dialog box appears.
9. Select the plus sign (+) next to an existing resource.  
The new entity is listed in the Comparator Type column.
10. Click the Comparator Name field of the new entity and then select the item listed.
11. Click **OK** twice and then **Save**.



## Localizing energy dashboards

### Before you begin

Some of the text that end users will see is entered through the Energy Dashboard Editor interface. Ensure that the text and graphics you enter are appropriate to the target language.

### About localization

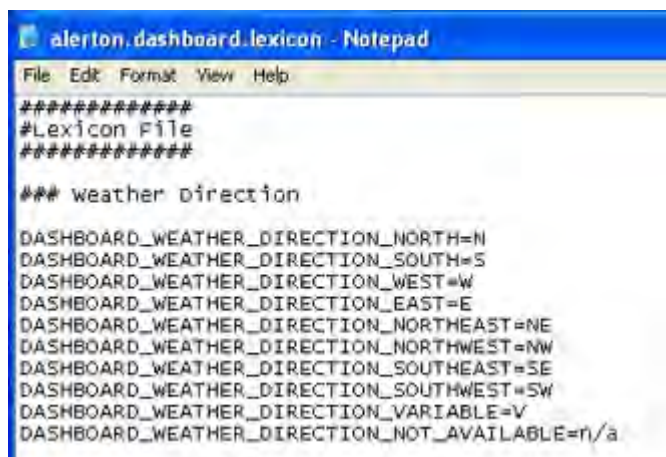
You can localize Envision for BACtalk dashboards into nearly any language supported by the Windows operating system.

If users speak multiple languages, you can localize dashboards to support all of them at the same time. The regional and language settings on the user's computer determines which language a dashboard appears in.

When the Dashboard application is launched, it checks to see if the user interface has been localized. To determine this, it looks for lexicon files.

### About lexicon files

Lexicon files are lists of text elements that appear in the user interface. For each text element, the lexicon files list a value. This value is what gets changed when the application is localized. When a text element is called for on a dashboard page, the application checks the lexicon file and displays the value assigned to that element.



```
alerton_dashboard.lexicon - Notepad
File Edit Format View Help
#####
#Lexicon File
#####

### weather direction

DASHBOARD_WEATHER_DIRECTION_NORTH=N
DASHBOARD_WEATHER_DIRECTION_SOUTH=S
DASHBOARD_WEATHER_DIRECTION_WEST=W
DASHBOARD_WEATHER_DIRECTION_EAST=E
DASHBOARD_WEATHER_DIRECTION_NORTHEAST=NE
DASHBOARD_WEATHER_DIRECTION_NORTHWEST=NW
DASHBOARD_WEATHER_DIRECTION_SOUTHEAST=SE
DASHBOARD_WEATHER_DIRECTION_SOUTHWEST=SW
DASHBOARD_WEATHER_DIRECTION_VARIABLE=V
DASHBOARD_WEATHER_DIRECTION_NOT_AVAILABLE=r/a
```

Figure 12.29 Lexicon file example

### Search order

Dashboards load lexicon files from one of three locations:

1. First it looks in *<installation directory>\System\Web\Apps\EnergyDashboard\Lexicon*. The lexicon files in this directory will be applied only to the Energy Dashboard application.

2. Next it looks in *<installation\_directory>\System\Web\Apps\Lexicon*. The lexicon files in this directory will be applied to all Envision for BACtalk drop-in applications.
3. If there are no lexicon files in the first two directories, Dashboard loads the default (English) lexicon files.

## Procedures

Localization is a three-step process:

1. Downloading lexicon files
2. Localizing content
3. Making localized lexicon files accessible

### Downloading lexicon files

The first step is to download the lexicon files so you can deliver them to a localization professional. The zipped files are available on the Alerton Building Suite product page of the Alerton Support Network (<http://asn.alerton.com/s/Files/Resources/68799>).

### Localizing content

Deliver the lexicon files to your localization resource. The files can be edited with a standard localization tool such as VisualLocalize<sup>®</sup> or with a simple text editor like Notepad.

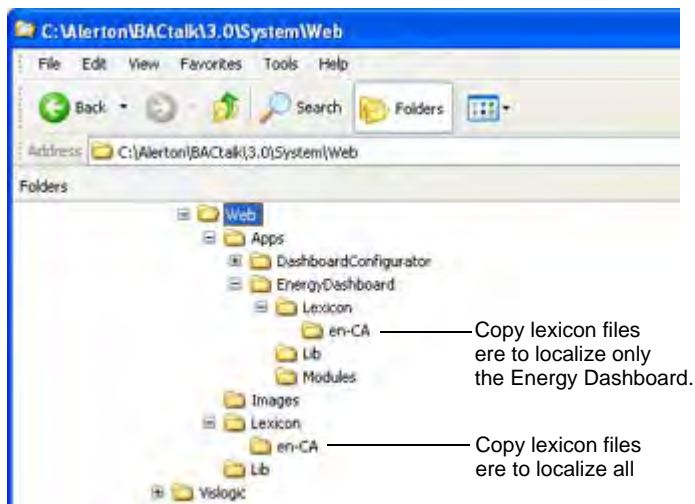
### Making localized lexicon files accessible

Once the files are localized, make them accessible to the dashboard application.

#### ► To make localized content accessible

1. Use Windows Explorer to browse to *<installation\_directory>\System\Web\Apps\EnergyDashboard\Lexicon*.

2. Create a sub-folder named for the target language. Use a valid Windows locale code. Codes are listed at [http://msdn.microsoft.com/en-us/library/0h88fahh\(v=vs.85\).aspx](http://msdn.microsoft.com/en-us/library/0h88fahh(v=vs.85).aspx).



**Figure 12.30** Lexicon file locations

3. Copy the localized lexicon files into the new folder.
4. Start (or restart) the dashboard application.

The localized content appears in the interface.

## Limitations

### Windows OS

Localization of dashboard lexicon files should be done on a system that supports the character set required by the target language. If you are using a Windows 7 Ultimate system as the server, you can localize to any language because that operating system supports all languages and character sets.

On some versions of Windows, you can install the Multiple User Interface (MUI) Pack available from Microsoft. The MUI Pack contains additional fonts and languages. Not all systems support the MUI Pack, so check for compatibility before proceeding with localization.

For older or less capable versions of Windows, perform the localization on a system that is set up for the target language and then copy the localized files to the server.

### Weather locations

Weather locations cannot be localized.



# Setup Reports

# 13

Setup Reports provide configuration information for Envision for BACtalk elements such as trendlogs, tenants, and schedules. For example, you can use them to compare the configuration values of all point alarms or a subset of alarms filtered by description, host device, alarm point device, and/or alarm type. You can sort reports on the filtering criteria. Reports are available in PDF, Excel, HTML, RTF, and Microsoft Word.

To view setup reports from a client computer, ensure the client is running a version of Envision for BACtalk that includes the Setup Reports feature.



## Practical application

Joe needs to see data from several trendlogs to compare energy use by different tenants. He wants to be sure the trendlogs are all configured similarly and that the tenants are also configured alike.

He runs setup reports for trendlogs and tenants and then compares all the trendlogs and all the tenants. The reports save Joe considerable time because he does not need to open the trendlogs and tenants in Envision for BACtalk and compare them two at a time.

## Running reports

### ► To run a setup report

1. On the Add-ins menu, point to Setup Reports and click a report name.



**Figure 13.1** Setup Reports menu

2. Enter filtering criteria.
3. Select sorting criteria.
4. In the Sort Order column, select **ASC** to sort in ascending order. Select **DESC** to sort in descending order.
5. Select a report type.
6. Click **Generate Report**.

The report opens and a copy is saved to a folder in  
<installation root>\<rep>\<job>\Reports\commissioning\.

## Setting up reports

### Alarm Handler Report Configuration

Each alarm in Envision for BACtalk has an alarm handler assigned to it. The alarm handler determines which devices are notified when an alarm occurs. See “Setting up alarm handlers” on page 77.

The Alarm Handler Report Configuration report lists the configuration settings of alarm handlers.

**Figure 13.2** Alarm Handler Report Configuration report

**Handler Description** Type a partial or complete alarm handler description. The report returns configuration data for alarm handlers that contain the string in their descriptions. Leaving this entry blank returns all alarm handlers.

**Starting and Ending Host Device** Type a range of host device instances. The report shows alarm handlers on the host devices in this range. Leaving one or both of these entries blank returns all alarm handlers.

**Sorting** Select sorting criteria and use the arrows to add or remove them from the sorting list. Select ASC to sort in ascending order or DESC to sort in descending order.

## Alarm Recipient Report Configuration

Alarm recipients accept alarms from alarm handlers and then act on the alarms. See “Setting up alarm handlers” on page 77 for more information.

The Alarm Recipient Report Configuration report lists the configuration settings of alarm recipients.



**Figure 13.3** Alarm Recipients Report Configuration report

**Recipient Description** Type a partial or complete alarm recipient description. The report returns configuration data for alarm recipients that contain the string in their descriptions. Leaving this entry blank returns all alarm recipients.

**Recipient type** Select the types of recipients to include.

**Sorting** Select sorting criteria and use the arrows to add or remove them from the sorting list. Select ASC to sort in ascending order or DESC to sort in descending order.



## Demand Limiter Report Configuration

A demand limiter enables you to monitor energy demand and then automatically adjust equipment operation to limit the demand and reduce costs. See “Demand Limiting” on page 213 for more information.

The Demand Limiter Report Configuration report lists the configuration settings of demand limiters.

The screenshot shows a software dialog box titled "Demand Limiter Report Configuration". It features several input fields and buttons. At the top left is a "Limiter Description" text box, followed by a "Generate Report" button. Below this is a note: "Include demand limiters with this substring in the description. Leave blank to include demand limiters with any description." To the right is a "Close" button. In the middle left are "Starting Host Device" and "Ending Host Device" text boxes, with a note: "Include demand limiters that are hosted on devices within this range. Leave blank to include demand limiters on all host devices." To the right is a "Report Type" dropdown menu currently showing "PDF" and other options like "Excel (complete)", "Excel (Data Only)", "HTML", "RTF", and "MS Word". At the bottom left is a "Sorting" section with a list box containing "HostDevice" and "LimiterDescription" and arrows to add or remove items. To the right is a table for sorting criteria.

Sort By	Sort Order
*	

**Figure 13.4** Demand Limiter Report Configuration report

**Recipient Description** Type a partial or complete demand limiter description. The report returns configuration data for demand limiters that contain the string in their descriptions. Leaving this entry blank returns all demand limiters.

**Starting and Ending Host Device** Type a range of host device instances. The report shows demand limiters on the host devices in this range. Leaving one or both of these entries blank returns all demand limiters.

**Sorting** Select sorting criteria and use the arrows to add or remove them from the sorting list. Select ASC to sort in ascending order or DESC to sort in descending order.

## Device List Report Configuration

The Device List Configuration report lists the devices recognized by Envision for BACtalk.

The screenshot shows a software dialog box titled "Device List Configuration". It features several input fields and a "Generate Report" button. The fields are: "Device Description" (with a text box and a "Generate Report" button), "Starting Device" (with a text box), "Ending Device" (with a text box), and "Model Name" (with a text box). Below these fields are instructions: "Include devices with this substring in the device description. Leave blank to include devices with any description." for the Device Description field; "Include devices with device ID numbers within this range. Leave blank to include all devices." for the Starting and Ending Device fields; and "Include devices with this substring in the model name. Leave blank to include devices with any model name." for the Model Name field. To the right of the input fields is a "Report Type" dropdown menu with options: PDF, Excel (Complete), Excel (Data Only), HTML, RTF, and MS Word. At the bottom of the dialog is a "Sorting" section. It contains a list of criteria: "Device ID", "Device Description", and "Model Name". There are arrows to move these criteria into a table. The table has two columns: "Sort By" and "Sort Order". The "Sort By" column contains an asterisk (\*). The "Sort Order" column contains a dropdown arrow.

**Figure 13.5** Device List Configuration report

**Device Description** Type a partial or complete device description. The report returns configuration data for devices that contain the string in their descriptions. Leaving this entry blank returns all devices.

**Starting and Ending Device** Type a range of device instances. The report shows devices in this range. Leaving one or both of these entries blank returns all devices.

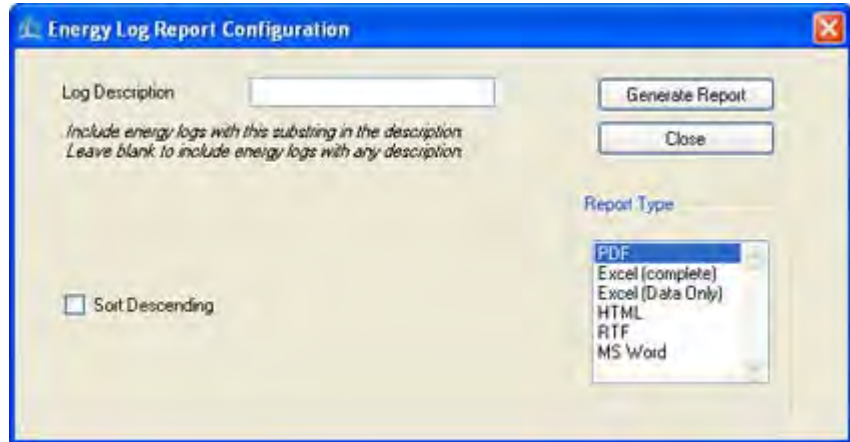
**Model Name** Type a partial or complete model name. The report returns configuration data for devices that contain the string in their IDs.

**Sorting** Select sorting criteria and use the arrows to add or remove them from the sorting list. Select ASC to sort in ascending order or DESC to sort in descending order.

## Energy Log Report Configuration

An energy log calculates energy demand and consumption based on a trendlog of *meter* data. Each energy log reports *consumption* and *peak demand* by hour, day, week, month, and year according to the units of measure in the trendlog setup, the meter setup, and the report setup. See “Energy Logs” on page 201 for more information.

The Energy Log Report Configuration report lists the configuration settings of energy logs.



**Figure 13.6** Energy Log Report Configuration report

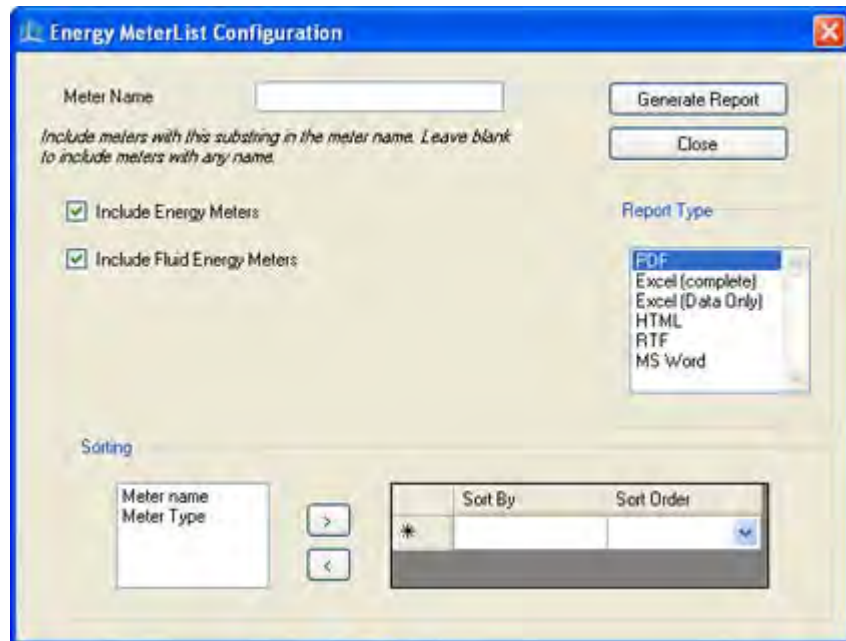
**Log Description** Type a partial or complete energy log description. The report returns configuration data for energy logs that contain the string in their descriptions. Leaving this entry blank returns all energy logs.

**Sorting** By default, the report will be sorted in ascending order. Select **Sort Descending** to change the sort order.

## Energy Meter List Configuration

Energy logs use *meters* to gather demand or consumption data. An energy log can use a single meter or the sum of a number of meters. Each meter references a trendlog, and each meter has a unique setup, or profile. A unique *meter number* identifies the meter setup. For example, you might set up one meter to measure power consumption in your building and another to measure heat consumption. See “About meters” on page 204 for more information.

The Energy Meter List Configuration report lists the energy meters configured in Envision for BACtalk.



**Figure 13.7** Energy Meter List Configuration report

**Meter Name** Type a partial or complete meter name. The report returns configuration data for energy meters that contain the string in their names. Leaving this entry blank returns all energy meters.

**Include Energy Meters** Select this check box to include energy meters in the report.

**Include Fluid Energy Meters** Select this check box to include fluid energy meters in the report.

**Sorting** Select sorting criteria and use the arrows to add or remove them from the sorting list. Select ASC to sort in ascending order or DESC to sort in descending order.

### General Setup Report Configuration

This report lists the settings configured in General System Setup. See “System Administration” on page 315 for more information. Select the items you want included in the report and then click **Generate Report**.

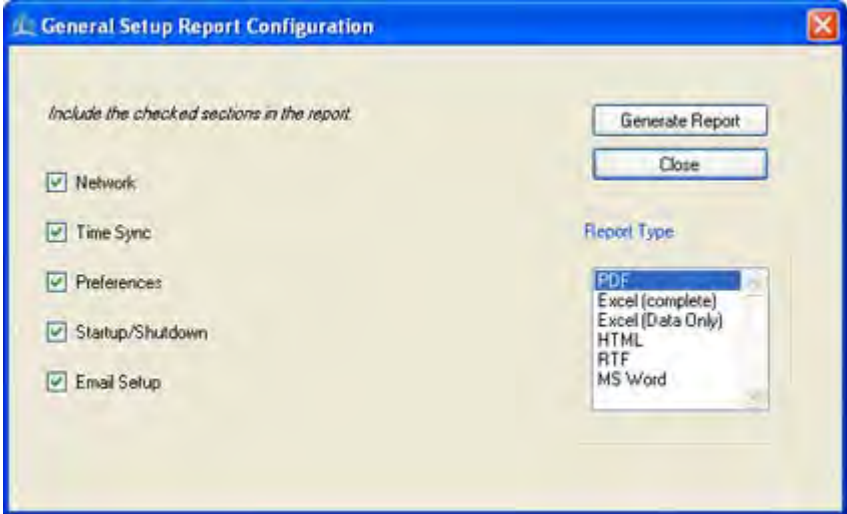


Figure 13.8 General Setup Report Configuration report

## Point Alarm Setup Report Configuration

The Point Alarm Setup Report Configuration report lists the alarms in the system. See “Alarms” on page 47 for more information.

The screenshot shows the 'Point Alarm Setup Report Configuration' dialog box. It features a title bar with a close button. The main area contains several input fields and controls:

- Alarm Description:** A text input field with a 'Generate Report' button to its right. Below it, a note reads: "Include alarm points with this substring in the description. Leave blank to include alarm points with any description."
- Starting Host Device:** A text input field.
- Ending Host Device:** A text input field. Below it, a note reads: "Include alarms that are hosted on devices within this range. Leave blank to include alarms on all host devices."
- Starting Alarm Point Device:** A text input field.
- Ending Alarm Point Device:** A text input field. Below it, a note reads: "Include alarms points for devices that are within this range. Leave blank to include all devices."
- Included Alarm Types:** Four checkboxes: 'Analog Fixed Limit', 'Floating Limit', 'Binary', and 'Command Fail'.
- Report Type:** A dropdown menu showing options: PDF, Excel (complete), Excel (Data Only), HTML, RTF, and MS Word.
- Sorting:** A section with a list of criteria (HostDevice, AlarmPointDevice, AlarmDescription, AlarmType) and a table for 'Sort By' and 'Sort Order'.

**Figure 13.9** Point Alarm Setup Report Configuration report

**Alarm Description** Type a partial or complete alarm description. The report returns configuration data for alarms that contain the string in their descriptions. Leaving this entry blank returns all alarms.

**Starting and Ending Host Device** Type a range of host device instances. The report shows alarms hosted on devices in this range. Leaving one or both of these entries blank returns all alarms.

**Starting and Ending Alarm Point Device** Type a range of alarm point device instances. The report shows alarm points for devices in this range. Leaving one or both of these entries blank returns all alarms.

**Alarm Types** Select the types of alarms you want included in the report.

**Sorting** Select sorting criteria and use the arrows to add or remove them from the sorting list. Select ASC to sort in ascending order or DESC to sort in descending order.

## Schedule Report Configuration

The Schedule Report Configuration report lists the schedules in the system. See “Schedules” on page 101 for more information.

**Schedule Report Configuration**

Schedule Description  Generate Report

*Include schedule with this substring in the schedule description. Leave blank to include schedules of any description.* Close

Starting Host Device  **Report Type**

Ending Host Device  PDF  
Excel (complete)  
Excel (Data Only)  
HTML  
RTF  
MS Word

*Include schedules that are hosted on devices within this range. Leave blank to include schedules limiters on all host devices.*

Include Standard

Include Holiday

Include Event

**Sorting**

HostDevice  
ScheduleDescription  
ScheduleType

Sort By	Sort Order
*	

**Figure 13.10** Schedule Report Configuration report

**Schedule Description** Type a partial or complete schedule description. The report returns configuration data for schedules that contain the string in their descriptions. Leaving this entry blank returns all schedules.

**Starting and Ending Host Device** Type a range of host device instances. The report shows schedules hosted on devices in this range. Leaving one or both of these entries blank returns all schedules.

**Schedule Types** Select the types of schedules (Standard, Holiday, or Event) you want included in the report.

**Sorting** Select sorting criteria and use the arrows to add or remove them from the sorting list. Select ASC to sort in ascending order or DESC to sort in descending order.



## Tenant Report Configuration

Setting up tenants helps you track energy use by group or individual and allows you to bill based on actual usage. See “Tenant activity” on page 141 for more information. The Tenant Report Configuration report lists the tenants configured in Envision for BACTalk.

The screenshot shows the 'Tenant Report Configuration' dialog box. It features a blue title bar with the text 'Tenant Report Configuration' and a close button. The main area is divided into several sections:

- Company Name:** A text input field with a 'Generate Report' button to its right. Below the field is the text: "Include tenants with this substring in the company name. If this is left blank tenants with all company names will be included."
- Property Manager:** A text input field with a 'Close' button to its right. Below the field is the text: "Include tenants with this substring in the property manager. If this is left blank tenants with all property managers will be included."
- Report Type:** A list box containing the following options: PDF, Excel (complete), Excel (Data Only), HTML, RTF, and MS Word.
- Sorting:** A section containing a list box with 'Company Name' and 'Property Manager', and a table for defining sort criteria.

Sort By	Sort Order
*	

**Figure 13.11** Tenant Report Configuration report

**Company Name** Type a partial or complete company name. The report returns configuration data for tenants that contain the string in their descriptions. Leaving this entry blank returns all tenants.

**Property Manager** Type a partial or complete property manager name. The report returns configuration data for tenants that contain the string in their property manager descriptions. Leaving one or both of these entries blank returns all tenants.

**Sorting** Select sorting criteria and use the arrows to add or remove them from the sorting list. Select ASC to sort in ascending order or DESC to sort in descending order.



## Trendlog Setup Report Configuration

Trendlogs help you troubleshoot problem areas and identify critical operating trends in your system. BACtalk *trendlogs* sample data values from any data point at a regular interval. The Envision for BACtalk server saves sampled values in records that you can view, print, and export. See “Trendlogs” on page 163 for more information.

The Trendlog Setup Report Configuration report lists the trendlogs set up in Envision for BACtalk.

The screenshot shows the 'Trendlog Setup Report Configuration' dialog box. It features a title bar with a close button. The main area contains several input fields and buttons:

- Log Description:** A text input field with a 'Generate Report' button to its right. Below it is the instruction: "Include trendlogs with this substring in the log description. Leave blank to include trendlogs with any description."
- Starting Host Device:** A text input field.
- Ending Host Device:** A text input field.
- Starting Reference Device:** A text input field.
- Ending Reference Device:** A text input field.
- Report Type:** A dropdown menu currently showing a list of options: PDF, Excel (complete), Excel (Data Only), HTML, RTF, and MS Word.
- Sorting:** A section with a list of criteria (HostDevice, ReferenceDevice, LogDescription) and a table for 'Sort By' and 'Sort Order'. The table has a header row with 'Sort By' and 'Sort Order' and a body row with a plus sign in the 'Sort By' column and a dropdown arrow in the 'Sort Order' column.

**Figure 13.12** Trendlog Setup Report report

**Log Description** Type a partial or complete trendlog description. The report returns configuration data for trendlogs that contain the string in their descriptions. Leaving this entry blank returns all trendlogs.

**Starting and Ending Device** Type a range of device instances. The report shows trendlogs hosted on devices in this range. Leaving one or both of these entries blank returns all trendlogs.

**Starting and Ending Reference Device** Type a range of device instances. The report shows trendlogs for points on devices in this range. Leaving one or both of these entries blank returns all trendlogs.

**Sorting** Select sorting criteria and use the arrows to add or remove them from the sorting list. Select ASC to sort in ascending order or DESC to sort in descending order.

## Trendlog Handler Report Configuration

A log handler is automatically created when you save a trendlog in a host device. By default, this log handler uses the Envision for BACtalk server as the recipient. The recipient must collect trendlog data from the controller periodically; otherwise, samples can be lost. The host device sends a notification to the recipient, and then the recipient loads data from the host device and stores the data in its databases. The trendlog setup determines when the host device sends a notification to the operator workstation. The log handler determines where this notification is sent.

The Trendlog Handler Report Configuration report lists the trendlog handlers set up in Envision for BACtalk.



**Figure 13.13** Trendlog Handler Report Configuration report

**Handler Description** Type a partial or complete trendlog handler description. The report returns configuration data for trendlog handlers that contain the string in their descriptions. Leaving this entry blank returns all trendlog handlers.

**Starting and Ending Host Device** Type a range of device instances. The report shows trendlog handlers hosted on devices in this range. Leaving one or both of these entries blank returns all trendlog handlers.

**Sorting** Select sorting criteria and use the arrows to add or remove them from the sorting list. Select ASC to sort in ascending order or DESC to sort in descending order.

## Zone Setup Report Configuration

A *zone* is a defined space in a building that is controlled by the BACtalk system. Zones provide a convenient mechanism to monitor, manage, and arbitrate multiple Envision for BACtalk features, such as schedules, optimum start, and tenant activity. See “Zones” on page 29 for more information.

The Zone Setup Report Configuration report lists the zones set up in Envision for BACtalk.

The screenshot shows the 'Zone Setup Report Configuration' dialog box. It features a title bar with a close button. The main area contains several input fields and controls:

- Zone Description:** A text input field with a 'Generate Report' button to its right. Below it, a note reads: "Include zones with this substring in the zone description. Leave blank to include zones with any description."
- Starting Host Device:** A text input field.
- Ending Host Device:** A text input field. Below it, a note reads: "Include zones that are hosted on devices within this range. Leave blank to include zones on all host devices."
- Starting Reference Device:** A text input field.
- Ending Reference Device:** A text input field. Below it, a note reads: "Include zones whose reference devices are within this range. Leave blank to include zones for all reference devices."
- Tenant Name:** A text input field. Below it, a note reads: "Include zones that are associated with this tenant. Leave blank to include zones for all tenants."
- Report Type:** A dropdown menu currently showing 'PDF'. Other options include 'Excel (Complete)', 'Excel (Data Only)', 'HTML', 'RTF', and 'MS-Word'.
- Sorting:** A list box containing 'Host Device', 'Reference Device', 'Zone Description', and 'Tenant Name'. To its right are '>' and '<' buttons. Further right is a table for sorting:

Sort By	Sort Order
*	▼

**Figure 13.14** Zone Setup Report Configuration report

**Zone Description** Type a partial or complete zone description. The report returns configuration data for zones that contain the string in their descriptions. Leaving this entry blank returns all zones.

**Starting and Ending Host Device** Type a range of device instances. The report shows zones hosted on devices in this range. Leaving one or both of these entries blank returns all zones.

**Starting and Ending Reference Device** Type a range of device instances. The report shows zones for points on devices in this range. Leaving one or both of these entries blank returns all zones.

**Tenant Name** Type a partial or complete tenant name. The report returns configuration data for zones that contain the string in their tenant names. Leaving this entry blank returns all zones.

**Sorting** Select sorting criteria and use the arrows to add or remove them from the sorting list. Select ASC to sort in ascending order or DESC to sort in descending order.

# System Administration

# 14

Once your BACtalk system is set up, it may seem to run itself. However, there are some maintenance tools and techniques you need to use to keep everything running smoothly.

This chapter describes the following system administration tools and tasks:

**Device Manager** Keep your Device Manager database up-to-date with information about all the devices connected to your BACnet network. Back up, restore, restart, and control devices. Scan and configure Alerton configurable devices from a remote location. Renumber VLCs, set the password required to download DDC to a device that has been configured as part of a smoke system, and remove cross-references to devices that are no longer in the Device Manager table.

**General system setup** Define settings that apply to a particular operator workstation and how it is used within the BACtalk system

**User management** With user profiles, you can control what features, displays and devices a user can access and the types of information or settings they can change. View the User Activity Log to see who performed a particular task and when.

**Group management** With group profiles, you can control what features, displays and devices groups of users can access. This is an easy and powerful way to control similar users. This is a simple way to add privileges to a user who may not already have certain privileges in their individual user profile. Group privileges are added onto user privileges.

**Reports** Use BACtalk reports to review and evaluate system activities and performance.

**Remote access** Set up or modify connection profiles, so you can access Envision for BACtalk remotely.

**Backup and restore job data** Use the backup and restore utilities to create a backup image of an Envision for BACtalk job and restore the job, if necessary.

**Advanced features** This section contains information on advanced features. These features are powerful, but caution must be applied when using them. Only experienced users should access the advanced features.

## Device Manager

Device Manager (BACtalk>Device Manager) is the brain of the BACtalk system. Device Manager records (device profiles) help identify the location and function of all of the devices in a facility. Understanding how to use it helps you manage your facility and expedites the setup and checkout of new equipment.

Use Device Manager to perform these tasks:

- View a list of devices defined for this BACnet network
- Add, edit or delete a device profile
- View a list of new devices on the BACnet network
- Scan for and configure BCMs (ROC v2.0 and later) and VLXs (ROC v2.3 and later) from a remote location
- Enable Device Communication Failure Alarms
- Scan to see information about the devices on your BACtalk system
- Save point data to the Envision for BACtalk server
- Restore data in a global controller (send data to device)
- Synchronize clocks in all devices
- Scan the internetwork to see if a device is online
- Auto-download basic ROC file capabilities to connected controllers
- Enable BACnet devices on the same network to communicate with MS/TP slave devices using the device instance address
- Back up and restore devices
- Restart and control devices
- Renumber device instances in a range of VLCs
- Print a list of device profiles
- Set the password required to download DDC to a device that has been configured as part of a smoke system
- Remove cross-references to devices that are no longer in the Device Manager table
- View when a device was commissioned and who commissioned it

Device Manager also provides the following capabilities (see the *Installation and Startup Guide* (LTBT-TM-ADMIN) for more information):

- Configure (populate) a Device Manager database
- Set device instances
- Copy device profiles
- Assign Alerton Standard applications to devices

**Note** Many Envision for BACtalk features reference Device Manager records for lists of device selections. This includes Envision for BACtalk's check for hardware key compliance. If a device profile does not exist, a \*no entry\* message appears on data displays. Keep your Device Manager list up-to-date

with your site's BACnet devices. Make sure that a device profile for the Envision for BACTalk server appears in its own Device Manager table.

## Enabling device communication failure alarms

Device communication failure alarms (BACTalk>Device Manager>[select a device]>Edit/Add>Preferences>Communication alarms>Enable) notify users with a pop-up alarm message that communication between the server and a device has been lost. This feature is disabled by default. Enable the device communication failure alarm, specify an alarm handler, specify an alarm host device, specify how often you want BACTalk to poll the device for communication failure alarms, and send the communication failure alarm object to the device.

## Using Device Scan

Device Scan is a component of Device Manager. Click **Device Scan** (BACTalk>Device Manager) to automatically locate BACnet devices on the BACnet internetwork. After you locate devices with a scan, you can select them and add records to the Device Manager. This is a good way to update the Device Manager when you add controllers to a system or change addressing or network configurations.

Make sure your operator workstation is connected to the BACnet internetwork over an Ethernet or a PTP connection before performing a device scan. Device Manager may scan the internetwork several times to search for devices. In fact, Device Manager continues to scan for devices as long as at least one new device was found in the previous scan.

**CAUTION** Depending on the size of your network, the amount of network traffic, and your connection, a scan may take anywhere from three minutes to an hour or more. You can click **Stop** at any time to interrupt a scan.

**Table 14.1** Information device scan displays

Field	Description
Device	The BACnet device instance is a unique identifier for the device. Each device on the BACnet internetwork must have a unique device instance.
Net	The BACnet network number that the device is on. This field is blank if the device is on the local network.
MAC Address	The unique MAC address for the device is a hexadecimal number. Each device on a BACnet internetwork has a unique MAC address and network number combination.
Model	The model name assigned by the manufacturer.
Description	This information comes from the description property of the device object.  While scanning, this field may also display <WAITING>, which indicates that BACTalk is awaiting a response from the device, or <NO RESPONSE>, which indicates a communications issue (the device was unable to respond).

When the scan is complete, you can select one or more of the devices found and save them to the Device Manager table.

**CAUTION** With the exception of a device's capabilities, if a device profile already exists in the Device Manager table, it is overwritten.

Scanning for devices is the preferred method of verifying the devices on the network. When you scan for devices, Device Manager confirms that the device is online and populates some of the device profile information automatically.

Use device scan to find new devices on the network or to update Device Manager when a device's address has changed.

► **To scan the BACnet network for devices**

1. On the BACtalk menu, click **Device Manager**.
2. Click **Device Scan**.
3. If you want to scan for device instances within a range, select **Device Range** and then type a range of device instances to scan. For example, you can scan for a controller in the range of 2000 to 2999. If you clear this option, device scan searches for all devices.
4. Click **Scan**.

Device scan searches the network for BACnet-compliant devices, making several passes. This may take some time. Devices found appear immediately in the list of devices. You can interrupt this process by clicking **Stop**. However, it is recommended that you allow the scan passes to complete, as the device capabilities are scanned after the device model is identified.

**Note** Previous records in Device Manager will have their device property information overwritten when new records are added to Device Manager. If device properties were previously sent to the controller, you can use the Save to disk feature to recover the information.

5. To add records to Device Manager for all devices found, click **Save to Device Manager Table**.  
—or—  
To add specific records, use Shift+click to select a range of devices and use Ctrl+click to add or delete a device in the selection. Then click **Save to Device Manager Table**.
6. Click **Close**.

## Automatically downloading a ROC file to controllers

Envision for BACtalk can be set up to automatically send ROC files from the operator workstation hard disk to controllers that have the Auto Download option selected in their device profiles. Select a device profile, and then click **Edit** to see if this option is selected for a particular device.

Whenever Envision for BACtalk checks to see if a download is needed, the current ROC file timestamp is compared with the timestamp from the device. By default, auto-download is checked at midnight. A user can also initiate this check at any time.

**CAUTION** Auto-download does not resend objects.



## Enabling MS/TP proxy

Enabling MS/TP slave proxy allows users to communicate with all MS/TP slave devices on the same network that do not support BACnet services. When enabled, the auto-detect proxy feature is enabled on all MS/TP trunks in the proxy device.

## Backing up and restoring devices

The Back Up Devices and Restore Devices features enable you to back up and restore configuration data in any BACnet device, regardless of manufacturer. Use these features to restore settings from a backup file into a device with corrupted configuration settings, or to restore data after a firmware upgrade.

**Note** You must have the Backup BACnet device privilege selected in your user profile to back up devices. You must have the Restore BACnet device privilege selected in your user profile to restore devices.

See “Restoring a BACTalk job” in the *Envision for BACTalk Installation and Startup Guide* (LTBT-TM-ADMIN26) for more information.

## Restarting and controlling device communication

Use the Restart/Control Devices feature primarily for diagnostic purposes. It is initiated from a client operator workstation and instructs a remote device to stop responding to or initiating messages except for these two messages. The ReinitializeDevice service instructs a remote device to reboot (cold start) or reset to some predefined initial state (warm start). Device Communication Control enables or disables network communication except for these two messages. Use this service to troubleshoot a problem with a particular device on the BACnet internetwork.

Advanced users can use the Disable Initiation option to prevent the device from initiating communications. The device will still be able to process APDUs and return responses as required. The device can also initiate I-Am requests in response to a Who-Is message.

**Note** You must have the Restart and control devices privilege selected in your user profile to restart and control devices.

## Viewing device statistics

Device Statistics (Device Manager>Advanced>Device Statistics) shows:

- the number of devices you can connect to the system (Allowed Devices)
- the number of devices currently connected to the system (Number of Devices)
- the number of workstations you can connect to the system (Allowed Workstations)
- the number of workstations currently connected to the system (Number of Workstations)

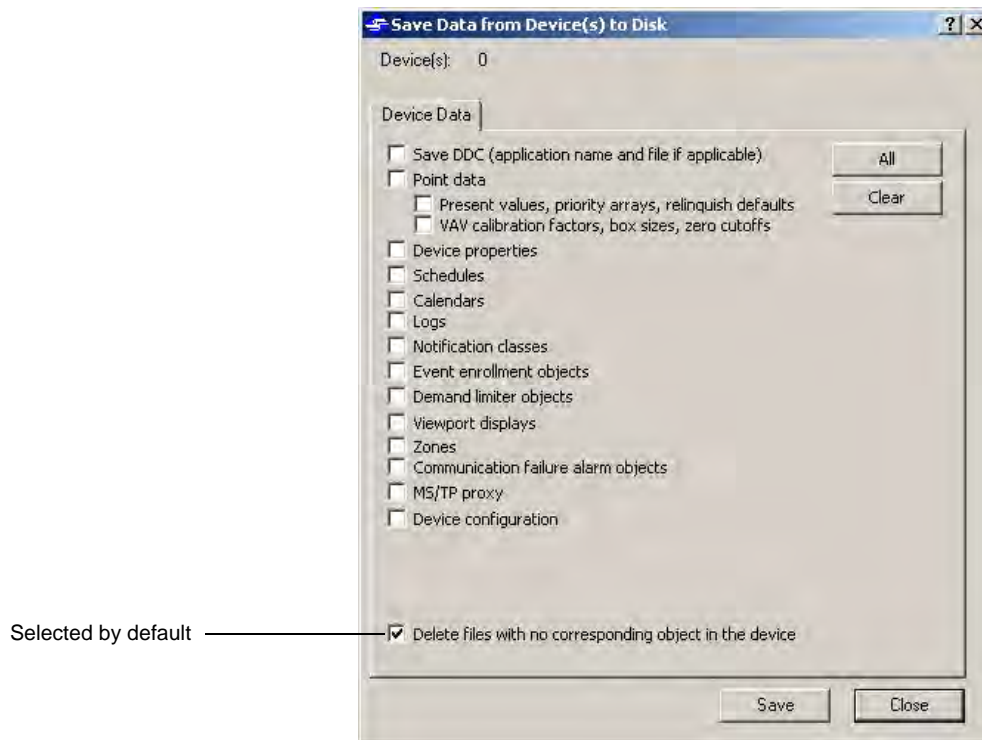
This information is useful in troubleshooting and in planning additions to a system.

## Sending to and saving from BACtalk controllers

When you send to or save from a device, Envision for BACtalk looks in the current rep/job folder on the server's hard disk for a folder that is associated with the device. This folder contains all the information about the device: device profile information, schedules, alarms, trendlogs, zone objects, and so on.

### Saving data from devices to disk

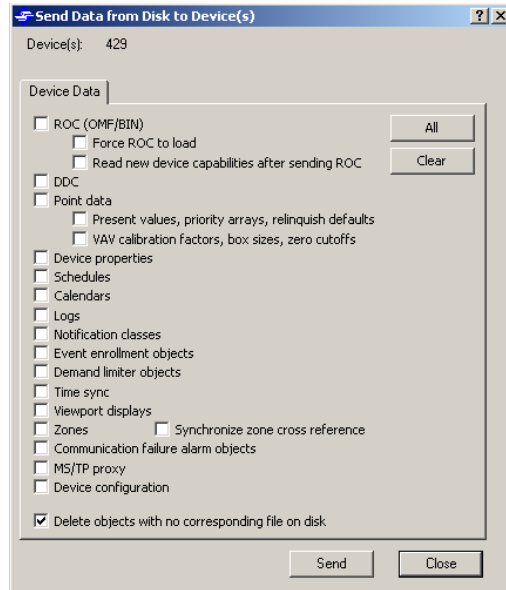
Select a device profile from the list, and then click **Save** to save information from the field device to the operator workstation hard disk. For example, you might do this when you want to save to disk the most current point data in one or more field devices.



**Figure 14.1** Save Data from Devices to Disk dialog box. See Table 14.2 for a description of the options.

## Sending data from disk to devices

Select a device profile from the list of devices in Device Manager, and then click **Send** to send information from the operator workstation hard disk to the field device. For example, you must do this after upgrading the ROC (firmware) on a global controller.



**Figure 14.2** Send Data from Disk to Devices dialog box. See Table 14.2 for a description of the options.

Use the following table to help you decide what to send to a device or save to disk.

**Table 14.2** Send and Save options

Option	Description
ROC (OMF/BIN)	Sends a ROC file to a BACtalk controller.
Force ROC to load	Device Manager overwrites the ROC file in the controller even if the dates are the same. Otherwise, Device Manager only overwrites the file if the dates are different (even if the file Device Manager is overwriting is newer).
Read new device capabilities after sending ROC	BACtalk automatically reads the device capabilities from the device after successfully sending the ROC to the device.
DDC	Saves/sends DDC to a controller or saves DDC setup from/to a BACtalk device. Saving the DDC setup verifies that the file is in the server. It does not remove the DDC and recreate the file. The DDC file is identified by rep, job, and application in the device record.  NOTE: The Save function works best when saving data from a programmable TUX to a BCM-TUX. To save other data, use VisualLogic See the BACtalk Systems Programmer's Guide and Reference (LTBT-TM-PRGRMR).
Point Data	Saves/sends point data values from/to a BACtalk device.

**Table 14.2** Send and Save options

Option	Description
Device properties	Saves/sends device properties, such as name, description, and location from/to a BACTalk device.  For example, if you update the description for a device in Device Manager, you can then send that new description to the device. This ensures that when other users scan the network for devices, the new description you created is found with the device. Additionally, all displays that reference the device description are updated.
Schedules	Saves/sends schedules from/to a BACTalk device.
Calendars	Saves/sends calendars from/to a BACTalk device.
Logs	Saves/sends trendlog and energy log setup (not data) from/to a BACTalk device. You must select all devices that are capable of hosting logs to save logs.
Notification classes	Saves/sends alarm and log handlers from/to a BACTalk device.
Event-enrollment objects	Saves/sends alarm setups from/to a BACTalk device.
Demand limiter objects	Saves/sends demand limiter objects from/to a BACTalk device.
Time sync	Synchronizes a device's clock with the clock on the operator workstation.
Viewport displays	Saves/sends Viewport device files from/to a Viewport device.
Zones / Synchronize zone cross-reference	Saves/sends all zone definitions to a BACTalk controller. Select Synchronize zone cross-references to resynchronize the affected zones.
Communication failure alarm objects	Saves/sends communication failure alarm objects from/to a BACTalk device.
MS/TP proxy	Saves/sends MS/TP proxy settings from/to a BACTalk device.
Device configuration	Saves/sends device configuration settings from/to a BACTalk device.
Delete objects with no corresponding file on disk/ Delete objects with no corresponding object in device	Deletes objects matching the criteria on local hard disk or controller that do not exist in the target device/disk. For example, if the setup on the disk was changed offline, delete the objects in controller that are no longer on the disk.

► **To send or save data to BACTalk controllers**

1. On the BACTalk menu, click **Device Manager**.
2. In the list of devices, select the device profiles you want to send or save.
3. Click **Send** or **Save** as appropriate.  
  
Send takes data from the Envision for BACTalk server hard disk and sends it to the controller. Save retrieves files from the controller and saves it to the Envision for BACTalk server hard disk.
4. Select the check boxes for the items you want to send or save.
5. Click **OK**.

See the *Envision for BACTalk Installation and Startup Guide* (LTBT-TM-ADMIN26) for more information about populating the Device Manager table.

## General System Setup

Use the General System Setup dialog box to define settings that apply to a particular operator workstation and how it is used within the BACtalk system.

**Table 14.3** General System Setup dialog box

General System Setup tabs	Description
Identification	Set options for how the operator workstation identifies itself to other devices on the BACnet network
Network	Control how this operator workstation communicates with the rest of the BACtalk system: as a client, server or Enterprise server.
Time Sync	Define the BACnet devices to receive date and time information from this BACtalk operator workstation. The date and time originate from the operator workstation's Windows setup
Preferences	Set defaults for this operator workstation and the current job
Startup/Shutdown	Define how Envision for BACtalk behaves upon startup or shutdown
Email Setup	Define SMTP server information. You must complete this information before you can use the email billing option in Tenant Activity. Note: Envision for BACtalk now supports SMTP authentication for increased security and compatibility with SMTP servers such as gmail and other email providers.

### Identification

Sets options for how the operator workstation identifies itself to other devices on the BACnet network.

#### Device instance

A BACnet device instance for this operator workstation. Each device instance throughout a BACnet internetwork must be unique. A valid range is 0 to 4,193,302.

#### Device name

A BACnet device name, an identifier for the operator workstation. The device name must be unique throughout the BACnet internetwork. This is the object-name property of the operator workstation's device object. No other device can have the same device name. This name appears in the device lists and reports.

#### Device description

An identifier for the operator workstation's function, location, or name. This is the description property of the operator workstation's device object. For example, 4th floor computer lab. This description appears in zone descriptions.

### Network

Control how this operator workstation communicates with the rest of the BACtalk system.

### Offline Mode

Useful if this operator workstation is used for off-site development (no connection to a host device). This speeds operation and prevents the operator workstation from searching for field devices.

### Ethernet Setup

Select this option to enable BACnet/Ethernet communications. Do not enable both Ethernet and Annex J.

**Primary ethernet adapter** Sets the Ethernet adapter that this operator workstation uses to communicate on the BACnet internetwork. Normally, Envision for BACTalk automatically detects your Ethernet adapter. Click the arrow and then select an adapter from the list, if necessary.

**Enable BACnet protocol** Enables the operator workstation to communicate with other BACnet devices using the BACnet protocol. If this check box is cleared and Annex J is not enabled, the operator workstation will not send or receive BACnet messages.

### Annex J setup

Select this option to enable Annex J BACnet/IP communications. Do not enable both Annex J and Ethernet.

**Enable "Annex J" BACnet/IP** Enables BACnet/IP communications to be sent and received at this operator workstation. Click **Settings** to set up details of the IP connection.

### AnnexJ BACnet/IP Settings

Sets up the details of BACnet/IP communications.

**Local UDP port** The UDP port this operator workstation should use when communicating with the BBMD. For flexible and reliable results, use a UDP port that is different from the BBMD UDP port. Confirm settings with the site's network administrator.

**Register with BBMD as Foreign Device** Specifies that the operator workstation is a foreign device (resides on a separate subnet with no global controllers).

**BBMD IP address or name** •The IP address or name of the BBMD that the operator workstation will register with on startup.

**BBMD UDP port** •The UDP port of the BBMD. This must match the UDP port set at the BBMD. Confirm settings with the site's network administrator.

**Re-registration interval** •How often the operator workstation must re-register (re-confirm communications) with the BBMD. The default is 300. Smaller intervals may impact performance.

**Use Local IP Address** For use if you want to use BACnet/IP but do not need to send packets to another subnet. Type the IP address and network mask of the operator workstation.

### Client/Server Communications Protocol

Prevents access to the Envision for BACTalk server from workstations that are running versions of Envision for BACTalk older than the version installed on the

server. In general, you would clear this check box during the upgrade process until all client workstations have been updated to the same version as the server. Selecting this option provides secure encrypted client/server communications.

### Site Configuration

Identifies the operator workstation as an Envision for BACtalk server or client. For servers, you select a primary controller, which is the default location for saving field data and setups. For clients, you select the BACnet device instance of the server.

### Advanced

Sets network time-out values and retry limits for BACnet protocol communications, for example, communications from an operator workstation to a controller. These settings do not apply to IP communications.

**APDU Timeout** The time, in milliseconds, between retransmission of BACnet messages. If you experience communication errors or lost data that you attribute to network conditions (high volume or slow connections, for example), try increasing this value (up to a limit of 10000) along with the APDU Segment Timeout. Increasing this value may adversely affect system response time. The default is 6000 milliseconds.

**APDU Segment Timeout** The time, in milliseconds, between retransmission of BACnet message fragments. If you experience communication errors or lost data that you attribute to network conditions (traffic or slow network connections, for example), try increasing this value (up to a limit of 10000) along with APDU Timeout. Increasing this value may adversely affect system response time. The default is 6000 milliseconds.

**APDU Retries** The maximum number of times a network message is retransmitted if no response is received. Each retry occurs only after the appropriate APDU timeout has elapsed. If you experience communication errors or lost data that you attribute to network conditions (high volume or slow connections, for example), try increasing timeout values before increasing APDU retries (to a maximum of 8). The default value is 3.

**Disable Read/Write Property Multiple** Select this check box if you suspect communications difficulties in VLCs with a firmware version earlier than 1.02. This may also be useful when troubleshooting communications with non-Alerton BACnet device.

**Default encoding** The character encoding used when sending text to BACnet devices. The default is ANSI X3.4. This is compatible with previous versions of Envision for BACtalk and with WEBtalk. Use other encoding types for foreign language interoperability with other products such as BCM-WEB or third-party devices. Do not use other encodings when WEBtalk is present in the system because WEBtalk is only compatible with ANSI X3.4.

**Fall back to ANSI X3.4** Sends text data in the most compact encoding available. If the text to be sent can be represented by an encoding that is more compact than the default, Envision for BACtalk uses ANSI X3.4 encoding. This saves space in devices and allows you to save longer strings. ANSI X3.4 typically uses one byte of RAM per character, while other encodings use up to 4 bytes per character.

## Time Sync

It is important to ensure that all devices on the BACnet network have the correct time. Use the Time Sync tab (Tools>General System Setup) to define the BACnet devices to receive date and time information from this BACtalk operator workstation. The date and time originate from the operator workstation's Windows setup.

**CAUTION** Only one operator workstation (preferably the Envision for BACtalk server) should be set up to broadcast the time. Inappropriate time sync settings are a common cause of trendlog and schedule problems.

### Add

Adds devices to your list of time sync recipients. You can specify devices by device instance or by network number and MAC address. You can also designate all devices on the BACnet internetwork or all devices on a particular network.

### Edit

Replaces a selected recipient with one chosen from the recipient list.

### Delete

Removes a recipient from the list. You can only delete one recipient at a time.

### Send time sync every

How often time sync information is sent to the devices in the list. Available options are every 5 minutes, every hour, or every day. You can also send time sync information immediately by clicking **Send Now**.

**Note** Sending time sync information often and having a lot of devices on your network increases network traffic.

### For global or network broadcast, use

Sets whether the Envision for BACtalk server uses local or UTC time when synchronizing internal clocks in network devices.

### Disable time sync

Temporarily disables time sync information. This prevents the operator workstation from sending the date and time to other devices on the network. For example, you would use this feature if you want to set up another operator workstation to send time sync information.

## Preferences

Sets defaults for the operator workstation and the current job.

### Default active/inactive/NULL terminology

**BACnet "active"** The text that appears on displays to indicate when a binary object is active. By default, this text is set to "Active." Other possible entries are "ON" or "Running."

**BACnet inactive** The text that appears on displays to indicate when a binary object is inactive. By default, this text is set to "Inactive." Other possible entries are "OFF" or "Standby."



**BACnet NULL** The text that appears on displays to indicate a NULL value of a property.

### **Empty date character**

The character you want to use to indicate an empty date character. Using the default (dash) as an example, an empty date field appears as --/--/-----.

### **Empty time character**

The character you want to use to indicate an empty time character. Using the default (dash) as an example, an empty time field appears as --:--:--.

### **Display templates**

Click **Configure** to define the display templates to use for the current rep/job. These object and device templates are the ones used when you right-click on a data point. The Alerton Standard displays are used by default. These templates are located in the Display subfolder in the rep/job folder.

### **Enable new devices notification**

Enables Envision for BACtalk to detect devices that have been newly added to the BACtalk system, notify local recipients of the new devices, and allow users at workstations on the local job to add the devices to the BACtalk database. You must set up new device notification at each workstation. View a list of new devices at any time from the Advanced menu in Device Manager.

### **Enable remote alarm notification**

Enable Envision for BACtalk to display a message when it receives a dial-up alarm from a remote network.

### **Enable annunciation of all alarms directed to this workstation regardless of user privilege**

Sets Envision for BACtalk to annunciate all alarms sent to the workstation even if the user does not have privileges for some devices.

## **Startup/Shutdown**

Defines how Envision for BACtalk behaves upon startup or shutdown.

### **Login**

**Enable auto Login** Logs in the specified user whenever Envision for BACtalk is started on this operator workstation. Type the user ID and password of the user you want to automatically log in.

**CAUTION** Enable this feature only if the operator workstation is secure and only authorized users are able to start Envision for BACtalk.

**Start display** The number of the data display that automatically appears at start up. This is also referred to as the top display. By default, the top display is set to 1.

### Default user

**Enable default user** Automatically logs the specified user in to Envision for BACtalk when nobody else is logged in. This allows data to be displayed when nobody is logged in. Type the User ID and Password for the default user.

**CAUTION** Select the privileges for the default user carefully. Anyone with access to the Envision for BACtalk operator workstation will have the same privileges.

► **To set up a default user**

1. Create a default user account. See “Creating user profiles” on page 331.
2. Click **Tools>General System Setup** and then select the Startup/Shutdown tab.
3. Select **Enable default user**.
4. Type the user ID and password associated with the default user account.
5. Click **OK**.

**Default user versus auto login** The default user profile logs in when the last active logged-in user logs out. By contrast, auto login logs in a user when the system starts up. The reason for two distinct features is that the default user should have more restrictive users than the auto login user.

### Logout

**Enable auto logout** Automatically logs a user out when no keyboard or mouse action is detected within a specified time frame.

**Time-out in minutes** Type the number of minutes (when no action is detected) before logging out the user.

### Only authorized users can shut down BACtalk

Allows only certain users to shut down Envision for BACtalk on this operator workstation. Define these users by selecting **Shut down Envision for BACtalk** on the User Privileges and Passwords dialog box.

**Note** If you clear this check box, any user (regardless of privileges) can shutdown Envision for BACtalk.

## Email Setup

Defines SMTP server information. Complete this information before using the email billing option in Tenant Activity.

### SMTP server hostname or IP Address

The IP address for your email server.

### SMTP server port

The port number to use when sending email across the Internet.

**Time out in seconds**

The number of seconds to try and send an email message before quitting and prompting the user to try again. The default is 60 seconds.

**SMTP Server requires authentication**

Enables Envision for BACtalk to communicate with an email server that requires authentication. Enter the User name and Password that the email server recognizes.

**SMTP Server requires an encrypted connection (SSL)** Select if the email server requires an encrypted connection.

**Test Connection**

Tests email server authentication.

**Test email address**

The system sends a test email to this address when you click **Test Connection**.

## User and Group management

A user's access to Envision for BACtalk functions and features depends on the privileges and security level defined in their user profile and any group's profile of which they are members. Information defined in the user's profile includes name, description, security level, password, start display and an authorized system access period. The user ID is also used to identify operations in the User Activity Log. Information defined by any group membership includes access to ranges of authorized devices, select privileges for those authorized devices, and possibly additional start displays.



### Practical application

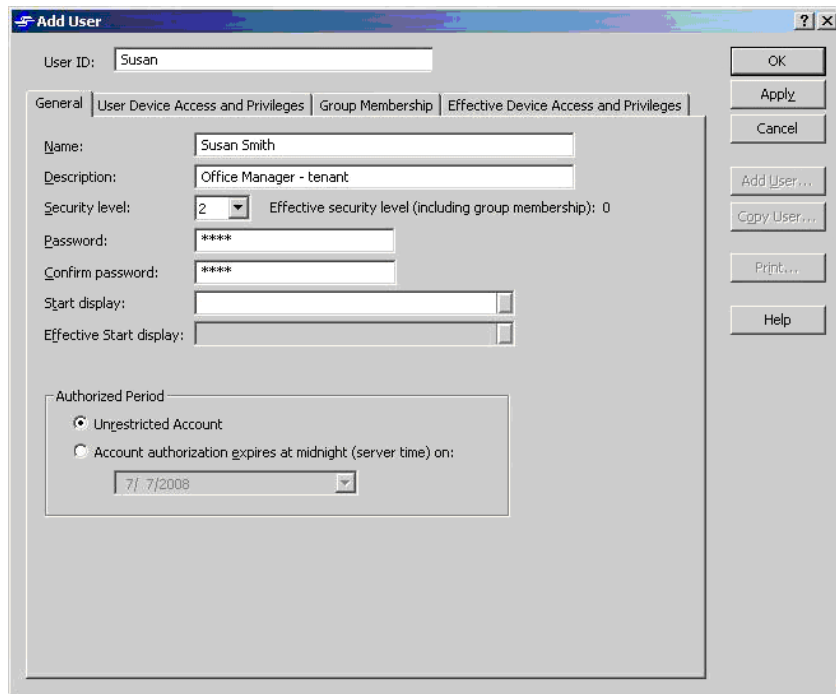
Terry works for the State University dealer, ALERREP. he is responsible for setting up user and group profiles for each new job. He does this often so he is created a cheat sheet for himself. The sheet is basically a table that maps the most common privileges to a security level and similar job titles/responsibilities to group profiles. For example, the Facilities Manager and Lead Technicians will have access to similar start displays and have the authorization to access to all network devices. The receptionist on the other hand can see 1display only, her thermostat, and access 1 device only so she may view the space temperature in her zone. Terry can modify this cheat sheet as necessary for each job.

Job function	Key user profile properties	Key group profile properties
Facilities Manager	Security level = 9 -and- Individual user properties (name, ID, description, password, start display)	Authorized devices = All devices (X+Y) Start Display
Lead Technician/ Mechanic	Security level = 7 -and- Individual user properties (name, ID, description, password, start display)	Authorized devices = Most network devices (X) Start Display
Technician/Mechanic	Security level = 5 -and- Individual user properties (name, ID, description, password, start display)	Authorized devices = Some network devices (Y) Start Display
Facilities Dept. Receptionist	Security level = 3 -and- Individual user properties (name, ID, description, password, start display)	Authorized devices = 1 network device. The device controlling the space temperature in her tenant zone. Start Display

For the State U job, Terry has set up four job functions or user groups that will work with Envision for BACtalk: Facilities Manager, Lead Technician/Mechanic, Technician/Mechanic, and Facilities Dept. Receptionist. He maps these job functions to his cheat sheet.



You may also want to assign your users to groups so they get the extra benefit of privileges specified in each group profile.



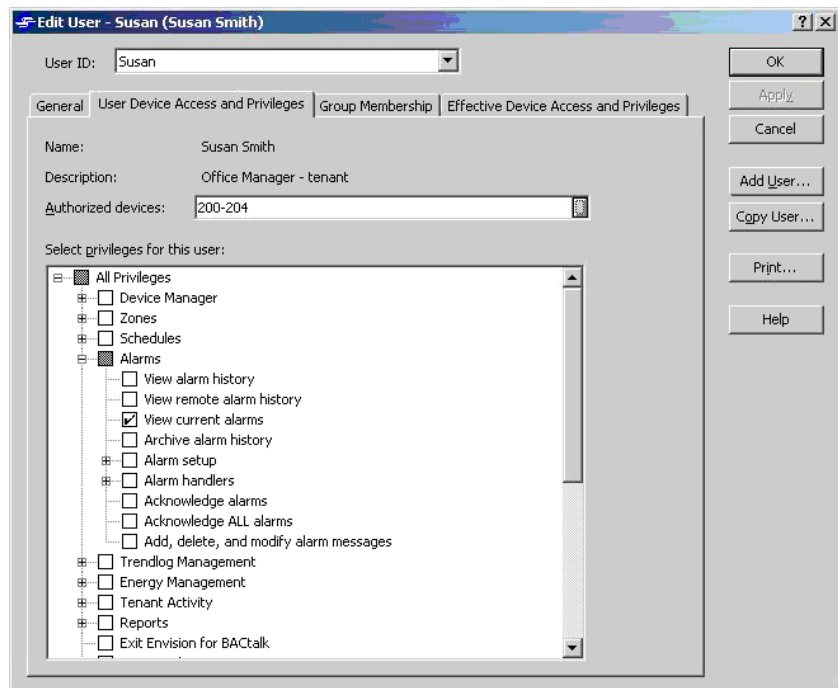
**Figure 14.4** The General tab on the Add User dialog box.

**Table 14.5** General tab - Add User dialog box

Field	Description
ID	Create a unique identification tag for each user. Used to track data in the User Activity Log. Maximum length is 40 characters. Alpha-numeric characters, space, underscore, and dash are valid.  This allows you to use the same user ID, for example, that you may be using for your Windows login. Envision for BACtalk and Windows passwords are managed separately.
Name	Type a descriptive name for each user. Maximum of 80 alphanumeric characters.
Description	Type a description of each user. For example, job title, location or building name. Maximum of 80 alphanumeric characters.
Security level	Specify a security level for each user between 0 and 10. Zero is no ac
Effective security level	The security level BACtalk uses to determine if the user has access to certain display items. The highest security level in the user's profile or any of the group profiles for which the user is a member.
Password	Type a password for each user. Passwords are case-sensitive and must be a minimum of 3 and a maximum of 20 alphanumeric characters.
Confirm password	Confirm the password.

**Table 14.5** General tab - Add User dialog box

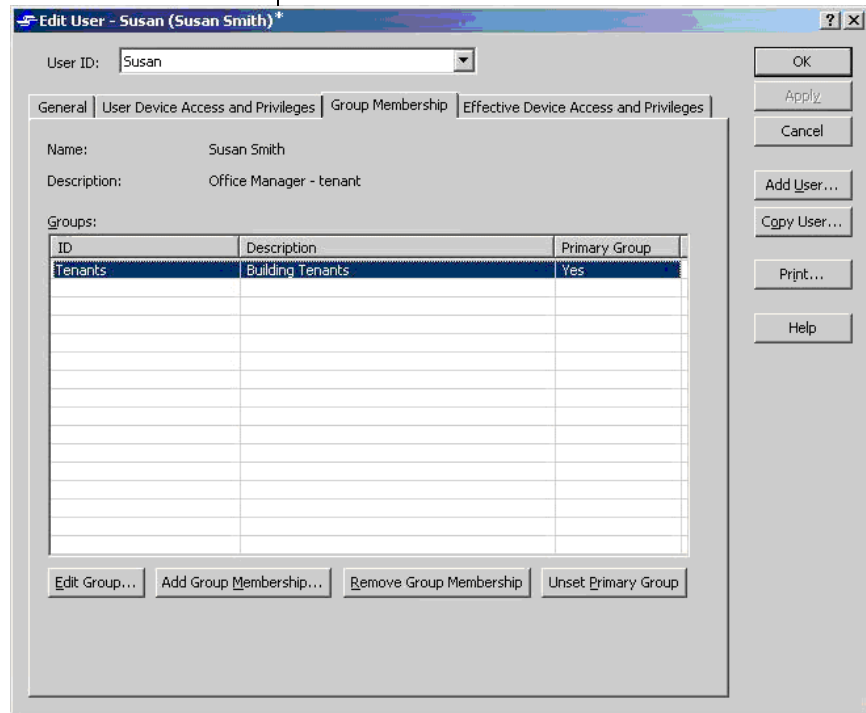
Field	Description
Start display	Specify a start display for each user, or leave blank and the user's start display will be the system default start display. Start display may also be determined by group membership.
Effective start display	If there is a Start Display defined for this User Profile, it will be the Effective Start Display.  If a Start Display is not defined but the User Profile has a Primary Group assigned and that group has a Start Display, it will be the Effective Start Display.  If neither is true, the Effective Start Display is the default Start Display for the Rep/Job.
Authorization Period	Specify either an unrestricted account or define an expiration date. System access will expire on the defined date when the server strikes midnight.
OK	Saves your changes and closes the dialog box.
Apply	Saves your changes to the user profile and keeps the dialog box open.

**Figure 14.5** User Device Access and Privileges tab

**Table 14.6** User Device Access and Privileges tab - Add User dialog box

Field	Description
Authorized devices	Type or view a list of authorized devices for the selected user. Click the command button to edit the device list.
Select privileges for this user	Specify the privileges this user has for devices in the user's list of authorized devices.

An asterisk indicates changes have not been saved. Click **Apply** to save changes.



**Figure 14.6** Group Membership tab on the Add/Edit User dialog box.  
 Note: The Add User dialog box becomes the Edit User dialog box once changes are saved

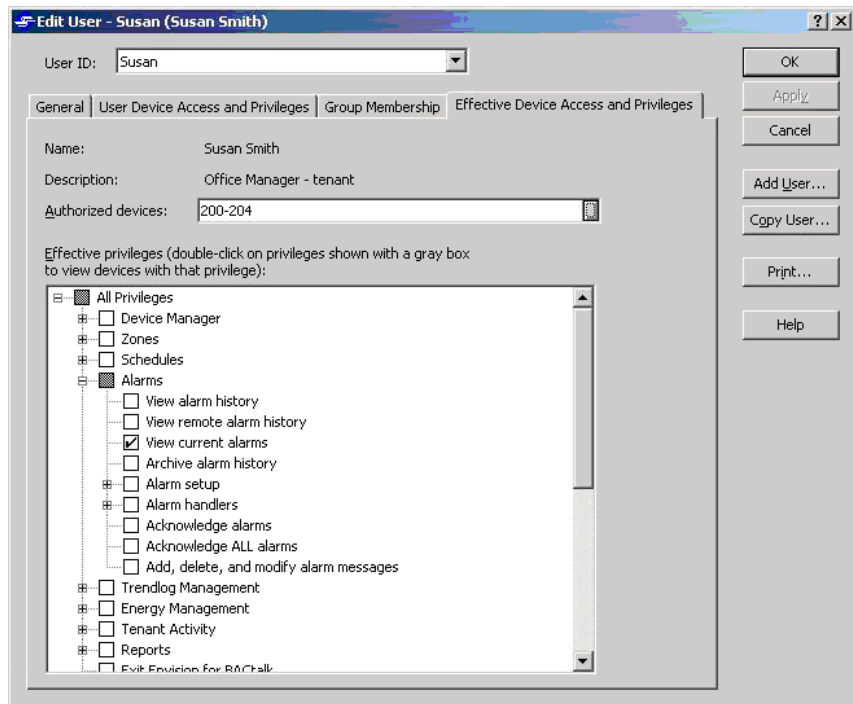
**Table 14.7** Group Membership tab - Add/Edit User dialog box

Field	Description
ID	List of groups to which the selected user has membership.
Description	
Primary Group	The user uses the start display specified for the Group defined as their Primary Group.
Edit Group	Opens the Edit Group dialog box where you may modify the selected group's profile.



**Table 14.7** Group Membership tab - Add/Edit User dialog box

Field	Description
Add Group Membership	Opens the Select Group dialog box where you may add the selected user to a group.
Remove Group Membership	Deletes the user from the selected Group.
Set as Primary Group	Specifies the selected group as the user's primary group, meaning the user's start display is now the start display specified in the Primary Group's group profile.
Unset as Primary Group	Revokes the selected group as the Primary Group. The start display defined in the user's own profile is once again the user's start display if no other group gets specified as the Primary Group.

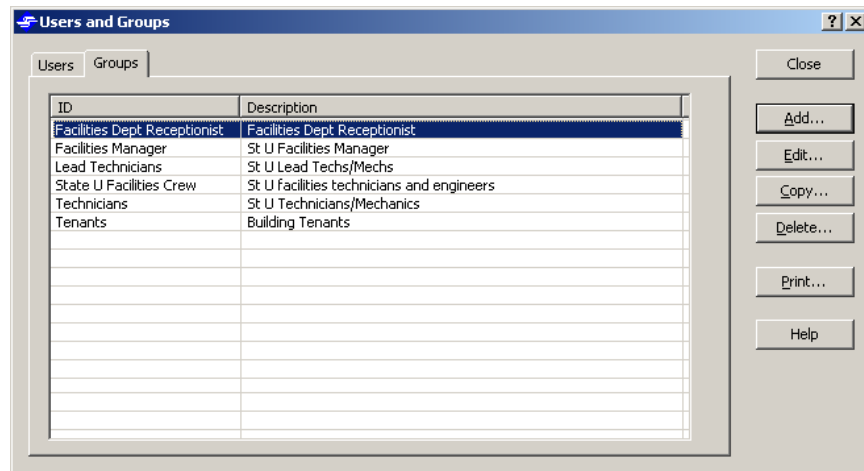
**Figure 14.7** Effective Device Access and Privileges tab

**Table 14.8** Effective Device Access and Privileges tab - Add/Edit User dialog box

Field	Description
Authorized devices	List of devices for which the selected user has some privileges based on either their own user profile or a group profile for which they are a member.
Effective privileges	List of privileges for which the selected user has for the devices listed in their Authorized devices list. Effective privileges include those granted through the user's own profile and those granted by any assigned group memberships. Empty boxes indicate no privileges, gray boxes indicate some privileges (click the + sign to view privilege details), checked boxes indicate the selected user has the selected privilege.

## Creating group profiles

By default, there are no group profiles installed with Envision for BACtalk; they must be created. Either create groups and then add members to them, or create users and then assign them to groups.

**Figure 14.8** Groups tab - Users and Group dialog box.

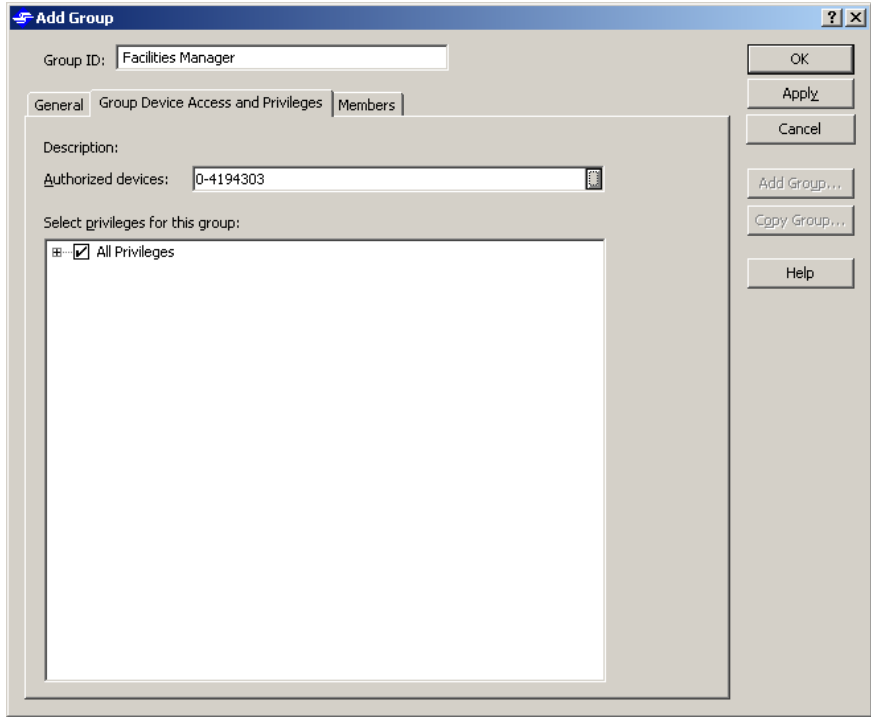
**Table 14.9** Users and Groups dialog box- Groups tab

Components- Groups tab	Description
ID	Create a unique identification tag for each group. For example, <i>Technicians</i> , <i>Tenants</i> , or <i>Facilities Crew</i> . Maximum length is 40 characters. Alpha-numeric characters, space, underscore, and dash are valid.
Description	Enter a brief description of each group. Use job title, location or building name. For example, <i>Leads</i> , <i>St U Admin Bldg</i> , <i>Registration Office</i> , <i>Teachers</i> , <i>Seattle Facilities</i> .
Add	Opens the Add Group dialog box.
Edit	Opens the Edit Group dialog box. Modify an existing group profile.
Copy	Opens the Add Group dialog box pre-populated with the selected group's profile. The group ID is blank. Allows you to quickly create similar group profiles to reduce development time.
Delete	Deletes the selected group profile.
Print	Prints the selected group profile.

**Figure 14.9** General tab

**Table 14.10** General tab - Add Group dialog box

<b>Components- General tab</b>	<b>Description</b>
Group ID	Use a unique name for each group ID using a maximum of 40 alphanumeric characters (an underscore is a valid character). For example, Facilities Manager or Technicians.
Description	Enter a brief description for each group such as job title, location, or building name. For example, St U Facilities Manager, St U Facilities Crew, Health Sciences Bldg, or Seattle Campus.
Security level	Specify the security level that all users assigned membership to the group should have.  <b>Note</b> If a user's own profile has a lower security level, the group security level is their effective security level. If their assigned group's security level is higher than their personal security level, the user's effective security level is the group's security level. BACtalk uses the highest security level to determine a user's access to data display items.
Starting display	If desired, specify a starting data display or display template for this group that will apply to all members. Users with multiple group memberships can quickly switch between starting displays for each group to filter their views of data coming from their authorized devices.  <b>Note</b> Users may belong to multiple groups and all groups may or may not have a specified start display. A user's own profile may have a set start display. Users with no defined start display use the system default start display.



**Figure 14.10** Group Device Access and Privileges tab

**Table 14.11** Group Device Access and Privileges tab - Add Group dialog box

<b>Components- Group Device Access and Privileges tab</b>	<b>Description</b>
Authorized devices	List of authorized devices for this group.
Select privileges for this group	List of privileges members of the group have for their authorized devices.

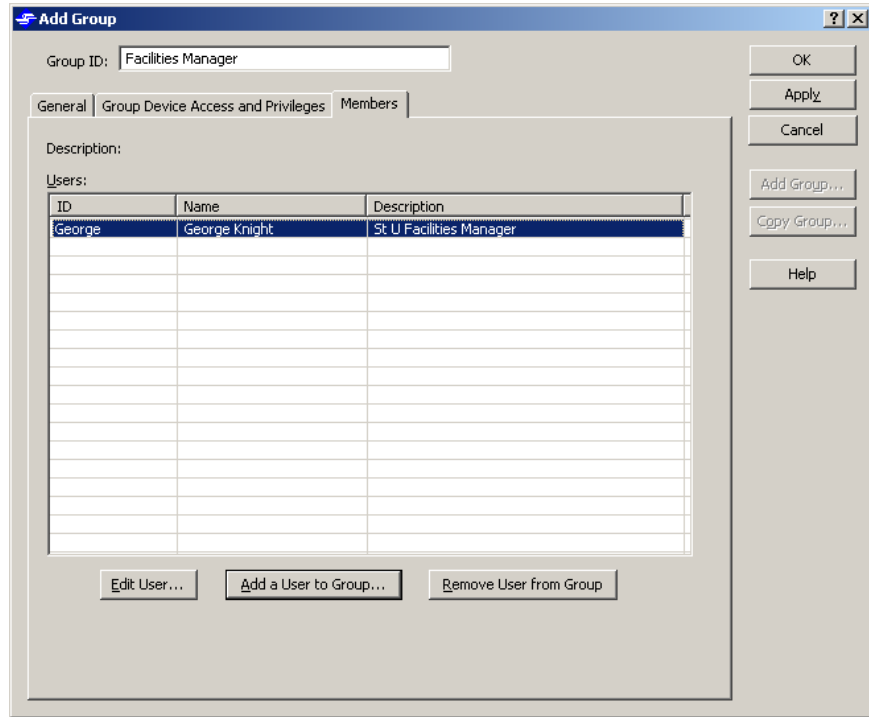


Figure 14.11 Members tab

Table 14.12 Members tab - Add Group dialog box

Components-Members tab	Description
Users	List of all members assigned to this group.
Edit User	Edit the selected user's profile.
Add a User to Group	Add users to this group.
Remove User from Group	Cancel the selected user's membership to this group.

► **To create a new user profile with group membership**

1. From the Tools menu, click **Users and Groups**.  
The Users and Groups dialog box appears.
2. On the Users tab, click **Add**.  
The Add User dialog box appears.
3. On the General tab, type a user ID. Use a maximum of 40 alphanumeric characters (you may use an underscore).

**Note** The User ID is saved in all upper case letters regardless of how it is typed. User Activity is logged by User ID.

**Figure 14.12** General tab of the Add User dialog box

4. Type a user name.
5. Type a description for the new user.
6. Select a security level between 1 and 10.
 

**Note** The effective security level is shown to the right of the user security level.
7. Type a password for the new user. The password is case-sensitive and must be at least 3 but not more than 8 alphanumeric characters.
8. Retype the password for confirmation.
9. Specify the starting display for this user.
10. If this is a temporary account, select **Account authorization expires...** and then select an expiration date.
11. Click the **User Device Access and Privileges** tab, specify the range of devices this user may access, and then select the privileges you want to assign to this user.
12. Click the **Group Membership** tab and assign the user to a group, if desired.
13. Repeat steps 2 through 12 for each new user.
14. Click **Save**, and then click **Close**.

► **To create a new group**

1. From the Tools menu, select **Users and Groups**.  
The Add Users and Groups dialog box appears.
2. Click the **Groups** tab, and then click **Add**.  
The Add Group dialog box appears.
3. Type a **Group ID**.
4. On the General tab, enter a group description, security level and start display.  
**Note** Specifying a group start display is optional.
5. Click the **Group Device Access and Privileges** tab, specify the range of devices users in this group are authorized to access, and then select the device privileges they have for their authorized devices.
6. Click the **Members** tab and then click **Add a User to Group**.  
The Select User dialog box appears.
7. Select users from the list, and then click **Select**.
8. Click **Apply** to save your work.
9. Click **OK**.

## Editing user or group profiles

After you save a user or group profile, you can modify the user name, security level, password, starting display, and privileges at any time from the Users and Groups dialog box. You cannot change the user ID.

You can delete users from the Users and Groups dialog box. For example, if a user leaves the company, select the user ID from the list, and then click **Delete**.

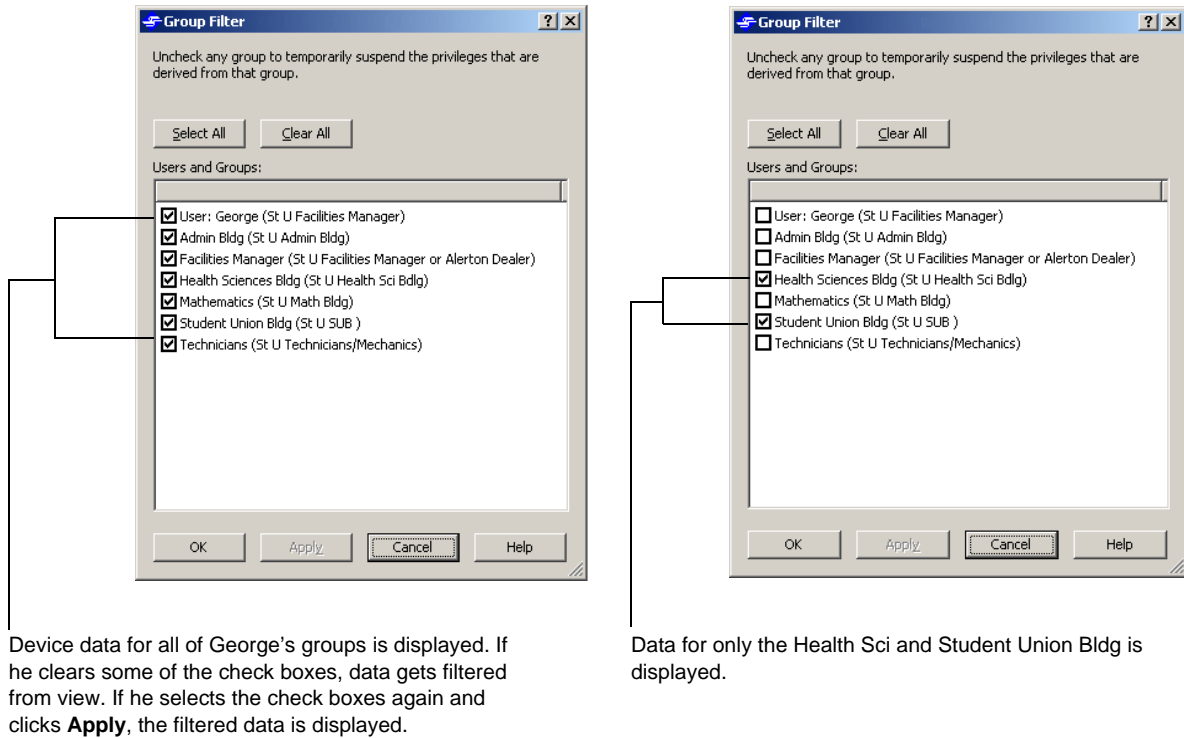
**Note** User profiles edited in earlier versions of Envision for BACtalk are not compatible for use in version 2.5 and later. Set up and edit 2.5 user profiles in 2.5 only since not all capabilities are available in previous versions.

## Using Group Filter

Use Group Filter to filter your data view by devices (View>Show Group Filter). This feature enables you to see sub-sections of data only instead of an entire system. For example, George is the St U Facilities Manager and he has access to devices across the entire St U campus. He can open Group Filter and clear the



check box in front of several of his groups to hide data from those devices.



Device data for all of George's groups is displayed. If he clears some of the check boxes, data gets filtered from view. If he selects the check boxes again and clicks **Apply**, the filtered data is displayed.

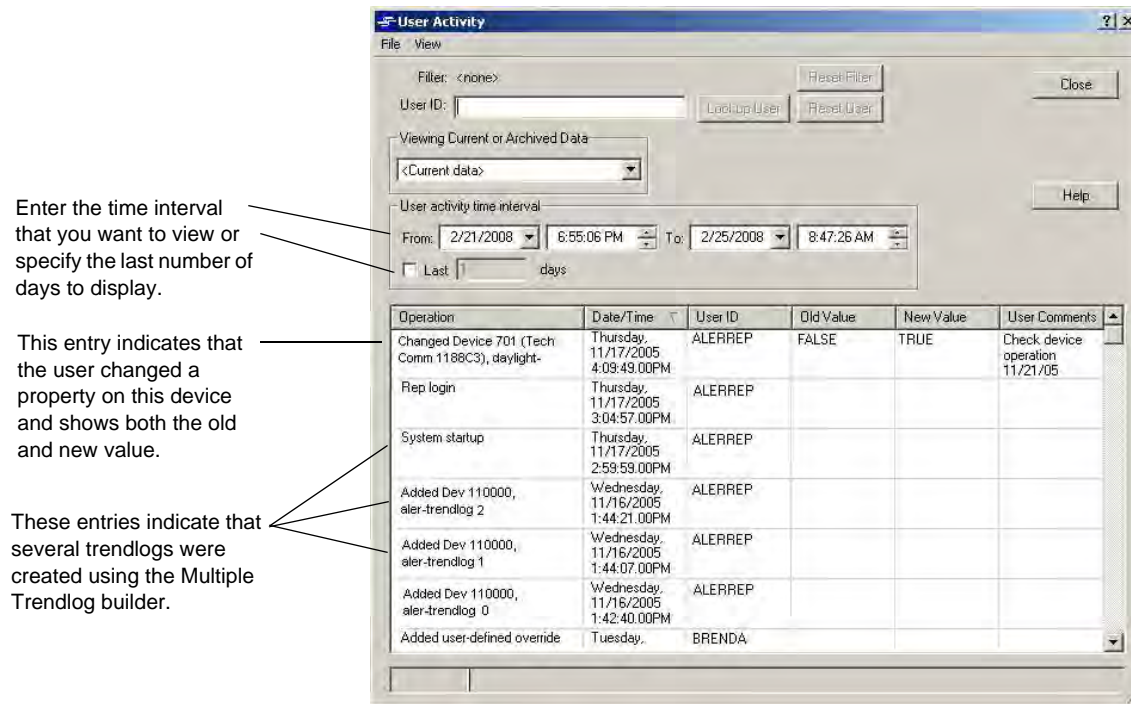
Data for only the Health Sci and Student Union Bldg is displayed.

**Figure 14.13** All groups selected versus only some groups selected. Filter groups to easily customize your data view.

## Viewing user activity

The User Activity Log (View>User Activity) enables you to monitor activity throughout the BACnet internetwork on the current job. For each activity, the log displays the operation performed, the data and time it was performed, the user ID of the person who performed the operation, the old value and new value, and user comments about a log entry, if appropriate.

**Note** Clicking **User Activity** while working in the Override Points Scanner opens the User Activity dialog box, filtered on the selected point (Tools>Advanced>Override Points>Scan>User Activity).



**Figure 14.14** The User Activity Log displays detailed information about operations performed throughout the BACnet internetwork.

You can also open the User Activity Log from a data display. For example, to check and see who turned on a fan, right-click the data point on a display and click **User Activity** on the shortcut menu. The user activity log opens, with entries confined to the selected item.

The optional User Comments column displays text messages, up to 80 characters long, that were entered in the user comment field on data display property edit dialog boxes. User comments can be added for the following property value types:

- Numeric values in either int, unit, real, or double BACnet data types
- Enumerated values
- String value

You can filter and sort the information in the user activity log depending on what you want to see. For example, you can type a user ID in the box, and then click **Lookup User** or **Reset Filter** to view only activity by that user. Use the **Show Override Points Only** option on the View menu to filter out all points that are not in override from being displayed. You can also view activity by user or date and time range.

Sort displayed User Activity data by clicking any of the column headings: Operation, Date/Time, User ID, Old Value, New Value, and User Comments.

**Table 14.13** User Activity File menu

File menu item	Description
Archive Data	Set up how to archive user activity logs. Select either manual archive or set up BACtalk to automatically archive logged data.
Export	Export the current User Activity view as a .CSV file to a user-defined location.
Print	Send a copy of the user activity log to a printer. Only activity during the defined user activity time interval is printed.
Exit	Closes the User Activity dialog box.

**Table 14.14** User Activity View menu

View menu item	Description
Refresh	Trigger the system to gather data on-demand and display the most recent information in the User Activity dialog box.
Show Override Points Only	Filters out other entries from the User Activity view

**Note** The User Activity window tracks all override points in the specified time range, but the same override point will only be displayed once no matter how many times the override occurred.



## Practical application

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George recently set up optimum start in the Health Sciences building. This is the first time he is used optimum start, so he monitors operations in all of the Health Sciences zones to see how it is working. While viewing the trendlogs for the previous week, he notices that the setpoint in the main lecture hall was changed. He right-clicks on the setpoint item on the data display and selects User Activity from the shortcut menu. The user activity log opens and displays the user ID of the person who changed the setpoint (Joe). George follows up with Joe to make sure that they are not duplicating efforts.

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## About BACtalk reports

The Envision for BACtalk reports feature provides a quick way for you to set up and edit printed reports for your BACtalk system. By creating and editing reports, you can track variables and processes on your system.

You can create a report for alarm histories, device summaries, energy logs, and trendlog variables. You can also output report data to a rich text file (\*.rtf) or into Excel spreadsheet format (\*.xls).

You can structure a report for a particular set of variables using a filter, specifying a print time and date, a print frequency, and the sort order of the variables within the report.

**Note** The Report Generator uses Crystal Reports to generate your reports.

**Table 14.15** Available BACtalk reports

Report	Description
Alarm History	Contains alarm histories of specific points. You can report on alarm time, type, who acknowledged it, device instance, object type and instance, ending time, and ending state.
Device Summary	Contains information on the device. This can include device instance, unit type, rep and job folder, application file, object name and description, location, model, network, MAC address, log host, and device firmware.
Energy Logging	Contains energy consumption based on trendlog data gathered for a data point. Information can be chosen according to report number, date, and display frequency filter (hourly, daily, weekly, or monthly).
Trendlog Chart	A trendlog graph that contains specific trendlog information based on a selected start date and number of records to chart. Filter includes the trendlog, start time, and number of records. This report contains the same information as accessing information through the trendlogs icon.
Trendlog Event	A trendlog table that contains events logged to a trendlog in lieu of data. Information includes the device number, point, date stamp, and event description. You can see the information to be included in the report by viewing trendlogs.
Trendlog Report	Contains the information from the trendlog table view: time of sample, log number, device, object, property, and unit type. You can set up this report and not have to go into the trendlog viewer to review data.
Trendlog Summary	Contains a summary of trendlogs.
Override Points	Contains a complete list of points that are currently in override. Includes system- and user-defined override points.  <b>Important!</b> Setting up hourly reporting is not recommended. Hourly reporting may take longer than an hour if there are many override points. Hourly reporting will affect network traffic. Daily reporting is recommended.

## Viewing the list of reports

View, edit, copy, print, and delete any of the reports you set up in the report log. The buttons on the right of the Reports dialog box allow you to edit existing reports and create new ones.

### ► To view the report log

- On the BACtalk menu, click **Reports**. The Reports dialog box appears, showing a list of existing reports.

### ► To view a spreadsheet of the report log

- From the list of reports, select a report in rich text (\*.rtf) or Excel (\*.xls) format, and then click **View**.

**Table 14.16** Report log fields

Item	Explanation
Report Status	Enabled indicates printing is enabled for a report. Disabled indicates printing is not enabled for a report.
Report Name	Name of the report. This is selected from a list box in the Add Report window.
Print Date	The date the report is scheduled to print. The printing cycle is done in the background and is on a one-minute interval. If a report has a print date prior to the present and Printed = No, the report prints during the next cycle.
Frequency	Indicates how often the report prints. Possible values are H=Hourly, D=Daily, W=Weekly, M=Monthly. <b>Note</b> After reports with a print frequency other than once print, BACtalk creates a new report with the same fields and new print information. The new report appears at the top of the list to await printing.
File Name	Displays the path and file name of a report if it is output to a file.

## Setting up a BACtalk report

When you set up a report (BACtalk>Reports>Add | Edit), select the pre-defined report you want to generate from the Report Name list. Different options appear for the selected report type. Use Table 14.15 on page 347 to understand each report's setup specifics and options.

### ► To set up a report

- On the BACtalk menu, click **Reports**. The Reports dialog box appears, showing a list of existing reports.

### ► To add or edit a report

1. In the Reports dialog box, click **Add** or **Edit** button.  
The Setup Report dialog box appears.
2. In the Report Name list, select the report type you want.
3. Modify report settings, if necessary.
4. Click **OK** to save your choices.

### Filtering or sorting report data

Use a filter to specify which information bits to report. Filters distill information so that a report shows only the required information. Filters define a specific range of dates and times and allow you to select from a list of available data fields that you want to include in the report.

When you select the information you want to include, you are also setting the sort order in which the information will appear on the report.

**Note** Filters and sort order are available only for Alarm History, Device Summary, and Trendlog Summary reports.

### Setting a print frequency

After choosing a report and the sort order, you can set a print frequency for the report. This defines how often the report is printed. The default is hourly. You can also print reports daily, weekly, or monthly. It also defines the length of a report in conjunction with the separator time. An hourly report will print one hours worth of data ending with the separator time. Likewise, a daily report will output 24 hours worth of data ending at the separator time.

### Setting Print/Separator Date/Time

The Print/Separator Date/Time setting in the Setup Report dialog box defines the day and time the report prints. If you do not specify a print time, the default is the same as the separator time.

The print time is the month, day, date, and time the report will print. Because reports recur on an hourly, daily, weekly, or monthly schedule, use portions of the print time to set recurrence. For example, an hourly report set up to print on April 2 at 8:00 AM, will print at 8:00, 9:00, 10:00, and so on. A daily report with the same setting will print every day at 8:00 AM. A weekly report will print every Monday at 8:00 AM (since the date selected is a Monday). And a monthly report will print on the second of every month at 8:00 AM.

The separator time is the date and time of the last sample you want to include in the report when the report prints. It must be a date and time earlier than the print time. The separator time updates for each subsequent printing of the report based on the report frequency.

For example, set up a report to print on Monday, April 2, 2001 at 8:00 AM. Select a separator date of April 2, 2001 at 7:00 AM. If setup as an hourly report, when the report prints at 8:00 AM, it includes data from 6:00 AM through 7:00 AM; when it prints at 9:00 AM, it includes data from 7:00 AM to 8:00 AM; and so on. If it's a weekly report, it includes data from Monday, March 26, at 7:00 AM through Monday, April 2, at 7:00 AM; when the report prints the next Monday, it includes data from May 7 to May 14; and so on.

### Printer and export options

You can save your report to a file, or print to a Windows printer set up in the Windows Control Panel, or both.

You must enter a unique filename which Envision for BACtalk will automatically append with a unique report identifier. For example, an initial report's filename is "LobbySpace@1.xls. Each subsequent report will be

incremented by a value of 1 (LobbySpace@2.xls, LobbySpace@3.xls, LobbySpace@4.xls). This file naming mechanism is not configurable.

**Rich text format** Retains the information, font type and size, as well as other character formatting, but does not retain any styles you applied, spacing parameters, or setups. Information is separated by tabs and line breaks. In other words, your information will be there, but it will not appear the same as it would if you printed it.

**Excel spreadsheet** If you export your report to an Excel spreadsheet, report information is filtered into columns. Some headings are not exported verbatim and Excel substitutes generic headings.



## Working with remote sites in Envision for BACtalk

Remote site access enables a portable computer or a centrally located operator workstation running Envision for BACtalk to connect to a BACtalk system. The connection is made through a global controller over a temporary connection. The global controller and Envision for BACtalk operator workstation support three connection methods:

- A portable operator workstation connected over EIA-232 serial cable (*direct* connection)
- A remote operator workstation connected over modem (*dialup* connection)
- A portable or remote operator workstation connected over an IP wide area network (*Annex J* connection)

When you connect temporarily, the operator workstation and global controller route data between their respective networks and create a new BACnet internetwork. Even if you use a stand-alone portable computer directly connected to a BACtalk global controller, the portable computer is considered its own network.

Portable and remote operator workstations establish connections through the Connection Manager in Envision for BACtalk. When you set up a remote site profile, you define the physical method of connection to the remote site as well as whether the site is stand-alone or server based. The dialout schedules and log gathering features also use remote site profiles.

**CAUTION** If you set up a remote connection, it is highly recommended that you contact your Alerton representative for recommendations about device instances and network numbers.

### Capabilities using a remote connection

The capabilities of a portable or remote operator workstation depend on whether the site it connects to is stand-alone or server-based. A stand-alone site has no operator workstation permanently connected on site; only a global controller is present at the remote site. A server-based site has an Envision for BACtalk server permanently connected on site.

For server-based sites, capabilities of the portable or remote operator workstation are nearly identical to those of a client operator workstation on site. Stand-alone operator workstations have some slight limitations.

**CAUTION** When using a portable or remote operator workstation to connect to a stand-alone site, only those alarms generated while the connection session is open can be viewed in or logged to alarm history. Also, depending on the trendlog setup and how often you connect, gaps in trendlog data may appear.

### Hardware requirements and options for remote connections

This section describes the hardware required for each type of remote connection.

**Note** For specific information about hardware requirements and global controller setup for remote connections, see the *Installation and Operations Guide* provided with the global controller.

**Table 14.17** Serial cable connection

Item	Details
Cable	<p>EIA-232 null modem cable with DB-9 female connector at the global controller and a connector compatible with the operator workstation at the other end.</p>
Global Controller	<p>Each global controller has a standard male 9-pin EIA-232 socket for serial cable connections. An optional serial interface card provides an additional EIA-232 socket for gateway functions only.</p>
Operator Workstation	<p>Available EIA-232 COM port (DB-9 or DB-25).</p>

**Table 14.18** Modem connection

Item	Details
Global Controller	<p>See <i>Installation and Operations Guide</i> provided with the global controller.</p>
Operator workstation	<p>Internal or external modem that connects to the public switched telephone network. Follow these guidelines for setting up a modem profile. Typical commands (which vary from modem to modem) appear in boldface after the description:</p> <ul style="list-style-type: none"> <li>• Enable RTS/CTS hardware flow control. <b>&amp;K3</b></li> <li>• Enable modem-hangup, dropping DTR (the global controller sets this control line to a low state when it wants to hang up). <b>&amp;D2</b></li> <li>• Enable line speed negotiation, error correction, etc. as desired. <b>&amp;Q5</b></li> <li>• Enable responses after “AT” commands (preferably word responses). <b>V1</b></li> <li>• Issue commands to store the current settings (profile) in NVRAM and configure the modem to use the profile on start up. <b>Store (8Wn)/startup(8Wn)</b>, where <b>n</b> is the modem profile number.</li> </ul>

## BACnet/IP (Annex J) connection

Setting up a BACnet system on an IP internetwork requires close coordination with IT and networking professionals who maintain the network. Setting up a BACnet/IP connection also requires a solid understanding of BACnet/IP and IP networking fundamentals. Contact your Alerton dealer before setting up a BACnet/IP system.

**Table 14.19** BACnet/IP (Annex J) connection

Item	Details
Physical and network connection	Remote or portable operator workstation must have access to the IP wide area network (WAN). Operator workstation can use any physical and network connection method that the IP network supports, such as an Ethernet jack or a remote terminal connection.
Global controller	Global controller must be set up as a BACnet broadcast management device (BBMD) with port settings and network options enabled according to device-specific installation and setup instructions as well as IP network architecture.
Operator workstation	Operator workstation must be set up for IP communications. Operator workstation's remote site profile must be set up with a local UDP port and information about the BBMD. See Envision for BACtalk Help for more detailed information.

## Setting up and connecting to a remote site

Use Envision for BACtalk to configure and connect to remote sites. This topic provides instructions for setting parameters in the Connection Manager and Remote Configuration modules. You also use the Connection Manager to initiate the connection to a remote site and open the remote site workspace. This topic provides information about capabilities and data handling while working with a remote site.

### Setting connection details

Use the Remote Configuration dialog box to specify the COM port (for serial connections) or the modem (for dialout connections). If the operator workstation uses both connection types, specify both the direct connect port and a dialout modem.

You also can use this dialog box to set the time-out and retry limit parameters for APDUs. Typically, you do not need to change the default APDU values. Make sure you are familiar with these settings before changing them.

### Using the Connection Manager

Use the Connection Manager to:

- Create profiles for a remote site
- Edit site profiles (change a phone number or connection detail)
- Connect to sites
- Edit data displays while working offline

When you first open the Connection Manager, it lists the remote sites that the operator workstation can connect to. Each record shows the site ID, the description of the site, the type of connection (direct, dialup, or IP).

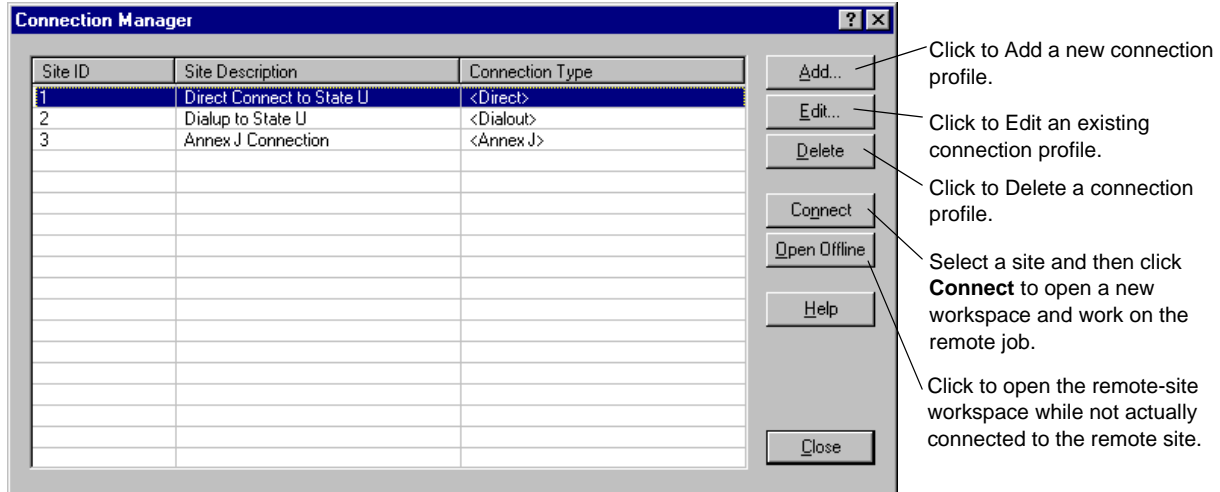


Figure 14.15 Connection Manager dialog box

To create a new remote site profile, click **Add** in the Connection Manager dialog box. To edit an existing remote site profile, select a profile from the list, and then click **Edit** to display the Edit Remote Site Profile dialog box.

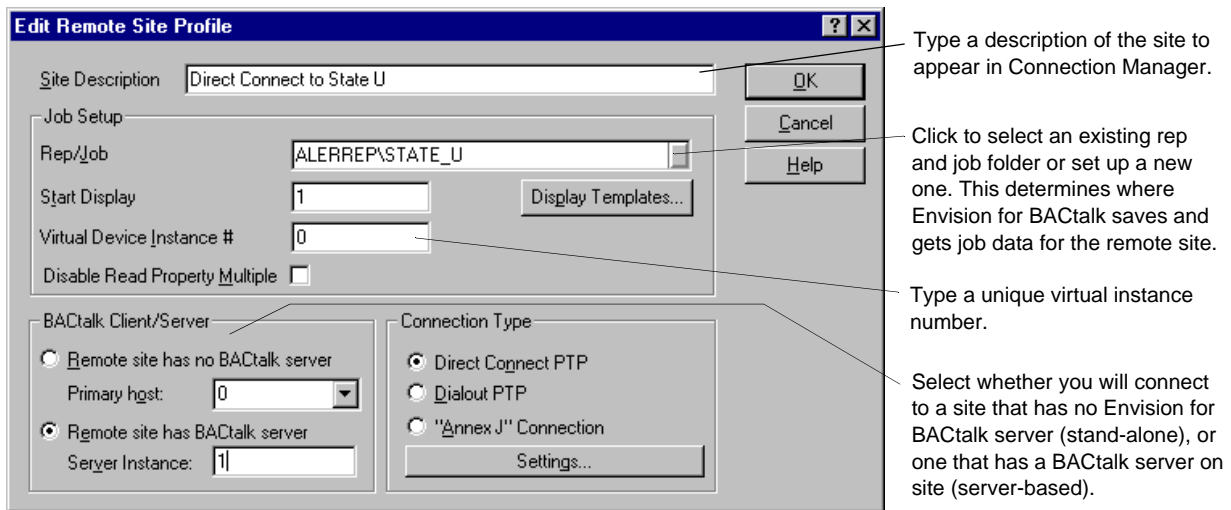


Figure 14.16 Edit Remote Site Profile dialog box

The architecture of BACnet requires that only one logical path exist between one device and another on an internetwork. Under any number of circumstances, a PTP connection could create an illegal architecture, allowing one device to have multiple logical paths to another on the newly created internetwork.

To solve this problem, BACTalk products that support incoming PTP connections (operator workstations and global controllers) use a PTP virtual

network (PTP VNET) and devices making an outbound connection use virtual device instances and another PTP VNET. The virtual device instance mirrors almost every property of the original device object, but exists solely for the purpose of PTP connections. The device is the same physically, but the VNET and virtual device instance differentiate it logically during a PTP connection, effectively separating it from its local network, if one exists.

**General rules for VNET numbers and virtual device instances** When you set up operator workstations to connect to BACnet systems and devices that will host incoming connections, follow these rules:

- **Use unique VNET numbers for each device** The VNET numbers you assign cannot match any other network number on connected networks or any other VNET number in any connected device.
- **Use unique virtual device instances for each operator workstation** The virtual device instances you assign cannot match the device instance of any other device on connected networks, including other devices connected remotely.

**CAUTION** If you are setting up a dialup or portable computer connection, it is highly recommended that you contact your Alerton dealer for recommendations about device instances and network numbers.

**Connecting to a remote site and using the remote site workspace** After you set up or edit a remote site profile, use the Connect button in the Connection Manager to connect to the remote site and open a remote site workspace. The remote site workspace is a separate instance of Envision for BACTalk that runs alongside the main Envision for BACTalk workspace. You can use the remote site workspace to display and configure information at the remote site. You can still use the main workspace to work with the local network (if applicable).

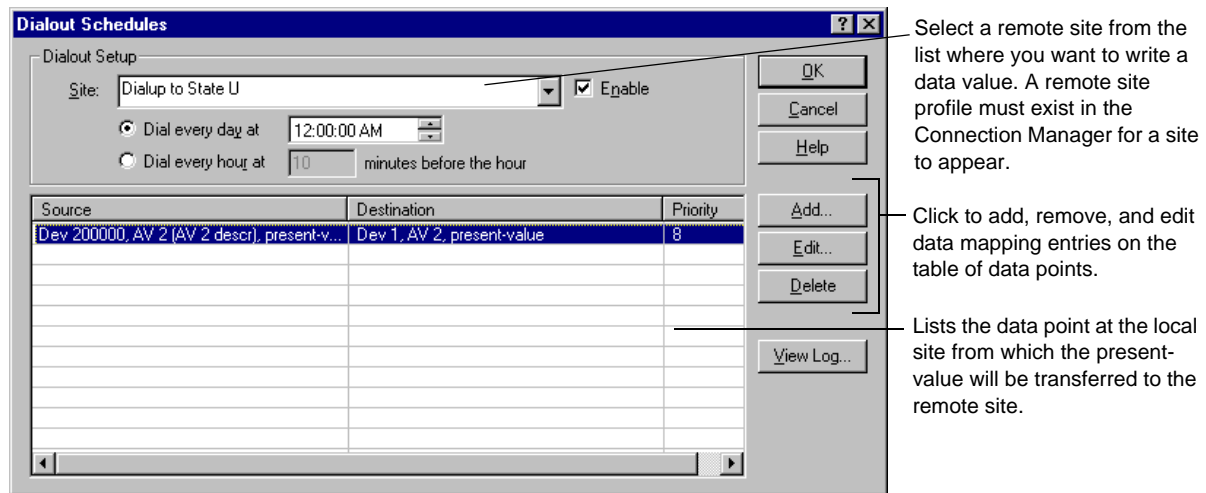
### Remote site facts

- Trendlog data is uploaded from a stand-alone global controller upon connection using the reverse engineering feature. Depending on your trendlog setup, gaps may appear in your data.
- Local BACnet network devices, if applicable, are not accessible through the remote site workspace. Use the main Envision for BACTalk workspace to work with local devices.
- See Envision for BACTalk Help for additional limitations.

## Transferring point data to a remote site

You can set up a BACtalk operator workstation to dial a remote site at regular intervals to transfer point data. The local operator workstation must have a modem and the remote site must have an global controller with a modem. If you are using a client-server setup, the dialout must occur from the server or the point data transfer does not work and no log is created.

**Note** You must configure your global controller properly to receive a connection from a remote operator workstation. See “Hardware requirements and options for remote connections” on page 351 and your global controller documentation for more information.



**Figure 14.17** Dialout Schedules dialog box

You can also use the Dialout Schedules dialog box to view the log of data transactions. When you click **View Log**, the log is displayed in a text editor, showing the time the connection occurred, what events happened during the connection, and what time the connection ended.

```

----- Begin dialout session - Tuesday, March 07, 2000 08:38:03 -----
Connecting to site...
Alarm Dialout Test
Dialing...
Connected.
OK
Transferring points...
Source: Dev 4000, AV 0, present-value
Destination: Dev 2000, AV 10, present-value
Value: 0
Status: OK
Source: Dev 4000, AV 1, present-value
Destination: Dev 2000, AV 11, present-value
Value: 0
Status: OK
Source: Dev 4000, AV 2, present-value
Destination: Dev 2000, AV 12, present-value
Value: 0
Status: OK
Source: Dev 4000, AV 3, present-value
Destination: Dev 2000, AV 13, present-value
Value: 0
Status: OK
.
.
.
Source: Dev 4000, AV 22, present-value
Destination: Dev 2000, AV 32, present-value
Value: 0
Status: OK
Source: Dev 4000, AV 23, present-value
Destination: Dev 2000, AV 33, present-value
Value: 0
Status: OK
Source: Dev 4000, AV 24, present-value
Destination: Dev 2000, AV 34, present-value
Value: 0
Status: OK
Source: Dev 4000, AV 25, present-value
Destination: Dev 2000, AV 35, present-value
Status: Reading - * Err(local,other) *
Source: Dev 4000, AV 26, present-value
Destination: Dev 2000, AV 36, present-value
Value: 0
Status: OK
----- End of dialout session - Tuesday, March 07, 2000 08:39:14 -----

```

*Shows the process of connecting to the remote site and whether the connection is successful.*

*Shows date and time of dialout session attempt.*

*Shows the source and destination points transferred.*

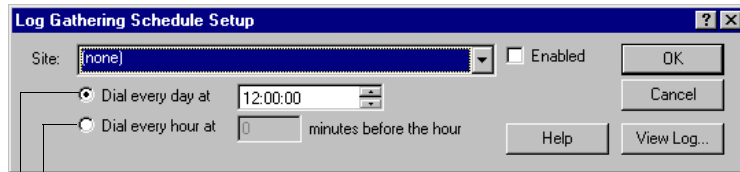
*Shows errors when the point data is not transferred.*

*Shows the date and time at the end of the dialout session.*

## Scheduling BACtalk to dial remote sites and gather trendlog data

The log gathering feature of Envision for BACtalk allows the user to dial in to a remote site and gather the trendlog and energy log data for that site and view it offline. The local operator workstation must have a modem and the remote site must have a global controller with a modem.

**Note** You must configure the target global controller so that the buffer is large enough to hold incoming log information without losing data between dialup sessions.



- Select this option to update logs hourly. Then type the number of minutes before the top of each hour at which the site will be dialed.
- Select this option to update logs daily. Then type or select a time of day to dial the site.

**Figure 14.18** Log Gathering Setup dialog box



## Backup and restore

Envision for BACTalk's backup and restore utilities enable you to create a backup image of your BACTalk job, and then restore it, if necessary. Backup saves all the files for a job that you select to a zip file format (\*.zip). You can then run the BACTalk restore utility to restore the files to their appropriate locations in your BACTalk program directory.

**Why should I back up?** Backing up a job is a way of safeguarding against computer failure. If your hard disk crashes or your Envision for BACTalk operator workstation experiences other problems, data may be lost. The backup utility lets you save job data and reload it if you need to.

**What is saved when I back up?** The entire contents of the rep/job folder you specify is backed up to a zip file format (\*.zip) along with information about the folder the file was in. This includes DDC files and VisualLogic drawings, user profiles, trendlog and energy log setups, displays and templates, and any schedules and calendars saved to disk.

**Where should I save the backed up data?** It is strongly recommended that you back up job files to removable media (a CD-ROM, a large-capacity disk, or a server that is itself backed up frequently) and have at least two copies in two separate locations.

**How often should I back up?** You may want to use a backup schedule to have backups occur at regular intervals; such as daily, weekly, or monthly. You may also decide to perform a manual backup at your discretion: when some system change or development warrants it.

**Are any Envision for BACTalk system files or executables backed up?** No. If Envision for BACTalk operating files are damaged or lost, reinstall BACTalk and then run the restore utility. See the *Envision for BACTalk Installation and Startup Guide* (LTBT-TM-ADMIN26) for more information about the BACTalk Restore Utility and its restore/merge data options.

## Running a manual backup and scheduling regular backups

You can run a manual backup to immediately archive job data. You can also choose to schedule a backup so it automatically occurs daily, weekly, or monthly.

### ► To manually back up BACTalk job data

1. Start Envision for BACTalk and log in.
2. On the Tools menu, point to **Backup**, and click **Backup Job**.

The Backup Job dialog box opens.

3. Under Job, select the rep/job that you want to back up. (If you want to back up the job you are logged in to, the rep/job appears in the Envision for BACTalk title bar.)
4. Under Archive File Name, type a path and file name for the file you want to back up to.

—or—

Click **Browse** to select the folder and type the file name you want to save to, and then click **Save**.

**Note** BACtalk automatically adds a .zip file extension to the file name you type when backing up.

5. Click **Backup**.

Envision for BACtalk creates a zip file with the name you specified in the folder you selected. Progress messages appear in the Output list.

► **To schedule regular backups**

1. Start Envision for BACtalk and log in.

2. On the **Tools** menu, point to **Backup**, and then click **Schedule Backups**.

3. Under Job, select the rep/job that you want to back up. (If you want to back up the job you are logged in to, the rep/job appears in the title bar of the BACtalk workspace.)

4. Under Archive Path, type a path and file name for the file you want to back up to.

—or—

Click **Browse** to select the folder and type the file name you want to save to, and then click **Save**.

**Note** BACtalk automatically adds a .zip file extension to the file name you type when backing up.

5. Under Schedule, select the criteria and the day of the week, and then type the time you want the backup to occur.

6. Click **OK**.

Envision for BACtalk runs the backup utility in the background according to the schedule criteria you set up. The backup overwrites the zip file with each subsequent archive action.

### Backup log and information files

Before the backup utility creates a backup file, it creates activity files, which you can use to identify the contents of a backup file or details about a backup file. These files are saved to the rep/job directory that you back up and are also included in the archive zip file.

You can open these files with any text editor, such as WordPad or Notepad.

**Backup.log** The Backup.log file contains an entry for each file backed up to the archive zip file. Each line shows the path and name of the backed up file as well as the date and time the file was last modified.

**Backup.info** The Backup.info file contains a single entry that contains information about the date and time the backup ran, the source rep and job location, and the destination zip file.

**Entry Syntax** <yr>/<mo>/<day>/<hr>/<min>/<repname>/<jobname>/<sourcedir>/<destzip>



## Practical application

It's Terry's responsibility to back up the State U job regularly to guard against computer failure. The backup utility in Envision for BACTalk enables Terry to schedule regular backups to any drive and restore it, if necessary. Since changes are made to the system on a daily basis, Terry decides to schedule a nightly backup to ensure that no data is lost.

## Restoring job data

The restore utility is an executable file separate from Envision for BACTalk. The Envision for BACTalk installation creates a shortcut to the program file, `Btrestore.exe`, in the Envision for BACTalk program group. The file itself is in the `<bactalk root>\system` folder.

To use the restore utility, you must have a valid archive zip file created according to the instructions earlier in this chapter. The restore utility will only run on files created with the Envision for BACTalk backup utility.

**Note** Shut down Envision for BACTalk. You cannot restore a job with Envision running.

See the *Envision for BACTalk Installation and Startup Guide* (LTBT-TM-ADMIN26) for more information about the BACTalk Restore Utility and its restore/merge data options.

## Maintaining database files

Envision for BACTalk provides a database tool, called Compact and Repair Databases, to manage the Access database in a rep/job folder.

Operating conditions may cause database file performance to degrade over time. The Compact and Repair tool helps improve the operation of the BTAcess database.

Use this tool if:

- The database appears to cause an inordinate amount of disk activity, reading and writing from the hard drive more and more frequently.
- Compact and Repair Database appears to function unpredictably.
- The computer was shut down unexpectedly or a power outage occurred during database operation.

**About the compact and repair operation** Compact and repair operations are done in a single step. The repair operation repairs a database that was marked as possibly corrupt by an incomplete write operation, which can occur if an application is closed unexpectedly because of a power outage or computer hardware problem. The repair operation validates all system tables and indexes. Any data that can not be repaired is deleted.

Compacting your database is similar to defragmenting. It consolidates database files on the hard disk, rearranging how the files are stored so they use disk space more efficiently.

► **To compact and repair BACtalk database files**

1. Open Envision for BACtalk and perform a system backup. See “To manually back up BACtalk job data” on page 359.
2. Close Envision for BACtalk.
3. Launch Compact BACtalk Access Database from the Windows Start menu (Programs>Alerton>Envision for BACtalk>Compact BACtalk Access Database).
4. Set the Rep/Job.
5. If you want to back up the databases, select **Create a copy of the databases prior to compacting them**.
6. Click **Compact/Repair**.

This operation will apply to all .mdb files (databases) in the specified rep/job folder.

## Advanced features

Advanced features of Envision for BACtalk allow advanced users to make changes. Some of these features are disabled by default; you must edit the `bactalk.ini` file to enable them.

**CAUTION** You should have detailed knowledge of the Envision for BACtalk file structure before attempting to edit any `*.ini` file. Back up these files before you change them. Editing these files incorrectly may result in adverse system behavior such as loss of information, loss of historical data, or application errors.

## Override Points

Use the Override Points Scanner to assist with troubleshooting and maintenance tasks.

### Override Points Scanner

Scan the network and generate a list of points that are currently in override. The list includes both system- and user-defined override points. The Description column displays “<stopped>” if a user cancels the scanning process. Select a point from the list and view its properties, view which user put the selected point in override, if applicable, or print a complete list of points currently in override.

**Note** NR means the device is not responding when the scanner is attempting to gather a point description. It does not indicate that an error occurred.

### Override Point Setup

Use the Override Points Setup dialog box (Tools > Advanced > Override Points > Override Point Setup) to configure the BACtalk system to generate a list of user-defined points that are currently in override.

Add or delete an override point, select one or more points in the list and click **Copy** to define the same override point in other devices, or print a complete list of points currently in override.

You can print a list of current override points at the start of each work day to ensure that points in override get handled.

**Note** The override point list is refreshed at the client operator workstation only periodically to minimize network traffic. The default frequency is one minute. Valid values are 1-60 minutes. If an out-of-range value is specified, the closest valid value is used.

### Override Points Report Errors

This report lists the errors generated during the compilation of the override points scan. This information can be useful in troubleshooting override problems. To filter the data in the list, type a date range and press **Enter**.

## Raw editors

Raw editors allow advanced users to edit BACnet objects directly. Use caution when editing objects in raw editors.

### Schedules raw editor

BACnet schedules are stored and operated in a host device. They are also stored on your Envision for BACtalk operator workstation hard disk. The device instance of the host device appears in the Dev Inst box. Under Object Location, you can choose whether to view schedules stored at the operator workstation or in the host device.

In the Objects list of the Schedule editor (Tools > Advanced > Schedules > Add/Edit), each schedule is identified by an ID (Sched 5, for example) and a description enclosed in parenthesis. Click a schedule in the list to work with it.

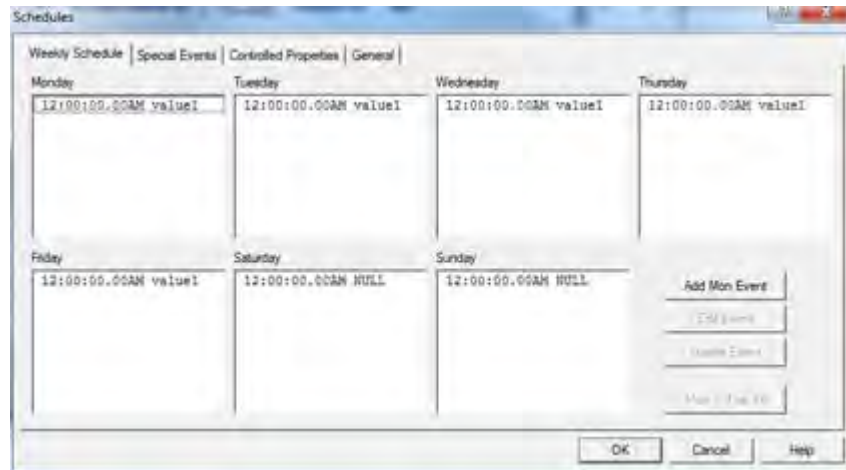


Figure 14.19 Schedules raw editor

### Calendars raw editor

Calendars store dates, date ranges, and special dates (for example, the first Saturday in March), which are used by the event portion of schedules. Calendars in BACtalk exist only to provide a list of dates for special events.

Calendars make it easy to create a generic list of dates and date ranges that all schedules can reference. Rather than editing each schedule's event dates individually, you can edit the dates in one location—the calendar—and have the event portion look up dates from the calendar.

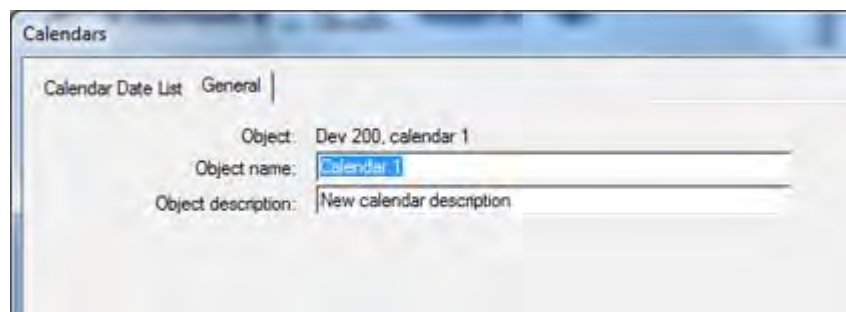


Figure 14.20

### Notification Classes raw editor

Caution! It is highly recommended that you edit notification classes by editing a log handler or alarm handler rather than directly editing a notification-class object. Only advanced system developers and integrators should edit raw objects. More than one Envision for BACTalk feature may use a notification-class object. Before you modify one, make sure you don't accidentally modify the recipients of another notification.

Notification-class objects define which devices are notified when an event-enrollment object (alarm) generates a To-offnormal, To-fault, or To-normal event. Alarm handlers are, in fact, notification-class objects. Trendlogs also use notification-class objects (log handlers) to notify an operator workstation to gather trendlog data. When you create either one, Envision for BACTalk creates notification-class objects and chooses settings based on your selection.

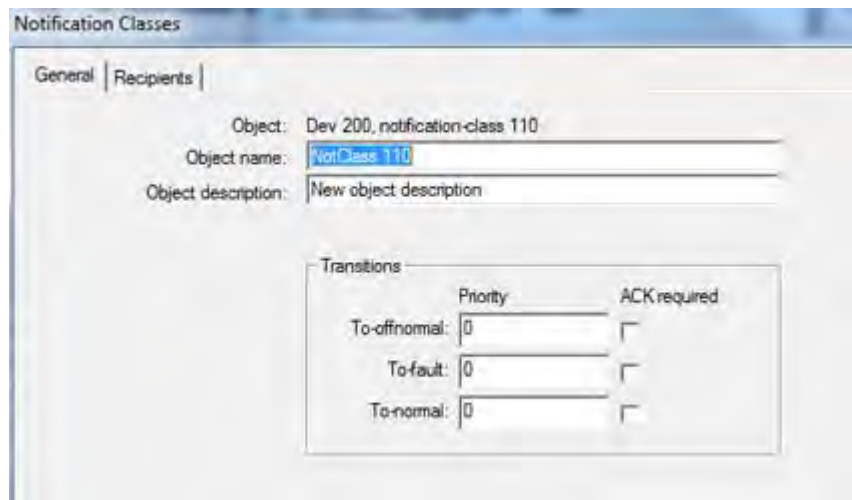


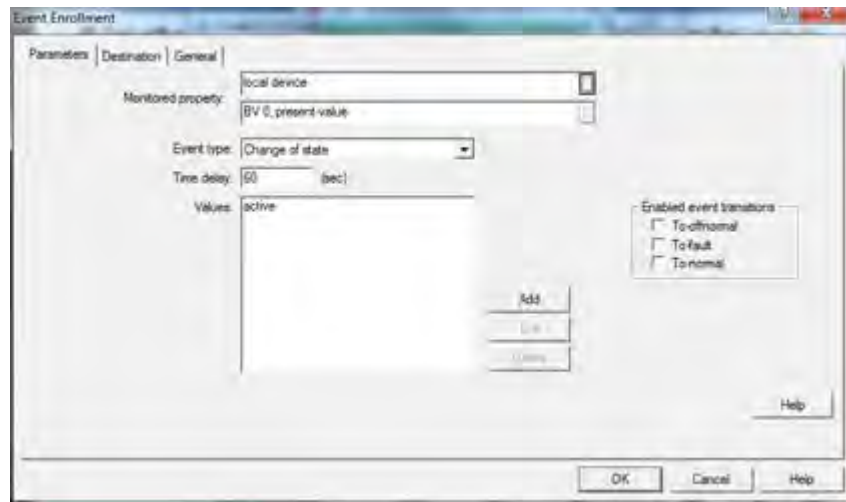
Figure 14.21 Notification Classes raw editor

### Event Enrollment (alarm) raw editor

**CAUTION** It is highly recommended that you use the Alarm Wizard or Point Alarm Setup dialog boxes to set up Envision for BACTalk alarms. Only advanced system developers should edit event-enrollment objects. Typically, editing event-enrollment objects is necessary only when integrating with other manufacturers' applications.

An event-enrollment object is the essential element of an Envision for BACTalk alarm. When you create alarms with the Alarm Wizard or through Point Alarm Setup, Envision for BACTalk creates event-enrollment objects and chooses

settings based on your selections. You can use Event Enrollment to change alarm settings or set up alarms of a type unavailable in Point Alarm Setup.

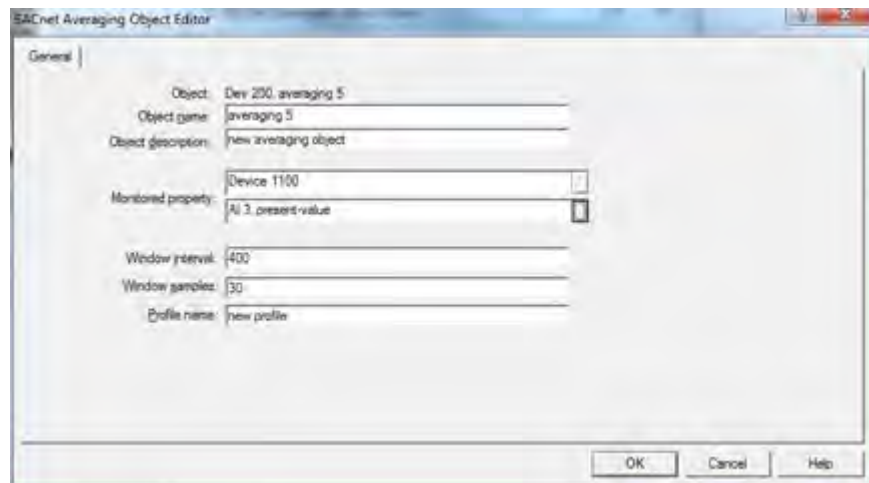


**Figure 14.22** Event Enrollment raw editor

### Averaging Objects raw editor

Averaging objects provide a way to obtain the minimum, maximum and average value of a particular BACnet property over a specified time interval.

The Averaging Objects raw editor allows advanced users to create and edit averaging objects.



**Figure 14.23** BACnet Averaging Object raw Editor

## Object Scanner

Use the Object Scanner dialog box to search the network or the Envision for BACTalk server for an object. Use the Server tab to locate objects in the current job. Use the Network tab to search for an object by name or identifier.

After the search results are displayed, you can click a column heading to sort the list in ascending or descending order.



Note The Scan Objects user privilege must be selected in your user profile to use this feature.

### **Server tab**

You can search the server for object names or descriptions using simple strings or using complex Boolean expressions. You can also specify a device range to narrow your search. The search function searches object names and descriptions.

**Simple search** Select this option to search for an object using a simple text string. Type the string in the text box, for example, AV0 or air temp. Note Simple search does not support wildcards.

**Advanced search** Select this option to search for an object using Boolean expressions and wildcard characters. Click the Edit button to enter your search strings. Your search criteria will then appear in the text box. See Edit Search Dialog Box for more information.

**Device range** Select this check box to narrow your search to a specific range of device numbers. Type the starting and ending device instances in the From and To boxes.

### **Scan button**

Click this button after entering your search criteria. As objects are found, they appear in the results list. When the scan is complete, you can click a column heading to sort the list in ascending or descending order.

### **Stop button**

Click this button to stop the scan at any time.

### **Properties button**

Click this button to display the object template for the selected object. This button is disabled if more than one item is selected.

### **Edit button**

Click this button to edit properties for the selected object. This button is disabled if different object types are selected or if the present-value property is read-only.

Notes: Setting an object's present-value may take a long time so you may click Cancel to stop the process, if necessary. Operator activity is logged if present-value is modified.

### **Network tab**

You can search the network for an object by name or identifier. For example, you can search for devices that contain an object named "OA Temp." You can also specify a device range to limit your search.

Important! You must type the object search string exactly or no objects will be found. For example, you cannot use wildcard or partial object names.

**By object name** Select this option to search for objects with the name you type in the text box. The object name can be any text string. If you use the object name as your search criteria, you must also specify a character set the device will recognize. ANSI X3.4 is selected by default. You can select ISO 8859-1 if appropriate.

**By object identifier** Select this option to search for objects that have the object type and object instance you enter in the text box. For example, event-enrollment-5.

**Device range** Select this check box to narrow your search to a specific range of device numbers. Type the starting and ending device instances in the From and To boxes.

### **Scan button**

Click this button after entering your search criteria. As objects are found, they are shown in the results list. When the scan is complete, you can click a column heading to sort the list in ascending or descending order.

### **Stop button**

Click this button to stop the scan at any time.

### **Properties button**

Click this button to display the object template for the selected object. This button is disabled if more than one item is selected.

### **Edit button**

Click this button to edit properties for the selected object. This button is disabled if different object types are selected or if the present-value property is read-only.

**Note** Setting an object's present-value may take a long time. Click **Cancel** to stop the process if necessary. Operator activity is logged if present-value is modified.

## Event Notification Monitor

The Event Notification Monitor is a real-time list of BACnet events received by the workstation it is running on. It records every BACnet event for the workstation. This feature is disabled by default because it can become resource intensive in some environments.

**IMPORTANT!** In a job with large numbers of BACnet events being generated per second, enabling the Event Notification Monitor may degrade the performance of the Envision for BACtalk server. Use this feature with care.

The Event Notification Monitor will display the following data for each standard BACnet event:

- Event time
- Event type
- Notification type
- Initiating object (device, object type, instance)
- Indication of whether the event is confirmed or unconfirmed
- Message text (if present)
- Notification class
- Priority
- Event state (To State)
- Indication whether ack is required
- Event parameters for alarm and event notification types, these vary according to the event type.

**Note** This feature is similar to the User Request Monitor in that you can copy data from the viewer and then paste it elsewhere.

### **Enabling Event Notification Monitor**

In order to enable this feature, you need to edit the **bactalk.ini** file. You should have detailed knowledge of the Envision for BACTalk file structure before attempting to edit any \*.ini file. Back up these files before you change them. Editing these files incorrectly may result in adverse system behavior such as loss of information, loss of historical data, or application errors.

► **To enable the Event Notification Monitor**

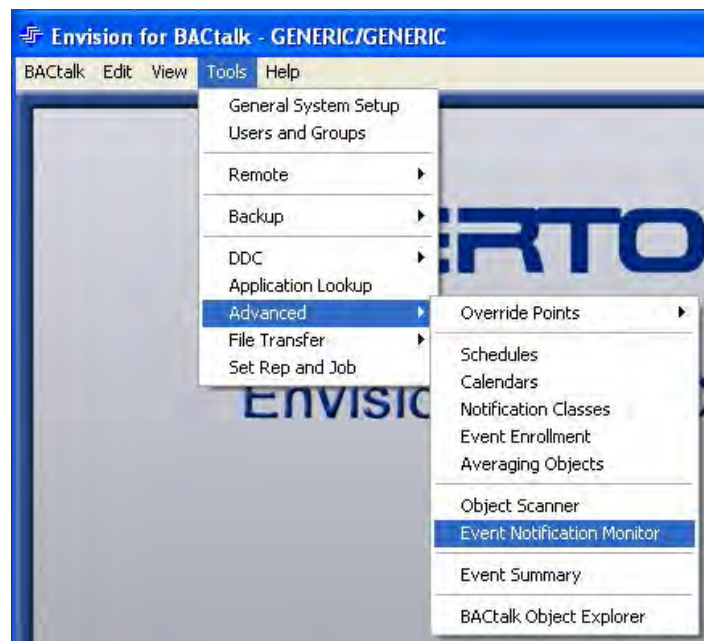
1. On the server, locate and open the bactalk.ini file using Notepad or another text editor.
2. Go to the [BACTalk] section.
3. Anywhere in the [BACTalk] section, enter a new line and then type **EventNotificationMonitor=Y**
4. Save and close the file.
5. Restart the Envision for BACTalk server.

**Accessing the Event Notification Monitor**

After you have enabled this feature, a new menu item will allow you access to the viewer.

► **To access the Event Notification Monitor**

- Click **Tools >Advanced > Event Notification Monitor**.



**Note** The data buffer will continue to log information even if the Event Notification Monitor window is closed.

## Event Summary

Use the Event Summary dialog box to query and view a list of events for a specific device or all devices. You can select from several different filters to refine your search.

**Note** This feature is available only to users with the View enrollment summary user privilege selected in their user profile.

**Acknowledged**

Use this filter to find only those events that either have been acknowledged or have not been acknowledged.

**Recipient address**

Use this filter to find only those events that a specified recipient and process ID can receive.

**Event state**

Use this filter to find only those events in a particular state: Normal, Fault, or Off-Normal. Select Active to find only those events with a value other than Normal. Select All to find all events.

**Event type**

Use this filter to find only a specific event type. Possible values include, change-of-bitstring, change-of-state, change-of-value, command-failure, floating-limit, out-of-range, complex-event-type, buffer-ready, and change-of-life-safety.

**Priority**

Use this filter to find only those events within the specified priority property value range (0 to 255).

**Notification class**

Use this filter to only find those events with the specified notification class.

**Print**

Use this button to print the displayed list of events to a specified Windows printer.

## BACtalk Object Explorer

The BACtalk Object Explorer is a general purpose viewer and editor for any standard property of any standard BACnet or Alerton object on any BACnet device listed in Device Manager. Use this powerful tool to quickly and easily view or change values for BACnet or Alerton object properties.

**Important considerations**

Used incorrectly, this tool can degrade system performance. Consider these points before you begin:

- Verify your inputs, because there may not be any validation for the values you change. If you input the wrong values, you may get a device error message, it may revert back to a previous value, ignore your input all together, or reset the device.
- It is possible to make a change to an object that is unreadable to the editors, such as the schedule editor. For example, suppose you use the editor to create a schedule for an ON-event at 8AM and an OFF-event at 5PM. Then, you create some extra ON-events during the day using

BACtalk Object Explorer. The Envision for BACtalk schedule editor will not be able to open the modified schedule.

- There can be a discrepancy between the trendlog definition in the database versus new values you enter through the BACtalk Object Explorer. Thus, the trendlogs can seem to be out of sync with what you set in the BACtalk Object Explorer. For example, suppose you have set a sampling rate of every five minutes in the trendlog editor. Then you change that to every three seconds in the BACtalk Object Explorer. The object will sample every three seconds, but the trendlog will indicate that you were sampling every five minutes. The trendlog's setup definition will therefore be inaccurate.

**Note** Save from the device to the hard drive in Device Manager to ensure that Envision for BACtalk and the device are in sync.

- If you change a property in a trendlog object and save it to the device, the entire trendlog definition will be written to the device. This will override any other property changes you may have made in the BACtalk Object Explorer.

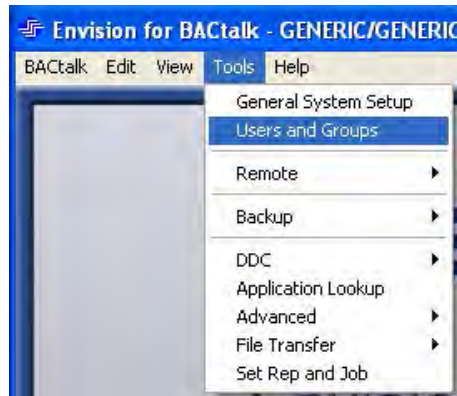
### Enabling the BACtalk Object Explorer

**CAUTION** To enable this feature, you need to edit the `bactalk.ini` file. You should have detailed knowledge of the Envision for BACtalk file structure before attempting to edit any `*.ini` file. Back up these files before you change them. Editing these files incorrectly may result in adverse system behavior, such as loss of information, loss of historical data, or application errors.

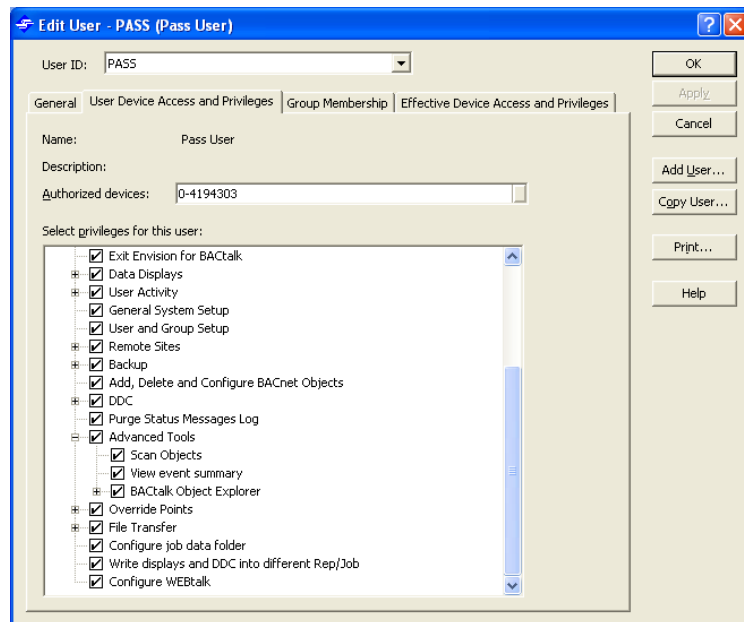
#### ► To enable the BACtalk Object Explorer

1. Locate and open the `bactalk.ini` file using Notepad or another text editor.
2. Go to the `[UsersAndGroups]` section, or create this section if it does not already exist.
3. Enter a new line, and then type: **DisplayBOE=Y**
4. Save and close the file.
5. Restart the BACtalk server.
6. Open Envision for BACtalk.

- Click **Tools > Users and Groups**.



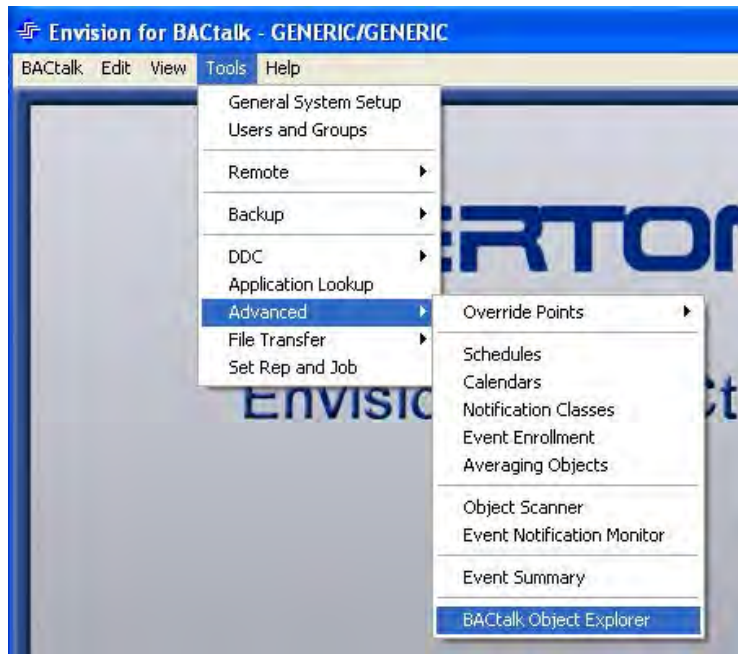
- From the **User** tab, select a user and then click **Edit**.
- Click **User Device Access and Privileges**.
- Open the privileges tree.
- Open the **Advanced Tools** node.
- Find the **BACtalk Object Explorer** node.



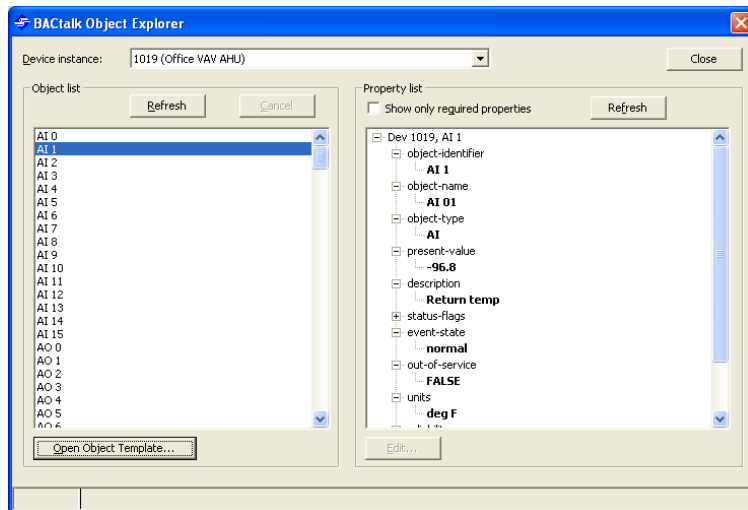
**Note** If this node does not appear, go back to step 1 above, and ensure that you have followed the .ini instructions correctly.

- Select **View objects in BACtalk Object Explorer**, and if appropriate, select **Edit objects in BACtalk Object Explorer**.
- Repeat this process for every user and group that needs to use this feature.
- Click **OK**.

16. Click **Tools > Advanced > BACtalk Object Explorer**.



The BACtalk Object Explorer appears.



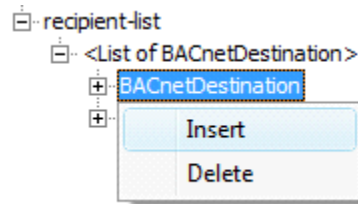
**Note** If you click **Refresh**, it may take up to one minute to repopulate the values.



## Working with BACtalk Object Explorer

The BACtalk Object Explorer is fairly self explanatory for someone familiar with a BACnet environment. However, these tips may be helpful:

- All editable values appear in bold. If edit rights are enabled, and if you select these bold fields, the **Edit** button will be enabled. Click **Edit** to make any changes.
- You can also insert or delete a list or an array element. Right-click the appropriate node in the tree, and then click **Insert** or **Delete**.





# Glossary

## A

**ABS** Alerton Building Suite. The umbrella name for the software package that includes Envision for BACtalk, WEBtalk VM, and BACtalk Builder. All three software applications are included on the ABS DVD. Envision for BACtalk runs as an application on the host operating system.

**advance time** The amount of time prior to occupancy that equipment will start in order to condition a space for occupancy. For example, if a space is scheduled to be occupied at 8:00 AM, and equipment starts at 7:30 AM, advance time is 30 minutes.

**after-hours activity** Activity in a zone or space that is outside of normally scheduled hours of operation. After-hours activity is usually initiated by a *tenant override*.

**alarm handler** A software object that saves references to alarm recipients, governing the devices and the actions that the devices take on alarm receipt. The alarm handler determines what operator workstations, pagers, and remote sites are notified when an alarm occurs. Alarm handlers are known as *notification-class objects* in BACnet.

**alarm setup** A software object that saves references to the monitored point and alarm parameters to generate an alarm. Alarm setups are saved to global controllers and building controllers, and use *alarm handlers* to distribute alarm notifications. The alarm setup is technically known as an *event-enrollment object* in BACnet.

**anticipation factor** A factor used to shorten the *demand window* and calculate *average demand*. This is used for faster reaction time. For example, with a *demand window* of 15 minutes and an anticipation factor of 3, average demand is calculated using a 5-minute rolling average (15/3).

**anticycle limits** Minimum on and off times designed to prevent equipment from short cycling, or turning on and off in rapid succession, which can be damaging.

**average demand** The average demand for energy or material, calculated as a rolling average over a given time period, called the *demand window*. To calculate a rolling average of demand, take the sum of the most recent meter inputs over a time period and then divide by the number of samples in that time period. Recalculate each time you take a sample.

## B

**BACtalk** Alerton's BACnet-compliant building automation system. A BACtalk system comprises Envision for BACtalk operator workstations, global controllers, building controllers, and sensors and actuators.

**billing adjustments** A seasonal multiplier or a surcharge amount to be added to a tenant bill.

**billing rate** The amount per hour a tenant is charged for *after-hours activity*.

**billing rules** The portion of a *tenant profile* that determines how a tenant will be billed. Billing rules consist of the minimum amount of time that a zone must be in override mode before the tenant is billed for *after-hours activity*, the minimum amount of time the tenant is billed for when an after-hours activity “qualifies” as an override event, and the maximum amount of time a tenant will be charged for a single override event.

**buffer size** The size of the memory buffer in a global controller serving as a trendlog host. After the host controller gets trend samples, it stores them in a memory buffer until the trend samples can be sent to an Envision for BACtalk server. You specify the buffer size when you set up the trendlog.

**building controller** An intelligent BACnet programmable device that works with the components at the management level to implement control strategies for an entire facility or multiple sites.

**building mass** A value used in optimum start calculations to indicate the relative mass of a building. You can set building mass equal to 3, 4, or 5. Larger numbers correspond to greater interior building mass (including heavy bookcases, thick walls, glass walls, and lots of oversized office equipment), increasing the effect of zone temperature within the equation. Smaller numbers correspond to lesser interior building mass, increasing the effect of outside air temperature within the equation.

## C

**client, Envision for BACtalk** Any operator workstation in a BACtalk system that is not the *Envision for BACtalk server*.

**command fail alarm** An alarm that compares one binary status to another and alarms when they do not match.

**command priority** The priority used to write a command to the present-value property of an object. This is technically known as a *priority-array index* in BACnet. Valid index values are 1-16. Lower numbers have higher priority.

**communications alarm** An alarm that the BACtalk system automatically generates if a controller goes off-line.

**companion log** A trendlog data set that is viewed side-by-side with a primary trendlog data set.

**consumption meter** A meter that outputs a running total of how much energy or material has been used, for example kWh, Btu, or gallons. Usually, consumption meters output pulses.

**control input** A referenced data point that enables you to define two sets of shed and restore ramps. When the control input is ON, one set is active; when the control input is OFF, the other set is active.

**control ramp** An abstraction used to control load shedding and restoring for demand limiting. The ramp goes from 0-100 in response to many factors. At 0, no loads are affected. At 100, all loads are affected. The control ramp can be thought of as a percentage.

**conversion factor** A scaling factor that converts an input unit to a demand unit.

**cooldown command** The *data point* that optimum start writes to when the system calls for cooling in preparation for scheduled occupancy.

**cooldown factor** A number that optimum start calculates automatically and is used in an equation to adjust advance time based on how well a space was cooled prior to the last scheduled occupancy.

**cooling setpoint** The temperature at which a space or zone requires cooling to remain comfortable. This is the temperature you want the zone cooled to by the next scheduled occupancy. Typically, this is set to a data point that represents the zone's occupied cooling setpoint. Alternately, this may be set to a data value.

## D

**dashboard** The Alerton energy dashboard is a web server that runs on the same computer as Envision for BACtalk and can be viewed from any computer that can be connected to the specified HTTP port (default 80) of the computer where Envision for BACtalk is installed.

**Dashboard Editor** An application that helps users create, change, and manage dashboards. It is installed as part of Envision for BACtalk and requires a separate license to activate.

**data point** Any reference to usable, discrete data in a control system. Data points can be inputs (feedback) or outputs (commands). For example, setpoints and temperature readings are data points, so are fan and pump commands. In a BACnet system, data points are represented in terms of property, object, and device instance.

**deadband** A widely used term used to indicate a range within which no action is taken. For example, when controlling a space temperature, the deadband refers to the temperature range requiring no equipment operation to condition the space, typically a few degrees F. Alarms in BACtalk also have a deadband value, which is added to the low limit equation and subtracted from the high limit equation.

**delay** The amount of time (in seconds) that the monitored property must be in an alarm condition before an alarm is generated.

**demand limiter** An Envision for BACtalk feature that enables you to monitor energy demand at meter inputs and then automatically adjust equipment operation to limit the demand and reduce costs

**demand limiting program** A site-wide initiative to limit energy demand, which may comprise any number of measures, including a BACtalk demand limiter.

**demand meter** A meter that outputs *instantaneous demand*, or the rate at which energy is being used, for example, kW or Btu/h. Usually, demand meters output a current or voltage signal: 4-20 mA or 0-5 VDC.

**demand offset** A demand offset is a value that is added to or subtracted from a setpoint to spread the setpoint—that is, to widen the deadband and reduce the need for equipment operation.

**demand threshold** An energy demand level you assign that, when reached, tells the demand limiter to begin adjusting equipment operation (shedding loads) to limit energy demand.

**demand window** A period of time over which demand is averaged to calculate average demand for a sample period.

**device instance** A unique numeric identifier for a controller in a BACnet system.

## E

**email alarm** BACtalk alarm notification sent through from a workstation on the local job to a legitimate email account anywhere in the world.

**energy** Power used to operate equipment. Utility companies charge customers for the amount of energy they consume and may also track the amount required at a given time (demand).

**energy index calculation** A widely recognized method for normalizing energy use into common units. This enables you to compare energy use in different buildings or spaces. For index calculations, total energy use for a month or year is divided by the square footage to yield energy use per square foot.

**energy log** An historical record of energy demand and consumption based on a trendlog of meter data. Energy can be logged by day, week, month or year.

**Enhanced Trendlog Viewer** Enhanced Trendlog Viewer extends Envision for BACtalk's built-in trendlog viewing functionality. It helps you troubleshoot the behavior of a building control system and allows you to see how data from one trendlog relates to other trendlog data. It shows data from as many as ten trendlogs on an interactive line graph.

**Envision for BACtalk** A powerful, easy-to-use, graphical workstation software program that allows users to view, monitor, and control all levels of a building management system. Envision for BACtalk gives your customers complete control to manage individual or multiple sites throughout the world. One of the software applications offered as part of the Alerton Building Suite (ABS) software package. Runs as an application on the host operating system.

**event-enrollment object** *See alarm setup.*

**event schedule** One of the three schedules in a schedule set. The event schedule has time blocks only for events with a limited duration. The event schedule overrides the *standard schedule* and the *holiday schedule*.

## F

**fault alarm** An alarm state related to the reliability property of BACnet objects, occurring when the reliability property of a monitored object is other than No Fault Detected. Envision for BACtalk does not currently support fault alarms.

**field controller** Native BACnet logic controllers that support a range of applications to control equipment such as air handling units, terminal units such as VAV boxes, heat pumps, and air conditioning units.

**fixed-limit alarms** An alarm that occurs when an analog value is above or below fixed high and low limits.

**floating-limit alarms** An alarm that occurs when an analog value varies from a setpoint value by a certain amount.

## G

**global controller** An intelligent BACnet programmable device that works with the components at the management level to orchestrate control strategies among different field controllers, networks, and systems.

## H

**heating setpoint** The data point that provides the target heating setpoint for this zone. This is the temperature at which equipment needs to warm the space to keep it at a comfortable temperature.

**high-limit alarm** A value used in fixed limit analog alarms. Establishes the value the referenced property must exceed for an alarm to occur.

**high-limit offset** A value used in floating limit alarms. This value establishes the amount above setpoint that the referenced property must be for an alarm to occur. For example, if the high-limit offset is set to 4, and the setpoint is equal to 72, an alarm occurs when the referenced property is greater than 76 ( $72 + 4$ ).

**holiday schedule** One of the three schedules in a schedule set. A holiday schedule overrides the *standard schedule* and is overridden by the *event schedule* for specific time blocks. Holiday schedules always begin with an initial OFF command at 12:00 AM on a day. They can also contain any number of ON events throughout the holiday.

**host device** A BACtalk device that saves and runs Envision for BACtalk software features and components. Usually, host devices are *global controllers* or *building controllers*.

## I

**instantaneous demand** The current sample of power demand as read from a *demand meter* or extrapolated from two successive *consumption meter* readings.

## J, K, L

**load** In demand limiting, any equipment or process with a control reference that uses the energy or material being limited.

**load lockout** A term used to describe a control point that prevents operation of a load (and its restarting) under certain circumstances, such as when a demand limiter sheds the load.

**load restoring** The act of adjusting equipment operation back to normal operation after it has been shed.

**load shedding** The act of adjusting equipment operation or command parameters to limit energy demand.

**logged property** A data point whose value you want to track using a trendlog.

**log handler** A software object (in BACnet, technically known as a notification-class object) that handles sending trendlog samples to the *Envision for BACtalk server*.

**low-limit offset** A value used in floating limit alarms. This value establishes the amount below setpoint that the referenced property must be for an alarm to

occur. For example, if the low limit offset is set to 2, and the setpoint is equal to 72, an alarm occurs when the referenced property is less than 70 (72 - 2).

## M

**maximum advance** The greatest *advance time* that optimum start is allowed.

**meter/meter input** A device that registers the amount of energy or material being used. *See also demand meter, consumption meter.*

**monitored point** A status or value that an alarm watches for an alarm state.

**multistate object support** Allows you to enable multistate objects for a zone device, such as a fan which can be set to low, medium, high or off. Then, you can define the points to write to and the values to write for each state that the zone device supports.

## N

**normal alarm** Indicates that the referenced property returned from off-normal to normal status. A property must return to normal before it can alarm, so this selection does not appear in the alarm setup and is always enabled.

**notification-class object** *See alarm handler, log handler.*

**notification threshold** The number of samples taken for a trendlog at which the *host device* sends notification to the *operator workstation* to gather the sampled data. This value should be significantly less than the *buffer size* to minimize the possibility of data loss.

## O

**object** *See data point.*

**occupied command reference** A data point in a zone controller that indicates whether the zone is occupied or unoccupied.

**off-normal alarm** The most common alarm state. An off normal alarm indicates that the monitored point does not conform to the alarm parameters set up for it. For example, the present-value of an AV is out of range or a BV has changed state.

**optimum start** An intelligent, self-correcting feature that automatically calculates how early to begin warmup or cooldown before a scheduled start time.

**out-of-service property** For BACnet objects that support the *priority-array* property, the out-of-service property controls the relationship of the present-value to the priority array. When out-of-service = TRUE, the present value is decoupled from its priority-array, and the value is the result only of DDC execution.

**override event** Any system event (usually, a data point turning ON) that indicates a tenant override in a zone that initiates *after-hours activity*.

## P, Q

**pager ID** A unique identifier for a pager, which the pager company uses to identify a specific pager after a call connects to the pager modem.



**peak demand** The highest demand for any given period. Peak demand is based on the highest average peak demand for the *demand window* interval.

**priority-array** BACnet uses a priority-array property to control the present-value of objects that support it. Not all objects support the priority array. Every command written to a present-value property has a command priority from 1-16 associated with it. Priority 1 is the highest and priority 16 is the lowest. The command with the highest priority affects the present-value. Lower priority commands are ignored. See the *BACtalk Systems Programmer's Guide and Reference* for more information. See also *relinquish default, out of service*.

**priority-array index** The priority level for writing a command to the present-value of objects that support the priority array property. See *command priority*.

**process ID** A BACnet mechanism by which a number is sent to a controller, which the controller then interprets into an action. When you set up a BACtalk controller or operator workstation as the recipient of an alarm, Envision for BACtalk automatically assigns process IDs based on the recipient type and the actions you specify.

**property** See *data point*.

**property manager** The billing party whose name will appear on all bills you generate.

## R

**recipient profiles** A setup for an alarm recipient that indicates where the alarm should go and what should be done with it by the intended recipient. Each recipient profile determines the type of alarm the recipient accepts and the actions the recipient carries out.

**refresh rate** With respect to zones, the refresh rate determines how frequently, in seconds, that Envision for BACtalk polls the field controller for data about this zone (space temperature, outside air temperature, target heating and cooling setpoints, and humidity, if defined). Data is refreshed at least every 15 minutes by default. Users can set this rate anywhere between 10 and 900 seconds.

**relinquish default** Default value to be used for present-value property when all command priorities are NULL.

**restore** See *load restoring*.

**restore command** The command the demand limiter writes to when a load is restored. The restore command is typically NULL, returning equipment control to other processes.

## S

**schedule set** A standard schedule, a holiday schedule, and an event schedule that work in combination.

**seasonal multiplier** A number used in tenant activity to adjust tenant bills for seasonally variant costs, such as the cost of a kilowatt hour of electrical energy, which may be more expensive during peak seasons. The seasonal multiplier is only applied when computing the billing amount and is listed on the bill itself. The subtotal is multiplied by the seasonal multiplier.

**self-tuning factor** A factor that optimum start uses to control how aggressively it adjusts based on previous warmup and cooldown efforts. Range is 0.0 to 1.0. 1.0 is most aggressive. 0.1 is least aggressive. 0 disables adjustment. Adjusting the self-tuning factor rather than warmup and cooldown factors directly is recommended.

**server, Envision for BACtalk** The operator workstation that stores core database files and records in a BACtalk system. *Client* operator workstations reference the server.

**setpoint spreading** A term that refers to adjusting heating setpoints downward and cooling setpoints upward to increase the deadband, limiting equipment operation and demands for energy.

**shed** See *load shedding*.

**shed command** The command the demand limiter writes when a load is shed.

**slack time** When working with trendlogs, the amount of time that the server can be offline before the oldest samples in the trendlog are deleted. If slack time is exceeded, gaps in trendlog data appear.

**specific gravity** The density of a substance divided by the density of water.

**specific heat** The amount of heat, measured in Btus, required to raise the temperature of a given mass (typically one pound) of any substance one degree Fahrenheit.

**standard schedule** One of the three schedules in a schedule set, used to control equipment with ON and OFF commands during routine hours of operation. This schedule may contain ON commands for operating hours or an all day ON command. The standard schedule is overridden by the holiday schedule and the event schedule.

**surcharge** A fixed cost in tenant activity, which is added to the bill and is not dependent on a tenant's after-hours activity. A surcharge may be a monthly processing fee, a late payment penalty, or a credit to the customer. Use a negative number to apply a credit to the customer's bill. The surcharge is applied after the seasonal multiplier.

## T

**tenant activity log** A list of all after-hours activity for each tenant. A tenant activity log can be viewed and modified before billing.

**tenant profile** For tenant activity, the contact and billing information for a tenant, and a list of the zones the tenant occupies.

**terminal unit controller** See *field controller*.

**trend interval** The interval at which a host device gathers information from, or "polls" a device for trendlog data.

**trendlog** An historical record of a data point value, which can be used to monitor and verify system activity, identify critical operating trends, or troubleshoot. BACtalk trendlogs sample data values from any data point at a regular interval.

## U, V, W

**warmup command** The data point that optimum start writes to when heating is called for in preparation for scheduled occupancy. Envision for BACtalk assumes heating is required when the zone temperature is less than the target heating setpoint. If a data point is not specified (None is selected), optimum start will not warm up the zone by occupancy.

**warmup factor** A number that optimum start calculates automatically and is used in an equation to adjust advance time based on how well a space was warmed prior to the last scheduled occupancy.

**window size** See *demand window*.

**WEBtalk VM** Allows the WEBtalk application to run in a virtual environment.

## X, Y, Z

**zone** Space inside of a building that is set up to be monitored and controlled by a BACtalk global controller.



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**HSD Vocational Tech**  
**Building M & E Upgrades**  
Operations and Maintenance Manual

---

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Record Drawing Set  
9/22/2015

CONTROL DIAGRAMS FOR:

# HSD Vocational Tech Building M & E Upgrades

## Haines, AK

**Controls Contractor**

**ATS Alaska**

PM: Robby Bray

ENGINEER: Robby Bray

TECHNICIAN: Robby Bray

907-868-5100

**Architect:**

**Consulting Engineer:**

Murray & Assoc.

Doug Murray

907-780-6151

**Prime Contractor:**

Premier Electric

Steve Linden

907-745-4200

**(Contract With)**

Premier Electric

Steve Linden

907-745-4200

HSD Vocational Tech		JOB# 3115003
SALESMAN: JN	DRAWN BY: RB	DATE: 9/22/2015
ENGINEER: RB	APPROVED BY: JR	REV: Record Drawing Set
ATS Alaska		
139 East 51st Ave, Suite 100 Anchorage, Alaska 99503 907-868-5100		
TITLE SHEET		SHT#: 1.000

## Installation Guidelines

### Installation Notes and Guidelines:

1. Thermostat installation:
  - a. Verify thermostat location and height as specified on most recent set of mechanical plans.
  - b. Use rough-in box in lieu of mud ring.
  - c. For thermostat located on exterior walls, or on interior columns/walls subject to infiltration, verify/add insulation behind sensor. Install and insulate wire mold 2347 shallow device box single gang as required for thermostat sub-base.
  - d. Verify thermostat height before any work begins.
  - e. On new construction or TI. Work locate thermostat as per most current mechanical drawing set. See mechanical on job site. For retrofit – use control drawings as guide.
  - f. Contact ATS Alaska with any height and/or location conflict. No field changes to be made without proper approval.
2. Outdoor temperature sensor installation:
  - a. Install outdoor housing on north side of building. Mount housing so unit can be serviced with a 6' ladder. Locate housing away from exhaust louvers or objects that can influence outdoor temperature.
  - b. Contact ATS with any height and/or location conflict. No field changes to be made without proper approval.
3. Outdoor immersion well installation:
  - a. Use Silicon Seal as required and drill drain holes in bottom of sensor housing.
4. Photocell installation:
  - a. Locate photocell on roof in face up position. Use Silicon Seal as required and drill drain holes in bottom of photocell housing.
5. Outdoor static reference:
  - a. Install outdoor housing and seal outdoor tubing wall penetration.
  - b. Mount housing so unit can be serviced with a 6' ladder. Locate housing as per control drawings. Contact ATS with any height and/or location conflict. No field changes to be made without proper approval.
  - c. Use A-306 for outdoor reference when using same or near level indoor reference. Mount at 45 deg. See 1.031 Installation Guidelines.dwg
  - d. Evaluate the building with mechanical project manager and determine if approval from architect is required for outdoor housing location.
6. Indoor static reference:
  - a. Use Housing supplied by ATS; RPS, RPS-W, microtouch housing or Leviton louver plate for wall mount installations. See 1.031 Installation Guidelines.dwg.
  - b. Locate reference as per control drawings. Contact ATS with any location conflict. No field changes to be made without proper approval.
7. Under floor cable runs:
  - a. Support wire as required to guard against movement from supply fan air flow.
8. Mount all control panels. Assemble the transformer panels.
9. Assemble the transformer panels.
10. Provide a 6"x6" gutter above control panels in mechanical/electrical rooms, where applicable. This is to facilitate the use of panel knockouts in the control panel and to provide a space for spare wires.
11. Provide all wire, cable, electrical hardware: conduit, fittings, boxes etc.
12. Tube VAV box airflow sensors to individual controller. 1/4" Fire Rated tubing is required.
13. Permanently label all cables at both ends.
14. Dedicated 120vac power required for control circuits. Provide 24vac power to trunk devices except where factory mounted transformers are provided.
15. Dedicated 120vac circuit required for each global controller. Global controller panel requires a solid earth ground.
16. Wiring shall be installed in conduit when routed through inaccessible areas or in mechanical/electrical spaces as per national and local electrical codes. Use plenum rated cable when conduit is not required. Use cable rated for wet location in all underground race way. When pulling 10 Base T (twisted pair) CAT 5 wire, ensure that pull boxes are placed every 100 feet or where (2) 90 degree bends have been placed. This requirement is to ensure that no more than 25 lbs of pulling force is used when pulling wire.
17. Terminate the trunk communication shield wire to the same earth ground as the global controller. As the wire is pulled from controller to controller, tie the shields together – Do Not Ground Communication Shields at the controller! The continuous shield wire should only be connected at the ground lug at the Global Controller panel. Input shields must be grounded only at the Controller.
18. Keep polarity consistent on all 24VAC power circuits, LAN and Trunk communication lines. Black wire to (+), white wire to (-). Transformer secondary 24vac to be grounded on one side for all LAN or Trunk unitary controllers.
19. No "star" configurations for communication wiring. Use "daisy chain" method of wiring from one controller to another.
20. No splices in communications trunk/segment wiring.
21. No splices in other wiring without prior approval from ATS.
22. Run all cable with building lines and adequately supported as per national and local electrical codes. All wiring and panel installations to be installed in a neat and workmanlike manner.
23. All Ethernet wiring (10BaseT [CAT-5], and 10Base2 [Coaxial]) must be installed in its own conduit. MS/TP and Modbus are allowed in the same conduit with Ethernet.
  - a. No exceptions for spaces that are completely installed in conduit.
  - b. Exception is on the case of a 6 foot or Less conduit stub up from controller enclosure to open ceiling wiring or a wall stub through.
  - c. All communication conduit will cross high voltage (220 VAC or Greater) conduit at 90° when possible.
24. Make sure no wires carrying ac voltage are run in the same raceway (conduits, trays, panels, J-boxes, gutters, etc.) with Ethernet. Make sure no AC voltages greater than 30VAC share the same conduit with MS/TP or Modbus.
25. No wiring or devices from other trades to share the same raceway (conduits, trays, panels, J-boxes, gutters, etc.) with ATS devices or ATS control wiring.
26. Bactalk Wiring Limits: Max distance between VLC: 1250 feet. Total length of MS/TP max 4000 feet without repeater. Maximum distance between BTI's:
  - a. 10 Base 2 (thin coaxial cable) R658A: 984 feet without repeater.
  - b. 10 Base 2 (thin coaxial cable) R658A: 607 feet with repeater, min 1.5'.
  - c. 10 Base T (twisted pair) CAT 5: 328 feet.
27. Poly tubing of pressure sensors and Copper tubing of differential pressure switches are to be in the scope of ATS Alaska subcontractors work.

### WIRE TABLE

The following schedule lists wire tagging used on these drawings to indicate the type of cable to be installed and terminated:

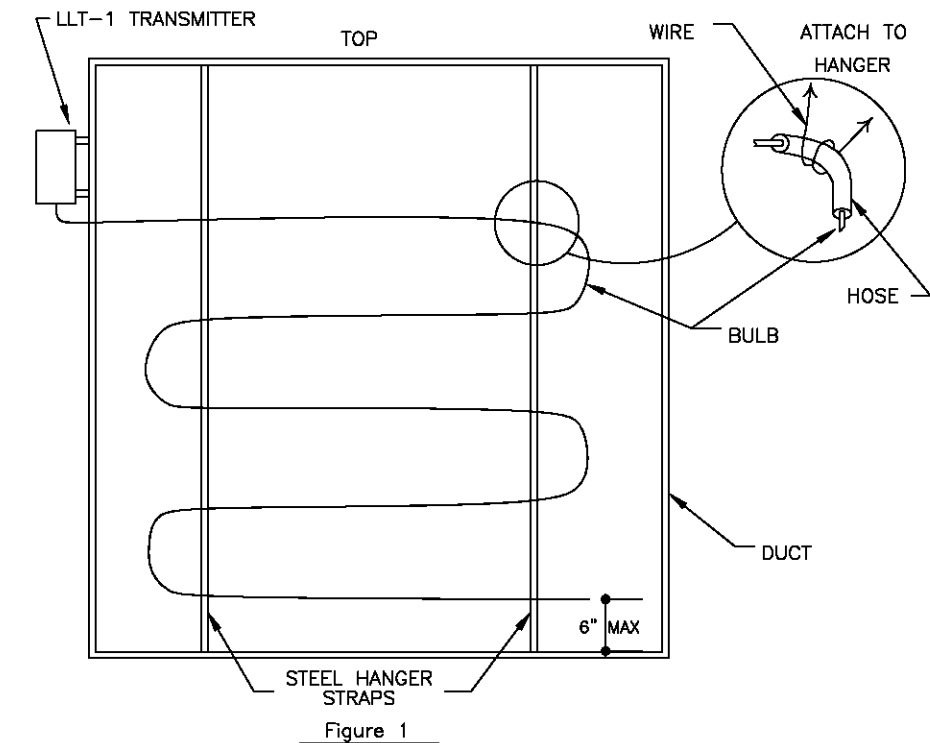
Wire Tag	AWG	Conductors	Shield	NEC Type	Typical Applications	MFG or Supplier & P/N	Jacket Color
PWR	18	2	NO	MPR/CMR or MPP/CMP	24VAC POWER	W181P-2051PRB	PURPLE
NET	24	4PR	NO	MPR/CMR or MPP/CMP	CAT5 5(E) 2 WIRE LAN	W244P-2175B	BLUE
MSTP	18	2	YES	Article 725 Type CL3P	MS/TP TRUNK WIRE	W181P-20400R	ORANGE
2DN	18	2	YES	Article 725 Type CL3P	VFD NETWORK WIRE	W181P-2540	MINT GREEN
MS	18	3	YES	Article 800 Type CMP	MICROSET II	W183C-2058	WHITE
2CS	18	2	YES	Article 725 Type CL3P	INPUT (2 CONDUCTOR)	W181P-2040Y	YELLOW
3CS	18	3	YES	Article 800 Type CMP	INPUT (3 CONDUCTOR)	W183C-2058Y	YELLOW
2BS	18	2	YES	Article 725 Type CL3P	BINARY OUTPUT (2 COND)	W181P-2040BL	BLUE
3BS	18	3	YES	Article 800 Type CMP	BINARY OUTPUT (3 COND)	W183C-2058BL	BLUE
4BS	18	4	YES	Article 800 Type CMP	BINARY OUTPUT (4 COND)	W184C-2059BLRB	BLUE
8PS	18	8	YES	Article 800 Type CMP	PHOENIX VALVE (8 COND)	W188C-2030	WHITE
2AS	18	2	YES	Article 725 Type CL3P	ANALOG OUTPUT (2 COND)	W181P-2040TAN	BROWN
3AS	18	3	YES	Article 800 Type CMP	ANALOG OUTPUT (3 COND)	W183C-2058TAN	BROWN

**LLT-1 Mounting and Installation General (Figure 1)**

1. Install the device per the manufacturer's installation instructions using the following guidelines:
2. Locate the sensing element on the downstream side of the heating coil. If no heating coil is present, locate the sensing element on the downstream side of the cooling coil.
3. Locate the case and bellows where the ambient temperature will always be warmer than the set point.
4. Install the thermostat so that the reset button is readily accessible and the element bellows points down.
5. Install as much of the bulb as possible in a horizontal plane. If too much of the bulb is vertical, it will not operate properly.
6. Caution - Mount bulb securely so it is not damaged by vibration. Make sure screws will not penetrate coil fins or tubing!

**Large Walk in Ducts (Figure 1):**

1. Drill a hole in the side of the duct. Install grommet to protect bulb. With the bulb still coiled, thread the bulb through the hole using a rotary movement.
2. Mount the thermostat case per guidelines #2-#4 above.
3. Mount perforated steel strap hangers, if used, inside the duct with the wide part of the hanger strap parallel to the air flow.
4. Mount the bulb in a horizontal, serpentine manner, attaching the bulb to the strap as shown on figure 1 of Installation Guideline Drawing 1.031. Note: for an alternate method of mounting, use coil clips, capillary clips or wire ties with screw eyes.



**Limited access ducts (Figure 2)**

1. Attach a mounting flange on the opposite side of the duct (near the bottom) from where the thermostat case will be mounted.
2. Cut access hole and mount a second flange on the duct diagonally across from the first flange. Drill a hole in the second flange for the bulb. Install grommet to protect bulb.
3. Cut a length of conduit to fit diagonally across the duct. Stretch out the bulb and wrap it around the conduit. Use wire ties to secure bulb to conduit. See figure 2.
4. Insert the conduit and bulb through the access hole into the opposite flange. Fasten second flange to the duct.
5. Mount the thermostat on the outside of duct.
6. Seal all openings with appropriate compound.

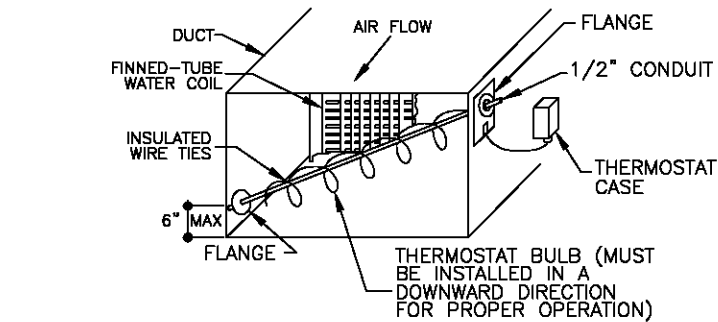


Figure 2

**Building Static Reference (Figure 4)**

**A-306 Outdoor Static Pressure Reference**

1. Install the device per the manufacturer's installation instructions using the following guidelines:
2. Select a mounting location as free as possible from rooftop or building obstructions, trees, chimneys, signs or other sources of turbulence. Location should also consider routing of pneumatic tubing into the building to minimize tubing run on the roof or outdoors.
3. If available, an existing structure such as a radio or TV antenna mast can be used to mount the sensor. Alternately, the bracket can be attached directly to any rooftop.
4. Assemble and mount the sensor as shown in Figure 4.
5. Connect the clear 1/8\"/>

**RPS or RPS-W Indoor Static Pressure Reference**

1. Mount on wall or on ceiling tile. Indoor reference to be on main entrance floor in most cases. See ATS control drawings. Locate in an area away from exterior doors and elevators, and in the most un-noticeable location possible to the public. Locate the building static sensor in a serviceable location. Confirm location with ATS Project Manager prior to installation.

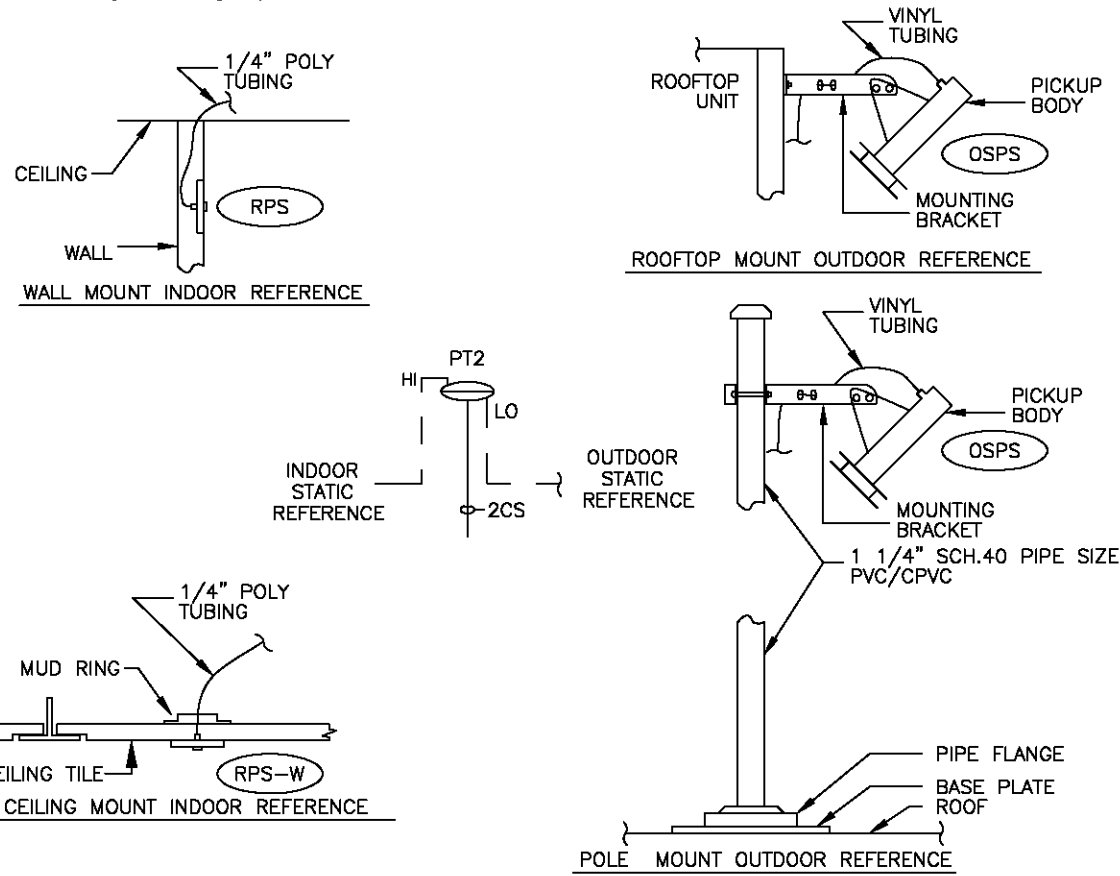
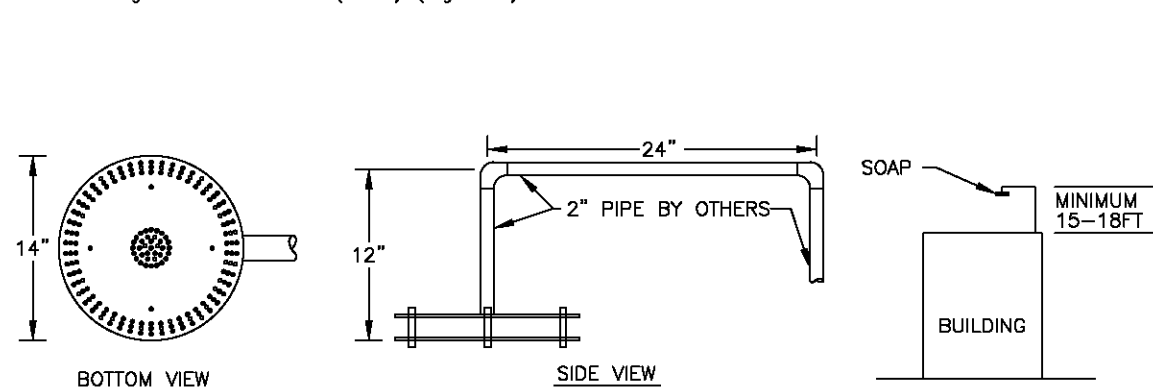


Figure 4

**Building Static Reference (SOAP) (Figure 5)**



**Duct averaging sensors (Figure 3)**

Drill a 3/8\"/>

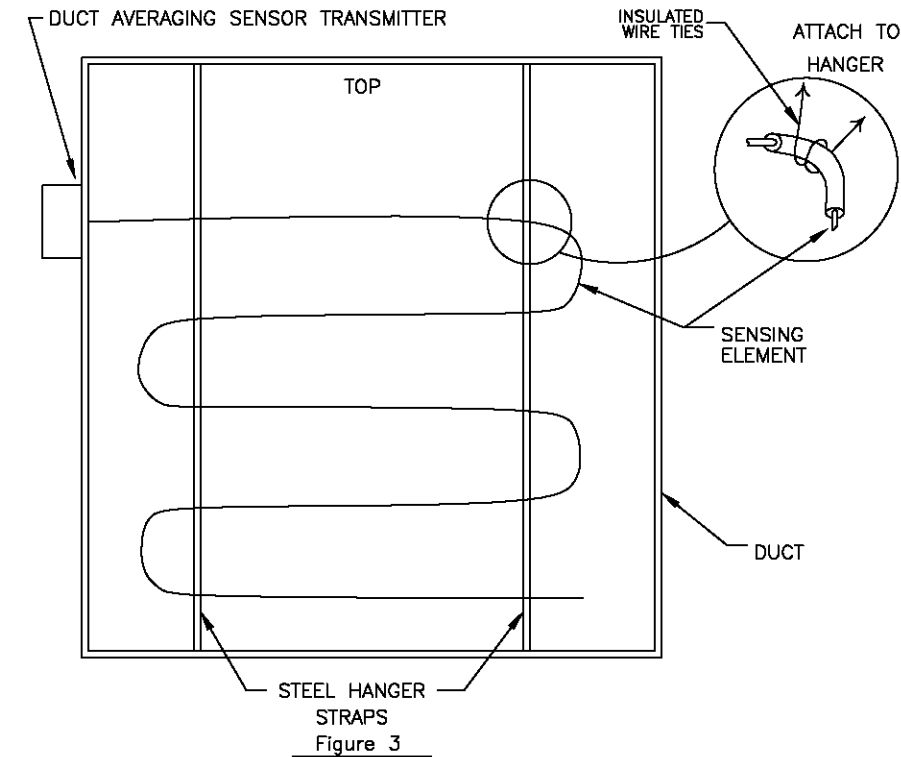
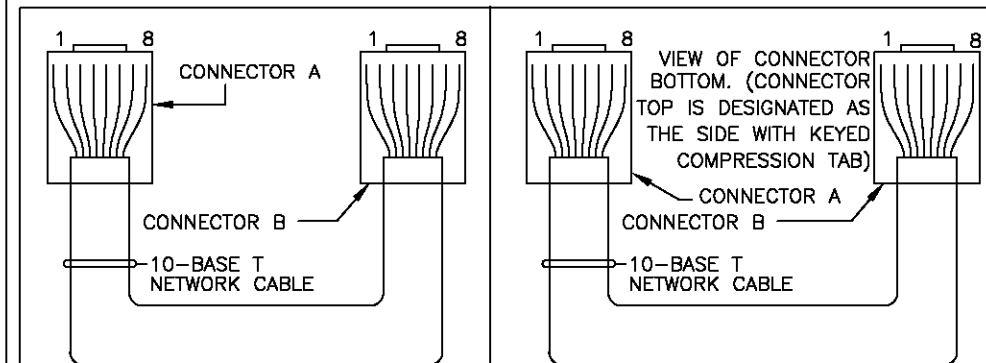


Figure 3



**CABLE TERMINATIONS FOR CONNECTOR A AND B**

PIN1	GRN/WHT	TX+
PIN2	GRN	TX-
PIN3	ORN/WHT	RX+
PIN4	BLUE	
PIN5	BLU/WHT	
PIN6	ORN	RX-
PIN7	BRN/WHT	
PIN8	BRN	

**STANDARD 568A**

**CABLE TERMINATIONS FOR CONNECTOR A AND B**

PIN1	ORN/WHT	TX+
PIN2	ORN	TX-
PIN3	GRN/WHT	RX+
PIN4	BLUE	
PIN5	BLU/WHT	
PIN6	GRN	RX-
PIN7	BRN/WHT	
PIN8	BRN	

**STANDARD 568B (ATS PREFERRED METHOD)**

WIRE TERMINATIONS FOR STRAIGHT THROUGH CABLE, STANDARD 568A AND 568B



# Sequence of Operation

## 1.1 SEQUENCE OF OPERATIONS

- A. BOILER (B-1) ENABLE:** DDC system shall enable boiler continuously when boiler control switches are in AUTO mode. DDC system shall monitor heating supply header temperature and report reset temperature in heating supply main where shown. Alarm sent to BAS when burner fails to operate or any safety functions shutdown a respective burner.
1. Separate Packaged Reset Schedule Provided under Boiler Section: Boilers shall operate to maintain heating supply temperature in heating distribution main according to the following schedule: 190F HS temperature at 20F OSA temperature modulating to 150F HS temperature at 60F OSA temperature. Alternate can be DDC type boiler set back system upon approval of Engineer and Owner with local/remote switch to go between local controls and DDC.
  2. All WORK required for a complete operating boiler control system included hereunder, including entire line voltage electrical installation, low voltage electrical installation, and integration with burner controls. Coordinate provision of sensors, wiring, and connection points with electrical division and burner controls for a complete system. Coordinate provision with Mechanical Contractor during Bidding.
  3. Provide heating supply and return sensor for BAS monitoring of building hot water return temperature. Display on Graphics.
- B. BOILER HEATING RETURN TEMPERATURE CONTROL:** Immersion thermostat in heating return piping for boiler shall modulate open P-2 bypass valve to maintain a minimum 135F return water temperature.
- C. BOILER PRIMARY HEATING PUMP (P-1):** A manual starter with on-off switch provides direct power for the burner motor through their safeties.
- D. BUILDING SECONDARY HEATING PUMP (P-2):** A variable frequency drive (VFD) provides direct power for the pump motor. When the VFD is in the AUTO position, the BAS shall operate and modulate the speed of the pump to maintain the hydronic static pressure sensor pressure differential setpoint. Sensor located between the heating mains where shown. Pressure differential required at pressure sensing location determined by the Adjustment and Control Contractors. Initially set pressure differential at 6 psi. When the VFD is in HAND position, a digital speed control integral with the VFD panel provides manual speed control. When VFD is in BYPASS mode, the pump operates at full speed (60 HZ). Activate an alarm when a VFD generated status alarm occurs due to low current. Include VFD speed and VFD fault alarm inputs to the BAS. Display actual speed, alarms, and status on Graphics.
1. Pressure Differential Sensor located where shown.
  2. DDC Display: Indicate heating water main temperature setpoint, reset schedule, pump speed, operation status, and alarms.
  3. Bypass Valve: Automatic valve shall modulate open when pressure is above setpoint of 15 gpm to maintain a minim flow through pump. Flow to be set and measured during TAB work.
- E. HEATING PLANT SCHEMATIC:** In addition to individual equipment control schematics on graphics, an overall Heating Plant Control Schematic shall be included on graphics to provide a quick overview of heating plant system operation.
- F. GENERAL FAN UNIT NOTES:** The following controls apply to the various ventilation systems outlined in this section, as indicated within each fan system description or listed below as typical for all fan units.
1. Smoke Sensors: Furnished and installed under the ELECTRICAL division.
  2. Filter Alarm: Differential pressure sensor across filter to send filter alarm to BAS whenever the differential pressure exceeds an adjustable 0.50 inches water column for pre-filters. Analog input signal with set point adjustable at the BAS. Alarm is to be sent to the BAS for confirmation.
  3. Low-limit control: Averaging bulb thermostat at the discharge of the heating coil to stop the fan below an adjustable 40°F upon a time delay of 45 seconds. Mixing dampers repositioned to full recirculation position and automatic valve positioned to full open heating. Fan automatically reset on temperature rise above set point. Alarm is to be sent to the BAS for confirmation.
  4. Fan operation status Differential pressure sensor installed across supply fans units to send signal to BAS when in operation. Alarm is to be sent to the BAS for confirmation when fan does not operate when commanded on. Current sensor not acceptable.
  5. In HAND position all AHU fan shall operate in occupied mode and at the command of the smoke sensor.
  6. All Exhaust Fans operation status: Current sensor to send fan operation signal to BAS. Alarm is to be sent to the BAS for confirmation when fan does not operate when commanded on.
  7. Exhaust Fan Automatic Damper: Where exhaust fan has an automatic damper, an end switch shall be utilized so that fan unit will not start until damper is mostly open. This control shall work in either Auto or Hand position through use of relay. A programmed delay start is not acceptable.
  8. AHU coil minimum flow: When OSA drops below 32F, AHU AV-2 minimum flow rate shall be set at 10% open when fan unit is off to reduce chance of freeze-up.
- G. AIR HANDLING UNIT (AHU-1):** A variable frequency drive (VFD) located on the mounting board, provides direct power for the respective fan motor. When the VFD is in the AUTO position, the BAS shall operate each fan unit at the speed required to meet design CFM (as verified with TAB Contractor). When the VFD is in HAND position, a digital speed control integral with the VFD panel provides manual speed control. When VFD is in BYPASS mode, the fan operates at full speed (60 HZ). Activate an alarm when a VFD generated status alarm occurs due to low current or other alarm. Include VFD speed and VFD fault alarm inputs to the BAS. Display speed, alarms, and status on Graphics. In the AUTO, HAND, or BYPASS positions, the fan units operate according safety functions such as the low-limit thermostat and the smoke sensor.
1. Schedule of Operation:
    - a. Normal Occupied Schedule: See General Fan Notes (Schedule) above for hours of operation. During normal operation, AHU-1 fan to provide minimum outdoor air as scheduled below.
    - b. Unoccupied Mode: AHU-1 shall remain OFF in Unoccupied mode.
    - c. Night Setback Mode: AHU-1 does not have a Night Setback mode.
  2. During the Occupied schedule, Minimum outside air damper (OAD-1) to open to minimum position to provide the required minimum outside air. Minimum OSA volume is as follows and is to be manually verified during initial adjustment of mechanical systems. Air monitoring station installed in OSA duct to monitor OSA air volume. Damper to continue to open when additional exhaust fans and dust collector are operating as follows:
    - a. AHU-1 Occupied Minimum OSA: 800 CFM
    - b. AHU-1 Occupied Minimum OSA with Dust Collector On: Add 2500 CFM OSA.
    - c. AHU-1 Occupied Minimum OSA with either welding exhaust fan On: Add 1500 OSA CFM.
    - d. AHU-1 Occupied Minimum OSA with Vehicle exhaust fan On: Add 1000? CFM
  3. Dampers (OAD-A, OAD-B, RAD-1, RAD-2, EAD-1, EAD-2D): Supply air sequence control to modulate the modulating

outside air damper (OAD-B), the recirculating air dampers (RAD-1 and RAD-2), and exhaust air damper (EAD-1, EAD-2) to maintain the adjustable supply air setpoint provided minimum outdoor air volume is attained and the carbon dioxide control sequence is satisfied. Dampers to modulate cooperatively, with the modulating outside air damper OAD and the exhaust air damper EAD closed when the recirculating air damper RAD is open. Dampers to position to the full recirculating positions when the unit is not operating. Exhaust air damper (EAD-1, EAD-2) shall modulate independently with separate control signal as needed to maintain building pressure.

4. Supply air temperature: Supply air discharge sensor to control the heating coil automatic valve and mixing dampers in order to supply an adjustable air discharge temperature set by the supply air reset schedule; 62°F supply air at 62°F outside air temperature modulating to 66°F supply air at 20F outside air temperature and below. Heating coil automatic valve to close to heating on an outside air temperature above an adjustable 62°F OSA.
  7. Building pressure sensor. Outdoor pressure reference sensor located on exterior of Service 105 north wall. Duct pressure sensor located in each shop. Provide input to BAS system.
  8. SF VFD Speed: When the VFD is in the AUTO position, the BAS shall operate fan unit at the speed required (constant speed) to meet design CFM (as verified with TAB Contractor). Air measuring station on fan inlet to display CFM on BAS and on AHU cabinet display.
  9. Provide Low-Limit Control, Filter Alarms, Air Measuring Station(s) for SA, RA, and OSA, Fan Operation Status, and AHU Minimum Coil Flow: See above for descriptions.
- H. EXHAUST FAN (EF-1):** Manual starter with ON\_OFF switch shall control operation of EF-1 through hazardous gas control panel.
- I. EXHAUST FAN (EF-2, EF-3):** Manual starter with ON\_OFF switch shall control operation of EF-2 Welding.
- J. EXHAUST FAN (EF-4):** Manual starter with ON\_OFF switch shall control operation of EF-4 Vehicle Exhaust.
- K. EXHAUST FAN (EF-5):** A manual starter with an ON-OFF switch is located adjacent to the unit.
- L. COMBUSTION AIR SUPPLY FAN (SF-1):** A room thermostat, operates the fan and activates the supply air fan when the room temperature is at or above 90°F. Combustion air damper CAD-1 is to open whenever SF-1 operates with adjustable delay of operation until CAD-1 is open. Thermostat sensor value displayed on floor plan graphic with Alarm sent to BAS when temperature reaches above adjustable 90°F. Local Control is NOT acceptable.
- M. COMBUSTION AIR CAD-1:** Combustion air damper actuator to open whenever burner operates. Provide relays and connections as required.
- N. UNIT HEATER ZONE CONTROL:** room thermostat to modulate respective radiant zone valve and operate unit heater blower to maintain setpoint, initially set at 65F. Room thermostats and automatic valves to be provided hereunder.
- DUST COLLECTOR:** Provide operation status for existing dust collector starter for modulating of VU-1 OSA.



# VALVE SCHEDULE PAGE 1

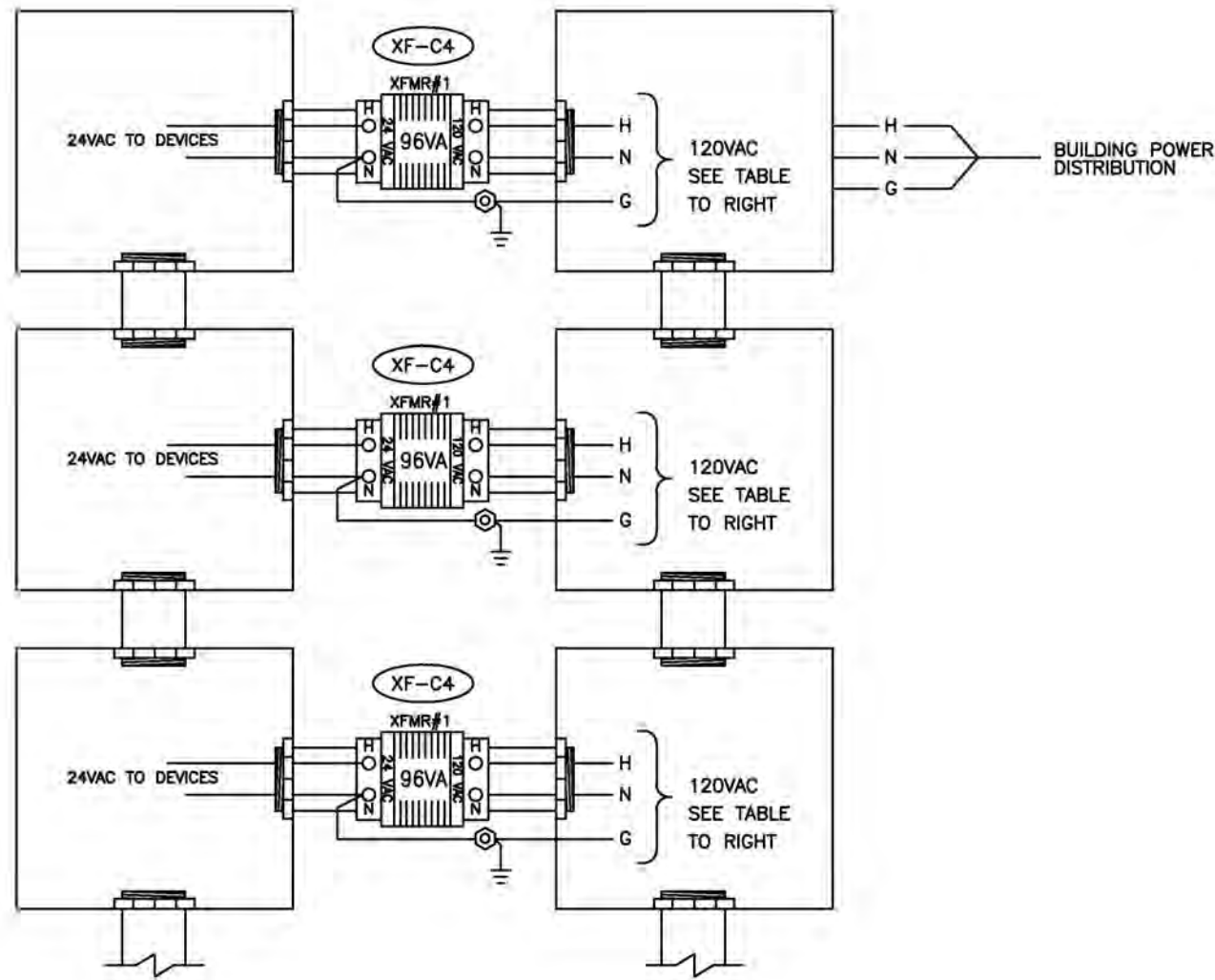
ITEM	PROJECT SPECIFICATIONS								SIZING DATA		VALVE TYPE AND ACTUATOR SPECIFICATIONS													ORDERING DATA							
	QUANTITY	VALVE TAG	2-WAY OR 3-WAY	FLOW (GPM)	DESIGN PRESSURE DROP PSI	DESIRED CV RATING	PIPE SIZE (IN)	CLOSE-OFF PRESSURE PSI	VALVE SIZE (IN)	VALVE CV	ACTUAL PRESSURE DROP PSI	CCV	BALL	ZONE	GLOBE	BUTTERFLY	24 VAC	120 VAC	ON-OFF	FLOATING POINT	MODULATING 2-10	MFT	MFT CODE	SPRING RETURN	SWITCHES	NORMAL POSITION NO A-AB NC A-AB	FAIL POSITION SPRING RETURN ONLY FO A-AB OR FC A-AB	BUTTERFLY SETUP	VALVE #	ACTUATOR #	
1	1	CUH	2-Way	2	1	1.63	1/2"	200	1/2"	1.9	1.11	x												x		NC A-AB	FO A-AB		B211	TFRB120	
2	4	UH	2-Way	7.7	1	7.70	1"	200	1/2"	7.4	1.08	x												x		NC A-AB	FO A-AB		B214	TFRB120	
3	1	HTG-BYPASS	2-Way	15	3	8.66	1-1/2"	200	3/4"	10.0	2.25	x				x								x		NC A-AB	FC A-AB		B219	TFRB24-SR	
4	1	HC-1	2-Way	30	3	17.32	2"	200	-1/4"	18.2	2.72	x				x								x		NC A-AB	FO A-AB		B230	LF24-SR US	
5																															
6																															
7																															
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50																															

GLOBAL MAC Address Table (Global 01A 01B)

BCM Ethernet Module				Configuration Settings		Default Settings	
Mac	Tag	DI	Notes	Mac	Tag	DI	Notes
0	BCM	11100	4	57			
1	BCA01	11101	7.4	58			
2	BCA02	11102	7.4	59			
3	BCA03	11103	7.4	60			
4	BCA04	11104	7.4	61			
5	BCA05	11105	7.4	62			
6	BCA06	11106	7.4	63			
7	BCA07	11107	7.4	64			
8	BCA08	11108	7.4	65			
9	BCA09	11109	7.4	66			
10	BCA10	11110	7.4	67			
11	BCA11	11111	7.4	68			
12	BCA12	11112	7.4	69			
13	BCA13	11113	7.4	70			
14	BCA14	11114	7.4	71			
15	BCA15	11115	7.4	72			
16	BCA16	11116	7.4	73			
17	BCA17	11117	7.4	74			
18	BCA18	11118	7.4	75			
19	BCA19	11119	7.4	76			
20	BCA20	11120	7.4	77			
21	FPB07	11121	7.41	78			
22	FPC02	11122	7.41	79			
23	FPC03	11123	7.41	80			
24	FPC04	11124	7.41	81			
25	FPC05	11125	7.41	82			
26	FPC06	11126	7.41	83			
27	BCC07	11127	7.4	84			
28	BCC08	11128	7.4	85			
29	CVA22	11129	7.41	86			
30	SF1	11130	7.5	87			
31	BOILR	11131	7.02	88			
32	PUMP	11132	7.03	89			
33	VFD4A	11133	7.04	90			
34	VFD4B	11134	7.04	91			
35	AHU5	11135	7.19	92			
36	AHU6	11136	7.21	93			
37	AHU7	11137	7.23	94			
38	AHU8	11138	7.25	95			
39	AHU9	11139	7.27	96			
40	KITCH	11140	7.29	97			
41	MZCN1	11141	7.43	98			
42	MZCN2	11142	7.43	99			
43	MZCN3	11143	7.43	127			
44	MZCN4	11144	7.43	ADDITIONAL NOTES:			
45	MZCN5	11145	7.43				
46							
47							
48							
49							
50							
51							
52							
53							
54							
55							
56							

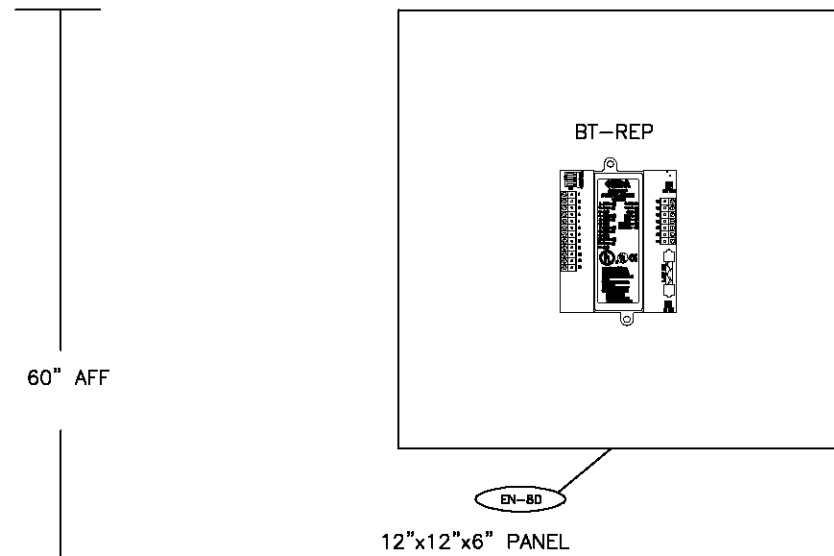
BCM Ethernet Module				Configuration Settings		Default Settings	
Mac	Tag	DI	Notes	Mac	Tag	DI	Notes
0	BCM	11200	4	57			
1	BCD01	11201	7.4	58			
2	BCD02	11202	7.4	59			
3	BCD03	11203	7.4	60			
4	BCD04	11204	7.4	61			
5	FPD05	11205	7.41	62			
6	FPD06	11206	7.41	63			
7	FPD07	11207	7.41	64			
8	FPD08	11208	7.41	65			
9	FPD09	11209	7.41	66			
10				67			
11	FPD11	11211	7.41	68			
12	FPD12	11212	7.41	69			
13				70			
14	FPD14	11214	7.41	71			
15	FPD15	11215	7.41	72			
16	FPD16	11216	7.41	73			
17	FPD17	11217	7.41	74			
18	UHD18	11218	7.42	75			
19	FPD19	11219	7.41	76			
20	FPD20	11220	7.41	77			
21	FPD21	11221	7.41	78			
22	UHE02	11222	7.42	79			
23	UHE03	11223	7.42	80			
24	UHE04	11224	7.42	81			
25	UHE05	11225	7.42	82			
26	FPE06	11226	7.41	83			
27	FPE07	11227	7.41	84			
28	FPE08	11228	7.41	85			
29	FPE09	11229	7.41	86			
30	FPE10	11230	7.41	87			
31	VNTU1	11231	7.11	88			
32	VNTU2	11232	7.13	89			
33	VNTU3	11233	7.15	90			
34	VNTU4	11234	7.17	91			
35	POOL	11235	7.52	92			
36	VOCED	11236	7	93			
37	VOCED2	11237	7	94			
38	VOCBLR	11238	7.1	95			
39				96			
40				97			
41				98			
42				99			
43				127			
44				ADDITIONAL NOTES:			
45							
46							
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TRANSFORMER SCHEDULE

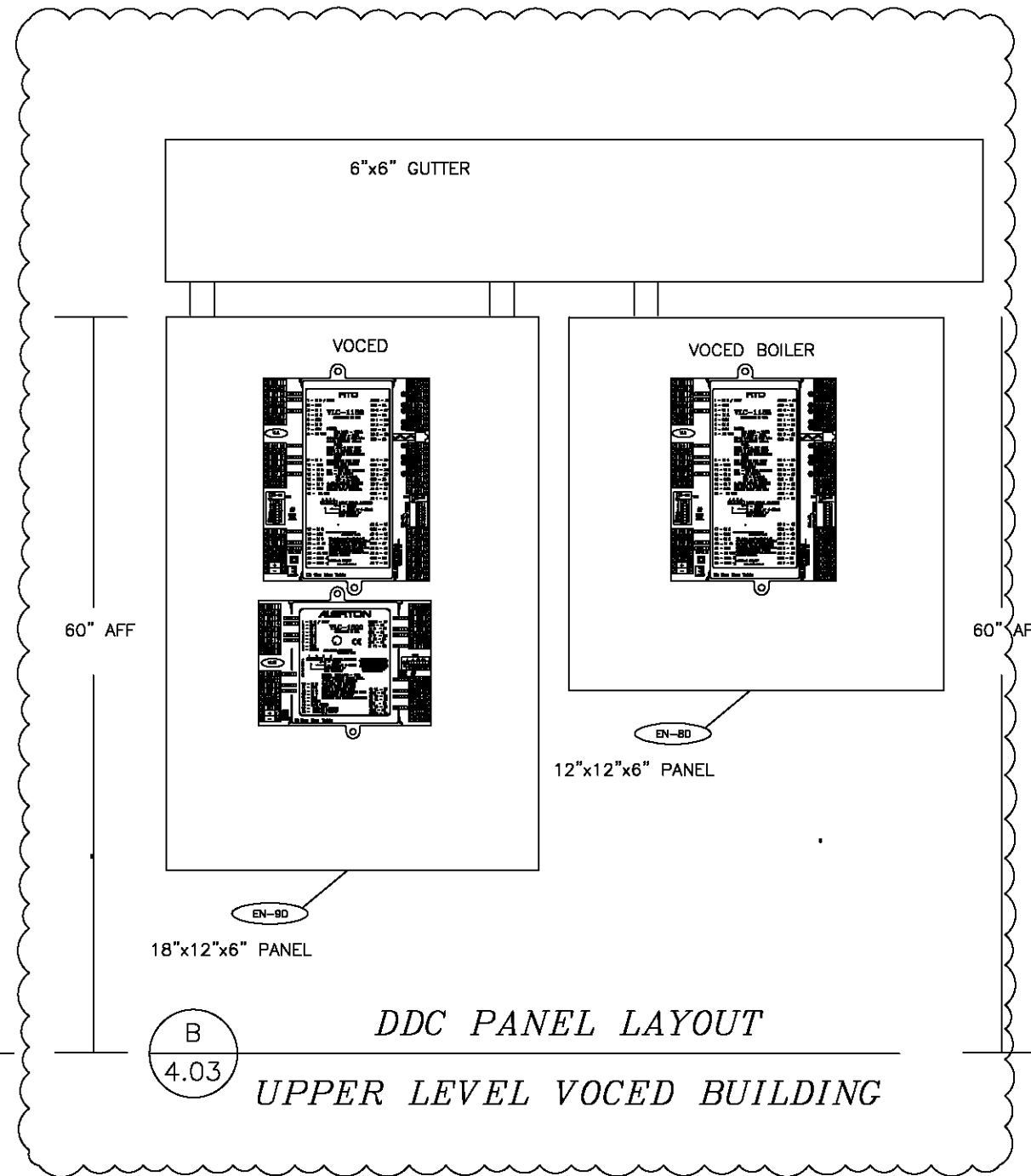


XFMR #	LOCATION	CKT #	CONTROLLER	LOAD
XFMR-22	VOCED		VOCED	60
			VOCEF	10
			TOTAL	70
XFMR-24	VOCED BOILER		VOCBLR	40
			TOTAL	40

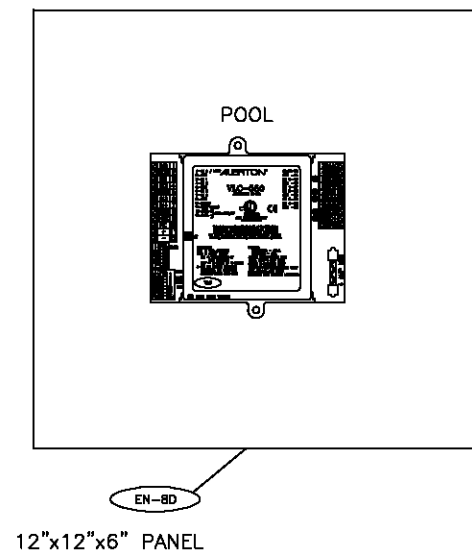
ALL TRANSFORMERS TO BE MOUNTED SUCH THAT ONE IS EASILY REMOVEABLE WITHOUT REMOVING THE REST OF THE TRANSFORMERS.  
 RECOMMENDED METHOD: MOUNT EACH TRANSFORMER TO A 4-SQUARE EXTENSION AND MOUNT ON WALL IN SERIES AS SHOWN ABOVE.  
 ALL TRANSFORMERS TO BE MOUNTED IN MECHANICAL ROOM FOR EASY ACCESS. POWER WILL BE DISTRIBUTED FROM THERE.



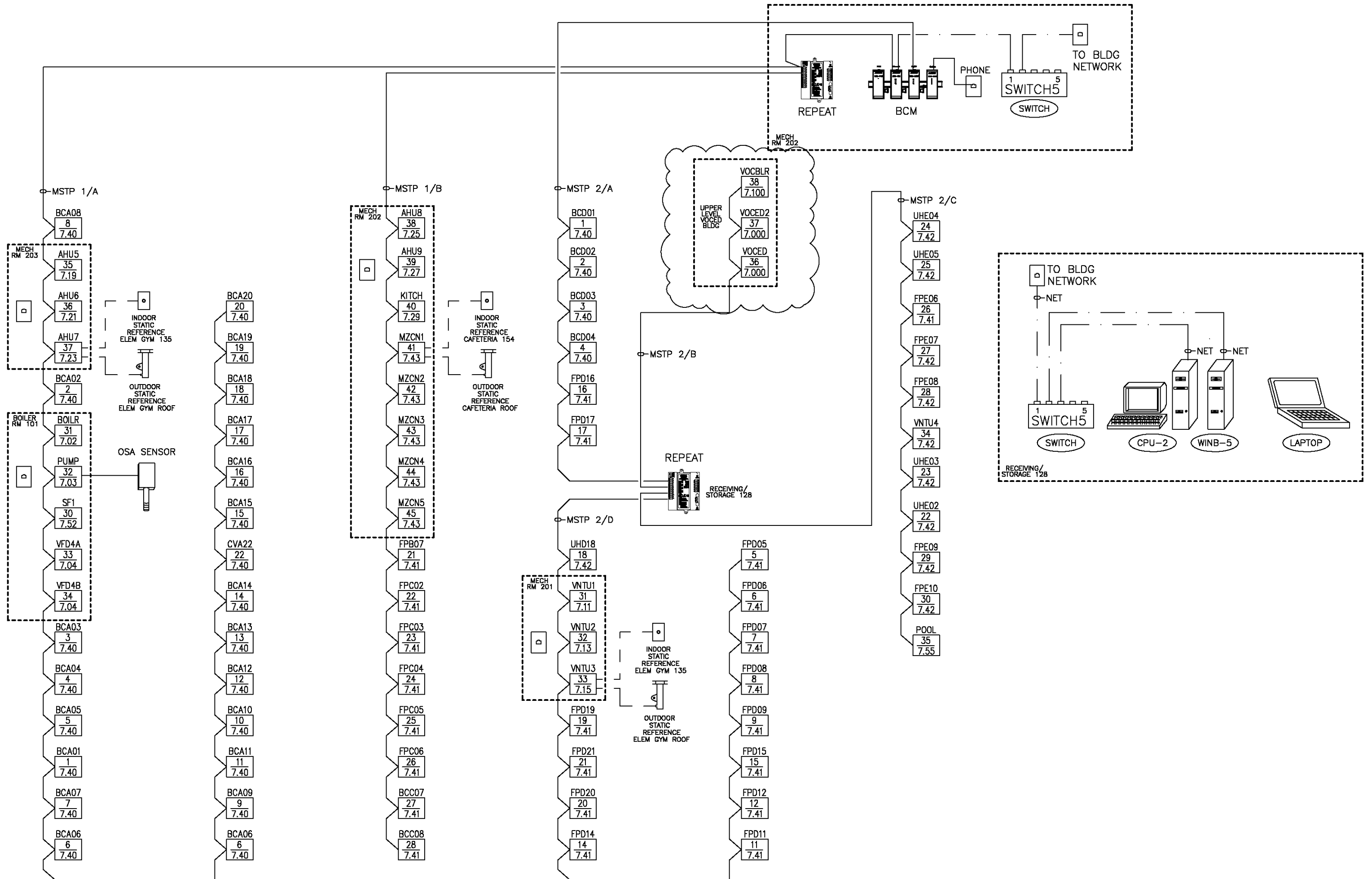
**A**  
4.03  
*REPEATER PANEL LAYOUT*  
*RECEIVING / STORAGE 128*

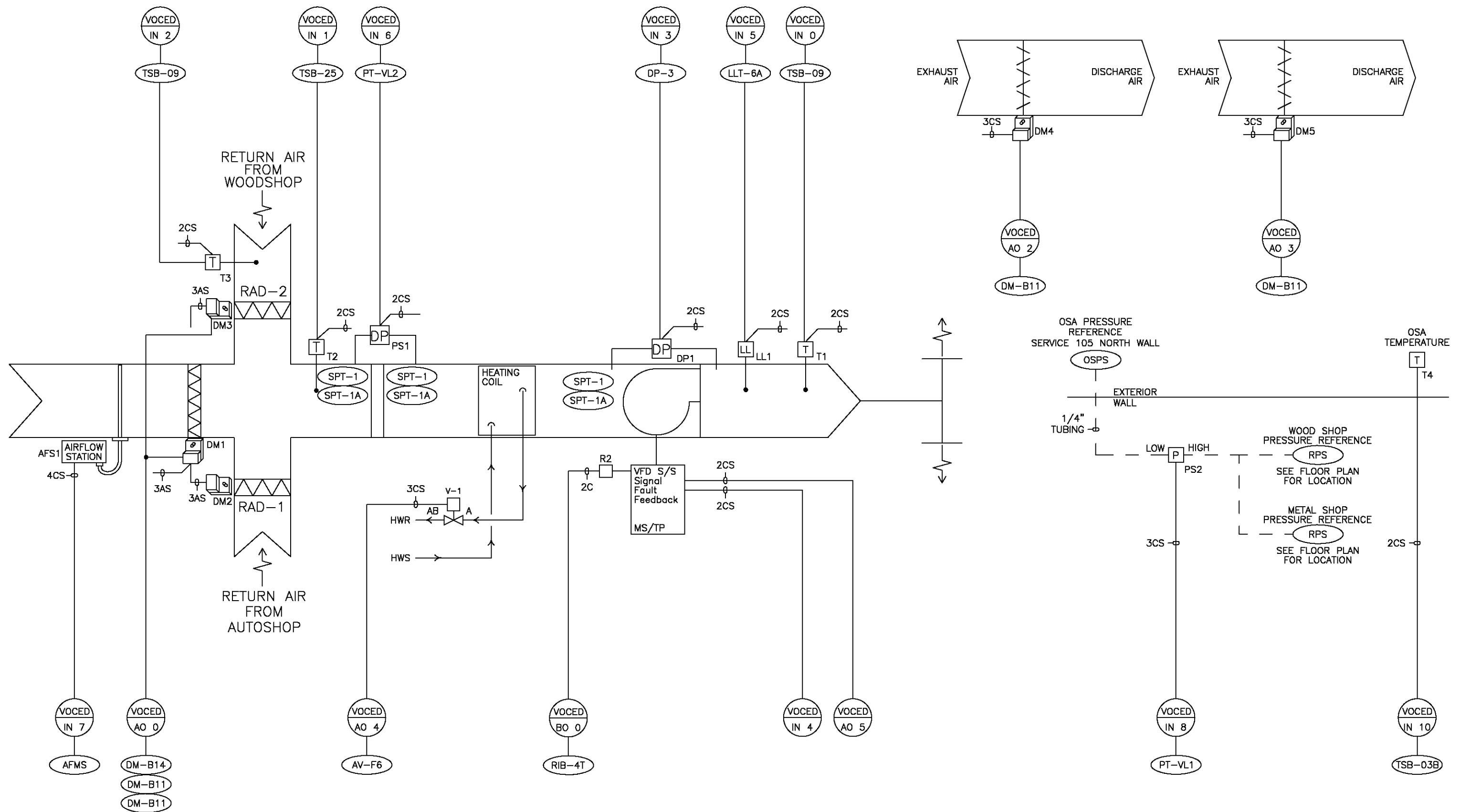


**B**  
4.03  
*DDC PANEL LAYOUT*  
*UPPER LEVEL VOCED BUILDING*



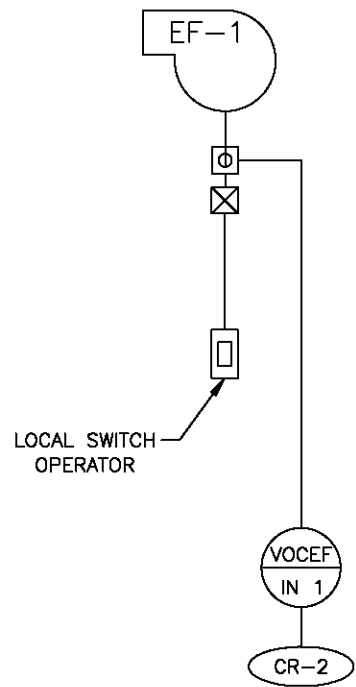
**A**  
4.03  
*DDC PANEL LAYOUT*  
*STORAGE 62*



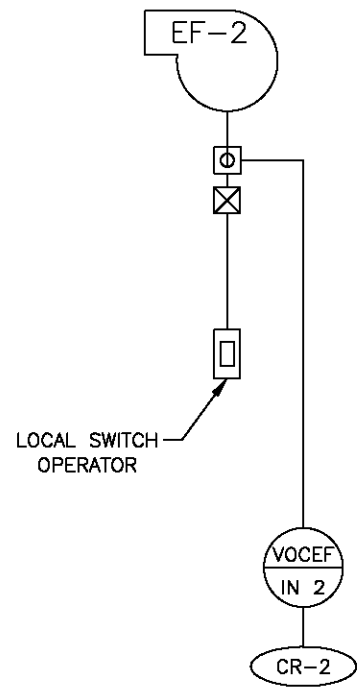


VOCEDEN VENTILATION DIAGRAM (VOCED)  
MECHANICAL MEZZANINE

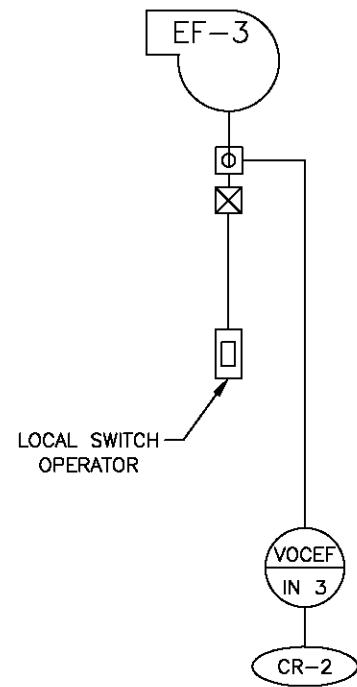




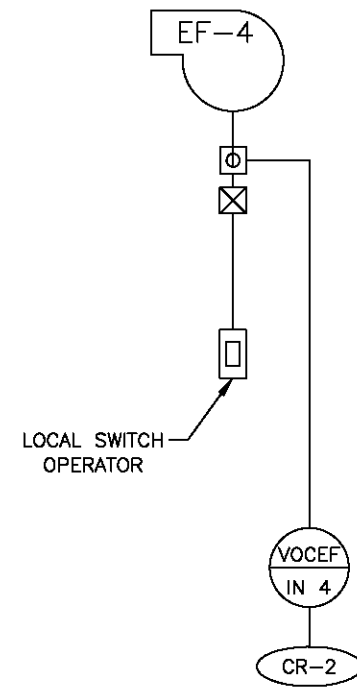
EF-1  
SYSTEM DIAGRAM



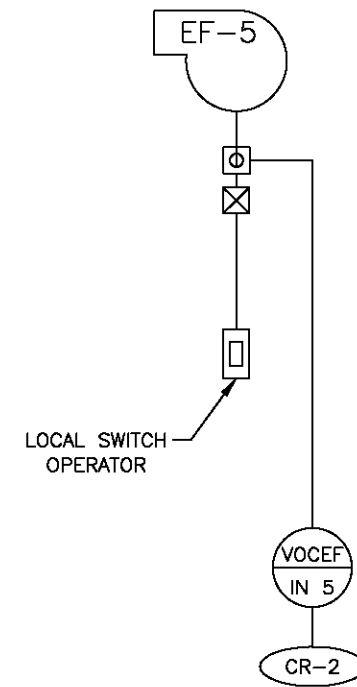
EF-2  
SYSTEM DIAGRAM



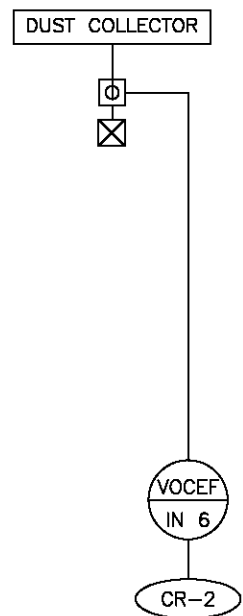
EF-3  
SYSTEM DIAGRAM



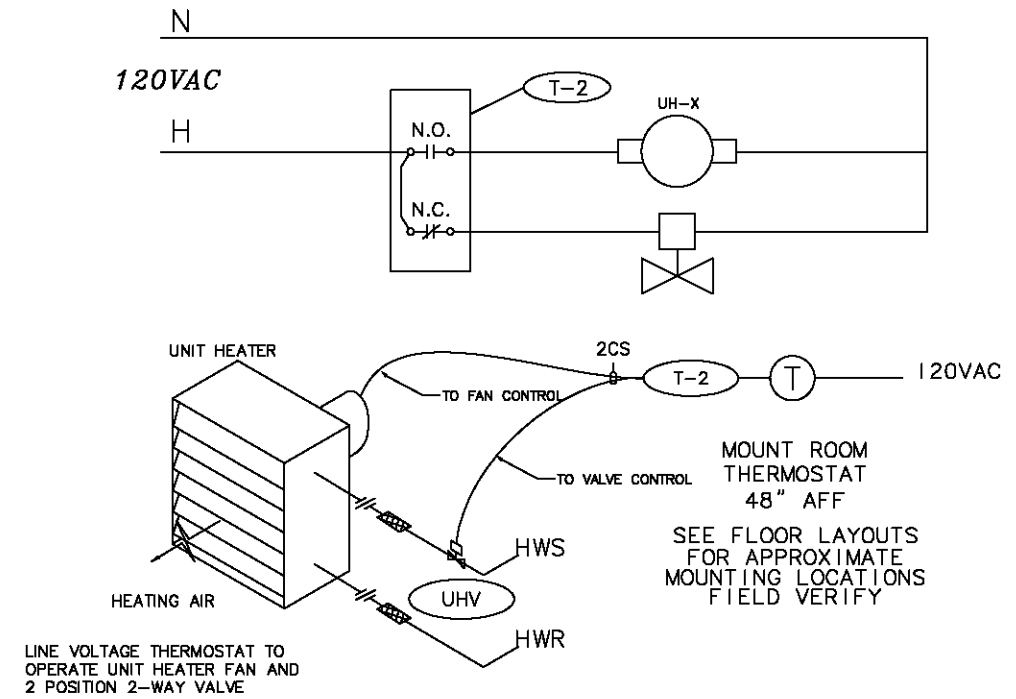
EF-4  
SYSTEM DIAGRAM



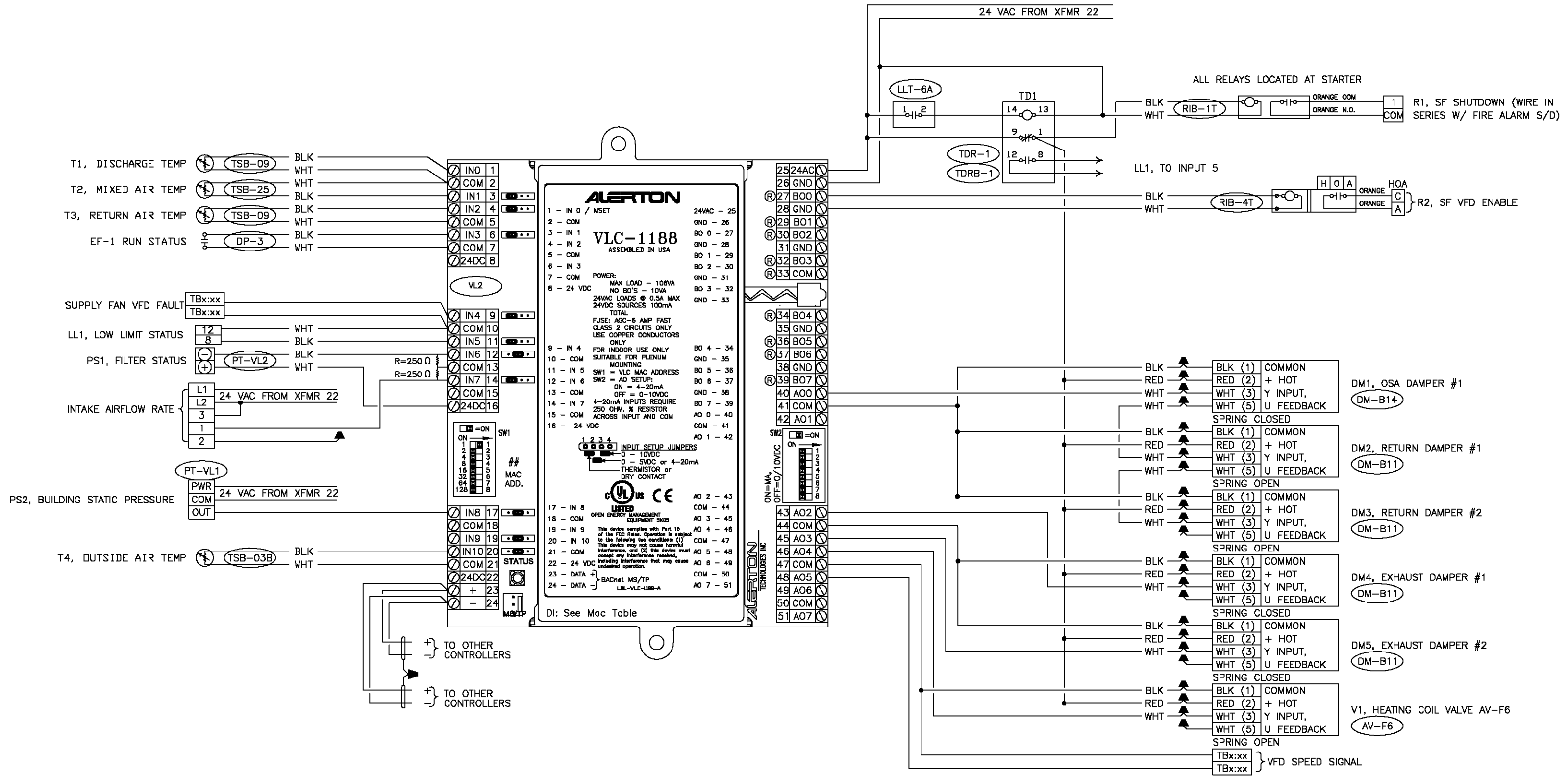
EF-5  
SYSTEM DIAGRAM



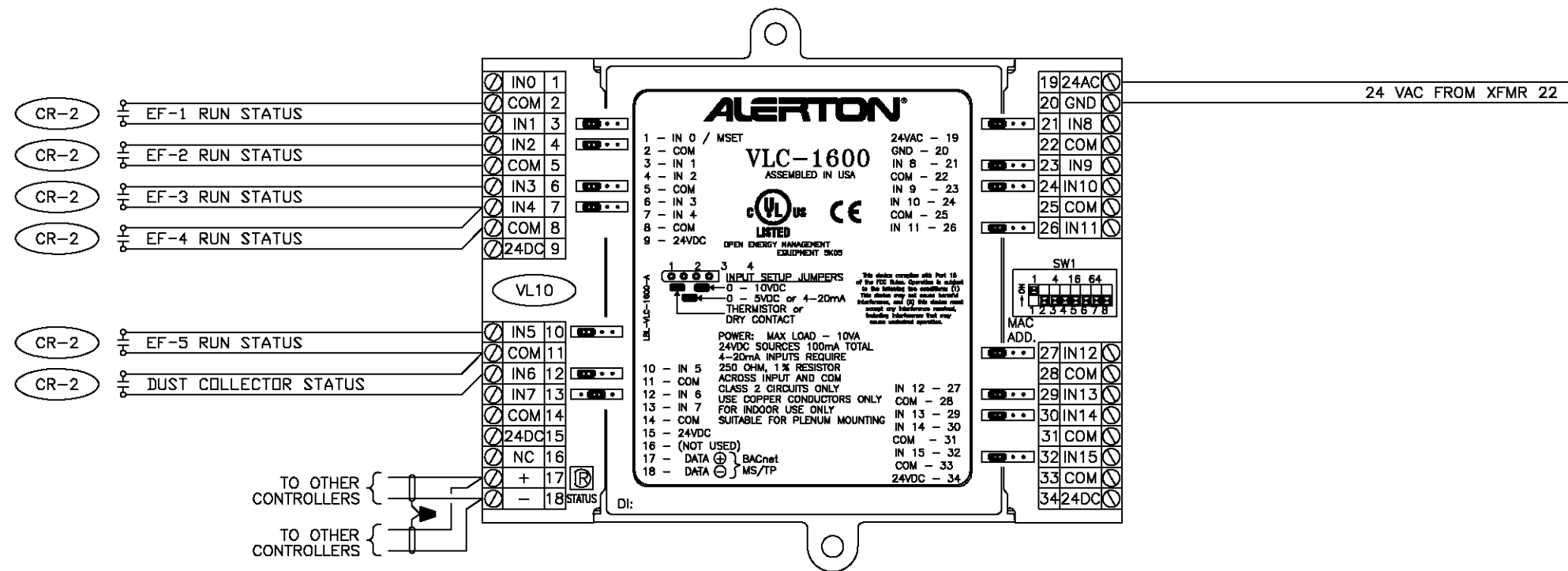
DUST COLLECTOR  
SYSTEM DIAGRAM



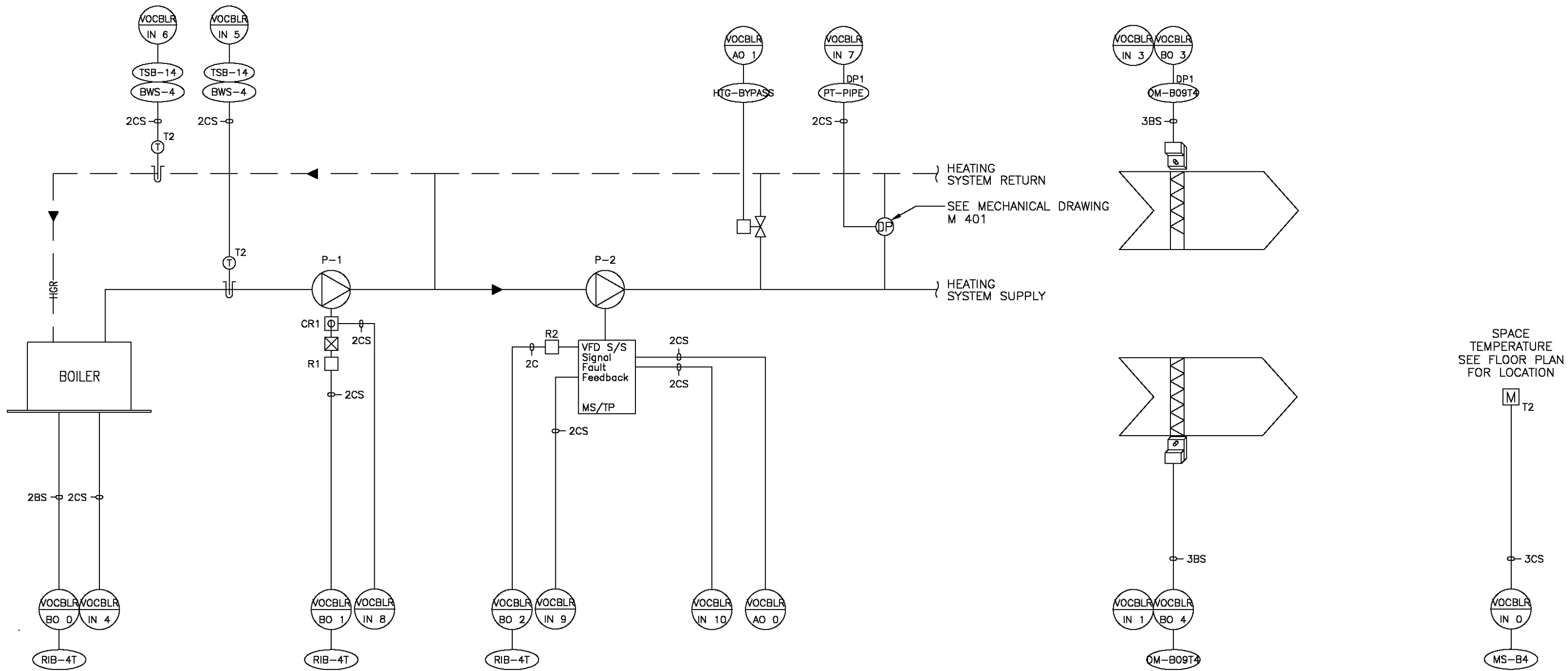
UNIT HEATER WITH REMOTE THERMOSTAT  
TYPICAL OF: 4



**AHU-VOCED WIRING DIAGRAM (VOCED)**  
**VOCED BLDG UPPER LEVEL**

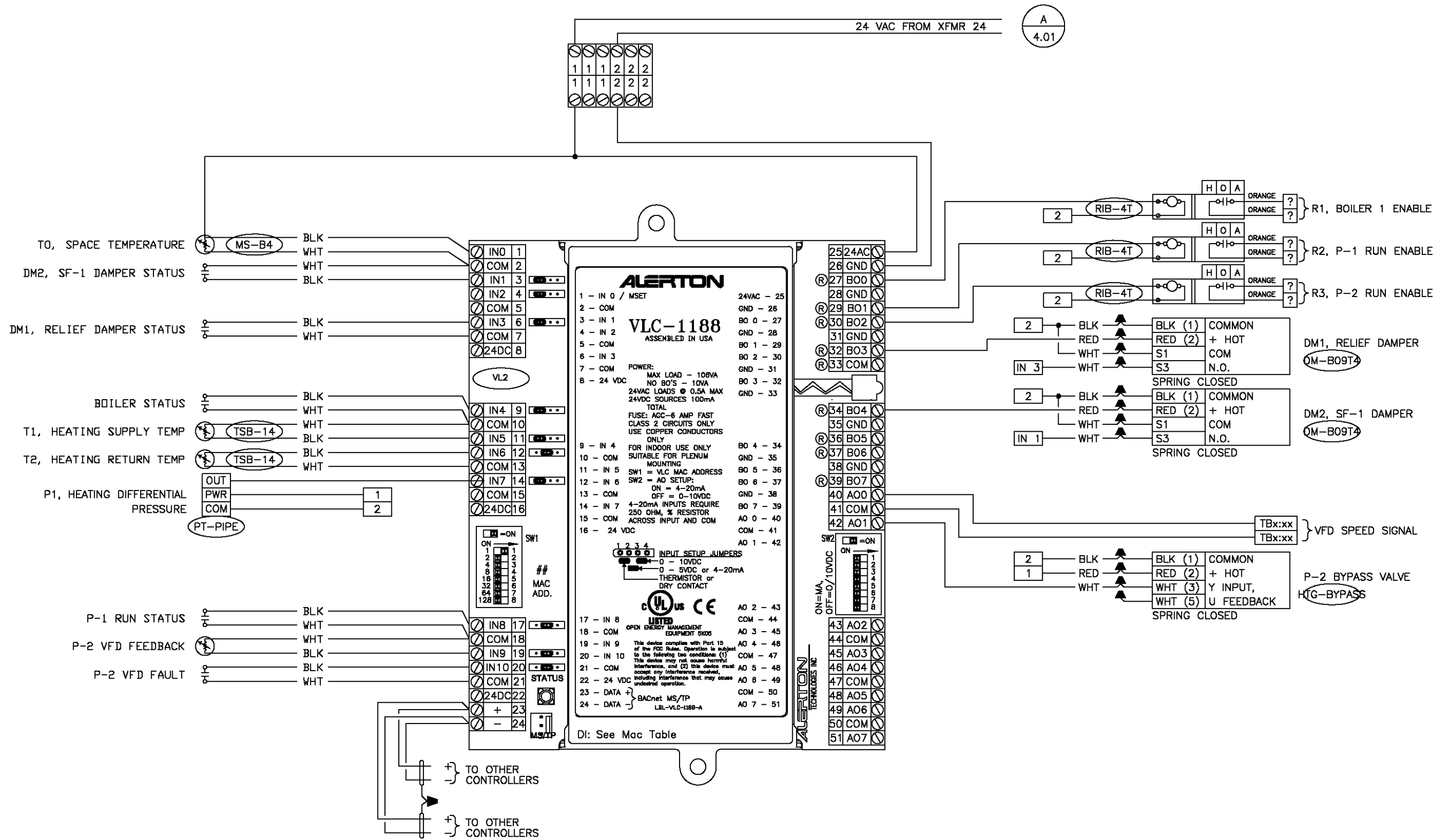


VOCED EF WIRING DIAGRAM (VOCEF)  
 VOCED BLDG UPPER LEVEL



**BOILER SYSTEM SCHEMATIC**  
**BOILER ROOM**

**VENTILATION SCHEMATIC**  
**BOILER ROOM**



**BOILER ROOM WIRING DIAGRAM (VOCBLR)**  
**VOCED BLDG UPPER LEVEL**

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**BILL OF MATERIALS:****HSD Vocational Tech  
Building M & E Upgrades**

ATS ID	QTY	MANUFACTURER	DESCRIPTION	MAN PART #	SECTION
AFMS	1	Ebtron	Air flow monitoring station, Gold series	GTC116-P+	4
BWS-4	2	Alerton Technologies-ACI	Stainless Well, 4", 1/2NPT Internal ,3/4" External	TS-3104-CJ-00-AA	5
CR-2	6	Functional Devices	Current Sensing Switch, Adj. Threshold, w/ LED .5-150amp	RIBXKTA	4
DM-B09T4	2	Belimo	22 in-lb, spring, 2-Pos, 5W, 4 sq ft	TFB24-S	3
DM-B11	4	Belimo	35 in-lb, spring, 2-10vdc, 2.5W, 8 sq ft	LF24-SR	3
DM-B14	1	Belimo	90 in-lb, spring, 2-10vdc, 3.5W, 20 sq ft	NFB24-SR	3
DP-3	2	Honeywell	Filter Air Flow Switch, adj	AP-5130/B	5
EN-08	1	Hoffman	12X12X4 Small Encl, Hinge, No Backplate (lrg cflr, 4Xfmr)	A-HE12X12X4	5
LLT-6A	1	Intec Controls	Low Limit Temp Detector, 6 ft, Auto Reset (2) SPDT	NTF-32-US	5
MS-B4	1	Alerton Technologies	BACtalk Microset II Digital Sensor, LCD Readout	MS 2000 BT	4
OSPS	1	Kele & Associates	Outside air pressure reference probe kit	A-306-K	5
PT-PIPE	1	Veris Industries	Press Trans DP 0-25/ 50 / 125 / 250 psi, LCD Display	PW2LX05S	4
PT-VL1	2	Veris Industries	Press Trans 0-1" Selectable, Panel/Duct, W/Display	PXPLX01S	4
PT-VL2	1	Veris Industries	Press Trans 0-10" Selectable, Panel/Duct, W/Display	PXPLX02S	4
RIB-1T	1	Functional Devices	SPDT, 24-120vac in,10amp,Terminals,1/3 HP@120	RIBTU1C	5
RIB-4T	5	Functional Devices	SPST, 24vac in,10amp, Terminals, normally open, w/HOA	RIB-TU1S	5
SPT-1	5	Kele & Associates	Duct Static Pressure Tip, 1/4" Compression	A-301-K	5
SPT-1A	5	Kele & Associates	Flange Mounting Kit for A-301 & 302	A-345-K	5
T-2	4	Kele & Associates	SPDT Line Voltage Htg/Clg Thermostat	ETD5-S1S	4
TSB-03B	1	Alerton Technologies-ACI	Temp Sensor, Outside Air, Plastic Encl, 10K	TS-3200-PD-10-AA	4
TSB-09	2	Alerton Technologies-ACI	Temp Sensor,Duct, 8",Flange, 10K	TS-2008-FA-10-AA	4
TSB-14	2	Alerton Technologies-ACI	Temp Sensor, Immersion 4",Galv,1/2NPT,10K, Nema 1	TS-2104-GH-10-AA	4
TSB-25	1	Alerton Technologies-ACI	Temp Sensor, Duct Avg, Flex 12',10K	TS-5012-XD-10-AB	4
VL02	1	Alerton Technologies	VLC 1188 Programmable Controller, 20va	VLC-1188	1
VL10	1	Alerton Technologies	VLC 1600 Programmable Controller, 20va	VLC-1600	1
XF-C4	1	Functional Devices	100 VA 120/240/277/480-24vac Transformer	TR100VA004	5

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**MAINTENANCE CHECKLIST:**

**HSD Vocational Tech  
Building M & E Upgrades**

ATS ID	MANUFACTURER	DESCRIPTION	MAN PART #	MAINTENANCE REQUIRED	FREQUENCY	COMMENTS
AFMS	Ebtron	Air flow monitoring station, Gold series	GTC116-P+	No maintenance required.		
BWS-4	Alerton Technologies-ACI	Stainless Well, 4", 1/2NPT Internal, 3/4" External	TS-3104-CJ-00-AA	No maintenance required.		
CR-2	Functional Devices	Current Sensing Switch, Adj. Threshold, w/ LED, 5-150amp	RIBXXTA	No maintenance required.		
DM-B0914	Belimo	22 in-lb, spring, 2-Pos, 5W, 4 sq ft	TFB24-S	Verify Actuator strokes completely	Every Year	
DM-B11	Belimo	35 in-lb, spring, 2-10vdc, 2.5W, 8 sq ft	LF24-SR	Verify Actuator strokes completely	Every Year	
DM-B14	Belimo	90 in-lb, spring, 2-10vdc, 3.5W, 20 sq ft	NFB24-SR	Verify Actuator strokes completely	Every Year	
DP-3	Honeywell	Filter Air Flow Switch, adj	AP-5130/B	Verify Actuator strokes completely	Every Year	
EN-08	Hoffman	12X12X4 Small Encl, Hinge, No Backplate (Irg ctr, 4Xfmr)	A-HE12X12X4	No maintenance required.		
LLT-6A	Intec Controls	Low Limit Temp Detector, 6 ft, Auto Reset (2) SPDT	NTF-32-US	No maintenance required.		
MS-B4	Alerton Technologies	BACtalk Microset II Digital Sensor, LCD Readout	MS 2000 BT	No maintenance required.		
OSPS	Kele & Associates	Outside air pressure reference probe kit	A-306-K	Update firmware as required by Alerton	As necessary	
PT-PIPE	Veris Industries	Press Trans DP 0-25/ 50 / 125 / 250 psi, LCD Display	PW2LX05S	Verify Calibration	Every Year	
PT-VL1	Veris Industries	Press Trans 0-1" Selectable, Panel/Duct, W/Display	PXPLX01S	Verify Calibration	Every Year	
PT-VL2	Veris Industries	Press Trans 0-10" Selectable, Panel/Duct, W/Display	PXPLX02S	Verify Calibration	Every Year	
RIB-1T	Functional Devices	SPDT, 24-120vac in, 10amp, Terminals, 1/3 HP @120	RIBTU1C	No maintenance required.		
RIB-4T	Functional Devices	SPST, 24vac in, 10amp, Terminals, normally open, w/HOA	RIB-TU1S	No maintenance required.		
SPT-1	Kele & Associates	Duct Static Pressure Tip, 1/4" Compression	A-301-K	No maintenance required.		
SPT-1A	Kele & Associates	Flange Mounting Kit for A-301 & 302	A-345-K	No maintenance required.		
T-2	Kele & Associates	SPDT Line Voltage Htg/Cig Thermostat	ETD5-S1S	No maintenance required.		
TSB-03B	Alerton Technologies-ACI	Temp Sensor, Outside Air, Plastic Encl, 10K	TS-3200-PD-10-AA	Check for moisture in sensor.	Every year	
TSB-09	Alerton Technologies-ACI	Temp Sensor, Duct, 8" Flange, 10K	TS-2008-FA-10-AA	Verify sensor is reading correctly	Every Year	
TSB-14	Alerton Technologies-ACI	Temp Sensor, Immersion 4", Galv, 1/2NPT, 10K, Nema 1	TS-2104-GH-10-AA	Verify sensor is reading correctly	Every Year	
TSB-25	Alerton Technologies-ACI	Temp Sensor, Duct Avg, Flex 12', 10K	TS-5012-XD-10-AB	Verify sensor is reading correctly	Every Year	
VL02	Alerton Technologies	VLC 1188 Programmable Controller, 20va	VLC-1188	Update firmware as required by Alerton	As necessary	
VL10	Alerton Technologies	VLC 1600 Programmable Controller, 20va	VLC-1600	Update firmware as required by Alerton	As necessary	
XF-C4	Functional Devices	100 VA 120/240/277/480-24vac Transformer	TR100VA004	No maintenance required.		

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**RECOMMENDED REPAIR METHODS:**

**HSD Vocational Tech  
Building M & E Upgrades**

ATS ID	MANUFACTURER	DESCRIPTION	MAN PART #	RECOMMENDED REPAIR METHODS
AFMS	Ebtron	Air flow monitoring station, Gold series	GTC116-P+	Whole Item Replacement
BWS-4	Alerton Technologies-ACI	Stainless Well, 4", 1/2NPT Internal, 3/4" External	TS-3104-CJ-00-AA	Whole Item Replacement
CR-2	Functional Devices	Current Sensing Switch, Adj. Threshold, w LED .5-150amp	RIBXKTA	Whole Item Replacement
DM-B09T4	Belimo	22 in-lb, spring, 2-Pos, 5W, 4 sq ft	TFB24-S	Whole Item Replacement
DM-B11	Belimo	35 in-lb, spring, 2-10vdc, 2.5W, 8 sq ft	LF24-SR	Whole Item Replacement
DM-B14	Belimo	90 in-lb, spring, 2-10vdc, 3.5W, 20 sq ft	NFB24-SR	Whole Item Replacement
DP-3	Honeywell	Filter Air Flow Switch, adj	AP-5130/B	Whole Item Replacement
EN-08	Hoffman	12X12X4 Small Encl, Hinge, No Backplate (lrg cflr, 4Xlfr)	A-HE12X12X4	Whole Item Replacement
LLT-6A	Intec Controls	Low Limit Temp Detector, 6 ft, Auto Reset (2) SPDT	NTF-32-US	Whole Item Replacement
MS-B4	Alerton Technologies	BACtalk Microset II Digital Sensor, LCD Readout	MS 2000 BT	Whole Item Replacement
OSPS	Kele & Associates	Outside air pressure reference probe kit	A-306-K	Factory Repair
PT-PIPE	Veris Industries	Press Trans DP 0-25/ 50 / 125 / 250 psi, LCD Display	PW2LX05S	Factory Repair
PT-VL1	Veris Industries	Press Trans 0-1" Selectable, Panel/Duct, W/Display	PXPLX01S	Factory Repair
PT-VL2	Veris Industries	Press Trans 0-10" Selectable, Panel/Duct, W/Display	PXPLX02S	Factory Repair
RIB-1T	Functional Devices	SPDT, 24-120vac in, 10amp, Terminals, 1/3 HP @120	RIBTU1C	Whole Item Replacement
RIB-4T	Functional Devices	SPST, 24vac in, 10amp, Terminals, normally open, w/HOA	RIB-TU1S	Whole Item Replacement
SPT-1	Kele & Associates	Duct Static Pressure Tip, 1/4" Compression	A-301-K	Whole Item Replacement
SPT-1A	Kele & Associates	Flange Mounting Kit for A-301 & 302	A-345-K	Whole Item Replacement
T-2	Kele & Associates	SPDT Line Voltage Htg/Clg Thermostat	ETD5-S1S	Whole Item Replacement
TSB-03B	Alerton Technologies-ACI	Temp Sensor, Outside Air, Plastic Encl, 10K	TS-3200-PD-10-AA	Whole Item Replacement
TSB-09	Alerton Technologies-ACI	Temp Sensor, Duct, 8", Flange, 10K	TS-2008-FA-10-AA	Whole Item Replacement
TSB-14	Alerton Technologies-ACI	Temp Sensor, Immersion 4", Galv, 1/2NPT, 10K, Nema 1	TS-2104-GH-10-AA	Whole Item Replacement
TSB-25	Alerton Technologies-ACI	Temp Sensor, Duct Avg, Flex 12', 10K	TS-5012-XD-10-AB	Whole Item Replacement
VL02	Alerton Technologies	VLC 1188 Programmable Controller, 20va	VLC-1188	Factory Repair
VL10	Alerton Technologies	VLC 1600 Programmable Controller, 20va	VLC-1600	Factory Repair
XF-C4	Functional Devices	100 VA 120/240/277/480-24vac Transformer	TR100VA004	Whole Item Replacement

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**RECOMMENDED MAINTENANCE/REPAIR TOOLS:**

**HSD Vocational Tech  
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ATS ID	MANUFACTURER	DESCRIPTION	MAN PART #	TOOLS NEEDED
AFWS	Ebrion	Air flow monitoring station, Gold series	GTC116-P+	B, C, D
BWS-4	Alerton Technologies-ACI	Stainless Well, 4", 1/2NPT Internal, 3/4" External	TS-3104-C-100-AA	E
CR-2	Functional Devices	Current Sensing Switch, Adj. Threshold, w/ LED 5-150amp	RIBXKTA	B, C, D
DM-B09T4	Belimo	22 in-lb. spring, 2-Pos, 5W, 4 sq ft	TFB24-S	D, H, I, J
DM-B11	Belimo	35 in-lb. spring, 2-10vdc, 2.5W, 8 sq ft	LF24-SR	D, H, I, J
DM-B14	Belimo	90 in-lb. spring, 2-10vdc, 3.5W, 20 sq ft	NFB24-SR	D, H, I, J
DP-3	Honeywell	Filter Air Flow Switch, adj	AP-5130/B	D, H, I, J
EN-08	Hoffman	12X12X4 Small Encl, Hinge, No Backplate (lrg cfr, 4Xfmr)	A-HE12X12X4	C
LLT-6A	Intec Controls	Low Limit Temp Detector, 6 ft, Auto Reset (2) SPDT	NTF-32-US	B, C, D
MS-B4	Alerton Technologies	BACtalk Microset II Digital Sensor, LCD Readout	MS 2000 BT	B, J
OSP5	Kele & Associates	Outside air pressure reference probe kit	A-306-K	B, C, D
PT-PIPE	Veris Industries	Press Trans DP 0-25/ 50 / 125 / 250 psi, LCD Display	PW2LX05S	B,C,D,J
PT-VL1	Veris Industries	Press Trans 0-1" Selectable, Panel/Duct, W/Display	PXPLX01S	B,C,D,J
PT-VL2	Veris Industries	Press Trans 0-10" Selectable, Panel/Duct, W/Display	PXPLX02S	B,C,D,J
RIB-1T	Functional Devices	SPDT, 24-120vac in, 10amp, Terminals, 1/3 HP@120	RIBTU1C	B, J
RIB-4T	Functional Devices	SPST, 24vac in, 10amp, Terminals, normally open, w/HOA	RIB-TU1S	B, J
SPT-1	Kele & Associates	Duct Static Pressure Tip, 1/4" Compression	A-301-K	C
SPT-1A	Kele & Associates	Flange Mounting Kit for A-301 & 302	A-345-K	C
T-2	Kele & Associates	SPDT Line Voltage Htg/Clg Thermostat	EIDS-S1S	C,D,J
TSB-03B	Alerton Technologies-ACI	Temp Sensor, Outside Air, Plastic Encl, 10K	TS-3200-PD-10-AA	C, D, J
TSB-09	Alerton Technologies-ACI	Temp Sensor, Duct, 8" Flange, 10K	TS-2008-FA-10-AA	C, D, J
TSB-14	Alerton Technologies-ACI	Temp Sensor, Immersion 4" Galv, 1/2NPT, 10K, Nema 1	TS-2104-GH-10-AA	C, D, J
TSB-25	Alerton Technologies-ACI	Temp Sensor, Duct Avg, Flex 12', 10K	TS-5012-XD-10-AB	C, D, J
VL02	Alerton Technologies	VLC 1188 Programmable Controller, 20va	VLC-1188	B, C, D
VL10	Alerton Technologies	VLC 1600 Programmable Controller, 20va	VLC-1600	B, C, D
XF-C4	Functional Devices	100 VA 120/240/277/480-24vac Transformer	TR100VA004	C, D, J

CODE	TOOL
A	8" Adjustable Wrench
B	Precision Screwdriver for Electronics
C	Klein 10-in-1 Screwdriver
D	Digital Multimeter
E	12" Adjustable Wrench
F	Vacuum with Micro Cleaning Kit
G	12" "v-jaw" toungre and groove pliers (Channellocks)
H	10mm box wrench
I	Ratchet with extensions and 10mm deep socket
J	Wire Strippers
K	
L	

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www.atsalaska.com

139 East 51<sup>st</sup> Avenue  
Anchorage, AK 99503  
Tel: 907-868-5100  
Fax: 907-868-5123

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## MANAGEMENT CONTACTS

### **Operations Manager**

Dan Fawcett, President  
907-375-4101

[dfawcett@atsalaska.com](mailto:dfawcett@atsalaska.com)

### **Project Sales and Business Manager**

Dave Rand, CEO  
907-375-4102

[drand@atsalaska.com](mailto:drand@atsalaska.com)

### **Service Manager**

Bobby Alston,  
907-375-4152

[balston@atsalaska.com](mailto:balston@atsalaska.com)

### **Fairbanks Manager**

Brian Henne  
907-350-9308

[bhenne@atsalaska.com](mailto:bhenne@atsalaska.com)

## SALES CONTACTS

### **Fire Alarm/Low Voltage**

Bill Fair  
907-375-4107

[bfair@atsalaska.com](mailto:bfair@atsalaska.com)

### **Security**

Max Salazar  
907-375-4163

[msalazar@atsalaska.com](mailto:msalazar@atsalaska.com)

### **Controls Sales**

Jacob Noel  
907-375-4135

[jnoel@atsalaska.com](mailto:jnoel@atsalaska.com)

### **Fire Suppression**

Pat Thompson  
907-375-4176  
[pthompson@atsalaska.com](mailto:pthompson@atsalaska.com)

### **Fairbanks Sales**

Jason Bell  
907-322-5369  
[jbelle@atsalaska.com](mailto:jbelle@atsalaska.com)

### **Service Sales**

Drew Skrocki  
907-375-4169  
[askrocki@atsalaska.com](mailto:askrocki@atsalaska.com)

## Service/Warranty Needs

Linda Langner  
Service Coordinator  
907-375-4114

[llangner@atsalaska.com](mailto:llangner@atsalaska.com)



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**BILL OF MATERIALS:**

**HSD Vocational Tech  
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ATS ID	QTY	MANUFACTURER	DESCRIPTION	MAN PART #	SECTION
VL02	1	Alerton Technologies	VLC 1188 Programmable Controller, 20va	VLC-1188	1
VL10	1	Alerton Technologies	VLC 1600 Programmable Controller, 20va	VLC-1600	1

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## Features and highlights

- **Capable**  
Eleven 10-bit universal inputs, eight binary outputs, and eight analog outputs.
- **Interoperable**  
Fully BACnet-compliant on MS/TP LAN at up to 76.8 Kbps.



BACnet is a registered trademark of ASHRAE. ASHRAE does not endorse, approve or test products for compliance with ASHRAE standards. Compliance of listed products to requirements of ASHRAE Standard 133 is the responsibility of the BACnet Manufacturer Association (BMA). BTL is a registered trademark of the BMA.

- **Versatile**  
Fully programmable and capable of stand-alone operation.
- **Reliable**  
AZ60 processor and extensive on-board filtering, with all program data backed up in nonvolatile flash memory.
- **Fast**  
Internal logic loop of 100 msec.



The Alerton® BACtalk® VLC-1188 is a versatile, fully programmable logic controller designed for central plant systems, air handling units, clean rooms, fume hoods, large terminal units, and similar control and process equipment. As a native BACnet controller, it integrates seamlessly with your BACnet system, communicating on a BACnet MS/TP LAN at up to 76.8 Kbps.

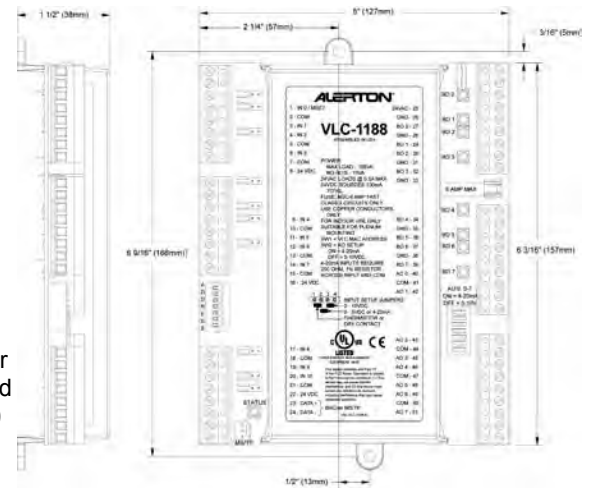
The VLC-1188 supports the Alerton Microtouch™, as well as the Microset™ and Microset II intelligent wall sensors, which offer convenient data display, setpoint adjustment, and technician access to equipment setup parameters.

All VLC-1188 control logic is programmed with Alerton's easy-to-learn graphical programming language, VisualLogic™. Programming and setup data is stored in nonvolatile flash memory, ensuring stable and reliable operation.

High-resolution 10-bit analog inputs are field-adjustable for thermistor/dry contact, 0–5 VDC/4–20 mA, or 0–10 VDC. Analog outputs are switch-selectable for 4–20 mA or 0–10 VDC.

## Technical Data

- **Power** 24 VAC @ 20 VA min., plus binary output loads (110 VA max). Utilizes a half-wave rectifier, which allows a single transformer to power multiple VLCs. One leg of 24 VAC connects to earth (panel) ground.
- **Inputs** 11 universal inputs with 10-bit resolution. Input 0 can be used for a BACtalk® Microset™ or Microset II. Inputs 1–10 are jumper-selectable for thermistor/dry contact, 0–5 VDC/4–20 mA., or 0–10 VDC signals.
- **Binary Outputs** 8 outputs each rated at 24 VAC, 0.5A. The outputs utilize optically coupled triacs, which have a common connection to the fused 24 VAC supply.
- **Analog Output** 8 outputs with 8-bit resolution. Each is switch-selectable for 0–10 VDC or 4–20 mA. 4–20 mA outputs are sourced by the VLC. Connected loads must return to the VLC ground. 4–20 mA max. load resistance is 1,000 ohm. 0–10 VDC min. load resistance is 500 ohm.
- **24VDC Output** Up to 100 mA of 24 VDC power is provided to power transducers or other devices.
- **Processor & Memory** Motorola AZ60 processor with on-board flash memory. Flash memory provides nonvolatile program and data storage, and allows for encrypted updates to the program for future product enhancements.
- **Dimensions** 6.98" (177mm)H x 5.0" (127mm)W x 1.5" (38mm)D.
- **Terminations** Removable header-type screw terminals accept 14–24 AWG wire.
- **Environmental** 0–158 deg. F (-17–70 deg. C). 0–95% RH, non-condensing.
- **Communications** BACnet MS/TP LAN up to 76.8Kbps.
- **BACnet Conformance** B-ASC level device; tested and approved by BTL. See Protocol Implementation Conformance Statement (PICS).



## • Ratings

Listed Underwriters Laboratory for Open Energy Management Equipment (PAZX) under the UL Standard for Safety 916; listing includes both U.S. and Canadian certification

Suitable for plenum mounting

EMC Directive 89/336/EEC (European CE Mark)

FCC Part 15, Subpart J, Class A



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## Ordering Information

Item number	Description
→ VLC-1188	BACtalk field controller for central plant systems application with 11 inputs, 8 binary triac outputs, 8 analog outputs
VLC-1188-C	VLC-1188 field controller with available custom DDC

Specifications subject to change without notice

## Features and highlights

- **Capable**  
Sixteen 10-bit universal inputs.
- **Interoperable**  
Fully BACnet-compliant on MS/TP LAN at up to 76.8 Kbps.



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- **Versatile**  
Fully programmable control logic can be field-modified.
- **Reliable**  
AZ-60 processor, with all program data backed up in nonvolatile flash memory.
- **Fast**  
Internal logic loop of 100 msec.



The Alerton® BACtalk® VLC-1600 is a high-performance, fully programmable input monitoring device. With 16 high-resolution inputs, it is perfectly suited for applications with high input density, where it can augment the input capabilities of other controllers. The VLC-1600 has no control outputs. As a native BACnet controller, it integrates seamlessly with your BACnet system, communicating on a BACnet MS/TP LAN at up to 76.8 Kbps.

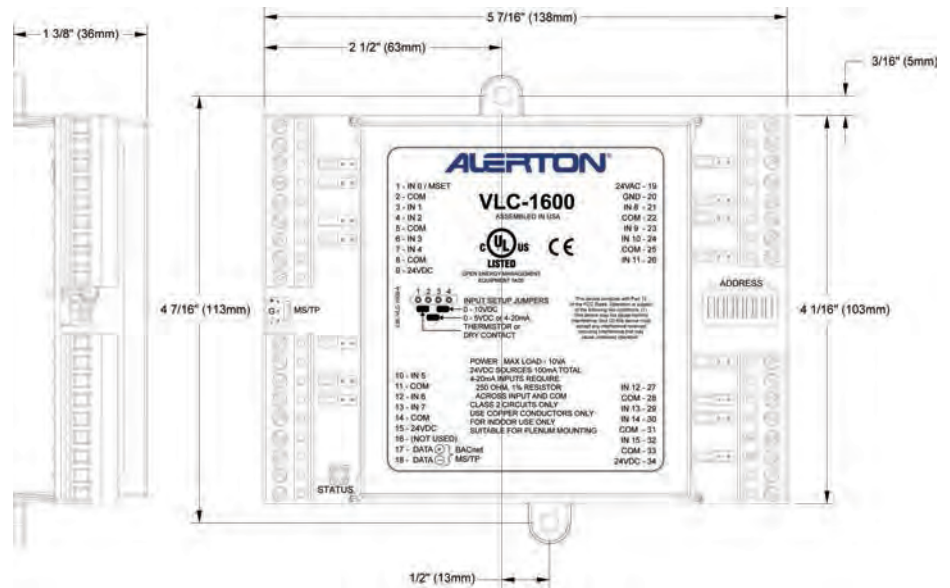
The VLC-1600 supports the Alerton Microtouch™ as well as the Microset™ and Microset™ II intelligent wall sensors, which offer convenient data display, setpoint adjustment, and technician access to equipment setup parameters.

All VLC-1600 control logic is programmed with Alerton's easy-to-learn graphical programming language, VisualLogic®. An AZ-60 processor provides powerful operation, and nonvolatile flash memory stores all program data.

The VLC-1600 is built for high-speed processing, with an internal logical loop time of 100 msec. Programmable timers also maintain a resolution of 100 msec. The VLC-1600 supports pulse-type inputs, and high-resolution, 10-bit analog inputs are jumper-configurable to accept thermistor, dry contact, 0–5 VDC/4–20 mA signals and 0–10 VDC input signals.

## Technical Data

- Power** 24 VAC @ 10 VA max. Utilizes a half-wave rectifier, which allows a single transformer to power multiple VLCs. One leg of 24 VAC connects to earth (panel) ground.
- Inputs** 16 inputs with 10-bit resolution. Input 0 can be used for a BACtalk® Microset™. Inputs 1–15 are jumper-configurable for thermistor/dry contact, 0–5 VDC/4–20 mA signals or 0–10 VDC signals. Inputs 1–3 accept pulse inputs.
- 24VDC Output** Three terminals provide up to 100 mA (total) of 24 VDC to power transducers or other devices.



- Processor & Memory** Motorola AZ-60 processor with on-board flash memory. Flash memory provides nonvolatile program and data storage, and allows for encrypted updates to the program for future product enhancements.
- Dimensions** 4.90" (125mm) H x 5.45" (138mm) W x 1.40" (36mm) D.
- Terminations** Removable header-type screw terminals accept 14–24 AWG wire.
- Environmental** 0–158 deg. F (-17–70 deg. C). 0–95% RH, non-condensing.
- Communications** BACnet MS/TP LAN up to 76.8 Kbps.
- BACnet Conformance** An application specific controller (ASC) level device; tested and approved by BTL. See Protocol Implementation Conformance Statement (PICS).
- Ratings**



BACnet is a registered trademark of ASHRAE. ASHRAE does not endorse, approve or test products for compliance with ASHRAE standards. Compliance of third parties to requirements of ASHRAE Standard 110 is the responsibility of the BACnet Manufacturers Association (BMA). BTL is a registered trademark of the BTL.

Listed Underwriters Laboratory for Open Energy Management Equipment (PAZX) under the UL Standard for Safety 916. Listing includes both U.S. and Canadian certification.

EMC Directive 89/336/EEC (European CE Mark).

FCC Part 15, Subpart J, Class A.

## Ordering information

Item number

Description



VLC-1600

BACtalk field controller with 16 inputs

*Specifications subject to change without notice*

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**BILL OF MATERIALS:****HSD Vocational Tech  
Building M & E Upgrades**

ATS ID	QTY	MANUFACTURER	DESCRIPTION	MAN PART #	SECTION
DM-B09T4	2	Belimo	22 in-lb, spring, 2-Pos, 5W, 4 sq ft	TFB24-S	3
DM-B11	4	Belimo	35 in-lb, spring, 2-10vdc, 2.5W, 8 sq ft	LF24-SR	3
DM-B14	1	Belimo	90 in-lb, spring, 2-10vdc, 3.5W, 20 sq ft	NFB24-SR	3

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# TFB24(-S), TFX24(-S)

On/Off, Spring Return, 24 V

ATS BOM Tag:DM-B09T4, Manufacture's P/N:TFB24-S



Technical Data		TFB24(-S), TFX24(-S)
Power supply		24VAC ± 20%, 50/60Hz 24VDC ± 10%
Power consumption	running	2 W
	holding	1.3 W
Transformer sizing		5 VA (class 2 power source)
Electrical connection	TFB24...	3 ft, 18 GA appliance cable, 1/2" conduit connector <b>-S models:</b> two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	TFX24...	3 ft [1m], 10 ft [3m], or 16 ft [5m], 18 GA appliance or plenum cables, with or without 1/2" conduit connector <b>-S models:</b> two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with or without 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Angle of rotation		max 95°, adjust. with mechanical stop
Torque		22 in-lbs [2.5 Nm] minimum
Direction of rotation		reversible with cw/ccw mounting
Position indication		visual indicator, 0° to 95° (0° spring return position)
Running time (nominal)	motor	< 75 sec
	spring	< 25 sec @-4°F to 122°F [-20°C to 50°C] < 60 sec @-22°F [-30°C]
Humidity		5 to 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA type 2 / IP42, UL enclosure type 2
Housing material		UL94-5VA
Agency listings†		cULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC (and 2006/95/EC for -S versions)
Noise level (max)	running	< 50 db (A)
	spring return	62 db (A)
Servicing		maintenance free
Quality standard		ISO 9001
Weight		1.4 lbs (0.6 kg), 1.5 lbs (0.7 kg) with switch

† Rated Impulse Voltage 800V, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 3.

TFB24-S, TFX24-S	
Auxiliary switch	1 x SPDT 3A (0.5A) @ 250 VAC, UL approved adjustable 0° to 95°

**Torque min. 22 in-lbs, for control of air dampers**

## Application

For on/off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is on/off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft from 1/4" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

## Operation

The TF series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

The TF series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 90°.

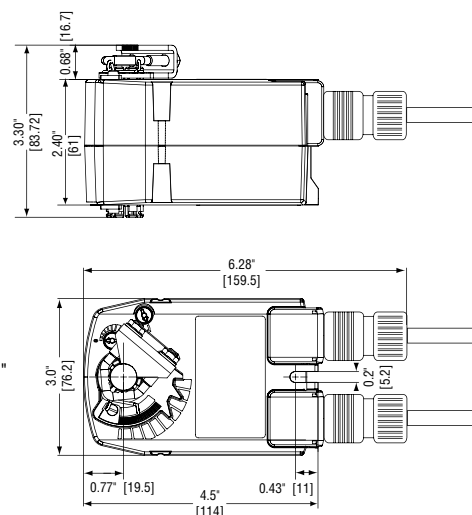
The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode.

The TF-S versions are provided with one built-in auxiliary switch. This SPDT switch is provided for safety interfacing or signaling, for example, for fan start-up. The switching function is adjustable between 0° and 95°.

## SAFETY NOTE

Screw a conduit fitting into the actuator's bushing. Jacket the actuator's input and output wiring with suitable flexible conduit. Properly terminate the conduit in a suitable junction box.

## Dimensions (Inches [mm])



### Standard:

- ⊙ 1/4" to 1/2"
- 1/4" to 5/16"

D096

M40103 - 09/11 - Subject to change. © Belimo Aircontrols (USA), Inc.

**Accessories**

Tool-06	8mm and 10 mm wrench
KH-TF	Crank arm for up to 1/2" round shaft
ZG-TF2	Crank arm adaptor kit for TF
ZG-TF112	Mounting bracket, kit for TF
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)

**NOTE:** When using TFB24(-S), TFX24(-S) actuators, only use accessories listed on this page. For actuator wiring information and diagrams, please see Belimo wiring guide.

**Typical Specification**

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 1/2" diameter and center a 1/2" shaft. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, one SPDT auxiliary switch shall be provided having the capability of being adjustable. Actuators with auxiliary switch must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus listed certified, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

**Wiring Diagrams**
**INSTALLATION NOTES**

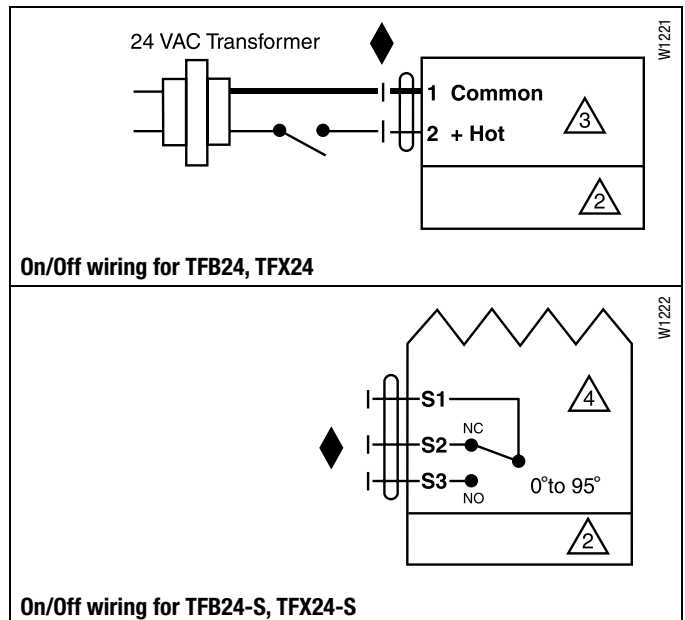
- 1 Provide overload protection and disconnect as required.
- 2 **CAUTION Equipment Damage!**  
Actuators may be connected in parallel. Power consumption must be observed.
- 3 Actuators may also be powered by 24 VDC.
- 4 For end position indication, interlock control, fan startup, etc., TFB24-S, TFX24-S incorporates a built-in auxiliary switch: 1 x SPDT, 3A (0.5A) @250 VAC, UL Approved, adjustable 0 to 95.

**APPLICATION NOTES**

- ◆ Meets cULus requirements without the need of an electrical ground connection.

**WARNING Live Electrical Components!**

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



# LF24-SR (-S) US

ATS BOM Tag:DM-B11, Manufacture's P/N:LF24-SR



Proportional damper actuator, spring return safety, 24 V for 2 to 10 VDC, or 4 to 20 mA control signal.  
Output signal of 2 to 10 VDC for position indication.



**Torque min. 35 in-lb, for control of air dampers**

### Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft from 3/8" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. For shafts up to 3/4" use K6-1 accessory. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to a 2 to 10 VDC, or with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. A 2 to 10 VDC feedback signal is provided for position indication or master-slave applications.

### Operation

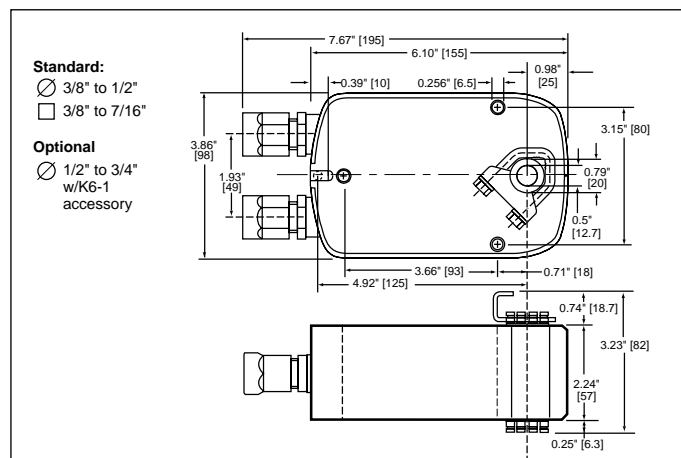
The LF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator. The LF series provides 95° of rotation and is provided with a graduated position indicator showing 0 to 90°.

The LF24-SR (-S) US uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact fail-safe position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode.

The LF24-SR-S US version is provided with 1 built-in auxiliary switch. This SPDT switch is provided for safety interfacing or signaling, for example, for fan start-up. The switching function is adjustable between 0° and 95°. The auxiliary switch in the LF24-SR-S US is double insulated so an electrical ground in not necessary.

Technical Data	LF24-SR (-S) US
Power supply	24 VAC ± 20% 50/60 Hz 24 VDC ± 10%
Power consumption	running: 2.5 W; holding: 1 W
Transformer sizing	5 VA (class 2 power source)
Electrical connection	LF24-SR US 3 ft, plenum rated cable LF24-SR-SUS 3 ft, 18 GA appliance cables (2) 1/2" conduit connector
Overload protection	electronic throughout 0 to 95° rotation
Operating range Y	2 to 10 VDC, 4 to 20mA
Input impedance	100 kΩ (0.1 mA), 500Ω
Feedback output U	2 to 10 VDC (max. 0.7 mA) for 95°
Angle of rotation	max. 95°, adjust. with mechanical stop
Torque	35 in-lb [4 Nm]
Direction of rotation	spring return reversible with cw/ccw mounting control direction selected by switch: CW=CW with a decrease in signal CCW=CCW with a decrease in signal
Position indication	visual indicator, 0° to 95° (0° is spring return position)
Auxiliary switch (LF24-SR-S us)	1 x SPDT 6A (1.5A) @ 250 VAC, UL listed adjustable 0° to 95° (double insulated)
Running time (nominal)	motor: 150 sec constant, independent of load spring: < 25 sec @ -4°F to +122°F [-20°C to +50°C] < 60 sec @ -22°F [-30°C]
Humidity	5 to 95% RH non-condensing
Ambient temperature	-22°F to +122°F [-30°C to +50°C]
Storage temperature	-40°F to +176°F [-40°C to +80°C]
Housing	NEMA type 2 / IP54
Housing material	zinc coated metal
Agency listings	UL 873 listed; CSA C22.2 No. 24 certified, CE
Noise level	max: running < 30 db (A) spring return 62 dB (A)
Servicing	maintenance free
Quality standard	ISO 9001
Weight	LF24-SR 3.1 lbs (1.40 kg.) LF24-SR-S 3.2 lbs (1.45 kg.)

### Dimensions (All numbers in brackets are metric.)



F20358 / 5 4 3 2 1 -01/04-10M-IG-Subject to change. © Belimo Aircontrols (USA), Inc.

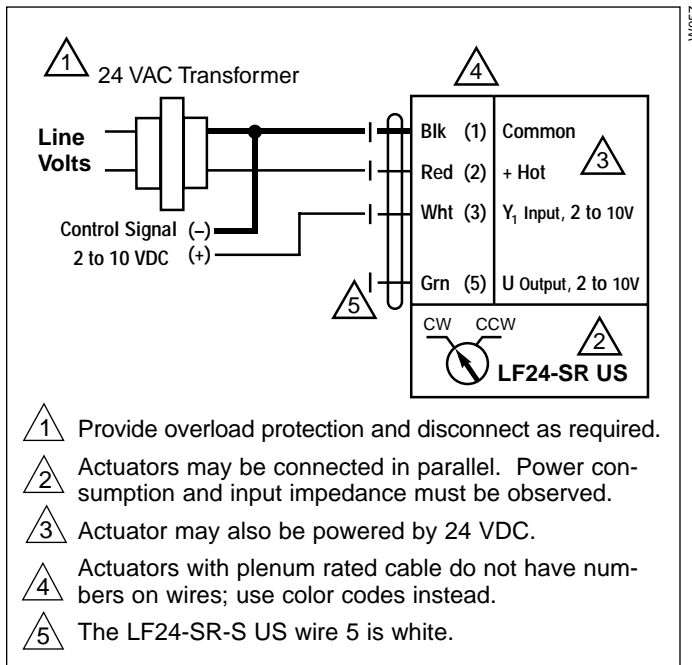
Proportional damper actuator, spring return safety, 24 V for 2 to 10 VDC, or 4 to 20 mA control signal.  
Output signal of 2 to 10 VDC for position indication.

### Accessories

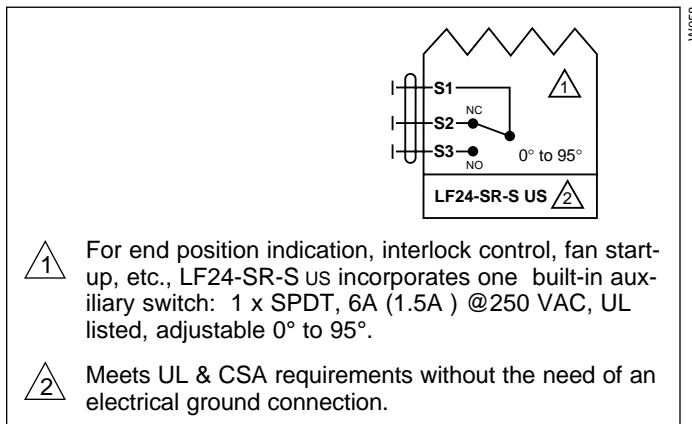
AV 10-18	Shaft extension (K6-1 is required)
IND-LF	Damper position indicator
K6-1	Universal clamp for up to 3/4" diameter shafts
KH-LF	Crankarm for up to 1/2" round shaft
SGA24	Min. and/or man. positioner in NEMA 4 housing
SGF24	Min. and/or man. positioner for flush panel mounting
Tool-01	10 mm wrench
ZG-LF2	Crankarm adaptor kit for LF
ZG-112	Mounting bracket for Honeywell Mod IV, M6415 type actuators, and new installations
ZG-LF112	Crankarm adaptor kit for Honeywell Mod IV, M6415 type actuators, and new installations
ZG-R01	500Ω resistor for 0 to 20 mA control signal
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing

**Note:** When using LF24-SR (-S) US actuators, only use accessories listed on this page.

### Wiring diagrams



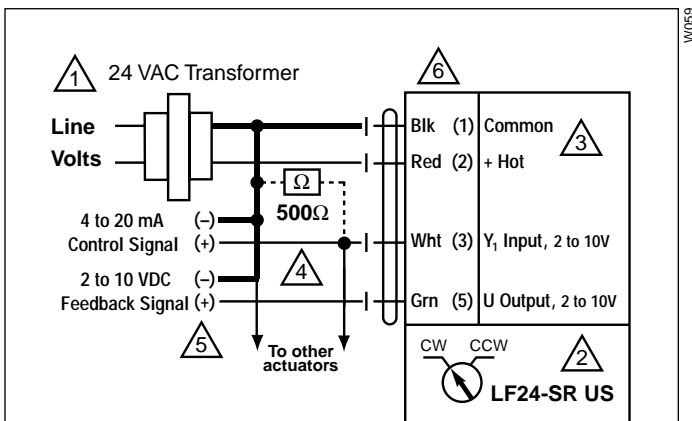
### 2 to 10 VDC control of LF24-SR (-S) US



### Auxiliary switch of LF24-SR-S US

### LF24-SR (-S) US Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crankarm and linkage and be capable of direct mounting to a shaft up to a 3/4" diameter and center a 1/2" shaft. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback or master-slave applications. If required, 1 SPDT auxiliary switch shall be provided having the capability of being adjustable. Actuators with auxiliary switch must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be UL listed and CSA certified, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.



### 4 to 20 mA control of LF24-SR (-S) US with 2 to 10 VDC feedback output

Proportional, Spring Return, 24 V, for 2 or 10 VDC or 4 to 20 mA Control Signal



Technical Data		NFB24-SR, NFB24-SR-S, NFX24-SR, NFX24-SR-S
Power supply		24 VAC ±20%, 50/60 Hz 24 VDC +20% / -10%
Power consumption	running	3.5 W
	holding	2.5 W
Transformer sizing		6 VA (class 2 power source)
Electrical connection		
	NFB...	3 ft, 18 GA appliance cable, 1/2" conduit connector <b>-S models:</b> Two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	NFX...	3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance or plenum cables, with or without 1/2" conduit connector <b>-S models:</b> Two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables, with or without 1/2" conduit connectors
Overload protection		Electronic throughout 0 to 95° rotation
Operating range Y		2 to 10 VDC, 4 to 20mA
Input impedance		100 kΩ for 2 to 10 VDC (0.1 mA) 500 Ω for 4 to 20 mA
Feedback output U		2 to 10 VDC (max. 0.5 mA)
Torque		90 in-lb [10 Nm] minimum
Direction of rotation	spring	reversible with CW/CCW mounting
	motor	reversible with built-in switch
Mechanical angle of rotation		95° (adjustable with mechanical end stop, 35° to 95°)
Running time	spring	< 20 sec @ -4°F to 122°F [-20°C to 50°C]; < 60 sec @ -22°F [-30°C]
	motor	95 sec
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (3/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		Nema 2, IP54, Enclosure Type2
Housing material		Zinc coated metal and plastic casing
Agency listings†		cULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		≤40dB(A) motor @ 95 seconds ≤62dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		4.15 lbs (1.9 kg); 4.25 lbs (1.9 kg) with switches
† Rated Impulse Voltage 800V, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 3.		
<b>NFB24-SR-S, NFX24-SR-S</b>		
Auxiliary switches		2 x SPDT 3A (0.5A) @ 250 VAC, UL Approved one set at +10°, one adjustable 10° to 90°

Torque min. 90 in-lb, for control of air dampers

### Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to a 2 to 10 VDC, or with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. A 2 to 10 VDC feedback signal is provided for position indication. Not to be used for a master-slave application.

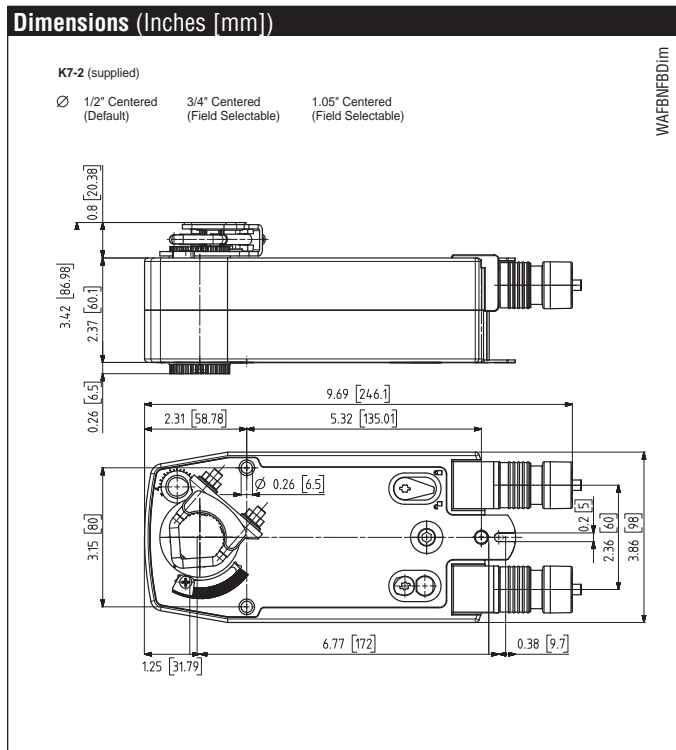
### Operation

The NFB and NFX series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

The NFB and NFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The NFB24-SR and NFX24-SR uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact fail-safe position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The NFB24-SR-S and NFX24-SR-S versions are provided with 2 built-in auxiliary switches. These SPDT switches provide safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°. The NFB24-SR, NFB24-SR-S, NFX24-SR and NFX24-SR-S actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.



L30028 - 12/09 - Subject to change. © Belimo Aircontrols (USA), Inc.



### Accessories

AV 8-25	Shaft extension
IND-AFB	Damper position indicator
KH-AFB	Crankarm
K7-2	Universal clamp for up to 1.05" dia jackshafts
TF-CC US	Conduit fitting
Tool-06	8mm and 10 mm wrench
ZG-100	Universal mounting bracket
ZG-101	Universal mounting bracket
ZG-118	Mounting bracket for Barber Colman® MA 3../4..., Honeywell® Mod III or IV or Johnson® Series 100 replacement or new crankarm type installations
ZG-AFB	Crankarm adaptor kit
ZG-AFB118	Crankarm adaptor kit
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing
ZS-300	NEMA 4X housing

**NOTE:** When using NFB24-SR, NFB24-SR-S, NFX24-SR and NFX24-SR-S actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

### Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crankarm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

### Wiring Diagrams

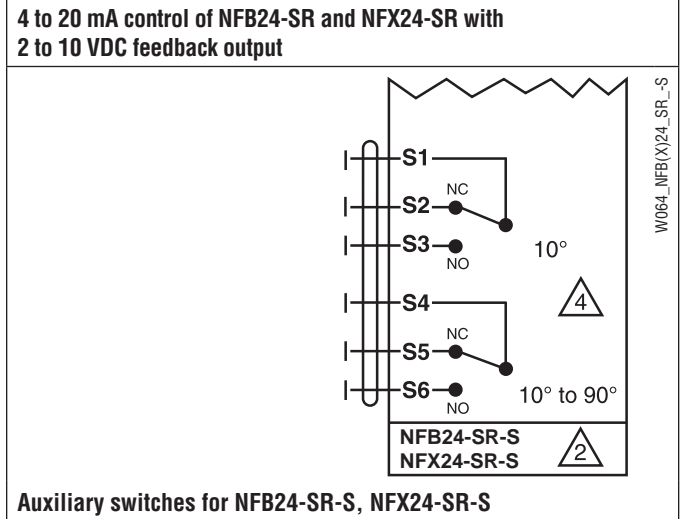
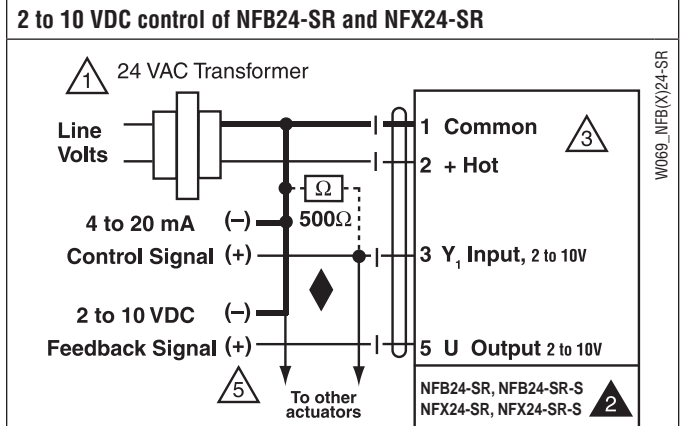
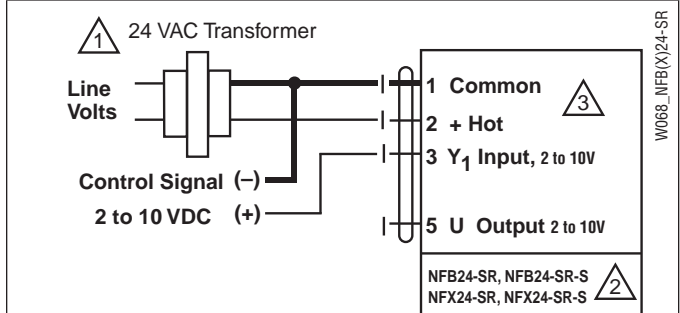
#### INSTALLATION NOTES

- 1 Provide overload protection and disconnect as required.
- 2 **CAUTION Equipment Damage!**  
Actuators may be connected in parallel. Power consumption and input impedance must be observed.
- 2 Up to 4 actuators may be connected in parallel. With 4 actuators wired to one 500 Ω resistor. Power consumption must be observed.
- 3 Actuator may also be powered by 24 VDC.
- 4 For end position indication, interlock control, fan startup, etc., NFB24-SR-S and NFX24-SR-S incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°, one is adjustable 10° to 90°.
- 5 Only connect common to neg. (-) leg of control circuits

#### APPLICATION NOTES

- ◆ The ZG-R01 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

**WARNING Live Electrical Components!**  
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



**HSD Vocational Tech  
Building M & E Upgrades  
Operations and Maintenance Manual**

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**BILL OF MATERIALS:****HSD Vocational Tech  
Building M & E Upgrades**

ATS ID	QTY	MANUFACTURER	DESCRIPTION	MAN PART #	SECTION
AFMS	1	Ebtron	Air flow monitoring station, Gold series	GTC116-P+	4
CR-2	6	Functional Devices	Current Sensing Switch, Adj. Threshold, w/ LED .5-150amp	RIBXKTA	4
MS-B4	1	Alerton Technologies	BACtalk Microset II Digital Sensor, LCD Readout	MS 2000 BT	4
PT-PIPE	1	Veris Industries	Press Trans DP 0-25/ 50 / 125 / 250 psi, LCD Display	PW2LX05S	4
PT-VL1	2	Veris Industries	Press Trans 0-1" Selectable, Panel/Duct, W/Display	PXPLX01S	4
PT-VL2	1	Veris Industries	Press Trans 0-10" Selectable, Panel/Duct, W/Display	PXPLX02S	4
T-2	4	Kele & Associates	SPDT Line Voltage Htg/Clg Thermostat	ETD5-S1S	4
TSB-03B	1	Alerton Technologies-ACI	Temp Sensor, Outside Air, Plastic Encl, 10K	TS-3200-PD-10-AA	4
TSB-09	2	Alerton Technologies-ACI	Temp Sensor,Duct, 8", Flange, 10K	TS-2008-FA-10-AA	4
TSB-14	2	Alerton Technologies-ACI	Temp Sensor, Immersion 4", Galv, 1/2NPT, 10K, Nema 1	TS-2104-GH-10-AA	4
TSB-25	1	Alerton Technologies-ACI	Temp Sensor, Duct Avg, Flex 12', 10K	TS-5012-XD-10-AB	4

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# A<sub>3</sub> Advantage 3

**Gold Series by Ebtron**

*Installation, Operation and Maintenance Technical Manual*

## **GTx116**

### **“Plug & Play” Transmitters**

Combination RS-485 and Dual Analog output model: GTC116  
Combination Ethernet and Dual Analog output model: GTM116  
LonWorks<sup>®</sup> output model: GTL116  
Data Logger output model: GTD116

**Document Name: TM\_GTx116\_R8A**



TM\_GTx116\_R8A



European Union  
Shipments  
Models GTC116 and GTE116



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Models GTC116 and GTM116

Part Number: 930-0000

**LIST OF EFFECTIVE AND CHANGED PAGES**

Insert latest changed pages (in bold text); remove and dispose of superseded pages.  
Total number of pages in this manual is **44**.

Page No	Revision *	Description of Change	Date
1-44	.R8A	All pages revised/updated to reflect Advantage 3 updates	01/21/2015

TM\_GTx116\_R8A

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## OVERVIEW

EBTRON's GTx116-P+ transmitter is designed for measurement of airflow and temperature in duct and plenum applications. The GTx116-P+ transmitter accepts from one to four model GP1 probes with a total of up to 16 sensors and provides individual flow and temperature readings as well as average readings. A programmable alarm feature on models GTC116 and GTM116 can be set for average flow low limit, high limit and system/probe/sensor faults. Analog output 2 (OUT2) can be configured as active low (OVDC or 4mA) or active high (5/10VDC or 20mA) when assigned as an alarm output. The transmitter is fully independent of the sensors and does not require field matching to them. It includes a 16 character LCD display for airflow, temperature and system configuration and diagnostics. Field configuration is accomplished through a simple four-button interface on the main circuit board. Individual sensor airflow and temperature measurements can be displayed from the diagnostic mode and are beneficial as an HVAC system diagnostic tool. The airflow output signal can be filtered, and a process low limit can be set to force the output to zero when airflow falls below a user defined value. A Field Adjustment Wizard feature can be engaged for one or two point field adjustment in applications where field adjustment is required. The GTx116-P+ transmitter is available in analog output and network output versions.

## SPECIFICATIONS

### Maximum Sensing Points

- 16 (16 airflow + temperature, independently processed)

### Sensor System Configuration (max.)

- Type A (probes x sensors): 2x8
- Type B (probes x sensors): 4x4

### Digital Signal Processing

- Microprocessor: Yes
- Multiplexing: 32 channels
- A/D Converter: 12-Bit

### "Plug and Play" Sensor Systems

- Probes do not require matching to transmitter

### Power Requirements

- 24 VAC (22.8 to 26.4 VAC), at 12 to 20 VA (dependent on number of sensors); isolation not required
- "Brownout" protection: "Watchdog" reset circuit
- Protection: Over voltage, over current and surge protection

### Enclosure

- Aluminum

### User Interface

- Pushbutton and LCD display

### Display

- 16 character alpha-numeric display (auto-ranging)

### Output to Host Controls

**GTC116, GTM116:** (Combination Dual Analog Output + Network models):

**Analog Output:** Isolated dual 0-10VDC / 0-5VDC (resolution 0.010 / 0.020% FS) or 4-20mA **and:**

for **GTC116:** Dual analog plus RS-485 Output at 76.8 kbps max BACnet<sup>®</sup>, Modbus **or**

for **GTM116:** Dual Analog plus 10-BaseT Ethernet, BACnet, Modbus, and TCP/IP

**GTL116:** LonWorks<sup>®</sup> Free Topology Transceiver (no analog output)

### Airflow Output Adjustments:

- Field Adjustment Wizard
- Offset/gain
- Airflow Output adjustable integration 1 to 1000
- Airflow Low Limit Cutoff: Forces output to zero below defined value
- Alarm Output programmable for low and high limits

### System Diagnostics

- Sensor/transmitter diagnostics mode and alarm output option

### Environmental Limits

- Operating Temperature: -20° F to 120° F (-28.8° C to 48.8° C)
- Moisture: 0 to 99% rh, non condensing (protect from water)

### Compatible Sensor Systems

- GP1 probes
- GB1 differential airflow sensors

### Listings

- UL<sup>®</sup> 873 Airflow & Temperature Indicating Devices
- CE (EU shipments only)
- BACnet BTL Listing (pending)

### Warranty

- 36 months from shipment



Figure 1. GTx116 Transmitter

## ADVANCED TECHNOLOGY

- Microprocessor-based electronics with industrial grade integrated circuits.
- "Plug and Play" design.
- Accepts from 1 to 4 probes with maximum of 16 airflow and temperature sensors.
- LCD display and Push-button user interface for simple field configuration and diagnostics.
- Programmable Alarm Output (models GTC116 and GTM116) for average flow low/high limits or system/sensor faults.
- Independent airflow and temperature output.
- Analog output signals and network protocols available for interface with virtually all modern building automation systems.

### Network Connectivity Solutions



LonWorks<sup>®</sup>

Modbus

Ethernet



**GTx116 TRANSMITTER FEATURES**

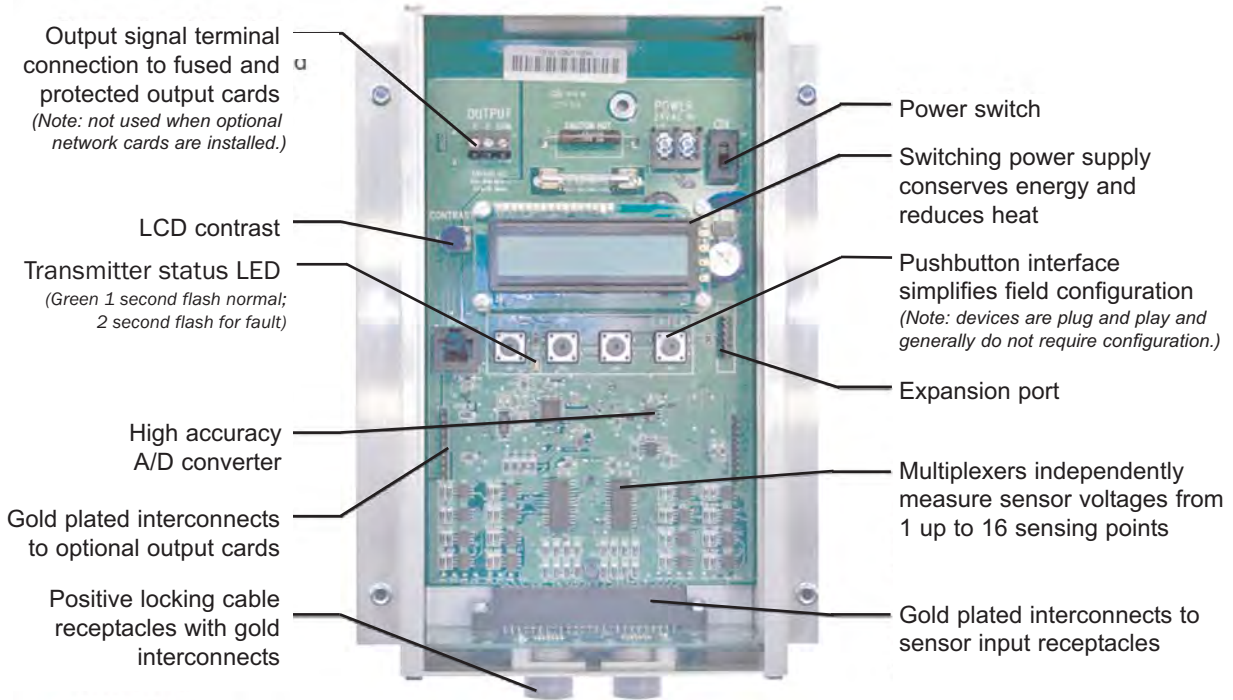


Figure 2. GTx116 Transmitter Features

**ORDERING GUIDE - GTx116 TRANSMITTER**

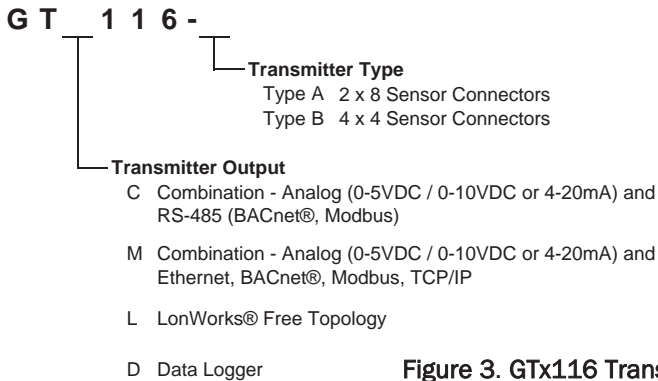


Figure 3. GTx116 Transmitter Ordering Guide

Table 1. GTx116 Connectivity Options

Output to Host Controls	Output/Protocols Supported	Airflow	Temperature	Status
Combination Analog / RS-485 Model <b>GT<b>C</b>116</b>	Analog: Linear 0-5VDC / 0-10VDC or 4-20mA	Yes	Yes	Yes
	RS-485: BACnet®-MS/TP, Modbus-RTU	Yes	Yes	Yes
Combination Analog / Ethernet Model <b>GT<b>M</b>116</b>	Analog: Linear 0-5VDC / 0-10VDC or 4-20mA	Yes	Yes	Yes
	BACnet® Ethernet	Yes	Yes	Yes
	BACnet®-IP			
	Modbus-TCP			
TCP/IP				
LonWorks® - Model <b>GT<b>L</b>116</b>	Free Topology Transceiver	Yes	Yes	Yes
Data Logger - Model <b>GT<b>D</b>116</b>	Connectivity is not available while the Data Logger is connected. Airflow, temperature and timestamp are recorded on the attached USB thumb-drive.			

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## GTx116 TRANSMITTER INSTALLATION

The GTx116 transmitter is designed for use in an environment between -20° F to 120° F (-28.8° C to 48.8° C) where it will not be exposed to rain or snow.

The transmitter should be mounted upright in a field accessible location. The enclosure (Figure 4) is designed to accept 3/4 in. (19.0 mm) conduit fittings for signal and power wiring at the top left and right sides of the circuit board. The transmitter should be located such that the connecting cables from all of the sensor probes reach the receptacles on the bottom of the transmitter enclosure.



In locations exposed to direct rain and/or snow, the transmitter must be enclosed in a NEMA4 enclosure.



Leave at least 10 in. (254.0 mm) above, and 2 in. (50.8 mm) to each side and bottom, of unobstructed space around the transmitter to allow for heat dissipation and cover removal.



Locate the transmitter in a location that can be reached by all connecting cables from the sensor probes.



Do not drill into the transmitter enclosure since metal shavings could damage the electronics.

### GTx116 Mechanical Dimensions

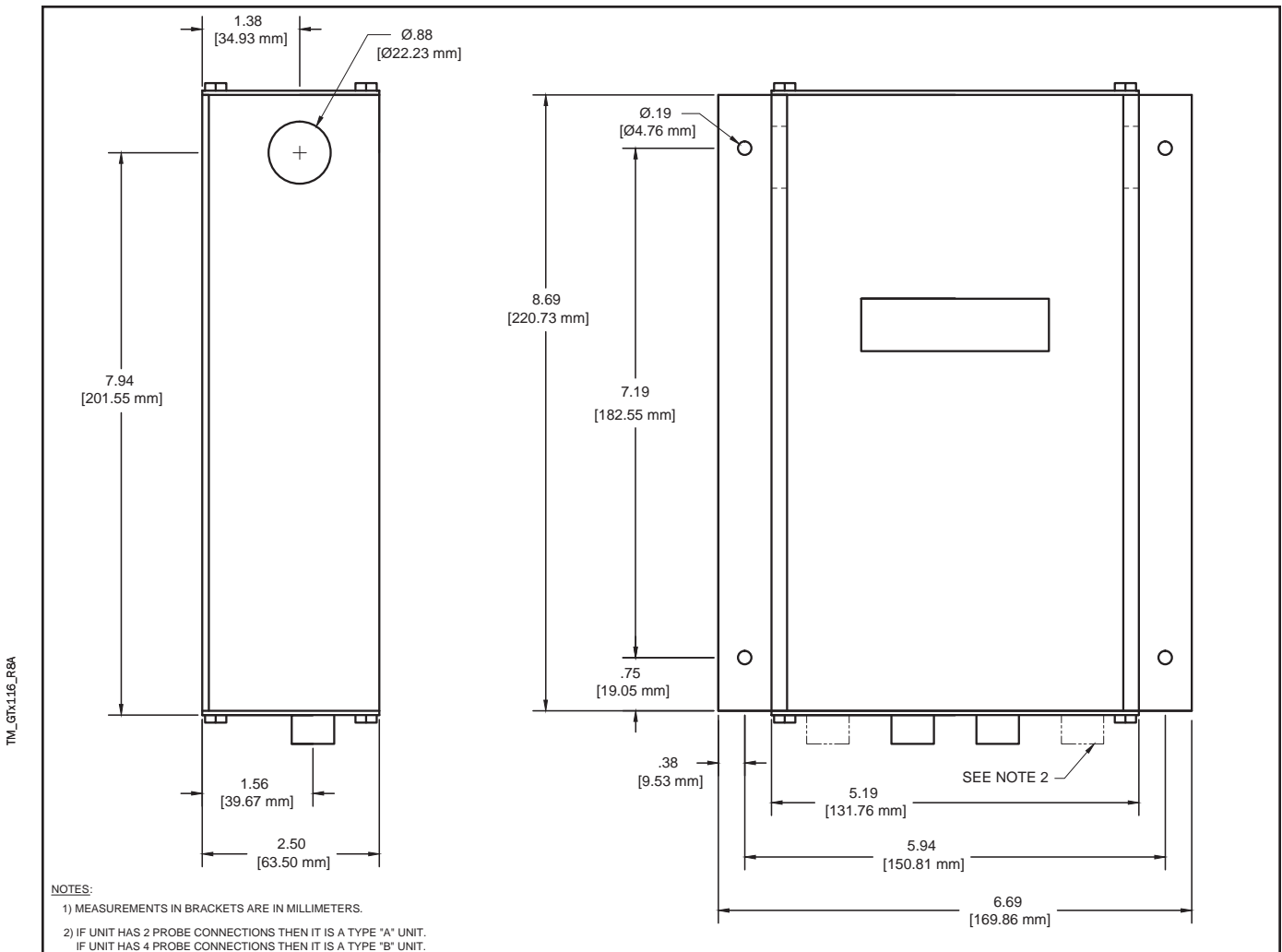


Figure 4. GTx116 Transmitter Mechanical Detail Drawing

**Power Transformer Selection**

Select a 24 VAC transformer based on the maximum power requirements indicated on the transmitter label (20 VA) or from the table below. The operating supply voltage (transmitter power “ON” with all sensor probes connected) should not be less than 22.8 VAC or greater than 26.4 VAC.

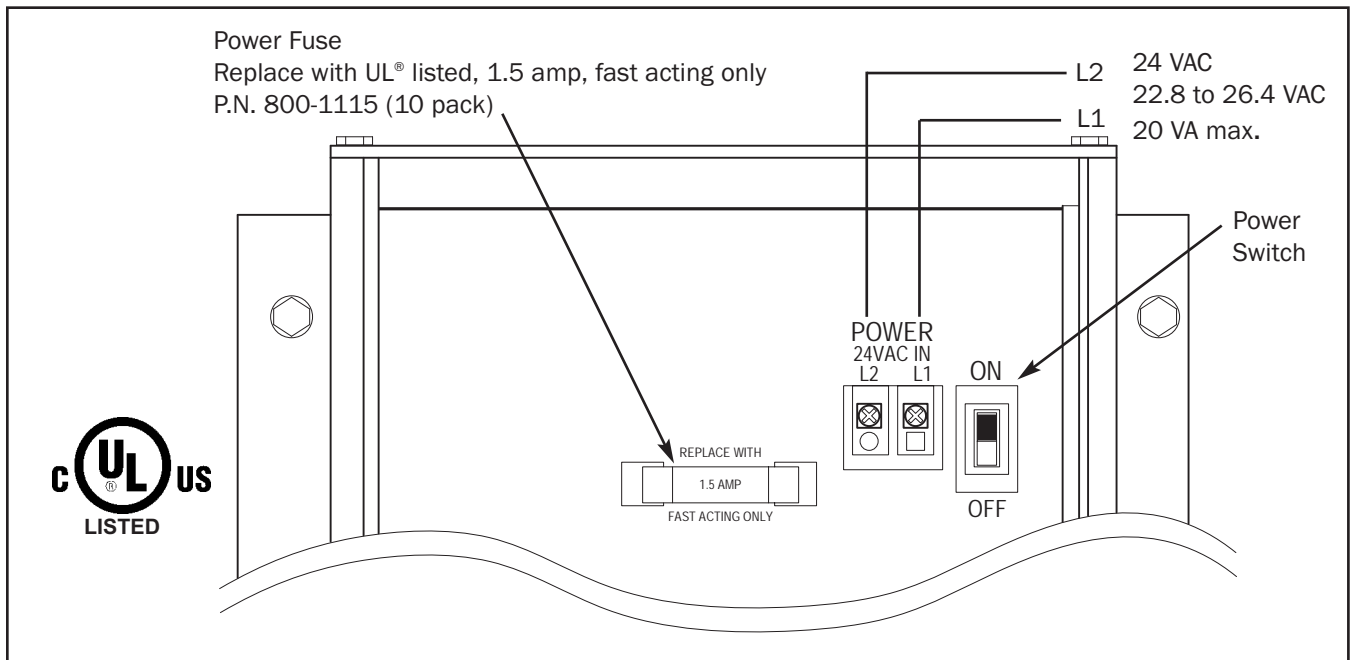
**Table 2. GTx116 Power Transformer Selection Guide**

Total Sensors	Minimum VA Req.	Total Sensors	Minimum VA Req.	Total Sensors	Minimum VA Req.	Total Sensors	Minimum VA Req.
1	12	5	14	9	17	13	19
2	13	6	15	10	17	14	19
3	13	7	15	11	18	15	20
4	14	8	16	12	18	16	20

**Connecting Power to the Transmitter**

Slide the cover plate up and off of the transmitter enclosure, and ensure that the power switch is in the “OFF” position before connecting the 24 VAC power source.

Connect 24 VAC power to the large, two position power input terminal labeled “POWER” on the upper right hand side of the main circuit board (Figure 5). Since the output signals are isolated from the power supply, it is not necessary to provide an isolated (secondary not grounded) power source.



**Figure 5. GTx116 Power Connections**

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Multiple GTx116 transmitters wired to a single transformer must be wired “in-phase” (L1 to L1, L2 to L2).



Sensor probes must be connected to the transmitter before turning the power switch to the “on” position to properly “flash” sensor calibration data to the transmitter.

**Connecting Sensor Probes to the Transmitter**

After mounting the sensor probes and transmitter, connect one or more sensor probe cable plugs to the circular receptacles located at the bottom of the GTx116 transmitter enclosure. Probes are “Plug and Play” and do not have to be connected to a specific receptacle on the transmitter (unless traverse data is desired - see note below). Transmitters accept only GP1 and GB1 sensors.



Provide a “drip loop” at the transmitter if there will be the potential for water runoff or condensation along the sensor probe cable(s).



Sensor probe cable plugs are “keyed” as shown in Figure 7. Line up plug with receptacle and push straight on to receptacle. **DO NOT TWIST.** Squeeze cable plug “ribs” towards receptacle when removing. Forcing the cable plug in or out of the receptacle will damage the connectors and void warranty.



If traverse data is desired, probes should be installed and connected to the transmitter using the mounting convention specified in the separate GP1/GB1 sensor probe manual. Proper installation simplifies sensor location decoding during data analysis.

**TYPE A TRANSMITTER**



Accepts 1 or 2 probes up to 8 sensors each.

**TYPE B TRANSMITTER**



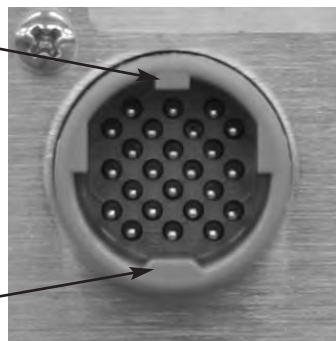
Accepts 1 to 4 probes up to 4 sensors each.

**Figure 6. Type A and Type B Transmitter Detail**

Align Small Key and Slot

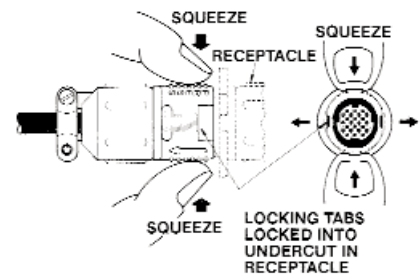


Cable End Plug



Transmitter Receptacle

Align Large Key and Slot



Squeeze and Pull to Remove  
**DO NOT TWIST!**

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**Figure 7. Connector Detail**

## **GTC116, GTM116 - COMBINATION ANALOG + NETWORK TRANSMITTER SETUP**

The GTC116 Combination card option allows simultaneous analog outputs and RS-485 differential bus/line transceiver outputs designed to integrate with various network protocols.

The GTM116 Combination Analog/Ethernet card option allows simultaneous analog outputs and full duplex IEEE 802.3 ethernet interface with automatic re-transmission on collision and cyclic redundancy checking on network data. An on-board microcontroller performs over 7 million instructions per second to insure minimal network latency. Link status as well as network activity are available via on-board LED indicators.

The GTC116 and GTM116 combination cards plug directly onto the main circuit board as shown in Figures 8 and 9.

### **GTC/GTM116 - ANALOG OUTPUT OUTPUT WIRING AND SETUP**

Analog output connections are made at the top left of the transmitter main circuit board OUTPUT connector as shown in Figures 8 and 9. Independent 12-bit (4096 discrete states) linear analog outputs are provided for airflow at OUTPUT terminal 1, and for temperature (or alarm) at OUTPUT terminal 2, each with over voltage and over current protection. **Airflow and temperature outputs are field selectable for either 0-5/0-10VDC or 4-20 mA.** The OUTPUT terminal 2 can be assigned as an Alarm output to provide an active high, active low or trouble alarm output (as determined by SW2 setting). Outputs are galvanically and optically isolated from the main power supply to permit simple integration with virtually all building automation systems.



When configured for a 4-20mA output, the GTC116 is a "4-wire" device. The host controls shall not provide any excitation voltage to the output of the GTC116.

To wire the analog output signals, slide the cover plate up and off of the enclosure. Ensure that the power switch is in the "OFF" position. Connect signal wires for airflow rate and temperature (or alarm) to the small, three position output terminal labeled "OUTPUT" on the upper left hand side of the main circuit board as indicated in Figure 8. Airflow output is at terminal 1, and temperature, airflow alarm or trouble alarm output is at terminal 2.

### **GTC116 - RS-485 NETWORK WIRING CONNECTIONS**

Refer to Figure 8, and the following paragraph for network wiring considerations.

#### **RS-485 Network Cable Specifications**

The RS-485 network cable shall be shielded twisted pair with a characteristic impedance of 100 to 130 ohms. Distributed capacitance between conductors shall be less than 100 pF per meter. Distributed capacitance between conductors and shield shall be less than 200 pF per meter. The maximum recommended length of a network segment is 1200 meters with AWG 18 cable.

#### **Connecting to an RS-485 Network:**

Connect the NET+, NET- and COM terminals with shielded twisted pair cable meeting the specifications defined in the previous paragraph (typically using two pairs, with one wire not used; one pair for +/- and both wires in other pair for COM when using 2-pair cable). The connection to the network must be made in a "daisy chain" configuration. "T" connections and stubs are NOT permitted. The shield should be terminated at one end on the network only. If the GTC116 is not the first or last device, set the on-board termination DIP switches for NO TERMINATION. If the GTC116 is the first or last device, set the on-board termination DIP switches to either END OF LINE or FAIL SAFE BIAS termination.

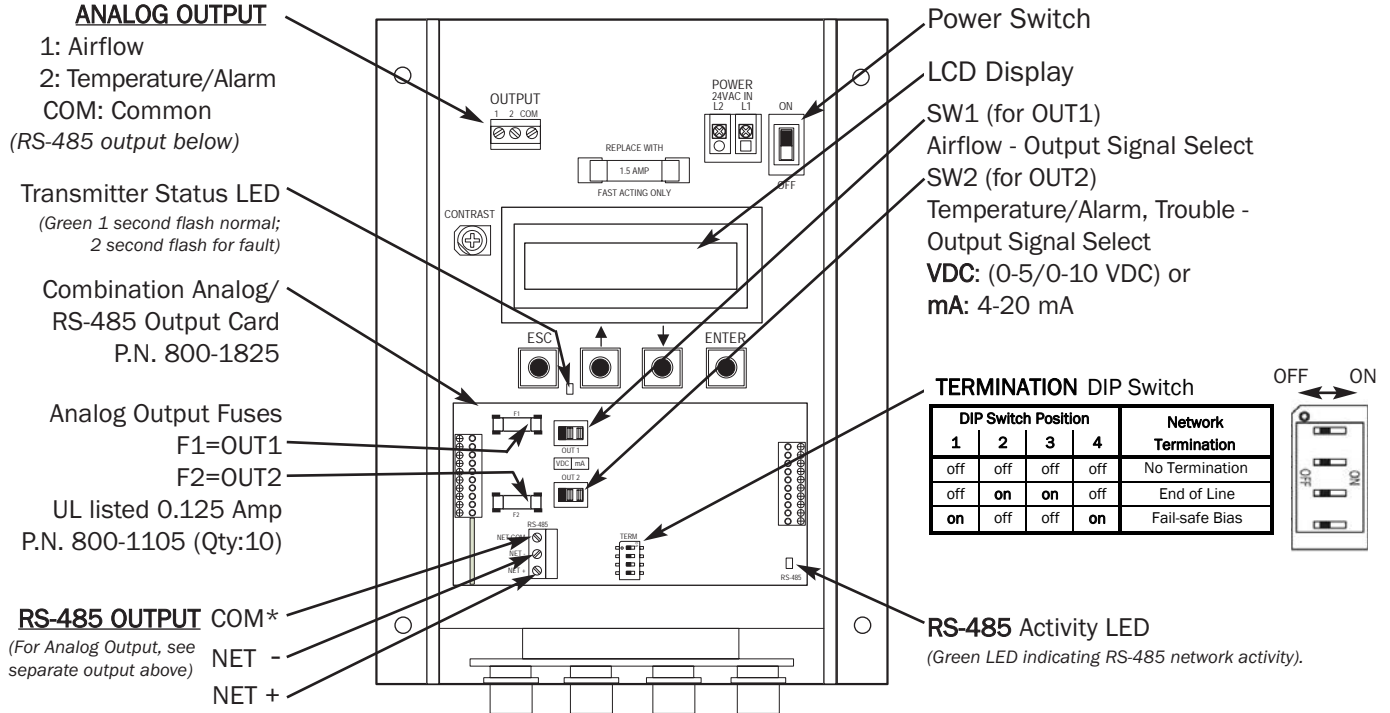
#### **\*CAUTION**



For ISOLATED output, the **COM** connection MUST BE CONNECTED to the network common for proper operation. In addition, when the Analog Output is concurrently used with the RS-485 Output, the Common connection for both Analog and RS-485 Outputs must be at the same potential.



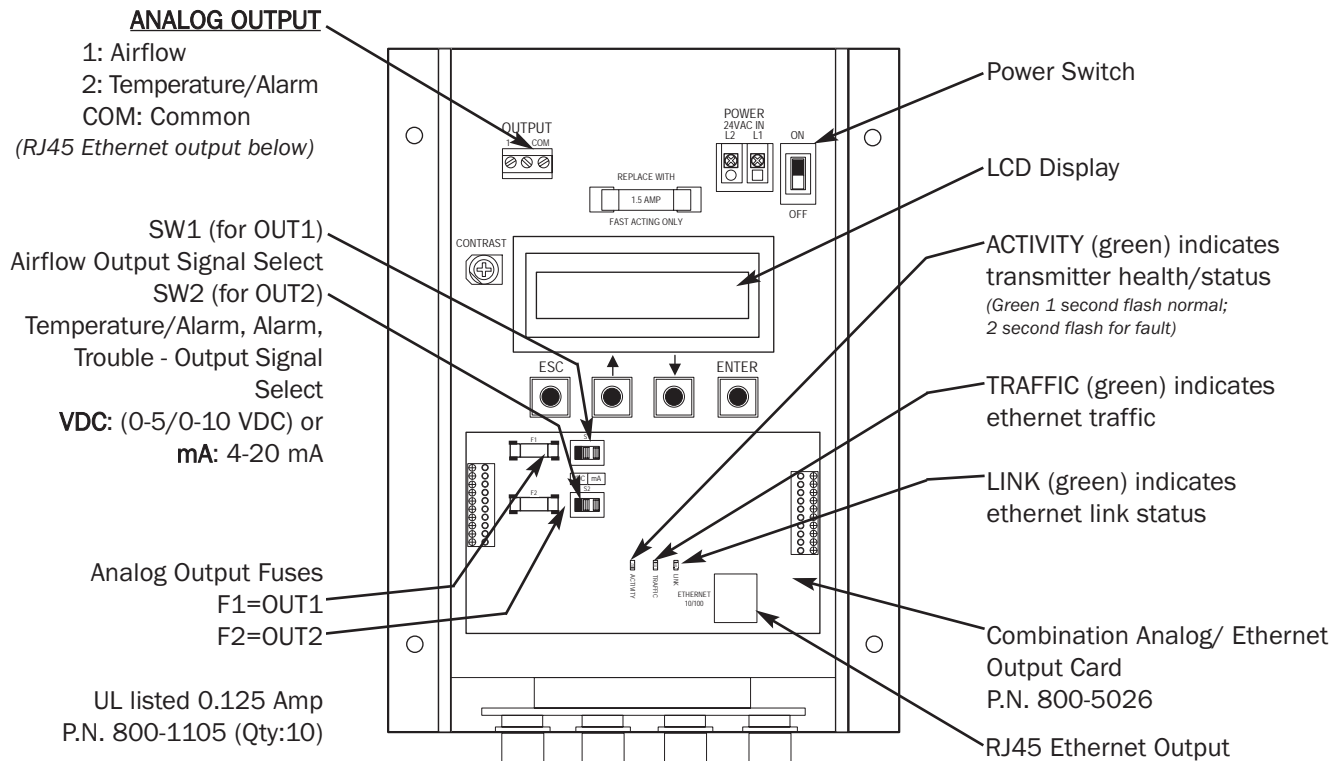
For NON-ISOLATED output, the **COM** connection MUST BE CONNECTED to the common ground that is used by the other network devices (typically the ground side of the 24VAC supply; the L2 terminal at the POWER connector block as shown in Figure 8). In addition, when the Analog Output is concurrently used with the RS-485 Output, the Common connection for both Analog and RS-485 Outputs must be at the same potential.



⚠ The common for the ANALOG and the RS-485 outputs must be at the same potential.  
For **ISOLATED** RS-485 output, **COM** connection **MUST BE CONNECTED** to network common.  
For **NON-ISOLATED** output, **COM** connection **MUST BE CONNECTED** to the common ground that other network devices are using (typically the ground side of the 24VAC supply - L2 of the POWER terminals). Refer to **RS-485 Network Wiring Connections** paragraph for additional detail.

**Figure 8. GTC116 Combination Analog/RS-485 Transmitter Interior Detail**

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**Figure 9. GTM116 Combination Analog/Ethernet Transmitter Interior Detail**

## GTx116 TRANSMITTER START-UP, INITIALIZATION AND SETUP MENUS

To ensure a successful start-up, verify that the airflow measuring station and transmitter are installed in accordance with **EBTRON** guidelines.



Check the physical installation, power connections and model specific signal wiring prior to turning the power switch to the “on” position.

Move the power switch to the “ON” position. The transmitter executes a complete self-check each time the power is turned on that takes 10 seconds to complete.

The GTC116 and GTM116 default analog output signals are set to 4-20mA. The output signal can be changed to 0-5VDC/0-10VDC using board by setting switches SW1, SW2 and then entering the desired setting in the Setup menu. The GTC116, GTM116 and GTL116 must be properly configured based on the system network protocol. Review the section for the corresponding transmitter output card or contact **EBTRON** Customer Service, toll free, at 800-232-8766.

### Changing the System of Units - IP (Inch Pound) units or SI (Standard International) Units

The GTx116 transmitter is provided with the system of units set to I-P. To change to S.I., simultaneously press and release the “ENT” and “ESC” buttons during normal operation. “IP/SI UNITS” will be indicated on the LCD display. Refer to Appendix B SYSTEM OF UNITS MENU for details on the System of Units menu. Note that Setup Menu items are shown in IP System Of Units. When SI System of Units is selected, the units of measure abbreviations used in the menus is shown in Table 3.

**Table 3. Standard “IP” and “SI” Menu Units Abbreviations**

“IP” System of Units	Description	“SI” System of Units	Description
FPM	Feet per minute	MPS	Meters per second
CFM	Cubic feet per minute	LPS	Liters per second
SQF	Square feet	SQM	Square meters
F	Fahrenheit	C	Celsius

## GTx116 TRANSMITTER CALIBRATION

The GTx116 uses high quality industrial grade components and is designed for years of trouble-free operation. Periodic recalibration of the transmitter is neither required or recommended. Transmitter field calibration verifiers are available for purchase from **EBTRON** for installations requiring periodic validation of instrumentation. Contact **EBTRON** for more information.

## GTx116 LCD DISPLAY NOTIFICATIONS

Following a brief initialization at power up, the LCD display automatically displays airflow and temperature with units of measurement in all upper case (caps) characters. The display provides additional information on system status and alarm conditions. Refer to the **ALARM FEATURES** section of this manual for additional detail on Alarm and Trouble Error code indications.



a measurable difference!

**Factory Default Menu Settings for GP1 Sensor Probes**

The GTx116 transmitter is “plug and play” and does not require setup unless a network option is selected that requires configuration. Table 4 shows the factory default settings for all compatible sensor probes.

To change the Factory Default Settings, see: CHANGING FACTORY DEFAULT SETUP MENU SETTINGS.

**Table 4. Factory Default Menu Settings**

Display	Description	I-P	S.I.
AIRFLOW=	Airflow measurement method, Actual or Standard.	ACT	ACT
*LCDU/M=	Airflow units of measure	ACFM	ALPS
*AREA=	Free area where station is located (required for volumetric measurement)	0.00 sq.ft. (see note)	0.000 sq.meters (see note)
*AO1 SGNL=	GTC/GTM116 output 1 signal type voltage or mA (airflow)	mA	mA
*AO1 UM=	Output 1 units of measure	AFPM	AMPS
*AO1 FS=	GTC/GTM116 output 1 signal full scale	5,000 FPM	25 MPS
*LLIMIT=	GTC/GTM116 low limit cutoff	0 AFPM	0 AMPS
*FLOW ADJ=	Output 1 Offset-Gain On/Off	Off	Off
*GAIN=	Output 1 Gain factor	1.000	1.000
*OFF=	Output 1 Offset factor	0.000	0.000
*TEMP METH=	Temperature Averaging	Weighted Avg.	Weighted Avg.
*AO2 SGNL=	GTC/GTM116 output 2 signal voltage or mA (temperature or alarm)	mA (see alarms)	mA (see alarms)
*AO2 MS=	GTC/GTM116 output 2 signal minimum scale	-20° F	-30° C
*AO2 FS=	GTC/GTM116 output 2 signal full scale	160° F	70° C
*LCD INTG=	Number of flow calculations to be averaged for LCD display.	100	100
*AO1 INTG=	Number of flow calculations to be averaged for AO1 output.	30	30
*EB-LK INT=	Number of flow calculations to be averaged for EB-Link readings.	300	300
*ALT=	Altitude for flow correction relative to mean sea level (0 ft).	0 ft	0 m
<b>*AO2 ASGN =</b>	Output 2 Assigned Type: Temperature/Alarm as follows:		
<b>*AO2 ASGN = TEMP</b>	AO2 Output indicates temperature.	TEMP	TEMP
<b>AO2 ASGN = ALARM</b> (Average airflow alarm)	AO2 output indicates <b>HI, LO</b> (or <b>OFF</b> ) average airflow alarm type that is selected in <b>ALARM</b> submenu:		
+ LO ALRM=OFF/ON	The average Low Alarm is activated when the average airflow falls below a selected set point (SETPNT=) - tolerance (TOL=) value. Once active, the alarm can be cleared when the average airflow rises above the set point - tolerance value.		
+ HI ALRM=OFF/ON	The average High Alarm is activated when the average airflow rises above a selected set point (SETPNT=) + tolerance (TOL=) value. Once active, the alarm can be cleared when the average airflow falls below the set point + tolerance value.		
<b>AO2 ASGN=TROUBLE</b> (Transmitter/sensor status)	Alarm when a fault is detected in the transmitter, sensor or setup of the system. Error code and brief description of trouble is provided on LCD display.		
*SETPNT=	Alarm setpoint value. For <b>AO2 ASGN=ALARM</b> , operates in conjunction with <b>TOL=</b> value.	0	0
*TOL=	Alarm range tolerance value. For <b>AO2 ASGN=ALARM</b> , this setting establishes the alarm range relative to the <b>SETPNT=</b> value.	10%	10%
*NO FAULT=	Sets the AO2 normal (not alarm) output state relative to the full scale analog output selected. <b>HI</b> provides maximum full scale under normal conditions and minimum scale during alarm. <b>LO</b> provides minimum full scale under normal conditions and maximum scale during alarm.	HI	HI
*DELAY=	Time in seconds that the alarm condition must exist before alarm output is activated.	2 minutes	2 minutes
*ZERO OFF =	Set to <b>YES</b> to inhibit LO alarm condition when flow reading is zero (dependent on <b>LLIMIT=</b> setting). Set to <b>NO</b> to disable this feature.	NO	NO
*RESET =	Set to <b>AUTO</b> to have alarm self-clear when alarm condition no longer exists. Set to <b>MANUAL</b> to require manual reset of alarm.	AUTO	AUTO

**Note:** For GP1 probes, area is stored in one-wire, but can be changed.

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## **GTx116 CHANGING FACTORY DEFAULT SETUP MENU SETTINGS**

### **Setup Menu Options**

The GTx116 Transmitter is setup and tested at the factory to be fully operational when sensor probes are connected and power is applied (set the power switch to the “ON” position). Factory settings can easily be changed using the SETUP MENU by simultaneously pressing and releasing the “UP” and “DOWN” buttons while the transmitter is in its normal operating mode. Navigate through the menu using Appendix B to make changes to the transmitter configuration. The settings take effect immediately. The following are common field modifications to the factory default settings.

### **Selecting Actual and Standard Output Measurement Type**

The transmitter is set from the factory to provide actual airflow measurement units (displayed as “ACFM” and “AFPM”). In this mode, airflow measurements are corrected for the for actual inlet conditions. If using Actual conditions, corrections for altitude are entered through the **ALT=** setting in the Setup menu. If desired, the output can be set to provide standard airflow measurement units (displayed as “SCFM” and “SFPM”) which provides measurements that are corrected to standard temperature (70 degrees fahrenheit) and atmospheric pressure at sea level (29.92 inches).

### **Output Scaling**

**EBTRON**'s Gold Series sensors are individually calibrated between 0 and the factory default full scale to standards in wind tunnels traceable to the National Institute of Standards and Technology (NIST). Sensors are independent and produce “percent of reading” accuracy. Changing the full scale does not change the accuracy of the device). Factory default output scaling for analog GTC116 and GTM116 transmitters can be changed using setup menus of Appendix B.

### **Changing the LCD Display from Volumetric Flow CFM to Velocity FPM**

The GTx116 transmitter is shipped from the factory to indicate volumetric flow. To display velocity in FPM, enter the *Setup Menu* and in the **DISPLAY** submenu, change the “\*LCD UM=ACFM” to “\*LCD UM=AFPM”. Changing the LCD display units will not affect the analog output signal. The analog output signal can be scaled if required as described below.

### **Converting the Analog Output Signal from FPM to CFM**

The GTx116 transmitter is shipped from the factory with analog output “OUTPUT 1” set to indicate velocity in AFPM. To automatically convert this analog velocity output to volumetric flow (ACFM), simply set the \*AO1 UM from AFPM (default) to ACFM in the *Setup Menu* (Appendix B). If you wish to manually convert the velocity output to volumetric flow (ACFM), simply multiply the indicated output velocity (in FPM) by the free area of the air flow probe installation location. Refer also to Table 6 for a complete listing of conversions for each of the analog outputs of the GTx116. The AO1 full scale analog output (OUTPUT1 ) value is determined by the **AO1 RNGE** setting within the *SETUP MENU*.

### **Locking the Configuration Settings**

The GTx116 transmitter configuration settings can be locked at one of three security levels within the SECURITY submenu using the **LOCK SEC=** item.

When LOW security level is selected (**LOCK SEC=LOW**) the last 4 digits of the board serial number are automatically assigned as the lock code. To see the board serial number, navigate to DIAGNOSTICS menu in SERIAL NUMBERS item.

When the MED security level is selected (**LOCK SEC=MED**) the user enters a security code. **In the event that this code is lost/misplaced, EBTRON can provide a key that is unique to the transmitter to unlock it.** Contact EBTRON customer service for this code.

When the HIGH security level is selected (**LOCK SEC=HIGH**) the user enters a security code. **In the event that this code is lost/misplaced, the transmitter must be returned to the factory in order to unlock it.**



When **LOCK SEC=HIGH** is selected, the user defined setting can only be changed after entering the user defined code. **STORE THE LOCK CODE IN A SAFE LOCATION!** For security reasons, the HIGH level lock code can only be reset by returning the transmitter to the factory.



## VIEWING SENSOR DATA

### Viewing Sensor Data on the Local LCD Display

Airflow and temperature can be displayed on the local LCD display by entering the Diagnostic Menu. Simultaneously depress the up ↑ and down ↓ arrows to enter the GTx116 Setup Menu, and then navigate to the Diagnostic Menu as shown (Appendix B).

### Viewing Sensor Data over BACnet or Modbus Networks or through the EB-Link Reader

Airflow and temperature of individual sensors can be read across BACnet or Modbus networks, or downloaded directly to a PDA if the infra-red **EB-Link** option has been installed. Refer to the following Sensor Addressing and Probe Positioning paragraph for the suggested probe installation configuration. The string is described as follows:

<sensor type>,<C1>,<C2>,<C3>,<C4>, data<sub>1</sub>, data<sub>2</sub>, data<sub>3</sub>,...data<sub>n</sub>

where:

sensor type = PROBE or BLEED

C1 = number of sensors on connector C1 (0 to 8 on PROBE, 0 to 1 on BLEED)

C2 = number of sensors on connector C2 (0 to 8 on PROBE, 0 to 1 on BLEED)

C3 = number of sensors on connector C3 (0 to 8 on PROBE, 0 to 1 on BLEED)

C4 = number of sensors on connector C4 (0 to 8 on PROBE, 0 to 1 on BLEED)

data = airflow fpm (m/s) or temperature °F (°C) as sequential data starting at connector C1 as shown below.

Note that traverse data can also be acquired from AV objects when enabled.

Registers describing individual airflow and temperature data at the time of request are available when the device is configured for Modbus (see Register Maps Tables 5 and 6 in this manual).

### Sensor Addressing and Probe Positioning

Sensors are automatically addressed after power is applied to the transmitter as follows:

#### **Type 'A' (2 Connector) Transmitter**

The probe that is connected to the left-most **used** receptacle (labeled **C1-C2**) on the transmitter is addressed as **probe 1**. Up to 8 sensors can be individually viewed. To standardize installation and decoding of the data, **EBTRON** suggests the sensor probe mounting convention as shown in Figure 10.

#### **Type 'B' (4 Connector) Transmitter**

Probes are statically numbered. The probe that is connected to the left-most receptacle (labeled **C1**) on the transmitter is addressed as **probe 1**. To standardize installation and decoding of the data, **EBTRON** recommends the sensor probe mounting convention as shown in Figures 10 and 11.

Note that if only average data is desired, the mounting position of the probes is not critical. When a probe is disconnected and then plugged in to a different port, the transmitter will re-discover it within 15 seconds and make any necessary addressing adjustments.

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Figure 10. GTx116 Transmitter Connector Diagram

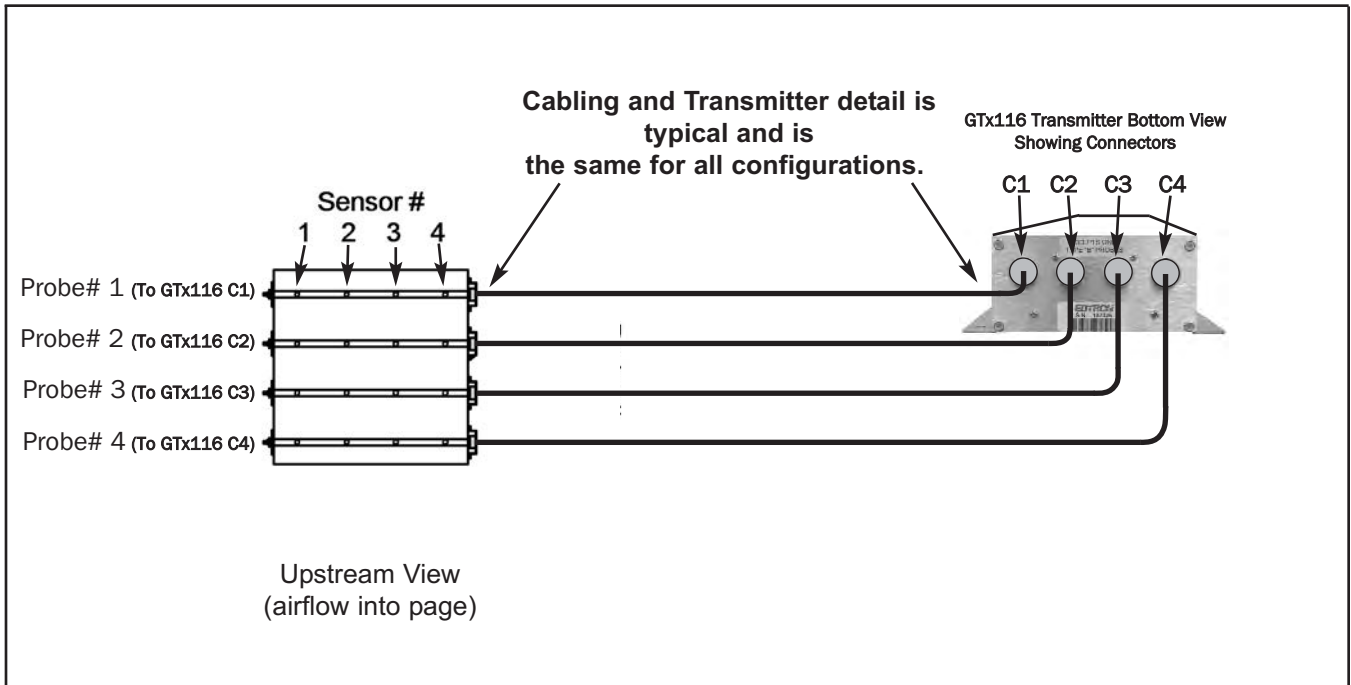


Figure 11. Example of Probe Mounting and Connector Locations for Proper Decoding of Traverse and EB-Link Data

**GTC/GTM116 - ALARM FEATURES**

The analog temperature output AO2 (OUT2) of the GTC/GTM116 transmitter can be assigned to function instead as an alarm output. The OUT2 alarm output can be assigned in the SETUP menu to operate as an average alarm (**AO2 ASGN=ALRM**) or as a trouble alarm (**AO2 ASGN=TRBL**) for monitoring the status of the transmitter and sensors. The **AO2 ASGN=** setting is located in the **ANALOG OUT** submenu of the **SETUP** menu:

**Average Alarm (AO2 ASGN=ALRM)**

AO2 output is assigned as an average airflow alarm output. Useful for applications where a low flow alarm, a high flow alarm for operation outside of a defined range (setpoint and tolerance) is required.

**Trouble Alarm (AO2 ASGN=TRBL)**

AO2 output is assigned as a transmitter trouble alarm indicating a fault within the transmitter or a sensor of the airflow measurement system. The transmitter LCD will indicate a trouble code and a brief description of the trouble. Contact EBTRON customer service for additional information or assistance with trouble codes.

The transmitter LCD display will indicate the Alarm status for 2 seconds, and will cycle through any other alarms if multiple alarm events are active for 2 seconds each, and then display the current actual flow for 2 seconds. Detailed set up of the Alarm features is shown in the Setup menu.

**No Fault (NO FAULT=HI)**

When AO2 output is assigned as an alarm, this setting configures the normal output condition to be HI or LO relative to the full scale analog output level selected when no fault condition exists.

**Alarm Indications**

Table 5 details the alarm types, LCD indications and AO2 alarm outputs available from the GTC/GTM116. User can select either of the two Average Alarms or the Trouble Alarm:

**Low Alarm - “LO ALRM= ON”**

The Low Alarm is activated when the average airflow falls below a selected set point (**SETPNT=**) - tolerance (**TOL=**) value. Once active, the alarm can be cleared when the average airflow rises above the set point - tolerance value.

**High Alarm - “HI ALRM= ON”**

The High Alarm is activated when the average airflow rises above a selected set point (**SETPNT=**) + tolerance (**TOL=**) value. Once active, the alarm can be cleared when the average airflow falls below the set point + tolerance value.

**Trouble Alarm - “AO2 ASGN=TRBL”**

The Sensor Trouble alarm is selected in the ANALOG OUT submenu (**AO2 ASGN=TRBL**) and provides trouble codes useful for isolating setup issues or problems within the transmitter or sensors. The transmitter LCD will indicate **TROUBLE!** The Diagnostic submenu can be engaged for the error code and a brief description of the trouble. Contact EBTRON customer service for information on troubleshooting using the Trouble error codes.

**Table 5. GTx116 Alarm Types and Notifications**

ALARM OUTPUT ASSIGNMENT TYPE	LOCAL LCD DISPLAY OF ALARM TYPE AND NOTIFICATION	ALARM (OUT2) INDICATION
User can select either of the two Average Alarms or the Trouble Alarm:		
<b>**LOW ALARM** (Average Alarm)</b>	Display alternates between <b>**LOW ALARM**</b> (then any other alarms) and actual reading for 2 seconds each.	On alarm or trouble, OUT2 is active high (or active low) relative to the full scale maximum (or minimum) analog value as determined by SETUP Menu “ <b>NO FAULT=</b> ” selection. Individual sensor velocities can be viewed using the Diagnostics submenu.
<b>**HIGH ALARM** (Average Alarm)</b>	Display alternates between <b>**HIGH ALARM**</b> (then any other alarms) and actual reading for 2 seconds each.	
<b>TROUBLE ! (Trouble Alarm)</b>	Display indicates <b>TROUBLE !</b> (Refer to DIAGNOSTIC menu to obtain a brief description of the error and any other alarms).	

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**GTC/GTM116 - ANALOG OUTPUT TYPE SELECTION AND SETUP**

The analog output signal type at OUT1 (airflow) and OUT2 (temperature/alarm) can be set for mA or VDC output by setting switches SW1/SW2 (Figure 8) and by selecting the 4-20mA, 0-5VDC or 0-10VDC ranges in ANALOG OUT sub menu options \*AO1 RNGE= / \*AO2 RNGE= settings (Appendix B). The transmitter is shipped from the factory with SW1/SW2 and Setup menu options \*AO1 RNGE= and \*AO2 RNGE= set for 4-20mA.

**GTC/GTM116 - Converting Analog Output Signal Values to Airflow and Temperature**

Since the accuracy of the GTC/GTM116 is “percent of reading” there should be no need to reconfigure the default output scales listed inside of the transmitter cover. However, factory default settings can be easily reconfigured in the field (see: CHANGING FACTORY DEFAULT SETTINGS).

The equivalent volumetric flow full scale reading can easily be determined by multiplying the full scale reading by the free area where the airflow measuring station is located (free area x 1000 for S.I. scaling when the area is calculated in square meters). Table 6 lists specific conversion factors for analog voltage or current output options.

**GTC116 - OUTPUT TEST - Sending a Test Output Signal to the Host Control System**

A test output signal between 0 and 100% of the full scale output (4-20 mA or 0-5VDC/0-10VDC) can be provided by the GTC/GTM116 transmitter to verify proper conversion of the output signals from the transmitter at the host control system. To set a fixed output signal for airflow and temperature, navigate to the OUTPUT TEST sub menu in the TOOLS menu (refer to Appendix B in TM\_GTx116). OUT1 and OUT2 tests are independently accessed, and the output will maintain the % shown until the “ESC” button is pressed and normal operation resumes. OUTPUT TEST is located in the TOOLS menu. Refer to Appendix B.

**Table 6. GTC/GTM116 Converting Analog Output Values to Airflow/Temperature**

When OUTPUT 1 is Configured as Linear Airflow (FPM, MPS):

TO CONVERT TO	ANALOG OUTPUT SCALING AND TYPE		
	0-10 VDC	0-5 VDC	4-20 mA
Airflow (FPM, MPS)	Output Voltage/10 x FS1	Output Voltage/5 x FS1	(Output Current-4)/16 x FS1
Airflow (CFM)	Area (SQF) x Output/10 x FS1	Area (SQF) x Output/5 x FS1	Area (SQF) x (Output - 4)/16 x FS1
Airflow (LPS)	Area (SQM) x Output/10 x FS1 x 1000	Area (SQM) x Output/5 x FS1 x 1000	Area (SQM) x (Output - 4)/16 x FS1 x 1000

When OUTPUT 1 is Configured as Volumetric Airflow (CFM, LPS):

TO CONVERT TO	ANALOG OUTPUT SCALING AND TYPE		
	0-10 VDC	0-5 VDC	4-20 mA
Airflow (CFM, LPS)	Output Voltage/10 x FS1	Output Voltage/5 x FS1	(Output Current - 4)/16 x FS1

When OUTPUT 2 is Configured as Temperature (°F, °C):

TO CONVERT TO	ANALOG OUTPUT SCALING AND TYPE		
	0-10 VDC	0-5 VDC	4-20 mA
Temp (°F, °C)	Output Voltage/10 x (FS2 - MS2) + MS2	Output Voltage/5 x (FS2 - MS2) + MS2	(Output Current - 4)/16 x (FS2 - MS2) + MS2

**NOTES:**

- FS1 is AO1 full scale analog output value from ANALOG OUT MENU.
- FS2 is AO2 full scale analog output value from ANALOG OUT MENU.
- MS2 is AO2 minimum scale analog output value from ANALOG OUT MENU.

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## **GTC116 - TRANSMITTER SETUP FOR RS-485 NETWORK OPERATION**

For RS-485 operation, network connections are made on the GTC116 Combination board as shown in Figure 8, and set up is as follows. Network protocol, MS/TP address, device instance number and baud rate options are all selected within the NETWORK section of SETUP menu shown in Appendix B.

### **NOTE:**

Prior to power up the GTC116 network configuration and termination switches must be set as shown in Figure 8. Wiring to the RS-485 network will be accomplished following setting of the GTC116 network configuration switches.

## **GTC116 - RS-485 Network Options and Communications Menu Settings**

The transmitter is shipped from the factory with the protocol set for **BACnet MS/TP Master, address 2, MS/TP Device ID 2, Baud rate of 76,800 and no termination**. Initial RS-485 communications settings are accomplished within the GTC116 NETWORK sub menu shown in Appendix B. Termination is set up by the TERM DIP switch SW3 located on the Combination card shown in Figure 8.

## **GTC116 - Setting Transmitter Termination for RS-485 Network**

The GTC116 is shipped with the Termination switch set for No termination, which is the recommended setting for devices installed on the network bus anywhere EXCEPT at the ends of the bus/segment. **EBTRON** recommends the following termination strategy for devices connected at the ends of the network bus/segment:

The device at one end of the network should be terminated with “End of Line” (or 120 ohm standard) termination, and the device at the other end should be terminated with “Fail Safe Bias” termination. This method will provide proper network termination and will ensure that the bus is in a known state during idle-line conditions (when no devices are driving the bus). **EBTRON** GTC116 transmitters include all three termination options for “No Termination”, “End of Line” (standard 120 ohm) or “Fail-safe Bias” (recommended at one end of the bus). Termination is selected by setting the TERMINATION DIP switch SW3” (Figure 8) on the Combination board.



**Check the network/network segment to ensure that only one device is terminated with either of these methods. If multiple devices are terminated as described above, network segment operation will be adversely affected.**

## **GTC116 - Setting RS-485 Network Protocol**

Transmitter protocol can be set for MS/TP or MODBUS as shown in the NETWORK submenu (Appendix B). Tables 8 and 9 list the specific features of each protocol.

## **GTC116 - Setting Transmitter Address**

The GTC116 is factory set to an address of 2. Each transmitter must be assigned a **unique** address between 1 and 255 (127 BACnet) prior to connecting it to the network by setting the address in the NETWORK submenu (Appendix B).

## **GTC116 - Setting Baud Rate**

The GTC116 transmitter default baud rate for MS/TP is 76,800 and for MODBUS is 19,200. Baud rate can be configured in the NETWORK sub menu (Appendix B).

## **GTC116 - Setting Device Instance Number**

The GTC116 is factory set with a Device Instance Number of 2. The Device Instance Number can be set as shown in the NETWORK submenu (Appendix B). The Device Instance Number can also be changed to any number between 1 and 4,194,302 by writing to the Device Object's Object Identifier Property over the network.

## **GTC116 - Resetting Communications Options to Factory Default Values**

Communications options can be reset to factory default values (asterisk) \* values using the GTC116 RESET NET menu option as shown in Appendix B.

## **GTM116 - TRANSMITTER SETUP FOR ETHERNET NETWORK OPERATION**

An RJ45 network connector is provided on the GTM116 Ethernet/Analog combination board as shown in Figure 9. The user can manually select network protocol (BACnet/IP or BACnet Ethernet - MODBUS TCP is always enabled), IP address and device instance number, or can set the GTM116 to automatically configure itself when used on a network/segment with a DHCP server. By default, the DHCP setting is OFF (**\*DHCP=OFF**) for manual device configuration, with BACnet IP protocol (**BAC MODE=IP**), a static IP address of **10.0.0.100**, a subnet mask of **255.255.255.0**, and with gateway set for **10.0.0.10**. These values can be changed within the NETWORK sub menu (Appendix B) as described below.

When IP configuration is complete, confirm IP communications locally by “pinging” the assigned GTM116 IP address and observing 5 rapid blinks of the **ACTIVITY** LED (Figure 9). For example, “ping **10.0.0.100**” for the GTM116 factory default IP address of **10.0.0.100**. and observe 5 blinks of the GTM116 **ACTIVITY** LED for each ping received.

### **GTM116 - Selecting Static or Dynamic IP Settings**

For automated device configuration on a network/segment with a properly operating DHCP server, set **\*DHCP=ON** as shown in Appendix B. Then, set **\*BAC MODE=** for BACnet/IP (factory default) or BACnet Ethernet operation, and set **\*DI=** device instance number (factory default=2) as described below. No additional device configuration is required.

For manual device configuration of the GTM116, set menu item **\*DHCP=OFF** (factory default) as shown in Appendix B. When manually changing IP settings (**\*DHCP=OFF**), the display will blink the 3-digit address segment that is under change. Change the blinking segment by pressing the UP or DOWN buttons to arrive at the desired segment setting. Depress the ENTER key to set this segment and to move the blinking cursor to the next (right) segment. Set this segment as before, using the UP or DOWN arrow buttons, and then depress ENTER to store and move to the next (right) segment. Repeat this until the last segment has been selected, and then depress ENTER to store the new address setting.

### **GTM116 - Setting Ethernet Transmitter IP Address**

The GTM116 is factory set with an IP address of **10.0.0.100**. Each transmitter must be assigned a unique address on the network/segment it is connected to. To change the IP address, navigate to the **\*IP=10.0.0** menu item as shown in Appendix B and set segments as previously described. (See note above regarding **\*DHCP=OFF**).

### **GTM116 - Setting Subnet Mask**

To change this value, navigate to the **\*MASK=255.2...** menu item as shown in Appendix B, and set new segment values as previously described. (See note above regarding **\*DHCP=OFF**).

### **GTM116 - Setting Gateway IP**

To change this value, navigate to the **\*GATE=10.0.0...** menu item as shown in Appendix B, and set new segment values as previously described. (See note above regarding **\*DHCP=OFF**).



**GTM116 - Setting BACnet Protocol Mode**

The GTM116 is factory set with **\*BAC MODE=IP** for BACnet IP protocol operation. This menu item can be changed to **\*BAC MODE=ETH** for BACnet Ethernet protocol as shown in Appendix B. Tables 7, 8 and 9 provide details of TCP/IP, BACnet Objects and Modbus Register Maps respectively. Note that Modbus IP is always enabled regardless of \*BAC MODE setting.

**NOTE:**

For BACnet IP operation, use port 47808. For Modbus TCP operation, use port 502. Modbus IP is always enabled regardless of the \*BAC MODE setting.

**GTM116 - Setting Device Instance Number**

The GTM116 is factory set with a Device Instance Number of 2 (**\*DI=2**). The Device Instance Number can be set to any value between 0 and 4194302 as shown in Appendix B. The Device Instance Number can also be changed by writing to the Device Object's Object Identifier Property over the network.

**GTM116 - Resetting Communications Options to Factory Default Values**

Communications options can be reset to factory default values (asterisk) \* values using the GTM116 RESET NET menu option as shown in Appendix B.

**GTM116 - ETHERNET WIRING CONNECTIONS**

Ensure that the transmitter network settings have been properly set up as previously described. Ensure that the power switch is in the "OFF" position. Connect the 10/100 base-T ethernet connection (RJ45) to the female connector on the output card as shown in Figure 9.

Tables 8 and 9 list the specific values provided for BACnet and Modbus communication protocols.


**TCP/IP**

http://10.0.0.100  
(or your custom IP address)

Table 7. GTM116 TCP/IP Example

GTM Data	
Parameter	Value
Flow	3094
Pressure	0
Temperature	89

**Table 8. GTx116 BACnet Object List**

Analog Inputs				Analog Values			
Type, ID	Name	Default Units		AV, 1	Area	sq.ft.	
Device, 2	GTx 116		x = C for RS-485 x = M for Ethernet	AV, 2	Traverse Data Status		0=None, 1=Flow, 2=Temp, 3=Both
AI, 1	Average Flow	CFM		AV, 3	Flow Traverse	FPM	
AI, 2	Average Temperature	°F		↕	↕	↕	
AI, 3	Alarm Status			AV, 18	Flow Traverse	FPM	
				AV, 19	Temperature Traverse	°F	
				↕	↕	↕	
				AV, 34	Temperature Traverse	°F	
 <b>BACnet MS/TP</b> <b>NOTE:</b> For GTM116 BACnet IP operation, use port 47808.				<b>Notes:</b>			
				1. Flow and Temp traverse must be enabled through AV2. 2. User Executed Services Supported: Subscribe COV, Read Property, Write Property, Device Communication Control, Who-Is.			

**Table 9. GTx116 Modbus Register Map**

Function	Address	Type	Units	Description	Range/Value
2	10001	boolean		Trouble Status	0:OK, 1:Trbl
4	30001-30002	float	FPM	Average Airflow	0 to 15,000
4	30003-30004	float	°F	Average Temperature	-20 to 160
4	30005	word		Number of Inserts	0 to 8
4	30006	word			0
4	30007	word		Alarm Status	0: No alarm 1: High Alarm 2: Low Alarm 3: Both
4	30008	word		Connector C1 Sensors	0 to 8
4	30009	word		Connector C2 Sensors	0 to 8
4	30010	word		Connector C3 Sensors	0 to 8
4	30011	word		Connector C4 Sensors	0 to 8
4	<b>30012-30043</b>	float	FPM	<b>Airflow Flow Traverse</b>	0 to 15,000
	30012-30013			Insert 1 Flow	
	↕			↕	
	30042-30043			Insert 16 Flow	
4	<b>30044-30075</b>	float	°F	<b>Temperature Traverse</b>	-20 to 160
	30044-30045			Insert 1 Temp	
	↕			↕	
	30074-30075			Insert 16 Temp	
4	30076-30077	float	Sq.Ft.	Area	0 to 100
4	300202	word		Float word order	0: high word first; 1: low word first

**Modbus**

Modbus RTU  
for GTC116

Modbus TCP  
for GTM116

**NOTE:** For GTM116 Modbus operation, use port 502. Modbus IP is always enabled regardless of \*BAC MODE setting.

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**GTL116 - LONWORKS TRANSMITTER SETUP**

The GTL116 includes a full featured LonWorks compatible interface. The **EBTRON** LonWorks output card (part number 800-5030) plugs directly onto the GTL116 main circuit board as shown in Figure 12. It includes a high speed FTT-10A, 78k baud Free Topology transceiver interface that is relatively insensitive to network wiring topology. The GTL116 may be pre-configured using the GTL116.XIF file available for download at [www.ebtron.com/lonworks](http://www.ebtron.com/lonworks), or configured at installation via direct LonWorks parameter upload from the GTL116 transmitter. A service push-button and LED are provided for standard installation. A "Wink" LED is provided for easy device identification. An "Activity" LED and separate transmit and receive "TX" and "RX" provide visual indication of transmitter and communication status. The "Activity" LED normally flashes on for 1 second, off for 1 second when the card is commissioned and online, and remains illuminated constantly if there is an error

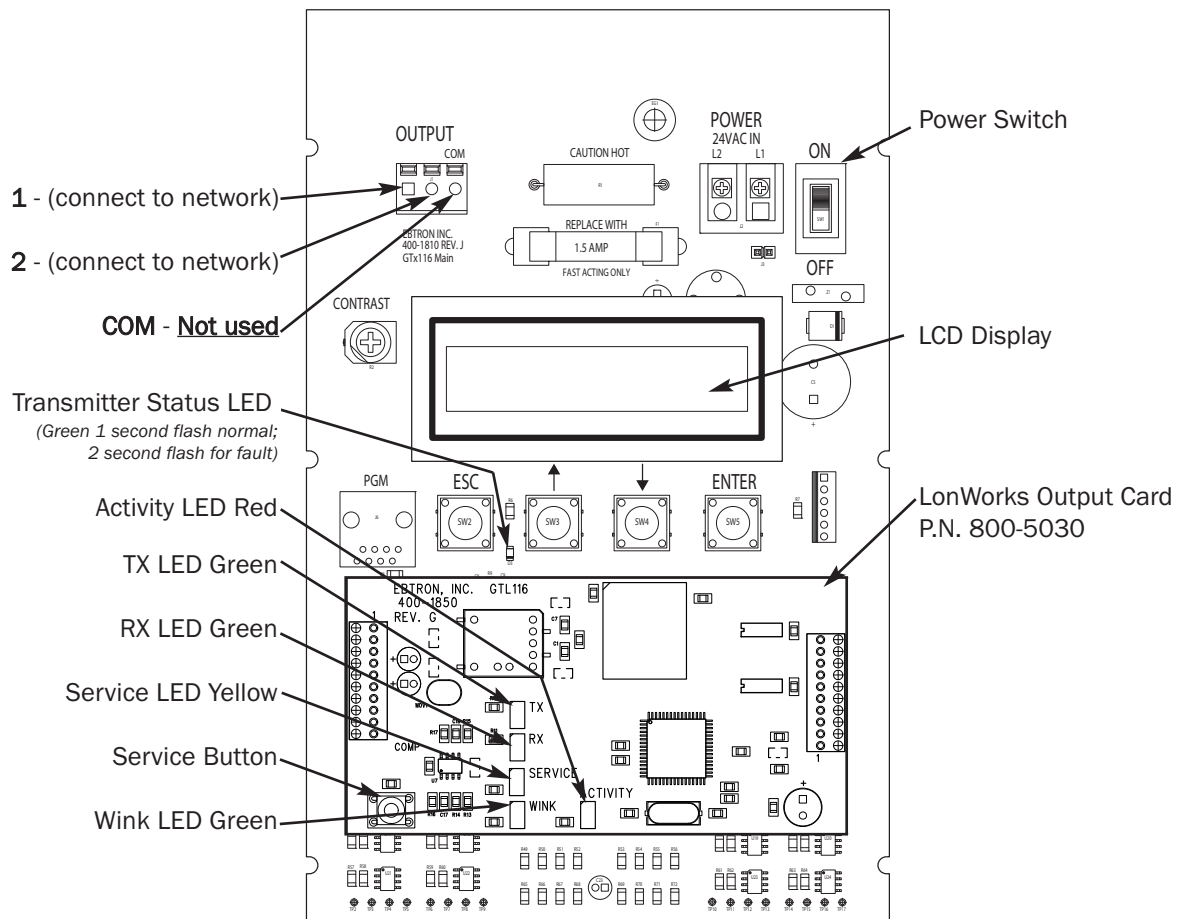
To wire the output signal, slide the cover plate up and off of the enclosure. Ensure that the power switch is in the "OFF" position. Connect network cables to the small, three position output terminal labeled "OUTPUT" on the upper left hand side of the main circuit board (shown below) at terminals 1 and 2 only.

**GTL116 - LONWORKS NETWORK CONNECTIONS**

Connect the transmitter output to the LonWorks bus in a "daisy-chain" configuration using a shielded, twisted pair communication wire with a signal ground conductor (3 wires and a shield). The transmitter provides an output that is isolated from the main power input. Connect the LonWorks cable at the "OUTPUT" terminal block as follows:

OUTPUT TERMINAL	SIGNAL DESCRIPTION
1	NET+
2	NET-
COM	COMMON (NOT USED)

(The shield will typically be grounded at one end of the bus and not connected to the transmitter terminals.)



**Figure 12. GTL116 LonWorks Transmitter Interior Detail**

## GTL116 - LONWORKS INTERFACE

### **Introduction**

The Ebtron LonWorks interface adapter is designed to provide an output capability for connection to an Echelon LonWorks based network. Two basic function blocks are provided. These include a node object and a gtx116 function block.

The node object is used for overhead activities on the LonWorks bus. This object is of little interest to the end user.

The gtx116 function block contains a set of network variables and configuration properties that allow the end user to monitor various parameters related to airflow, pressure, and temperature that are generated by the transmitter.

### **Basic Description**

The LonWorks protocol is based on "network variable objects"("nvo"). Each device on the network communicates with other devices by "connecting" to the variables of the device it wishes to monitor. These variables consist primarily of pre-defined types that are part of the network specification.

Additionally, a special class of network properties is defined to allow the configuration of various parameters within a device. These are intended to control the basic operation of a device.

All network variables are defined in terms of "SNVT\_xxx". SNVT is an acronym for Standard Network Variable Type. "xxx" is a descriptive phrase that relates to the units used by the parameter represented by the variable. All of the variables described below are always visible on the network; however, some variables are meaningful only with certain types of sensors attached to the transmitter. Tables 10 through 17 describe each of the variables used and the configuration properties for each.

All configuration properties are defined in terms of "SCPTxxx". SCPT is an acronym for Standard Configuration Property Type. There are configuration properties that apply to multiple objects, but may not be listed directly under them when viewed on the network. Check the "applies to" tag in the description for the configuration property in the following sections.

**GTL116 - VELOCITY AND FLOW VARIABLES CONFIGURATION**

This section details the air flow and air velocity variables and how the configuration properties relate to them.

**Velocity and Flow Variables**

Table 10. GTL116 LonWorks Node Velocity and Flow Variables

Air Flow Sensor Objects					
Variable Name	Variable Type	Measurement	Type Category	Type Resolution	Units
nvoAirVel	SNVT_speed_mil	Linear Velocity	Unsigned Long	0.001	Feet/second
nvoAirFlow	SNVT_flow	Flow Volume	Unsigned Long	1	Cubic feet/min
nvoAirFlowFl	SNVT_flow_f	Flow Volume	Floating Point	n/a	Cubic feet/min



For the “nvoAirFlow” and “nvoAirFlowFl” variables to be meaningful, the ductArea configuration property must be set.

***nvoAirVel (SNVT\_speed\_mil - Air Velocity)***

This variable provides simple linear airflow in feet/second.

***nvoAirFlow (SNVT\_flow - Airflow)***

This variable provides volumetric airflow in cubic feet/min. For this variable to be meaningful, the ductArea configuration property must be set.

***nvoAirFlowFl (SNVT\_flow\_f - Airflow Float)***

This variable provides volumetric airflow in cubic feet/min. For this variable to be meaningful the ductArea configuration property must be set.

**Velocity and Flow Configuration Properties**

Table 11. GTL116 LonWorks Node Velocity and Flow Configuration Properties

Air Flow Sensor Configuration Properties					
<i>nvoAirVel</i>	SCPTmaxSendTime	Time	Signed Long	0.1	Seconds
<i>nvoAirVel</i>	SCPTminSendTime	Time	Signed Long	0.1	Seconds
<i>nvoAirVel</i>	SCPTminDelta	Linear Velocity	Unsigned Long	0.001	Feet/second
<i>nvoAirFlow</i>	SCPTductArea	Area	Unsigned Long	0.0002	Square Meters

***nvoAirVel (SCPTmaxSendTime - Maximum Time Between Updates)***

This configuration property sets the maximum time to elapse between updates to the network for velocity and flow to occur.

***nvoAirVel (SCPTminSendTime - Minimum Time Before Updates)***

This configuration property sets the minimum time to elapse before an update to the network for velocity and flow may be sent. This configuration property takes priority over **maxSendTime** and **sndDelta**.

***nvoAirVel (SCPTsndDelta - Minimum Change for Update)***

This configuration property sets the minimum change in velocity that will cause an update of flow and velocity to the network. The change is only checked for in velocity, and when the minimum is reached updates will occur for nvoVel, nvoFlow, and nvoFlowFl.

***nvoAirFlow (SCPTductArea - Duct Area for Air Flow Calculation)***

This configuration property sets the duct area to be used in flow calculations. Note that this variable must be set to a non-zero value to get flow information.

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## GTL116 - AREA INPUT VARIABLE

This section details the network input variable area.

### Area Input Variable

Table 12. GTL116 LonWorks Area Input Variable

Area Object					
Variable Name	Variable Type	Measurement	Type Category	Type Resolution	Units
nviArea	SNVT_area	Area	Unsigned Long	0.0002	Square Meters

#### *nviArea (SNVT\_area – Duct Area for Air Flow Calculation)*

This network input sets the duct area to be used in flow calculations. This variable is essentially a copy of nvoAirFlow:SCPTductArea; only one of these inputs needs to be configured before using nvoAirFlow or nvoAirFlowFI.

## GTL116 - PRESSURE VARIABLES AND CONFIGURATION

This section details the pressure variables and how the configuration properties relate to them.

### Pressure Variables

Table 13. GTL116 LonWorks Node Pressure Variables

Dynamic Pressure Sensor Object					
Variable Name	SNVT	Measurement	Type Category	Type Resolution	Units
nvoPrecisePres	SNVT_press_p	Pressure	Signed Long	0.00001	Inches of H2O
nvoFloatPres	SNVT_press_f	Pressure	Floating Point	n/a	Inches of H2O

#### *nvoPrecisePres (SNVT\_press\_p - Airflow Pressure)*

This variable provides air pressure in inches of H2O. For this variable to be meaningful a bleed sensor must be attached to the transmitter.

#### *nvoFloatPres (SNVT\_press\_f - Airflow Pressure Float)*

This variable provides air pressure in inches of H2O. For this variable to be meaningful a bleed sensor must be attached to the transmitter.

### Pressure Configuration Properties

Table 14. GTL116 LonWorks Node Pressure Configuration

Dynamic Pressure Sensor Configuration Properties					
nvoPrecisePres	SCPTmaxSendTime	Time	Signed Long	0.1	Seconds
nvoPrecisePres	SCPTminSendTime	Time	Signed Long	0.1	Seconds
nvoPrecisePres	SCPTsndDelta	Pressure	Signed Long	0.0001	Inches of H2O

#### *nvoPrecisePres (SCPTmaxSendTime - Maximum Time Between Updates)*

This configuration property sets the maximum time to elapse between updates to the network for pressure to occur.

#### *nvoPrecisePres (SCPTminSendTime - Minimum Time Before Updates)*

This configuration property sets the minimum time to elapse before an update to the network for pressure may be sent. This configuration property takes priority over maxSendTime and sndDelta.

#### *nvoPrecisePres (SCPTsndDelta - Minimum Change for Update)*

This configuration property sets the minimum change in pressure that will cause an update for pressure to the network. When this change is met both nvoPrecisePres and nvoFloatPres will be updated on the network.

**Temperature Variables and Configuration Properties**

This section details the temperature variable and how the configuration properties that relate to it.

**Table 15. GTL116 LonWorks Node Temperature Variable**

Variable Name	SNVT	Measurement	Type Category	Type Resolution	Units
nvoTemp	SNVT_temp_p	Temperature	Signed Long	0.01	Degrees F

***nvoTemp (SNVT\_temp\_p - Temperature Variable)***

This network variable provides temperature in degrees Fahrenheit.

**Temperature Configuration Properties**

**Table 16. GTL116 LonWorks Node Temperature Variable**

<b>Temperature Sensor Configuration Properties</b>					
<i>nvoTemp</i>	SCPTmaxSendTime	Time	Signed Long	0.1	Seconds
<i>nvoTemp</i>	SCPTminDeltaTemp	Temperature	Signed Long	0.001	Degrees F
<i>nvoTemp</i>	SCPTminSendTime	Time	Signed Long	0.01	Seconds

***nvoTemp (SCPTmaxSendTime - Maximum Time Between Updates)***

This configuration property sets the maximum time to elapse between updates to the network for temperature to occur.

***nvoTemp (SCPTminDeltaTemp - Minimum Change for Update)***

This configuration property sets the minimum change in temperature that will cause an update of nvoTemp to the network.

***nvoTemp (SCPTminSendTime - Minimum Time Before Updates)***

This configuration property sets the minimum time to elapse before an update to the network for temperature may be sent. This configuration property takes priority over maxSendTime and minDeltaTemp.

**GTL116 - DEFAULT DELTA VALUES**

This section details the default Delta values which determine when updates are sent from the transmitter to the network. The Delta Values in Table 17 are set with a large factory default value to prevent any undesired messages from being sent to the network. Refer to the preceding paragraphs for a description and configuration of the Delta values.

**Table 17. GTL116 LonWorks Node Temperature Variable**

<b>Delta Values</b>		
nvoAirVel	SCPTsndDelta	200 fps
nvoPrecisePres	SCPTsndDelta	1 iWc
nvoTemp	SCPTminDeltaTemp	160 °F



## **EB-Link WIRELESS INFRARED COMMUNICATIONS OPTION**

The **EB-Link** wireless infrared communications option is ideal for air balance contractors, engineers, building owners and/or contractors who desire fast and accurate measurement without additional interfacing. Individual and average sensor airflow(s) and temperature(s) from GTx116 transmitters equipped with the **EB-Link** option can be instantly transferred to the new **EB-Link Reader** model EBR-1000 or to a Palm<sup>®</sup> or Microsoft<sup>®</sup> Windows Mobile<sup>®</sup> operating system PDA. This method reduces the data acquisition time and sampling error inherent with hand held measurements. The data can then be transferred to your PC for review, update or analysis.

In addition, a Setup-Upload feature (available only with the PDA software version) permits rapid transfer of preset transmitter setup configuration to another **EB-Link** equipped GTx116 transmitter. This is especially useful when multiple transmitters are to be set up or modified.

Real-time duct flow/temperature traverses can be accomplished quickly and easily using the GTx116 transmitter equipped with the **EB-Link** option. Individual airflow and temperature data can be returned directly to your **EB-Link Reader** or PDA (using Palm<sup>®</sup> or Microsoft<sup>®</sup> Windows Mobile<sup>®</sup> operating system). The data can also be returned over BACnet or Modbus when probes are connected to a type GTC116/GTM116 networked transmitter.

This innovative feature is ideal for balancers and commissioning agents that desire “on-the-fly” airflow and temperature traverses. The advantages of using permanently installed GP1 probes include nearly instantaneous traverse data (no sampling error over time), accurate and repeatable measurement and simple report generation using the Microsoft<sup>®</sup> Excel<sup>®</sup> spreadsheet provided by **EBTRON**. Performing duct traverses with permanently mounted EBTRON airflow probes eliminates the requirement to make additional sampling holes in the duct, and reduces the need to carry around the job site cumbersome equipment and ladders to accomplish them.

### **EB-Link Card Installation**



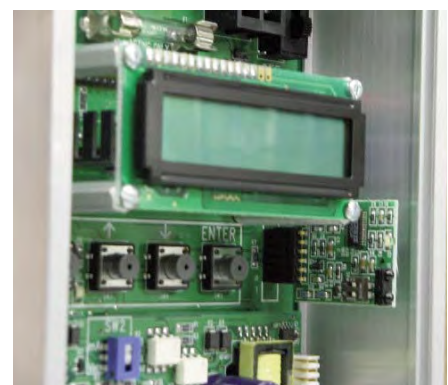
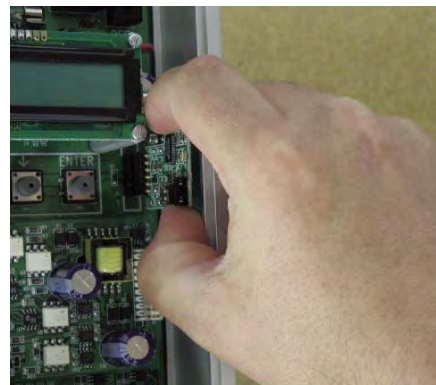
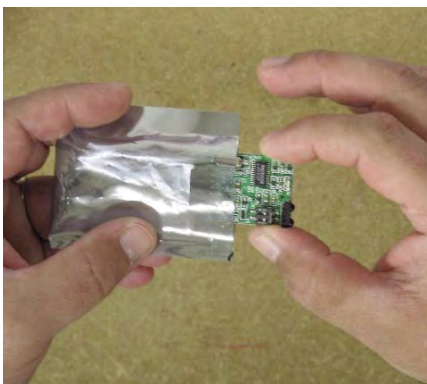
**CAUTION:** Observe all electrostatic Discharge (ESD) handling precautions. Do not touch internal components. Failure to observe ESD precautions can cause damage to components.



**CAUTION:** Turn the transmitter “POWER” switch to the “OFF” position before installing the **EB-Link** card. Failure to do so can cause damage to the **EB-Link** card and/or the transmitter.

The **EB-Link** card must be installed on the GTx116 main board in order to access sensor data with your PDA. If the **EB-Link** card is ordered separately from the transmitter, it should be installed after the transmitter is mounted.

To install the **EB-Link** option card, slide the cover up and off of the transmitter enclosure. Turn the power switch, SW1, to the “OFF” position on the transmitter main circuit board. Observe ESD precautions when handling and installing the **EB-Link** card. Touch a grounded object, such as a metal duct, before removing the **EB-Link** card from the anti-static package. Remove the **EB-Link** card from the anti-static package, being careful not to touch exposed components or circuit board traces (hold the card by the edges as indicated on left frame of Figure 13). With the components facing in towards the center of the main circuit board, carefully plug the **EB-Link** card into the header connector labeled J5 on the right hand side of the transmitter just below the LCD display (center frame, Figure 13). Do not press on any components. The card should stand on its own when properly installed (right frame of Figure 13).



**Figure 13. EB-Link Installation Detail**

### Obtaining and Installing *EB-Link* Software

*EB-Link* software can be downloaded free of charge at [www.ebtron.com/eblink](http://www.ebtron.com/eblink). Versions are available for the *EB-Link Reader*, or for PDAs (for either the Palm<sup>®</sup> or Microsoft<sup>®</sup> Windows Mobile<sup>®</sup> operating systems) as shown in Figure 14. Figure 15 shows the *EB-Link* in use.

The software includes all of the files required for operation of the *EB-Link Reader* or for PDAs as well as a Microsoft<sup>®</sup> Excel<sup>®</sup> spreadsheet for converting the PDA files to a Test and Balance report.

### EB-Link Reader Software

The *EB-Link Reader* software is designed for operation on Windows XP (or later) operating systems and permits file management and time synchronization for the *EB-Link Reader*.

The latest version of the *EB-Link Reader* software, as well as installation, operation and descriptions of all *EB-Link Reader* functions are contained in the *EB-Link Reader* Technical Documentation available at [www.ebtron.com/eblink](http://www.ebtron.com/eblink).

### EB-Link Software for PDA Devices

The *EB-Link Software for PDA Devices* is designed for operation with PDA devices using the Palm<sup>®</sup> or Microsoft<sup>®</sup> Windows Mobile<sup>®</sup> operating systems. The software includes a Microsoft<sup>®</sup> Excel<sup>®</sup> spreadsheet that allows for the pre-configuration, review or modification of GTx116 transmitter setup parameters.

The latest version of the software, as well as installation, operation and descriptions of all *EB-Link* functions are contained in the *readme.txt* file that is provided with the download.

Real-time duct traverses can be accomplished quickly and easily using the GTx116 transmitter equipped with the *EB-Link* option. Individual airflow and temperature data can be returned directly to your PDA (Palm<sup>®</sup> or Microsoft<sup>®</sup> Windows Mobile<sup>®</sup> operating system). Data can also be returned over BACnet or Modbus when probes are connected to a GTC116, RS-485 transmitter.

### Real Time Duct Traverses Using *EB-Link*

Simply slide the GTx116 cover up and off of the GTx116 transmitter enclosure and point your *EB-Link Reader* or PDA to the *EB-Link* sensor located just to the right and below the transmitter LCD display as shown in Figure 15 (note: the *EB-Link* card option must be installed). The acquisition of data takes less than 10 seconds to complete. After acquiring data, you can display individual or average airflow and/or temperature data on your *EB-Link Reader* or PDA. Saved data (stored as a comma separated value CSV file) can also be downloaded to your PC for creation of individual test and balance reports using the software of your choice, or with the Microsoft<sup>®</sup> Excel<sup>®</sup> spreadsheet that *EBTRON* has included with the PDA software. Note that the traverse sensor data is averaged to provide more stable readings.

Note also that on rectangular ducts, the *EBTRON* Excel<sup>®</sup> balance report will always show the traverse data starting at the top left position of the duct when viewing from upstream of the flow station, regardless of the orientation of the probes, when the probes are installed as indicated in the configuration diagrams of Figure 11. On round/oval ducts, the balance report will always show traverse data in columns, starting with probe number one.

**NOTE**



If traverse data is desired, ensure that probes are installed using the mounting convention specified in Figure 11. Proper installation simplifies sensor location decoding during data analysis.

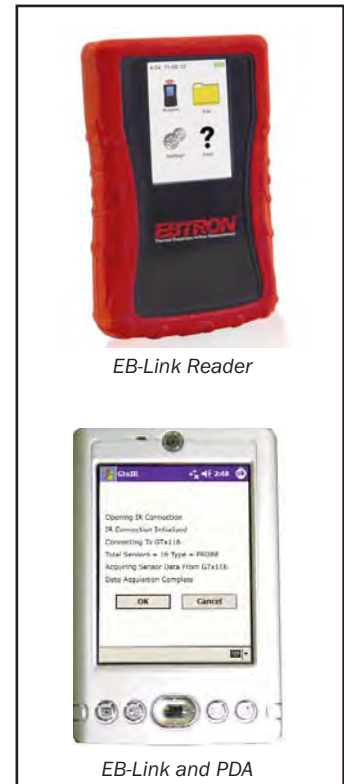


Figure 14. *EB-Link Reader* and PDA Devices



Figure 15. Typical *EB-Link* Data Acquisition

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## **FIELD ADJUSTMENTS**

### **ALTITUDE CORRECTION ADJUSTMENT**

The Altitude Correction Adjustment allows for correction of airflow readings at the installed site altitude and more precise readings regardless on installed altitude. Refer to the SETUP MENU of Appendix B for the \*ALT= menu item, and set this value to the installation altitude.

### **ADJUSTING THE LOW LIMIT CUTOFF**

The low limit cutoff forces the output signal for the airflow rate to zero whenever the airflow rate calculated falls below the specified Low Limit value. This feature is useful on outside air intakes that often indicate false airflow rates, induced by transient wind gusts or when the intake damper is closed and there is no net flow across the damper. Readings of 100 FPM or more are not uncommon on many outside air intake applications when the intake damper is closed and are a result of air movement in the intake plenum (not a malfunction in the airflow measuring device). Setting the low limit to a value significantly below the control setpoint and higher than the threshold flow for false wind readings simplifies control and interpretation of the airflow rate signal on many applications.

To set the low limit cutoff, enter the Setup menu and set “\*LLIMIT={desired value in FPM (MPS in SI units)}” as shown in Appendix B.



Fluctuations in the airflow output signal are normal. **EBTRON's** laboratory research indicates that dampening true fluctuations will result in poor control and a larger dead-band of operation.

### **FACTORY CALIBRATION ADJUSTMENTS**

The factory calibration should not require adjustment if the sensor probes are installed in accordance with published installation guidelines. However, some installations may not meet placement guidelines or commissioning requirements may dictate field adjustment. Field adjustment may improve the “installed accuracy” of GTx116 systems when determining volumetric flow rates. Only the Output 1 signal, airflow rate, can be adjusted. Ensure that the reference device and technique used to determine the airflow rate in the field are suitable for such measurement. Select a location that is acceptable for the device being used as the reference, recognizing that this may not be the same location where the **EBTRON** airflow station is installed. The inherent accuracy of field measurement will not be better than  $\pm 5\%$  of reading and can often exceed  $\pm 10\%$ . Do not adjust the output of the GTx116 if the difference between the transmitter and the field measurement is less than 10%.

### **Field Adjustment Wizard - AUTOMATED FIELD ADJUSTMENT**

#### **Overview of the Field Adjustment Wizard**

The simple to use Field Adjustment Wizard provides a one or two point automated menu driven field adjustment to factory calibration of the OUTPUT 1 airflow rate signal.

#### **Engaging and Using the Field Adjustment Wizard**

Use Appendix B to navigate to the FIELD ADJUST submenu. Appendix B provides details of the FIELD ADJUST menu and how to use it in applications for one or two point automated field adjustment. If you wish to disable the FIELD ADJUST setting, navigate to the ADJUSTMENTS submenu and set FLOW ADJ=OFF.

### **MANUAL ADJUSTMENT OF FACTORY OFFSET/GAIN CALIBRATION**

If you prefer, you can instead perform a manual adjustment at one or two points. The GTx116 firmware can be adjusted for Output 1 signal “gain” and “offset”. To adjust the output signal “gain”, the “FLOW ADJ” override must be set to “\*FLOW ADJ=ON” from the Setup Menu. The adjustments affect both the LCD display and output signal. When “\*FLOW ADJ=OFF” is set, adjusting the output signal “offset” and/or “gain” does not affect the transmitter output.



### Procedure for 1 Point Field Adjustment

Select an airflow rate that represents a valid operating condition for the system. Set fan speed, dampers and VAV boxes to a fixed speed or position when measurements are taken. Complete the following worksheet to determine the gain setting to be set on the transmitter.

#### **Direct Entry of Gain factor Method(most accurate):**

1. Enter the setup menu and set “\*FLOW ADJ=OFF”. This is the factory default setting and disables any adjustments, returning the unit to its original factory calibration.
2. \_\_\_\_\_ Record the transmitter output by taking the visual reading from the transmitter LCD. Readings can be taken by the host controls if the output signal conversion has been confirmed. Time averaging the data will improve field recalibration.
3. \_\_\_\_\_ Record the reference reading. Make sure that the unit of measure (FPM, CFM) is identical for both the transmitter and the reference. If the unit of measure is velocity (FPM), make sure that the reference airflow measurement was corrected for the area where the measurement was taken.
4. \_\_\_\_\_ Calculate the gain factor (m): **m=line 3/line 2.**
5. Enter the setup menu and set “\*FLOW ADJ=ON”.
6. Set “\*GAIN={value calculated in line 4}”.
7. Confirm that “\*OFF=0.00”.
8. Press the “ESC” button until you return to the normal operating mode. Field adjustment is complete.

### Procedure for 2 Point Field Adjustment

Select the minimum and maximum airflow rate that the airflow station will encounter as a valid operating condition for the system. Set fan speed, dampers and VAV boxes to a fixed speed or position when measurements are taken. Complete the following worksheet to determine the gain and offset settings to be set on the transmitter.

1. Enter the setup menu and set “\*FLOW ADJ=OFF”. This is the factory default setting and disables any adjustments, returning the unit to its original factory calibration. MEASUREMENTS MUST BE RECORDED IN FPM.
  2. Set the minimum airflow rate.
  3. \_\_\_\_\_ Record the transmitter airflow rate by taking the visual reading from the transmitter LCD. Readings can be taken by the host controls if the output signal conversion has been confirmed. Time averaging the data will improve field recalibration.
  4. \_\_\_\_\_ Record the reference airflow rate. Make sure that the unit of measure has been converted to FPM. Make sure that the reference airflow measurement was corrected for the area where the measurement was taken.
  5. Set the maximum airflow rate.
  6. \_\_\_\_\_ Record the transmitter airflow rate.
  7. \_\_\_\_\_ Record the reference airflow rate.
  8. \_\_\_\_\_ Calculate the gain factor (m): **m=(line 7 - line 4)/(line 6 - line 3).**
  9. \_\_\_\_\_ Calculate the offset factor (b): **b=(line 4 - (line 8 x line 3)).**
- If more than 2 points are available, perform a linear regression on the data to determine gain and offset.**
10. Enter the setup menu and set “\*FLOW ADJ=ON”.
  11. Set “\*GAIN={value calculated in line 8}”.
  11. Set “\*OFF={value calculated in line 9}”.
  12. Press the “ESC” button until you return to the normal operating mode. Field adjustment is complete.

## **MAINTENANCE**

When transmitter and probes are installed in accordance with **EBTRON** guidelines, instrument difficulties are rare. Issues may easily be resolved by viewing Diagnostic data from the Diagnostic Menu (Appendix B) and by proceeding through the following troubleshooting guides (Tables 18 through 22). Customer support is available Monday - Friday from 8 AM to 4:30 PM ET, at 800-2**EBTRON** (232.8766). **EBTRON** Diagnostic Customer Service forms are available on-line at [www.ebtron.com](http://www.ebtron.com) to assist us in accurately diagnosing issues and will greatly expedite their resolution. A sketch of the installation, along with the control sequence of operations is recommended to help us diagnose problems. Fax the information to 843.756.1838 before you call, and have it available when speaking with the Customer Service team. Address all correspondence to the **EBTRON** Customer Service Department. Additional information is also available from your local **EBTRON** representative.

## **STANDARD LIMITED PARTS WARRANTY**

If any **EBTRON** product fails within 36 months from shipment, **EBTRON** will repair/replace the device free of charge as described in the company's warranty contained in **EBTRON's** *TERMS AND CONDITIONS OF SALE*. Defective equipment shall be shipped back to **EBTRON**, freight pre-paid, for analysis.

**Table 18. General Troubleshooting (All GTx116 Systems)**

<b>Problem</b>	<b>Possible Cause</b>	<b>Remedy</b>
No LCD display indication and the green Transmitter Status LED (D3) on the main circuit board is not illuminated.	Power switch not in the "ON" position.	Move the power switch to the "ON" position.
	Improper supply voltage to the power input terminal block.	Ensure that 24VAC power is connected to L1 and L2 of the POWER terminal block and that the voltage with the power switch in the "ON" position is between 22.8 and 26.4 VAC.
	Blown fuse.	Check power wiring. Ensure that multiple devices wired on a single transformer are wired "in-phase". Replace fuse only with a 1.5 amp, fast-acting fuse after the problem has been identified and corrected.
No LCD display indication and the green Transmitter Status LED (D3) on the main circuit board is flashing.	LCD contrast too low.	Turn "Contrast" potentiometer on the main circuit board "clockwise".
The LCD display is scrambled or there is no LCD display indication after touching the switches, LCD display or circuit board.	Static electricity.	Touch an earth-grounded object, such as a duct, to discharge static electricity then reset the power. Avoid direct contact with the LCD display or circuit board.
The green Transmitter Status LED (D3) on the main circuit board is "ON" but not flashing.	The microprocessor is not running.	Reset 24VAC power by moving the power switch from the "ON" to "OFF" position and then back to the "ON" position.
The green Transmitter Status LED (D3) on the main circuit board is flashing at 1-second intervals.	No problem, normal operation.	No remedy required.
The green Transmitter Status LED (D3) on the main circuit board is flashing at 2-second intervals.	The sensor detection system has detected trouble.	Check sensor probe cable connections. If sensor probe connections look OK and match the number of sensor probes indicated on each probe's hang tag, please call EBTRON's customer service department or visit us at <a href="http://www.ebtron.com">www.ebtron.com</a> .
	Wrong type of sensor probes attached to transmitter.	GTx116 transmitter will only operate with GP1 or GB1 sensors connected.
The transmitter indicates airflow when the HVAC system is not operating.	Sensors are sensitive and can measure very low air velocities. If a reading is indicated, there is airflow present where the airflow measuring station is located.	Do not attempt to adjust zero ("offset"). Doing so will result in an error in airflow measurement. The Low Limit airflow cutoff value can be set to force the output signal to zero.

**Table 19. GTC116 and GTM116 - Analog Operation Transmitter Troubleshooting**

Problem	Possible Cause	Remedy
No output signal can be measured at the OUTPUT terminal block of the GTC116/GTM116 transmitter.	Output card is not securely mounted on main circuit board.	Turn the transmitter power "OFF", and then press the output card firmly onto main circuit board. Turn the transmitter power back "ON".
	Blown output fuse (output 1 and output 2 are fused and protected independently on GTC116/GTM116 transmitters).	Make sure that power has not been connected to the output terminal block. Correct the problem and replace with 0.125 amp, fast acting fuse only.  Make sure that the host control system is not configured for a 2-wire device (no excitation voltage should be present on the signals from the host controls). Correct the problem and replace with 0.125 amp, fast acting fuse only.
	The Low Limit airflow cutoff value is above the actual airflow reading.	Decrease the Low Limit airflow cutoff value in the Setup menu until it is below the actual airflow reading.
The output signal on the GTC116/GTM116 transmitter fluctuates while the flow and/or temperature readings on the LCD are steady.	Electrical interference from other devices is creating noise in the signal wires to the host control system.	The output signal wiring must be shielded. Individually ground one or more of the following points: the signal wire shield at host controls; signal wire shield at the transmitter, or L2 of the power terminal block of the GTC116/GTM116.
	The LCD INTG= value may be greater than the AO1 INTG= value.	Review and verify LCD INTG= and AO1 INTG= settings.
The LCD display does not match the readings indicated by the host control system.	The scaling in the host control system is incorrect, or the AO1/AO2 RNGE= settings are incorrect.	Compare the current configuration of the transmitter with that of the host control system. Compare the minimum and full scale settings for each output by navigating through the Setup menu. Verify AO1/AO2 RNGE= settings

**Table 20. GTC116 RS-485 Transmitter Troubleshooting**

Problem	Possible Cause	Remedy
The host control system is unable to communicate with the GTC116 transmitter.	Output card is not securely mounted on main circuit board.	Turn the transmitter power "OFF" and press the output card firmly onto main circuit board. Turn the transmitter power back "ON".
	Network signal wiring is not properly connected to the GTC116 transmitter or the host controls.	Verify that the network signal wires from the host controls are connected to the proper terminals of the OUTPUT block. On the GTC116 transmitter OUTPUT terminal block, NET+ is for A, NET- is for B and COM for common.
	Network protocol is not properly set on the GTC116.	Set network protocol based on the network requirements and reset transmitter power.
	Network address is not properly set on the GTC116.	Set address based on network requirements and reset transmitter power. The address must be unique for the network.
	Network termination is not properly set on the GTC116.	Set transmitter termination based on network requirements and reset the transmitter power. Refer to Figure 8 of this technical manual for TERMINATION DIP switch settings.
The LCD display does not match the readings indicated by the host control system.	The Area of the GTC116 transmitter does not match that of the host controls.	Compare the value of the Area of the transmitter with that of the host control system and make adjustments to ensure a match.
The returned value for airflow is zero when airflow is indicated on the LCD display of the GTC116 transmitter.	The Low Limit airflow cutoff value is above the actual airflow reading.	Decrease the Low Limit airflow cutoff value in the Setup menu until it is below the actual airflow reading.
The status point from the GTC116 transmitter has a Trouble value.	The sensor detection system has detected one or more malfunctioning or missing sensors.	Check sensor probe cable connections. If sensor probe connections look OK and match the number of sensor probes indicated on each probe's hang tag, please call <b>EBTRON's</b> customer service department or visit us at <a href="http://www.ebtron.com">www.ebtron.com</a> .
	Wrong type of sensor probes attached to transmitter.	GTx116 transmitter will only operate with GP1 or GB1 sensors connected.
There is no value for the differential pressure point.	Differential pressure is only available from transmitters that have <b>EBTRON's</b> Bi-directional Bleed Airflow Sensors connected.	If a differential pressure measurement is required, contact your local <b>EBTRON</b> Representative about <b>EBTRON's</b> Bi-directional Bleed Airflow Sensor.

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**Table 21. GTM116 Ethernet Transmitter Troubleshooting**

Problem	Possible Cause	Remedy
The host control system or web browser is unable to communicate with the GTM116 transmitter.	Verify that power is available to board (ACTIVITY LED is illuminated). If not verify that Output card is securely mounted on main circuit board.	Set transmitter power to "OFF" and press the output card firmly onto main circuit board. Turn the transmitter power back "ON".
	There is no link to the network indicated by the LINK LED on the output card.	The LINK LED indicates a valid connection to the network when it is illuminated. If the LINK LED is not on, verify network cabling and connections between the GTM116 and the network switch or hub. If LINK LED is on, verify that traffic is flowing by observing the TRAFFIC LED. If LINK LED is on, but TRAFFIC LED is not, check for defective network cabling.
	The network protocol has not been properly set on the GTM116.	Set network protocol based on network requirements and reset transmitter power.
	The transmitter address has not been properly set on the GTM116.	Set the address based on your network requirements. Note that each address must be unique for the network.
The LCD display does not match the readings indicated by the host control system.	The area factor in the GTM116 transmitter does not match that of the host controls.	Compare the value of the Area factor of the GTM116 transmitter with that of the host control system and make adjustments to ensure a match.
The returned value for airflow is zero when there is airflow indicated on the LCD display of the GTM116 transmitter.	The Low Limit airflow cutoff value is above the actual airflow reading.	Decrease the Low Limit airflow cutoff value in the Setup menu until it is below the actual airflow reading.
The status register from the GTM116 transmitter has a Trouble value.	The sensor detection system has detected one or more malfunctioning or missing sensors.	Check sensor probe cable connections. If sensor probe connections look OK and match the number of sensor probes indicated on each probe's hang tag, please call <b>EBTRON's</b> customer service department or visit us at <a href="http://www.ebtron.com">www.ebtron.com</a> .
	Wrong type of sensor probes attached to transmitter.	GTx116 transmitter will only operate with GP1 or GB1 sensors connected.
There is no value for the differential pressure point.	Differential pressure is only available from transmitters that have <b>EBTRON's</b> Bi-directional Bleed Airflow Sensors connected.	If a differential pressure measurement is required, contact your local <b>EBTRON</b> Representative about <b>EBTRON's</b> Bi-directional Bleed Airflow Sensor.

**Table 22. GTL116 LonWorks Transmitter Troubleshooting**

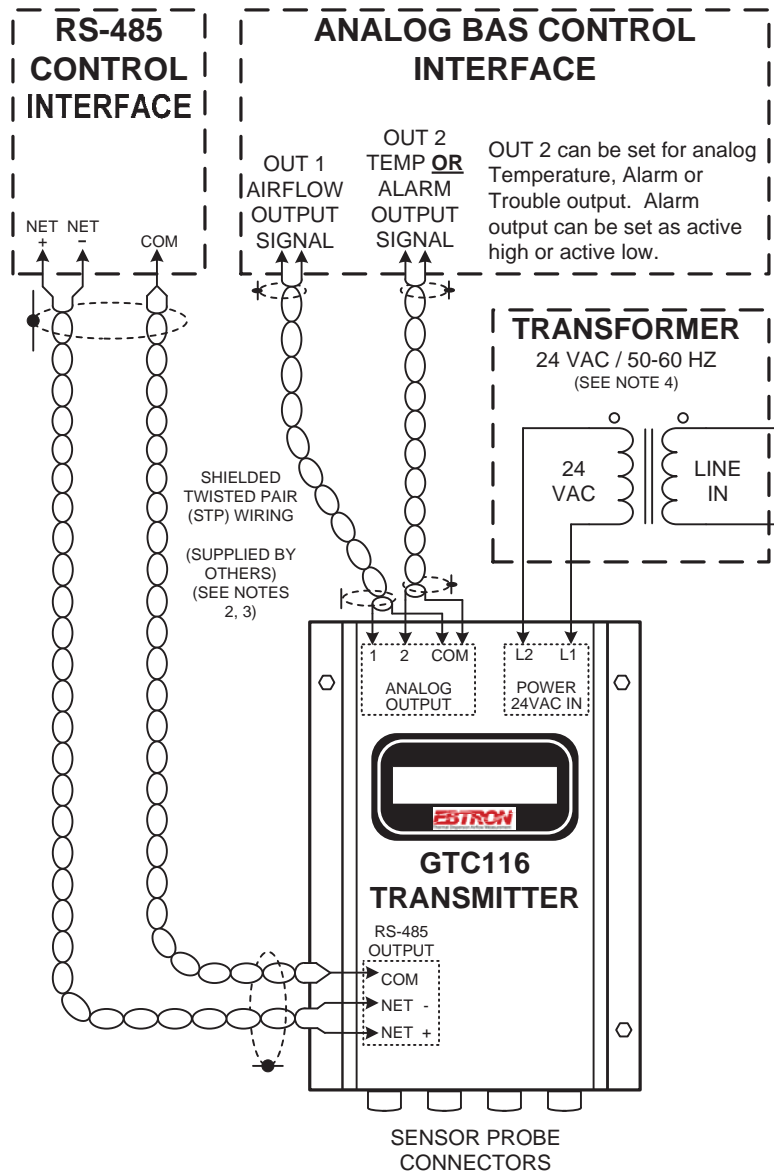
Problem	Possible Cause	Remedy
The host control system is unable to communicate with the GTL116 transmitter.	Output card is not securely mounted on main circuit board.	Turn the transmitter power "OFF" and press the output card firmly onto main circuit board. Turn the transmitter power back "ON".
	The network signal wiring is not properly connected to the GTL116 transmitter or the host controls.	Verify that network cabling from the host controls is connected to the proper terminals of the OUTPUT terminal block on the GTL116 transmitter. Wires should only be connected to positions 1 and 2 on the terminal block.
	The LonWorks network database has not been configured for the GTL116 transmitter.	The LonWorks network database may be pre-configured using the GTL116.XIF file available for download at <a href="http://www.ebtron.com">www.ebtron.com</a> or configured at installation time by direct LonWorks parameter upload from the GTL116 transmitter.
The GTL116 transmitter is not providing values for any of the variables.	The required network configuration variables have not been set.	Certain network configuration variables must be set to enable the LonWorks output card to request data from the GTL116 transmitter. Refer to the GTL116 - LonWorks INTERFACE section of this technical manual for specific GTL116 variables and settings.
There is no value for the differential pressure variables.	Differential pressure is only available from transmitters that have <b>EBTRON's</b> Bi-directional Bleed Airflow Sensors connected.	If a differential pressure measurement is required, contact your local <b>EBTRON</b> Representative about <b>EBTRON's</b> Bi-directional Bleed Airflow Sensor.
The LCD display does not match the readings indicated by the host control system.	The area factor in the GTL116 transmitter does not match that of the host controls.	Compare the value of the Area of the GTL116 transmitter with that of the host control system and make adjustments to ensure a match.
The returned value for airflow is zero when airflow is indicated on the LCD display of the GTL116 transmitter.	The Low Limit airflow cutoff value is above the actual airflow reading.	Decrease the Low Limit airflow cutoff value in the Setup menu until it is below the actual airflow reading.
The status variable from the GTL116 transmitter has a Trouble value.	The sensor detection system has detected one or more malfunctioning or missing sensors.	Check sensor probe cable connections. If sensor probe connections look OK and match the number of sensor probes indicated on each probe's hang tag, please call <b>EBTRON's</b> customer service or visit us at <a href="http://www.ebtron.com">www.ebtron.com</a> .
	Wrong type of sensor probes attached to transmitter.	GTx116 transmitter will only operate with GP1 or GB1 sensors connected.

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**APPENDIX A - WIRING DIAGRAMS**

**GTC116 Combination Analog/RS-485 Output Transmitter Wiring Diagram**

Figure A-1 is a typical wiring diagram for the GTC116 transmitter.



**NOTES:**

1. OUTPUT 2 CAN BE SET AS TEMPERATURE OR AS AN ALARM. ALARM CAN BE SET AS ACTIVE HIGH OR ACTIVE LOW.
2. CONNECT OUTPUT SIGNAL CABLE DRAINS TO EARTH GROUND AT ONE END OF EACH CABLE ONLY.
3. RS-485 COM CONNECTION MAY USE A SINGLE CONDUCTOR.
4. ON MULTIPLE TRANSMITTER INSTALLATIONS WITH A COMMON 24VAC SOURCE, WIRE 24 VAC POWER IN-PHASE TO THE SAME TERMINALS ON ALL TRANSMITTERS (e.g.: L1 to L1, L2 to L2).

**Figure A-1.**

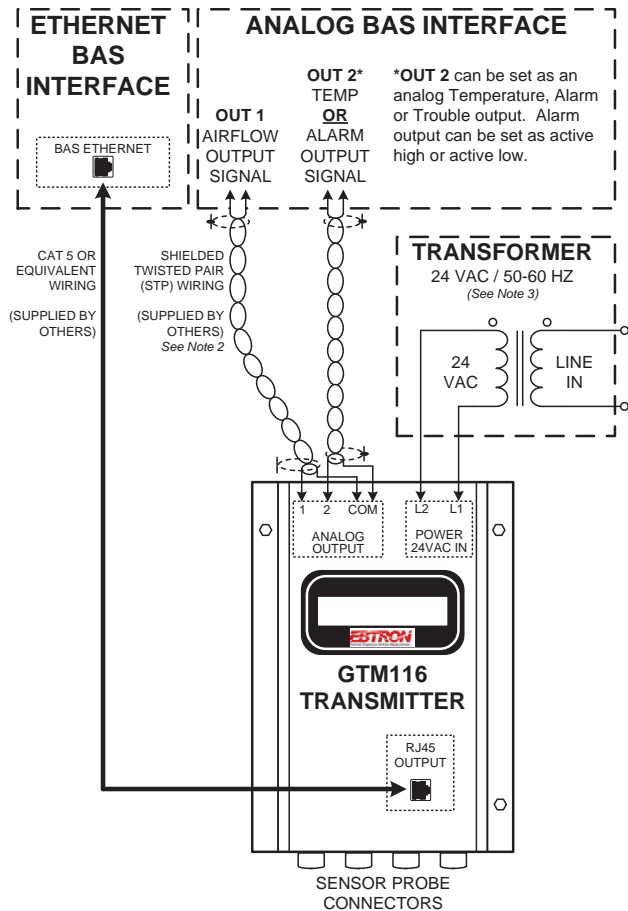
**Model GTC116 Combination Analog/RS-485 Wiring Diagram**

TM GTX116\_R6A

**APPENDIX A - WIRING DIAGRAMS (cont'd)**

**GTM116 Combination Analog/Ethernet Output Transmitter Wiring Diagram**

Figure A-2 is a typical wiring diagram for the GTM116 transmitter.



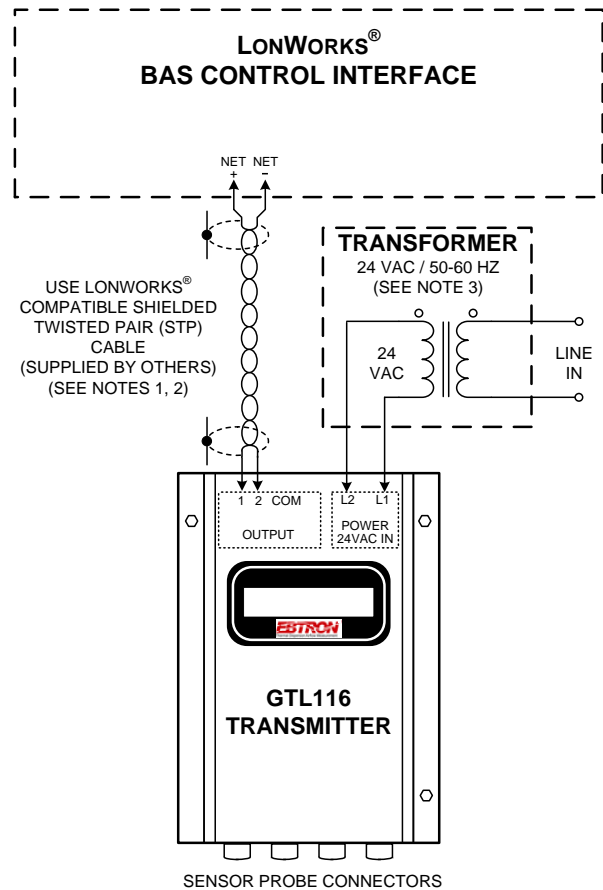
**NOTES:**

1. OUTPUT 2 CAN BE SET AS TEMPERATURE OR AS AN ALARM. ALARM CAN BE SET AS ACTIVE HIGH OR ACTIVE LOW.
2. CONNECT OUTPUT SIGNAL CABLE DRAINS TO EARTH GROUND AT ONE END OF EACH CABLE ONLY.
3. ON MULTIPLE TRANSMITTER INSTALLATIONS WITH A COMMON 24VAC SOURCE, WIRE 24 VAC POWER IN-PHASE TO THE SAME TERMINALS ON ALL TRANSMITTERS (e.g.: L1 to L1, L2 to L2).

**Figure A-2.**  
**Model GTM116**  
**Combination Analog/Ethernet Wiring Diagram**

**GTL116 LonWorks Output Transmitter Wiring Diagram**

Figure A-3 is a typical wiring diagram for the GTL116 transmitter.



**NOTES:**

1. REFER TO *LonWorks® FTT-10A Free Topology Transceiver User's Guide* AVAILABLE AT [www.echelon.com](http://www.echelon.com) FOR LONWORKS® NETWORK WIRING SPECIFICATIONS AND TERMINATION REQUIREMENTS.
2. GTL116 CONNECTIONS AT TERMINALS 1 AND 2 (NET + and NET -) ARE NOT POLARITY SENSITIVE, AND THE COM CONNECTION IS NOT USED.
3. ON MULTIPLE GTL116 TRANSMITTER INSTALLATIONS WITH A COMMON 24VAC SOURCE, WIRE 24 VAC CONNECTIONS IN-PHASE TO THE SAME TERMINALS ON ALL TRANSMITTERS (e.g.: L1 to L1, L2 to L2).

**Figure A-3.**  
**Model GTL116**  
**LonWorks Wiring Diagram**

TM\_GTx116\_P8A

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# APPENDIX B - GTx116 SETUP MENUS

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**SYSTEM OF UNITS MENU**

Simultaneously depress/release ENTER + ESC keys during normal operation to select

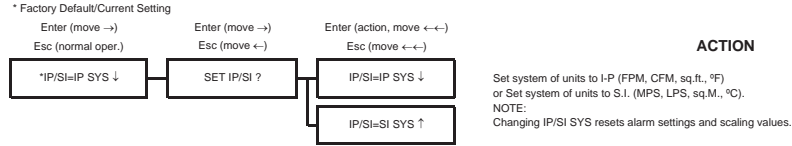


Figure B-1. TM\_GTx116 System of Units Menu

**TM\_GTx116 Setup Menu (PART 1 OF 6)**

**SETUP MENU**

Simultaneously depress/release ↑ + ↓ keys during normal operation to select

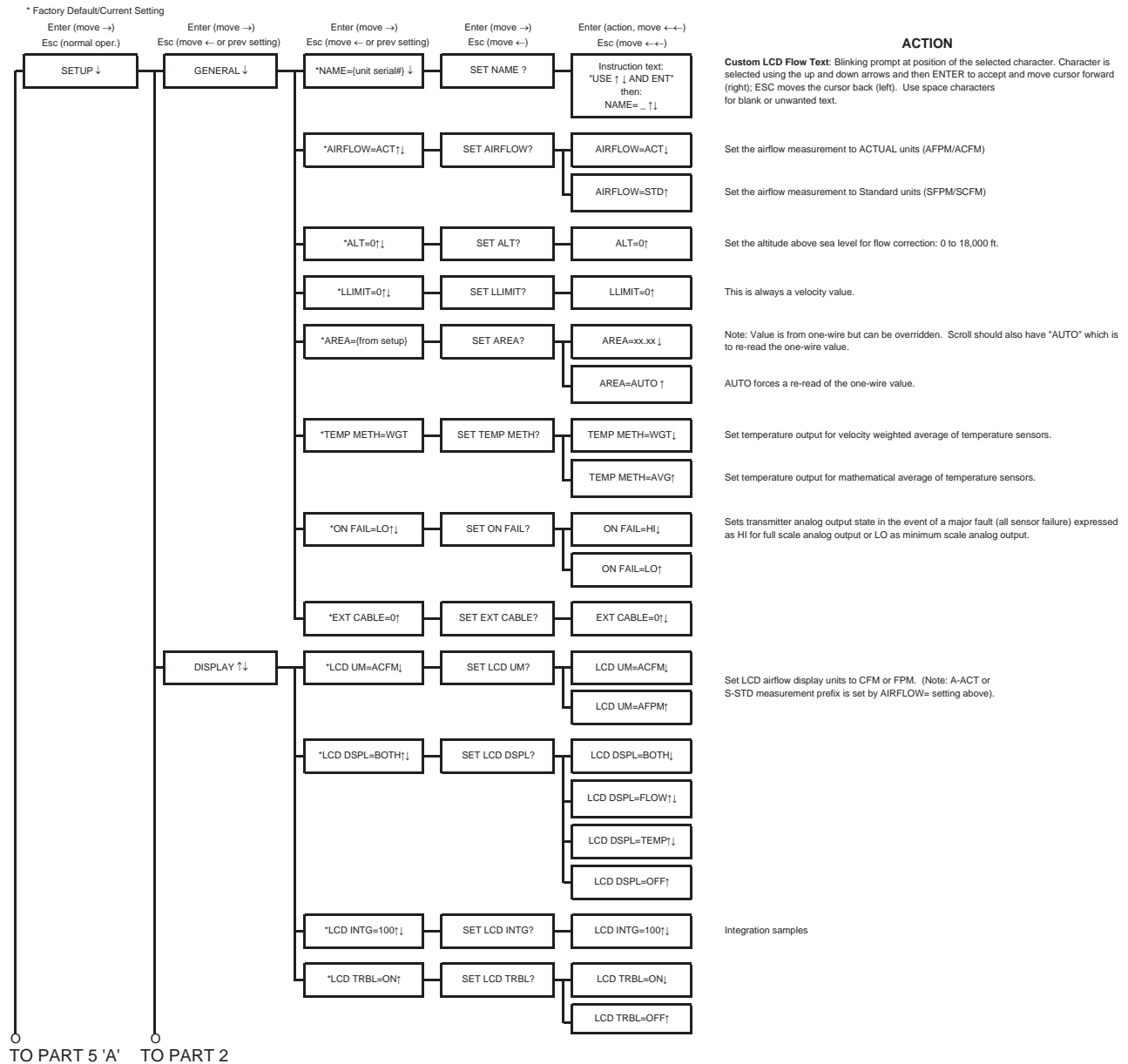
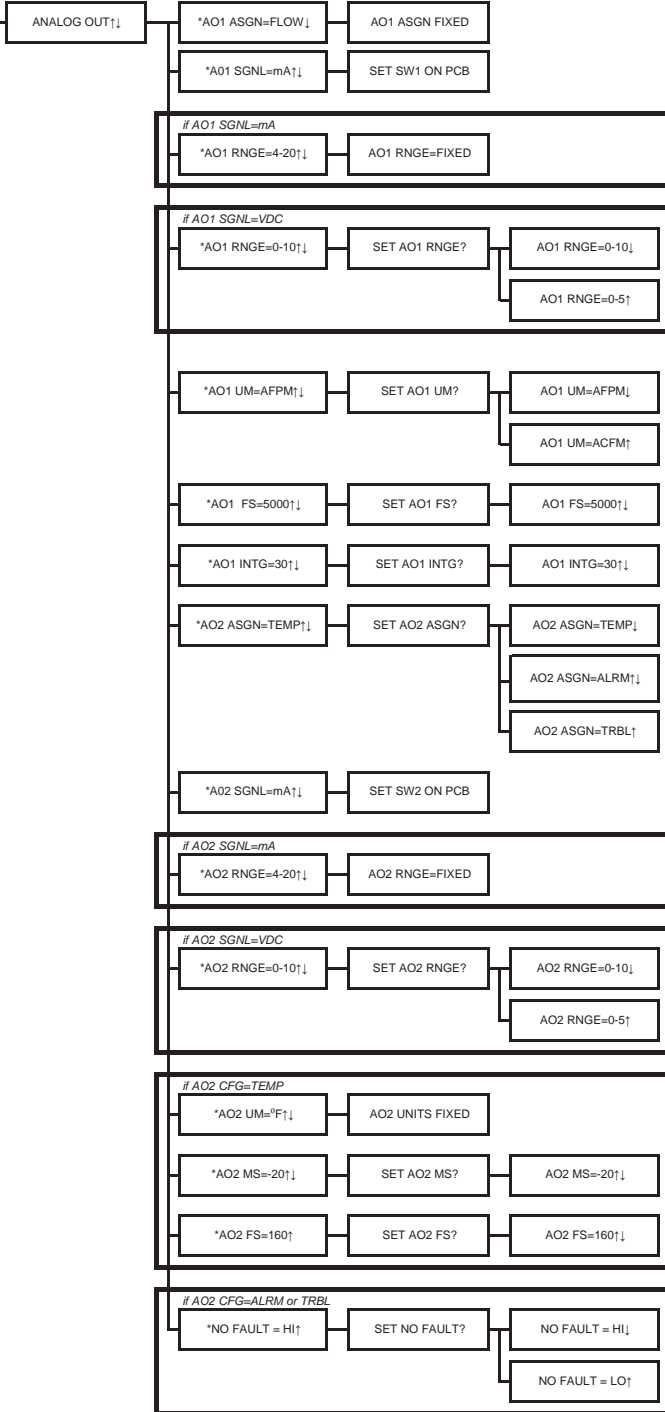


Figure B-2. GTx116 Setup Menu

**TM\_GTx116 Setup Menu (PART 2 OF 6)**

FROM PART 1

Analog cards only



The text "AO1 ASGN FIXED" flashes to indicate that this setting is fixed and cannot be modified.

Display initially shows the current SW1 PCB switch setting (VDC or mA) for AO1. Pressing enter displays "SET SW1 ON PCB" prompt to confirm SW1 PCB setting.

The text "AO1 RNGE=FIXED" flashes to indicate that this setting is fixed and cannot be modified.

Set AO1 output units to FPM or CFM. (Note: A-ACT or S-STD measurement is set by AIRFLOW= setting above).

Integration samples. Also affects network average.

AO2 output is assigned as temperature output.

AO2 output is assigned as an airflow alarm output. Refer to ALARM settings (part 4).

AO2 output is assigned as a transmitter trouble alarm indicating that a sensor or transmitter fault has occurred.

Display initially shows the current SW2 PCB switch setting (VDC or mA) for AO2. Pressing enter displays "SET SW2 ON PCB" prompt to confirm SW2 PCB setting.

The text "AO2 RNGE=FIXED" flashes to indicate that this setting is fixed and cannot be modified.

The text "AO2 UNITS FIXED" flashes to indicate that this setting is fixed and cannot be modified.

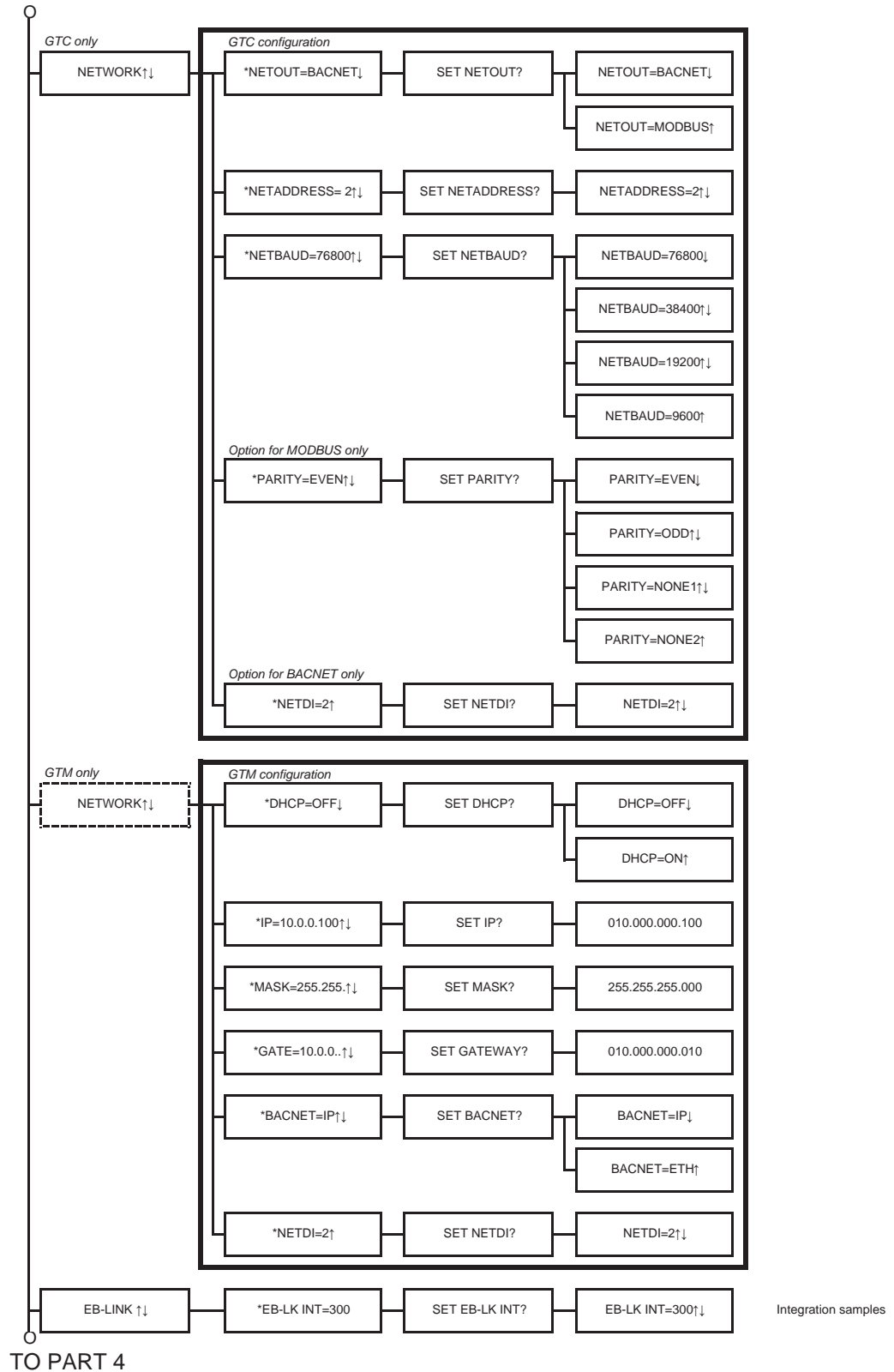
Sets AO2 alarm/trouble output state when no fault condition is present, expressed as HI (full scale analog output) or LO (minimum scale analog output).

TO PART 3

TM\_GTx116\_R6A

**TM\_GTx116 Setup Menu (PART 3 OF 6)**

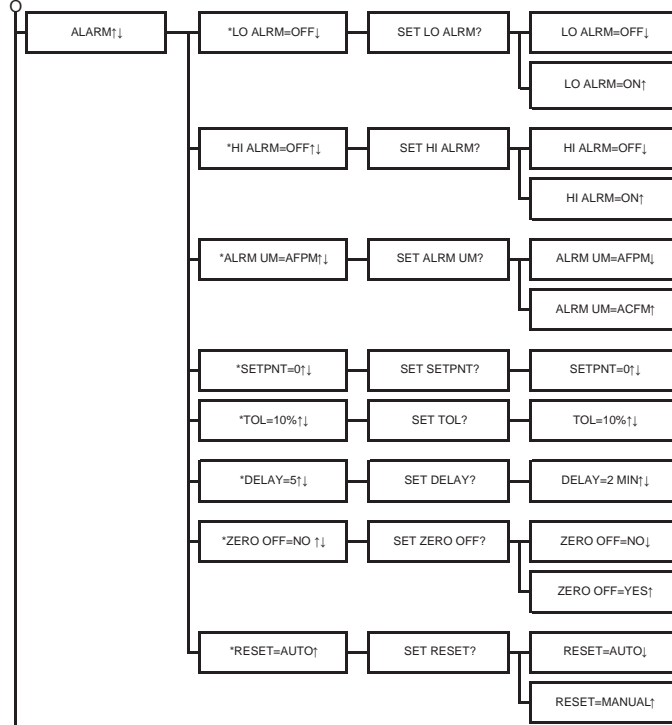
FROM PART 2



TM\_GTx116\_P8A

**TM\_GTx116 Setup Menu (PART 4 OF 6)**

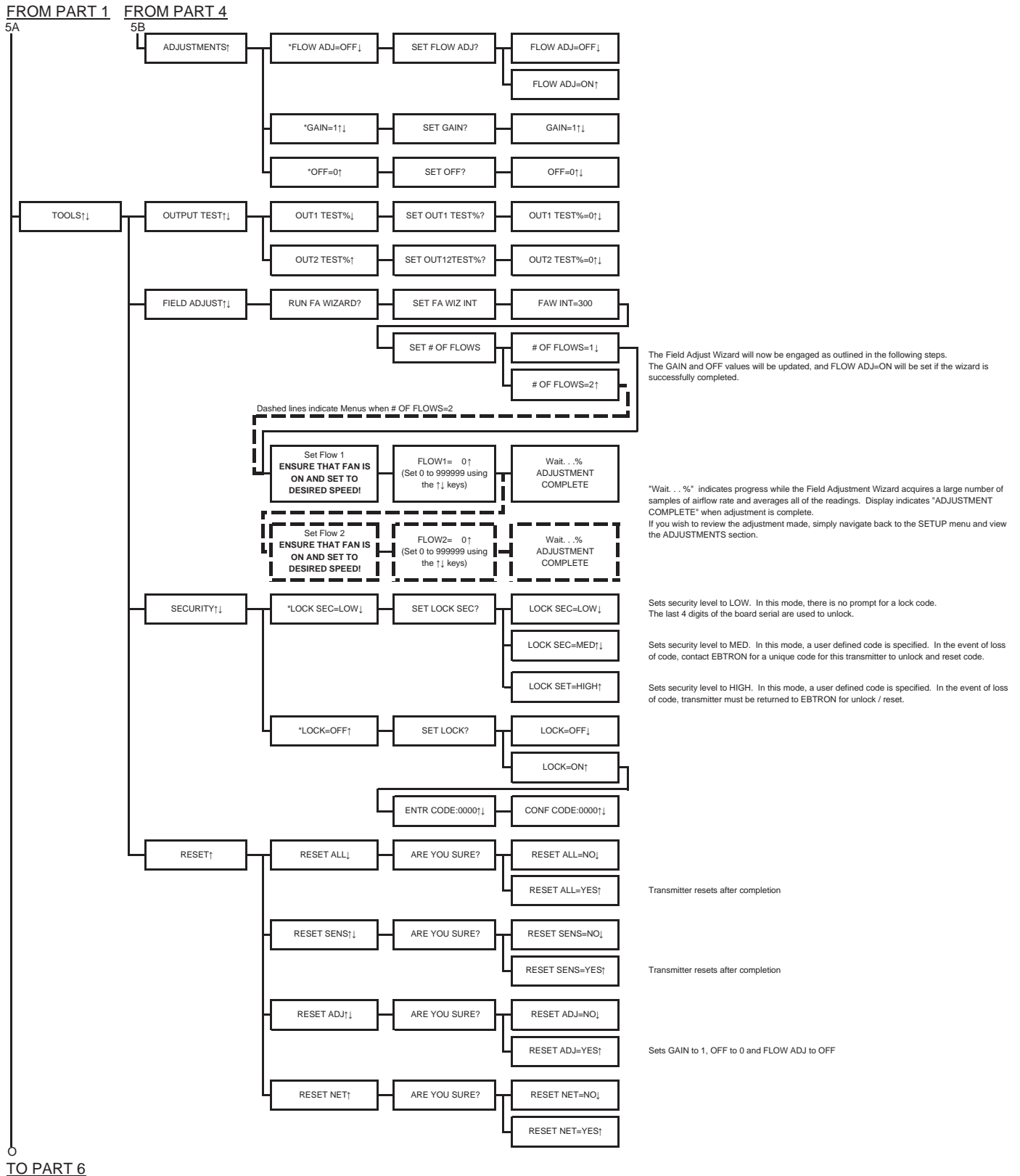
FROM PART 3



TO PART 5 'B'

When ZERO OFF=YES, this setting is used to inhibit the LO ALRM condition when the unit is reading 0. This is dependent on the low limit setting.

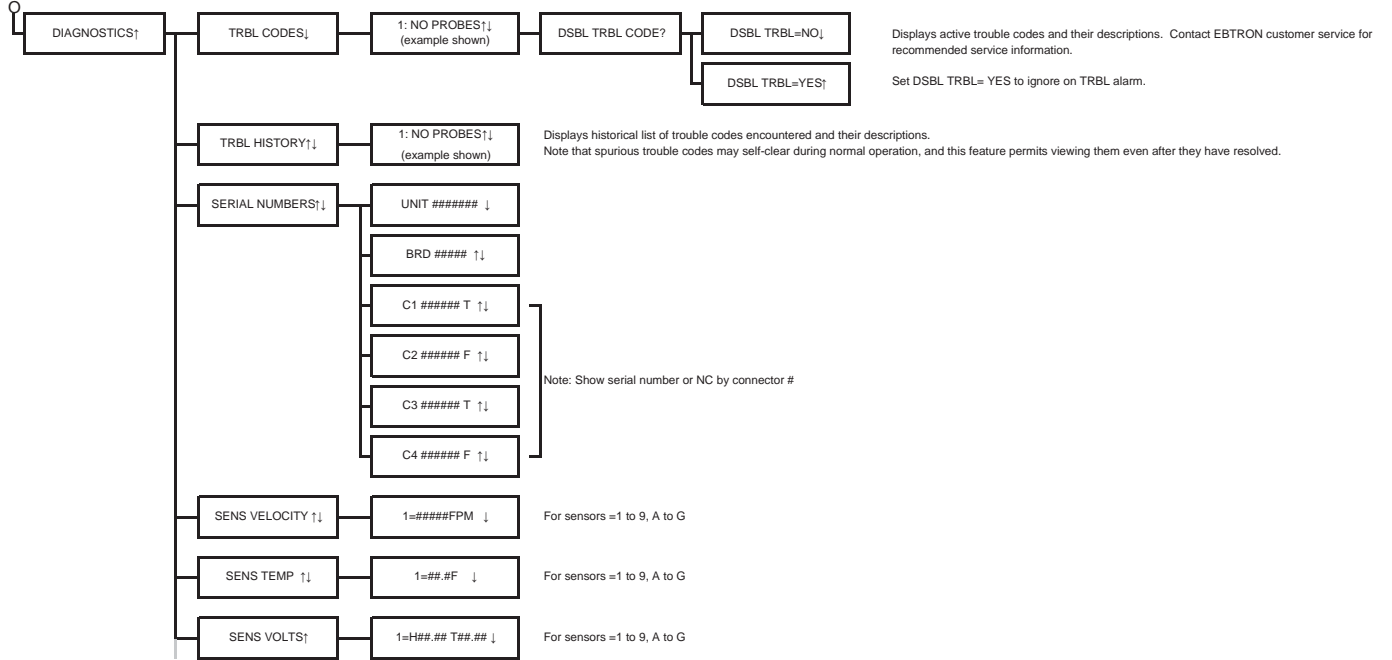
**TM\_GTx116 Setup Menu (PART 5 OF 6)**



TM\_GTx116\_P8A

**TM\_GTx116 Setup Menu (PART 6 OF 6)**

FROM PART 5





# Hawkeye® Solid- & Split-Core Adjustable Setpoint Digital Output Current Switches 708/908 Series

24

THE INDUSTRY STANDARD!



H708 Solid-core

H908 Split-core

FIVE-YEAR  
**5**  
WARRANTY

The Hawkeye 708/908 Series solid- and split-core adjustable current sensors provide accurate, reliable and maintenance-free fan and pump status indication.

**APPLICATIONS**

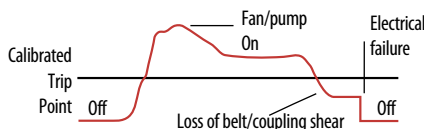
**Monitor fans, pumps, motors & other electrical loads for proper operation**

- Detect belt loss and motor failure...ideal for fan and pump status
- Replace pressure switches and other electromechanical devices
- Verify lighting circuit loads
- Monitor critical motors (compressor, fuel, etc.)
- Industrial process equipment status (OEM)

**Cost effective...reduced installation & service costs**

- Adjustable set-point...1 to 135A (708), 2.5 to 135A (908)
- More reliable & cost-effective than differential pressure switches... no fitting or tapping
- 100% solid-state, no moving parts to fail
- Output status LEDs for fast setup
- Polarity insensitive output...easy wiring
- Adjustable mounting bracket...easy placement
- Self-gripping iris eliminates the need for drill mounting...easy installation
- 5-year limited warranty

**Detects belt loss/coupling shear!**



Now you can easily detect when drive belts slip, break, or pump couplings shear. In fact, a typical HVAC motor that loses its load has a reduction of current draw of up to 50%. That's why our sensors are the industry standard for status.

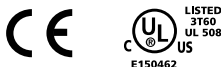


ORDERING INFORMATION

MODEL	AMPERAGE RANGE	OUTPUT TYPE	OUTPUT RATING (MAX.)	TRIP POINT ADJUSTMENT	STATUS OPEN LED	STATUS CLOSED LED
<i>Solid-Core</i>						
H701	1-135A	N.O. Solid-state	1.0A@30VAC/DC	●		
H706*	1-135A	N.C. Solid-state	0.1A@30VDC	●	●	●
H708	1-135A	N.O. Solid-state	1.0A@30VAC/DC	●	●	●
H709	1-135A	N.O. Solid-state	0.2A@120VAC/DC	●	●	●
<i>Split-Core</i>						
H906*	2.5-135A	N.C. Solid-state	0.1A@30VDC	●	●	●
H908	2.5-135A	N.O. Solid-state	1.0A@30VAC/DC	●	●	●
H909	2.5-135A	N.O. Solid-state	0.2A@120VAC/DC	●	●	●



\*Hx06 Models require a constant source of 5-30VDC power to the status contacts



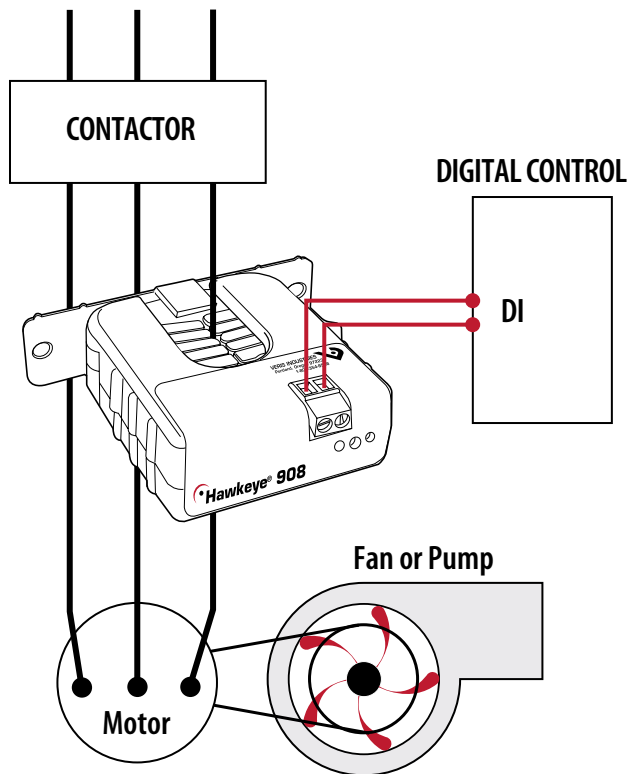
Do not use the LED indicators for evidence of applied voltage

ACCESSORIES

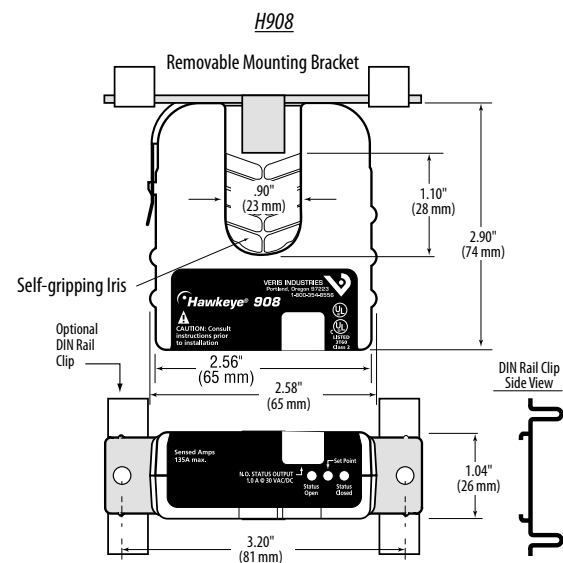
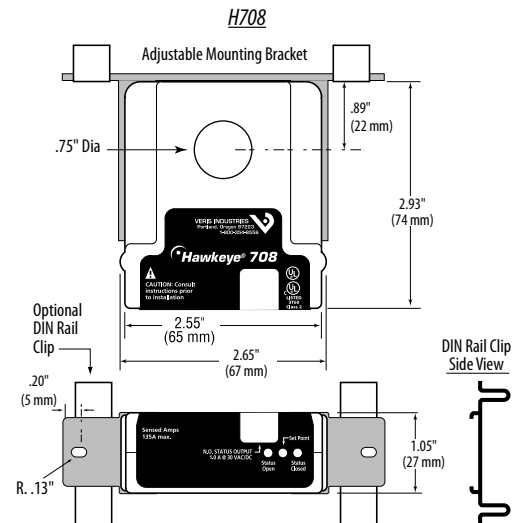
MODEL	DESCRIPTION
AH01	DIN Rail Clip Set

## APPLICATIONS/WIRING EXAMPLE

## Monitoring Fan /Pump Motors for Positive Proof of Flow



## DIMENSIONAL DRAWINGS



## SPECIFICATIONS

Sensor Power	Induced from line
Output	Digital switch (see ordering table)
Insulation Class	600VAC rms
Frequency Range	50/60Hz
Temperature Range	-15° to 60°C
Humidity Range	0 - 95% non-condensing
Trip Setpoint	Adjustable 1-135A
Hysteresis	10% Typical
Dimensions (708) ... (L x W x H)	2.93" x 2.65" x 1.05"
Sensor Hole Size (708)	0.75" diameter
Dimensions (908) ... (L x W x H)	2.90" x 2.58" x 1.04"
Sensor Opening Size (908) ... (L x W)	1.10" x .90"
Status Contacts (Hx06 Models)	
Supply Voltage	5-30VDC, permanently connected
Off-state Leakage (max.)	24µA@30VDC
On-state Voltage Drop	1.7VDC (max.)@0.1A



# BACtalk<sup>®</sup> Microset<sup>™</sup> II

## Wall Unit ■



The Alerton<sup>®</sup> BACtalk<sup>®</sup> Microset<sup>™</sup> II is an intelligent and attractive wall unit that updates the functions of the typical thermostat. The Microset II connects to Alerton's BACtalk VisualLogic<sup>®</sup> Controllers (VLCs<sup>™</sup>) and serves as a tenant control center and field service tool. Sleek styling, a backlit liquid crystal display (LCD) and simple push-button controls make operation intuitive. The LCD simultaneously displays the setpoint, room and outside air temperatures, and fan status.

An occupant can use the Microset II to view room and outside air temperatures and change setpoints within established limits. The Microset II is programmable, allowing site developers the flexibility to display information and allow occupant control according to the varied needs of each application.

Typically, the unit displays room and outside air temperatures. But site developers can program the unit to display additional information: time-of-day, room humidity and outdoor humidity for example. The LCD shows temperatures in Fahrenheit or Centigrade.

## Features & Application Highlights

- **Versatile** Occupant can view room and outside air temperatures, select fan speed and change room temperature setpoints. Data and functions are programmable.
- **Energy Efficient** Occupants can select after-hours operation in 30-minute increments or turn zone equipment ON and OFF.
- **Flexible** A programmable field service mode allows maintenance personnel to monitor and adjust control parameters in the VLC from the Microset's field service mode.
- **Attractive** Modern styling enhances any interior, and functional design makes operation intuitive.

The Microset II's push-button operations can be customized so that an occupant can use them to turn zone HVAC equipment ON or OFF. This is useful for areas that are occupied sporadically, such as conference rooms. Push-buttons also support fan-speed control, and the LCD shows current fan-speed. An occupant can select after-hours operation in 30-minute increments up to established limits.

The Microset II communicates with programmable VLCs, which directly connect to zone mechanical equipment. The VLC stores programmed control parameters and temperature settings, executing DDC to control equipment and maintain optimum environmental conditions.

The Microset II's programmable field service mode (activated with a special code) enables maintenance personnel to view and adjust control parameters in the field. This reduces maintenance and service time while providing facility personnel with increased flexibility.

### Product Numbers

→ MS-2000-BT  
MS-2000H-BT (with optional humidity sensor)

## BACtalk® Microset™ II SPECIFICATIONS

**Thermistor** The thermistor is integrated with the device. The unit is a microprocessor-based sensor with a built-in analog to digital converter for temperature and humidity, which is designed to communicate directly to VLCs.

**Type** Uni-curve Type II.  
**Resistance** 10KΩ at 77°F (22°C).  
**Interchangeability** 0.36°F (0.2°C).  
**Time Constant\*** 10 seconds (to 66% of new temperature).  
**Stability\*** 0.036°F (0.02°C) drift per year.  
**Accuracy\*** ± 0.36°F (0.2°C) over range of 32–158°F (0–70°C).

\*Based on normal operating conditions.

**Power** 24 VAC @ 25 mA for backlit display. Orange lead terminates to 24 VAC terminal on VLC. Sensor draws 5 VDC @ 10 mA from VLC.

**VLC Connection** 18–22 AWG, shielded, 3-conductor. 1000 ft. max. Black wire to VLC IN, white to VLC input COM, orange is optional 24 VAC for backlit display. Low capacitance wire recommended.

**Dimensions** 4.6" (117mm) H X 3.0" (76mm) L X 0.7" (18mm) D.

**Environmental** 32–158°F (0–70°C). 0–90% RH, non-condensing.

### Optional Humidity Sensor

**Total Accuracy** ± 2% RH, 0–100% RH @ 25°C, with saturated salt calibration.  
**Operating Temp.** -40–185°F (-40–85°C).  
**Repeatability** ± 0.5% RH.  
**Interchangeability** ± 5% RH up to 60%RH, ± 8% RH at 90% RH (typical humidity).

**Ratings**

- Listed Underwriters Laboratory as an accessory for VAVs and VLCs.
- EMC Directive 89/336/EEC (European CE Mark). *Pending.*
- FCC Part 15, Subpart J, Class A. *Pending.*

*Specifications subject to change without notice.*

Visit our website at [www.alerton.com](http://www.alerton.com) or e-mail us at [info@alerton.com](mailto:info@alerton.com)

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# Wet Media Differential Pressure Transducer

4-20 mA, 2-Wire Device

## APPLICATIONS

- Monitoring and controlling pump differential pressure
- Chiller/boiler differential pressure drop
- CW/HW system differential pressure

## FEATURES

- The jumper-selectable output switch for normal (4-20mA) or reverse (20-4mA) operation provides application flexibility
- Rugged, die-cast enclosure provides NEMA 4 sealing
- Selectable differential units: psid or bard

### Exceptional accuracy and stability

- Dual sensor design for improved overpressure tolerance... eliminates the requirement for a bypass valve assembly in most applications
- Jumper-controlled electronic surge dampening for high stability
- Pushbutton zero calibration – no trim pots to adjust.....maintain accuracy and prevent callbacks with automatic zero calibration

### Lowest total installed cost

- Jumper-selectable port swap feature eliminates costly replumbing when the high and low ports are improperly plumbed...change the jumper position from normal to swap – problem solved!
- Switch-selectable pressure ranges...fewer models to order and stock
- LCD displays high pressure, low pressure, and differential pressure with easy readability

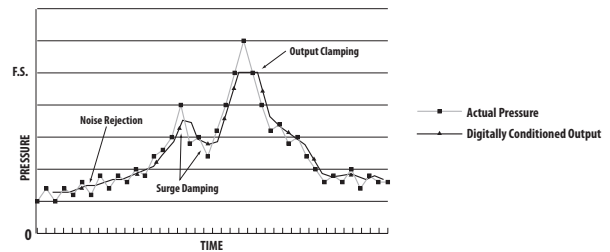


PW2



## DESCRIPTION

The PW2 Series 2-wire, 4-20 mA wet/wet pressure transducers incorporate microprocessor profiled sensors for exceptional accuracy and reliability. Easy to use and designed to provide exceptional installation savings, the PW2 Series is ideal for measuring pressure across pumps, filters, heat exchangers, compressors, and other non-corrosive wet media applications.



### Microprocessor provides digital signal conditioning

- Noise rejection reduces fluctuating readings due to noise or turbulence
- Surge damping prevents false alarms by averaging fast peaks

PRESSURE

## SPECIFICATIONS

<b>Input Power</b>	12 to 24VDC, loop powered
<b>Maximum Current Draw</b>	29mA
<b>Output</b>	2-wire transmitter; user selectable 4-20mA, (clipped and capped)
<b>Accuracy @ 25°C*</b>	Range A, B, C: ±1% F.S.; Range D: ±2% F.S.**
<b>Surge Damping</b>	Electronic; 5-second averaging
<b>Pressure Ranges (Selectable):</b>	
0-50 psi (0-3.45 bar)	0-5/10/25/50 psid (0-0.34/0.69/1.72/3.45 bard)
0-100 psi (0-6.89 bar)	0-10/20/50/100 psid (0-0.69/1.38/3.45/6.89 bard)
0-250 psi (0-17.24 bar)	0-25/50/125/250 psid (0-1.72/3.45/8.62/17.24 bard)
<b>Product Operating Environment</b>	-10° to 55°C (14° to 130°F); 0 to 90%RH, non-condensing
<b>Long Term Stability</b>	±0.25% per year
<b>Zero Adjust</b>	Pushbutton auto-zero
<b>Housing Material</b>	White powder-coated aluminum
<b>Sensor:</b>	
<b>Media Compatibility</b>	Media compatible with 17-4 PH stainless steel
<b>Proof Pressure</b>	Max. 2x F.S. range
<b>Burst Pressure</b>	Max. 5x F.S. range
<b>Temperature Compensated Range</b>	0° to 50°C (32° to 122°F); TC Zero <±1.5% of product F.S. per sensor; TC Span <±1.5% of product F.S. per sensor, (2 sensors per unit)
<b>Media Temperature Limits</b>	-20° to 85°C (-4° to 185°F); 0 to 90% RH non-condensing
<b>Fittings</b>	1/8" NPT female thread, 17-4 PH stainless

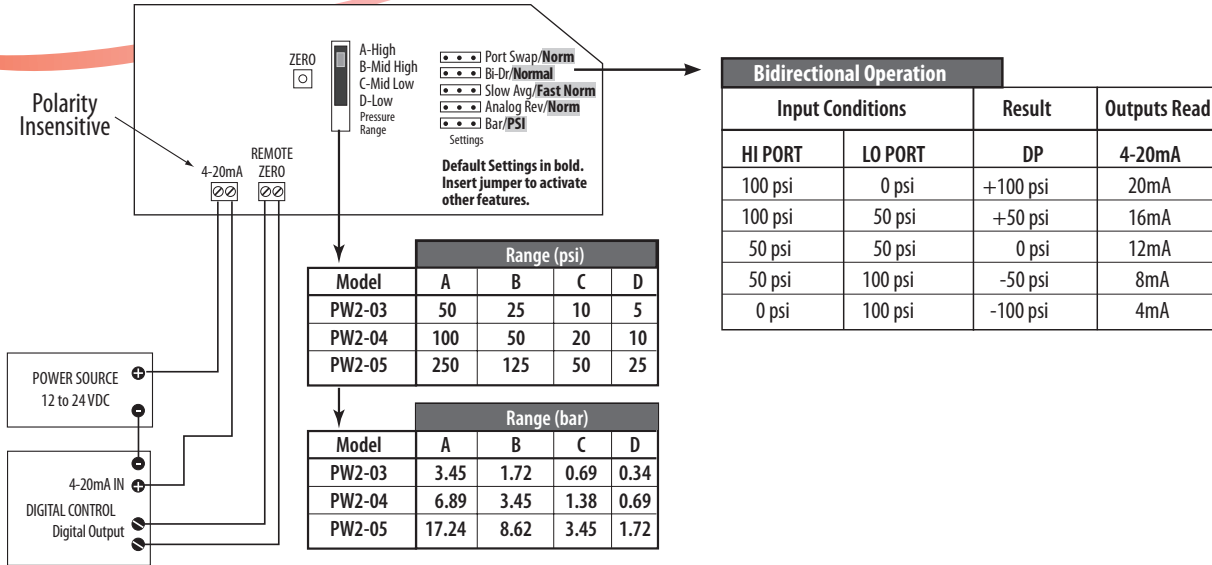
\* Accuracy combines linearity, hysteresis, and repeatability.

\*\* FS is defined as full span of selected range in bi-directional mode.

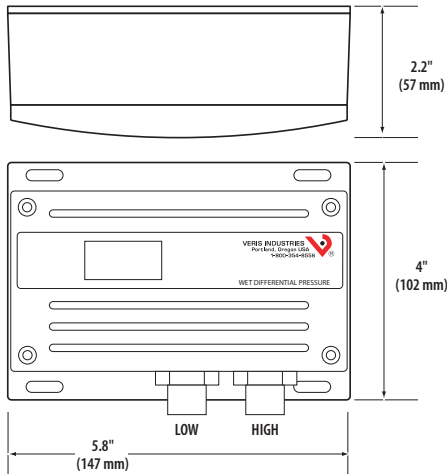
EMC Conformance: Low voltage directive 2006/95/EC; EMC directive 2004/108/EC.

EMC Special Note: Connect this product to a DC distribution network or an AC/DC power adaptor with proper SURGE PROTECTION (EN 61000-6-1:2007 specification requirements).

APPLICATION/WIRING DIAGRAM



DIMENSIONAL DRAWING



PRESSURE

ORDERING INFORMATION



- PW2**
- Local Display:  L = LCD Display,  X = No Display
  - NIST:  N = NIST,  X = None
  - Operational Range<sup>1</sup>:  03 = 0-50 psi/3.45 bar,  04 = 0-100 psi/6.89 bar,  05 = 0-250 psi/17.24 bar
  - US or EU:  S = Standard,  C = CE

Example:  
PW2  L  X  04  C

ACCESSORIES

Bypass Valve assemblies (AA14A, AA16A), snubbers (AA11, AA12), steam siphon (AA13)

<sup>1</sup>Select operational range according to maximum gauge pressure, NOT differential pressure. Example: High gauge pressure=90 psig, Select 100 psig model (04).

## INSTALLATION INSTRUCTIONS

- Read instructions thoroughly prior to install

Applications shown are suggested means of installing sensors, but it is the responsibility of the installer to ensure that the installation is in compliance with all national and local codes and OSHA requirements. Installation should be attempted only by individuals familiar with proper installation techniques and with codes, standards, and proper safety procedures for control installations.

## PX SERIES

Differential Pressure Transducer  
Dry Media

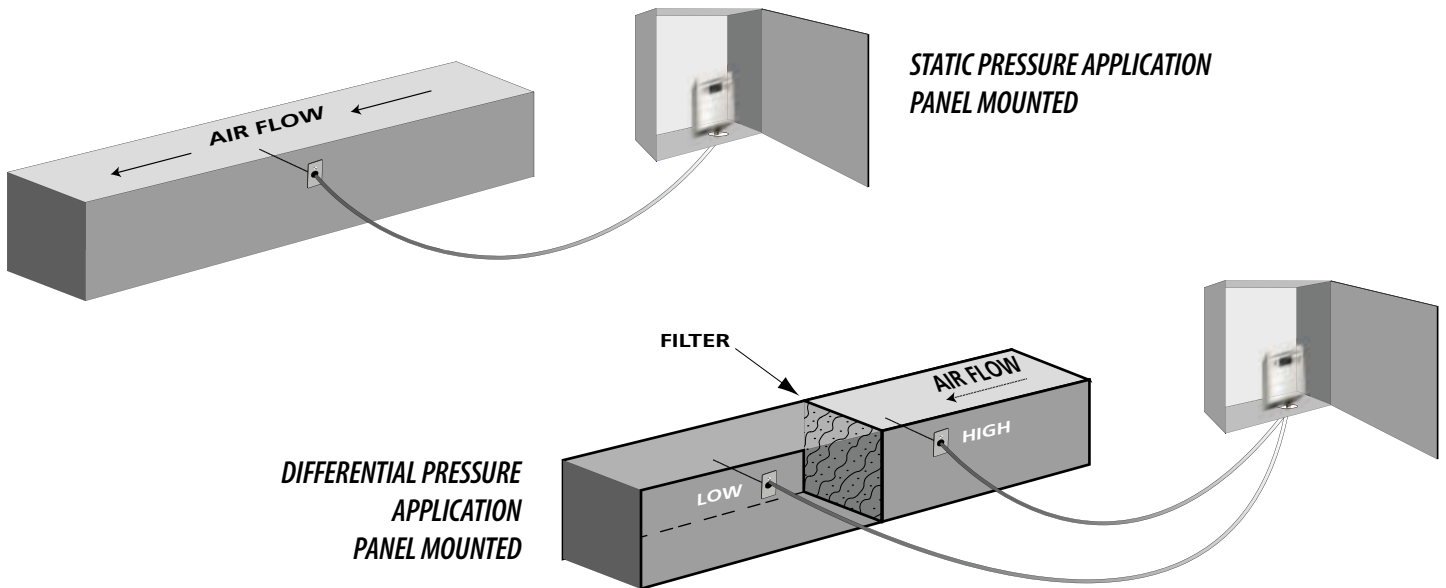
**VERIS INDUSTRIES**

PORTLAND, OREGON USA  
(503) 598-4564 FAX (503) 598-4664  
1-800-354-8556

<http://www.veris.com> email: [sales@veris.com](mailto:sales@veris.com)

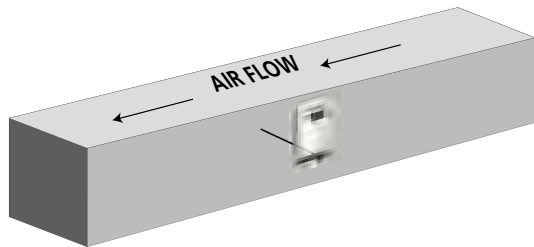


## PXP PANEL INSTALLATIONS

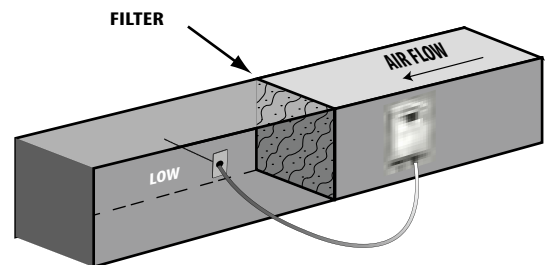


## PXD DUCT INSTALLATIONS

*STATIC PRESSURE APPLICATION  
DUCT MOUNTED*



*DIFFERENTIAL PRESSURE APPLICATION  
DUCT MOUNTED*



## WIRING

Connect transmitter to control system and power supply as indicated.

Optional: Connect ZERO terminals to digital output (contact closure) of control system.

## CONFIGURATION

Use switch to select voltage (V) or current (mA) mode.

Use jumper JP4 to select 0-10V or 0-5V output span. (Voltage mode only).

Use jumper JP5 to select bidirectional or unidirectional mode.

Select appropriate full-scale range using the slide switch. LCD models will momentarily indicate selected range.

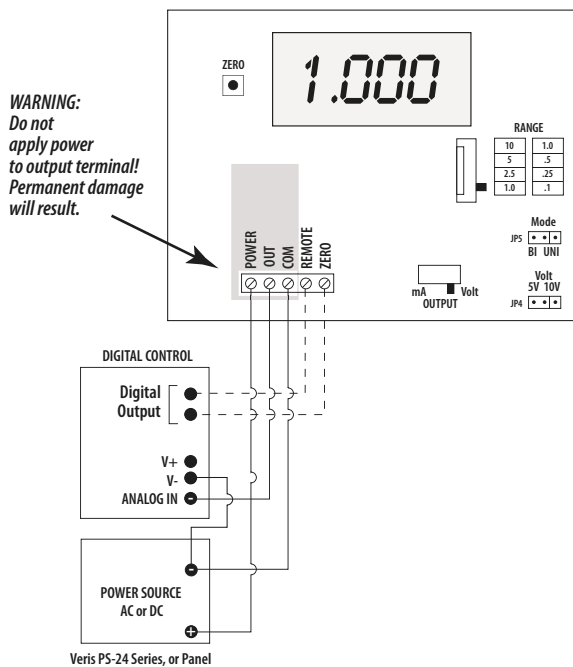
## OPERATION

**IMPORTANT:** PX Series employ ceramic capacitive sensors and sophisticated temperature compensation circuitry. Sensor achieves best accuracy after initial warm-up period. During the first few minutes of operation, readings at zero pressure and lowest pressure ranges will appear erroneous. Following this initial warm-up period, PX Series will maintain specified accuracy and stability.

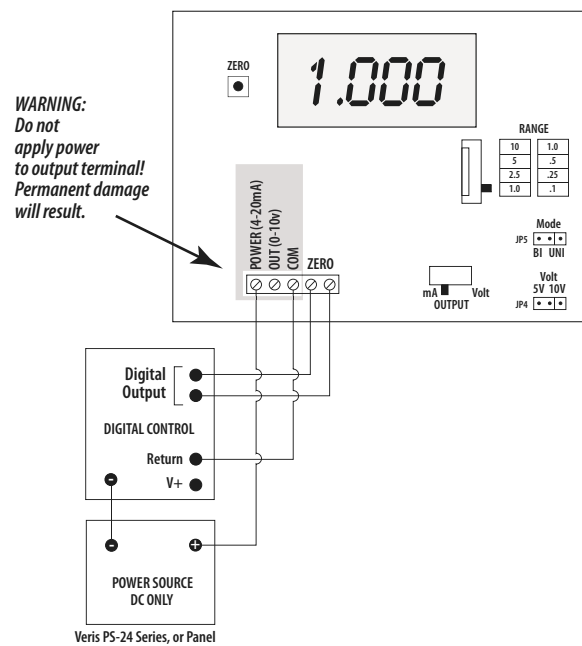
**LCD DISPLAY:** Display momentarily indicates range "SET" when selection is made. Pressure is normally indicated on display. Units are in inches water column ("W.C.)

**ZERO:** Press and hold the ZERO pushbutton for 2 seconds or provide contact closure on 'AUX ZERO' terminal to automatically reset output and display to zero pressure. To protect the unit from accidental zero, this feature is enabled only when detected pressure is within 5% of factory calibration.

### 3-wire, 0-5V/0-10V Configuration



### 2-wire, 4-20mA Configuration



## SPECIFICATIONS

Media Compatibility.....	Dry air or inert gas
Input Power.....	15-30VDC; 24 VAC(Voltage out only)
Output.....	Field selectable: 2-wire, loop-powered 4-20mA, or 3-wire 0-5V/0-10V
Pressure Ranges: 01:.....	Unidirectional: 0.1/0.25/0.5/1.0" W.C. F.S., jumper selectable
	Bidirectional: $\pm 0.1/\pm 0.25/\pm 0.5/\pm 1.0$ " W.C. F.S., jumper selectable
02:.....	Unidirectional: 1.0/2.5/5.0/10" W.C. F.S., jumper selectable
	Bidirectional: $\pm 1.0/\pm 2.5/\pm 5.0/\pm 10$ " W.C. F.S., jumper selectable
Mode.....	Unidirectional or bidirectional, jumper selectable
Display (option).....	Signed 3-1/2 digit LCD, indicates pressure in inches H <sub>2</sub> O
Proof Pressure.....	3 psid
Burst Pressure.....	5 psid
Accuracy.....	$\pm 1\%$ F.S. of selected range
Temperature Effect.....	01 Model, 0.05%/°C; 02 Models, 0.01%/°C (Relative to 25°C) 0 to 50°C†
Zero Drift (1-year).....	01 Model, 2.0% max.; 02 Model, 0.5% max.
Zero Adjust.....	[Pushbutton auto-zero and digital input (2-pos terminal block)]
Operating Environment.....	0-60°C; 10 to 90% RH non-condensing
Fittings.....	Barb brass; 1/8" i.d.
Physical.....	High-impact ABS plastic





# HVAC CONTROLS

## TWO-POSITION ROOM THERMOSTATS ET SERIES, MODEL MX8001

### DESCRIPTION

The **ET Series** and **Model MX8001 Two-Position Room Thermostats** are designed for on/off control with set points from 50° to 90°F (10° to 32°C). The **Model MX8001** has a mercury bulb switch and is designed for low-voltage control applications. The **ET5-S-1S Series** is a heating-only thermostat and uses a snap-acting switch for line- or low-voltage applications. The **ETD5-S-1S Series** is a heating/cooling thermostat and uses a snap-acting switch for line- or low-voltage applications.



ETD5-S-1S



MX8001



### FEATURES

- **Line- or low-voltage ET5 heating**
- **Line- or low-voltage ETD5 heating/cooling**
- **Low-voltage MX8001 with fan and system switch**  
*Single or dual transformer with adjustable anticipator or mV operation and thermometer*

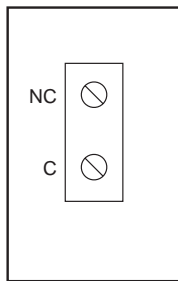
### SPECIFICATIONS

Model	Voltage/Current	Differential	Switch	Contact	Dimensions
<b>ET5-S-1S</b>	24-277 VAC/22A	Htg 2°F	None	SPST, snap acting	2.75"W x 4.75"H x 2.75"D (7.0 x 12.1 x 7.0 cm)
<b>ETD5-S-1S</b>	24-277 VAC/22A	Htg 2°F, Clg 4°F	None	SPDT, snap acting	2.75"W x 4.75"H x 2.75"D (7.0 x 12.1 x 7.0 cm)
<b>MX8001</b>	24 VAC/1A	Htg 1°F, Clg 1.5°F	Fan and system	SPDT, mercury bulb	2.75"W x 4.75"H x 1.25"D (7.0 x 12.1 x 3.2 cm)

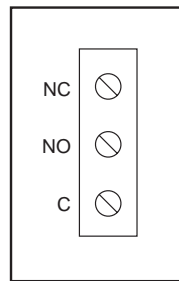
  

<b>Set point range</b>	50° to 90°F (10° to 32°C)	<b>Mounting</b>	2" x 4" (5.1 x 10.2 cm) vertical switch box
<b>Control type</b>	Two-position, on/off	<b>Agency listings</b>	UL listed; CSA ( <b>ET5</b> ), CSA ( <b>MX8001</b> ) UL not required
<b>Weight</b>	0.5 lb (0.23 kg)	<b>Anticipator</b>	<b>MX8001</b> only (-3 to 1.2 mA)

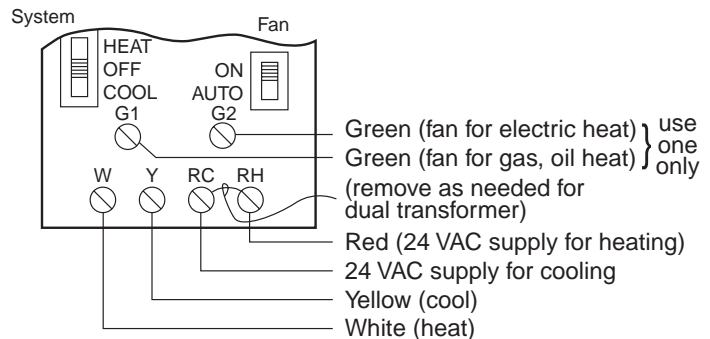
### WIRING



Open on temp rise  
**ET5-S-1S**



C-NC Open on temp rise  
C-NO Close on temp rise  
**ETD5-S-1S**



Note: Must be mounted within 1° of vertical due to mercury bulb switch

**MX8001**

### ORDERING INFORMATION

MODEL	DESCRIPTION
<b>ET5-S-1S</b>	Line- or Low-Voltage Heating Thermostat
<b>ETD5-S-1S</b>	Line- or Low-Voltage Heating or Cooling Thermostat
<b>MX8001</b>	Low-Voltage Thermostat with Fan and System Switch

# Temperature Sensors

## Duct sensors

- Accurate over a wide temperature range
- Tabs for easy installation
- Variety of housings, lengths, harness lengths, and mounting options for versatility



## Immersion sensors and wells

- Four, six, and eight inch lengths
- Immersion wells in stainless steel



## Wallplate sensors

- Brushed stainless steel is attractive and tamper resistant
- Rugged, reliable design
- Order versions with field service jack, override switch, or both



## Outside air sensors

- Gasketed, weathertight enclosures

## Duct average sensors

- Six-foot, twelve-foot, or twenty-four-foot
- Rigid or flexible probe

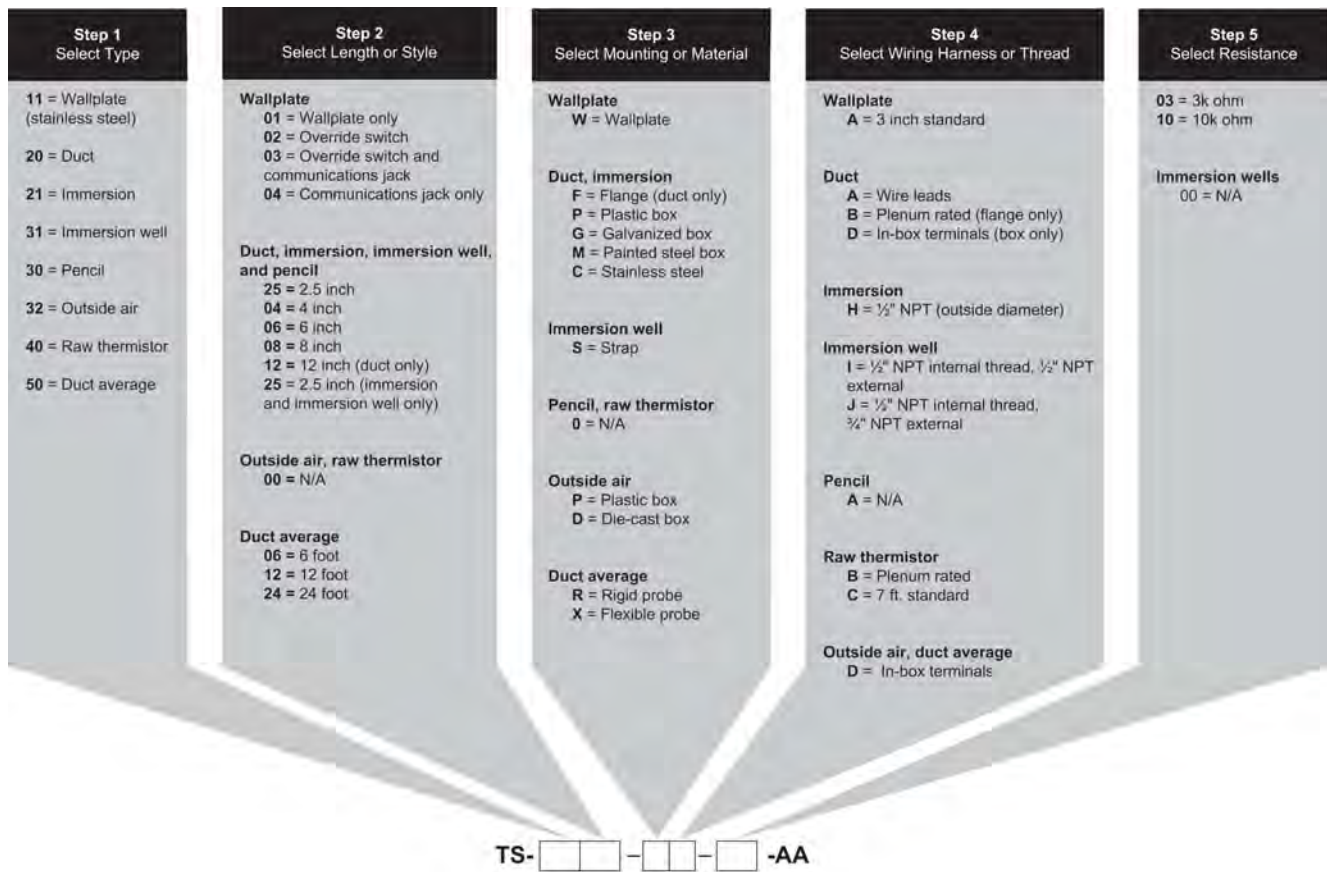


**See page 2 for ordering and technical information**

## Technical Data

- **Type**  
Uni-curve Type II
- **Resistance**  
3k ohm or 10k ohm at 77 deg. F (22 deg. C)
- **Interchangeability**  
0.36 deg. F (0.20 deg. C)
- **Time constant\***  
10 seconds (to 66% of new temperature)
- **Stability\***  
0.036 deg. F (0.020 deg. C) drift per year
- **Accuracy**  
±0.36°F (0.2°C) over range of 32–158°F (0–70°C)

## Ordering information



Example: 3k ohm duct sensor, 6 inches, with flange, 3 inch leads

**TS-2006-FA-03-AA**

Example: 10k ohm immersion sensor, 8 inch probe with plastic enclosure and 1/2 NPT

**TS-2108-PH-10-AA**

Example: Stainless well for 6" immersion sensor with 1/2 NPT internal thread, 3/4 inch external

**TS-3106-CJ-00-AA**

\*Under normal operating conditions

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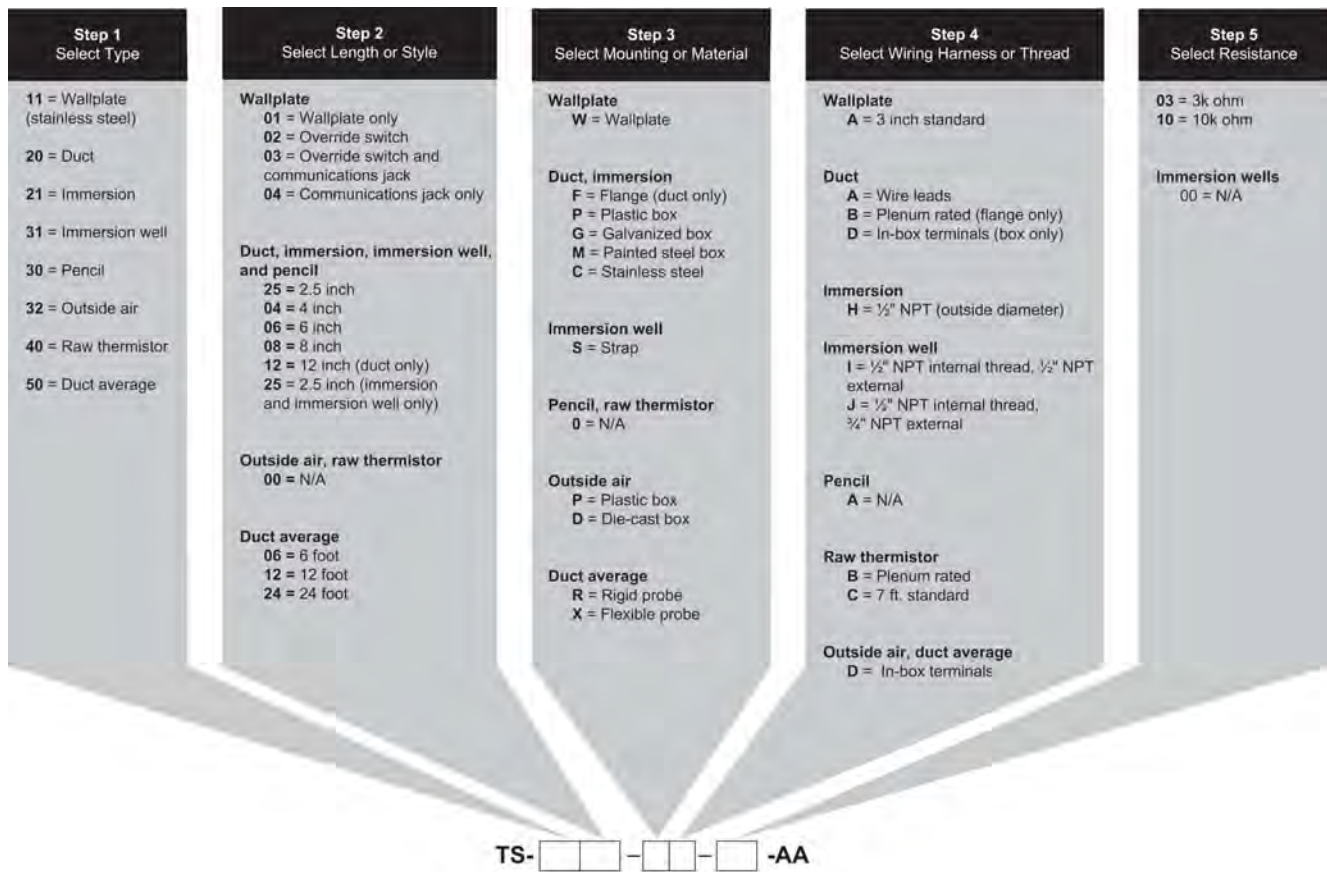
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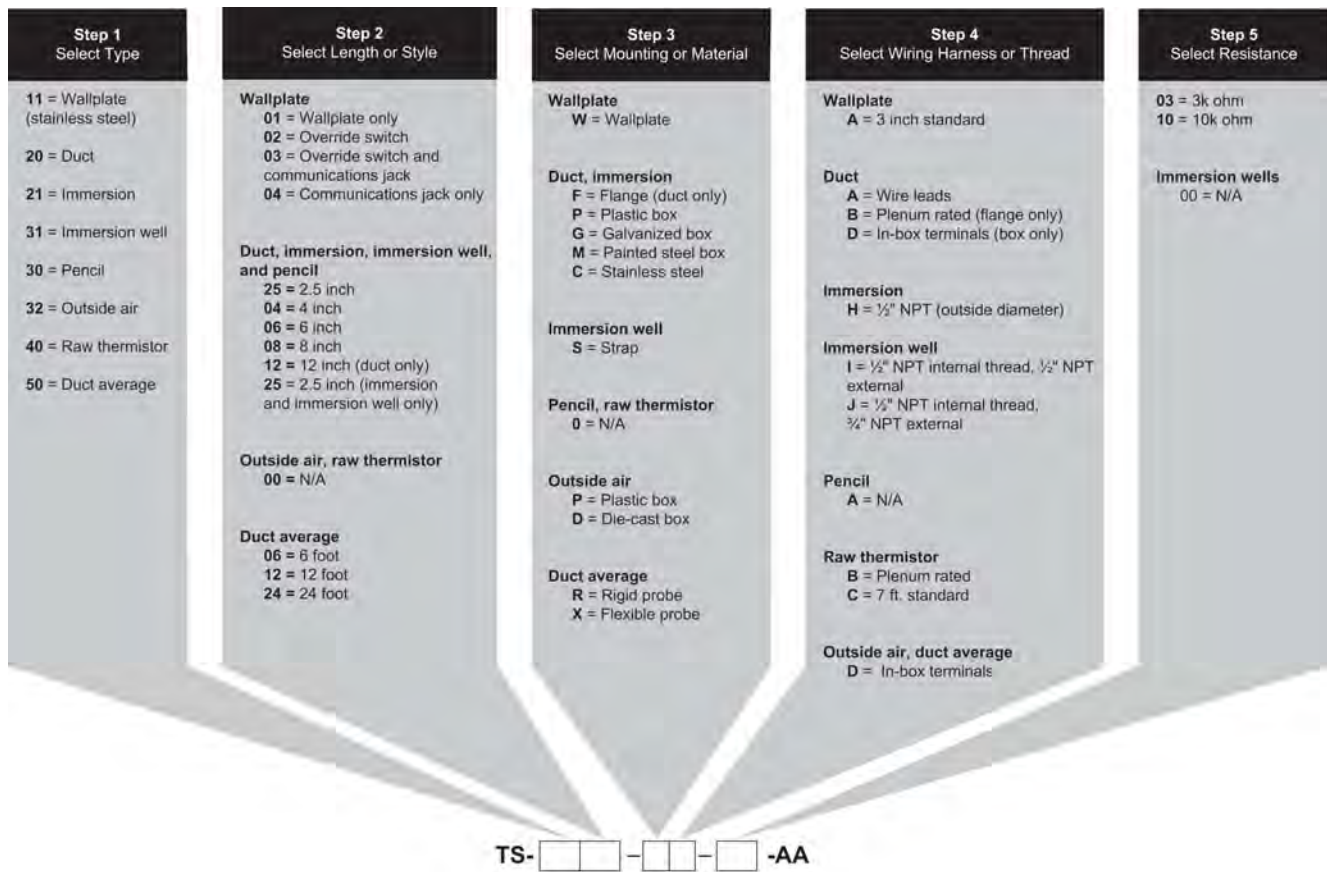


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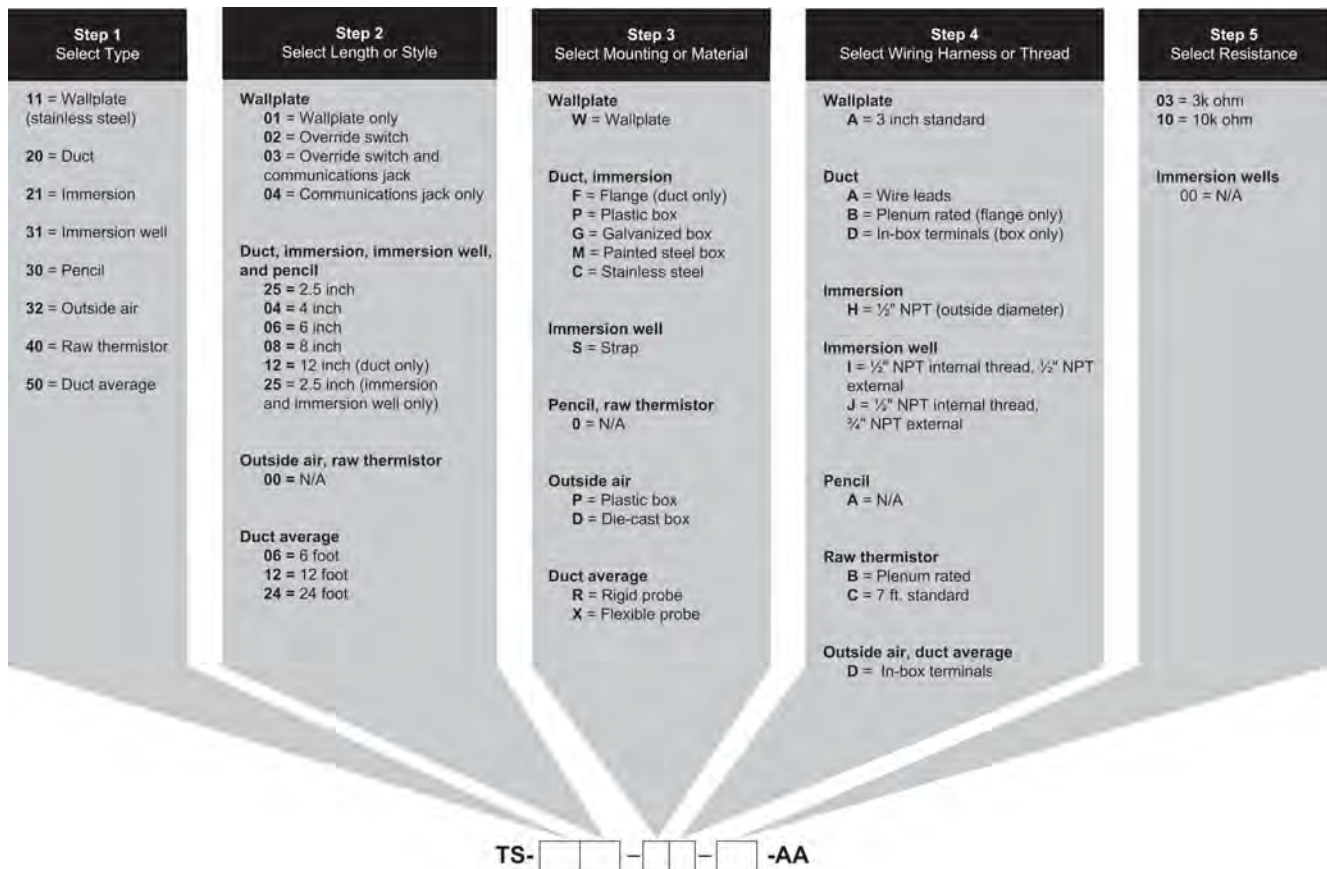
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**HSD Vocational Tech  
Building M & E Upgrades  
Operations and Maintenance Manual**

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**Section A) Envision for BACtalk Operator's Manual**

- a. Before you Begin
- b. Data Displays
- c. Zones
- d. Alarms
- e. Schedules
- f. Optimum Start
- g. Tenant Activity
- h. Trend Logs
- i. Energy Logs
- j. Demand Limiting
- k. System Administration

**Section B) Asbuilt Drawings**

**Section C) Bill of Materials**

**Section D) Maintenance Checklist**

**Section E) Recommended Repair Methods**

**Section F) Repair Tools**

**Section G) Service / Warranty Contacts**

**Equipment Data Sheets and Manuals**

- Section 1: Alerton Technologies Equipment
- ~~Section 2: Operator Workstation Equipment~~
- Section 3: Valves and Dampers
- Section 4: Sensors
- Section 5: Miscellaneous Equipment

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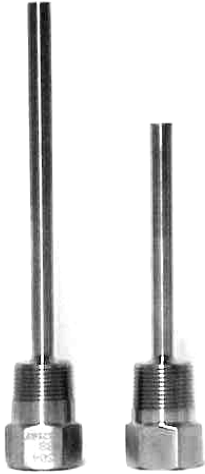
**BILL OF MATERIALS:****HSD Vocational Tech  
Building M & E Upgrades**

ATS ID	QTY	MANUFACTURER	DESCRIPTION	MAN PART #	SECTION
BWS-4	2	Alerton Technologies-ACI	Stainless Well, 4", 1/2NPT Internal, .3/4" External	TS-3104-CJ-00-AA	5
DP-3	2	Honeywell	Filter Air Flow Switch, adj	AP-5130/B	5
EN-08	1	Hoffman	12X12X4 Small Encl, Hinge, No Backplate (lrg cflr, 4Xfmr)	A-HE12X12X4	5
LLT-6A	1	Intec Controls	Low Limit Temp Detector, 6 ft, Auto Reset (2) SPDT	NTF-32-US	5
OSPS	1	Kele & Associates	Outside air pressure reference probe kit	A-306-K	5
RIB-1T	1	Functional Devices	SPDT, 24-120vac in, 10amp, Terminals, 1/3 HP@120	RIBTU1C	5
RIB-4T	5	Functional Devices	SPST, 24vac in, 10amp, Terminals, normally open, w/HOA	RIB-TU1S	5
SPT-1	5	Kele & Associates	Duct Static Pressure Tip, 1/4" Compression	A-301-K	5
SPT-1A	5	Kele & Associates	Flange Mounting Kit for A-301 & 302	A-345-K	5
XF-C4	1	Functional Devices	100 VA 120/240/277/480-24vac Transformer	TR100VA004	5

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## Product Data



### Machined Thermowell

## TS-3100-CJ Series

#### Features

- \* 3/4" NPT Male Process Thread
- \* 1/2" NPSM Female Instrument Thread
- \* Machined Thermowell
- \* 304 Series Stainless Steel
- \* 2-year Warranty
- \* ROHS Compliant

### Product Description

The **TS-3100-CJ Series** thermowells are made of 304 series stainless steel to ensure long lasting reliability and stability. The thermowells are machined from solid bar stock using the most modern CNC machines. The bore is smooth, true, accurately centered, and precisely sized for 0.250" (6.35 mm) diameter probes.

The thermowells are machined from one piece of stainless steel to avoid the weak point inherent in a weld. The well will be able to withstand rapid temperature changes without any degradation in its mechanical structure. The precision bore gives excellent thermal conductivity from the well to the temperature sensor.

If preferred, thermal grease may be used with all of the thermowells. ACI offers thermal grease in both a silicone and non-silicone compound. The silicone compound is available in a 1.5 oz. jar and the non-silicone grease is available in a 2 oz. tube.

The **TS-3100-CJ Series** thermowells may be used with any liquid, fluid, or gas that is compatible with 304 series stainless steel.

All of these units come with a two year warranty. For more information regarding these products, please contact ACI at the numbers listed below, or visit our website address at [www.workaci.com](http://www.workaci.com) for all of the up to date product literature.

### Product Specifications

<b>Material</b>	304 Series Stainless Steel		
<b>Thermowell Bore</b>	0.260" +/- 0.002" (Accepts 0.250" O.D Probe Diameters)	<b>Environmental Compliance</b>	ROHS-Directive 2002/95/EC

### Maximum Pressure Rating vs. Temperature Chart

Pressure (PSI)	Temperature °F (°C)
6200	200 °F (93.24°C)
5600	400 °F (204.24°C)
5400	600 °F (315.24°C)
5200	800 °F (426.24°C)
4500	1000 °F (537.24°C)

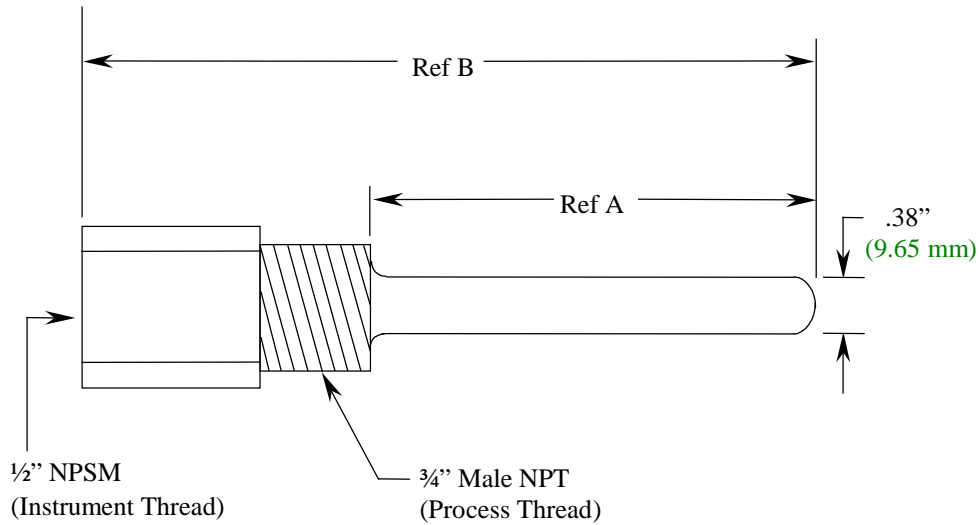
2305 Pleasant View Rd. ● Middleton Industrial Park ● Middleton, WI 53562

PH: (608) 831-2585 ● FAX (608) 831-7407

[www.workaci.com](http://www.workaci.com)

Filename: C0000035 Rev 2.Doc

## Dimensions



## Ordering Information

Alerton Model #	Insertion Length (Ref A)	Overall Length (Ref B)
TS-3104-CJ-00-AA	4.00" (101.6 mm)	5.75" (146.05 mm)
TS-3106-CJ-00-AA	6.00" (152.4 mm)	7.75" (196.85 mm)
TS-3108-CJ-00-AA	8.00" (203.2 mm)	9.75" (247.65 mm)

*These units are manufactured for Alerton by Automation Components, Inc.*

2305 Pleasant View Rd. ● Middleton Industrial Park ● Middleton, WI 53562

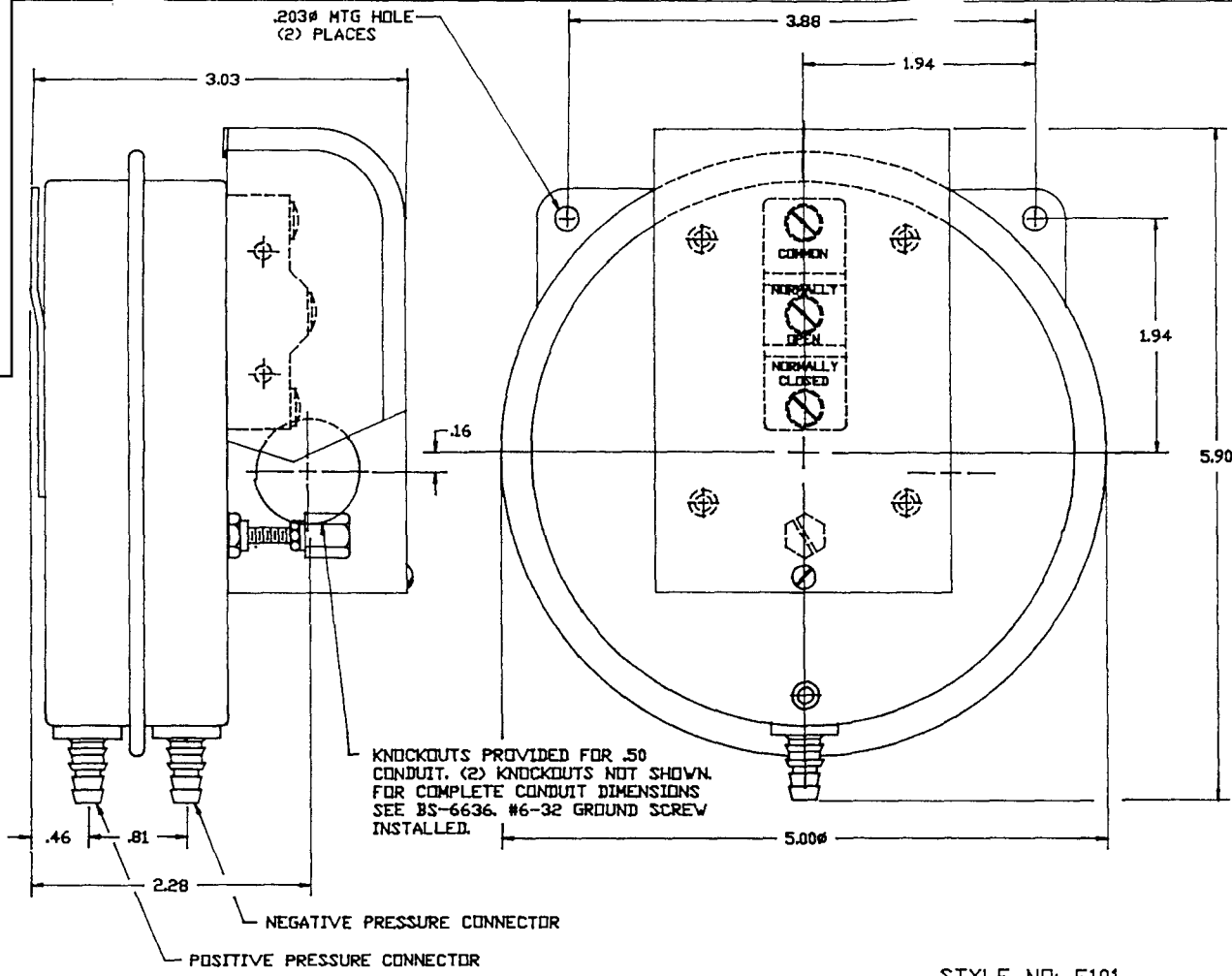
**PH: (608) 831-2585 ● FAX (608) 831-7407**

**www.workaci.com**

Filename: C0000035 Rev 2.Doc



Tag: DP-3, Manufacturer's P/N: AP-5130  
 23 0900, Paragraph: 2.11, F2



SPECIFICATIONS : MODEL AP5130



**ELECTRICAL RATING:**  
 278 VA pilot duty @ 24 volts AC  
 300 VA pilot duty @ 120 to 277 volts AC  
 15 amps non-inductive to 277 volts AC

**ELECTRICAL SWITCH:**  
 Single pole, double throw, snap acting contacts

**ELECTRICAL CONNECTORS:**  
 #6-32 screw terminal with cup washers

**CONTROL SET POINT:**  
 Adjustable

**FIELD ADJUSTABLE SET POINT RANGE:**  
 Contacts change on pressure rise @ .05' ± .02' V.C. to 12.0' V.C.

**MAXIMUM PRESSURE:**  
 1/2 PSI

**OPERATING TEMPERATURE RANGE:**  
 -40° to 190° F.

**RECOMMENDED OPERATING POSITION:**  
 Diaphragm vertical

**SAMPLE LINE CONNECTORS:**  
 Positive: Combination barbed type for use with 1/4 in. or 5/16 in. ID flexible plastic or rubber tubing.  
 Negative: same as above

STYLE NO: E101

LET.	EN #	DESCRIPTION	DATE	BY	PRODUCT DESCRIPTION	UNLESS OTHERWISE SPECIFIED	NAME
					AP5130 AIRSW	A	AIR SWITCH SPECIFICATION SHEET
							1. DIMENSIONS ARE IN INCHES.
							2. DIMENSIONS ARE NOMINAL FOR REFERENCE ONLY.
A	4769	REVISED CONDUIT HOLE LOCATION & ADDED REVISION LEVEL SYSTEM	11/4/92	CHERRISE			SUPERSEDES
-	1320	RELEASE TO SALES	05/07/87	C.R.V.			SUPERSEDED BY
-		PRELIMINARY	02/06/86	J.J.			
					E.R. NO. 60436-E		DRAWN BY J.JAMES
					SCALE NTS		CHK. BY
							APPR. BY
							DATE 02/06/86
							DATE
							DATE



7350 CORPORATE BLVD. MENTOR, OHIO

PART NUMBER  
**BS-AP5130**

# Hinged Cover Cutout Boxes



**Features**

- Various sizes of easily-removable concentric knockouts on all four sides

**Construction**

- 16 gauge or 14 gauge steel
- Butt hinges
- Mounting holes on back of box
- Provision for grounding

**Finish**

ANSI 61 gray polyester powder paint finish inside and out over phosphatized surfaces.

Unless otherwise specified, all custom cutout boxes are finished with ANSI 61 gray polyester paint.

**Industry Standards**

UL 50, File No. E27567: Type I

NEMA/EEMAC Type I

CSA, File No. LL42184: Type I

IEC 60529, IP30

**Accessories**

Cylinder Lock Kit

Grounding Device

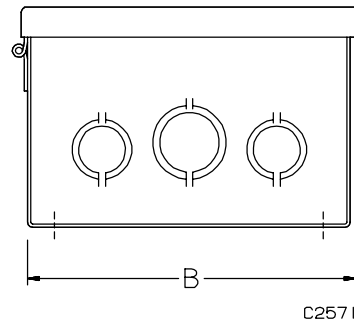
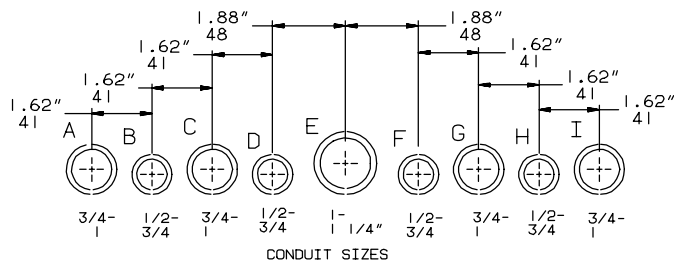
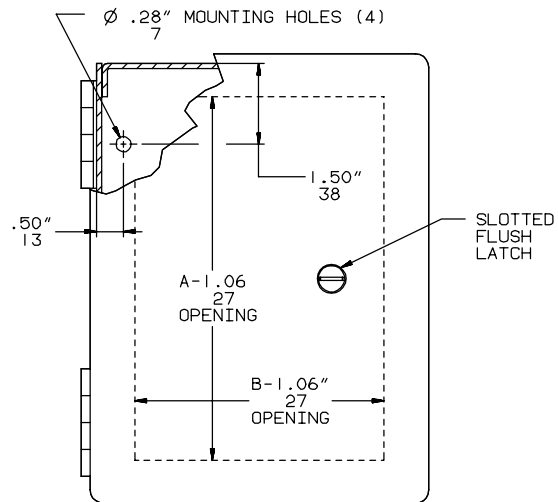
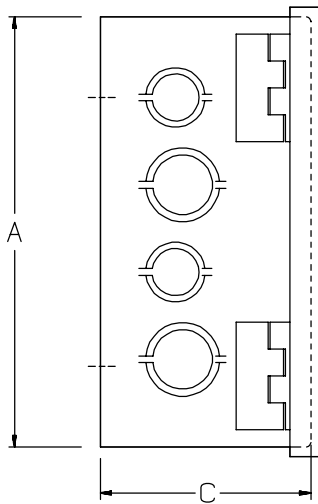
Padlock Kit

"T" Handle Latch Kit

Touch-Up Paint (ATPPY61)

**Application**

Designed for use as a surface-mounted junction box, service box, switch box, and cutout box.



**Knockout Pattern**  
(from outside of box)

NOTE: Refer to Table for applicable knockout pattern.

## Hinged Cover Cutout Boxes

1

## Standard Sizes Hinged Cover Cutout Boxes

Catalog Number	Box Size A x B x C		Knockout Pattern along	
	inch	mm	"A" Sides	"B" Sides
AHE6X6X4	6.00 x 6.00 x 4.00	152 x 152 x 102	BCD	BCD
AHE6X4X4	6.00 x 4.00 x 4.00	152 x 102 x 102	BCD	BCD
AHE8X6X4	8.00 x 6.00 x 4.00	203 x 152 x 102	FGHI	BCD
AHE8X8X4	8.00 x 8.00 x 4.00	203 x 203 x 102	FGHI	FGHI
AHE10X8X4	10.00 x 8.00 x 4.00	254 x 203 x 102	FGHI	FGHI
AHE10X10X4	10.00 x 10.00 x 4.00	254 x 254 x 102	FGHI	CDEFG
AHE12X8X4	12.00 x 8.00 x 4.00	305 x 203 x 102	CDEFG	FGHI
AHE12X10X4	12.00 x 10.00 x 4.00	305 x 254 x 102	CDEFG	CDEFG
AHE12X12X4	12.00 x 12.00 x 4.00	305 x 305 x 102	CDEFG	CDEFG
AHE16X12X4	16.00 x 12.00 x 4.00	406 x 305 x 102	BCDEFGH	CDEFG
AHE18X12X4	18.00 x 12.00 x 4.00	457 x 305 x 102	ABCDEFGHI	CDEFG
AHE6X6X6	6.00 x 6.00 x 6.00	152 x 152 x 152	BCD	BCD
AHE8X8X6	8.00 x 8.00 x 6.00	203 x 203 x 152	FGHI	FGHI
AHE10X8X6	10.00 x 8.00 x 6.00	254 x 203 x 152	FGHI	FGHI
AHE10X10X6	10.00 x 10.00 x 6.00	254 x 254 x 152	FGHI	CDEFG
AHE12X10X6	12.00 x 10.00 x 6.00	305 x 254 x 152	CDEFG	CDEFG
AHE12X12X6	12.00 x 12.00 x 6.00	305 x 305 x 152	CDEFG	CDEFG
AHE16X12X6	16.00 x 12.00 x 6.00	406 x 305 x 152	BCDEFGH	CDEFG
AHE16X16X6	16.00 x 16.00 x 6.00	406 x 406 x 152	BCDEFGH	BCDEFGH
AHE18X12X6	18.00 x 12.00 x 6.00	457 x 305 x 152	ABCDEFGHI	CDEFG
AHE18X18X6	18.00 x 18.00 x 6.00	457 x 457 x 152	ABCDEFGHI	ABCDEFGHI
AHE24X18X6	24.00 x 18.00 x 6.00	610 x 457 x 152	ABCDEFGHI	ABCDEFGHI
AHE24X24X6	24.00 x 24.00 x 6.00	610 x 610 x 152	ABCDEFGHI	ABCDEFGHI
AHE30X24X6	30.00 x 24.00 x 6.00	762 x 610 x 152	ABCDEFGHI	ABCDEFGHI
AHE36X24X6	36.00 x 24.00 x 6.00	914 x 610 x 152	ABCDEFGHI	ABCDEFGHI
AHE36X24X8	36.00 x 24.00 x 8.00	914 x 610 x 203	ABCDEFGHI	ABCDEFGHI



# Low-Temperature, Cut-Out Capillary Thermostats

## DESCRIPTION

Electro-mechanical, low-temperature limit/cut-out thermostat with a 20 ft, 10 ft or 6 ft capillary sensing element, auto- or manual reset, and 1-SPDT or 2-SPDT switched output.

## APPLICATION

The thermostat and its capillary sensing element provide an antifreeze function. It detects temperature drops below a fixed safety value (setpoint), i.e. heaters in A/C units, exchangers in cooling systems, etc.

## FEATURES

- Vapor-filled 20 ft, 10 ft or 6 ft copper capillary sensing element
- Joint spring protector at capillary-bellow connection
- Airtight single-stage switch, 1-SPDT or 2-SPDT contacts, 250 VAC, 15A
- Auto- or manual reset
- Wide range, 14 to 54°F, fits water w/glycol added applications
- Setpoint safety-lock protection and simple adjustment
- Visual setpoint scale
- Easy installation and wiring
- Maintenance-free
- Two-year warranty

## SPECIFICATIONS

<b>Thermostat Type</b>	Self-contained, electromechanical
<b>Sensing</b>	
- element	Vapor-filled capillary
- media	Temperature in air
- operating range	14°F to 54°F (-10°C to 12°C)
- response	To lowest temperature sensed by any 1 ft. section of the capillary element
<b>Type of Control</b>	
General	On/off, low-level single-stage or cut-out control, w/ (1) microswitch output
Low-level setpoint	
- factory set	At 39°F (4°C), and safety-lock secured
- adjustment	Over full operating range, via screwdriver slot
- visual scale	14°F to 54°F
Switch output	1-SPDT or 2-SPDT, airtight
- contact rating	24...250 VAC, 15 (8)A
- switching differential	1.8°F (1°K), auto- or manual reset
<b>Environmental</b>	
Permissible ambient	
- working temperature	14°F to 54°F (-10°C to 12°C)
- enclosure temperature	14°F to 131°F (-10°C to 55°C)
- capillary overload temperature	392°F (200°C), max. 60 min.
- storage temperature	14°F to 158°F (-10°C to 70°C)
- humidity	0 to 95% rH (rF), non-condensing

## Physical

<b>Enclosure (base and cover)</b>	
- base material	Steel, galvanized
- cover material	ABS, fire retardant
- color	Silver / light gray
- protection	NEMA 1 (IP 40)
<b>Capillary</b>	
- material	Copper
<b>Installation</b>	
- enclosure	Surface mounted
- capillary	Duct and across coil mounted
<b>Dimensions (H x W x D)</b>	
- enclosure	3.3 x 4.1 x 2.1 in. (83 x 105 x 53 mm)
- capillary sensing element	∅ 0.08 in. (2 mm), various lengths: 20 ft (6 m), 10 ft (3 m), or 6 ft (1.8 m)
<b>Cable entry</b>	(1) M20 compression fitting, removeable, hole fits 1/2 in. conduit connector
<b>Wire connection</b>	Terminal with wire-retaining screws
<b>Wire size</b>	Max. 14 AWG (2.5 mm <sup>2</sup> )
<b>Weight</b>	1.6 lbs. (0.7 kg)
<b>Manufacturing</b>	ISO 9001 certified
<b>Approvals/Listings</b>	CE
<b>Warranty</b>	Two-year material and workmanship



"Bulb on 6-ft capillary stores excess vapor (gas); still responds to the lowest temperature along any 1 ft. section of the entire capillary length."

**ORDERING INFORMATION**

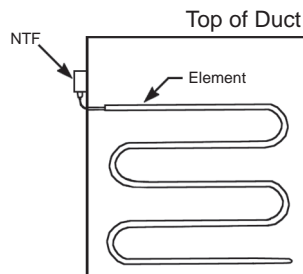
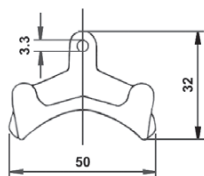
Part Numbers	SPDT 15(8)A	Capillary Length ft (m)	Reset
NTF-3-US NTF-3R-US	1 1	6 (1.8) 6 (1.8)	Auto Manual
NTF-5-US NTF-5R-US	1 1	10 (3) 10 (3)	Auto Manual
NTF-1-US NTF-1R-US	1 1	20 (6) 20 (6)	Auto Manual
NTF-32-US NTF-3R2-US	2 2	6 (1.8) 6 (1.8)	Auto Manual
NTF-52-US NTF-5R2-US	2 2	10 (3) 10 (3)	Auto Manual
NTF-12-US NTF-1R2-US	2 2	20 (6) 20 (6)	Auto Manual
DBZ-05/0	Capillary mntg. clips, metal (6 pcs)		



**INSTALLATION**

- Thermostat enclosure to be surface mounted; avoid location subject to excessive vibration
- Allow unrestrictive access to the manual reset button (NTF-.R series)
- Use mounting holes, located rear case site, for flush mounting to duct or other flat surfaces
- Capillary sensing element to be located down the stream-side of a coil, exposed to all areas that encounter low temperature
- Install capillary sensing element across the face of the coil, horizontally serpentine only

DBZ-05/0 Accessory Capillary Mounting Clip Dimensions (mm)

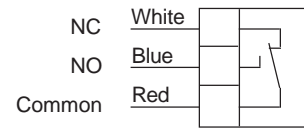


- Do not kink or apply excessive force to the capillary sensing element
  - Tie up the capillary element at appropriate points to prevent damage from air movement or vibration
- Note:
- Thermostat enclosure **must not** be exposed to temperatures lower than the capillary element's sensing ability

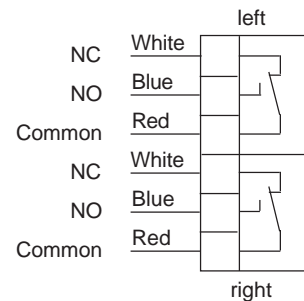
**WIRING CONFIGURATION**

**NTF and NTF-2**

Falling temperature and attained low cut-out setpoint, contact connection: Red to Blue



Vapor-filled capillary; control responds to the lowest temperature along any 1ft section of the capillary length.



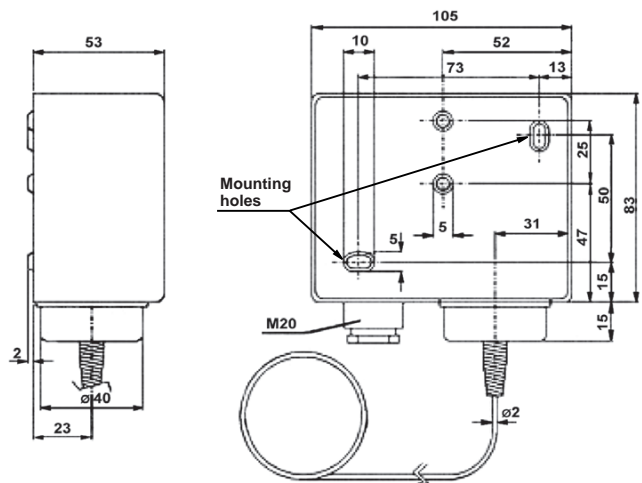
- All wiring should comply with national and electrical codes
- All operations performed on the units, whether wiring, testing, or maintenance, must be done with neither power supply on the unit nor external load
- For protection, enclosure cover must be installed, all screws to be fastened and cable entry secured

**OPERATION**

- The low cut-out setpoint is factory set and can be adjusted by turning the slotted screw on top of the enclosure
- Auto-reset types will automatically switch back to the normal position if the temperature returns to normal conditions.

Manual-reset types will switch back *only* if both the temperature returns to normal conditions *and* the reset button (at the enclosure's front) is manually pushed.

**Dimensions (mm)**





# PRESSURE

## AIR PRESSURE SENSORS

**A-300 SERIES, 60681, 21122**

### DESCRIPTION

#### Static Pressure Sensors

**A-300 Series Sensors** are used with pressure transmitters and pressure switches to sense duct pressures. Two sensors are required to monitor pressure across coils, filters, and blowers. **A-301-K** and **A-302-K** have four radial sensing holes and a 4" (10.2 cm) insertion depth. The **A-308-K** should be used only where accuracy is not critical. All mount in a 3/8" hole in the duct. If the interior of the duct is not accessible, an optional **A-345-K** flange mounting kit may be used.

#### Room Static Pressure or Total Pressure Sensor Kit

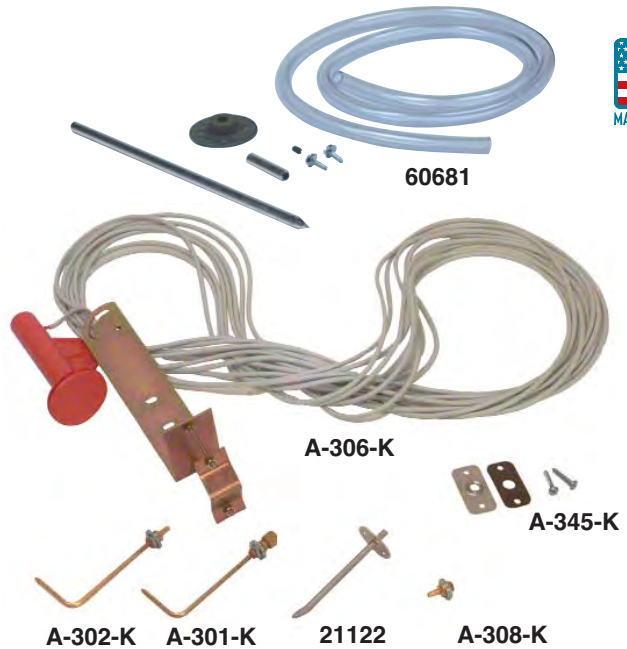
The versatile **Model 60681 Pressure Sensing Kit** is used for monitoring static pressure (aspiration) or total pressure (impact). The kit includes a 7" (17.8 cm) universal sensing probe, adjustable mounting flange, 1/4" adapter, and 3 ft (0.9m) length of tubing (1/4" ID x 3/8" OD). For total (impact) pressure applications, install the curved tip opening facing into the air stream or away from the air stream for vacuum applications.

#### Total Pressure Sensor

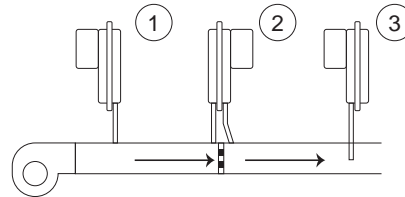
**Model 21122 Sensor** is used primarily for proving air-flow in ducts. The opening in the tip of the 4" (10.2 cm) aluminum tube faces upstream and senses impact (total) pressure.

#### Outdoor Static Pressure Sensor

The **A-306-K Outdoor Static Pressure Sensor Kit** provides an outdoor pressure signal for reference in building pressurization applications. The **A-306-K** includes the sensor, 50' (15.24m) of vinyl tubing, mounting bracket,



### TYPICAL APPLICATIONS



1. Positive static pressure increases as the filter gets dirty.
2. Differential across filter changes as filter gets dirty.
3. Flow is reduced as filter gets dirty.



4. Negative pressure increases as the filter gets dirty.
5. Fan operation and true air flow: varying amounts of static pressure. Probes must be perpendicular to air flow.

PRESSURE

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### ORDERING INFORMATION

MODEL	DESCRIPTION
A-301-K	Duct static pressure tip, 1/4" compression
A-302-K	Duct static pressure tip, 1/4" barb
A-308-K	Duct static pressure fitting, 1/4" barb
A-345-K	Flange mounting kit
60681	Static or total pressure sensing kit
21122	4" aluminum impact tube for 3/8" OD plastic tubing
B-137	1/4" barb adapter for #21121 (standard pack-50)
→ A-306-K	Outdoor air static pressure kit





Functional Devices, Inc.  
 310 South Union Street  
 Russiaville, IN 46979  
 www.FunctionalDevices.com

Office 765.883.5538  
 Sales 800.888.5538  
 Fax 765.883.7505  
 Email sales@functionaldevices.com

**RIBTU1C** | Enclosed Relay Hi/Low Separation 10 Amp SPDT with 10-30 Vac/dc/120 Vac Coil



**SPECIFICATIONS**

**# Relays & Contact Type:** One (1) SPDT Continuous Duty Coil  
**Expected Relay Life:** 10 million cycles minimum mechanical  
**Operating Temperature:** -30 to 140° F  
**Operate Time:** 20ms  
**Relay Status:** LED On = Activated  
**Dimensions:** 4.00" x 4.00" x 1.80" with .50" NPT nipple  
**Wires:** 16", 600V Rated  
**Approvals:** UL Listed, UL916, UL864, C-UL  
 California State Fire Marshal, CE  
**Housing Rating:** Plenum, NEMA 1  
**Gold Flash:** Yes  
**Override Switch:** No

**Contact Ratings:**

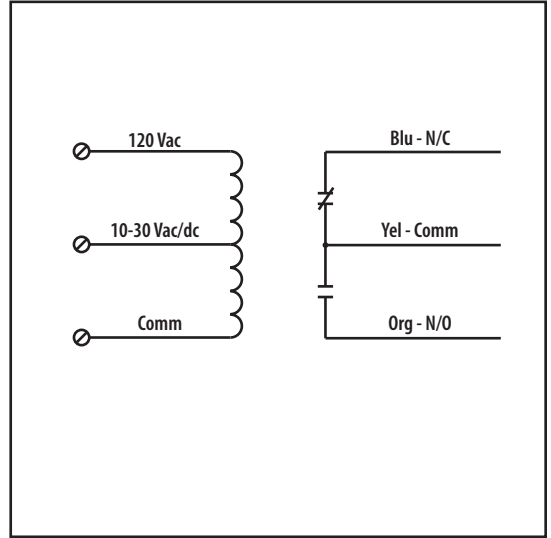
10 Amp Resistive @ 120-277 Vac  
 10 Amp Resistive @ 28 Vdc  
 480 VA Pilot Duty @ 240-277 Vac  
 480 VA Ballast @ 277 Vac  
 600 Watt Tungsten @ 120 Vac N/O  
 240 Watt Tungsten @ 120 Vac N/C  
 1/3 HP for N/O @ 120-240 Vac  
 1/6 HP for N/C @ 120-240 Vac  
 1/4 HP for N/O @ 277 Vac  
 1/8 HP for N/C @ 277 Vac

**Coil Current:**

30 mA @ 10 Vac	12 mA @ 10 Vdc
32 mA @ 12 Vac	14 mA @ 12 Vdc
42 mA @ 24 Vac	16 mA @ 24 Vdc
50 mA @ 30 Vac	18 mA @ 30 Vdc
25 mA @ 120 Vac	

**Coil Voltage Input:**

10-30 Vac/dc ; 120 Vac ; 50-60 Hz  
 Drop Out = 2.1 Vac / 2.8 Vdc  
 Pull In = 9 Vac / 10 Vdc



**NOTES**



Functional Devices, Inc. Office: (765) 883-5538  
 310 South Union Street Sales: (800) 888-5538  
 Russiaville, IN 46979 Fax: (765) 883-7505  
 www.functionaldevices.com Email: sales@functionaldevices.com  
 Manufacturing quality products in the United States of America since 1969



**RIBTU1S**

**Enclosed Relay Hi/Low Separation 10 Amp SPST + Override with 10-30 Vac/dc/120 Vac Coil**



Functional Devices, Inc. A600C 2005



**Contact Ratings:**

10 Amp Resistive @ 277 Vac  
 480 VA Pilot Duty @ 277 Vac  
 480 VA Ballast @ 277 Vac  
 600 Watt Tungsten @ 120 Vac N/O  
 240 Watt Tungsten @ 120 Vac N/C  
 1/3 HP for N/O @ 120-240 Vac  
 1/6 HP for N/C @ 120-240 Vac  
 1/4 HP for N/O @ 277 Vac  
 1/8 HP for N/C @ 277 Vac

**Coil Current:**

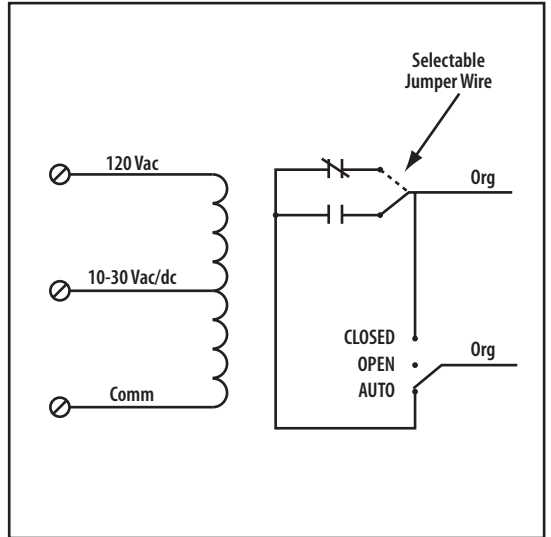
30 mA @ 10 Vac	12 mA @ 10 Vdc
32 mA @ 12 Vac	14 mA @ 12 Vdc
42 mA @ 24 Vac	16 mA @ 24 Vdc
50 mA @ 30 Vac	18 mA @ 30 Vdc
25 mA @ 120 Vac	

**Coil Voltage Input:**

10-30 Vac/dc ; 120 Vac ; 50-60 Hz  
 Drop Out = 2.1 Vac / 2.8 Vdc  
 Pull In = 9 Vac / 10 Vdc

**Notes:**

» Normally Open or Normally Closed selected by yellow jumper wire



**# Relays & Contact Type:** One (1) SPST Continuous Duty Coil  
**Expected Relay Life:** 10 million cycles minimum mechanical  
**Operating Temperature:** -30 to 140° F  
**Operate Time:** 20mS  
**Relay Status:** LED On = Activated  
**Dimensions:** 4.00" x 4.00" x 1.80" with .50" NPT nipple  
**Wires:** 16', 600V Rated  
**Approvals:** UL Listed, UL916, UL864, C-UL Canada  
 California State Fire Marshal  
**Housing Rating:** Plenum, NEMA 1  
**Gold Flash:** Yes  
**Override Switch:** Yes

**Notes:**





# PRESSURE

## AIR PRESSURE SENSORS

**A-300 SERIES, 60681, 21122**

### DESCRIPTION

#### Static Pressure Sensors

**A-300 Series Sensors** are used with pressure transmitters and pressure switches to sense duct pressures. Two sensors are required to monitor pressure across coils, filters, and blowers. **A-301-K** and **A-302-K** have four radial sensing holes and a 4" (10.2 cm) insertion depth. The **A-308-K** should be used only where accuracy is not critical. All mount in a 3/8" hole in the duct. If the interior of the duct is not accessible, an optional **A-345-K** flange mounting kit may be used.

#### Room Static Pressure or Total Pressure Sensor Kit

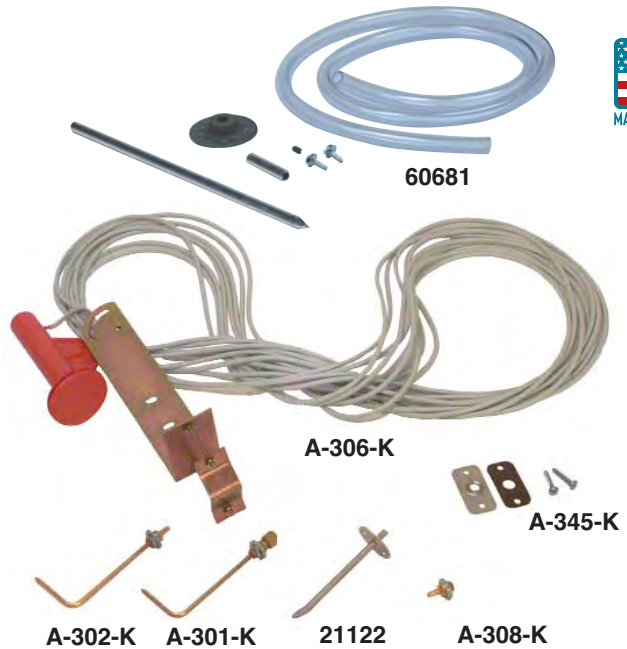
The versatile **Model 60681 Pressure Sensing Kit** is used for monitoring static pressure (aspiration) or total pressure (impact). The kit includes a 7" (17.8 cm) universal sensing probe, adjustable mounting flange, 1/4" adapter, and 3 ft (0.9m) length of tubing (1/4" ID x 3/8" OD). For total (impact) pressure applications, install the curved tip opening facing into the air stream or away from the air stream for vacuum applications.

#### Total Pressure Sensor

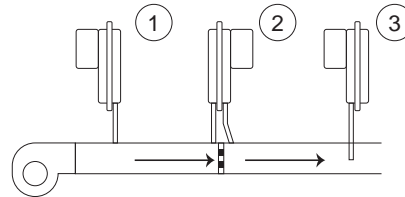
**Model 21122 Sensor** is used primarily for proving air-flow in ducts. The opening in the tip of the 4" (10.2 cm) aluminum tube faces upstream and senses impact (total) pressure.

#### Outdoor Static Pressure Sensor

The **A-306-K Outdoor Static Pressure Sensor Kit** provides an outdoor pressure signal for reference in building pressurization applications. The **A-306-K** includes the sensor, 50' (15.24m) of vinyl tubing, mounting bracket,



### TYPICAL APPLICATIONS



1. Positive static pressure increases as the filter gets dirty.
2. Differential across filter changes as filter gets dirty.
3. Flow is reduced as filter gets dirty.



4. Negative pressure increases as the filter gets dirty.
5. Fan operation and true air flow: varying amounts of static pressure. Probes must be perpendicular to air flow.

### ORDERING INFORMATION

MODEL	DESCRIPTION
→ A-301-K	Duct static pressure tip, 1/4" compression
A-302-K	Duct static pressure tip, 1/4" barb
A-308-K	Duct static pressure fitting, 1/4" barb
A-345-K	Flange mounting kit
60681	Static or total pressure sensing kit
21122	4" aluminum impact tube for 3/8" OD plastic tubing
B-137	1/4" barb adapter for #21121 (standard pack-50)
A-306-K	Outdoor air static pressure kit



# PRESSURE

## AIR PRESSURE SENSORS

**A-300 SERIES, 60681, 21122**

### DESCRIPTION

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#### Room Static Pressure or Total Pressure Sensor Kit

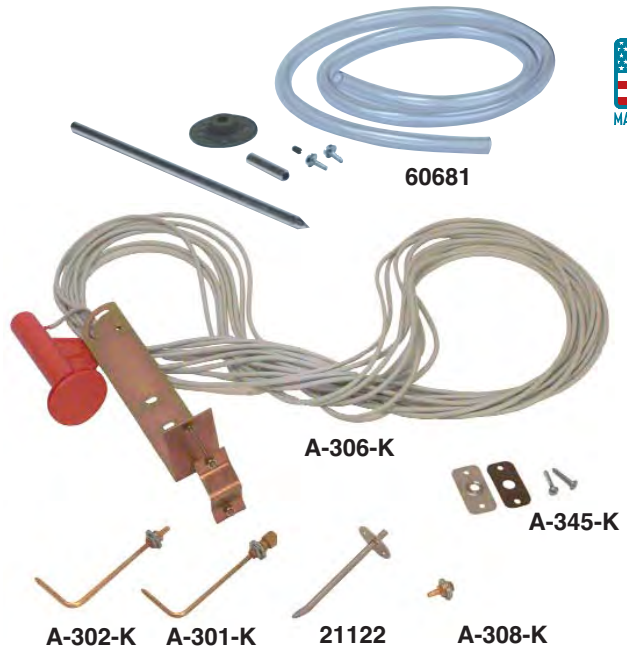
The versatile **Model 60681 Pressure Sensing Kit** is used for monitoring static pressure (aspiration) or total pressure (impact). The kit includes a 7" (17.8 cm) universal sensing probe, adjustable mounting flange, 1/4" adapter, and 3 ft (0.9m) length of tubing (1/4" ID x 3/8" OD). For total (impact) pressure applications, install the curved tip opening facing into the air stream or away from the air stream for vacuum applications.

#### Total Pressure Sensor

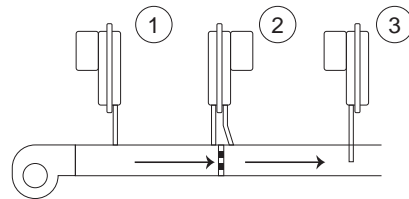
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#### Outdoor Static Pressure Sensor

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### TYPICAL APPLICATIONS



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PRESSURE

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### ORDERING INFORMATION

MODEL	DESCRIPTION
A-301-K	Duct static pressure tip, 1/4" compression
A-302-K	Duct static pressure tip, 1/4" barb
A-308-K	Duct static pressure fitting, 1/4" barb
→ A-345-K	Flange mounting kit
60681	Static or total pressure sensing kit
21122	4" aluminum impact tube for 3/8" OD plastic tubing
B-137	1/4" barb adapter for #21121 (standard pack-50)
A-306-K	Outdoor air static pressure kit



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 Email sales@functionaldevices.com

**TR100VA004**

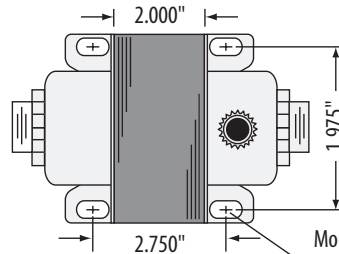
**TRANSFORMER**

Transformer 100 VA, 480/277/240/120 to 24 Vac, Circuit Breaker, Foot and Dual Threaded Hub Mount

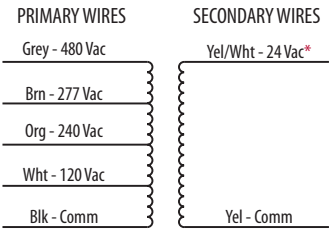


**SPECIFICATIONS**

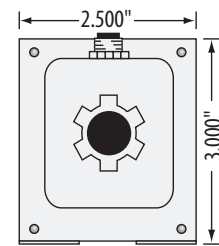
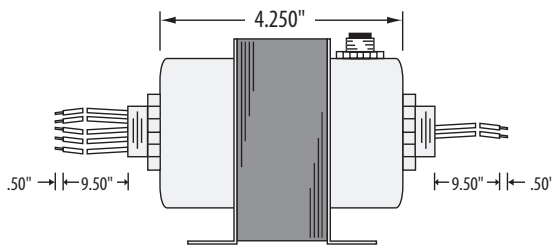
- VA Rating:** 100
- Frequency:** 50/60 Hz
- Mounting:** Foot & Dual Threaded Hubs
- Over Current Protection:** Circuit Breaker
- Dimensions:** 3.000" x 2.500" x 4.250"  
(w/ .500" NPT Hubs)
- Wire Length:** 9.5" Typical w/ .5" Strip
- Operating Temperature:** -30 to 140° F
- MTBF:** 100,000 Hours @ 77° F
- Construction:** Split-Bobbin
- Weight:** 4.60 lbs.
- Approvals:** Class II UL1585 Listed, C-UL, CE, RoHS



Mounting Hole = .350" x .175"



\*Secondary Yel/Wht wire in phase with Primary Blk wire.



**NOTES**

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 2114 2.1 Hydronic Pumps

Submittal Number: 1

Item: ET-1 Expansion Tank

Manufacturer: Amtrol

Model #: LF AX-100 Extrol Diaph 58G

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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# EXTROL<sup>®</sup>

ASME Commercial Expansion Tanks



For Closed Hydronic Heating & Chilled Water Systems

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# EXTROL®

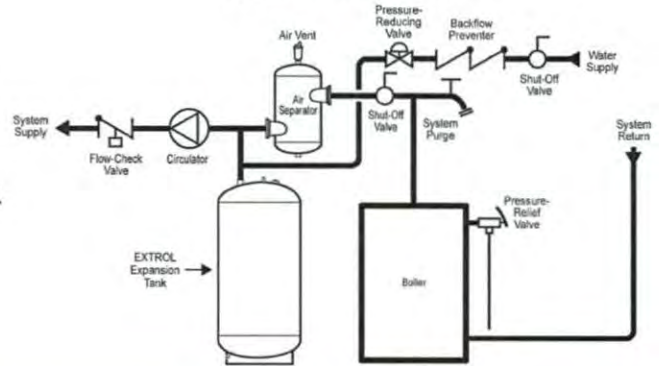
Amtrol hydronic expansion tanks are for use in closed, non-potable hydronic heating and chilled water systems. Available in diaphragm, full acceptance and partial acceptance bladder designs, all Extrol expansion tanks are made in the USA at our ISO 9001: 2008 registered facilities. ASME tanks meet all Section VIII, Division I standards.



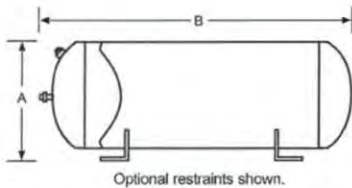
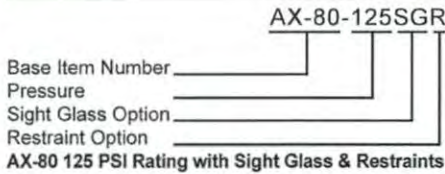
## EXTROL AX Series

- Diaphragm design; industry's thickest.
- Horizontal and vertical models are available with optional restraints.
- Factory pre-charge: 12 psig.
- Maximum operating temperature: 240° F.

## Typical Installation



## How to Order: Specify Item & Options



## AX Horizontal Series Specifications

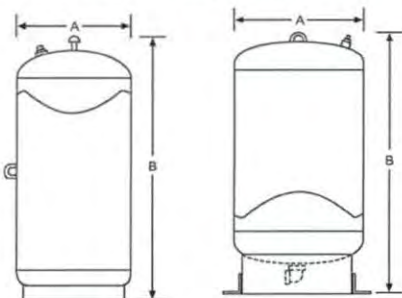
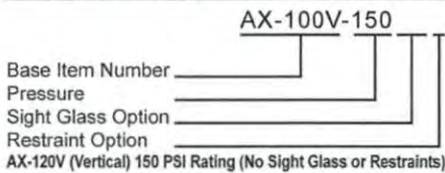
Model Number	Tank Volume (Gallons)	Max. Accept. Volume (Gallons)	A Diameter (Inches)	B Length (Inches)	System Conn. <sup>1</sup> (Inches)	Shipping Weight (lbs.) Max. Working Pressure				
						125 PSI	150 PSI	175 PSI	250 PSI	300 PSI
AX-15	8.0	2.4	12	19	½	37	39	48	55	59
AX-20	10.9	2.4	12	26	½	46	48	60	69	74
AX-40	21.7	11.3	16	29	½	74	76	96	111	118
AX-60	33.6	11.3	16	43	½	96	120	125	144	154
AX-80	44.4	22.6	24	29	1	153	160	200	230	245
AX-100	55.7	22.6	24	33	1	174	180	227	261	279
AX-120	68.0	34.0	24	41	1	204	245	266	306	327
AX-144	77.0	34.0	24	46	1	218	250	285	327	350
AX-180	90.0	34.0	24	54	1	232	265	301	348	372
AX-200	110.0	34.0	24	64	1	269	320	350	404	430
AX-240	132.0	46.0	30	51	1	401	403	522	602	642
AX-260	159.0	56.0	30	62	1¼	455	460	572	683	728
AX-280	211.0	84.0	30	80	1¼	580	600	755	870	930

<sup>1</sup>AX-15 through AX-100: Malleable Iron NPTF System Connection. Location: Center.

AX-120 through AX-240: Malleable Iron NPTM System Connection. Location: Center.

AX-260 and AX-280: Malleable Iron NPTM System Connection. Location: Top Offset.

## How to Order: Specify Item & Options



AX-15V through AX-100V  
AX-260V and AX-280V

AX-120V through AX-240V  
Optional restraints shown.

## AX Vertical Series Specifications

Model Number	Tank Volume (Gallons)	Max. Accept. Volume (Gallons)	A Diameter (Inches)	B Height (Inches)	System Conn. <sup>2</sup> (Inches)	Shipping Weight (lbs.) Max. Working Pressure				
						125 PSI	150 PSI	175 PSI	250 PSI	300 PSI
AX-15V	8.0	2.4	12	20	½	39	41	49	59	62
AX-20V	10.9	2.4	12	27	½	47	49	61	71	75
AX-40V	21.7	11.3	16	30	½	76	80	99	114	122
AX-60V	33.6	11.3	16	45	½	98	103	127	147	157
AX-80V	44.4	22.6	24	29	1	155	167	201	233	248
AX-100V	55.7	22.6	24	34	1	176	187	229	264	282
AX-120V	68.0	34.0	24	47	1	214	255	278	321	342
AX-144V	77.0	34.0	24	52	1	230	267	299	345	368
AX-180V	90.0	34.0	24	60	1	271	275	352	407	434
AX-200V	110.0	34.0	24	66	1	290	358	377	435	464
AX-240V	132.0	46.0	30	58	1	401	403	521	602	642
AX-260V	159.0	56.0	30	65	1¼	460	467	598	690	736
AX-280V	211.0	84.0	30	82	1¼	590	605	767	885	945

<sup>2</sup>AX-15V through AX-100V: Malleable Iron NPTF System Connection. Location: Top Center.

AX-120V through AX-240V: Malleable Iron NPTF System Connection. Location: Bottom.

AX-260V and AX-280V: Malleable Iron NPTM System Connection. Location: Top Offset.





# EXTROL® Sizing Guide

## Things You Must Know:

1. Total System Volume ..... gallons
2. Minimum System Temperature ..... °F
3. Maximum System Temperature ..... °F
4. Minimum Operating Pressure at Expansion Tank .. psig
5. Maximum Operating Pressure at Expansion Tank . psig

## Selection of Expansion Tank:

6. Find and enter "Water Expansion Factor" ..... (see Table 1)
7. Amount of Expanded Water = Line (1) x Line (6) .. gallons
8. Find and enter "Tank Acceptance Factor" ..... (see Table 2)
9. Minimum Volume = Line (7) + Line (8) ..... gallons
10. Select an Expansion Tank that is at least equal to Line (9) for Tank Volume (gallons) and Line (7) for Max. Acceptance Volume (gallons). Multiple tanks may be required.

**Table 1: Water Expansion Factor**

Maximum System Temp.	Minimum System Temperature						
	40° F	50° F	60° F	70° F	80° F	90° F	100° F
60° F	.0005	.0049	—	—	—	—	—
70° F	.0015	.0014	.0009	—	—	—	—
80° F	.0026	.0025	.0020	.0011	—	—	—
90° F	.0041	.0040	.0035	.0026	.0015	—	—
100° F	.0058	.0057	.0052	.0043	.0031	.0017	—
110° F	.0077	.0077	.0072	.0062	.0051	.0037	.0019
120° F	.0100	.0099	.0095	.0086	.0074	.0060	.0043
130° F	.0124	.0123	.0118	.0109	.0098	.0083	.0066
140° F	.0150	.0149	.0145	.0135	.0124	.0110	.0093
150° F	.0179	.0178	.0173	.0164	.0153	.0133	.0121
160° F	.0209	.0208	.0204	.0194	.0181	.0165	.0148
170° F	.0242	.0241	.0236	.0227	.0216	.0201	.0184
180° F	.0276	.0275	.0271	.0261	.0250	.0236	.0219
190° F	.0313	.0312	.0307	.0298	.0287	.0272	.0255
200° F	.0351	.0350	.0346	.0336	.0325	.0311	.0294
210° F	.0391	.0390	.0386	.0376	.0365	.0351	.0334
220° F	.0434	.0433	.0428	.0419	.0408	.0393	.0376
230° F	.0476	.0475	.0471	.0461	.0450	.0436	.0419
240° F	.0522	.0521	.0517	.0507	.0496	.0482	.0465

For fluid applications other than water, consult AMTROL technical services.

**Table 2: Tank Acceptance Factor**

Maximum Operating Pressure (psig)	Minimum Operating Pressure at Tank (psig)										
	5	10	12	15	20	30	40	50	60	70	80
27	0.527	0.408	0.360	0.288	0.168	—	—	—	—	—	—
30	0.560	0.447	0.403	0.336	0.224	—	—	—	—	—	—
35	0.604	0.503	0.463	0.403	0.302	0.101	—	—	—	—	—
40	0.640	0.548	0.512	0.457	0.366	0.183	—	—	—	—	—
45	0.670	0.586	0.553	0.503	0.419	0.251	0.084	—	—	—	—
50	0.696	0.618	0.587	0.541	0.464	0.309	0.155	—	—	—	—
55	0.717	0.646	0.617	0.574	0.502	0.359	0.215	0.072	—	—	—
60	0.736	0.669	0.643	0.602	0.536	0.402	0.268	0.134	—	—	—
65	0.753	0.690	0.665	0.627	0.565	0.439	0.314	0.188	0.062	—	—
70	0.767	0.708	0.685	0.649	0.590	0.472	0.354	0.236	0.118	—	—
75	0.780	0.725	0.702	0.669	0.613	0.502	0.390	0.279	0.167	0.056	—
80	0.792	0.739	0.718	0.686	0.634	0.528	0.422	0.317	0.211	0.106	—
90	0.812	0.764	0.745	0.716	0.669	0.573	0.478	0.382	0.287	0.191	0.096
100	0.828	0.785	0.767	0.741	0.698	0.610	0.523	0.436	0.347	0.261	0.174
110	0.842	0.802	0.786	0.762	0.723	0.642	0.561	0.481	0.401	0.321	0.240

Acceptance factors based on expansion tank charged to minimum operating pressure while empty of liquid.



Non-ASME & Residential Models can be found in catalog MC 2680.



1400 Division Road, West Warwick, RI USA 02893  
 T: 800.426.8765 F: 800.293.1519  
[www.amtrol.com](http://www.amtrol.com)



**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 2114 2.3 Hydronic Pumps

Submittal Number: 1

Item: Air Separator

Manufacturer: Spirotherm

Model #: Spirovent Air / Dirt Eliminator

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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SVHTFA

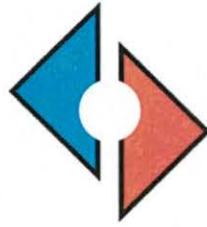
SPIROTHERM

**AIR SEPARATOR**

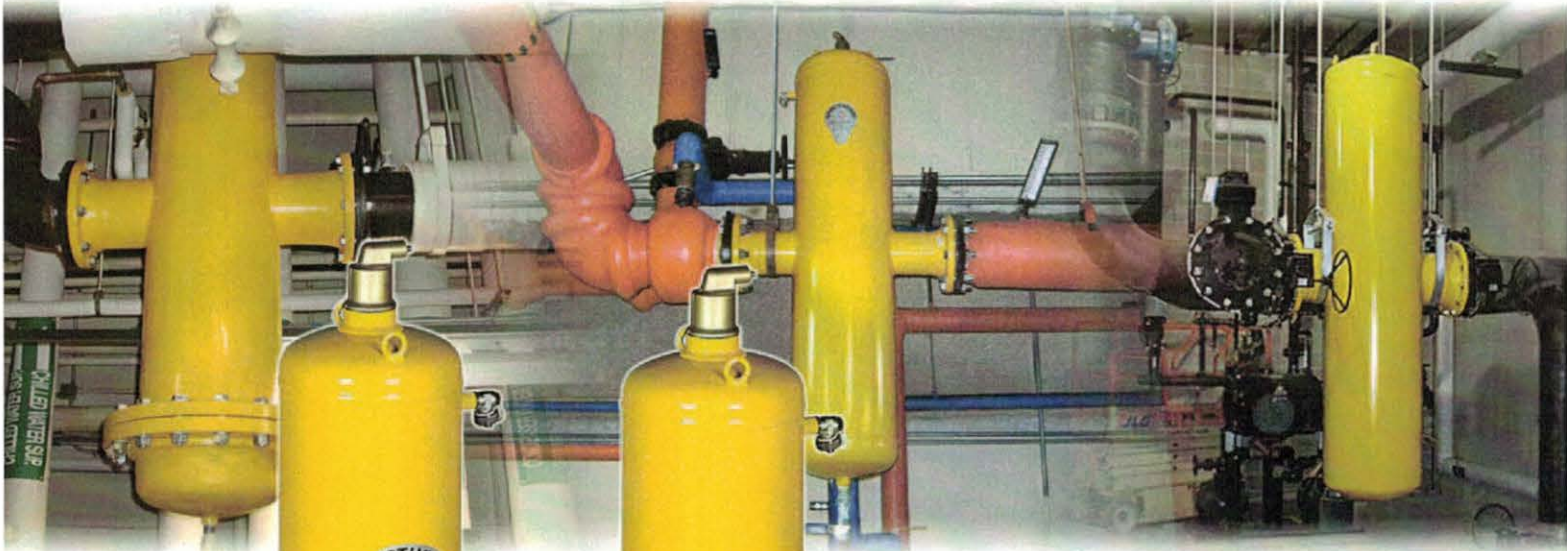
SPIROVENT AIR/DIRT ELIMINATOR, 3: FLG, HUIGH VELOCITY ASME 150#, 99.6% AIR ELIMINATUION, 80% OF DIRT 30 MICRON & LARGER REMOVED IN 100 PASSES. PRICE INCLUDES AUTO AIR VENT, SIDE SKIMMER VALVE & BLOW DOWN VALVE.

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# SPIROVENT® DIRT



**AIR ELIMINATORS  
DIRT SEPARATORS  
HIGH VELOCITY**

## SPIROTHERM

THE ULTIMATE IN DISTRIBUTION EFFICIENCY



# AIR- AND DIRT-FREE SYSTEM WATER THROUGH A SINGLE UNIT

## AIR AND DIRT IN LARGE VOLUME FLUID SYSTEMS CAUSE MANY PROBLEMS.

The life and the efficiency of a large volume fluid system are greatly dependent on clean system water. Air and dirt problems cause frequent breakdowns and increased customer complaints. Corrosion, cavitation and wear are only some of the consequences of system water filled with air and dirt.

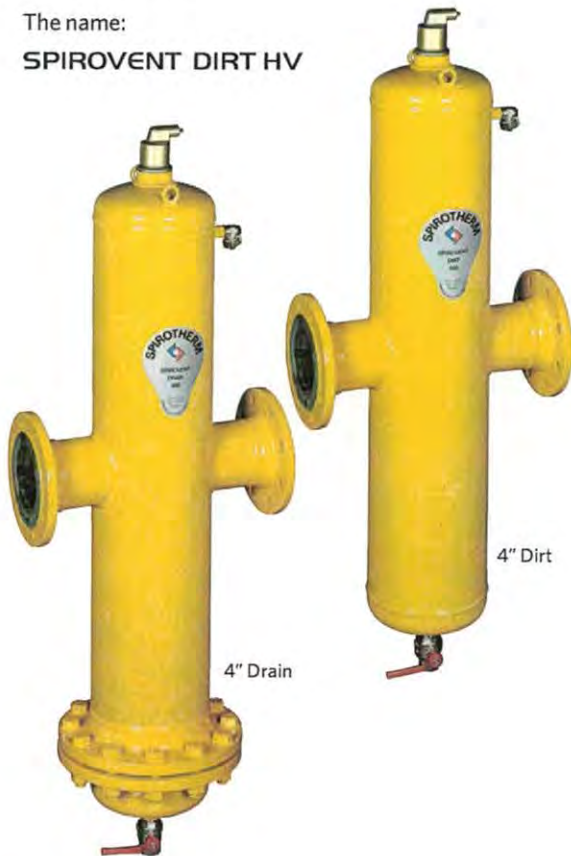
Recurring problems and increased maintenance result in unnecessary costs and dissatisfied owners.

**There is a solution!**

A large volume fluid system without air and dirt is possible! There is a unique dual-purpose device that will remove all air and dirt down to the smallest particle, keeping the system free from air and dirt, permanently. It is low-maintenance and works without strainers or filters. Less maintenance, fewer costs, satisfied owners!

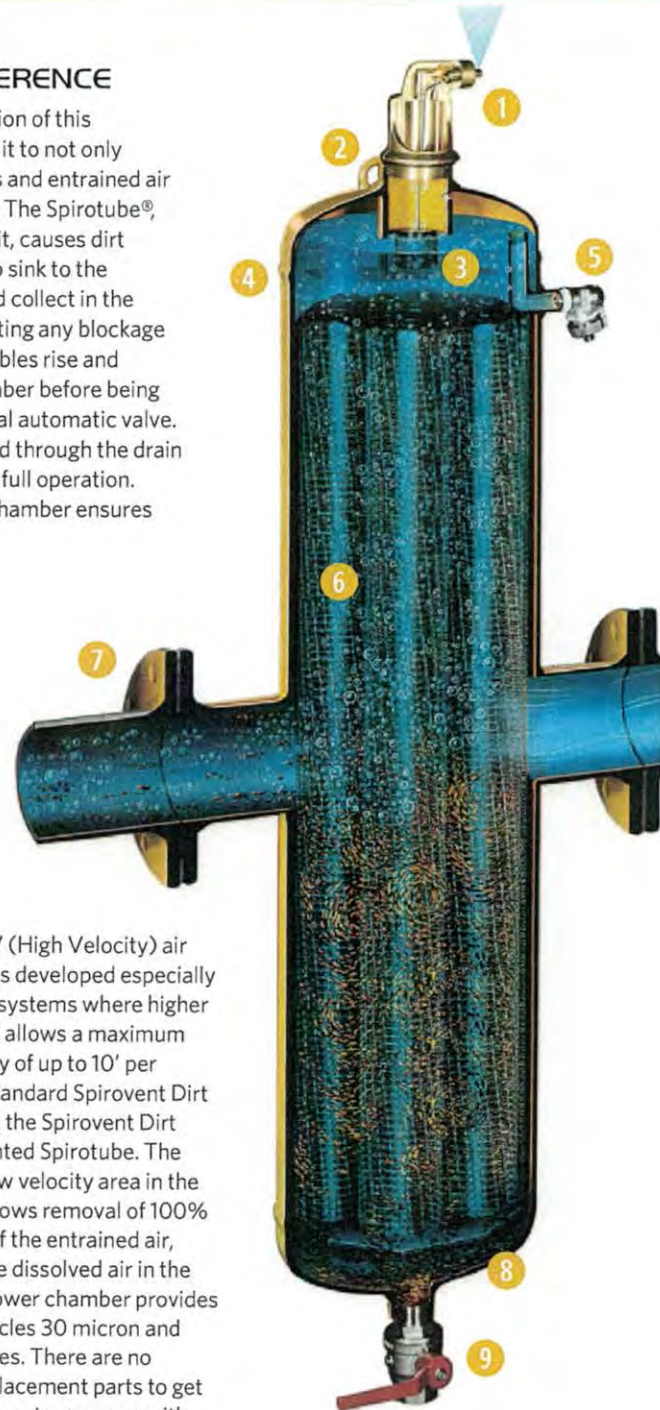
The name:

**SPIROVENT DIRT HV**



## THE KEY DIFFERENCE

The unique construction of this combined unit allows it to not only remove microbubbles and entrained air but also dirt particles. The Spirotube®, the core of the HV unit, causes dirt particles of all sizes to sink to the bottom of the unit and collect in the dirt chamber, eliminating any blockage concerns. The air bubbles rise and collect in the air chamber before being released via an integral automatic valve. The dirt can be flushed through the drain while the system is in full operation. The large collection chamber ensures infrequent flushing.



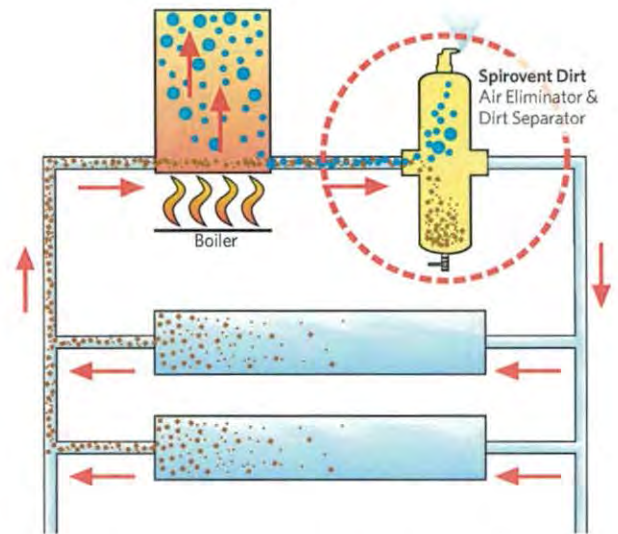
The Spirovent DIRT HV (High Velocity) air and dirt eliminator was developed especially for large volume fluid systems where higher velocities are found. It allows a maximum entering water velocity of up to 10' per second, and like the standard Spirovent DIRT air and dirt eliminator, the Spirovent DIRT HV contains the patented Spirotube. The Spirotube creates a low velocity area in the Spirovent core that allows removal of 100% of the free air, 100% of the entrained air, and up to 99.6% of the dissolved air in the upper chamber. The lower chamber provides for removal of all particles 30 micron and larger within 100 passes. There are no strainers, filters or replacement parts to get clogged. Blockages are not a concern with the Spirovent DIRT HV! Flow always remains constant, without high pressure drop. The result: increased component life and heat transfer capabilities; decreased oxygen-based corrosion and cavitation; and the elimination of annoying gurgling and other air-related noises.





## ADVANTAGES TO THE SPECIFIER, INSTALLER AND OWNER

- No change to piping design selection required. HV units often match pipe size.
- Larger shell and increased coalescing/ barrier medium provide high efficiency.
- Exclusively designed for full-flow high velocity systems such as central plants and district heating/cooling.
- No bypass, isolating valves or replacement filters to clog and reduce flow.
- Dirt can be flushed while system is fully operational.
- Quiet operation.
- Reduced oxygen-based corrosion and pump cavitation.
- Minimum pressure drop; always constant.
- Optional removable head for bundle inspection.



## INSTALL THE SPIROVENT DIRT HV FOR OPTIMUM PERFORMANCE

Ideal placement of a Spirovent unit is based on microbubble separation and Henry's Law. Simply put, Henry's Law states that air is released from water as the temperature increases or the pressure decreases\*. For this reason, the Spirovent is typically installed in the hottest point in the system. For a heating installation, this is in the supply from the boiler. In a chilled water circuit, the warmest point is in the return to the chiller.

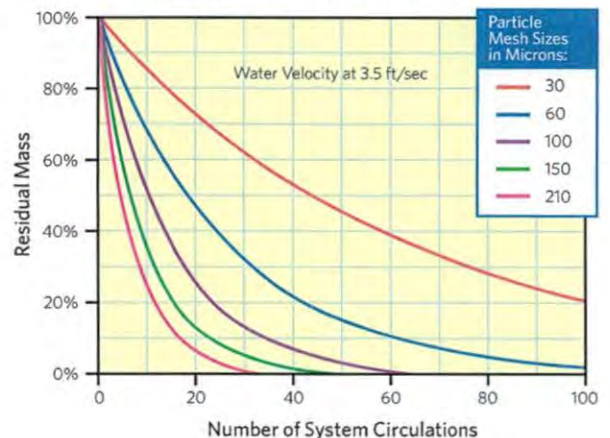
\*For more detailed technical information, ask about our Spirotism booklet.

- 1 The automatic air vent is guaranteed not to leak and can only be closed by the installer for a pressure test.
- 2 Lifting eyes make installation easy.
- 3 The air chamber has been specially designed so that dirt cannot reach the valve.
- 4 Welded steel construction guarantees long life.
- 5 Valve for releasing large amounts of air during filling and for skimming off floating dirt.
- 6 The unique Spirotube is the core of the Spirovent Dirt HV. Designed to trap the smallest microbubble and microscopic dirt particle, yet it offers little resistance to flow.
- 7 Flanged connections
- 8 Large capacity collection chamber reduces the need for frequent draining.
- 9 Drain valve for flushing out the dirt.



When the drain valve is opened the system pressure flushes out the collected dirt. This only takes a few seconds.

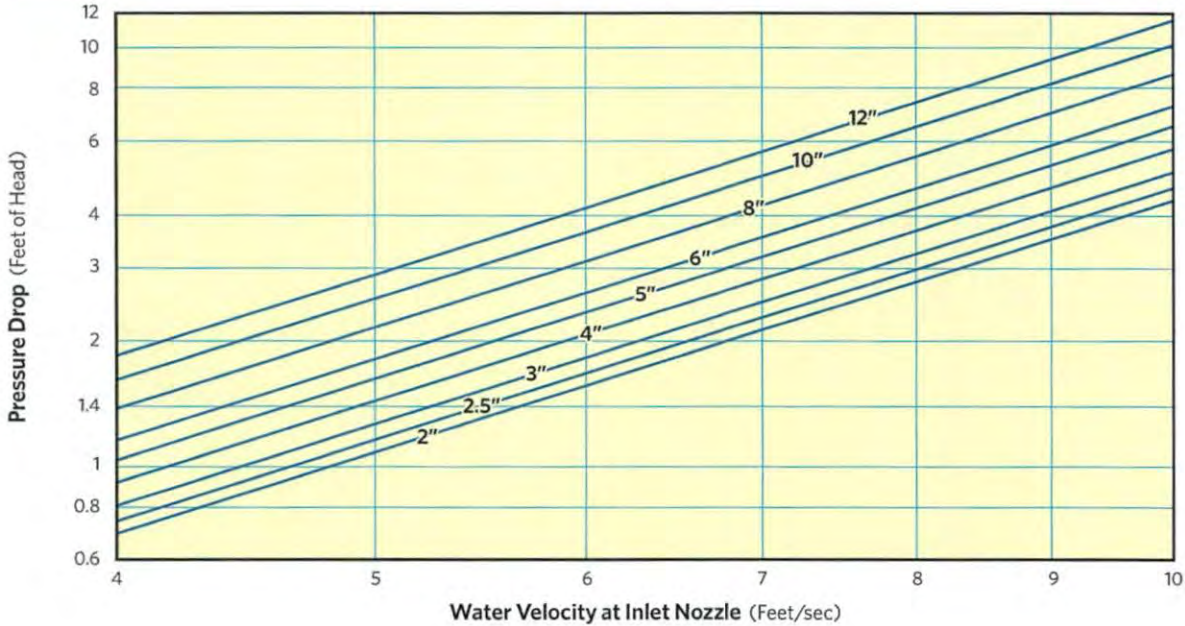
## DIRT SEPARATION EFFICIENCY





# SPIROVENT® DIRT HV

## PRESSURE DROP



## TECHNICAL SPECIFICATIONS

### SPIROVENT HV SENIOR

DIRT Part Number	VHT200	VHT250	VHT300	VHT400	VHT500	VHT600	VHT800	VHT1000	VHT1200	
DRAIN Part Number	VHN200	VHN250	VHN300	VHN400	VHN500	VHN600	VHN800	VHN1000	VHN1200	
Pipe Size	Inch	2	2.5	3	4	5	6	8	10	12
O.D.	Inch	2.375	3	3.5	4.5	5.5	6.625	8.625	10.75	12.75
D	Inch	6.3	6.3	8.6	8.6	12.8	12.8	16.0	20.0	24.0
DF	Inch	11.2	11.2	13.4	13.4	18.1	18.1	22.8	28.1	33.1
H2	Inch	35.8	35.8	45.1	45.1	61.8	61.8	78.5	95.0	113.0
h2	Inch	15.9	15.9	20.7	20.7	29.3	29.3	37.6	47.0	55.0
LF	Inch	15.2	15.7	20.2	20.6	27.7	27.7	33.6	37.5	42.5
e	Inch	1	1	1	1	1	1	1	1	1
Volume	Gal.	3.5	3.5	8.8	8.8	28.9	28.9	59	117	198.4
Weight: Dirt	Lbs.	88	95	178	186	312	336	590	986	1518
Weight: Drain**	Lbs.	120	150	195	262	479	505	820	1269	2025
Max. Flow*	GPM	100	150	230	400	620	900	1550	2450	3500

\*Approximately 10 ft. per second inlet velocity.

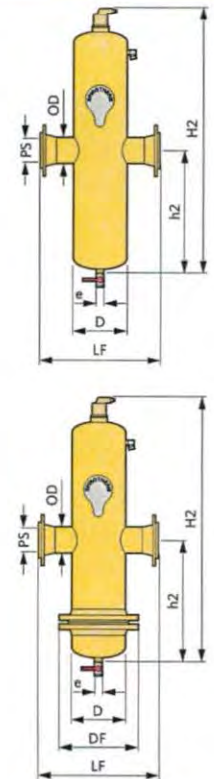
\*\*Spirovent Drain models feature a removable lower head to facilitate cleaning.

All Spirovents fabricated and stamped in accordance with ASME Section VIII, Division 1 for unfired pressure vessels.

Standard rating is 150 psi at 270°F. Consult local sales office for special requirements.

Custom dimensions available for space limitations.

Refer to web site Submittal Data for higher flows and models up to 36".



**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 2123 2.3 Hydronic Pumps  
Submittal Number: 1  
Item: Circulating Pumps P-1  
Manufacturer: Grundfos  
Model #: UPS32-80/2 ½ HP 208V CI Circ Pump  
Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No  
Named Equipment  Yes  No  
Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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**P-1**

G96402710  
G519604

GRUNDFOS  
GRUNDFOS

**P-1 PUMP SCHEDULE**

UPS32-80/2 1/2HP 208V CI CIRC PUMP  
1-1/2 CI FLANGE SET

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## UP Series 200

Installation and operating instructions

In-line, wet-rotor, single-speed, circulator pumps

UP 43-70, UP 43-110, UP 53-45, UP 53-46



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# UP Series 200

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<b>Español (MX)</b>	
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# English (US) Installation and operating instructions

Original installation and operating instructions.

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### Warning

*Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.*

*This booklet should be left with the owner of the pump for future reference and information regarding its operation.*

## 1. Limited warranty

Products manufactured by GRUNDFOS PUMPS CORPORATION (Grundfos) are warranted to the original user only to be free of defects in material and workmanship for a period of 24 months from date of installation, but not more than 30 months from date of manufacture.

Grundfos' liability under this warranty shall be limited to repairing or replacing at Grundfos' option, without charge, F.O.B. Grundfos' factory or authorized service station, any product of Grundfos' manufacture. Grundfos will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim.

Products which are sold but not manufactured by Grundfos are subject to the warranty provided by the manufacturer of said products and not by Grundfos' warranty. Grundfos will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with Grundfos' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of Grundfos' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact Grundfos or an authorized service station for instructions. Any defective product to be returned to Grundfos or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limit actions on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

## 2. Introduction

### 2.1 Safety warning

#### 2.1.1 Read this booklet

This booklet is designed to help a certified installer install, begin operation of and troubleshoot the Grundfos UP Series 200 pumps. The booklet should be left with the owner of the pump for future reference and information regarding its operation. Should the owner experience any problems with the pump, a certified professional should be contacted.

### 2.2 Electrical work

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

#### **Warning**

***A faulty motor or wiring can cause electric shock that could be fatal, whether touched directly or conducted through standing water. For this reason, proper grounding of the pump to the power supply's grounding terminal is required for safe installation and operation.***

***In all installations, the above-ground metal plumbing should be connected to the power supply ground as described in Article 250-80 of the National Electrical Code.***



## 3. Pre-installation checklist

### 3.1 Confirm you have the correct pump

Read the pump nameplate to make sure it is the one you ordered.

Compare the pump's nameplate data and its performance curve (for head, GPM, etc.) with the application in which you plan to install it.

Will the pump do what you expect it to do?

### 3.2 Check the condition of the pump

The shipping carton your pump came in is specially designed around your pump during production to prevent damage.

As a precaution, it should remain in the carton until you are ready to install it. At that point, look at the pump and examine it for any damage that may have occurred during shipping.

Examine any other parts of the shipment as well for any visible damage.

### 3.3 Verify electrical requirements

Verification of the power supply should be made to be certain the voltage, phase and frequency match that of the pump motor. The proper operating voltage and other electrical information can be found on the pump nameplate.

These motors are designed to run on  $\pm 10\%$  of the rated voltage.

Wiring diagrams can be found inside the terminal box cover and later in these installation and operating instructions. If voltage variations are larger than  $\pm 10\%$ , do not operate the pump.



### 3.4 Pumped liquid requirements

**Caution**

*The UP Series 200 pump is intended for use with water only.*

The pump can be used to circulate the following liquids:

- potable hot water
- water for hydronic heating
- water/glycol mixtures up to 50/50
- cooling water.

In domestic hot-water systems it is advisable to use bronze pumps (UP Series 200 or UPS model) only for water with a degree of hardness lower than 14 grains per gallon of hardness. For water with a higher degree of hardness, a direct-coupled TP pump is recommended. If the pump is installed in a heating system, the water should meet the requirements of accepted standards on water quality in heating systems.

In water/glycol mixtures, in order to prevent the glycol from degrading, temperatures above those for which the liquid is rated should be avoided and time spent at high temperatures minimized.

It is also important that the system is cleaned and flushed prior to the installation of the glycol mixture.

In order to avoid problems with corrosion or precipitation, the glycol liquids should be checked and maintained regularly. If further dilution of the supplied glycol is required, follow the requirements of the supplier of the glycol.

**Caution**

*Glycol with the trade name DEXCOOL® can damage the pump.*

DEXCOOL® is a registered trademark of General Motors Corporation, used under license by Texaco Lubricants NA.

The pump is lubricated and cooled by the pumped liquid. Therefore, the pumped liquid must always be allowed to circulate through the pump. Extended periods without circulation will cause premature wear to the bearings and excessive motor heat. The pumped liquid must also meet the following requirements:

#### Minimum inlet pressure (during operation)

UP model	At these liquid temperatures					
	167 °F/ 75 °C		194 °F/ 90 °C		230 °F/ 110 °C	
	[psi]	hf	[psi]	hf	[psi]	hf
UP 43-70	0.7	1.6	4.8	11.0	15.4	35.6
UP 43-110	3.6	8.3	8.2	18.9	18.9	43.7
UP 53-45	2.9	6.7	7.5	17.3	18.1	41.6
UP 53-46	1.1	2.5	5.8	13.3	16.4	37.7

#### Liquid temperature range

Continuously:

14 °F (-10 °C) up to 230 °F (110 °C).

Intermittent:

< 284 °F (140 °C) for short periods of time.

Domestic hot water:

< 140 °F (60 °C).

## 4. Installation procedures


**Warning**

*Never make any connections in the pump terminal box unless the power supply has been switched off.*

### 4.1 Electrical preparation

#### Terminal box position

At the bottom of the stator, closest to the pump housing, there are eight drain holes to allow condensed water to escape. The drain holes must not be blocked. The drain holes must point downwards. The terminal box must therefore point upwards in one of the positions shown in fig. 1. The following terminal box positions apply whether the piping is mounted vertically or horizontally.



Fig. 1 Possible terminal box positions

TMO3 7296 4706

### Rotating the terminal box

To rotate the terminal box, follow these steps:

#### Warning

*If the pump is already installed in the system, the system must be drained or the isolation valves on both sides of the pump must be closed before the hex socket head screws are removed as the pumped liquid may be scalding hot and/or under pressure.*

*Do not start the pump until the system has been filled with liquid and vented.*



1. Remove the four hex socket head screws holding the pump head onto the pump housing.
2. Carefully lift the pump head and rotate it so the terminal box is in the desired position. **DO NOT** locate the terminal box beneath the pump. Make sure the O-ring is properly seated in the pump housing.
3. Replace the pump head onto the pump housing.
4. Tighten the hex socket head screws evenly. Torque to:  
8 mm.....15 ft lbs  
10 mm.....25 ft lbs.
5. Check to make sure the rotor turns freely. Do this by removing the vent plug in the middle of the pump nameplate. Insert a medium size flat-blade screwdriver into the slot at the exposed end of the shaft. Gently turn the shaft. If it does not turn easily, repeat steps 1 to 4 above.
6. The position of the nameplate can be changed by easing the outer edge of the plate at the cutout with a screwdriver. Turn the nameplate to the required position and push into place.
7. Refer to pages 11 and 12 for additional instructions.

### 4.2 Piping considerations

Thoroughly clean and flush all dirt and sediment from the system before attempting to install the pump.

#### Location in the piping line

The pump should never be located at the lowest point of the piping system, where dirt and sediment collect. Nor should it be located at the highest point of the piping system, where air accumulates.

#### Mounting positions

The arrows on the flanges of the pump indicate the direction of water flow. Although the UP Series 200 may be installed in either vertical or horizontal piping, the motor shaft must always remain horizontal, as shown in figures 1 and 2.

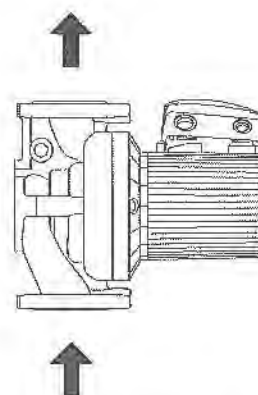


Fig. 2 Direction of water flow through the pump

Note

*Pumps installed outdoors must be protected by a ventilated, watertight cover to keep out moisture and dirt.*



#### Warning

*The pump must be positioned so that no one can accidentally come into contact with the hot surfaces of the pump.*

### 4.3 Connect the pump

Install the pump into the piping system.

Grundfos recommends that pressure gauges be installed in the inlet and discharge flanges or pipes to check pump and system performance.

TM03 7290 4706



### 4.4 Electrical connection

The electrical connection and protection should be carried out by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

**Warning**  
**Never make any connections in the pump terminal box unless the power supply has been switched off.**  
**The pump must be grounded.**  
**The pump must be connected to an external main power switch.**

The operating voltage and frequency are marked on the pump nameplate. Make sure that the motor is suitable for the power supply it is being installed to.

The pump should be grounded to protect against indirect contact and a ground fault interrupter can be used as extra protection.

#### Dual-voltage pump (single-phase)

All single-phase pumps are equipped with built-in, automatic resetting, thermal overload protection. The pump is protected at both 115 V and 230 V. The pump may also be protected by using an external contactor or motor starter.

If the pump is protected by means of a motor starter, the starter must be set to the current consumption of the pump. The current consumption is stated on the pump nameplate.

Figures 4 and 6 show the possible connections.

All UP Series 200 pumps (fig. 3 and fig. 5) come with a dual-voltage terminal box. The voltage is changed by the orientation of the jumpers as shown in fig. 9. All pumps are equipped with an internal automatic resetting thermal overload switch (terminals P1 and P2).

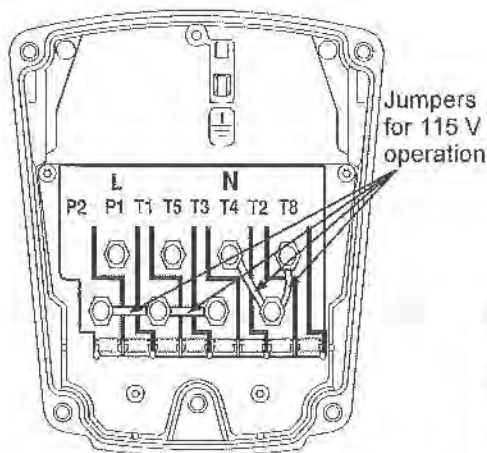


Fig. 3 UP Series 200 dual-voltage terminal box (1 x 115 V supply)

TM03 7304 4706

### Wiring diagram

Figure 4 shows the electrical connections when using built-in motor protection with 1 x 115 V supply.

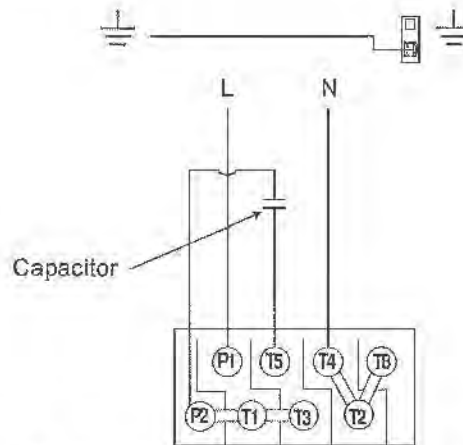


Fig. 4 Electrical connections (1 x 115 V supply)

TM03 7298 4706

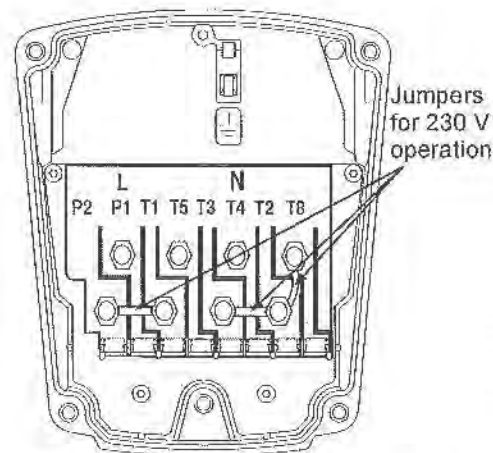


Fig. 5 UP Series 200 dual-voltage terminal box (1 x 230 V supply)

TM03 7306 4706

**Wiring diagram**

Figure 6 shows the electrical connections when using built-in motor protection with 1 x 230 V supply.

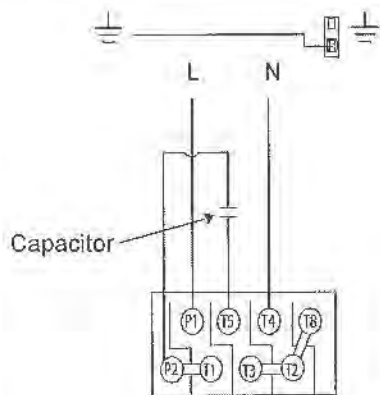


Fig. 6 Electrical connections (1 x 230 V supply)

TM03 7297 4706

**5. Starting the pump**

**5.1 Vent the piping system**


After the pump has been installed and the electrical connections made, the piping system must be vented.

**Caution** Never operate the pump dry - the system must first be filled with liquid and vented.


**Note** Do not vent the piping system through the pump.

Instead, follow these steps:

1. Fill and pressurize the system with liquid, and vent all trapped air from the piping by suitable means.
2. If isolation valves are used, make sure they are OPEN.

**Warning**  
 If the vent screw is to be loosened, care should be taken to ensure that the escaping scalding hot liquid does not cause personal injury or damage to components.

**5.2 Voltage selection**

**Warning**  
 Never make any connections in the pump terminal box unless the power supply has been switched off.

**Change the pump input voltage as follows:**

The voltage is changed by the position of the jumpers in the terminals. The jumpers are fitted according to:

figure 7 for 115 V AC

figure 8 for 230 V AC.

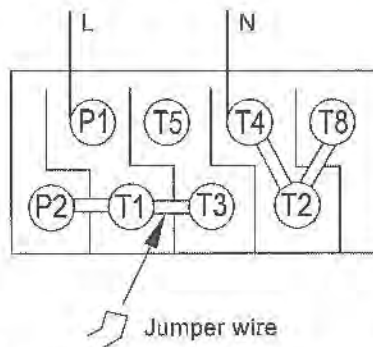


Fig. 7 Jumper position for 115 V AC

TM02 5757 3902

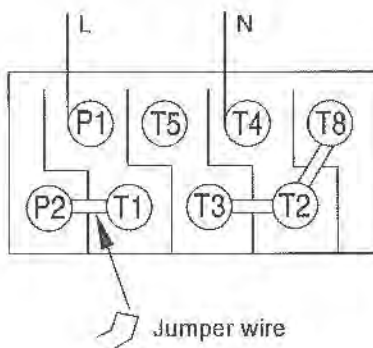


Fig. 8 Jumper position for 230 V AC

TM02 5758 5002

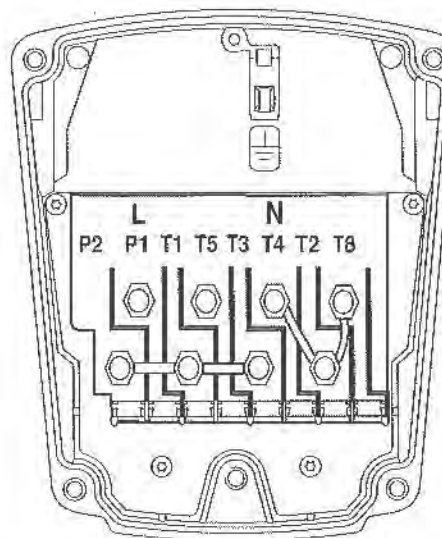


Fig. 9 Terminal box

TM03 7304 4706



## 6. Troubleshooting

### 6.1 Fault finding chart

#### Warning



Before removing the terminal box cover, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

The pumped liquid may be scalding hot and under high pressure. Before any removal or dismantling of the pump, the system must be drained or the isolation valves on both sides of the pump must be closed.

Fault	Cause	Remedy
1. The pump does not run.	a) One fuse in the installation is blown.	Replace the fuse.
	b) External circuit breaker is switched off.	Switch the circuit breaker on.
	c) Current-/voltage-operated ground fault interrupter has tripped.	Repair the insulation defects and reset the interrupter.
	d) The pump has been cut out by the thermal overload switch due to high liquid temperature or blocked rotor.	Check that the liquid temperature falls within the specified range. The pump will restart automatically when it has cooled to normal temperature.
	e) Rotor blocked, but the pump hasn't been cut out by the thermal overload switch.	Switch off the electrical supply and clean/repair the pump.
2. Noise in the system.	a) Air in the system.	Vent the system.
	b) The pump flow is too high.	Reduce the pump performance.
	c) The pressure is too high.	Reduce the pump performance.
3. Noise in the pump.	a) Air in the pump.	Vent the pump.
	b) The inlet pressure is too low.	Increase the inlet pressure and/or check the air volume in the expansion tank (if installed).
4. Insufficient heat in some places in the heating system.	a) The pump performance is too low.	Increase the pump performance, if possible, or replace the pump with a pump with higher flow.

## 6.2 Preliminary checks

### Supply voltage

To check the voltage being supplied to the motor, use a voltmeter.



#### Warning

*Be careful, since power is still being supplied to the pump. Do not touch the voltmeter leads together while they are in contact with the power lines.*

### Single-phase motors

Touch one voltmeter lead to each of the lines supplying power to the pump, L and N.

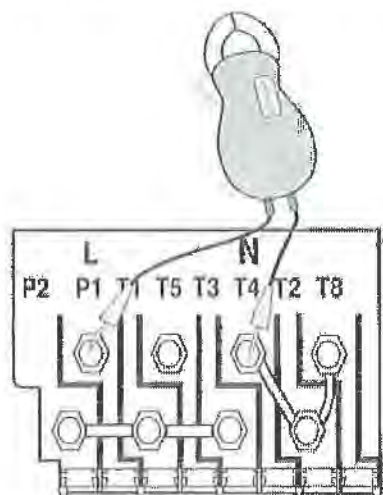


Fig. 10 Checking single-phase power

### Evaluation

When the motor is under load, the voltage should be within 10 % (+ or -) of the nameplate voltage. Any variation larger than this may indicate a poor power supply and can cause damage to the motor windings. The motor should not be operated under these conditions. Contact your power supplier to correct the problem or change the motor to one requiring the voltage you are receiving.

## 6.3 Current measurement

To check the current, use an ammeter.

To do so, follow these steps:

1. Make sure the pump is operating.
2. Set the ammeter to the proper scale.
3. Place the tongs of the ammeter around the leg to be measured.
4. Compare the results with the amp draw information on the nameplate.

### Evaluation

If the current exceeds the listed nameplate amps, then check the following:

The voltage supplied to the pump may be too high or too low.

The contacts on the motor starter may be burned.

The terminals in the starter or terminal box may be loose.

There may be a winding defect. Check the winding and insulation resistance.

The motor windings may be shorted or grounded.

The pump may be damaged in some way and may be causing a motor overload.

A voltage supply or balance problem may exist.

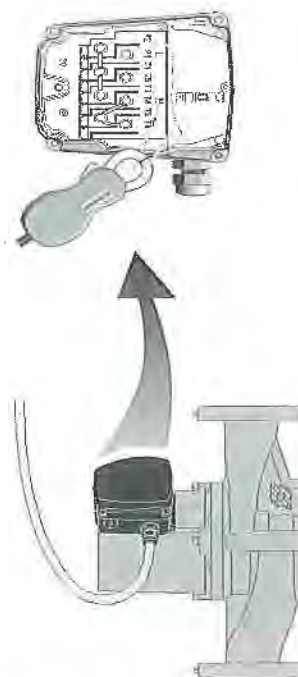


Fig. 11 Current measurement

TM03 7302 4706

TM03 7802 4906



## 6.4 Insulation resistance (lead-to-ground)

To check the insulation resistance (lead-to-ground) of the motor and leads, a megohmmeter is required.

To do so, follow these steps:

1. Turn the POWER OFF.
2. Disconnect all leads to the motor.
3. Set the scale selector on the megohmmeter to R x 100K, touch its leads together, and adjust the indicator to zero.
4. Touch the leads of the megohmmeter individually to each of the motor leads and to ground (i.e. L to ground; N to ground, etc.).

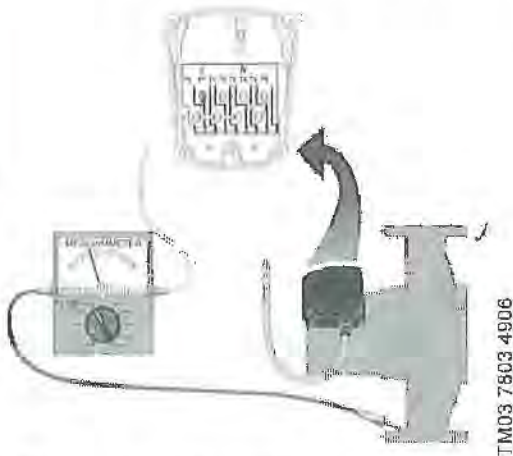


Fig. 12 Insulation resistance measurement

### Evaluation

The resistance values for new motors must exceed 1,000,000 ohms. If they do not, replace the motor.

## 6.5 Winding resistance (line-to-line)

To check the winding resistance of the motor windings, a megohmmeter is required.

To do so, follow these steps:

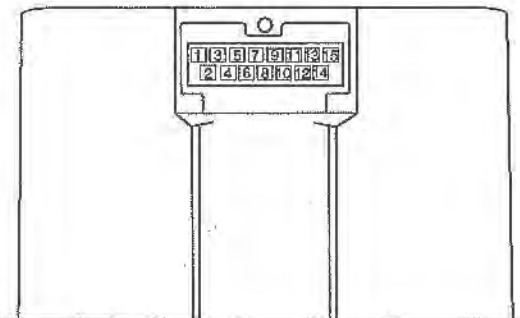
1. Turn the POWER OFF.
2. Disconnect all leads to the motor.
3. Set the scale selector on the megohmmeter to R x 1, touch its leads together and adjust the indicator to zero.
4. Using the following chart for reference, touch the leads of the megohmmeter to the appropriate pair of connectors. Check all pairs that are present and write down and label (RA<sub>1</sub>, RA<sub>2</sub>, RS) all readings.
5. Compare your readings to the matching model, phase and voltage on the chart in section 6.6 *Winding resistance chart*.

### Evaluation

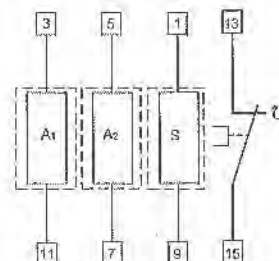
The resistance values must fall within the tolerances listed in section 6.6 *Winding resistance chart*. If they do not, replace the motor.

### Internal wiring UP

Terminal plug in stator



Single-phase



RA<sub>1</sub>: Main winding

RA<sub>2</sub>: Main winding

RS: Auxiliary winding

## 6.6 Winding resistance chart

UP dual voltage

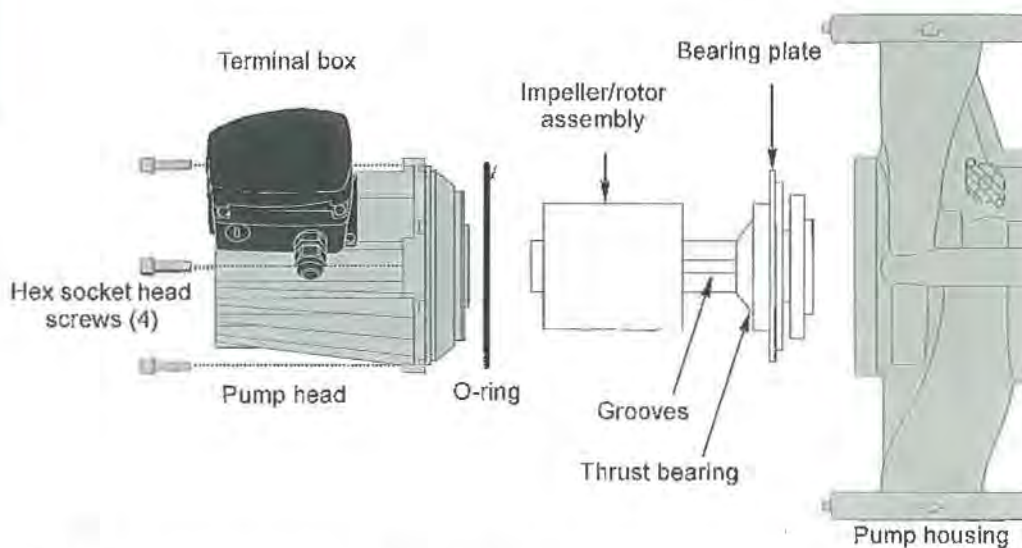
60 Hz

[Ω] 68 °F - 122 °F (20 °C - 50 °C)				
Pump type	Voltage	RA <sub>1</sub>	RA <sub>2</sub>	RS
UP 43-70	1 x 115 V	13.4 - 17.8	10.6 - 14.2	4.50 - 6.00
	1 x 230 V	13.4 - 17.8	10.6 - 14.2	4.50 - 6.00
UP 43-110	1 x 115 V	4.75 - 6.20	3.85 - 5.05	2.10 - 2.75
	1 x 230 V	4.75 - 6.20	3.85 - 5.05	2.10 - 2.75
UP 53-45	1 x 115 V	13.4 - 17.8	10.6 - 14.2	4.50 - 6.00
	1 x 230 V	13.4 - 17.8	10.6 - 14.2	4.50 - 6.00
UP 53-46	1 x 115 V	9.4 - 11.6	7.3 - 9.1	1.6 - 2.0
	1 x 230 V	9.4 - 11.6	7.3 - 9.1	1.6 - 2.0

## 7. Replacing components

### 7.1 Removing the pump head

1. Disconnect or TURN OFF the power supply.
2. Close isolation valves on either side of the pump to avoid draining the system of liquid.
3. Disconnect the leads from the terminal box.
4. Disconnect and remove the conduit from the terminal box.
5. Loosen and remove the four hex socket head screws (8 or 10 mm) which connect the pump head to the pump housing.
6. Remove the pump head from the pump housing.
7. Clean the machined surfaces in the pump housing of any foreign material.



TM03 7292 4706

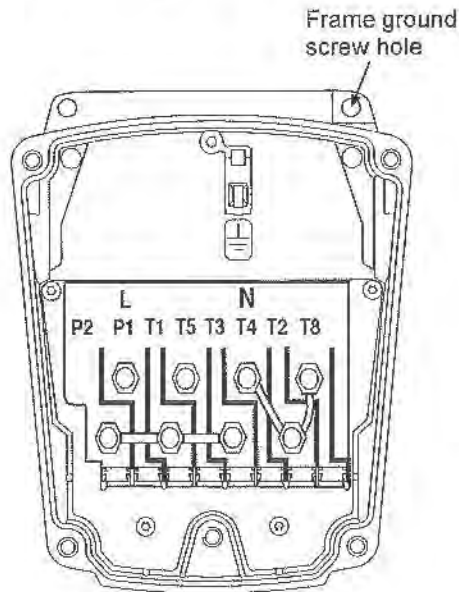
Fig. 13 Removing and fitting the pump head

### 7.2 Fitting the pump head

1. Carefully remove the new pump head from its packaging. Separate the impeller/rotor assembly from the new pump head.
2. While holding the thrust bearing, carefully place the impeller/rotor assembly into the pump housing. The bearing plate should fit snugly into the lowest machined surface in the pump housing.
3. Make sure that the impeller/rotor assembly can rotate freely.
4. Place the O-ring over the rotor and locate it into the inner diameter of the pump housing.
5. Carefully place the pump head over the rotor and rotate it so the terminal box is in the position you wish, see section 4.1 *Electrical preparation* under "Terminal box position".
6. Make sure the pump head is properly seated on the pump housing.  
**Do not force the two together** - if there is binding, disassemble them and repeat steps 2 to 6. Tighten the hex socket head screws evenly to secure the pump head.  
Torque to:  
8 mm.....15 ft lb  
10 mm.....25 ft lb.
7. Check to make sure the motor shaft turns freely, as explained in section 4.1 *Electrical preparation* under "Rotating the terminal box".



### 7.3 Replacing the terminal box or capacitor



TM03 7304 4706

If the terminal box is going to be replaced, make certain the electrical information listed on the new box matches the information listed on the old box, and that it is compatible with the pump and incoming power supply.

For all terminal boxes, it is very important to tightly secure the frame grounding screw through the terminal box, so that a proper connection between the terminal box and motor is made.

Fig. 14 Terminal box

All	1.	Before replacing the terminal box or capacitor, make sure the power is OFF.
	2.	Remove the terminal box cover by completely loosening all four torx/standard screws.
Capacitor	a.3.	<b>Capacitor replacement:</b> Disconnect the two capacitor leads from the terminals and unscrew the complete plastic strain relief nut. Remove capacitor wire and strain relief.
	a.4.	Screw in new complete strain relief nut and connect capacitor wires to terminals. Pull excess sheathed cable out of terminal box, being sure to leave at least 1/8" of sheath inside of terminal box.
Terminal box	b.3.	<b>Terminal box replacement:</b> Disconnect all wiring, remove the three Phillips-head screws holding the terminal box in place and remove the terminal box by pulling firmly and evenly on both sides.
	b.4.	Check that the clear rubber gasket is in place around the terminal box connector stem, carefully press the terminal box into the stator socket, replace the three Phillips-head terminal box screws and replace wiring.
All	5.	Replace the terminal box cover and tighten all four torx/standard screws.
	6.	Switch on power supply. The pump is now ready for operation.

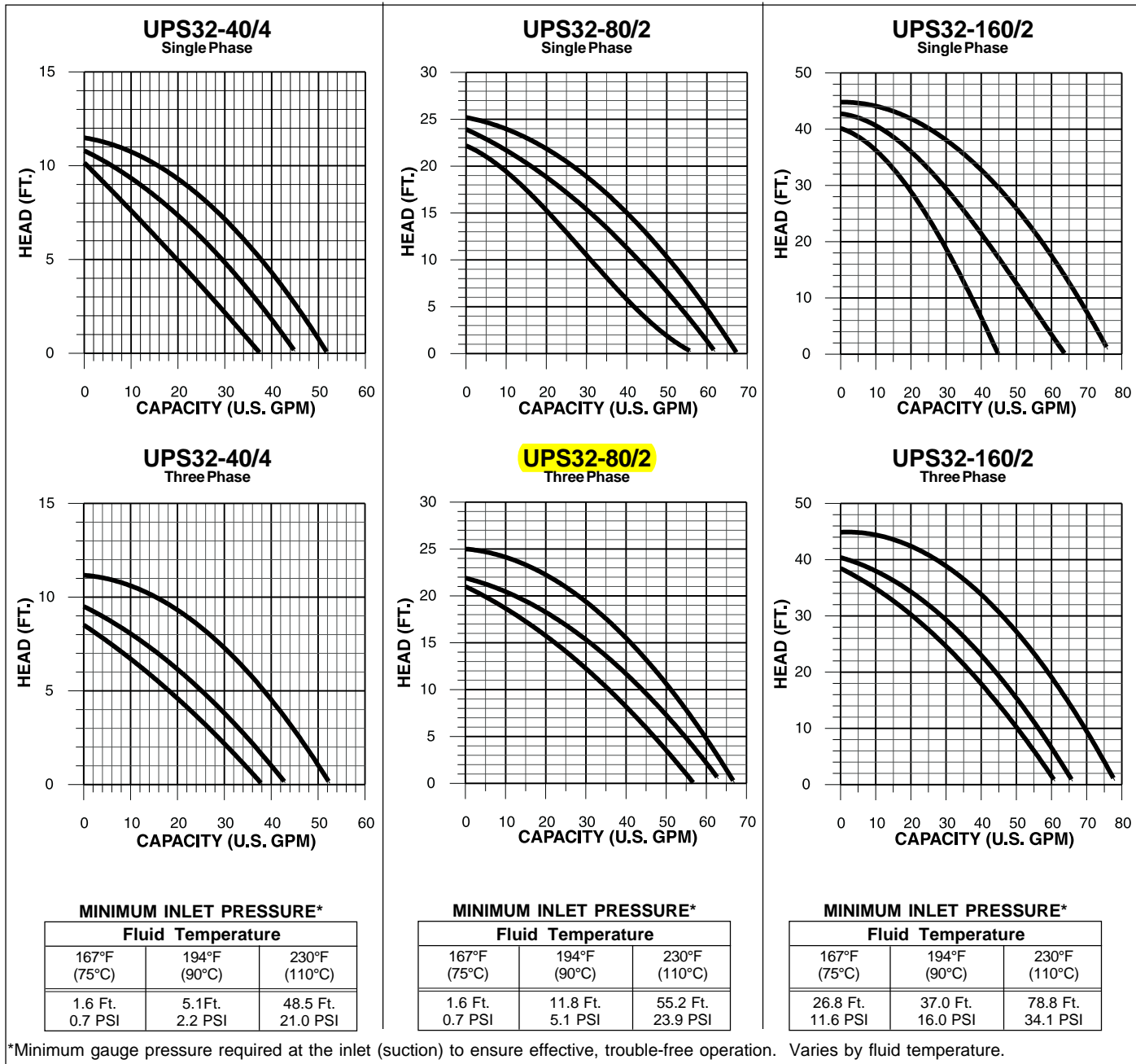
### 8. Disposal

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

Subject to alterations,

# Performance Curves (60 Hz – Single and Three Phase Models)



## Materials of Construction

DESCRIPTION	MATERIAL
Impeller, Bearing Plate, Rotor Cladding Bearing Retainers, Rotor Impeller, Rotor Can	AISI 304 SS
Impeller Seal Ring	AISI 304 SS/Teflon®
Inspection/Vent Screw, Shaft (cast iron pumps) Split Cone, Split Cone Nut	AISI 303 SS
Shaft (bronze pumps)	AISI 316 SS
Shaft Bearing Journals	Tungsten Carbide
Pump Housing* *Bronze – Optional	Cast Iron ASTM GG25 35B-40B
Stator Housing	Aluminum AISI 10Cu2
Rotor End Caps	Copper or Brass
Upper and Lower Radial Bearings	Ceramic Al2O3
Thrust Bearing	Carbon MY106
O-Rings	EPDM
Terminal Box, Nameplate	Composite PA66
Plug for Sensor	Composite PPS, GF40

Teflon® is a registered trademark of Dupont.

**GRUNDFOS®**



Leaders in Pump Technology

Grundfos Pumps Corporation • 3131 N. Business Park Avenue • Fresno, CA 93727  
Customer Service Centers: Allentown, PA • Fresno, CA  
Phone: (800) 333-1366 • Fax: (800) 333-1363  
Canada: Oakville, Ontario • Mexico: Apodaca, N.L.



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**USA**

GRUNDFOS Pumps Corporation  
17100 West 118th Terrace  
Olathe, Kansas 66061  
Phone: +1-913-227-3400  
Telefax: +1-913-227-3500

**Canada**

GRUNDFOS Canada Inc.  
2941 Brighton Road  
Oakville, Ontario  
L6H 6C9  
Phone: +1-905 829 9533  
Telefax: +1-905 829 9512

**México**

Bombas GRUNDFOS de México S.A.  
de C.V.  
Boulevard TLC No. 15  
Parque Industrial Stiva  
Aeropuerto  
Apodaca, N.L.C.P. 66600  
Phone: +52-81-8144 4000  
Telefax: +52-81-8144 4010

Grundfos companies

**BE > THINK > INNOVATE >**

Being responsible is our foundation  
Thinking ahead makes it possible  
Innovation is the essence

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**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 2123 2.3 Hydronic Pumps

Submittal Number: 1

Item: Circulating Pumps P-2

Manufacturer: Grundfos

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No



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# UPS Series 200

## Circulator pumps

### Installation and operating instructions





# UPS Series 200

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**Warning**

**Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.**



**This booklet should be left with the owner of the pump for future reference and information regarding its operation.**

**1. Limited warranty**

Products manufactured by GRUNDFOS PUMPS CORPORATION (Grundfos) are warranted to the original user only to be free of defects in material and workmanship for a period of 18 months from date of installation, but not more than 24 months from date of manufacture. Grundfos' liability under this warranty shall be limited to repairing or replacing at Grundfos' option, without charge, F.O.B. Grundfos' factory or authorized service station, any product of Grundfos' manufacture. Grundfos will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by Grundfos are subject to the warranty provided by the manufacturer of said products and not by Grundfos' warranty. Grundfos will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with Grundfos' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of Grundfos' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact Grundfos or an authorized service station for instructions.

Any defective product to be returned to Grundfos or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limit actions on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

## 2. Introduction

### 2.1 Safety warning

#### 2.1.1 Read this booklet

This booklet is designed to help a certified installer install, begin operation of and troubleshoot the Grundfos UPS pumps. The booklet should be left with the owner of the pump for future reference and information regarding its operation. Should the owner experience any problems with the pump, a certified professional should be contacted.

#### 2.1.2 Electrical work



##### **Warning**

***All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.***



##### **Warning**

***A faulty motor or wiring can cause electrical shock that could be fatal, whether touched directly or conducted through standing water. For this reason, proper grounding of the pump to the power supply's grounding terminal is required for safe installation and operation.***

***In all installations, the above-ground metal plumbing should be connected to the power supply ground as described in Article 250-80 of the National Electrical Code.***

## 3. Pre-installation checklist

### 3.1 Confirm you have the correct pump

- Read the pump nameplate to make sure it is the one you ordered.
- Compare the pump's nameplate data and its performance curve (for head, gpm, etc.) with the application in which you plan to install it.
- Will the pump do what you expect it to do?

### 3.2 Check the condition of the pump

The shipping carton your pump came in is specially designed around your pump during production to prevent damage.

As a precaution, it should remain in the carton until you are ready to install it. At that point, look at the pump and examine it for any damage that may have occurred during shipping.

Examine any other parts of the shipment as well for any visible damage.

### 3.3 Verify electrical requirements

Verification of the electrical supply should be made to be certain the voltage, phase and frequency match that of the pump motor.

The proper operating voltage and other electrical information can be found on the pump nameplate.

These motors are designed to run on + / - 10 % of the nameplate-rated voltage.

Wiring connection diagrams can be found inside the terminal box cover and later in these Installation and Operating Instructions. If voltage variations are larger than + / - 10 %, do not operate the pump.

### 3.4 Pumped liquid requirements

**Caution** *The UPS pump is intended for use with water only.*

The pump can be used to circulate:

- Potable hot water
- Water for hydronic heating
- Water/glycol mixtures up to 50/50
- Cooling water

In domestic hot-water systems it is advisable to use bronze pumps (UPS model) only for water with a degree of hardness lower than 14 grains per gallon of hardness. For water with a higher degree of hardness, a direct-coupled Grundfos TP pump is recommended.

If the pump is installed in a heating system, the water should meet the requirements of accepted standards on water quality in heating systems.

In water/glycol mixtures, in order to prevent the glycol from degrading, temperatures above those for which the fluid is rated should be avoided and time spent at high temperatures minimized.

It is also important that the system is cleaned and flushed prior to the installation of the glycol mixture.

In order to avoid problems with corrosion or precipitation, the glycol fluids should be checked and maintained regularly. If further dilution of the supplied glycol is required, follow the requirements of the supplier of the glycol.



**Warning**  
*Glycol with the trade name DEXCOOL® can harm the pump.*

DEXCOOL® is a registered trademark of General Motors Corporation, used under license by Texaco Lubricants NA.

The pump is lubricated and cooled by the liquid being pumped. Therefore, the pumped liquid must always be allowed to circulate through the pump. Extended periods without circulation will cause premature wear to the bearings and excessive motor heat. The pumped liquid must also meet the following requirements:

### Minimum pump inlet pressure (during operation)

UPS model	At these liquid temperatures					
	167 °F/75 °C		194 °F/90 °C		230 °F/110 °C	
	[psi]	hf	[psi]	hf	[psi]	hf
32-40/4	0.7	1.6	2.2	5.1	21.0	48.5
32-80/2	0.7	1.6	5.1	11.8	23.9	55.2
32-160/2	11.6	26.8	16.0	37.0	34.1	78.8
40-40/4	0.7	1.6	4.4	10.2	23.2	53.6
40-80/4	0.7	1.6	1.5	3.5	18.1	41.8
40-80/2	6.5	15.0	10.9	25.2	29.0	67.0
40-160/2	5.1	11.8	9.4	21.7	27.6	63.8
40-240/2	11.6	26.8	16.0	37.0	34.1	78.8
50-40/4	0.7	1.6	2.9	6.7	21.8	50.4
50-80/4	0.7	1.6	4.4	10.2	23.2	53.6
50-80/2	4.4	10.2	8.7	20.1	26.8	61.9
50-160/2	11.6	26.8	16.0	37.0	34.1	78.8
50-240/2	10.2	23.6	14.5	33.5	32.6	75.3
53-55/57	4.4	10.2	8.7	20.1	26.8	61.9
75-69	11.6	26.8	16	37	34.1	78.8
80-40/4	11.6	26.8	16.0	37.0	34.1	78.8
80-80/4	14.5	33.5	18.9	43.7	37.0	85.5
80-160/2	21.8	50.4	26.1	60.3	43.5	100.5
100-40/4	27.6	63.8	31.9	73.7	50.0	115.5

### Liquid temperature range

Continuously:  
14 °F (-10 °C) up to 230 °F (110 °C).

Intermittent:  
< 284 °F (140 °C) for short periods of time.

Domestic hot water:  
< 140 °F (60 °C).

## 4. Installation procedures



**Warning**

**Never make any connections in the pump terminal box unless the electrical supply has been switched off.**

### 4.1 Electrical preparation

**Terminal box position**

At the bottom of the stator, closest to the pump housing, there are eight drain holes to allow condensed water to escape. The drain holes shall not be blocked. The drain holes must point downwards. The terminal box must therefore point upwards in one of the positions shown in fig. 1. The following terminal box positions apply whether the piping is mounted vertically or horizontally.



TM03 7296 4706

**Fig. 1** Possible terminal box positions

**Rotating the terminal box**

To change the position of the terminal box, follow these steps:

**Warning**

**If the pump is already installed in the system, the system must be drained or the isolation valves on both sides of the pump must be closed before the allen-head screws are removed as the pumped liquid may be scalding hot and/or under pressure.**



**Do not start the pump until the system has been filled with liquid and vented.**

1. Remove the four allen-head screws holding the pump head onto the pump housing.
2. Carefully lift the pump head and rotate it so the terminal box is in the desired position. DO NOT locate the terminal box beneath the pump. Make sure the O-ring is properly seated in the pump housing.
3. Replace the pump head onto the pump housing.
4. Tighten the allen-head screws evenly.  
Torque:  
8 mm: 15 ft lbs  
10 mm: 25 ft lbs.

5. Check to make sure the rotor turns freely. Do this by removing the vent plug in the middle of the pump nameplate. Insert a medium size flat-blade screwdriver into the slot at the exposed end of the shaft. Gently turn the shaft. If it does not turn easily, repeat steps 1 to 4 above.
6. The position of the nameplate can be changed by easing the outer edge of the plate at the cutout with a screwdriver. Turn the nameplate to the required position and push into place.
7. Refer to page 19 and page 20 for additional instructions.

### 4.2 Piping considerations

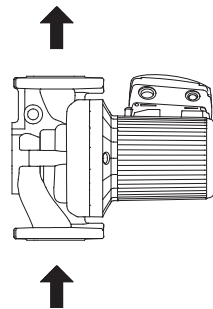
Thoroughly clean and flush all dirt and sediment from the system before attempting to install the pump.

**Location in the piping line**

The pump should never be located at the lowest point of the piping system, where dirt and sediment collect. Nor should it be located at the highest point of the piping system, where air accumulates.

**Mounting positions**

The arrows on the flanges of the pump indicate the direction of water flow. Although the UPS may be installed in either vertical or horizontal piping, the motor shaft must always remain horizontal, as shown in fig. 1 and fig. 2.



TM03 7290 4706

**Fig. 2** Direction of water flow through the pump

**Note**

**Pumps installed outdoors must be protected by a ventilated, watertight cover to keep out moisture and dirt.**



**Warning**

**The pump must be positioned so that someone cannot accidentally come into contact with the hot surfaces of the pump.**



### 4.3 Connect the pump

Install the pump into the piping system.

Grundfos recommends that pressure gauges be installed in the inlet and discharge flanges or pipes to check pump and system performance.

### 4.4 Electrical connection

The electrical connection and protection should be carried out in accordance with the latest edition of the National Electrical Code, local codes and regulations by a qualified electrician.

#### Warning

**Never make any connections in the pump terminal box unless the electrical supply has been switched off.**



**The pump must be grounded.**

**The pump must be connected to an external main power switch.**

The operating voltage and frequency are marked on the pump nameplate. Make sure that the motor is suitable for the electrical supply it is being installed to.

The pump should be grounded to protect against indirect contact and a ground fault interrupter can be used as extra protection.

#### Multi-speed pump (single-phase)

All single-phase pumps are equipped with built-in, automatic resetting, thermal overload protection. The pump is protected at all three speeds.

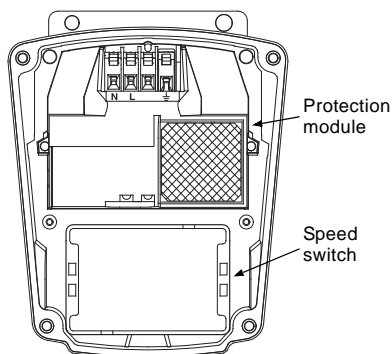
#### Multi-speed pump (three-phase)

The pump must be connected to the electrical supply via an external contactor. The contactor must be connected to the built-in thermal overload switch terminals T1 and T2 (3 x 208-230 V) or P1 and P2 (3 x 460 V and 575 V) to protect the pump against overloading at all three speeds.

**OR:** If the pump is protected by means of a motor starter, the starter must be set to the current consumption of the pump at the selected speed. The motor starter setting must be changed every time the pump speed is changed. The current consumption at the individual speeds is stated on the pump nameplate.

Figures 4, 6, 7, 9, and 10 on the next pages show the possible connections.

### 4.4.1 UPS 1 x 115 V and 1 x 230 V terminal box

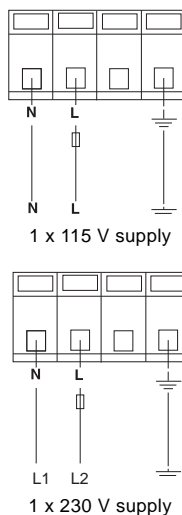


**Fig. 3** UPS 1 x 115 V and 1 x 230 V terminal box

All UPS single-phase pumps come with a protection module and a speed switch as shown in fig. 3. All pumps are equipped with built-in, automatic resetting, thermal overload protection. The pump is protected at all three speeds.

#### Wiring diagrams

Figure 4 shows the electrical connections for a single-phase pump with protection module.



**Fig. 4** 1 x 115 V and 1 x 230 V supply

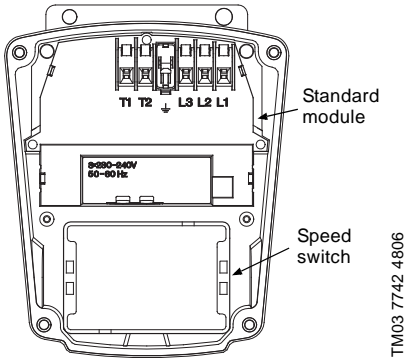
**Note** Provide electrical disconnect and current protection as per local electrical codes.

K = External contactor sized to FL and LR pump current.

TM03 7744 4806

TM03 7743 4806

#### 4.4.2 UPS 3 x 208-230 V terminal box

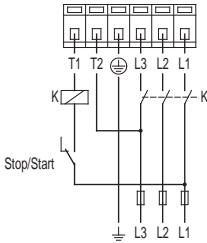


**Fig. 5** UPS 3 x 208-230 V terminal box

All UPS pumps with three-phase x 208-230 V come with a standard module and a speed switch as shown in fig. 5. All pumps are equipped with an internal thermal overload switch (terminals T1 and T2, to be connected to an external contactor) to protect the pump at all three speeds.

#### Wiring diagrams

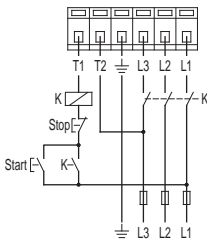
Figure 6 shows the electrical connections when using an external changeover contact (safety circuit) for start/stop push button station.



**Fig. 6** External changeover contact

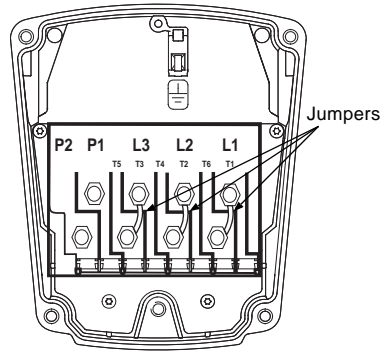
Auxiliary contacts rated for supply voltage.

Figure 7 shows the electrical connections when using external impulse contacts (momentary contacts) for start/stop push button station.



**Fig. 7** External impulse contacts

#### 4.4.3 UPS 3 x 460 V and 575 V terminal box

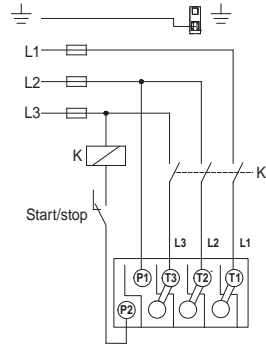


**Fig. 8** UPS 3 x 460 V and 575 V terminal box

All UPS pumps with three-phase x 460 V and 575 V terminal boxes (fig. 8) come with a special two-speed terminal box. The speed is changed by the orientation of the jumpers as shown on page 12. All pumps are equipped with an internal thermal overload switch (terminals P1 and P2) to be connected to external contactor.

#### Wiring diagrams

Figure 9 shows the electrical connections when using an external changeover contact (safety circuit) for start/stop push button station.



**Fig. 9** External changeover contact

Auxiliary contacts rated for supply voltage.

TM03 7742 4806

TM03 7739 4806

TM03 7892 5106

TM03 7738 5106

TM03 7740 4806

Figure 10 shows the electrical connections when using external impulse contacts (momentary contacts) for start/stop push button station.

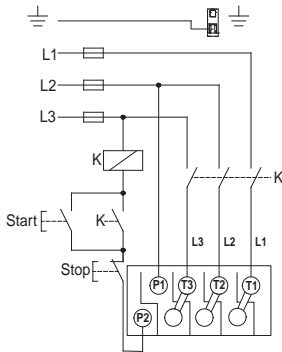


Fig. 10 External impulse contacts

TM03 7737 4806

## 5. Starting the pump

### 5.1 Vent the piping system

After the pump has been installed and the electrical connections made, the piping system must be vented.

**Caution**

**Never operate the pump dry - the system must first be filled with liquid and vented.**

**Note**

**Do not vent the piping system through the pump.**

Instead, follow these steps:

1. Fill and pressurize the system with liquid, and vent all trapped air from the piping by suitable means.
2. If any isolation valves are used, make sure they are OPEN.



**Warning**

**If the vent screw is to be loosened, care should be taken to ensure that the escaping scalding hot liquid does not cause personal injury or damage to components (see fig. 12).**

## 5.2 Check the direction of shaft rotation

### Applies to 460 V and 575 V two-speed models only

(The direction of rotation of three-speed pumps is checked by means of the fault finding chart, page 13 and page 14).

1. Make sure that the power is OFF.
2. Unscrew and remove the vent plug located at the center of the nameplate.
3. Insert a small, flat-blade screwdriver into the slot in the end of the motor shaft (see fig. 12). Rotate the shaft with the screwdriver to make sure it does so freely.
4. Bump the pump and watch to see which direction the shaft rotates. The shaft must rotate in the counterclockwise direction as shown on the nameplate (see fig. 11).
5. If the pump shaft is rotating incorrectly, disconnect the power and interchange any two power leads in the terminal box.
6. Check once again for proper counterclockwise rotation. When it is rotating correctly, replace the vent plug.

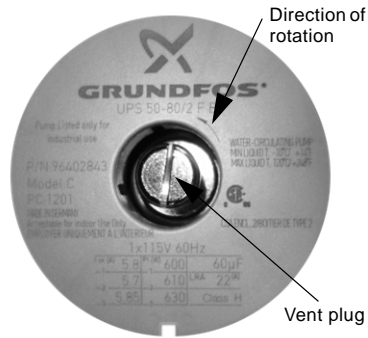


Fig. 11 Vent plug and direction of rotation

TM03 7750 1512

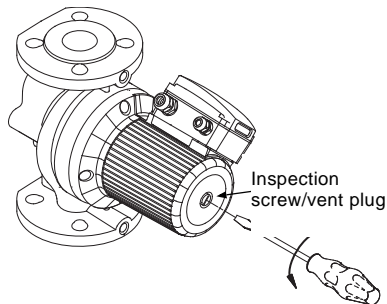


Fig. 12 Removing the vent plug

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## 5.3 Speed selection

### 5.3.1 Three-speed pumps, all models except 3 x 460 V and 575 V

The speed switch in the terminal box can be turned to three positions. The speed in the three positions appears in the table below (also see fig. 13).

Switch position	Speed in % of maximum speed	
	Single-phase pumps	Three-phase pumps
1	approx. 60 %	approx. 70 %
2	approx. 80 %	approx. 85 %
3	100 %	100 %

Changing to lower speeds offers considerable reduction in energy consumption and less noise in the system.

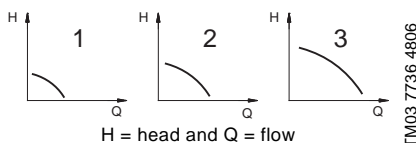


Fig. 13 Pump performance at speed settings



#### Warning

**Never make any connections in the pump terminal box unless the electrical supply has been switched off.**

#### Change the pump performance as follows:

- Switch off the electrical supply to the pump at the main circuit breaker.  
The green indicator light in the terminal box must be off.
- Remove the terminal box cover by loosening the four screws in the cover.
- Pull out the speed switch module and re-insert it so that the desired speed is visible through the window in the terminal box (see fig. 14).

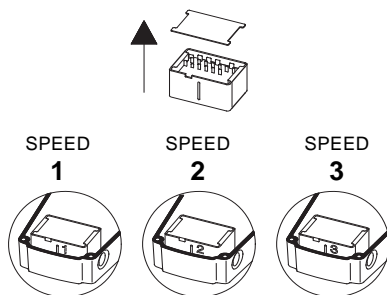


Fig. 14 Speed switch module

**Note** *When changing to and from speed 1, the cover of the speed switch module must be removed and fitted on the other side of the switch.*

- Fit the terminal box cover back onto the terminal box and tighten the four screws in the cover.
- Switch on the electrical supply.  
Check that the green indicator light is permanently on or flashing.

**Note** *The speed switch module must never be used as an on/off switch.*

TM03 7735 4806

### 5.3.2 Two-speed pumps, 3 x 460 V and 575 V

The speed setting in the terminal box can be changed to two positions. The speed in the two positions appears in the table below (also see fig. 13 on page 11).

Speed step	Speed in % of max. speed
1	approx. 75 %
2	100 %



#### Warning

**Never make any connections in the pump terminal box unless the electrical supply has been switched off.**

#### Change the pump performance as follows:

The speed is changed by the position of the jumpers in the terminals. The jumpers are fitted according to:

- figure 15 for speed 1 - low speed
- figure 16 for speed 2 - high speed.

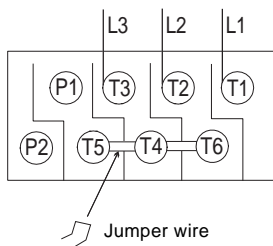


Fig. 15 Speed 1 (low speed)

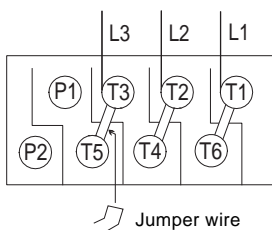


Fig. 16 Speed 2 (high speed)

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## 6. Troubleshooting

### 6.1 Fault finding chart



#### Warning

*Before removing the terminal box cover, make sure that the electrical supply has been switched off and that it cannot be accidentally switched on.*

*The pumped liquid may be scalding hot and under high pressure. Before any removal or dismantling of the pump, the system must be drained or the isolation valves on both sides of the pump must be closed.*

Fault	Cause	Remedy
1. The pump does not run. None of the indicator lights are on.	a) One fuse in the installation is blown.	Replace the fuse.
	b) External circuit breaker is switched off.	Switch the circuit breaker on.
	c) Current-/voltage-operated ground fault interrupter has tripped.	Repair the insulation defects and reset the interrupter.
	d) The pump's internal thermal overload switch has cut out ( <b>standard module only</b> ).	Check that the liquid temperature falls within the specified range. <b>With external on/off changeover contact:</b> The pump will restart automatically when it has cooled to normal temperature. <b>With external on/off impulse contacts:</b> The pump can be restarted when it has cooled to normal temperature.
2. The pump does not run. The green indicator light is on.	a) Rotor blocked, but the pump hasn't been cut out by the thermal overload switch.	Switch off the electrical supply and clean/repair the pump.
	b) The speed switch module has not been fitted.	Switch off the electrical supply at the external circuit breaker and fit the speed switch module into position.
3. <b>Three-phase pumps only:</b> The pump is running. The red and green indicator lights are on.	a) The pump is running with the wrong direction of rotation.	Switch off the electrical supply at the external circuit breaker and interchange any two phases (leads) in the pump terminal box.
4. Noise in the system. The green indicator light is on.	a) Air in the system.	Vent the system.
	b) The pump flow is too high.	Reduce the pump performance.
	c) The pressure is too high.	Reduce the pump performance.
5. Noise in the pump. The green indicator light is on.	a) Air in the pump.	Vent the pump.
	b) The inlet pressure is too low.	Increase the inlet pressure and/or check the air volume in the expansion tank (if installed).
6. Insufficient heat in some places in the heating system.	a) The pump performance is too low.	Increase the pump performance, if possible, or replace the pump with a pump with higher flow.

Fault	Cause	Remedy
7. <b>Single-phase pumps with protection module (only).</b> The pump does not run. The red indicator light is on. The green indicator light is off.	a) The pump has been cut out by the thermal overload switch due to high liquid temperature or blocked rotor.	Check that the liquid temperature falls within the specified range. The pump will restart automatically when it has cooled to normal temperature. <b>NOTE:</b> If the thermal overload switch has cut out the pump three times within a short period, the pump must be restarted manually by switching off the electrical supply.
	b) The speed switch module has not been fitted.	Switch off the electrical supply by means of the external mains switch and fit the speed switch module.

## 6.2 Preliminary checks

### Supply voltage

To check the voltage being supplied to the motor, use a voltmeter.



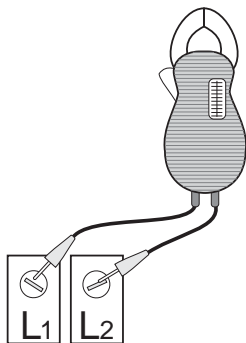
#### Warning

**Be careful, since power is still being supplied to the pump. Do not touch the voltmeter leads together while they are in contact with the power lines.**

### Evaluation

When the motor is under load, the voltage should be within 10 % (+ or -) of the nameplate voltage. Any variation larger than this may indicate a poor electrical supply and can cause damage to the motor windings. The motor should not be operated under these conditions. Contact your power supplier to correct the problem or change the motor to one requiring the voltage you are receiving.

Single-phase motors	Three-phase motors
<p>Touch one voltmeter lead to each of the lines supplying power to the pump:</p> <ul style="list-style-type: none"> <li>• L and N for 115 V circuits</li> <li>• L1 and L2 for 230 V circuits.</li> </ul>	<p>Touch a voltmeter lead to:</p> <ul style="list-style-type: none"> <li>• Power leads L1 and L2</li> <li>• Power leads L2 and L3</li> <li>• Power leads L3 and L1.</li> </ul> <p>These tests should give a reading of full line voltage.</p>



TM03 7749 4806

Fig. 17 Checking single-phase power

### 6.3 Current measurement

To check the current, use an ammeter.

To do so, follow these steps:

1. Make sure the pump is operating.
2. Set the ammeter to the proper scale.
3. Place the tongs of the ammeter around the leg to be measured.
4. Compare the results with the amp draw information on the motor nameplate.
5. Repeat for the other legs.

#### Evaluation

If the current draw exceeds the listed nameplate amps, or if the current imbalance is greater than 5 % between each leg on three-phase units, then check the following:

- The voltage supplied to the pump may be too high or too low.
- The contacts on the motor starter may be burned.
- The terminals in the starter or terminal box may be loose.
- There may be a winding defect. Check the winding and insulation resistance.
- The motor windings may be shorted or grounded.
- The pump may be damaged in some way and may be causing a motor overload.
- A voltage supply or balance problem may exist.

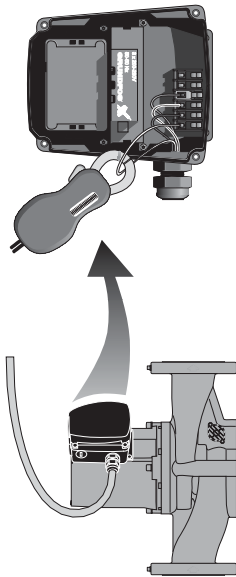


Fig. 18 Current measurement

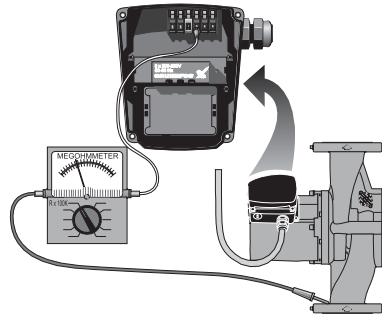
TM03 7293 4706

### 6.4 Insulation resistance (lead-to-ground)

To check the insulation resistance (lead-to-ground) of the motor and leads, a megohmmeter is required.

To do so, follow these steps:

1. Turn the POWER OFF.
2. Disconnect all electrical leads to the motor.
3. Set the scale selector on the megohmmeter to R x 100K, touch its leads together, and adjust the indicator to zero.
4. Touch the leads of the megohmmeter individually to each of the motor leads and to ground (i.e. L1 to ground; L2 to ground, etc.).



TM03 7293 4706

Fig. 19 Insulation resistance measurement

#### Evaluation

The resistance values for new motors must exceed 1,000,000 ohms. If they do not, replace the motor.

### 6.5 Winding resistance (line-to-line)

To check the winding resistance of the motor windings, a megohmmeter is required.

To do so, follow these steps:

1. Turn the POWER OFF.
2. Disconnect all electrical leads to the motor.
3. Set the scale selector on the megohmmeter to R x 1, touch its leads together, and adjust the indicator to zero.
4. Using the charts below for reference, touch the leads of the megohmmeter to the appropriate pair of connectors. Check all pairs that are present and write down and label (RA, RS<sub>1</sub>, RS<sub>2</sub>, R) all readings.
5. Compare your readings to the matching model, phase and voltage on the chart on page 17 and page 18.

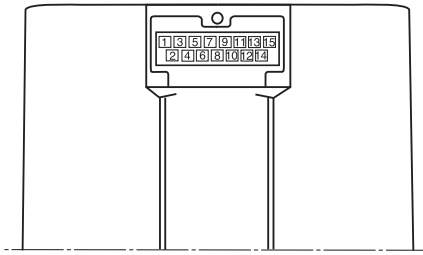
#### Evaluation

The resistance values must fall within the tolerances listed on page 17 or page 18. If they do not, replace the motor.

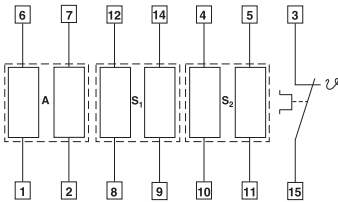


**Internal wiring UPS**

Terminal plug in stator



Single-phase



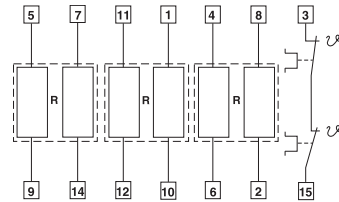
RA: 6-1 or 6-1, 7-2  
 RS<sub>1</sub>: 12-8 or 12-8, 14-9  
 RS<sub>2</sub>: 4-10 or 4-10, 5-11

RA: Main winding

RS<sub>1</sub>: Auxiliary winding

RS<sub>2</sub>: Auxiliary winding

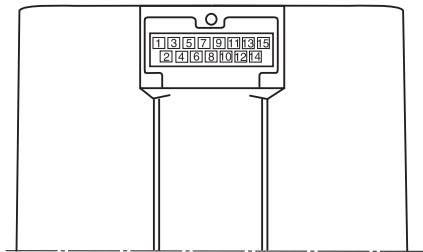
Three-phase 208-230 V



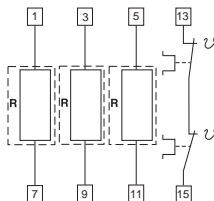
R: 5-9 or 5-9, 7-14  
 R: 11-12 or 11-12, 1-10  
 R: 4-6 or 4-6, 8-2

**Internal wiring UPS**

Terminal plug in stator



Three-phase 460/575 V



## 6.6 Winding resistance chart

60 Hz

Pump type	Voltage	[Ω] 68 °F - 122 °F (20 °C - 50 °C)			
		R	RA	RS <sub>1</sub>	RS <sub>2</sub>
UPS 32-40/4	1 x 115 V		17.8 - 23.2	3.95 - 5.20	9.40 - 12.4
	1 x 230 V		70.0 - 91.5	17.0 - 22.2	39.5 - 52.0
	3 x 208-230 V	180 - 236			
	3 x 460 V	360 - 470			
	3 x 575 V	575 - 750			
UPS 32-80/2	1 x 115 V		9.55 - 12.6	3.05 - 4.00	6.70 - 8.80
	1 x 230 V		19.4 - 25.5	5.45 - 7.10	12.6 - 16.4
	3 x 208-230 V	44.0 - 57.5			
	3 x 460 V	83.5 - 110			
	3 x 575 V	132 - 174			
UPS 32-160/2	1 x 115 V		4.15 - 5.45	1.20 - 1.56	2.65 - 3.50
	1 x 230 V		8.30 - 10.8	2.20 - 2.90	5.05 - 6.65
	3 x 208-230 V	26.0 - 34.0			
	3 x 460 V	53.5 - 70.0			
	3 x 575 V	84.5 - 110			
UPS 40-40/4	1 x 115 V		11.4 - 15.0	2.95 - 3.85	5.60 - 7.35
	1 x 230 V		50.5 - 66.5	14.0 - 18.4	25.5 - 34.0
	3 x 208-230 V	118 - 154			
	3 x 460 V	234 - 310			
	3 x 575 V	360 - 475			
UPS 40-80/2	1 x 115 V		5.60 - 7.35	1.84 - 2.42	4.50 - 5.90
	1 x 230 V		11.0 - 14.4	3.95 - 5.20	8.55 - 11.2
	3 x 208-230 V	32.0 - 42.0			
	3 x 460 V	64.0 - 84.0			
	3 x 575 V	102 - 132			
UPS 40-80/4	1 x 115 V		4.15 - 5.45	1.94 - 2.55	3.30 - 4.35
	1 x 230 V		8.10 - 10.6	3.05 - 4.00	4.60 - 6.05
	3 x 208-230 V	46.5 - 61.0			
	3 x 460 V	90.5 - 118			
	3 x 575 V	164 - 216			
UPS 40-160/2	1 x 115 V		2.85 - 3.75	1.10 - 1.44	1.94 - 2.55
	1 x 230 V		5.60 - 7.35	2.02 - 2.66	3.75 - 4.95
	3 x 208-230 V	22.8 - 30.0			
	3 x 460 V	45.5 - 59.5			
	3 x 575 V	72.0 - 95.0			
UPS 40-240/2	1 x 230 V		6.80 - 8.95	2.02 - 2.65	3.70 - 4.85
	3 x 208-230 V	11.0 - 14.4			
	3 x 460 V	22.0 - 29.0			
	3 x 575 V	35.0 - 45.5			

Pump type	Voltage	[Ω] 68 °F - 122 °F (20 °C - 50 °C)			
		R	RA	RS <sub>1</sub>	RS <sub>2</sub>
UPS 50-40/4	1 x 115 V		6.55 - 8.55	2.12 - 2.80	4.30 - 5.65
	1 x 230 V		25.0 - 33.0	8.30 - 10.8	15.0 - 19.8
	3 x 208-230 V	57.5 - 75.0			
	3 x 460 V	114 - 148			
	3 x 575 V	184 - 242			
UPS 50-80/2	1 x 115 V		4.15 - 5.45	1.20 - 1.56	2.65 - 3.50
	1 x 230 V		8.30 - 10.80	2.20 - 2.90	5.05 - 6.65
	3 x 208-230 V	26.0 - 34.0			
	3 x 460 V	33.5 - 70.0			
	3 x 575 V	84.5 - 110			
UPS 50-80/4	1 x 115 V		2.75 - 3.60	1.74 - 2.30	2.85 - 3.75
	1 x 230 V		5.50 - 7.25	2.65 - 3.50	4.95 - 6.50
	3 x 208-230 V	37.0 - 49.0			
	3 x 460 V	79.0 - 104			
	3 x 575 V	120 - 156			
UPS 50-160/2	1 x 230 V		6.80 - 8.95	2.02 - 2.65	3.70 - 4.85
	3 x 208-230 V	12.4 - 16.2			
	3 x 460 V	24.2 - 31.5			
	3 x 575 V	37.5 - 49.5			
UPS 50-240/2	3 x 208-230 V	7.80 - 10.2			
	3 x 460 V	15.6 - 20.6			
	3 x 575 V	25.0 - 33.0			
UPS 53-55/57	1 x 115 V		4.15 - 5.45	1.20 - 1.56	2.65 - 3.50
	1 x 230 V		8.30 - 10.80	2.20 - 2.90	5.05 - 6.65
	3 x 208-230 V	26.0 - 34.0			
	3 x 460 V	33.5 - 70.0			
	3 x 575 V	84.5 - 110			
UPS 75-69	1 x 230 V		6.80 - 8.95	2.02 - 2.65	3.70 - 4.85
	3 x 208-230 V	12.4 - 16.2			
	3 x 460 V	24.2 - 31.5			
	3 x 575 V	37.5 - 49.5			
UPS 80-40/4	3 x 208-230 V	46.5 - 61.0			
	3 x 460 V	90.5 - 118			
	3 x 575 V	164 - 216			
UPS 80-80/4	3 x 208-230 V	23.6 - 31.0			
	3 x 208-230 V	7.80 - 10.2			
UPS 80 -160/2	3 x 460 V	15.6 - 20.6			
	3 x 575 V	25.0 - 33.0			
	3 x 208-230 V	27.5 - 36.0			
UPS 100-40/4	3 x 460 V	54.5 - 71.5			
	3 x 575 V	86.0 - 114			
	3 x 575 V	86.0 - 114			

PROJECT: _____	UNIT TAG: _____	QUANTITY: _____
REPRESENTATIVE: _____	TYPE OF SERVICE: _____	DATE: _____
ENGINEER: _____	SUBMITTED BY: _____	DATE: _____
CONTRACTOR: _____	APPROVED BY: _____	DATE: _____
	ORDER NO.: _____	DATE: _____

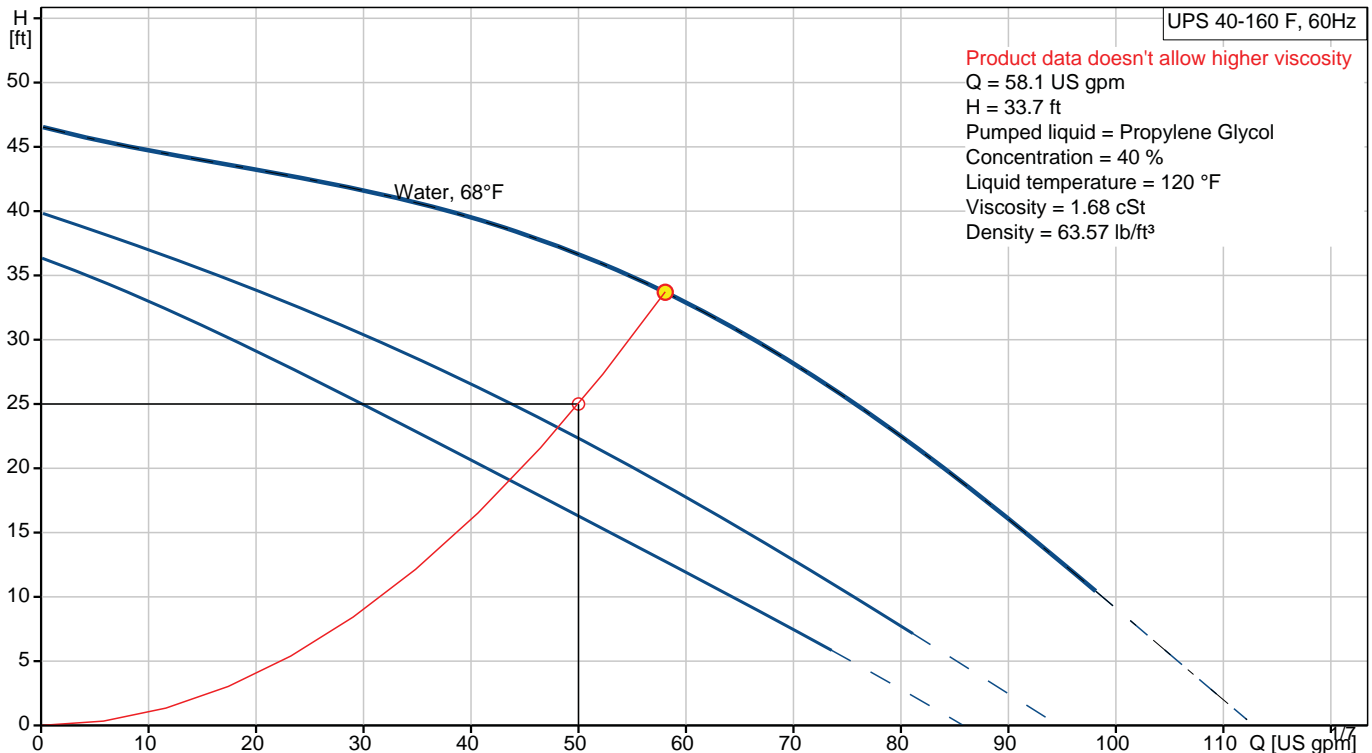


## UPS 40-160 F

Circulator pumps

Product photo could vary from the actual product

Conditions of Service	Pump Data	Motor Data
Flow: _____	Maximum operating pressure: 145 psi	Max. power input: 800 W
Head: _____	Liquid temperature range: 14 .. 248 °F	Rated voltage: 208-230 V
Efficiency: _____	Maximum ambient temperature: 104 °F	Main frequency: 60 Hz
Liquid: _____	Approvals: CUL	Enclosure class: X4D
Temperature: _____	Type of connection: F	Insulation class: H
NPSH required: _____	Flange standard: USA Oval	Motor protection: CONTACT
Viscosity: _____	Pipe connection: GF 40/43	Thermal protection: external
Specific Gravity: _____	Product number: 96402784	



**USA**

GRUNDFOS Pumps Corporation  
17100 West 118th Terrace  
Olathe, Kansas 66061  
Phone: +1-913-227-3400  
Telefax: +1-913-227-3500

**Canada**

GRUNDFOS Canada Inc.  
2941 Brighton Road  
Oakville, Ontario  
L6H 6C9  
Phone: +1-905 829 9533  
Telefax: +1-905 829 9512

**México**

Bombas GRUNDFOS de México S. A.  
de C.V.  
Boulevard TLC No. 15  
Parque Industrial Stiva  
Aeropuerto  
Apodaca, N.L.C.P. 66600  
Phone: +52-81-8144 4000  
Telefax: +52-81-8144 4010

**L-UPS-TL-001** 0612

<b>96459998</b> 0612
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ECM: 1095072
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**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 2500 2.2 HVAC Water Treatment

Submittal Number: 1

Item: Antifreeze Makeup System  
(Glycol Feed Unit)

Manufacturer: Axiom

Model #: AMF300

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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AMF300

AXIOM

GLYCOL FEED UNIT

17G 115VAC HYDRO SYSTEM FEEDER. COMPLIES WITH UL  
LISTING

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***INDUSTRIES LIMITED***

Installation, Operation & Maintenance  
Instructions for MF Series Solution Feeders

Axiom Industries Ltd.  
2615 Wentz Avenue  
Saskatoon, SK  
S7K 5J1  
Ph: (306) 651-1815  
Fax: (306) 242-3373  
Email: [sales@axiomind.com](mailto:sales@axiomind.com)



**INDUSTRIES LIMITED**

## **MF200 and MF300 HYDRONIC SYSTEM FEEDER**

### **INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS**

The System Feeder is used to maintain a minimum system pressure within a hydronic heating or cooling system. It should be used to pressurize the system while system temperature is at it's lowest.

#### **Installation Instructions**

1. Set System Feeder on a secure and level base or in the optional tank shelf.
2. Connect the unit to the system using copper or plastic tubing. Ensure that there is a system isolation valve installed to allow for isolation of the unit. **DO NOT INSTALL A CHECK VALVE OR PRESSURE REGULATOR BETWEEN SYSTEM FEEDER AND SYSTEM.**
3. Mount power supply and secure with mounting bracket. Do not power up System Feeder until a system connection is made and isolation valve is open.
4. If the System Feeder will be connected to an alarm system connect alarm circuit to terminals below discharge connection.
5. Install proper water/glycol mix in the tank to a level above minimum level indication on tank scale. A 30-50% Polypropylene Glycol is Recommended.
6. **Open system isolation valve.**
7. Insert DC plug into the System Feeder feeder first, and then plug power supply into 120v outlet. The red LED in the power supply cord should light up. If it does not, check the fuse and power receptacle. If system pressure is below pressure switch setting (18 psi) pump will start.
8. Turn mix/purge valve handle on front of unit to vertical position to purge air from pump. Once air is purged, turn valve handle to horizontal position and allow pump to pressurize system. The System Feeder will run until system is pressurized to approximately 18 psi. and shut-off. It may cycle rapidly a number of times while system pressure stabilizes and while air is removed from the system. The cycling will stop once system pressure rises above 18 psi due to thermal expansion.
9. If a higher fill pressure is required (up to 25 psi) the internal pressure switch may be adjusted by turning the center adjusting screw clockwise to increase pressure. Access to the pressure switch can be gained by lifting the left side of the top cover.
10. The MF200 is shipped with a small amount of 50% propylene glycol (non-toxic) in the discharge tubing between the pump and the check valve. This is to aid in priming.

Please note that the pressure gauge supplied with the unit may read differently from another gauge, which may be installed elsewhere in the system. This may be due to gauge calibration or differences in elevation within the system and should not be a concern.

The System Feeder does not require any scheduled maintenance. Should you wish to test pump operation, turn mix/purge valve to vertical position to start pump. Turning mix/purge valve handle to horizontal position will stop pump.



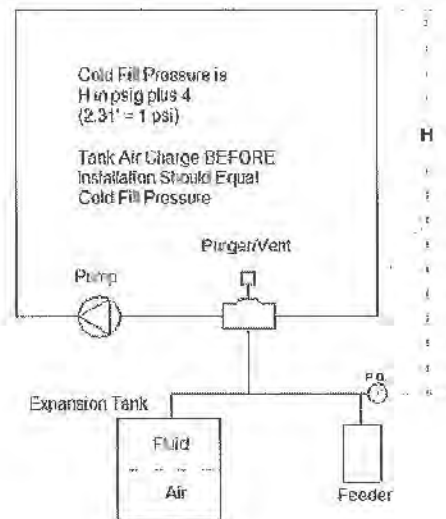
## COLD STATIC FILL PRESSURE

The cold static fill pressure (CSFP) in a closed hydronic system has to be high enough to accomplish three things.

- 1) Overcome the static head (height) between the fill point and the highest point in the system.
- 2) Provide adequate pressure (minimum 4 psig) at the top of the system for proper air venting.
- 3) Maintain adequate pressure at the inlet of the system pumps to prevent cavitation.

The formula for calculating the required CSFP to satisfy points 1 & 2 is:

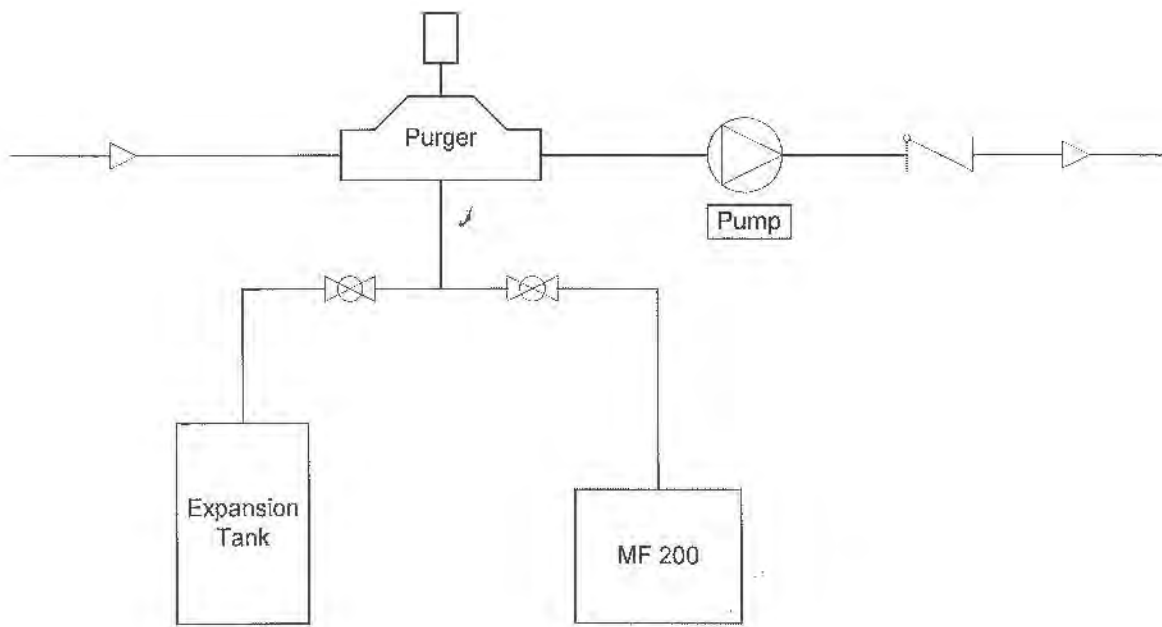
$$(\text{Static height in feet}/2.31) + 4 = \text{CSFP in psig.}$$



As an example, the CSFP for a system with a static height above the fill point of 40 feet would be:  
 $(40/2.31) + 4 = 21.3$  psig.

For most closed hydronic systems operating below about 210 F, maintaining the minimum top-of-system pressure at 4 psig will be adequate to prevent pump cavitation even if the pumps are at or near the top of the system as well.

**IMPORTANT NOTE** – For air-charged diaphragm or bladder tanks, the air charge in the tank must be adjusted to equal the cold static fill pressure before it is connected to the system.

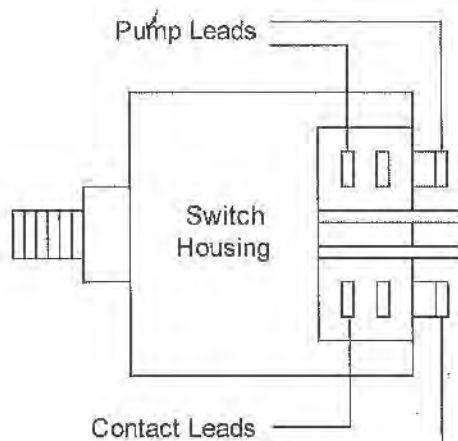


Connection Schematic – MF 200 Packaged System Feeder

### Connecting the Alarm Contacts in the MF Series to Other Alarm Systems

The alarm switch contacts in the MF series are factory wired to be OPEN on LOW PRESSURE. The switch is SPDT, so if some other alarm system is connected to this alarm contact and can not be configured to work with an open contact, the wiring on the low-pressure micro-switch can be changed to provide a closed contact on low pressure.

Remove the screws fastening the top cover to the unit and lift the cover to get access to the pressure switch. Disconnect the power before doing this.



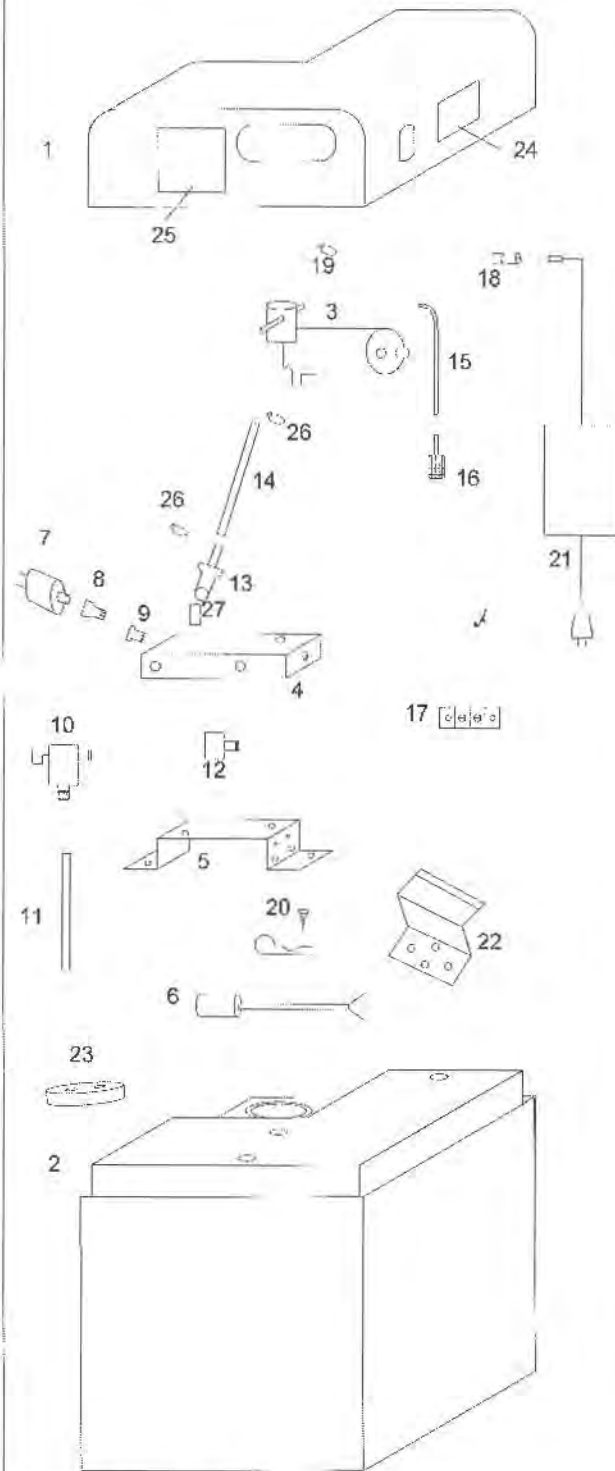
#### Wiring MF200 Pressure Switch For Closed Contact on Low Pressure

The upper micro-switch controls the pump. The lower micro-switch is used for a low-pressure warning. Move the wire from the middle terminal on the lower micro-switch to the rear-most terminal as shown in the diagram above to get an open circuit on low pressure. You should now have a closed alarm circuit at low pressure.

# LEGEND

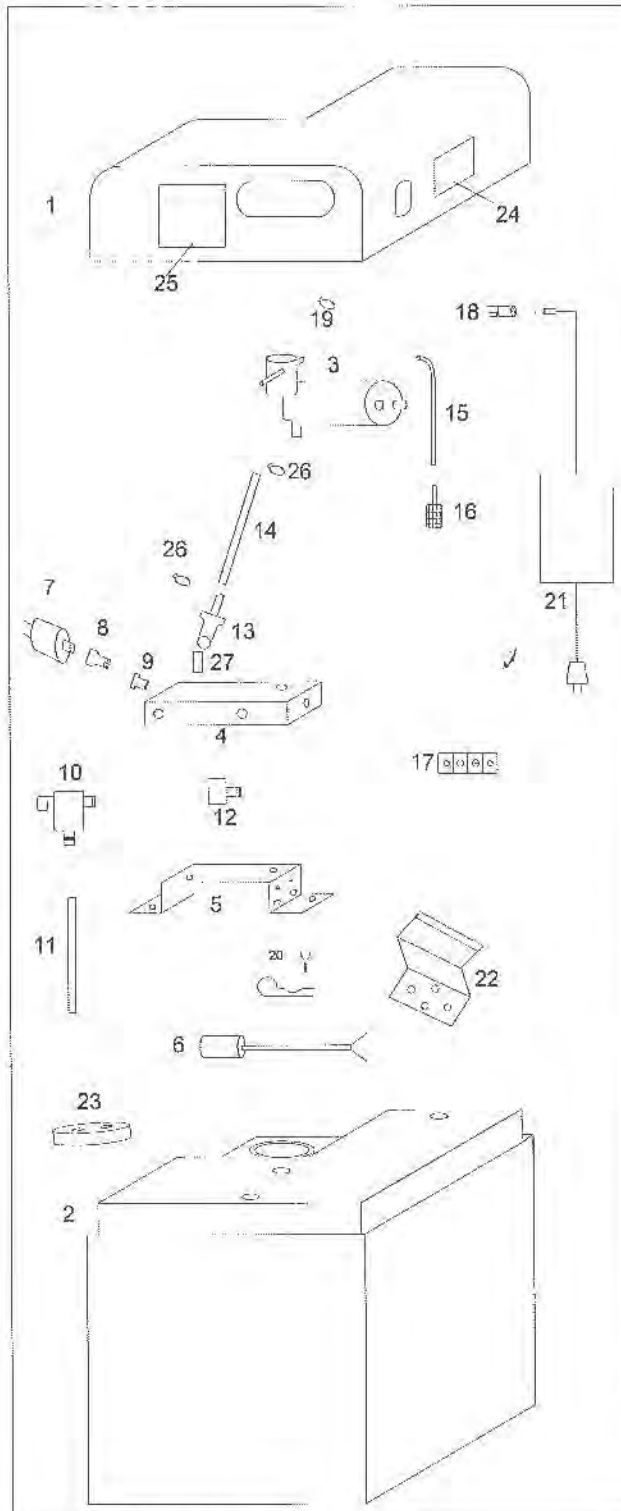
ITEM # PART # DESCRIPTION

- 1 MF200-1600 tank lid
- 2 MF200-1000 tank
- 3 MF200-1300 pump & motor assembly
- 4 MF200-1400 fluid diverter block
- 5 MF200-1410 diverter mounting bracket
- 6 MF200-0800 in-tank float
- 7 MF200-0200 adjustable pressure switch
- 8 MF200-0400 pressure snubber
- 9 MF200-0900 brass reducer
- 10 MF200-1200 1/4" angle ball valve
- 11 MF200-0930 3/8" plastic hose
- 12 MF200-0700 pressure gauge
- 13 MF200-0940 1/4" hose adapter
- 14 MF200-0950 1/2" OD clear hose
- 15 MF200-0960 1/2" OD plastic tubing
- 16 MF200-0910 foot valve strainer
- 17 MF200-0310 alarm hook up terminal block
- 18 MF200-0110 power adapter plug-in
- 19 MF200-1520 1/2" plastic clamp
- 20 MF200-0970 cable clamp
- 21 MF200-0101 120V to 24DCV power adapter
- 22 MF200-1420 power adapter bracket
- 23 MF200-0500 tank bung
- 24 MF200-0110 side decal
- 25 MF200-1100 s/n decal
- 26 MF200-0970 5/8" plastic clamp
- 27 MF200-0980 1/4" check valve



PROJECT		MF-200 (EXPLODE)	
CUSTOMER		AXIOM INDUSTRIES	
DRWS. NO.	EQUIP. NO.	JOB NO.	DATE
TLL-MF200-1005	PARTS LIST		13 OCTOBER 2005





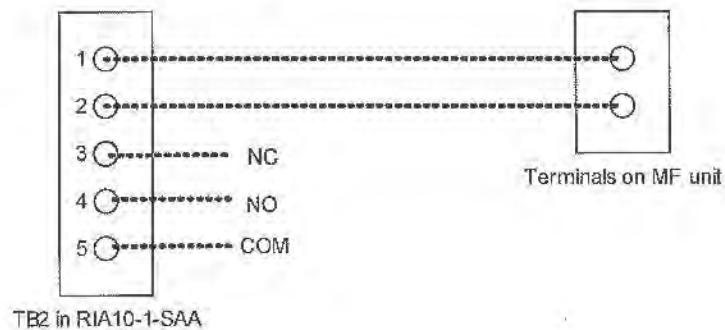
## LEGEND

ITEM #	PART #	DESCRIPTION
1	MF200-1600	tank lid
2	MF200-1001	tank
3	MF200-1300	pump & motor assembly
4	MF200-1400	fluid diverter block
5	MF200-1410	diverter mounting bracket
6	MF200-0810	in-tank float
7	MF200-0200	adjustable pressure switch
8	MF200-0400	pressure snubber
9	MF200-0900	brass reducer
10	MF200-1200	1/4" angle ball valve
11	MF200-0930	3/8" plastic hose
12	MF200-0700	pressure gauge
13	MF200-0940	1/4" hose adapter
14	MF200-0950	1/2" OD clear hose
15	MF200-0960	1/2" OD plastic tubing
16	MF200-0910	foot valve strainer
17	MF200-0310	alarm hook up terminal block
18	MF200-0110	power adapter plug-in
19	MF200-1520	1/2" plastic clamp
20	MF200-0970	cable clamp
21	MF200-0101	120V to 24DCV power adapter
22	MF200-1420	power adapter bracket
23	MF200-0500	tank bung
24	MF200-0110	side decal
25	MF200-1100	s/n decal
26	MF200-0970	5/8" plastic clamp
27	MF200-0980	1/4" check valve

EQUIP. NO. MF-300 (EXPLODE)		AXIOM INDUSTRIES	
CUST. NO.			
DRWG. NO. TLL-MF300-1005	EQUIP. NO. PARTS LIST	JOB NO.	DATE 13 OCTOBER 2005

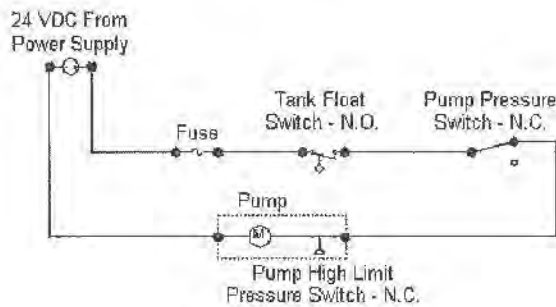
## Installation Instructions for the RIA10-1-SAA Control Panel for use with MF200 & MF300 Feeders

The MF series alarm dry contacts are factory wired to provide an OPEN contact on LOW PRESSURE. This is compatible with the alarm circuit in the RIA10-1-SAA panel. Connect terminals 1 and 2 from terminal block TB2 in the panel to the contact terminals located beside the power plug on the MF unit.



To disable the audible alarm in the RIA10-1-SAA panel, remove the jumper from the control board of the RIA10-1-SAA.

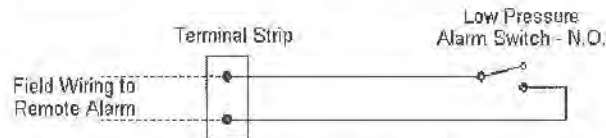
*Note - the switch positions shown in this document are for the unit as it comes out of the box, with no fluid in the tank and no pressure in the system.*



### MF200 Power Wiring

The high limit pressure switch is integral to the pump and will open if the pressure reaches approx. 25 psig. *NOTE - this switch is only found in units with the new style pump, serial number 03-1215 and higher.*

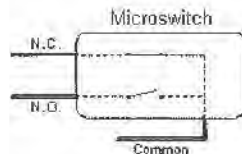
The pump pressure switch is factory set to shut off the pump at about 12 psig. It can be field adjusted to a maximum of about 18 psig.



### MF200 Low Pressure Dry Contact

The low limit pressure switch is factory wired to OPEN on low system pressure. It can, however, be re-wired to CLOSE on low pressure if necessary.

The pressure control switch in the MF200 has two microswitches. The upper switch controls the pump, and the lower switch provides the low pressure dry contacts. Switching action at low pressure is shown in the diagram below.



## Troubleshooting Chart

### Symptom

### Possible Cause

### Resolution

#### Pump will not start

Fluid level in tank is low	Add correct fluid. Check for cause of system fluid loss
Blown fuse	Check LED indicator light on power cord, check fuse and replace if needed (2.5 Amps)
Power supply or Breaker	Check LED indicator light on power cord, flip breaker or obtain power supply from reseller and replace
Power supply unplugged or loose electrical connections	Plug in power supply or correct faulty electrical connection
Pressure switch out of adjustment	Adjust pressure switch according to the manufacturers recommendations
Faulty pressure switch	First obtain snubber from reseller and replace. If problem continues obtain pressure switch from reseller then replace
Pump failure	Obtain pump from reseller and replace

#### Pump will not shut off

Air lock in pump	Turn purge/mixing valve to prime pump
Leak in system or pump	Inspect system and repair leak
Faulty pressure switch	Obtain pressure switch and snubber from reseller then replace

#### Pump will not prime

Check valve stuck	Tap check valve lightly
Fluid level in tank is low	Add correct fluid. Check for cause of system fluid loss
Strainer on inlet hose is blocked	Clean strainer
Product in tank is too thick or Congealed glycol	Clean strainer and check concentration of glycol mixture
Inlet tubing leak is drawing air	Replace tubing and repair leak
Inlet/Outlet tube severely restricted (Kinked)	Replace tubing

#### Noisy / Rough operation

Pump is overloaded and pump	Obtain Replacement pump from
-----------------------------	------------------------------



pressure switch not cutting out	reseller and install
Loose pump head or drive screws	Tighten screws
Feeder is plumbed with rigid pipe causing noise to transmit	Plumb with PEX or plastic pipe

**Feeder Leaking**

Manifold block over tightened and cracked	Obtain replacement manifold block from reseller and install
Loose fittings	Tighten fittings
Pump has punctured diaphragm	Obtain Replacement pump from reseller and install

**System pressure low**

Fluid level in tank is low	Add correct fluid. Check for cause of system fluid loss
Blown fuse	Check LED indicator light on power cord, check fuse and replace if needed
Power supply or Breaker	Check LED indicator light on power cord, flip breaker or obtain power supply from reseller and replace
Pressure switch out of adjustment	Adjust pressure switch according to the manufacturers recommendations
Snubber on pressure switch is plugged	Obtain snubber from reseller and replace
Faulty pressure switch	Obtain pressure switch and snubber from reseller then replace
Power supply unplugged or loose electrical connections	Plug in power supply or correct faulty electrical connection
Pump failure	Obtain pump from reseller and install

**System pressure to high**

Pressure switch not adjusted to proper setpoint	Adjust pressure switch, refer to maintenance manual for instructions
Snubber on pressure switch is plugged	Obtain snubber from reseller and replace
Faulty pressure switch	Obtain pressure switch and snubber from reseller then replace

**Pump Cycles Continually**

Air is being removed from system and pump is only making up fluid	No action required
Leak in system	Inspect system and repair leak
Check valve or Regulator installed between System Feeder and system	Remove check valve or regulator

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 3300 2.2 AIR DUCT ACCESSORIES

Submittal Number: 1

Item: Fire Dampers

Manufacturer: Ruskin

Model #: FD35

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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## INDUCT MOUNT CONTROL DAMPERS INSTALLATION INSTRUCTIONS

### RECEIVING/INSPECTION

Upon delivery, inspect shipping containers and contents closely. If shipping containers are damaged, contents could also be damaged. Note any damage on trucker's receipt. Contact the freight company within **24 hours** for a representative to come and inspect.

### STORAGE

Store in a safe location away from construction traffic, material, etc., to prevent damage. Cover with plastic sheeting to protect from excessive moisture, dirt, and debris or store in an area protected from the elements.

### INSTALLATION

Inspect for damage and corrosion prior to installation. Handle dampers by frame only. Do not lift by blades, linkage, axle, actuator, or jackshaft components. When handling multiple section assemblies, use sufficient support to evenly lift at each section mullion. Do not drop, drag, step on, or apply excessive bending, twisting, or racking. **Use operator shaft to cycle damper. Do not twist or turn damper blades to cycle damper.**

1. Inspect ductwork or opening where damper will be installed for any obstruction or irregularities that might interfere with blades or linkage rotation or actuator mounting. Duct opening should measure  $\frac{1}{4}$ " (6) larger than damper dimension and should be straight and level. **Support ductwork in area of damper to prevent sagging due to damper weight.**
2. Determine proper location of extended shaft or jackshaft before installing the damper. A sticker on the damper face shows recommended extended shaft location. **Attach shaft on labeled side of damper and preferably to that blade.** Use the shaft support bracket with snap-on extended shaft. See figure #1. Shaft must be attached to a power blade. On parallel blade units, all blades are power blades. On opposed blade units, blade with sticker and every other blade from the sticker blade are power blades.

3. If damper is shipped in multiple ship sections, position damper ship sections in duct or opening. Align and match frame markings or labels on adjacent sections. See figure #2. **Unless specifically designed and ordered for vertical blade application, damper must be mounted with blade axis horizontal.**
4. If no holes are present in frame, drill  $\frac{1}{4}$ " (6) dia. holes at 6" (52) centers and fasten frames together with  $\frac{1}{4}$ " 20 (6 - .03) bolts and nuts.
5. Use appropriate shims between damper frame and duct opening to prevent distortion of frame by fasteners holding it in place. Appropriately brace at every horizontal mullion and vertically brace at every 8 feet (2.4m) of damper width for strength. Dampers in high velocity systems (2000 fpm [610m per minute]) require more bracing. **Note: Ruskin dampers are specifically designed and engineered for structural integrity based on model and conditions. Attachment, framing, mating flanges, and anchoring of damper assemblies into openings, ductwork, or walls is the responsibility of the installer. Design calculations for these retaining and supporting members should be determined by field engineers for that particular installation.**
6. If damper assembly is provided with unjoined jackshaft ends, drill two  $\frac{1}{4}$ " (6) diameter holes and install roll pins as shown in figure #3. Completely drive roll pins through the jackshaft. Jackshaft may have been repositioned to prevent damage during shipment. To reposition, loosen bolts on crank arms, reposition clamps, and slide jackshaft to desired position. If damper actuator is to be mounted out of airstream, the jackshaft should extend through the jackshaft bearing assembly and approximately 6" (152) beyond the frame. Secure jackshafts in place with the clamps provided and retighten bolts on crank arms.
7. If applicable, link lower and upper jackshafts with the crossover bar through the ball joint on crank arm at each jackshaft. Locate crank arm close to jackshaft bearing assembly. See figure #3.

**Note:** Dimensions shown in parentheses ( ) indicate millimeters

(continued on back)

FIGURE 1

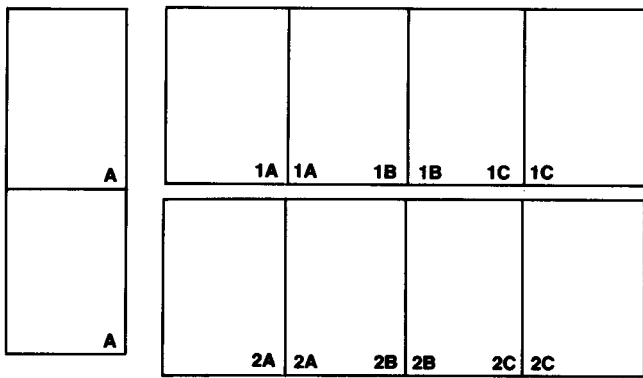
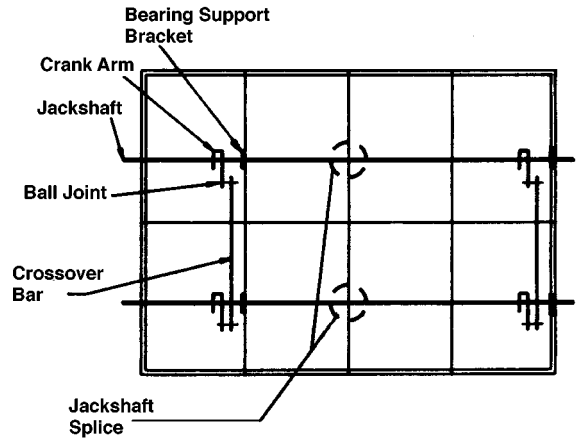
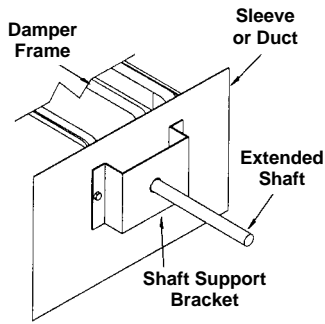


FIGURE 2

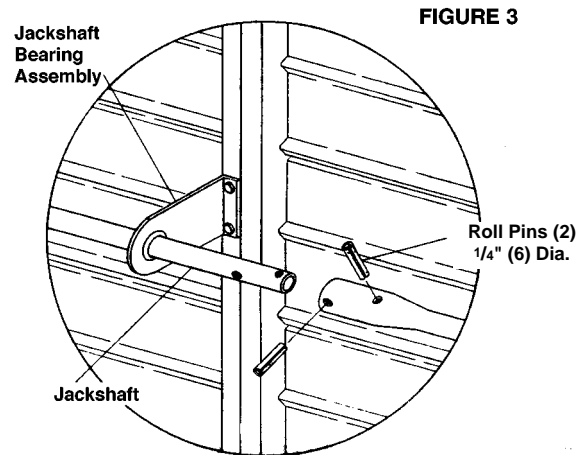


FIGURE 3

## INDUCT MOUNT CONTROL DAMPERS

8. Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each section as shown in Figure 4. Both dimensions must be equal  $\pm 1/8"$  (3).

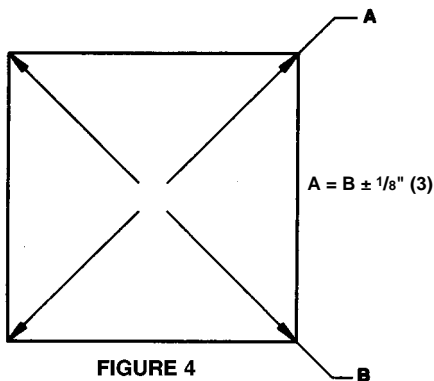


FIGURE 4

9. A clearance of  $1/8"$  (3)  $\pm 1/16"$  (1.5) must be maintained between bearing within frame and blade end. Move blade solidly against bearing on one side and measure clearance at other end of blade. See Figure 5. If jamb seals are present, compress to determine clearance.

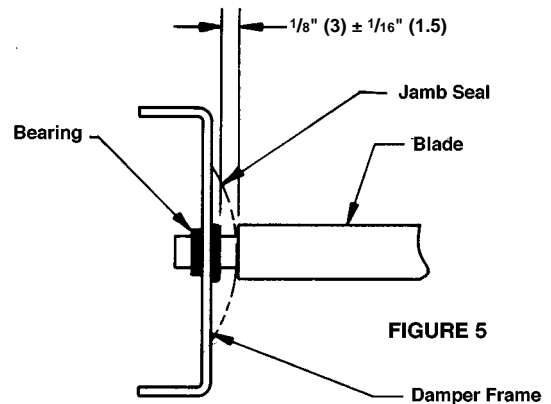


FIGURE 5

10. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to assure proper operation. On multiple section assemblies, all sections should open and close simultaneously.
11. After installation of low leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

**Note:** Dimensions shown in parentheses ( ) indicate millimeters

## COMMERCIAL CONTROL AND BACKDRAFT DAMPER OPERATION & MAINTENANCE

### MODELS: COMMERCIAL CONTROL AND BACKDRAFT DAMPERS

Regular maintenance is essential to ensure that a building's air control system will perform as intended under normal conditions. Regular maintenance should include periodic testing of all equipment associated with the air control system such as initiating devices, fans, dampers, controls, etc. Ruskin recommends each damper be cycled and tested every 6 months and in accordance with local codes and actuator manufacture recommendations (if damper has actuator). If dampers are installed in potentially dirty airstreams, the blades and other internal parts may need annual cleaning to avoid dirt build up.

### MAINTENANCE

- Remove any foreign material.
- Verify that hardware used to install damper does not contact moving parts of the damper.
- Lubricate linkage, bearings and other moveable parts with a silicone lubricant. **Do not use petroleum-base products as they could cause excessive dust collection.**
- Operate (open and close) the damper via the actuator or extended shaft.
- Check the blade linkage to make sure the blade shafts and blades rotate 90° from full open to full closed.
- Consult Ruskin if problems are encountered.

### OPERATION

- Operate damper through full cycle, verify that all blades open and close completely. Check for loose linkage from actuator (if used) through jackshifting (if multi-section) and damper side linkage. Tighten linkage as required.

## **LIMITED PRODUCT WARRANTY**

Products manufactured by Ruskin are warranted to be free from defects in material and workmanship for a period of 12 months after being installed or placed in service, but in no instance shall the period of warranty be longer than 18 months from the date of original shipment by Ruskin. Ruskin warrants only that it will furnish replacement material, or at its option, repair any product of its manufacture that is proven to Ruskin's satisfaction to be defective in material or workmanship during this described warranty period. To determine defects Ruskin may require material claimed defective to be returned freight prepaid to the Ruskin factory that originally shipped the product. If any defects are determined by Ruskin, freight charges relative to replacement material will be paid by Ruskin (limited to the 48 contiguous United States).

Products not manufactured by Ruskin will be warranted by Ruskin only to the extent that they are warranted to Ruskin by their manufacturer. Electric motor warranties and claims are administered by the motor manufacturer only. Ruskin shall have no responsibility for the operation or performance of any products in any manner other than that which the product is usually tested and applied under industry standards, nor for any damage to a product from abuse, misapplication, unauthorized repairs, abrasion, erosion, corrosion, or the like due to abnormal temperatures, or the influence of foreign matter, nor for the design or operation of any system of which any product may be made a part, or for the suitability of any product for any particular application. Ruskin shall not be liable for any cost or expense, including without limitation, labor expenses, in connection with removal or replacement of alleged defective equipment or any part or portion thereof nor for incidental or consequential damages of any kind, or under any circumstances for any damage beyond the price of the goods sold.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES EXCEPT THAT OF TITLE, WHETHER WRITTEN, ORAL OR IMPLIED, IN FACT OR IN LAW (INCLUDING ANY WARRANTY OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE). Correction of non-conformities, whether patent or latent, in the manner and within the period of time provided above, shall constitute fulfillment of all liabilities of Ruskin whether based on contract, tort, strict liability or other legal theory with respect to Ruskin's products. Ruskin neither assumes, nor does it authorize any other person to assume on its behalf, any other liability in connection with the sale of its products.

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 3300 2.7 AIR DUCT ACCESSORIES

Submittal Number: 1

Item: Welding Booth Station

Manufacturer: Avani Environmental Intl., Inc.

Model #: WB-5000 Series Booth Model: WB-5044

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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# AVANI Welding Booth



Customer:	Custom Mechanical Services; (Job Name: Haines School District, Voc Tech)		
Customer PO#:	201510-04		
AVANI SO#:	22934	Tested By:	
Serial #:			
Ship Date / Install Date:	06-01-15		

Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.



# AVANI Welding Booth

## General Safety Information

### MACHINE WARNING SIGNS



Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Used without the safety alert symbol (▲) indicates potentially hazardous situation which, if not avoided, may result in property damage.



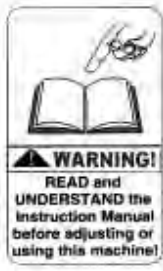
Warning of electric shock Do not expose the equipment to rain or use in damp locations.



Figure 1



Do not use the equipment around flammable products, if not avoided, sparks can ignite vapors from flammable products. Read and understand all warnings and operating instructions before using this equipment. Failure to follow all instructions may result in electric shock, fire, and/or serious personal injury or property damage.



Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.





# AVANI Welding Booth

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Specifications

- Hood Dimensions: 48" x 48" x 8.5"
- Back Draft Dimensions: 36.9" x 35.9" x 9.2" (NOT incl. clean out drawer)
- Hood Outlet Opening: 6" x 12" (72 square inches)
- Hood Service Panel: Removable 24.4" x 15.7" service panel
- Back Draft Adjustable Inlet Slots: (2) 1" x 32.2"
- Hood Adjustable Inlet Slots: (2) 1" x 32.2"
- \*\*\*Overhead Lights: (2) Explosion Proof Lights (110V, Single Phase, 60 Hz, 18W,

Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.



## AVANI Welding Booth

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non-recessed)

- Adjustable Knobs: (15) 2 ½" Five Star Twists
- Adjustable Level System: (6) 2 ½" Feet (maximum adjustment 5")
- Support Structure: 1 ½" x 4" steel stock welded
- Panel Construction: 14-gauge welded steel single wall with cross and up Bracing
- Rear Support: (2) 12" x 19" 30 degree gussets for overhead piping and accessories
- Welding Curtain Supports: (2) adjustable welding curtain brackets
- Lifting Lugs: (4) Hood mounted lifting lugs to set and move hood or booth
- Fume Arm Ceiling Supports & Brackets: Built into the hood
- Fume Arm Cover Plates: (2) cover plates (6 bolt pattern) to match optional dia. 5" fume arm
- Powder Coated: Avani Safety Blue Standard (custom colors available)
- Five Piece Configuration: (2) side panels, (1) back panel, (1) backdraft assembly, (1) hooddraft assembly.

\*\*\*Double Wall Construction (welded)

\*\*\*CO2 bracket

\*\*\*Adjustable Back Shelf: 50.9"W x 17.6"D x 1.1"H (solid with 2" hole drilled)

\*\*\*Light Conduit

\*\*\*Light Switch: For overhead lights

\*\*\*Electrical Outlets: (2) 110V Outlets @ (1) Switch (additional single or three phase outlets available)

\*\*\*Optional Open Shelf: (2) 6" x 25.7" (ID)

\*\*\*Reference: WB-5044 submittal + drawing (2015.04.02) REV C



# AVANI Welding Booth

## General Safety Information

(Continued)



**WARNING** Use this product carefully to

effectively avoid any possible danger. Observe the following safety regulations to avoid bodily injury due to electrocution during use.

Read this Manual carefully before operating the product and preserve the Operation Manual properly.

1. Keep work area clean and organized.
  - A disorderly working environment will cause inconvenience and danger during operation.
2. Check if the working environment is suitable for using the product.
  - Do not use the product in a humid environment.
  - Use the product in a good working environment to reduce risks.
  - Do not use the product in a flammable gas or liquid environment to avoid danger.
3. Keep other persons away from the

product, except for the operator, to avoid danger.

- Do not let children get close to the product. All wires used by the product shall be in a safe location to prevent children from touching them.
4. All tools shall be safely stored.
    - When the tools are not used, please store them in a dry place safely beyond the reach and access of children.
  5. If the machine breaks down, contact a service technician. Do not attempt to repair and possibly damage the machine.
  6. When using the product, be sure to put on a welding suit and mask.
  7. Use the electrical wires correctly.
    - During use, do not drag the electrical wires forcefully. Do not use these wires if fraying or current leakage occurs to avoid injury to the operator.
  8. Before replacing parts, shut off power to the machine.
    - Check that the switch is in “on” or “off” position. Do not attempt the replacement when the machine is

Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.



# AVANI Welding Booth

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running. To replace parts or filter material, make certain that the switch is “off”.

9. Use the power cord correctly. The total length of power cord shall not exceed 10 feet to avoid low power due to a drop in voltage and to prevent a possible hazard.

## **▲WARNING**

When connecting the product,

always follow the instructions in the Operation Manual to avoid injuries.

10. Care and Maintenance:

- Confirm that the parts/accessories have been fully assembled and will not adversely affect the machine operation.
- Check if the machine is operated properly.
- Replace damaged parts or accessories according to the instructions of the Manual. If the said instructions are not specified in the Manual, have a professional technician carry out the maintenance or replacement.
- Check that the electrical specifications of this machine meet safety

requirements, and that the maintenance is carried out by a professional technician. Use original manufacturer's parts and accessories to avoid injury.

- If a problem occurs, contact your dealer immediately.

## ADDITIONAL WELDING BOOTH SAFETY RULES

The Welding Booth can be dangerous if it is operated incorrectly. Therefore, the product must be used cautiously to avoid causing a hazard or damage. Unnecessary injuries may occur by failing to follow the instructions of the Safety Rules Manual. Be sure to put on protection equipment or suit that can protect your body, such as helmet and eye mask to avoid injuries from occurring. If any doubts or any unfitness occurs during use, be sure to stop the operation immediately. Keep in mind that the user shall be liable for using according to the specified safety rules and for operating the machine correctly.

1. Read this Manual carefully before operating the product.

# AVANI Welding Booth

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2. Be sure to follow local electrical and safety regulations and observe the electrical safety standards practiced in the relevant area. All electrical wire connections and installation shall be carried out by a professional technician.
3. Do not operate the product near flammable materials, as sparks may ignite these materials and cause an explosion. Please confirm there aren't any flammables near the working site to avoid hazard.
4. This product is suitable for collecting smoke and welding oil gas. Do not use it in collecting iron chips and dust at the same time to avoid producing sparks.
5. Before replacement of parts or filter materials, be certain that the switch is disconnected.
6. Do not kink the power cord and keep it away from oil, chemicals or flammables.
7. Check that the voltage, phase count and grounding wire match the machine requirements.
8. When the fan blades are operated at high speed, do not reach hand near these blades to prevent finger from breaking or clothes/necktie from getting caught. Do not put the hand or foreign matter into the air inlet to avoid getting caught in the high-speed rotation of fan blades.
9. When not in use, all air inlets of Welding Booth shall be covered.

## **▲WARNING**

### Assembly

Do not connect the Welding Booth before the assembly is finished and you have read and understood all of the precautions stated in the Manual.

NOTE: For correct assembly, refer to the Illustrations and Parts List on pages 13-17.

### Installation

#### MOVING AND TRANSPORTATION

The net weight of this machine is about lbs. It CANNOT be handled and transported without the help of lifting tools. For your safety, read all instructions carefully.

Do not move

## **▲WARNING**

without the help of others to avoid causing danger.

# AVANI Welding Booth

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## ELECTRICAL INSTALLATION

### POWER CONNECTION

1. Confirm that the power is properly connected under normal power supply condition. It is recommended to provide manual shutdown device before connecting power.
2. It is recommended to protect the control equipment with suitable grade of fuse, and the length of fuse and power cord shall not be over 10 feet.

### SHUTDOWN

1. Disconnect power by manual method.
2. When stopping operation, check if the switch is under off status.

### EARTHING WIRE

Connect yellow/green wires to the earthing wire power jack. Confirm that the earthing wire has been properly connected before connecting main power cord to the machine at all times.



**WARNING** Do not disconnect the wiring jack

before cutting off power!

### POWER INSTALLATION AND STORAGE

The electrical power is configured as

following. If conditions are beyond the scope stated below, then it is required to ensure that the power is well arranged and safe.

- Ambient temperature: Between 41°F and 131°F. If the time is over 24 hours, then the ambient average temperature shall not be over 122°F.
- Humidity: Between 30% and 95%
- Altitude: 3,280 feet
- Moving and Storing: -13°F to 131°F. For short-time storage (less than 24 hours), the storage temperature can be up to 158°F.

## Operation

### PRIOR TO START UP

Purpose: The Welding Booth is specially suitable for treating the smoke generated during ordinary welding processing work, which can effectively collect and screen the smoke resulting from the welding work in maintaining the air quality of the working environment.

- Before starting the machine, be sure to read this Manual carefully.
- Before starting the machine, check if

# AVANI Welding Booth

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relevant safety protection measures have been taken according to the Manual.

- Before starting the machine, watch the motor turning direction according to the instruction of arrow direction.

## START UP

1. To ensure satisfactory performance for the Welding Booth, please confirm the air volume, power and the matching table of the Welding Booth.
2. Connect power according to electrical installation procedure after installing the Welding Booth and the table. Disconnect power according to electrical installation procedure when the machine is not

used.

3. The Welding Booth shall be turned on and off by pushing I/O button. Under normal operation status, use such I/O button.

## Unpacking

The machine should be unpacked carefully. Check if the machine and components are consistent with those indicated in the Parts List. If any doubt arises or when the components are incomplete, contact your dealer.



# AVANI Welding Booth

Dimensions (in mm/inches)

DO NOT SCALE	P/IN (MM/IN)		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="4" style="text-align: center;">Revisions</th> </tr> <tr> <th style="width: 15%;">No.</th> <th style="width: 45%;">Description</th> <th style="width: 15%;">Date</th> <th style="width: 25%;">Approved</th> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table>	Revisions				No.	Description	Date	Approved				
Revisions															
No.	Description	Date	Approved												

**RED SPECIFICATION SHEET: WB-5000 (4' X 4') WELDING BOOTH**

Each 4' x 4' welding booth comes with fully welded steel body walls, back wall and an integrated fume arm bracket.

The front of the welding booth is open for a welding curtain.

The booth will have a rear-working table with a 1.2" diameter opening for fixtures.

The booth shall be structurally and engineered to support overhead ducting (from 8" - 48") without having to suspend the ducting from overhead. This eliminates any stress on the overhead supports and increases lighting and visibility.

**WB-5044 (DW walk) WELDING BOOTH SPECIFICATIONS:**

- Hood Dimensions: 48" x 48" x 8.5"
- Back Draft Dimensions: 36.5" x 25.5" x 0.2" (incl. clean out drawer)
- DWY Cycle: 18" x 12" (7) square inches
- Hood Service Panel: Removable 24.4" x 15.7" service panel
- Back Draft Adjustable Lower Slots: (3) 1" x 32.8"
- Hood Adjustable Inlet Slots: (2) 1" x 32.2"
- \*\*\*Overhead Light: (1) Explosion Proof Light (110W, Single Phase, 60 Hz, 120V, rain resistant)
- Adjustable Knock: (1) 2 1/2" Fine Star Tumble
- Clean Out Drawer: 3.0" x 31.6" (11) with (1) hand break lock
- Adjustable Level System: (4) 2 1/2" Feet (maximum adjustment 6")
- Support Structure: 1.75" x 4" steel stock welded
- Panel Construction: 14-gauge welded steel single wall with cross and air bracing
- Rear Support: (2) 12" x 18" 30 degree gussets for overhead piping wire accessories
- Welding Curtain Supports: (2) welding curtain brackets
- Lifting Legs: (4) Hood-mounted lifting legs to set and move hood or booth
- Fume Arm Ceiling Supports & Brackets: built into the hood
- Fume Arm Cover Plates: (2) cover plates (5-bolt pattern) to match optional dia. 6" fume arm
- Powder Coated: Averts Safety Blue (standard) (outside covers available)
- Floor Plate Configuration: (2) side panels, (1) rear panel, (1) backdraft assembly, (1) knockoff assembly
- Booths can be arranged back-to-back, side-to-side or both options
- \*\*\*Double Wall Construction (optional)
- \*\*\*Adjustable Back Shelves: 50.0"W x 17.0"D x 1.12"H (pairs with 2" floor plates)

**OPTIONS**

- Welded Hubs: Optional locations for J-Hooks
- Welding Hubs: For wire feeds or welder sockets
- Adjustable Rear Shelf (weld, grates or cutting table)
- Corner Stoppers
- Missing Hardware
- Custom Welding Brackets
- Foot Lockers
- Fixtures, Lazy Susans
- Any option that can fit inside the booth or on the booth

AVANI ENVIRONMENTAL INTL. INC. Sales Department 95 Gyrene Drive Youngsville, NC 27596	(919) 570-2862 info@avanienvironmental.com	Date: 2/13/2015 Name: Rev C Part Number: REVISION C	Title: WB-5044 Welding Booth Scale: 1:1 Drawing Number: WB-5044
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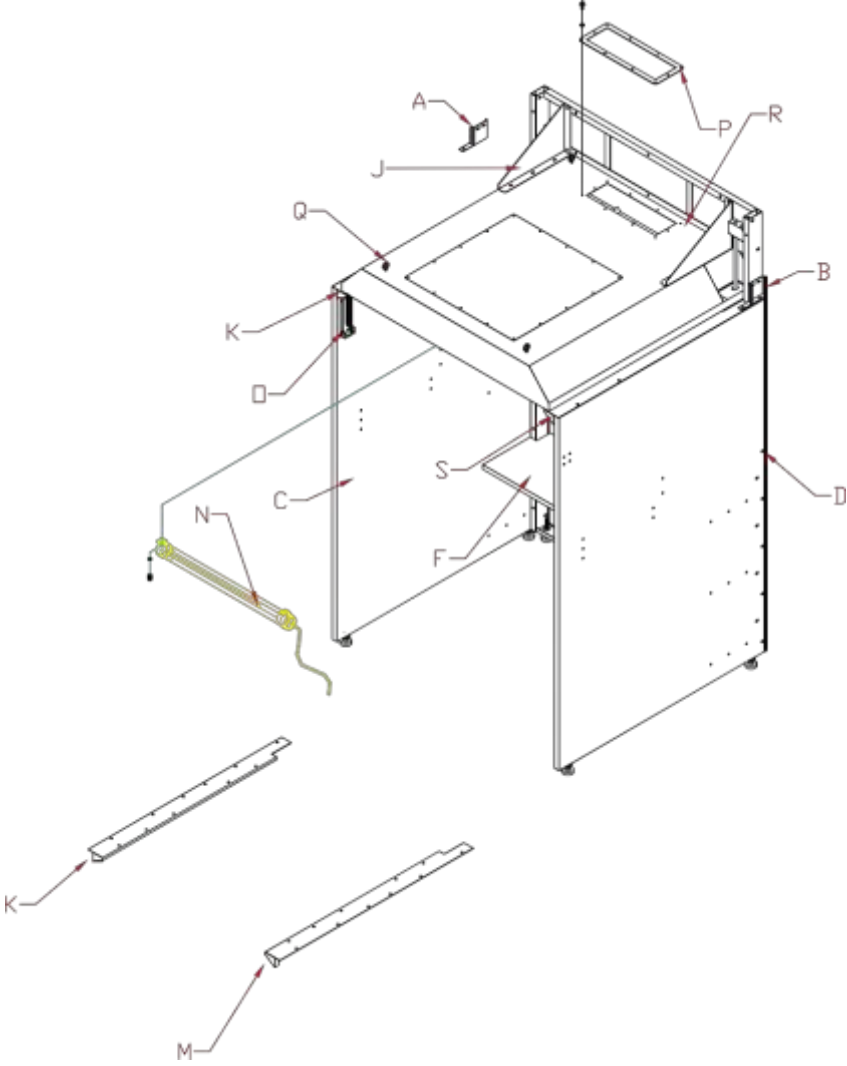
Reference: WB-5044 submittal 2015.04.02





# AVANI Welding Booth

## Assembly Label Configuration



# AVANI Welding Booth

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Repair Parts Illustration and Repair Parts List  
For Repair Parts, call +1-919-570-2862

24 hours a day – 365 days a year

Please provide following information:

- Model number
- Serial number (if any)
- Part description and number as shown in parts list



# AVANI Welding Booth

## Repair Parts List

Repair Parts List for Welding Booth

Reference Number	Description	Part Number	Quantity
1	Hex Screw (3/8"*3/4")	OA02-01-WB-4x4-1	2
2	Flat Washer (3/8"*OD23*2t)	OA02-01-WB-4x4-2	2
3	Fixing Base (left)	OA02-01-WB-4x4-3	1
4	Hex Screw (3/8"*2-1/2")	OA02-01-WB-4x4-4	4
5	Flat Washer (3/8"*OD23*2t)	OA02-01-WB-4x4-5	8
6	Hex Screw (5/16"*3/4")	OA02-01-WB-4x4-6	2
7	Flat Washer (5/16"*OD23*2t)	OA02-01-WB-4x4-7	2
8	Left Side Panel Top Joint	OA02-01-WB-4x4-8	1
9	Left Side Panel	OA02-01-WB-4x4-9	1
10	Curtain Rod	OA02-01-WB-4x4-10	2
11	Flat Washer (1/4"*OD19*2t)	OA02-01-WB-4x4-11	8
12	Hex Screw (1/4"*3/4")	OA02-01-WB-4x4-12	8
13	Lock Nut (3/8")	OA02-01-WB-4x4-13	4
14	Lock Nut (5/16")	OA02-01-WB-4x4-14	4
15	Hex Screw (5/16"*3/4")	OA02-01-WB-4x4-15	4
16	Flat Washer (5/16"*OD18*2t)	OA02-01-WB-4x4-16	4
17	Fixing Base (right)	OA02-01-WB-4x4-17	1
18	Backdraft Module	OA02-01-WB-4x4-18	1
19	Adjustable Feet	OA02-01-WB-4x4-19	2
20	Lock Nut (5/16")	OA02-01-WB-4x4-20	14
21	Flat Washer (5/16"*OD23*2t)	OA02-01-WB-4x4-21	28
22	Backdraft Module - Slot Cover	OA02-01-WB-4x4-22	5
23	Backdraft Module - Front Cover	OA02-01-WB-4x4-23	1

## AVANI Welding Booth

Reference Number	Description	Part Number	Quantity
24	Tool Rack (left)	OA02-01-WB-4x4-24	1
25	Tool Rack (right)	OA02-01-WB-4x4-25	1
26	Hex Screw (5/16"*3/4")	OA02-01-WB-4x4-26	6
27	Flat Washer (5/16"*OD18*2t)	OA02-01-WB-4x4-27	10
28	Hex Nut (5/16")	OA02-01-WB-4x4-28	4
30	Knob (3/8")	OA02-01-WB-4x4-30	15
31	Flat Washer (3/8"*OD23*2t)	OA02-01-WB-4x4-31	15
32	Phillips Head Screw (1/4"*3/4")	OA02-01-WB-4x4-32	24
33	Triangular Rear Support (right)	OA02-01-WB-4x4-33	1
34	Triangular Rear Support (left)	OA02-01-WB-4x4-34	1
35	Flat Washer (5/16"*OD23*2t)	OA02-01-WB-4x4-35	8
36	Hex Screw (5/16"*3/4")	OA02-01-WB-4x4-36	4
37	Hex Screw (5/16"*3/4")	OA02-01-WB-4x4-37	6
38	Flat Washer (5/16"*OD23*2t)	OA02-01-WB-4x4-38	6
39	Hex Screw (5/16"*3/4")	OA02-01-WB-4x4-39	14
40	Slot Cover	OA02-01-WB-4x4-40	2
41	Hood Service Panel	OA02-01-WB-4x4-41	1
42	Phillips Head Sheet Metal Screw (5/32"*1/2")	OA02-01-WB-4x4-42	16
43	Eye Bolt (3/8")	OA02-01-WB-4x4-43	4
44	Top Hood Draft	OA02-01-WB-4x4-44	1
45	Flat Washer (1/4"*OD19*2t)	OA02-01-WB-4x4-45	8
46	Hex Screw (1/4"*3/4")	OA02-01-WB-4x4-46	8

## AVANI Welding Booth

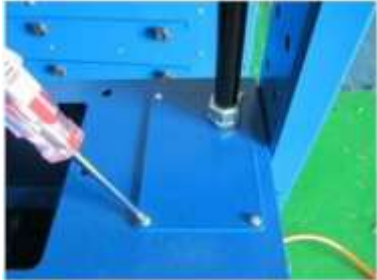
Reference Number	Description	Part Number	Quantity
47	Working Light	OA02-01-WB-4x4-47	2
48	Knob (3/8")	OA02-01-WB-4x4-48	6
49	Flat Washer (3/8"*OD23*2t)	OA02-01-WB-4x4-49	6
50	Hex Screw (5/16"*3/4")	OA02-01-WB-4x4-50	12
51	Flat Washer (5/16"*OD23*2t)	OA02-01-WB-4x4-51	12
52	Right Side Panel Top Joint	OA02-01-WB-4x4-52	1
53	Flat Washer (5/16"*OD23*2t)	OA02-01-WB-4x4-53	10
54	Hex Screw (5/16"*3/4")	OA02-01-WB-4x4-54	10
55	Right Side Panel	OA02-01-WB-4x4-55	1
56	Adjustable Feet	OA02-01-WB-4x4-56	4
57	Half-threaded Screw (3/8"*4")	OA02-01-WB-4x4-57	16
58	Flat Washer (3/8"*OD23*2t)	OA02-01-WB-4x4-58	32
59	Lock Nut (3/8")	OA02-01-WB-4x4-59	16
60	Outlet Flange	OA02-01-WB-4x4-60	1
61	Hex Screw (5/16"*3/4")	OA02-01-WB-4x4-61	10
62	Flat Washer (5/16"*OD23*2t)	OA02-01-WB-4x4-62	10
63	Adjustable Table	OA02-01-WB-4x4-63	1
64	Knob (5/16"*3/4")	OA02-01-WB-4x4-64	1
65	Hex Screw (5/16"*3/4")	OA02-01-WB-4x4-65	8
66	Flat Washer (5/16"*OD18*2t)	OA02-01-WB-4x4-66	8
67	Flat Washer (5/16"*OD23*2t)	OA02-01-WB-4x4-67	12
68	Hex Screw (5/16"*3/4")	OA02-01-WB-4x4-68	12
69	Round Phillips Head Screw	OA02-01-WB-4x4-69	3

## AVANI Welding Booth

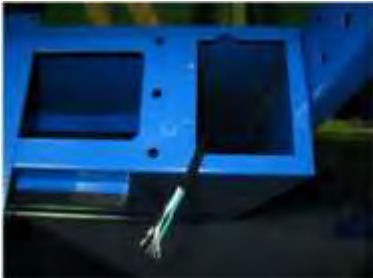
Reference Number	Description	Part Number	Quantity
	(3/16"*1/2")		
70	Cable Connector Panel	OA02-01-WB-4x4-70	1
71	Cable Connector Panel (front)	OA02-01-WB-4x4-71	1
72	Phillips Head Sheet Metal Screw (5/32"*1/2")	OA02-01-WB-4x4-72	6
73	Phillips Head Sheet Metal Screw (5/32"*3/4")	OA02-01-WB-4x4-73	2
74	Light Switch	OA02-01-WB-4x4-74	1
75	Electrical Conjunction Box	OA02-01-WB-4x4-75	1
76	Round Phillips Head Screw	OA02-01-WB-4x4-76	2
77	Nut	OA02-01-WB-4x4-77	2
78	CO2 Bracket	OA02-01-WB-4x4-78	1
79	Hex Screw (5/16"*3/4")	OA02-01-WB-4x4-79	7
80	Flat Washer (5/16"*OD23*2t)	OA02-01-WB-4x4-80	7

# AVANI Welding Booth

## Appendix 1 - Electrical Circuit Diagram



+ Loose the iron plate with the screwdriver.



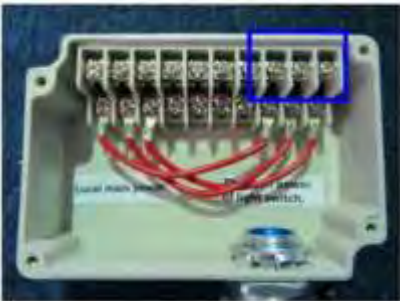
+ From the wireway, take out the cable of light switch.



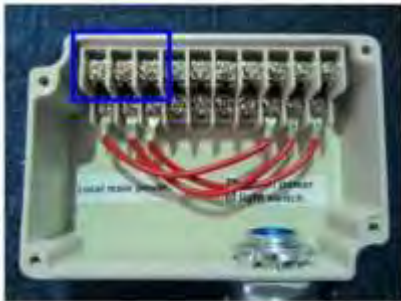
+ Insert the cable of the light switch through the flexible steel conduit into the electrical junction box.



+ Open the cover of the electrical junction box.



+ Connect the cable of the light switch with terminal blocks.



+ Link this set to local main power supply.



# AVANI Welding Booth

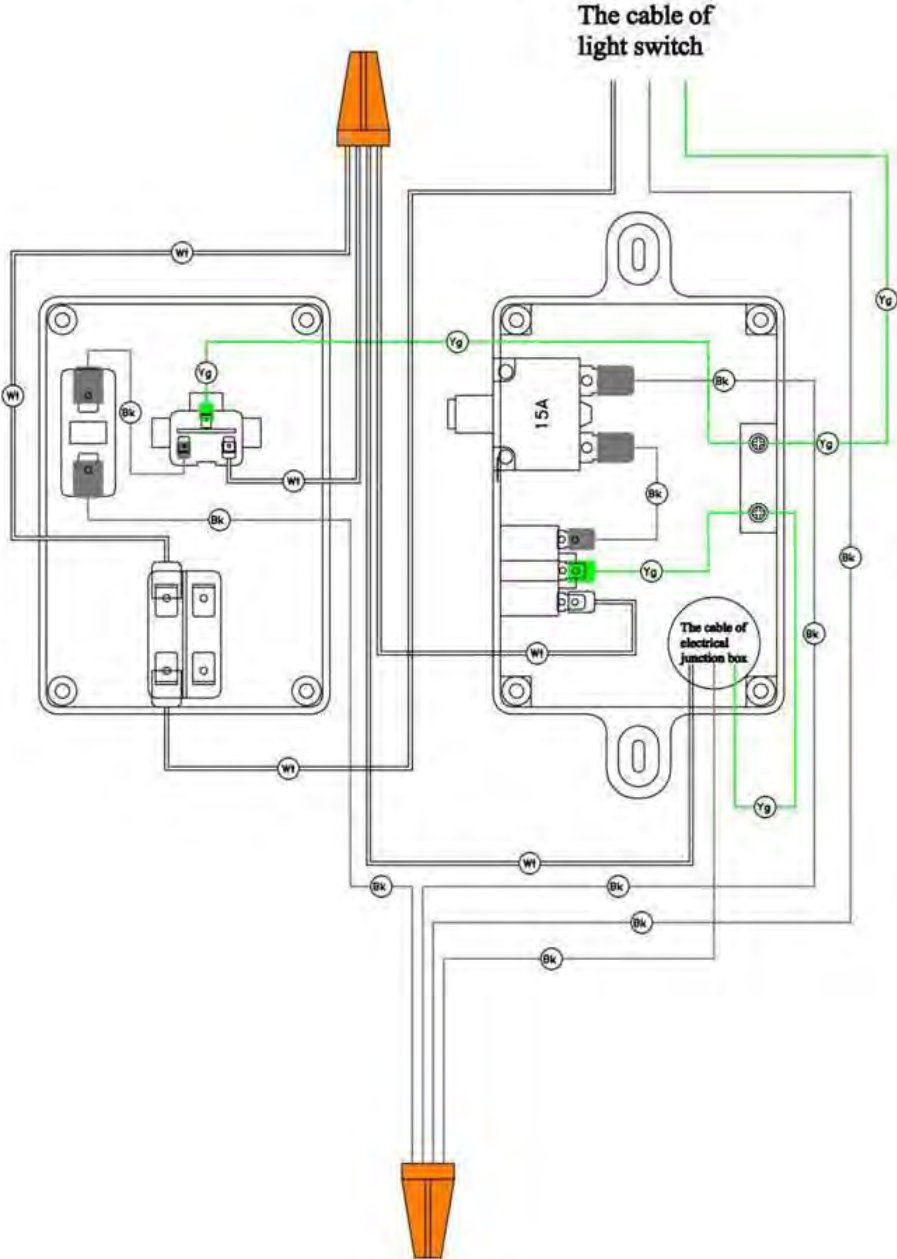
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# AVANI Welding Booth

The wiring of light switch



# AVANI Welding Booth

## Contact Information

Avani Environmental Intl. Inc.

95 Cypress Drive,

Youngsville, NC 27596

Email: [info@avanienvironmental.com](mailto:info@avanienvironmental.com)

[www.avanienvironmental.com](http://www.avanienvironmental.com)

Customer Service: [info@avanienvironmental.com](mailto:info@avanienvironmental.com)

Tel: 919-570-2862 ext. 208

Engineering Service: [engineering@avanienvironmental.com](mailto:engineering@avanienvironmental.com)

Tel: 919-570-2862 ext. 203

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 3423 2.3 HVAC POWER VENTILATORS

Submittal Number: 1

Item: Exhaust Fan 1

Manufacturer: GREENHECK

MODEL #: EF-1

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

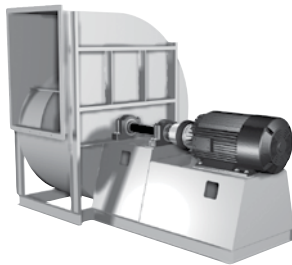
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## Installation, Operation and Maintenance Manual

Please read and save these instructions for future reference. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage!



Centrifugal



Industrial



Filtered Supply

### General Safety Information

Only qualified personnel should install this fan. Personnel should have a clear understanding of these instructions and should be aware of general safety precautions. Improper installation can result in electric shock, possible injury due to coming in contact with moving parts, as well as other potential hazards. Other considerations may be required if high winds or seismic activity are present. If more information is needed, contact a licensed professional engineer before moving forward.

1. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC), the National Fire Protection Agency (NFPA), where applicable. Follow the Canadian Electric Code (CEC) in Canada.
2. The rotation of the wheel is critical. It must be free to rotate without striking or rubbing any stationary objects.
3. Motor must be securely and adequately grounded.
4. Do not spin fan wheel faster than max cataloged fan rpm. Adjustments to fan speed significantly effects motor load. If the fan RPM is changed, the motor current should be checked to make sure it is not exceeding the motor nameplate amps.
5. Do not allow the power cable to kink or come in contact with oil, grease, hot surfaces or chemicals. Replace cord immediately if damaged.
6. Verify that the power source is compatible with the equipment.
7. Never open access doors to a duct while the fan is running.

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**DANGER**

Always disconnect power before working on or near a fan. Lock and tag the disconnect switch or breaker to prevent accidental power up.

**CAUTION**

When servicing the fan, motor may be hot enough to cause pain or injury. Allow motor to cool before servicing.

**CAUTION**

Precaution should be taken in explosive atmospheres.

## Receiving

Upon receiving the product check to make sure all items are accounted for by referencing the bill of lading to ensure all items were received. Inspect each crate for shipping damage before accepting delivery. Notify the carrier if any damage is noticed. The carrier will make notification on the delivery receipt acknowledging any damage to the product. All damage should be noted on all the copies of the bill of lading which is countersigned by the delivering carrier. A Carrier Inspection Report should be filled out by the carrier upon arrival and the Traffic Department. If damaged upon arrival, file claim with carrier. Any physical damage to the unit after acceptance is not the responsibility of Greenheck Fan Corporation.

## Unpacking

Verify that all required parts and the correct quantity of each item have been received. If any items are missing report shortages to your local representative to arrange for obtaining missing parts. Sometimes it is not possible that all items for the unit be shipped together due to availability of transportation and truck space. Confirmation of shipment(s) must be limited to only items on the bill of lading.

## Handling

Fans are to be rigged and moved by the lifting brackets provided or by the skid when a forklift is used. Location of brackets varies by model and size. Handle in such a manner as to keep from scratching or chipping the coating. Damaged finish may reduce the ability of the fan to resist corrosion. Fans should never be lifted by the shaft, fan housing, motor, belt guard, windband or accessories.

## Storage

- Rotate fan wheel monthly and purge bearings once every three months
- Energize fan motor once every three months
- Store belts flat to keep them from warping & stretching
- Store unit in location which does not have vibration
- After storage period, purge grease before putting fan into service

If storage of fan is in a humid, dusty or corrosive atmosphere, rotate the fan and purge the bearings once a month. Improper storage which results in damage to the fan will void the warranty.

Fans are protected against damage during shipment. If the unit cannot be installed and operated immediately, precautions need to be taken to prevent deterioration of the unit during storage. The user assumes responsibility of the fan and accessories while in storage. The manufacturer will not be responsible for damage during storage. These suggestions are provided solely as a convenience to the user.

## INDOOR

The ideal environment for the storage of fans and accessories is indoors, above grade, in a low humidity atmosphere which is sealed to prevent the entry of blowing dust, rain, or snow. Temperatures should be evenly maintained between 30°F (-1°C) and 110°F (43°C) (wide temperature swings may cause condensation and “sweating” of metal parts). All accessories must be stored indoors in a clean, dry atmosphere.

Remove any accumulations of dirt, water, ice or snow and wipe dry before moving to indoor storage. To avoid “sweating” of metal parts allow cold parts to reach room temperature. To dry parts and packages use a portable electric heater to get rid of any moisture build up. Leave coverings loose to permit air circulation and to allow for periodic inspection.

The unit should be stored at least 3½ in. (89 mm) off the floor on wooden blocks covered with moisture proof paper or polyethylene sheathing. Aisles between parts and along all walls should be provided to permit air circulation and space for inspection.

## OUTDOOR

Roads or aisles for portable cranes and hauling equipment are needed.

The fan should be placed on a level surface to prevent water from leaking into the fan. The fan should be elevated on an adequate number of wooden blocks so that it is above water and snow levels and has enough blocking to prevent it from settling into soft ground. Locate parts far enough apart to permit air circulation, sunlight, and space for periodic inspection. To minimize water accumulation, place all fan parts on blocking supports so that rain water will run off.

Do not cover parts with plastic film or tarps as these cause condensation of moisture from the air passing through heating and cooling cycles.

Fan wheels should be blocked to prevent spinning caused by strong winds.

## Inspection & Maintenance during Storage

While in storage, inspect fans once per month. Keep a record of inspection and maintenance performed.

If moisture or dirt accumulations are found on parts, the source should be located and eliminated. At each inspection, rotate the wheel by hand ten to fifteen revolutions to distribute lubricant on motor. If paint deterioration begins, consideration should be given to touch-up or repainting. Fans with special coatings may require special techniques for touch-up or repair.

Machined parts coated with rust preventive should be restored to good condition promptly if signs of rust occur. Immediately remove the original rust preventive coating with petroleum solvent and clean with lint-free cloths. Polish any remaining rust from surface with crocus cloth or fine emery paper and oil. Do not destroy the continuity of the surfaces. Wipe clean thoroughly with Tectyl® 506 (Ashland Inc.) or the equivalent. For hard to reach internal surfaces or for occasional use, consider using Tectyl® 511M Rust Preventive or WD-40® or the equivalent.

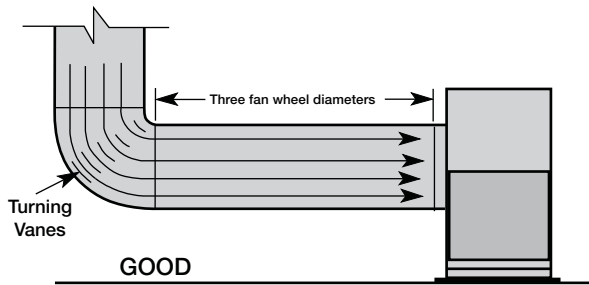
## Installation

Installations with inlet or discharge configurations that deviate from this standard may result in reduced fan performance. Restricted or unstable flow at the fan inlet can cause pre-rotation of incoming air or uneven loading of the fan wheel yielding large system losses and increased sound levels. Free discharge or turbulent flow in the discharge ductwork will also result in system effect losses. Refer to the following diagrams for the most efficient installation conditions.

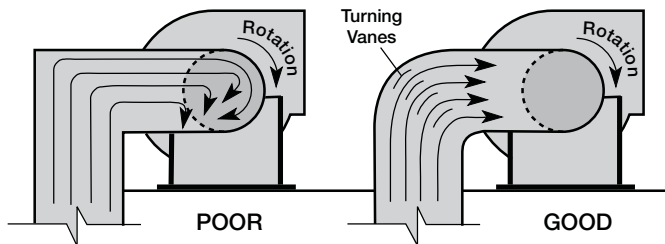
## Centrifugal and Industrial Process Fans Installations

### Ducted Inlet Installations

**Inlet Duct Turns** - Installation of a duct turn or elbow too close to the fan inlet reduces fan performance because air is loaded unevenly into the fan wheel. To achieve full fan performance, there should be at least three fan wheel diameters between the turn or elbow and the fan inlet.



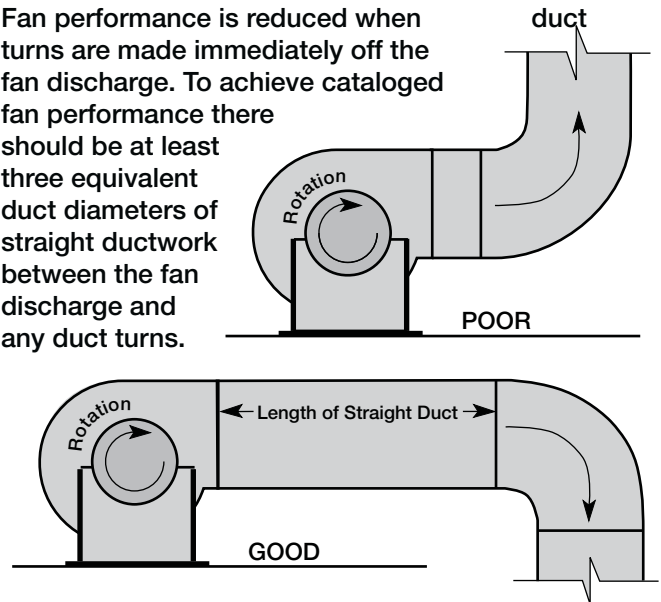
**Inlet Spin** - Inlet spin is a frequent cause of reduced fan performance. The change in fan performance is a function of the intensity of spin and not easily defined. The best solution is proper duct design and airflow patterns. Turning vanes reduce the effects of inlet spin.



### Ducted Outlet Installations

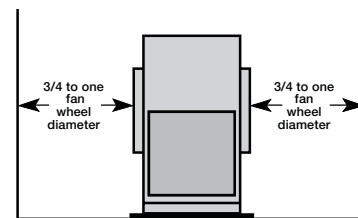
**Discharge Duct Turns** - Duct turns located near the fan discharge should always be in the direction of the fan rotation.

Fan performance is reduced when turns are made immediately off the fan discharge. To achieve cataloged fan performance there should be at least three equivalent duct diameters of straight ductwork between the fan discharge and any duct turns.

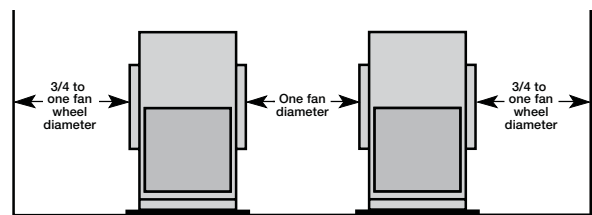


### Non-Ducted Installations

**Inlet Clearance** - Installation of a fan with an open inlet too close to a wall or bulkhead will cause reduced fan performance. It is desirable to have one fan wheel diameter between parallel fan units and a minimum of three-fourths of a wheel diameter between the fan inlet and the wall.

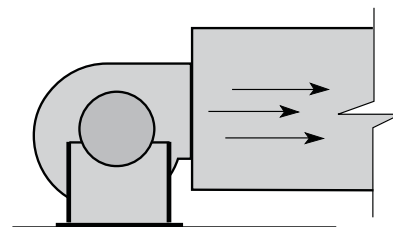


Single Fan Installation



Parallel Fan Installation

**Free Discharge** - Free or abrupt discharge into a plenum results in a reduction in fan performance. The effect of discharge static regain is not realized.

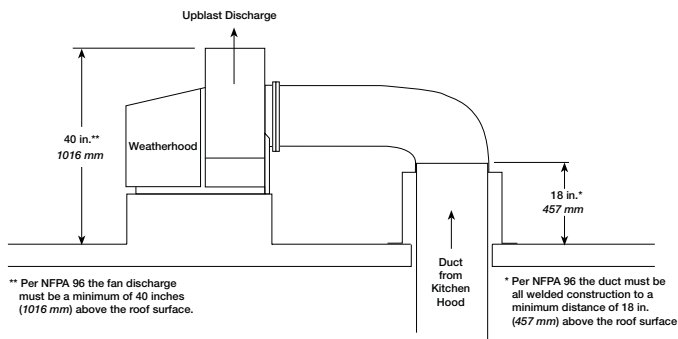




## Outdoor Installation for UL/cUL 762 Listed Fans for Restaurant Exhaust

The UL/cUL 762 listing for restaurant exhaust is available on the CSW models. Fans are listed for a maximum operating temperature of 400°F (204°C) and include a bolted access door and 1 inch (25 mm) drain connection. An outlet guard is strongly recommended when the fan discharge is accessible. An upblast discharge is recommended. The fan discharge must be a minimum of 40 inches (1016 mm) above the roof line and the exhaust duct must be fully welded to a distance of 18 inches (457 mm) above the roof surface.

The drawing below is for dimensional information only. See the latest edition of NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations for detailed installation instructions, materials, duct connections and clearances.



## Rotatable Housings

It may be necessary to rotate the scroll of the fan to achieve a different discharge position than what was originally supplied. Centrifugal fans models CSW, (sizes 7 - 30, arr. 1, 4, 8, 9, and 10, class I and II) and Industrial Process fans (sizes 5-19, standard and heavy duty) have the flexibility to be rotated in the field. This is accomplished by removing the housing bolts, rotating the housing to a new discharge position, and reinstalling the bolts.

### NOTE

The drain connection, if supplied, will move if the fan scroll is rotated.

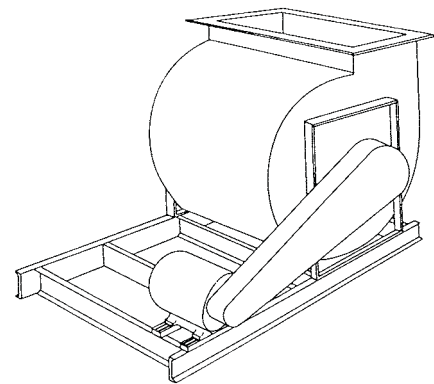
## Bases (Foundation and Isolation)

Critical to every fan installation is a strong, level foundation. A reinforced poured concrete pad with a structural steel base or inertia base provides an excellent foundation. Structural bases must be sturdy enough, with welded construction, to prevent flexing and vibration.

To eliminate vibration and noise from being transferred to the building, vibration isolators should be used. The fan is mounted directly on the isolation base and must be supported for the entire length of the fan base angle (Refer to the installation manual for structural bases if the base was supplied by Greenheck). Isolators are installed between the isolation base and the foundation.

After the fan, isolation base, and isolators are installed, the entire assembly must be leveled.

Position the level on the isolation base, not the fan shaft, for proper leveling. Additionally, the motor and fan shafts must be level and parallel relative to each other for proper alignment.



Typical Fan on Isolation Base

### CAUTION

When installing a fan, ensure the proper protective devices are used to protect personnel from moving parts and other hazards. A complete line of protective accessories are available from Greenheck including: inlet guards, outlet guards, belt guards, shaft guards, protective cages and electrical disconnects.

### Electrical Disconnects

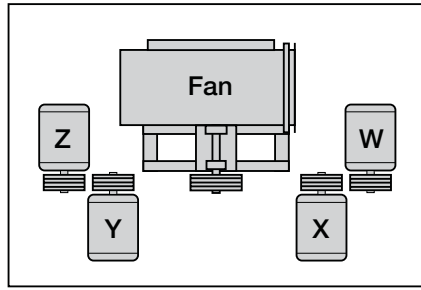
All fan motors should have disconnects located in close visual proximity to turn off electrical service. Service disconnects shall be locked out when maintenance is being performed.

### Moving Parts

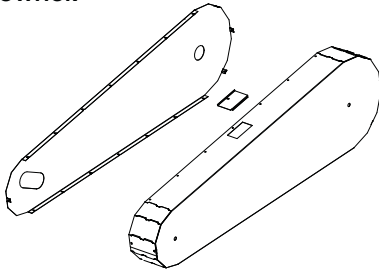
All moving parts must have guards to protect personnel. Refer to local codes for requirements as to the number, type and design. Fully secure fan wheel before performing any maintenance. The fan wheel may start "free wheeling" even if all electrical power has been disconnected. Before the initial start-up or any restart, check the guards (belt, shaft, inlet and outlet) and check the access doors to ensure that they are installed and secure.

## Belt Guards

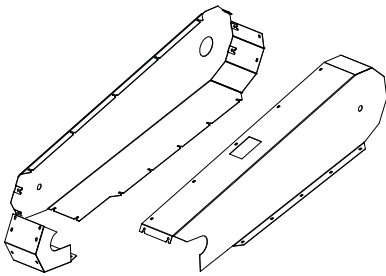
Greenheck offers various types of customized belt guards dependent upon fan model, arrangement and motor position. Motor position is determined from the drive side.



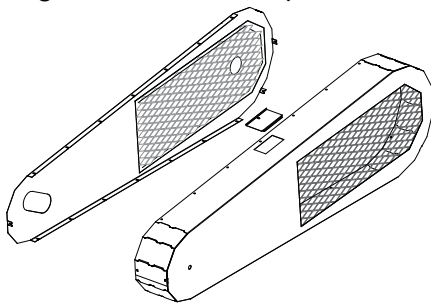
The various types of belt guards are shown in illustrations. If the guard is not purchased from Greenheck, they must be supplied by the installer or owner.



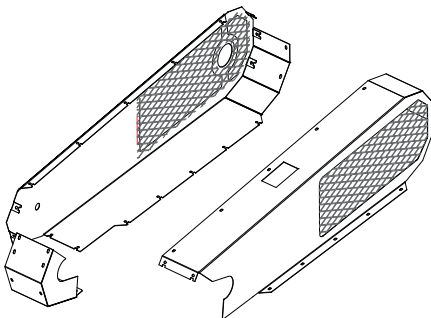
Single-Width - Arr. 1, 3 (Motor Position W/Z)  
Single-Width - Arr. 9, 10



Single-Width - Arr. 1, 3 (Motor Position X/Y)

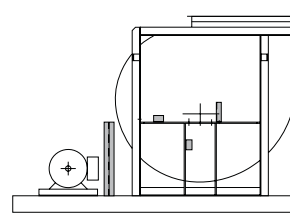


Double-Width - Arr. 3 (Motor Position W/Z)

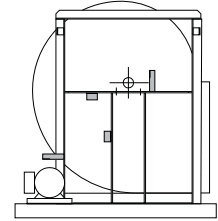


Double-Width - Arr. 3 (Motor Position X/Y)

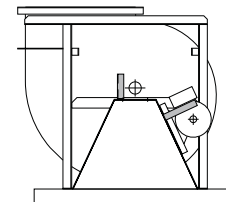
If the belt guard is not factory mounted or was not supplied by Greenheck, then it must be field mounted. Brackets and mounting hardware are the responsibility of the installer. The figures below illustrate suggested attachment points for belt guard mounting bracket locations. These locations vary with motor mounting position, arrangement, and fan type. The bearing supports and fan structure are used in most instances and when the motor is not mounted to the fan itself, a bracket should also be located near it. This information is intended as only a guide and actual field conditions may dictate another mounting location for the guard brackets. Refer to local codes for securing guarding.



Motor Position: W/Z  
Arrangement - 1, 3



Motor Position: X/Y  
Arrangement - 1, 3



Motor Position: L/R  
Arrangement 9

**Suggested Belt Guard Attachment Points  
(shaded gray)**

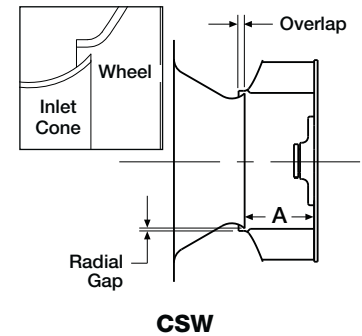
# Radial Gap, Overlap and Wheel Alignment

Efficient fan performance can be maintained by having the correct radial gap, overlap and wheel alignment. These items should be checked after the fan has been in operation for 24 hours and before start-up after the unit has been serviced. Radial gap and overlap information applies to models: CSW, BIDW, AFDW, and LSF.

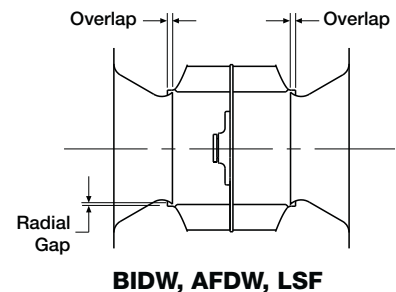
Unit Size	CSW, BIDW, AFDW, LSF Inlet Cone to Backplate			
	A Dimension*		A Dimension*	
	± Tolerance (in.)		± Tolerance (mm)	
7	1 <sup>3</sup> / <sub>16</sub>	± 1/8	30	± 3
8	2 <sup>3</sup> / <sub>16</sub>	± 1/8	36	± 3
9	3 <sup>3</sup> / <sub>16</sub>	± 1/8	81	± 3
10	3 <sup>7</sup> / <sub>16</sub>	± 1/8	87	± 3
12	4	± 1/8	102	± 3
13	4 <sup>7</sup> / <sub>16</sub>	± 1/8	113	± 3
15	5	± 1/8	127	± 3
16	5 <sup>7</sup> / <sub>16</sub>	± 1/8	138	± 3
18	6 <sup>3</sup> / <sub>8</sub>	± 1/8	162	± 3
20	7	± 3/16	178	± 5
22	7 <sup>13</sup> / <sub>16</sub>	± 3/16	198	± 5
24	8 <sup>5</sup> / <sub>8</sub>	± 1/4	219	± 6
27	9 <sup>7</sup> / <sub>16</sub>	± 1/4	240	± 6
30	10 <sup>9</sup> / <sub>16</sub>	± 3/8	268	± 10
33	11 <sup>7</sup> / <sub>16</sub>	± 3/8	291	± 10
36	12 <sup>3</sup> / <sub>4</sub>	± 3/8	324	± 10
40	14 <sup>3</sup> / <sub>16</sub>	± 3/8	360	± 10
44	15 <sup>9</sup> / <sub>16</sub>	± 3/8	395	± 10
49	17 <sup>1</sup> / <sub>8</sub>	± 1/2	435	± 13
54	18 <sup>13</sup> / <sub>16</sub>	± 1/2	478	± 13
60	20 <sup>15</sup> / <sub>16</sub>	± 1/2	532	± 13
66	22 <sup>7</sup> / <sub>8</sub>	± 1/2	581	± 13
73	25 <sup>1</sup> / <sub>2</sub>	± 1/2	648	± 13

\*A dimension does not apply to partial width wheels.

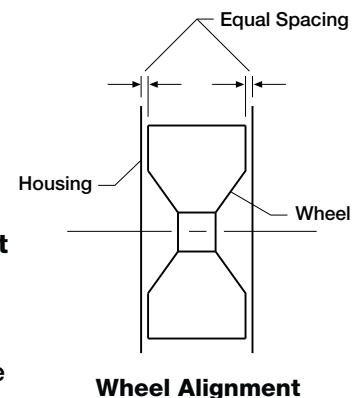
**Radial Gap** is adjusted by loosening the inlet cone bolts and centering the cone on the wheel. If additional adjustment is required to maintain a constant radial gap, loosening the bearing bolts and centering the wheel is acceptable as a secondary option.



**Overlap or offset**, is adjusted by loosening the wheel hub from the shaft and moving the wheel to the desired position along the shaft. The transition between the inlet cone and wheel should be as shown; there is a smooth feel to the profile when moving from one component to the other. Overlap on double width fans is set by having equal spacing on each side of the wheel.

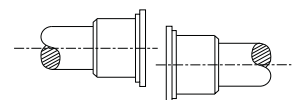


Correct **wheel alignment** for an industrial process fan (model IPA, IPO or IPW) is achieved by centering the wheel in the housing.

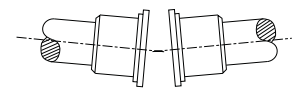


## Flexible Couplings (Arr. 8 Only)

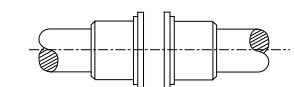
Check for misalignment between the coupling halves. Parallel and angular misalignment and separation gap are illustrated below. Refer to coupling manufacturer's installation instructions for allowable misalignment and separation gap tolerances. When correcting for misalignment using shims, the shims should only be located under the motor. Do not place shims under the shaft bearings.



**Parallel Misalignment**



**Angular Misalignment**



**Separation Gap**

After aligning procedure, check for tightness of all coupling component pieces and ensure that they are clean from dirt and debris.

## Unit Start-Up

1. Disconnect and lock-out all power switches to fan. See warning below.
2. Check all fasteners, set screws and locking collars on the fan, bearings, drive, motor base and accessories for tightness.
3. Rotate the fan wheel by hand and assure no parts are rubbing.
4. Check for bearing alignment and lubrication.
5. Check for coupling alignment (Arr. 8 only).
6. Check the V-belt drive for proper alignment and tension.
7. Check all guarding (if supplied) for being securely attached and not interfering with rotating parts.
8. Check operation of variable inlet vanes or discharge dampers (if supplied) for freedom of movement.
9. Check all electrical connections for proper attachment.
10. Check housing and ductwork, if accessible, for obstructions and foreign material that may damage the fan wheel.

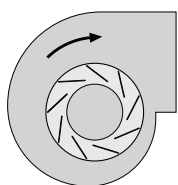
### WARNING

Disconnect and secure to the "Off" position all electrical power to the fan prior to inspection or servicing. Failure to comply with this safety precaution could result in serious injury or death.

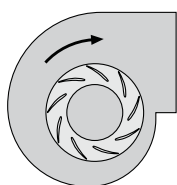
### Additional Steps for Initial Start-Up

1. Check for proper wheel rotation by momentarily energizing the fan. Rotation is always determined by viewing the wheel from the drive side and should correspond to the rotation decal affixed to the unit. One of the most frequently encountered problems with centrifugal fans is motors which are wired to run in the wrong direction. This is especially true with 3-phase installations where the motor will run in either direction, depending on how it has been wired. To reverse rotation of a 3-phase motor, interchange any two of the three electrical leads. Single phase motors can be reversed by changing internal connections as described on the motor label or wiring diagram.

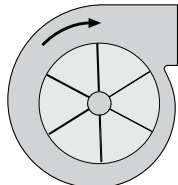
### Clockwise Rotation



Centrifugal  
Backward Inclined



Centrifugal  
Airfoil



Industrial Process  
Radial Blade

*Always viewed from the drive side.*

2. If the fan has inlet vanes, they should be partially closed to reduce power requirements. This is especially important if the fan is designed for a high temperature application and is being started at room temperature.
3. Fans with multi-speed motors should be checked on low speed during initial start-up.
4. Check for unusual noise, vibration or overheating of bearings. Refer to the "Troubleshooting" section of this manual if a problem develops.
5. Grease may be forced out of the bearing seals during initial start-up. This is a normal self-purging feature of this type of bearing.

## Vibration

Excessive vibration is the most frequent problem experienced during initial start-up.

### Common Sources of Vibration

1. Wheel Unbalance
2. Drive Pulley Misalignment
3. Incorrect Belt Tension
4. Bearing / Coupling Misalignment
5. Mechanical Looseness
6. Faulty Belts
7. Drive Component Unbalance
8. Poor Inlet/Outlet Conditions
9. Foundation Stiffness

Left unchecked, excessive vibration can cause a multitude of problems, including structural and/or component failure.

Many of these conditions can be discovered by careful observation. Refer to the troubleshooting section of this manual for corrective actions. If observation cannot locate the source of vibration, a qualified technician using vibration analysis equipment should be consulted. If the problem is wheel unbalance, in-place balancing can be done providing there is access to the fan wheel. Any correction weights added to the wheel should be welded to either the wheel back (single-plane balance) or to the wheel back and wheel cone (two-plane balance).

Greenheck performs a vibration test on all centrifugal fans before shipping. Three vibration readings are taken on each bearing in the horizontal, vertical, and axial directions. The allowable maximum vibration for belt drive units is 0.15 in/sec. peak (0.08 in/sec. direct drive) velocity filter-in for rigid mount and 0.20 in/sec. peak velocity filter-in for flexible mount at the fan RPM per AMCA Standard 204. These vibration signatures are a permanent record of how the fan left the factory and are available upon request.

Generally, fan vibration and noise is transmitted to other parts of the building by the ductwork. To eliminate this undesirable effect, the use of heavy canvas connectors is recommended. If fireproof material is required, Flexweave™1000 - Type FN-30 can be used.

## Routine Maintenance

Once the unit has been put into operation, a routine maintenance schedule should be set up to accomplish the following:

1. Lubrication of bearings and motor (see below).
2. Variable inlet vanes should be checked for freedom of operation and wear.
3. Wheel, housing, bolts and set screws on the entire fan should be checked for tightness.
4. Any dirt accumulation on the wheel or in the housing should be removed to prevent unbalance and possible damage.
5. Isolation bases should be checked for freedom of movement and the bolts for tightness. Springs should be checked for breaks and fatigue. Rubber isolators should be checked for deterioration.
6. Inspect fan impeller and housing looking for fatigue, corrosion, or wear.

When performing any service to the fan, disconnect the electrical supply and secure fan impeller.

## Motors

Motor maintenance is generally limited to cleaning and lubrication. Cleaning should be limited to exterior surfaces only. Removing dust and grease build up on the motor housing assists proper motor cooling. Never wash-down motor with high pressure spray. Many fractional motors are permanently lubricated for life and require no further lubrication. Motors supplied with grease fittings should be greased in accordance with the manufacturer's recommendations.

### CAUTION

When operating conditions of the fan are to be changed (speed, pressure, temperature, etc.), consult Greenheck to determine if the unit can operate safely at the new conditions.

## Variable Frequency Drive Operation

### WARNING

For operation with Variable Frequency Drive (VFD), always check motor amps when adjusting the operating frequency. Motor may be sized for the original selected operating speed under 60 Hz. Bypassing the VFD or increasing the speed from this original selection, even if less than 60 Hz, may cause motor overload or failure. Consult factory with fan serial number before increasing the upper limiting frequency.

Always check the fan rpm when adjusting the operating frequency. Do not exceed maximum class fan rpm of the wheel as stated on the unit identification nameplate.

## Shaft Bearings

The bearings for Greenheck fans are carefully selected to match the maximum load and operating conditions of the specific class, arrangement, and fan size. The instructions provided in this manual and those provided by the bearing manufacturer, will minimize any bearing problems. Bearings are the most critical moving part of the fan, therefore special care is required when mounting them on the unit and maintaining them.

Refer to the following chart and the manufacturers instructions for grease types and intervals for various operating conditions. Never mix greases made with different bases. This will cause a breakdown of the grease and possible failure of the bearing.

Recommended Bearing Lubrication Schedule Relubrication Schedule in Months*								
Fan RPM	Bearing Bore (inches)							
	1/2 - 1	1 1/8 - 1 1/2	1 5/8 - 1 7/8	1 15/16 - 2 1/16	2 1/16 - 3	3 3/16 - 3 1/2	3 15/16 - 4 1/2	4 15/16 - 5 1/2
To 250	12	12	12	12	12	12	10	8
500	12	12	11	10	8	7	5	4
750	12	9	8	7	6	4	3	2
1000	12	7	6	5	4	3	2	1
1250	12	6	5	4	3	2	1	.5
1500	12	5	4	3	2	1	.75	
2000	12	3	3	2	1	.5	.25	
2500	12	2	2	1	.5	.25		
3000	12	2	1	.5	.25			
3500	12	1	.5	.25				
4000	12	.5	.25					
5000	12	.25						
Number of shots**	4	8	8	10	16	25	41	57

\* Lubrication interval is based on 12 hour day operation and maximum 160°F housing temperature.

For 24 hour per day operation, the interval should be cut in half.

\*\* Lubricant should be added with the shaft rotating and until clean grease is seen purging from the bearing. The lubrication interval may be modified based on the condition of the purged grease. If bearing is not visible to observe purged grease, lubricate with number of shots indicated for bore size.

- For conditions including high temperatures, moisture, dirt or excessive vibration, consult the factory for a specific lubrication interval for your application.
- Lubricant should be a high quality lithium complex grease conforming to NLGI Grade 2. Factory recommends Mobilux EP-2 or synthetic Mobilith SHC100.
- The use of synthetic lubricants will increase lubrication intervals by approximately three times.
- Storage periods of three months or longer require monthly rotation of the shaft and purging grease prior to storage and start-up.

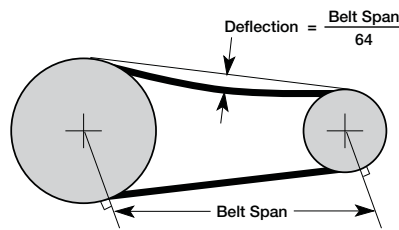


## V-Belt Drives

V-belt drives must be checked on a regular basis for wear, tension, alignment and dirt accumulation. Premature or frequent belt failures can be caused by improper belt tension, (either too loose or too tight) or misaligned sheaves. Abnormally high belt tension or drive misalignment will cause excessive bearing loads and may result in failure of the fan and/or motor bearings. Conversely, loose belts will cause squealing on start-up, excessive belt flutter, slippage, and overheated sheaves. Either excessively loose or tight belts may cause fan vibration.

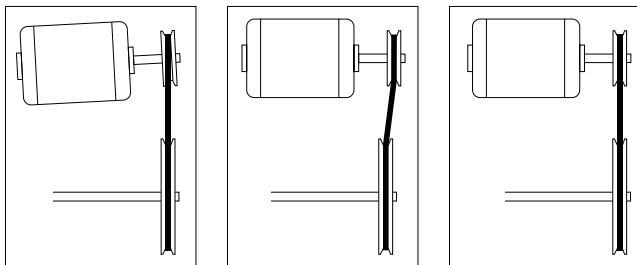
When replacing V-belts on multiple groove drives all belts should be changed to provide uniform drive loading. Do not pry belts on or off the sheave. Loosen belt tension until belts can be removed by simply lifting the belts off the sheaves.

After replacing belts, insure that slack in each belt is on the same side of the drive. Belt dressing should never be used.



Do not install new belts on worn sheaves. If the sheaves have grooves worn in them, they must be replaced before new belts are installed.

The proper tension for operating a V-belt drive is the lowest tension at which the belts will not slip at peak load conditions. For more information about measuring belt tension, refer to Greenheck's Product Application Guide, FA/127-10 Measuring Belt Tension. Check belt tension before start up and after the first 24 hours of operation. The belt tension should also be checked periodically thereafter.



Improper sheave alignment


Proper sheave alignment

### WARNING

Do not overtighten belts. Excessive belt tension can lead to premature belt and/or bearing failure.

## Unit Identification

This nameplate is an example of an identification label on the fan. The information provides general details about the fan, as well as containing specific information unique to the unit. When contacting your Greenheck representative with future needs or questions, please have the information provided on this nameplate available.

	
MODEL	<input type="text"/>
S/N	<input type="text"/>
MARK	<input type="text"/>
MAX FRPM @ 70° F	
<input type="text"/>	

**Model** = General description of fan

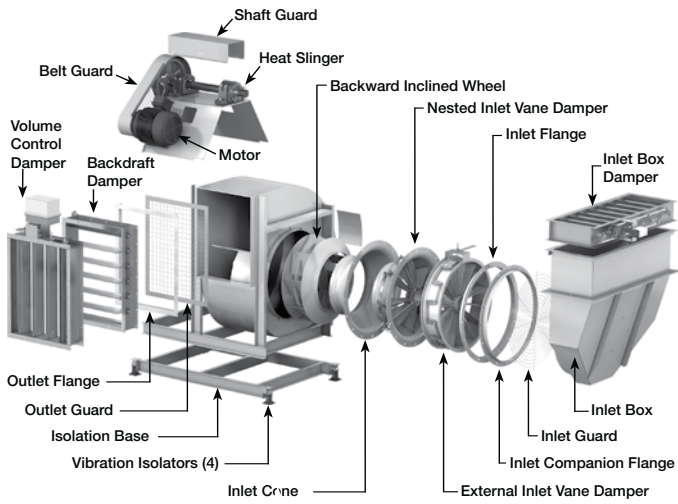
**S/N** = Serial Number assigned by Greenheck, which is a unique identifier for every unit

**Mark** = Customer supplied identification

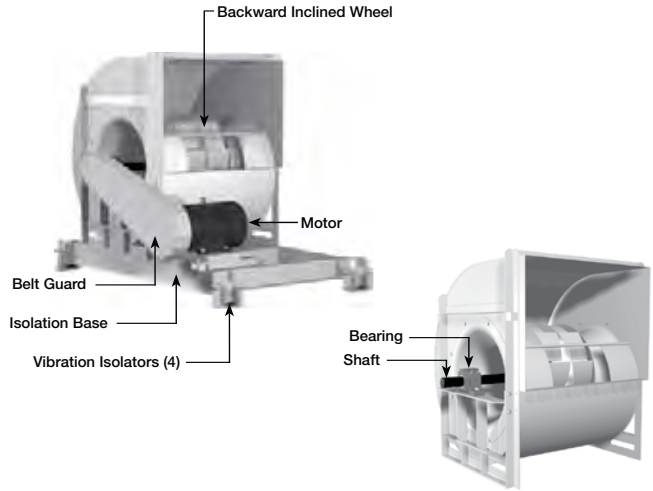
Nameplates are mounted in an area which is clearly visible, usually near the fan outlet on the drive side of the fan. The exact nameplate location may differ due to fan model and size.

# Parts List

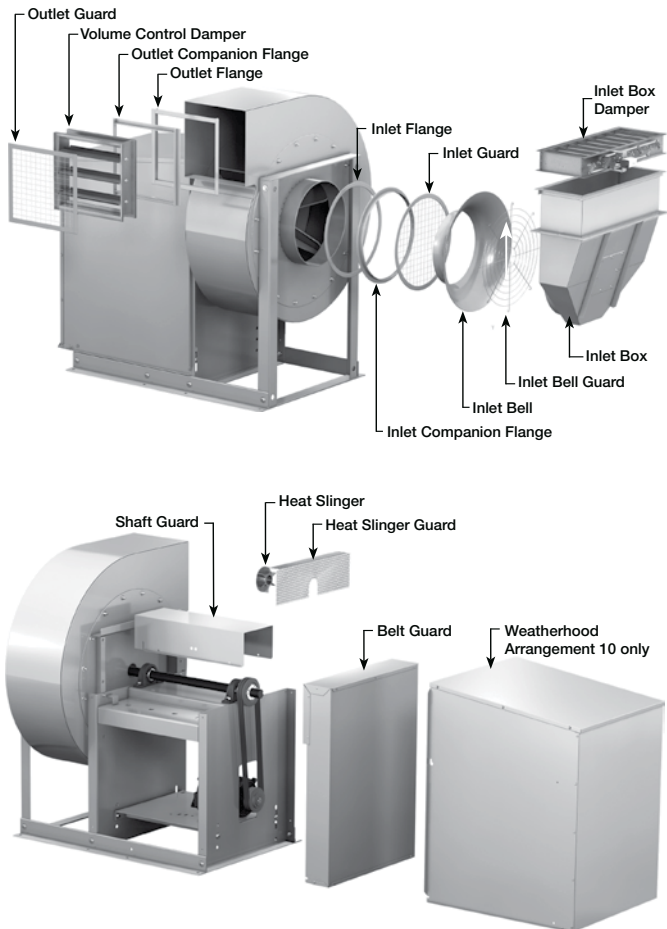
## Centrifugal • Single-Width



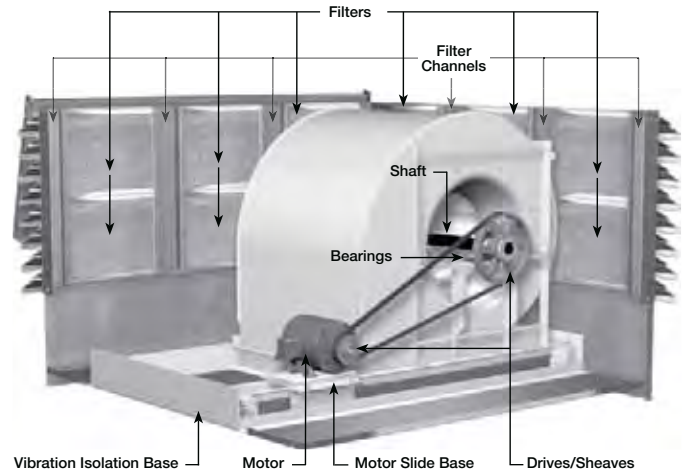
## Centrifugal • Double-Width



## Industrial



## LSF

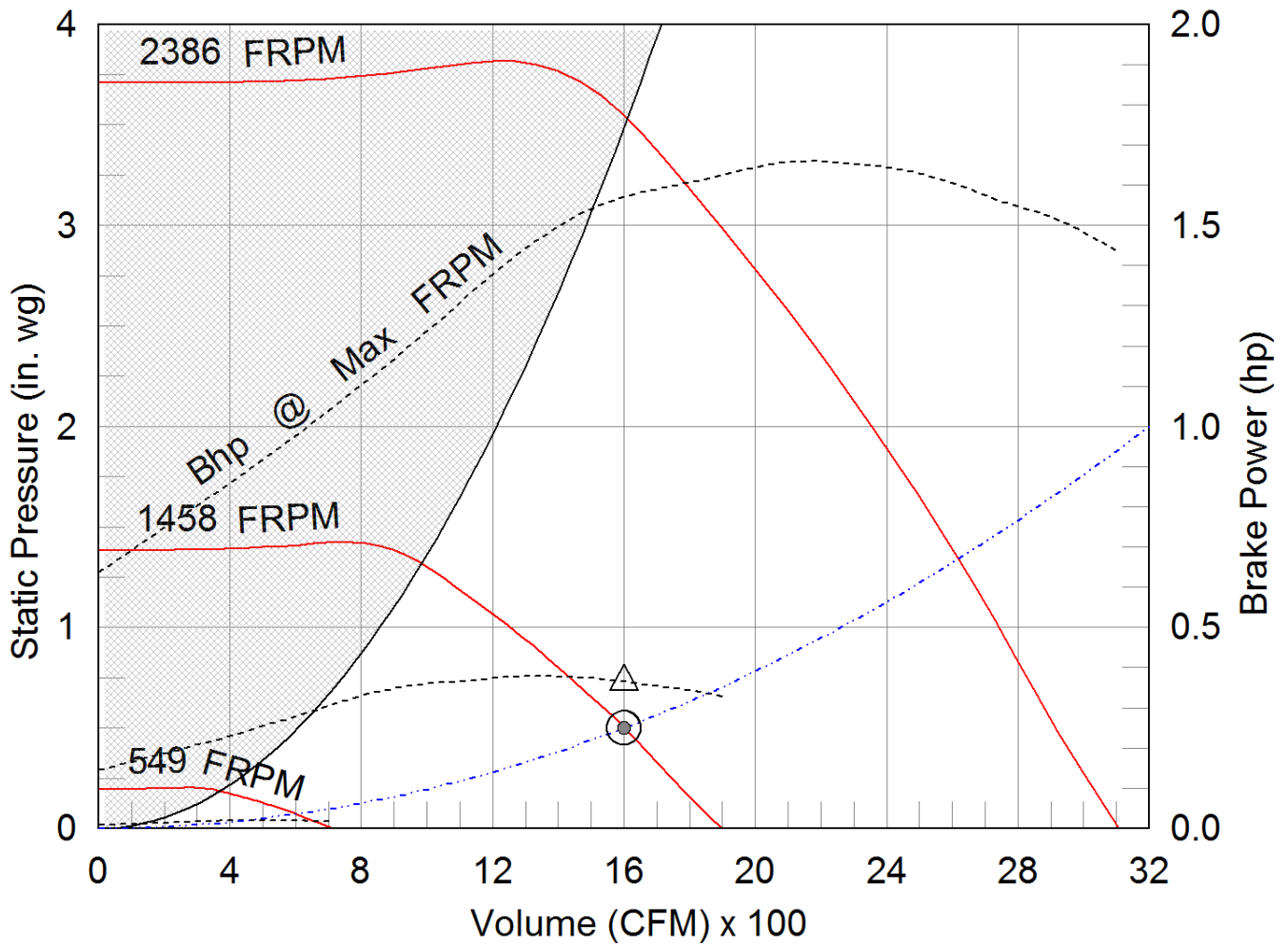


SWB-113-5

Min/Max Fan Curve

Performance

Requested Volume (CFM)	Actual Volume (CFM)	External SP (in. wg)	Total SP (in. wg)	Fan RPM	Operating Power (hp)
1,600	1,600	0.5	0.5	1458	0.36



- △ Operating Bhp point
- Operating point at Total SP
- Operating point at External SP
- Fan curve
- System curve
- - - - Brake horsepower curve



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## Troubleshooting

Problem	Cause	Corrective Action
Excessive Noise	Wheel rubbing (inlet)	Adjust wheel and/or inlet cone. Tighten wheel hub or bearing collars on shaft.
	V-belt drive	Tighten Sheaves on motor/fan shaft. Adjust belt tension. Align sheaves properly (see V-Belt Drives section). Replace worn belts or sheaves.
	Bearings	Replace defective bearing(s). Lubricate bearings. Tighten collars and fasteners.
	Wheel unbalance	Clean all dirt off wheel. Check wheel balance, rebalance in place if necessary.
Low CFM	Fan	Check wheel for correct rotation. Increase fan speed.*
	Duct system	See page 3.
High CFM	Fan	Decrease fan speed.
	Duct system	Resize ductwork. Access door, filters, grilles not installed.
Static Pressure Wrong	Duct system has more or less restriction than anticipated	Change obstructions in system. Use correction factor to adjust for temperature/altitude. Resize ductwork. Clean filters/coils. Change fan speed.*
	Dirty filters • Model LSF	Filters need to be cleaned or replaced. To remove the existing filters, open the top hood panel(s). The filters can now be removed by lifting them vertically and out of their racking. Be sure to carefully note the quantity and size of the filters being removed as some LSF units utilize multiple filters sizes. After the filters have been cleaned, or new filters are ready to be installed, place the filters back into the racks in the reverse order of which they were removed. When all filters are in place, close and secure the top roof panels.
High Horsepower	Fan	Check rotation of wheel. Reduce fan speed.
	Duct system	Resize ductwork. Check proper operation of face and bypass dampers. Check filters and access doors.
Fan Doesn't Operate	Electrical supply	Check fuses/circuit breakers. Check for switches turned off or disconnected. Check for correct supply voltage.
	Drive	Check for broken belts. Tighten loose pulleys.
	Motor	Assure motor is correct horsepower and not tripping overload protector.
Overheated Shaft Bearing	Lubrication	Check for excessive or insufficient grease in the bearings.
	Mechanical	Replace damaged bearing. Relieve excessive belt tension. Align bearings. Check for bent shaft.
Excessive Vibration	Belts	Adjust tightness of belts. Replacement belts should be a matched set.
	System unbalance	Check alignment of shaft, motor and pulleys. Adjustable pitch pulleys with motors over 15 hp are especially prone to unbalance. Check wheel balance, rebalance if necessary.
	Coupling misalignment	Check alignment between coupling, motor and fan shafts. Any adjustments should be made per coupling manufacturer's instructions. Shim only under motor.

\*Always check motor amps and compare to nameplate rating. Excessive fan speed may overload the motor and result in motor failure. Do not exceed the maximum cataloged RPM of the fan.

**NOTE:** Always provide the unit model and serial numbers when requesting parts or service information.

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# Maintenance Log

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Date \_\_\_\_\_ Time \_\_\_\_\_ AM/PM

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# Warranty

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Greenheck warrants this equipment to be free from defects in material and workmanship for a period of one year from the shipment date. Any units or parts which prove to be defective during the warranty period will be replaced at our option when returned to our factory, transportation prepaid. Motors are warranted by the motor manufacturer for a period of one year. Should motors furnished by Greenheck prove defective during this period, they should be returned to the nearest authorized motor service station. Greenheck will not be responsible for any removal or installation costs.

*As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.*

Greenheck's Centrifugal Fan Series 21 & 41, Industrial Process Fans and LSF catalogs provide additional information describing the equipment, fan performance, available accessories, and specification data.

AMCA Publication 410-96, Safety Practices for Users and Installers of Industrial and Commercial Fans, provides additional safety information. This publication can be obtained from AMCA International, Inc. at [www.amca.org](http://www.amca.org).



Phone: (715) 359-6171 • Fax: (715) 355-2399 • E-mail: [gfcinfo@greenheck.com](mailto:gfcinfo@greenheck.com) • Website: [www.greenheck.com](http://www.greenheck.com)

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 3423 2.3 HVAC POWER VENTILATORS

Submittal Number: 1

Item: Exhaust Fan 5

Manufacturer: GREENHECK

Model #: EF-5

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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## Installation, Operation and Maintenance Manual

Please read and save these instructions for future reference. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage!

### Model CW Direct Drive

Model CW is a direct drive centrifugal sidewall exhaust fan. These fans are specifically designed for wall mounted application. Performance capabilities range up to 6,400 cfm (10,874 m<sup>3</sup>/hr) and up to 3 in. wg (747 Pa) of static pressure. The maximum continuous operating temperature for fan sizes 098-200 is 400°F (204°C) and for fan sizes 060-095 is 160°F (71°C). CW fans are available in fourteen sizes with nominal wheel diameter ranging from 9 to 20 inches (229 mm to 508 mm) (060 - 200 unit sizes). Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number.



### Model CWB Belt Drive

Model CWB is a belt drive centrifugal sidewall exhaust fan. These fans are specifically designed for wall mounted application. Performance capabilities range up to 12,500 cfm (21,200 m<sup>3</sup>/hr) and up to 2.75 in. wg (685 Pa) of static pressure. The maximum continuous operating temperature is 400°F (204.4°C).

CWB fans are available in nineteen sizes with nominal wheel diameter ranging from 9 to 30 inches (229 to 762 mm) (098 - 300 unit sizes). Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number.

## General Safety Information

Only qualified personnel should install this fan. Personnel should have a clear understanding of these instructions and should be aware of general safety precautions. Improper installation can result in electric shock, possible injury due to coming in contact with moving parts, as well as other potential hazards. Other considerations may be required if high winds or seismic activity are present. If more information is needed, contact a licensed professional engineer before moving forward.

#### DANGER

Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury.

#### CAUTION

When servicing the fan, motor may be hot enough to cause pain or injury. Allow motor to cool before servicing.

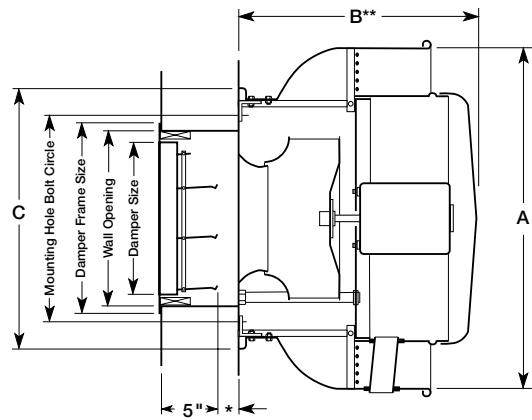
#### CAUTION

Precaution should be taken in explosive atmospheres.

1. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC) and the National Fire Protection Agency (NFPA), where applicable. Follow the Canadian Electric Code (CEC) in Canada.
2. The rotation of the wheel is critical. It must be free to rotate without striking or rubbing any stationary objects.
3. Motor must be securely and adequately grounded.
4. Do not spin fan wheel faster than max cataloged fan RPM. Adjustments to fan speed significantly effects motor load. If the fan RPM is changed, the motor current should be checked to make sure it is not exceeding the motor nameplate amps.
5. Do not allow the power cable to kink or come in contact with oil, grease, hot surfaces, or chemicals. Replace cord immediately if damaged.
6. Verify that the power source is compatible with the equipment.
7. Never open access doors to a duct while the fan is running.

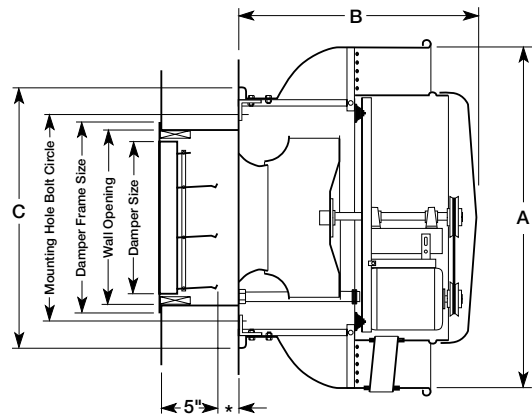
CW - Direct Drive Dimensions							
Model	A	B**	C	Wall Opening	Damper Size	Damper Frame Size	Mounting Bolt Circle
CW-060, 065, 070, 075	18 <sup>3</sup> / <sub>8</sub> (467)	13 <sup>1</sup> / <sub>2</sub> (343)	14 <sup>3</sup> / <sub>4</sub> (375)	8 <sup>1</sup> / <sub>2</sub> (216)	8 (203)	10 (254)	11 <sup>1</sup> / <sub>4</sub> (298)
CW-080, 085, 090	21 (533)	13 <sup>3</sup> / <sub>8</sub> (340)	17 <sup>7</sup> / <sub>8</sub> (454)	10 <sup>1</sup> / <sub>2</sub> (267)	10 (254)	12 (305)	15 (381)
CW-095	21 (533)	15 <sup>1</sup> / <sub>4</sub> (387)	17 <sup>7</sup> / <sub>8</sub> (454)	10 <sup>1</sup> / <sub>2</sub> (267)	10 (254)	12 (305)	15 (381)
CW-098, 101, 121, 131	24 <sup>7</sup> / <sub>8</sub> (632)	28 <sup>1</sup> / <sub>4</sub> (718)	19 <sup>3</sup> / <sub>4</sub> (502)	12 <sup>1</sup> / <sub>2</sub> (318)	12 (305)	14 (356)	16 <sup>7</sup> / <sub>8</sub> (429)
CW-141, 161	28 <sup>7</sup> / <sub>8</sub> (733)	29 <sup>3</sup> / <sub>4</sub> (756)	22 <sup>1</sup> / <sub>8</sub> (562)	15 <sup>1</sup> / <sub>2</sub> (394)	15 (381)	17 (432)	19 <sup>3</sup> / <sub>8</sub> (492)
CW-180, 200	35 <sup>3</sup> / <sub>8</sub> (905)	28 <sup>5</sup> / <sub>8</sub> (727)	27 <sup>3</sup> / <sub>4</sub> (705)	17 <sup>1</sup> / <sub>2</sub> (445)	17 (432)	19 (483)	25 (635)

All dimensions in inches (millimeters). \*NOTE: 2 inches minimum, 8 inches when motorized option is required. \*\*May vary depending on motor size.



CWB - Belt Drive Dimensions							
Model	A	B**	C	Wall Opening	Damper Size	Damper Frame Size	Mounting Bolt Circle
CWB-098, 101, 121, 131	24 <sup>7</sup> / <sub>8</sub> (632)	28 <sup>1</sup> / <sub>4</sub> (718)	19 <sup>3</sup> / <sub>4</sub> (502)	12 <sup>1</sup> / <sub>2</sub> (318)	12 (305)	14 (356)	16 <sup>7</sup> / <sub>8</sub> (429)
CWB-141, 161	28 <sup>7</sup> / <sub>8</sub> (733)	29 <sup>3</sup> / <sub>4</sub> (756)	22 <sup>1</sup> / <sub>8</sub> (562)	15 <sup>1</sup> / <sub>2</sub> (394)	15 (381)	17 (432)	19 <sup>3</sup> / <sub>8</sub> (492)
CWB-180, 200	35 <sup>3</sup> / <sub>8</sub> (899)	28 <sup>5</sup> / <sub>8</sub> (727)	27 <sup>3</sup> / <sub>4</sub> (705)	17 <sup>1</sup> / <sub>2</sub> (445)	17 (432)	19 (483)	25 (635)
CWB-220, 240	42 <sup>25</sup> / <sub>32</sub> (1087)	33 <sup>3</sup> / <sub>8</sub> (860)	31 <sup>1</sup> / <sub>4</sub> (794)	20 <sup>1</sup> / <sub>2</sub> (521)	20 (508)	22 (559)	28 <sup>3</sup> / <sub>8</sub> (721)
CWB-300	50 (1270)	36 (914)	38 <sup>3</sup> / <sub>8</sub> (975)	25 <sup>1</sup> / <sub>2</sub> (648)	25 (635)	27 (686)	35 <sup>27</sup> / <sub>32</sub> (910)

All dimensions in inches (millimeters). \*NOTE: 2 inches minimum, 7 inches when motorized option is required. \*\*May vary depending on motor size.



## Receiving

Upon receiving the product, check to make sure all items are accounted for by referencing the bill of lading to ensure all items were received. Inspect each crate for shipping damage before accepting delivery. Notify the carrier if any damage is noticed. The carrier will make notification on the delivery receipt acknowledging any damage to the product. All damage should be noted on all the copies of the bill of lading which is countersigned by the delivering carrier. A Carrier Inspection Report should be filled out by the carrier upon arrival and reported to the Traffic Department. If damaged upon arrival, file a claim with carrier. Any physical damage to the unit after acceptance is not the responsibility of Greenheck Fan Corporation.

## Unpacking

Verify that all required parts and the correct quantity of each item have been received. If any items are missing, report shortages to your local representative to arrange for obtaining missing parts. Sometimes it is not possible that all items for the unit be shipped together due to availability of transportation and truck space. Confirmation of shipment(s) must be limited to only items on the bill of lading.

## Handling

The motor amperage and voltage ratings must be checked for compatibility to supply voltage prior to final electrical connection. For CW/CWB installations,

the electrical supply should be routed through the conduit chase located between the mounting plate and the bottom of the motor compartment. Wiring must conform to local and national codes.

### CAUTION

Do not lift by the fan hood. Avoid lifting fans in a way that will bend or distort fan parts. Never pass slings or timbers through the venturi of fan. Fans with special coatings or paints must be protected in handling to prevent damage.

## Storage

Fans are protected against damage during shipment. If the unit cannot be installed and operated immediately, precautions need to be taken to prevent deterioration of the unit during storage. The user assumes responsibility of the fan and accessories while in storage. Greenheck Fan Corporation will not be responsible for damage during storage. These suggestions are provided solely as a convenience to the user.

## Indoor

The ideal environment for the storage of fans and accessories is indoors, above grade, in a low humidity atmosphere which is sealed to prevent the entry of blowing dust, rain or snow. Temperatures should be evenly maintained between 30° to 110°F (-1° to 43°C)



(wide temperature swings may cause condensation and “sweating” of metal parts). All accessories must be stored indoors in a clean, dry atmosphere.

Remove any accumulations of dirt, water, ice, or snow and wipe dry before moving to indoor storage. To avoid “sweating” of metal parts, allow cold parts to reach room temperature. To dry parts and packages use a portable electric heater to get rid of any moisture buildup. Leave coverings loose to permit air circulation and to allow for periodic inspection.

The unit should be stored at least 3½ in. (89 mm) off the floor on wooden blocks covered with moisture proof paper or polyethylene sheathing. Aisles between parts and along all walls should be provided to permit air circulation and space for inspection.

## Outdoor

Fans designed for outdoor applications may be stored outdoors, if absolutely necessary. Roads or aisles for portable cranes and hauling equipment are needed.

The fan should be placed on a level surface to prevent water from leaking into the fan. The fan should be elevated on an adequate number of wooden blocks so that it is above water and snow levels and has enough blocking to prevent it from settling into soft ground. Locate parts far enough apart to permit air circulation, sunlight and space for periodic inspection. To minimize water accumulation, place all fan parts on blocking supports so that rain water will run off.

Do not cover parts with plastic film or tarps as these cause condensation of moisture from the air passing through heating and cooling cycles.

Fan wheels should be blocked to prevent spinning caused by strong winds.

## Inspection and Maintenance During Storage

While in storage, inspect fans once per month. Keep a record of inspection and maintenance performed.

If moisture or dirt accumulations are found on parts, the source should be located and eliminated. At each inspection, rotate the wheel by hand ten to fifteen revolutions to distribute lubricant on motor. If paint deterioration begins, consideration should be given to touch-up or repainting. Fans with special coatings may require special techniques for touch-up or repair.

Machined parts coated with rust preventive should be restored to good condition promptly if signs of rust occur. Immediately remove the original rust preventive coating with petroleum solvent and clean with lint-free cloths. Polish any remaining rust from surface with crocus cloth or fine emery paper and oil. Do not destroy the continuity of the surfaces. Thoroughly wipe clean with Tectyl® 506 (Ashland Inc.) or the equivalent. For hard to reach internal surfaces or for occasional use, consider using Tectyl® 511M Rust Preventive, WD-40® or the equivalent.

## Removing From Storage

As fans are removed from storage to be installed in their final location, they should be protected and maintained

in a similar fashion until the fan equipment goes into operation.

## Installation

These fans exhaust directly away from the building, therefore their location and placement should be analyzed. Proximity to nearby buildings and people must be considered.

Access to the motor compartment is accomplished by removing the screws from the cover. The cover can then be removed and placed on a flat surface in an area protected from strong winds.

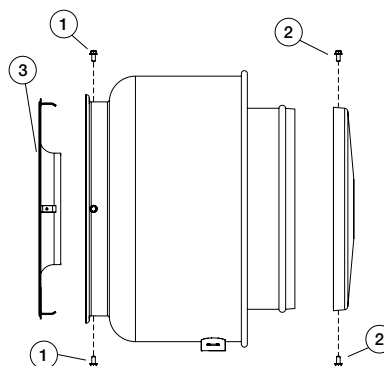
The motor’s amperage and voltage rating must be checked for compatibility to the supply voltage prior to final electrical connection. For NFPA Restaurant Applications, the electrical supply must enter the motor compartment through the breather tube. For other non-flammable applications the electrical supply can be routed through the conduit chase between the mounting plate and the bottom of the motor compartment. Consult local code authorities for your specific requirements. UL/cUL 762 Installations are for Restaurant Applications.

All CWB fans and CW fans with A, B and C motor RPMs are the only fans approved for this installation. All must include the suffix “G”.

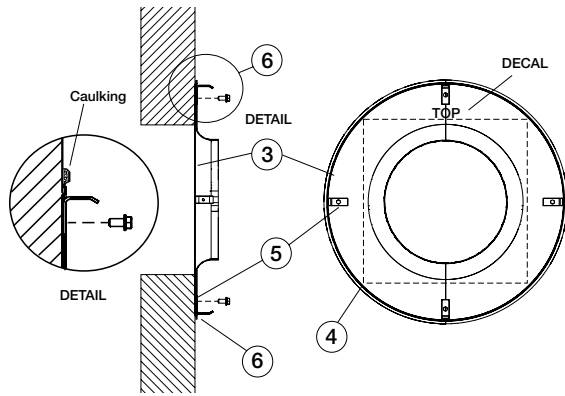
All fans must be installed per NFPA 96 and meet all local code requirements. In addition, the maximum operating temperature at the fan must not exceed 375°F (191°C).

## Typical Wall Mounting Installation

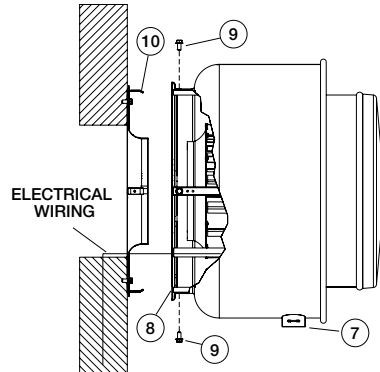
1. Remove mounting plate from unit by removing the fasteners shown above marked by (1). Remove motor compartment cover by removing fasteners marked by (2).



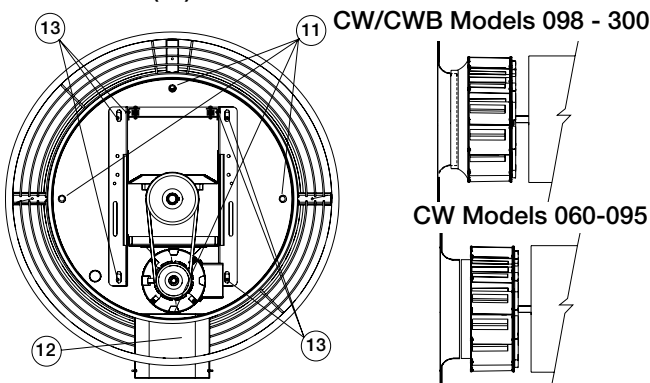
2. Locate the mounting plate (3) at the desired position and check to avoid unit clearance problems. Cut the wall opening (4) as shown based upon dimensions obtained from the Dimensional Data Section. Locate top of mounting plate (decal) and attach to the wall construction. The fasteners must pass through the holes provided in the mounting angle clips (5) on the mounting plate (3). For uneven surfaces, shims may be required. Sealant or caulking should be applied in the groove (6) formed by the mounting plate and the wall to prevent moisture leakage into the building.



3. Once the mounting plate has been attached to the wall, the unit can be installed. The unit should be aligned with the breather tube (7) pointing down. The electrical chase should be guided through the hole in the motor compartment. The horizontal support channels (8) should slide over the mounting angle clips (10) on the mounting plate until the holes in the windband and clips are aligned. Replace fasteners (9) and tighten. Wiring now can be done. Consult local code authorities for your specific requirements.



4. During shipping, wheel position may shift. Alignment should be as shown above (centered in the inlet) and can be accomplished by loosening the fasteners (11) located in the motor compartment. For belt drive units, additional vertical alignment can be accomplished by loosening the four fasteners on the drive frame support angles, and the 2 fasteners that hold the L-brackets to the support angles on top (13). Also, horizontal alignment can be made by loosening the bearings from the bearing plate. Removal of the entire power pack (motor, drives and wheel) for maintenance or cleaning can be accomplished by removing the breather tube (12) and fasteners (11).



## Pre-Starting Checks

1. Check all fasteners and setscrews for tightness. The wheel should rotate freely and be aligned as shown in figure 7.
2. Wheel position is preset and the unit is test run at the factory. Movement may occur during shipment and realignment may be necessary.

## Wheel Overlap and Gap Dimensions

Model	G - Overlap in (mm)	H - Gap in (mm)
060-095	–	3/32 (2)
098-161	1/4 (6)	–
180-300	1/2 (13)	–

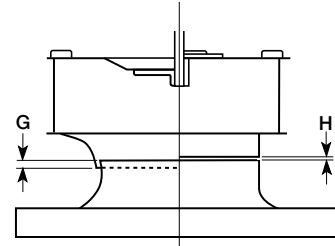


Figure 7

3. Only CW unit - Centering height alignment can be accomplished by loosening the set screws in the wheel and moving the wheel to the desired position.
4. Only CWB unit - Centering can be accomplished by loosening the bolts holding the drive frame to the shock mounts and repositioning the drive frame.
5. Only CWB unit - Wheel and inlet cone overlap can be adjusted by loosening the setscrews in the wheel and moving the wheel to the desired position.
6. Only CWB unit - Fan RPM should be checked and verified with a tachometer.
7. Check wheel rotation (viewing from the shaft side) by momentarily energizing the unit. Rotation should be clockwise and correspond to the rotation decal on the unit, see figure 8. If wheel rotation is incorrect reverse two of the wiring leads or check motor wiring for single phase.

## Wheel Rotation

All CW and CWB models have clockwise rotation when viewed from top of fan

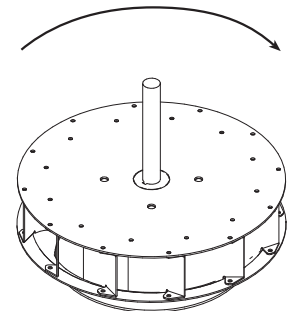


Figure 8

Clockwise  
Airflow

## WARNING

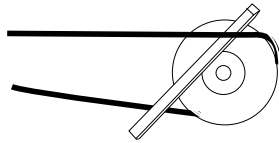
Correct direction of wheel rotation is critical. Reversed rotation will result in poor air performance, motor overloading and possible burnout.

## Model CWB

### Pre-Starting Belt Tension Checks

8. Always loosen tension enough to install belts without stretching, see figure 9.

#### Belts



Do not force belt(s). Forcing the belt(s) will break the cords and cause belt failure

Figure 9

9. For units with two groove pulleys, adjust so the tension is equal in both belts.
10. If adjustments are made, it is very important to check the pulleys for proper alignment. Misaligned pulleys lead to excessive belt wear vibration, noise and power loss, see figure 10.

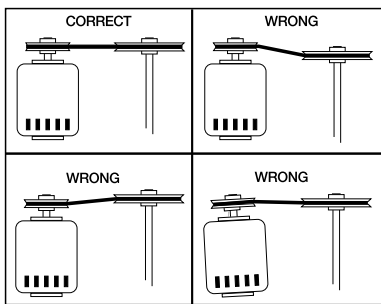


Figure 10

11. For CWB units: Belt tension can be adjusted by loosening four fasteners on the drive frame, see figure 11. The motor plate slides on the slotted adjusting arms and drive frame angles in the same manner.

#### Fasteners

(4) \*Fasteners

\*Identical fasteners on opposing side must also be loosened.

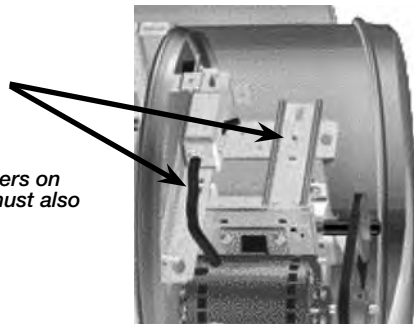


Figure 11

- 12a. Sizes 071-161: Belts should be tensioned just enough to prevent slippage at full load. Belts should have a slight bow on the slack side while running at full load (see figure 12a).
- 12b. Sizes 180-540: Belt tension should be adjusted to allow 1/64 in. (0.397 mm) of deflection per inch of belt span. For example, a 15 in. (381 mm) belt span

## WARNING

The fan has been checked for mechanical noises at the factory prior to shipment. If mechanical noise should develop, suggested corrective actions are offered in the Troubleshooting section.

## IMPORTANT

Over tightening will cause excessive bearing wear and noise. Too little tension will cause slippage at startup and uneven wear.

should have 15/64 in. (0.234 mm) (or about 1/4 in. (6 mm)) of deflection with moderate thumb pressure at mid-point between pulleys (see figure 12b).

#### Deflection

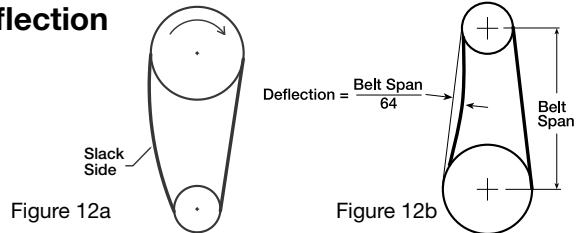


Figure 12a

Figure 12b

13. The adjustable motor pulley is factory set for the RPM specified. Speed can be increased by closing or decreased by opening the adjustable motor pulley. Two groove variable pitch pulleys must be adjusted an equal number of turns open or closed.
14. Any increase in speed represents a substantial increase in the horsepower required by the unit.
15. Motor amperage should always be checked to avoid serious damage to the motor when speed is varied.

### Operation: CW/CWB

1. Before starting up or operating fan, check all fasteners for tightness. In particular, check the setscrews in wheel hub (and pulleys, if applicable).
2. While in the OFF position or before connecting the fan to power, turn the fan wheel by hand to be sure it is not striking the venturi or any obstacle.
3. Start the fan and shut it off immediately to check rotation of the wheel with directional arrow in the motor compartment, see figure 8.
4. When the fan is started, observe the operation and check for any unusual noises.
5. With the system in full operation and all ductwork attached, measure current input to the motor and compare with the nameplate rating to determine if the motor is operating under safe load conditions.
6. Keep inlets and approaches to fan clean and free from obstruction.

## Inspection: CW/CWB

Inspection of the fan should be conducted at the first 30 minute and 24 hour intervals of satisfactory operation.

### 30 Minute Interval

Inspect bolts, setscrews and motor mounting bolts. Adjust and tighten as necessary.

### 24 Hour Interval

Check all internal components. On CWB unit only, inspect belt alignment and tension. Adjust and tighten as necessary.

### IMPORTANT

Adjust (tighten) belt tension after the first 24-48 hours of operation.

## Maintenance: CW/CWB

A proper maintenance program will help these units deliver years of dependable service. Installation and maintenance are to be performed only by qualified personnel who are familiar with local codes and regulations and who are experienced with this type of equipment.

Motor maintenance is generally limited to cleaning and lubrication (where applicable). Cleaning should be limited to exterior surfaces only. Removing dust buildup on motor housing ensures proper motor cooling.

Greasing of motors is only intended when fittings are provided. Many fractional horsepower motors are permanently lubricated and should not be lubricated after installation. Motors supplied with grease fittings should be greased in accordance with manufacturers' recommendations. Where motor temperatures do not exceed 104°F (40°C), the grease should be replaced after 2,000 hours of running time as a general rule.

Wheels require very little attention when moving clean air. Occasionally, oil and dust may accumulate causing imbalance. When this occurs the wheel and housing should be cleaned to ensure smooth and safe operation.

All fasteners should be checked for tightness each time maintenance checks are performed prior to restarting unit.

A proper maintenance program will help these units deliver years of dependable service.

### Belt/Bearing Maintenance CWB Unit

1. Belts tend to stretch after a period of time. They should be checked periodically for wear and tightness. When replacing belts, use the same type as supplied with the unit.
2. Matched belts should always be used on units with multi-groove pulleys.
3. For belt replacement, loosen the tensioning device enough to allow removal of the belt by hand. Do not force the belts on or off. This may cause cords to break, leading to premature failure.

### WARNING

Always disconnect, lock and tag power source before servicing. Failure to disconnect power source can result in fire, shock or serious injury.

### CAUTION

Uneven cleaning of the wheel will produce an out of balance condition that will cause vibration in the fan.

### WARNING

This unit should be made non-functional when cleaning the wheel or housing (fuses removed, disconnect locked off).

4. Once installed, adjust belts as shown in "Pre-Starting Checks."
5. Shaft bearings can be classified in two groups: relubricating and non-relubricating. All non-relubricating bearings on standard model CWB fans are factory lubricated and require no further lubrication under normal use (between -20° to 180°F (-29° to 82°C) in a relatively clean environment).
6. Units installed in hot, humid or dirty locations should be equipped with special bearings. These bearings will require frequent lubrication. On CWB belt driven fans, the standard cast pillow block bearings are factory lubricated and are provided with external grease fittings. Annual lubrication is recommended, or more frequently if needed, see Table 2. Do not over-grease. Use only one or two shots of lubricant with a hand gun. Maximum hand gun rating is 40 psi. Rotate bearings during lubrication where good safety practice permits. Caution should be employed to prevent over packing or contamination.
7. Grease fittings should be wiped clean. The unit should be in operation while lubricating. Extreme care should be used around moving parts.
8. Grease should be pumped in very slowly until a slight bead forms around the seal. A high grade lithium base grease should be used.
9. When installing restaurant exhaust applications follow NFPA 70 for cleaning fans.
10. Grease containers must be emptied at regular intervals to prevent overflow.
11. To ensure tightness, check pulley setscrews. Proper keys must be in keyways.
12. Fan RPM should not be readjusted. Only use pulleys of identical size and type when replacing pulleys.
13. During the first few months of operation check bearing set screws periodically to ensure tightness.
14. If unit is to be left idle for an extended period, remove belts and store in a cool, dry place to avoid premature belt failure.

## Recommended Relubrication Frequency in Months

NOTE: If unusual environment conditions exist (extreme temperature, moisture or contaminants) more frequent lubrication is required.

A good quality lithium base grease, conforming to NLGI Grade 2 consistency, such as those listed here may be used.

Interval (months)	Type of Service
1 to 3	Heavy duty in dirty, dusty locations; high ambient temperatures; moisture laden atmosphere; vibration.
3 to 6	12 to 24 hours per day, heavy duty, or if moisture is present
6 to 12	8 to 16 hours per day in clean, relatively dry atmosphere
12 to 18	Infrequent operation or light duty in clean atmosphere

Manufacturer	Grease (NLGI #2)
U.S. Electric Motors	Grease No. 83343
Chevron U.S.A. Inc	Chevron SRI Grease #2
Mobil Oil Corporation	Mobilith
	Mobil 532
Texaco, Inc.	Premium BRB #2
	Texaco Multifak #2
Amoco Oil Co.	Rykon Premium #2
Exxon	Unirex N2
Shell	B Shell Alvania #2

## Parts List

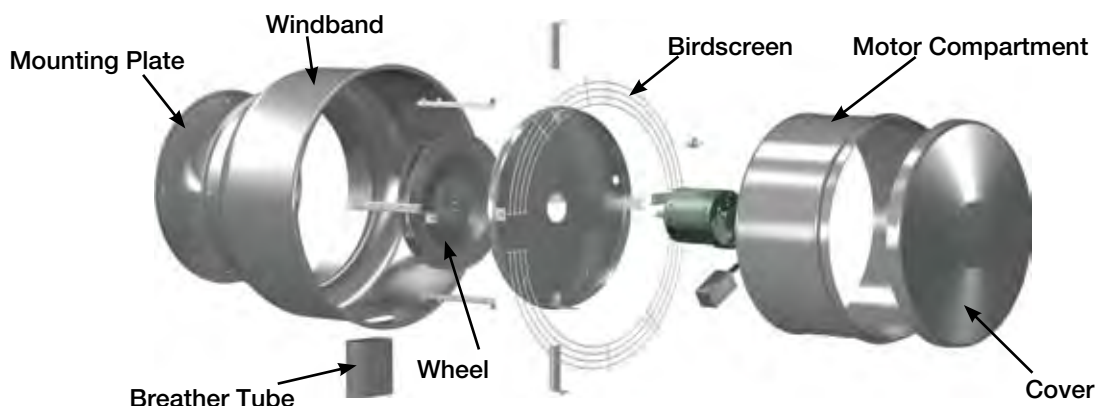
### NOTE

Each fan bears a manufacturer's nameplate with model number and serial number embossed. This information will assist the local Greenheck representative and the factory in providing service and replacement parts. Before taking any corrective action, make certain unit is not capable of operation during repairs.

### CAUTION

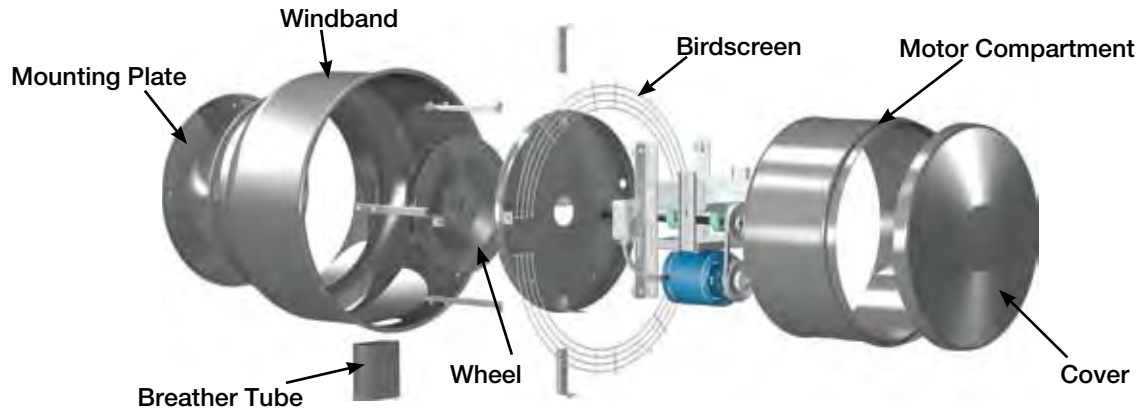
A fan manufactured with an explosion resistant motor does not certify the entire unit to be explosion proof.

## CW Direct Drive Centrifugal Sidewall Exhaust Fan





## CWB Belt Drive Centrifugal Sidewall Exhaust Fan



### Troubleshooting

**WARNING:** Before taking any corrective action, make certain unit is not capable of operation during repairs.

PROBLEM	CAUSE	CORRECTIVE ACTION
Excessive Noise or Vibration	Bad Bearings	Replace.
	Wheel unbalance	Clean and remove all dirt buildup off wheel. Check wheel balance, rebalance in place if necessary.
	Belts too tight or too loose	Adjust tension, see figure 12a-b.
	Wheel improperly aligned and rubbing	Center wheel on inlet, see figure 7.
	Loose drive or motor pulleys	Align and tighten. See "Pre-Starting Checks", see page 4-6.
	Foreign objects in wheel or housing	Remove objects, check for damage or unbalance.
Reduced airflow	System resistance too high	Check system: Proper operation of backdraft or control dampers, obstruction in ductwork, clean dirty filters.
	Unit running backwards	Correct as shown in figure 8.
	Excessive dirt buildup on wheels	Clean wheel.
	Improper wheel alignment	Center wheel on inlets, see Pre-Starting checks and figure 7.

## Warranty

Greenheck warrants this equipment to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at our option when returned to our factory, transportation prepaid. Motors are warranted by the motor manufacturer for a period of one year. Should motors furnished by Greenheck prove defective during this period, they should be returned to the nearest authorized motor service station. Greenheck will not be responsible for any removal or installation costs.

*As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.*



Greenheck Catalog Series C provides additional information describing the equipment, fan performance, available accessories, and specification data.

AMCA Publication 410-96, Safety Practices for Users and Installers of Industrial and Commercial Fans, provides additional safety information. This publication can be obtained from AMCA International, Inc. at: [www.amca.org](http://www.amca.org).

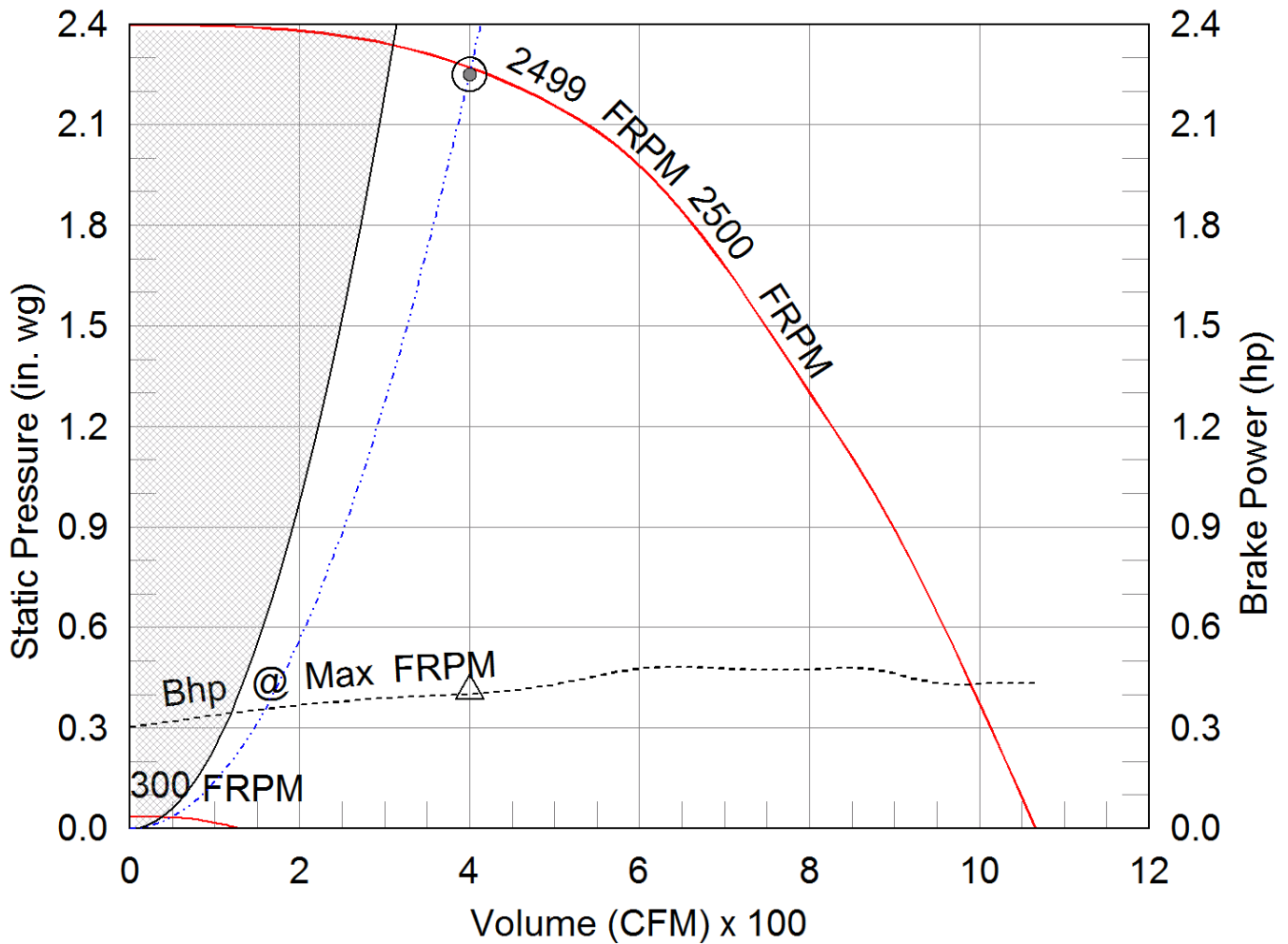
Phone: (715) 359-6171 • Fax: (715) 355-2399 • E-mail: [gfcinfo@greenheck.com](mailto:gfcinfo@greenheck.com) • Website: [www.greenheck.com](http://www.greenheck.com)

CW-101HP-VG

Min/Max Fan Curve

**Performance**

Requested Volume (CFM)	Actual Volume (CFM)	External SP (in. wg)	Total SP (in. wg)	Fan RPM	Operating Power (hp)
400	400	2.25	2.25	2499	0.41



- △ Operating Bhp point
- Operating point at Total SP
- Operating point at External SP
- Fan curve
- - - System curve
- - - Brake horsepower curve

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 3423 2.4 HVAC POWER VENTILATORS

Submittal Number: 1

Item: Exhaust Fan 2&3

Manufacturer: GREENHECK

Model #: EF-2 & EF-3

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No



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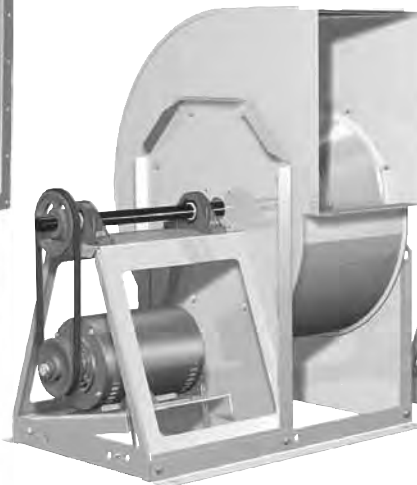
## Installation, Operation and Maintenance Manual

Please read and save these instructions for future reference. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage!

**Model SWB  
Series 300**



**Model SWB  
Series 200**

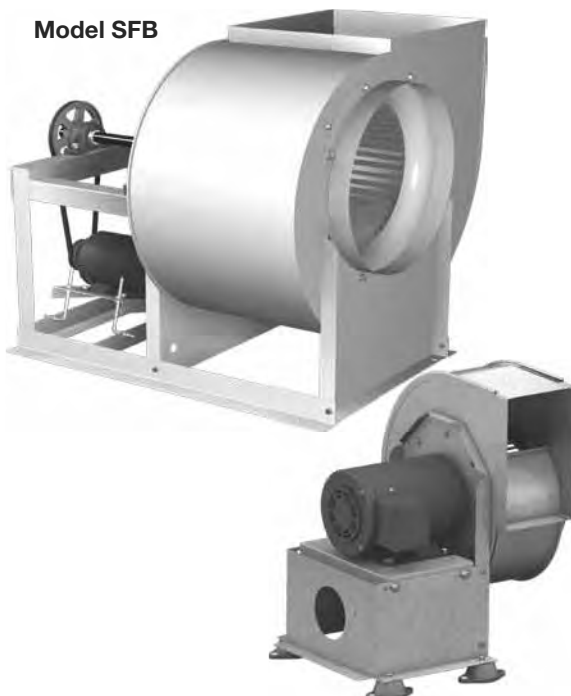


**Model SWB  
Series 100**



**Model SWD**

**Model SFB**



**Model SFD**

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## General Safety Information

Only qualified personnel should install this fan. Personnel should have a clear understanding of these instructions and should be aware of general safety precautions. Improper installation can result in electric shock, possible injury due to coming in contact with moving parts, as well as other potential hazards. Other considerations may be required if seismic activity is present. If more information is needed, contact a licensed professional engineer before moving forward.

1. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC) and the National Fire Protection Agency (NFPA), where applicable. Follow the Canadian Electric Code (CEC) in Canada.
2. The rotation of the wheel is critical. It must be free to rotate without striking or rubbing any stationary objects.
3. Motor must be securely and adequately grounded.
4. Do not spin fan wheel faster than max cataloged fan RPM. Adjustments to fan speed significantly effects motor load. If the fan RPM is changed, the motor current should be checked to make sure it is not exceeding the motor nameplate amps.
5. Do not allow the power cable to kink or come in contact with oil, grease, hot surfaces or chemicals. Replace cord immediately if damaged.
6. Verify that the power source is compatible with the equipment.
7. Never open access doors to a duct while the fan is running.

### **DANGER**

Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury.

### **CAUTION**

When servicing the fan, motor may be hot enough to cause pain or injury. Allow motor to cool before servicing.

### **CAUTION**

Precaution should be taken in explosive atmospheres.

### **DANGER**

Pour écarter les risques d'incendie, de choc électrique ou de blessure grave, veiller à toujours débrancher, verrouiller et étiqueter la source de courant avant l'installation ou l'entretien.

### **ATTENTION**

Lors de toute intervention sur la soufflante, le moteur peut être suffisamment chaud pour provoquer une douleur voire une blessure. Laisser le moteur refroidir avant toute maintenance.

### **ATTENTION**

Faire preuve de précaution dans les atmosphères explosives.

## Receiving

Upon receiving the product, check to ensure all items are accounted for by referencing the delivery receipt or packing list. Inspect each crate or carton for shipping damage before accepting delivery. Alert the carrier of any damage detected. The customer will make a notation of damage (or shortage of items) on the delivery receipt and all copies of the bill of lading which is countersigned by the delivering carrier. If damaged, immediately contact your Greenheck Representative. Any physical damage to the unit after acceptance is not the responsibility of Greenheck Fan Corporation.

## Unpacking

Verify that all required parts and the correct quantity of each item have been received. If any items are missing, report shortages to your local representative to arrange for obtaining missing parts. Sometimes it is not possible that all items for the unit be shipped together due to availability of transportation and truck space. Confirmation of shipment(s) must be limited to only items on the bill of lading.

## Storage

Fans are protected against damage during shipment. If the unit cannot be installed and operated immediately, precautions need to be taken to prevent deterioration of the unit during storage. The user assumes responsibility of the fan and accessories while in storage. The manufacturer will not be responsible for damage during storage. These suggestions are provided solely as a convenience to the user.

**Indoor** - The ideal environment for the storage of fans and accessories is indoors, above grade, in a low humidity atmosphere which is sealed to prevent the entry of blowing dust, rain or snow. Temperatures should be evenly maintained between 30° to 110°F (-1° to 43°C), wide temperature swings may cause condensation and “sweating” of metal parts. All accessories must be stored indoors in a clean, dry atmosphere.

Remove any accumulations of dirt, water, ice, or snow and wipe dry before moving to indoor storage. To avoid “sweating” of metal parts allow cold parts to reach room temperature. To dry parts and packages use a portable electric heater to remove any moisture build up. Leave coverings loose to permit air circulation and to allow for periodic inspection.

The unit should be stored at least 3½ inches (89 mm) off the floor on wooden blocks covered with moisture proof paper or polyethylene sheathing. Aisles between parts and along all walls should be provided to permit air circulation and space for inspection.

**Outdoor** - Fans designed for outdoor applications may be stored outdoors, if absolutely necessary. Roads or aisles for portable cranes and hauling equipment are needed.

The fan should be placed on a level surface to prevent water from leaking into the fan. The fan should be elevated on an adequate number of wooden blocks so it is above water and snow levels and has enough blocking to prevent it from settling into soft ground. Locate parts far enough apart to permit air circulation, sunlight and space for periodic inspection. To minimize water accumulation, place all fan parts on blocking supports so rain water will run off.

Do not cover parts with plastic film or tarps as these cause condensation of moisture from the air passing through heating and cooling cycles. Fan wheels should be blocked to prevent spinning caused by strong winds.

## Inspection and Maintenance During Storage

While in storage, inspect fans once per month. Keep a record of inspection and maintenance performed.

If moisture or dirt accumulations are found on parts, the source should be located and eliminated. At each inspection, rotate the wheel by hand ten to fifteen revolutions to distribute lubricant in motor and bearings. If paint deterioration begins, consideration should be given to touch-up or repainting. Fans with special coatings may require special techniques for touch-up or repair.

Machined parts coated with rust preventive should be restored to good condition promptly if signs of rust occur. Immediately remove the original rust preventive coating with petroleum solvent and clean with lint-free cloths. Polish any remaining rust from surface with crocus cloth or fine emery paper and oil. Do not destroy the continuity of the surfaces. Thoroughly wipe clean with Tectyl® 506 (Ashland Inc.) or the equivalent. For hard to reach internal surfaces or for occasional use, consider using Tectyl® 511M Rust Preventive, WD-40® or the equivalent.

## Removing From Storage

As fans are removed from storage to be installed in their final location, they should be protected and maintained in a similar fashion until the fan equipment goes into operation.

## Installation

Inspect the unit for any damage and report it to the shipper immediately. Also, check to see that all accessory items are accounted for.

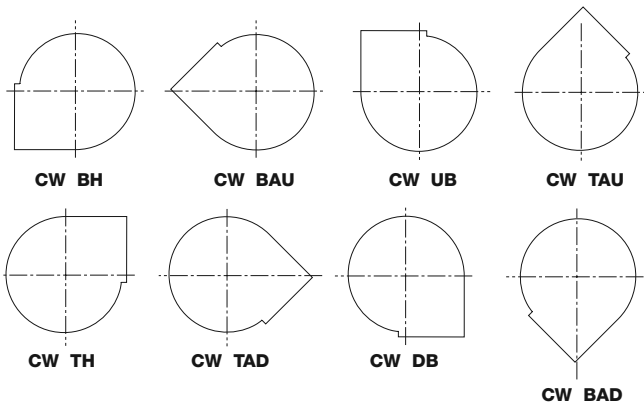
Move the fan to the desired location and fasten securely through mounting holes provided in the base angles. The unit must be set level (shimming may be necessary). Flexible duct connections and vibration isolators should be used where noise is a factor.

The motor voltage and ampere rating must be checked for compatibility with the electrical supply prior to final electrical connection. Supply wiring to the fan must be properly fused, and conform to local and national electrical codes.

The discharge is factory set as specified by customer order, however, it can be rotated to other discharge positions in the field if necessary. Removal of the housing bolts allows the discharge to be rotated to the clockwise positions below. For TAD, BD and BAD discharge positions, a portion of the frame angle must be removed.

Clockwise rotation shown. Counterclockwise discharge positions are a mirror image of those shown. Fan rotation is always specified from the drive side of the housing.

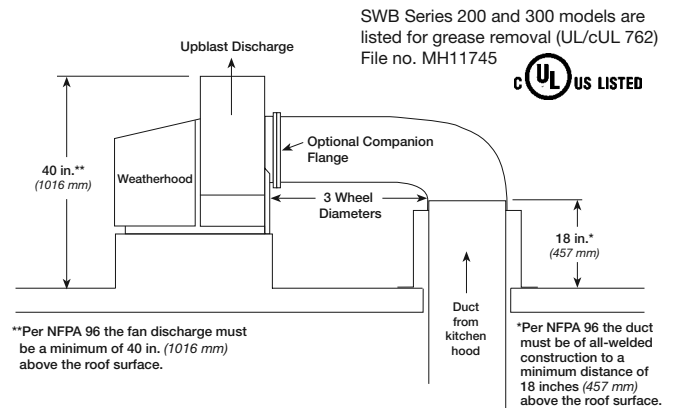
### Discharge Positions



## Installation of UL/cUL 762 Listed Fans for Restaurant Exhaust

The UL/cUL 762 listing for restaurant exhaust is available on model SWB Series 200, sizes 206 - 224, and Series 300, sizes 327 - 349 with a weatherhood.

UL/cUL 762 fans are listed for a maximum operating temperature of 375°F (191°C) and includes an access door and 1 inch (25.4 mm) drain connection. An outlet guard is strongly recommended when the fan discharge is accessible. An upblast discharge is recommended. The fan discharge must be a minimum of 40 inches (1016 mm) above the roof line and the exhaust duct must be fully welded to a distance of 18 inches (457 mm) above the roof surface.

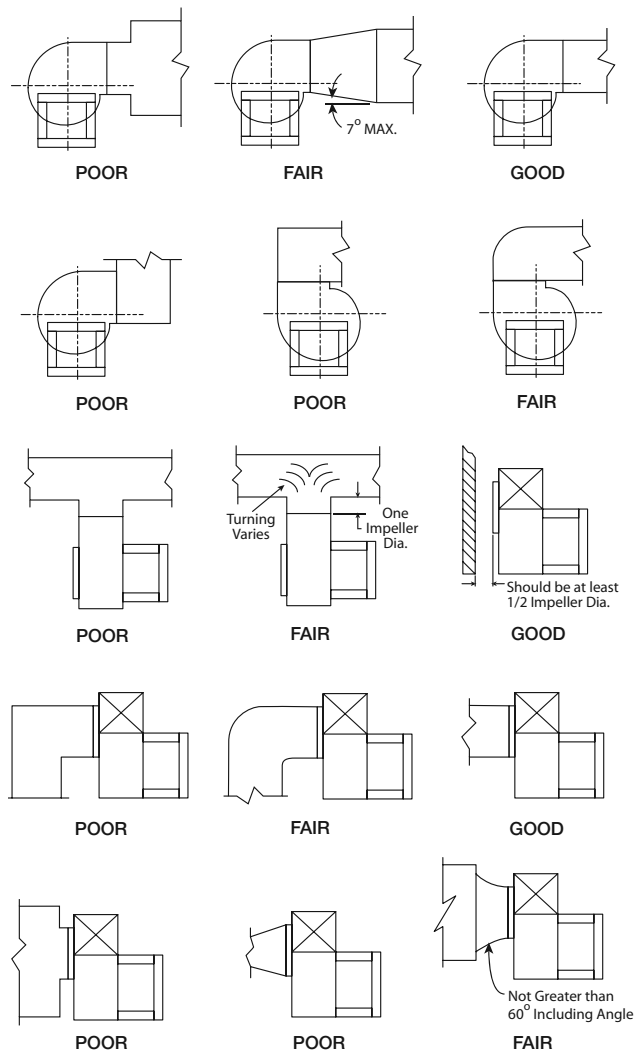


*This drawing is for dimensional information only. See the latest edition of NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations for detailed installation instructions, materials, duct connections and clearances.*

## Affect of Installation on Performance

Restricted or unstable flow at the fan inlet can cause pre-rotation of incoming air or uneven loading of the fan wheel, yielding large system losses, increased sound levels and structural failure of the fan wheel. Free discharge or turbulent flow in the discharge ductwork will also result in system effect losses.

These examples show the system layout and inlet and discharge configurations which can affect fan performance.



## Pre-Starting Checks

### DANGER

Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury.

### CAUTION

When servicing the fan, motor may be hot enough to cause pain or injury. Allow motor to cool before servicing.

### CAUTION

Precaution should be taken in explosive atmospheres.

### DANGER

Pour écarter les risques d'incendie, de choc électrique ou de blessure grave, veiller à toujours débrancher, verrouiller et étiqueter la source de courant avant l'installation ou l'entretien.

### ATTENTION

Lors de toute intervention sur la soufflante, le moteur peut être suffisamment chaud pour provoquer une douleur voire une blessure. Laisser le moteur refroidir avant toute maintenance.

### ATTENTION

Faire preuve de précaution dans les atmosphères explosives.

## Alignment of Pulleys and Belts

Check pulleys and belts for proper alignment to avoid unnecessary belt wear, noise, vibration and power loss. Motor and drive shafts must be parallel and pulleys in line as shown in Figure 1.

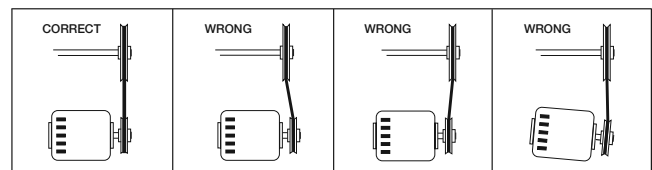


Figure 1

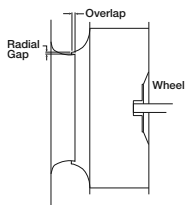
The adjustable motor pulley is set at the factory for the fan RPM specified by the customer. Fan RPM can be increased by closing or decreased by opening the adjustable motor pulley. Multigroove variable pitch pulleys must be adjusted an equal number of turns open or closed. Any increase in fan speed represents a substantial increase in load on the motor.

To avoid motor overheating and possible burnout, motor load amperes should always be checked and compared to nameplate rating when fan speed is increased.

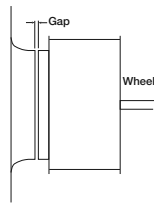
## Wheels

Wheels must rotate freely and not rub on the inlet venturi. Model SWB and SWD wheels overlap the inlet venturi as shown in Figure 2. Refer to the Approximate Wheel Clearance Dimensions table for the proper dimensions for wheel overlap and radial gap.

Models SFD and SFB wheels do not overlap the venturi, but have a gap between the inlet venturi and the wheel, see Figure 3. Wheel position is preset at the factory and the unit is test run. Wheel movement may occur during shipment or installation and wheel alignment may be necessary.



**Figure 2**  
Model SWB / SWD



**Figure 3**  
Model SFD / SFB

## Approximate Wheel Clearance Dimensions

Unit Size						SWB and SWD			SFD	SFB
SFD	SFB	SWD	SWB Series 100	SWB Series 200	SWB Series 300	Overlap	Overlap Tolerance	Radial Gap	Gap	Gap
inches (mm)										
6			106	206		—	—	—	3/8 (10)	—
7.5		7	107	207		—	—	—	3/8 (10)	—
9	9	8	108	208		—	—	—	1/2 (13)	1/2 (13)
10	10	10	110	210		3/8 (10)	1/4 (6)	5/32 (4)	1/2 (13)	1/2 (13)
	12			212		3/8 (10)	1/4 (6)	5/32 (4)	—	1/2 (13)
		13	113	213		7/16 (11)	1/4 (6)	5/32 (4)	—	1/2 (13)
	15	15	115	215		1/2 (13)	1/4 (6)	5/32 (4)	—	1/2 (13)
		16	116	216		1/2 (13)	1/4 (6)	5/32 (4)	—	—
	18	18	118	218		5/8 (16)	3/8 (10)	5/32 (4)	—	1/2 (13)
	20		120	220		5/8 (16)	3/8 (10)	5/32 (4)	—	5/8 (16)
	22			222		11/16 (18)	3/8 (10)	5/32 (4)	—	5/8 (16)
			124	224		3/4 (19)	3/8 (10)	5/32 (4)	—	—
	25					—	—	—	—	3/4 (19)
	27				327	7/8 (22)	1/4 (6)	3/16 (5)	—	3/4 (19)
	30				330	15/16 (24)	3/8 (10)	3/16 (5)	—	3/4 (19)
					333	1 1/16 (27)	3/8 (10)	3/16 (5)	—	—
					336	1 3/16 (30)	3/8 (10)	3/16 (5)	—	—
					340	1 1/4 (32)	3/8 (10)	1/4 (6)	—	—
					344	1 7/16 (37)	3/8 (10)	5/16 (8)	—	—
					349	1 9/16 (40)	1/2 (13)	5/16 (8)	—	—

## Method for Centering Wheel

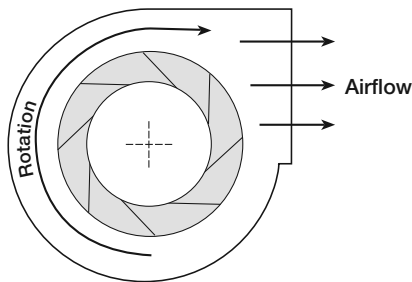
On belt drive units, centering can be accomplished by (a) loosening the inlet cone bolts to move the inlet cone or by (b) loosening the bearings in order to move the shaft. Wheel and inlet cone overlap can be adjusted by loosening the wheel hub set screws and moving the wheel to the desired position. Tighten all fasteners and set screws securely and realign drive pulleys after adjustment.

## Wheel Rotation

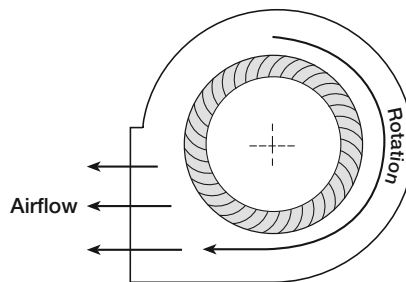
Rotation direction of the wheel is critical and incorrect rotation will result in reduced air performance, increased motor loading and possible motor burnout.

Check wheel rotation by momentarily energizing the unit and noting if rotation is in the same direction as the airflow at the outlet and conforms to the rotation decal affixed to the unit.

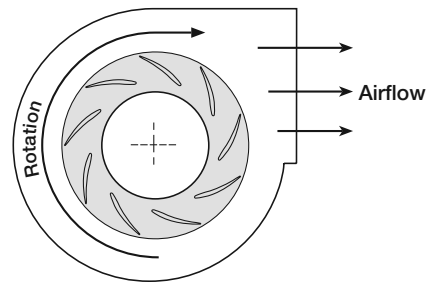
Wheels as viewed from the drive side:



**Backward Inclined**  
SWD and SWB Series 100, 200 & 300



**Forward Curved**  
SFD and SFB



**Airfoil**  
SWB 327 - 349

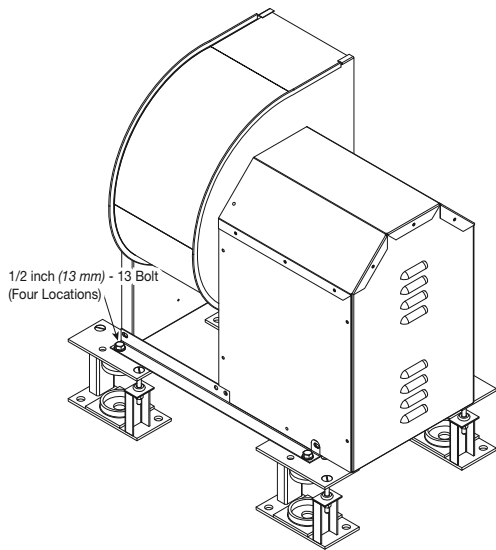
## NOTE

Models SFD and SFB units should be operated only when attached to the system for which they were designed. Without proper system static pressure, the motor could be overloaded.

# Mounting for Severe Duty Installation

## Isolator Anchoring

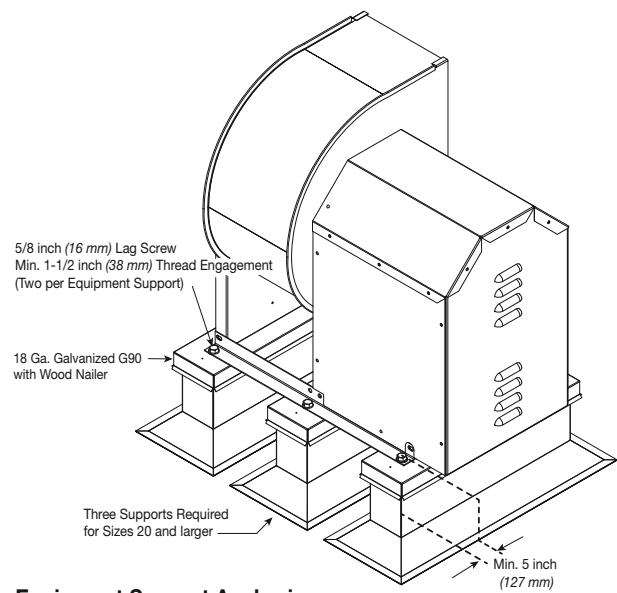
Two fasteners per equipment support.  
Three supports required for model sizes 20 and larger.



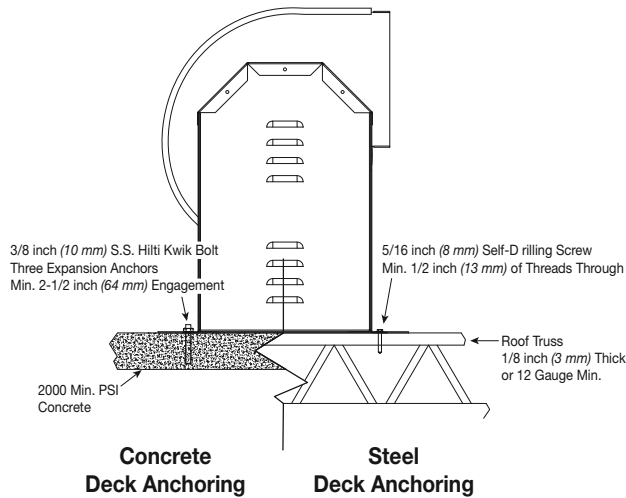
**Isolator Anchoring**

## Equipment Support Anchoring

One fastener per isolator anchoring.  
Four isolators required.

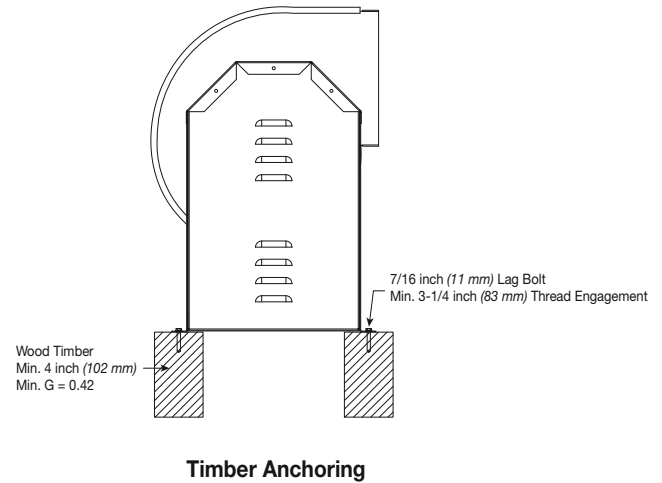


**Equipment Support Anchoring**



**Concrete Deck Anchoring**

**Steel Deck Anchoring**



**Timber Anchoring**



# Maintenance

## Bearing Lubrication Schedule

Shaft bearings are the most critical moving part of a fan. Therefore, special attention should be given to keeping the bearings clean and well lubricated. Proper lubrication provides for reduction in friction and wear, transmission and dissipation of heat, extended bearing life and prevention of rust.

In order for a lubricant to fulfill these tasks, the proper grease applied at regular intervals is required. See the recommended bearing lubrication schedule below.

If unusual conditions exist (temperatures below 32°F or above 200°F), moisture or contaminants - more frequent lubrication is required.

Recommended Bearing Lubrication Schedule					
Relubrication Schedule in Months					
Standard Grease					
Fan RPM	Bearing Bore (inches)				
	1/2 - 1	1 1/8 - 1 1/2	1 5/8 - 1 7/8	1 15/16 - 2 3/16	2 7/16 - 3
To 250	12	12	12	12	12
500	12	12	11	10	8
750	12	9	8	7	6
1000	12	7	6	5	4
1250	12	6	5	4	3
1500	12	5	4	3	2
2000	12	3	3	2	1
2500	12	2	2	1	0.5
3000	12	2	1	0.5	0.25
3500	12	1	0.5	0.25	-
4000	12	0.5	0.25	-	-
5000	12	0.25	-	-	-
Number of Shots	4	8	8	10	16

- Lubrication interval is based on 12 hour per day operation and maximum 160°F housing temperature. For 24 hour per day operation, the interval should be cut in half.
- Lubricant should be added with the shaft rotating and until clean grease is seen purging from the bearing. The lubrication interval may be modified based on the condition of the purged grease. If bearing is not visible to observe purged grease, lubricate with number of shots indicated in chart for bore size.
- For conditions including high temperatures, moisture, dirt or excessive vibration, consult the factory for a specific lubrication interval for your application.
- Lubricant should be a high quality lithium complex grease conforming to NLGI Grade 2. Factory recommends Mobilux EP-2.
- The use of synthetic lubricants will increase lubrication intervals by approximately 3 times.

In addition to lubricating the bearings at specified intervals, set screws in the bearing collars should be checked for tightness. A bearing collar which has loosened will cause premature failure of the fan shaft. Fasteners attaching the bearings to the drive frame should also be checked.

## Motor Maintenance (Belt and Direct Drive)

Motor maintenance is generally limited to cleaning and lubrication (where applicable). Cleaning should be limited to exterior surfaces only. Removing dust and grease buildup on the motor housing assures proper motor cooling. Use caution and do not allow water or solvents to enter the motor or bearings. Under no circumstances should motors or bearings be sprayed with steam, water or solvents.

Many fractional horsepower motors are permanently lubricated for life and require no further lubrication. Motors supplied with grease fittings should be greased in accordance with the manufacturer's recommendations.

## Wheel and Fastener Maintenance

Wheels require very little attention when exhausting clean air, however, air heavily laden with grease or dirt will tend to accumulate on the wheel causing unbalance. Wheels exhausting dirty or grease-laden air require frequent cleaning to assure smooth and safe operation.

All fasteners, including set screws in the bearing collars, should be checked for tightness each time maintenance checks are performed.

A proper maintenance program will help preserve the performance and reliability designed into the fan.

## Belt Maintenance (Belt Drive)

Belts tend to stretch after a period of time. They should be periodically checked for tension and wear. When replacing belts, use the same type as supplied with the unit. Replacement of belts should be accomplished by loosening the tensioning "L-Bolts" so the belts may be removed by hand. Do not force belts on or off as this may cause breakage of cords and lead to premature belt failure.

Belt tension should be adjusted to allow 1/64 in. of belt deflection per 1 in. of belt span. For example, a 16 in. belt span should have 16/64 in. or 1/4 in. of deflection with moderate thumb pressure at mid-point between the pulleys. (Figure 4).

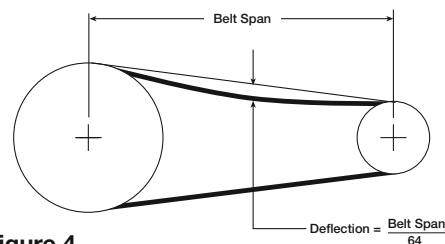


Figure 4

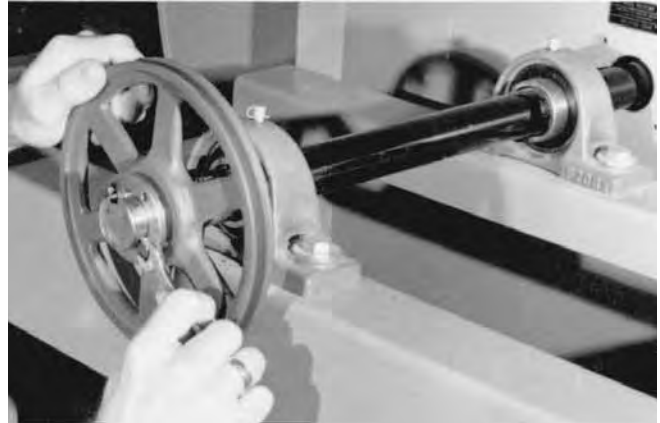
Refer to Greenheck's Product Application Guide, "Measuring Belt Tension" for additional information—FA/127-11, found online at [www.greenheck.com](http://www.greenheck.com) under the library section.

# Motor and Drive Installation Instructions

For model SWB and SFB units that are shipped from stock without motors or drives.



1. Adjust motor pulley to its closed position for maximum fan speed or increments of 1/2 turn open (maximum of 5 turns open) for reduced fan speed. Tighten set screw on flat area only.



4. Install shaft pulley to fan shaft.



2. Install motor pulley to the motor shaft and install motor to the motor plate. Pre-punched holes are provided for most common motor frame sizes.



5. Install drive belt(s). Belts should not be forced over pulleys. Align motor and shaft pulleys with a straight edge. Tighten all set screws.



3. If supplied, install taperlock bushing into shaft pulley.



6. Adjust belt tension.  
See page 8 for belt tensioning instructions.

## Parts List

Each fan bears a manufacturer's nameplate with model number and serial number embossed. This information will assist the local Greenheck representative and the factory in providing service and replacement parts. Before taking any corrective action, make certain unit is not capable of operation during repairs.

### CAUTION

A fan manufactured with an explosion resistant motor does not certify the entire unit to be explosion proof. Refer to UL Listing Mark for the fans approved usage.

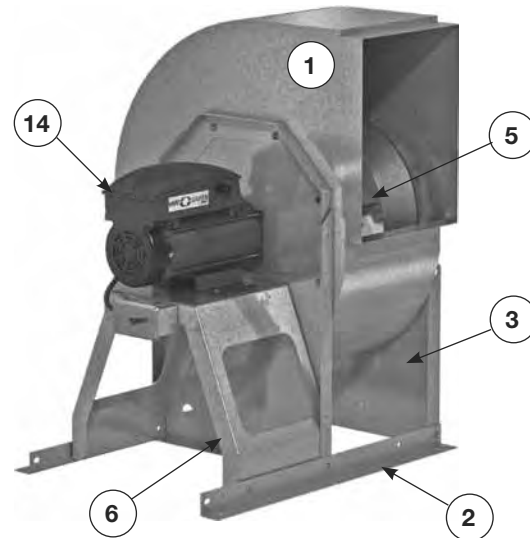
### CAUTION

La présence d'un moteur antidéflagrant sur un ventilateur ne garantit pas que tout l'appareil est antidéflagrant. Pour connaître les emplois autorisés de l'appareil, voir son marquage de conformité UL.

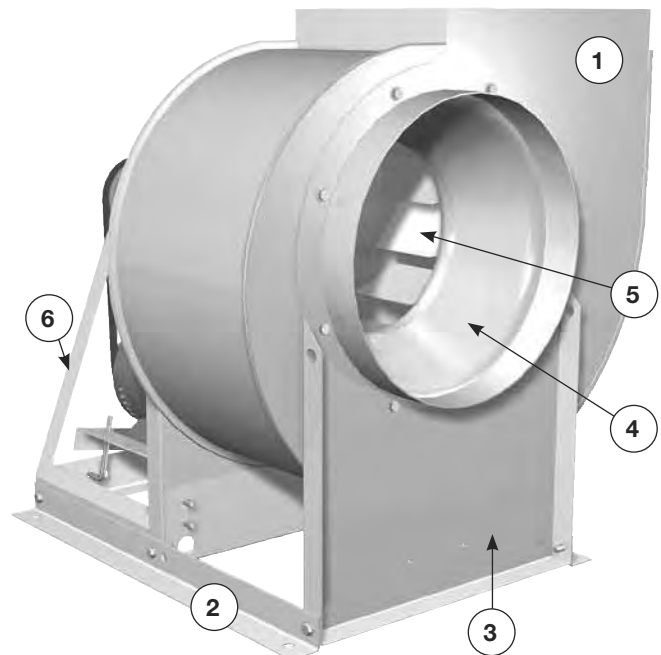
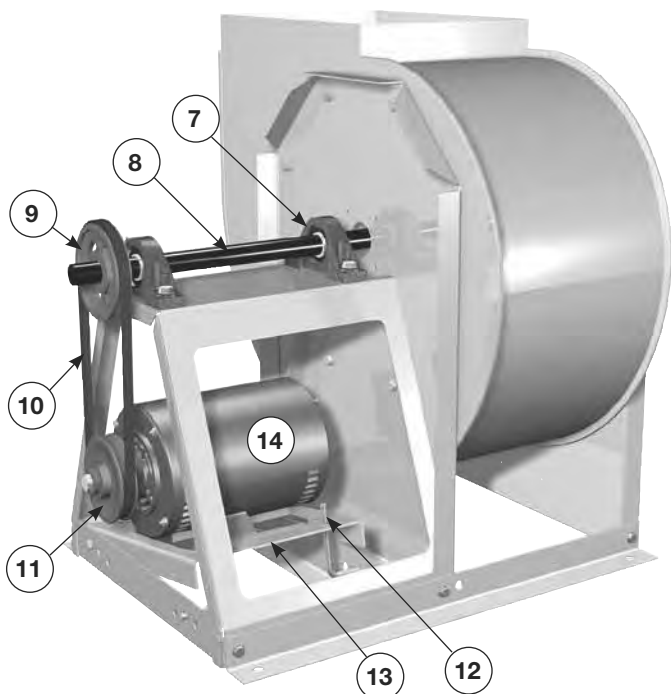
### Available Replacement Parts:

1. Scroll housing
2. Drive frame - base angle
3. Intake support panel
4. Inlet ring and cone
5. Wheel (specify rotation)
6. Drive frame assembly
7. Pillow block bearings
8. Fan shaft
9. Shaft pulley
10. Belt
11. Motor pulley
12. Belt tensioning bolts
13. Motor plate
14. Motor

### Direct Drive



### Belt Drive

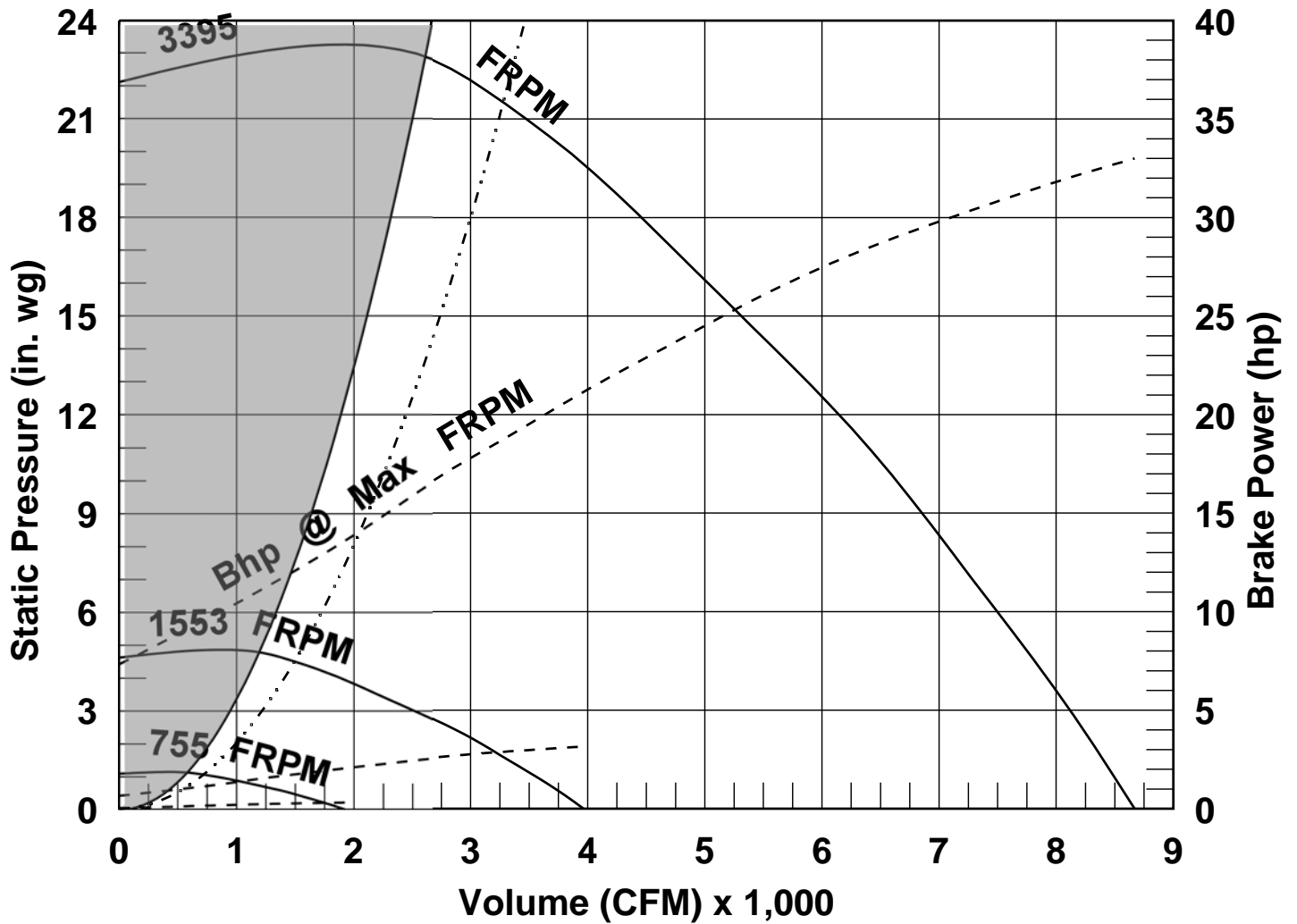


11-IPA

Min. / Max Fan Curve

**PERFORMANCE** (Elevation ft = 138, Airstream Temperature F = 70)

Actual Volume (CFM)	External SP (in. wg)	Total SP (in. wg)	FRPM (RPM)	Operating Power (hp)
1,500	4.5	4.5	1553	1.79



- Fan curve
- ..... System curve
- Brake horsepower curve

# Troubleshooting

## WARNING

Before taking any corrective action, make certain unit is not capable of operation during repairs.

## AVERTISSEMENT

Avant d'entreprendre toute action corrective, s'assurer que l'appareil ne pourra pas fonctionner durant les réparations.

PROBLEM	CAUSE	CORRECTIVE ACTION
Excessive Noise	Wheel Rubbing Inlet	Adjust wheel and/or inlet cone. Tighten wheel hub or bearing collars on shaft.
	V-Belt Drive	Tighten sheaves on motor/fan shaft. Adjust belt tension. Align sheaves properly (see page 4). Replace worn belts or sheaves.
	Bearings	Replace defective bearing(s). Lubricate bearings. Tighten collars & fasteners.
	Wheel Unbalance	Clean all dirt off wheel. Check wheel balance, rebalance in place if necessary.
Low CFM	Fan	Check wheel for correct rotation. Increase fan speed.*
	Duct System	See page 3.
High CFM	Fan	Resize ductwork. Access door, filters, grills not installed.
	Duct System	Change obstructions in system. Use correction factor to adjust for temperature/altitude. Resize ductwork. Clean filters/coils. Change fan speed.*
Static Pressure Wrong	Duct system has more or less restriction than anticipated	Check rotation of wheel. Adjust fan speed.
High Horsepower	Fan	Check rotation of wheel. Reduce fan speed.
	Duct System	Resize ductwork. Check proper operation of face and bypass dampers. Check filters and access doors.
Fan Doesn't Operate	Electrical Supply	Check fuses/circuit breakers. Check for switches off. Check for correct supply voltage.
	Drive	Check for broken belts. Tighten loose pulleys.
	Motor	Assure motor is correct horsepower and not tripping overload protector.
Overheated Bearing	Lubrication	Check for excessive or insufficient grease in the bearing.
	Mechanical	Replace damaged bearing. Relieve excessive belt tension. Align bearings. Check for bent shaft.

\*Always check motor amps and compare to nameplate rating. Excessive fan speed may overload the motor and result in burnout.

## Our Commitment

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*As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.*

Specific Greenheck product warranties are located on [greenheck.com](http://greenheck.com) within the product area tabs and in the Library under Warranties.

Greenheck's Centrifugal Utility Fans catalog provides additional information describing the equipment, fan performance, available accessories, and specification data.

AMCA Publication 410-96, Safety Practices for Users and Installers of Industrial and Commercial Fans, provides additional safety information. This publication can be obtained from AMCA International, Inc. at [www.amca.org](http://www.amca.org).



Phone: 715.359.6171 • Fax: 715.355.2399 • Parts: 800.355.5354 • E-mail: [gfcinfo@greenheck.com](mailto:gfcinfo@greenheck.com) • Website: [www.greenheck.com](http://www.greenheck.com)

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 3516 2.2 ENGINE EXHAUST SYSTEMS

Submittal Number: 1

Item: EF -4

Manufacturer: Nederman

Model #: N-40

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

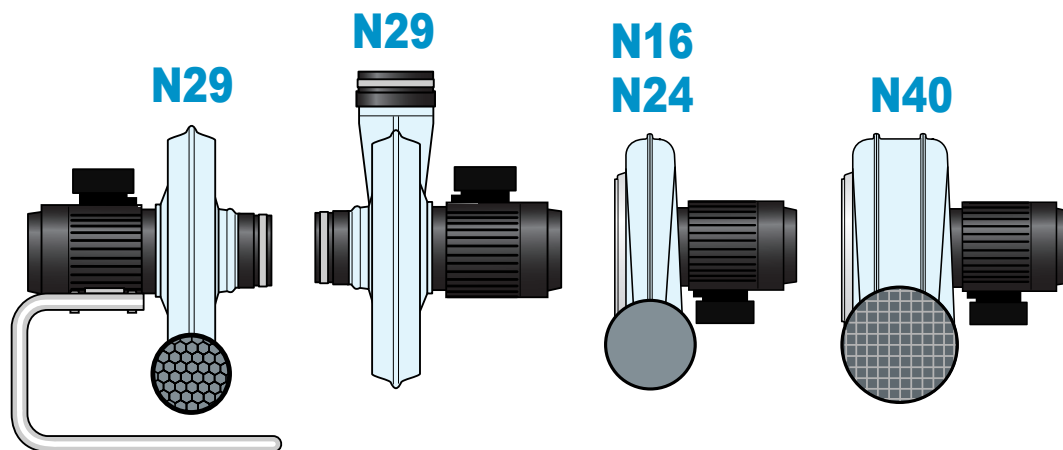
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# N16/24/29/40

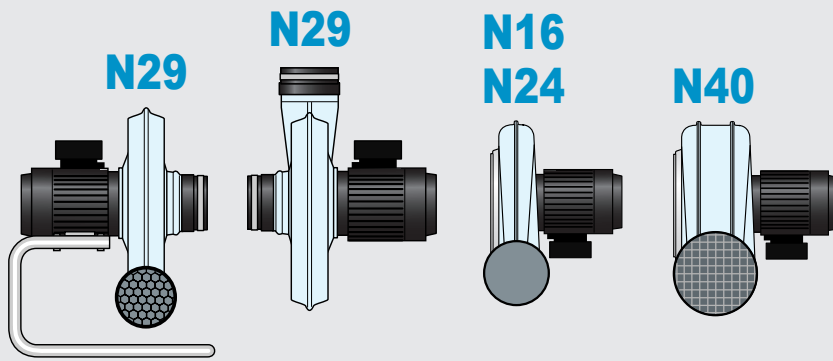
**Nederman**<sup>®</sup>

*Improving your workspace*



**INSTRUCTION MANUAL  
BEDIENUNGSANLEITUNG  
MANUEL D'INSTRUCTION  
MANUAL DE INSTRUCCIONES  
MANUALE DI ISTRUZIONI  
GEBRUIKSAANWIJZING  
ASENNUS- JA KÄYTTÖOHJE  
INSTRUKTIONSMANUAL**

No. 148233/05



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**Technical data**

<u>Capacity</u>	
- N 16, 0.55 kW	400 - 1250 m <sup>3</sup> /h**
- N 24, 0.75 kW	400 - 1500 m <sup>3</sup> /h**
- N 24, 0.9 kW	400 - 1750 m <sup>3</sup> /h**
- N 29, 1.5 kW	500 - 1500 m <sup>3</sup> /h**
- N 29, 2.2 kW	500 - 3000 m <sup>3</sup> /h**
- N 40, 1.5 kW	500 - 2500 m <sup>3</sup> /h**
- N 40, 2.2 kW	500 - 4000 m <sup>3</sup> /h**
Motor power	see product label
Motor speed	see motor label
Voltage / Phase	see motor label
Frequency	see product label
Rated current	see motor label
<u>Weight</u>	
- N 16	13 kg (29 lbs)
- N 24	17 kg (37 lbs)
- N 29, 1.5 kW	28 kg (62 lbs)
- N 29, 2.2 kW	32 kg (71 lbs)
- N 40, 1.5 kW	25 kg (55 lbs)
- N 40, 2.2 kW	29 kg (64 lbs)
<u>Temperature</u>	
Ambient temp.	-30°C to +40°C (-22°F to 104°F)
Airflow temp.	max. 60°C (140°F)
<u>Noise level*</u>	
- N 16	74 - 76 dB(A)
- N 24	75 - 79 dB(A)
- N 29	70 - 80 dB(A)
- N 40	60 - 80 dB(A)
Recycling	95 % of weight

\* according to ISO 11203, with duct connected to inlet and outlet

\*\* 100 m<sup>3</sup>/h ≈ 58 cfm

**Technische Daten**

<u>Kapazität</u>	
- N 16, 0,55 kW	400 - 1250 m <sup>3</sup> /h
- N 24, 0,75 kW	400 - 1500 m <sup>3</sup> /h
- N 24, 0,9 kW	400 - 1750 m <sup>3</sup> /h
- N 29, 1,5 kW	500 - 1500 m <sup>3</sup> /h
- N 29, 2,2 kW	500 - 3000 m <sup>3</sup> /h
- N 40, 1,5 kW	500 - 2500 m <sup>3</sup> /h
- N 40, 2,2 kW	500 - 4000 m <sup>3</sup> /h
Motorleistung	siehe Produktschild
Drehzahl	siehe Motorschild
Spannung	siehe Motorschild
Phasen	siehe Motorschild
Frequenz	siehe Produktschild
Nennstrom	siehe Motorschild
<u>Gewicht</u>	
- N 16	13 kg
- N 24	17 kg
- N 29, 1,5 kW	28 kg
- N 29, 2,2 kW	32 kg
- N 40, 1,5 kW	25 kg
- N 40, 2,2 kW	29 kg
<u>Umgebungs- temperatur</u>	
Umgebungs- temperatur	-30°C bis +40°C
<u>Luftstrom- temperatur</u>	
Luftstrom- temperatur	Maximal 60°C
<u>Geräuschpegel*</u>	
- N 16	74 - 76 dB(A)
- N 24	75 - 79 dB(A)
- N 29	70 - 80 dB(A)
- N 40	60 - 80 dB(A)
Recycling- fähigkeit	95 % des Gewichts

\* gem. ISO 11203, Rohrleitung an Ein- und Auslass angeschlossen

**Caractéristiques techniques**

<u>Capacité</u>	
- N 16, 0,55 kW	400 - 1250 m <sup>3</sup> /h
- N 24, 0,75 kW	400 - 1500 m <sup>3</sup> /h
- N 24, 0,9 kW	400 - 1750 m <sup>3</sup> /h
- N 29, 1,5 kW	500 - 1500 m <sup>3</sup> /h
- N 29, 2,2 kW	500 - 3000 m <sup>3</sup> /h
- N 40, 1,5 kW	500 - 2500 m <sup>3</sup> /h
- N 40, 2,2 kW	500 - 4000 m <sup>3</sup> /h
Puissance du moteur*	
Régime du moteur**	
Tension / Phase**	
<u>Fréquence*</u>	
Current nominal**	
<u>Poids</u>	
- N 16	13 kg
- N 24	17 kg
- N 29, 1,5 kW	28 kg
- N 29, 2,2 kW	32 kg
- N 40, 1,5 kW	25 kg
- N 40, 2,2 kW	29 kg
<u>Température</u>	
Temp. ambiante	-30°C à +40°C
Temp. débit d'air	maximum 60°C
<u>Niveau sonore***</u>	
- N 16	74 - 76 dB(A)
- N 24	75 - 79 dB(A)
- N 29	70 - 80 dB(A)
- N 40	60 - 80 dB(A)
Recyclage des matériaux	95 % du poids

\* sur la plaque signalétique

\*\* sur la plaque moteur

\*\*\* selon ISO 11203, avec une conduite connectée à l'entrée et à la sortie

**Datos técnicos**

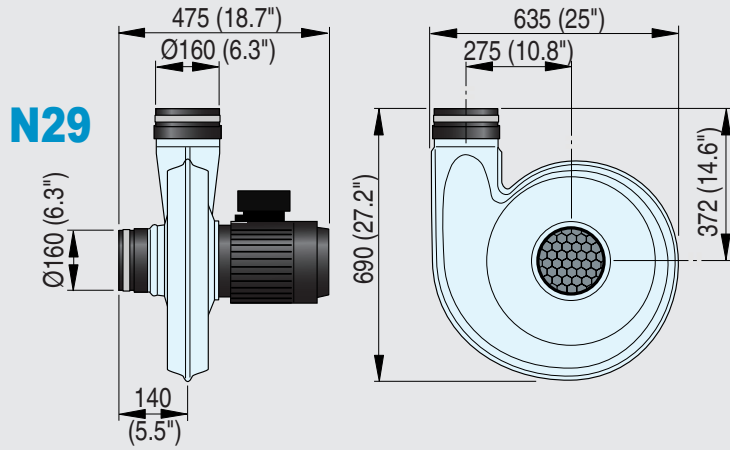
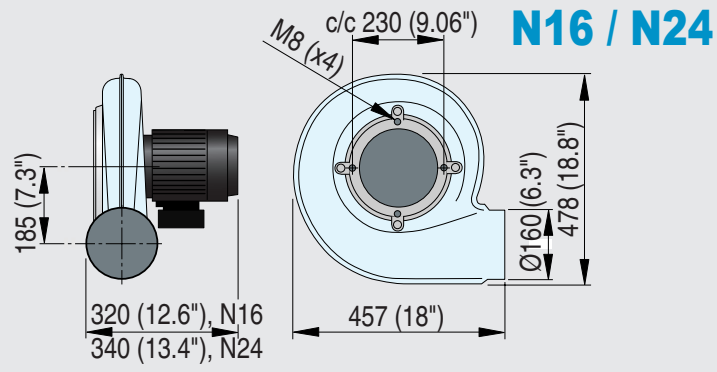
<u>Capacidad</u>	
- N 16, 0,55 kW	400 - 1250 m <sup>3</sup> /h
- N 24, 0,75 kW	400 - 1500 m <sup>3</sup> /h
- N 24, 0,9 kW	400 - 1750 m <sup>3</sup> /h
- N 29, 1,5 kW	500 - 1500 m <sup>3</sup> /h
- N 29, 2,2 kW	500 - 3000 m <sup>3</sup> /h
- N 40, 1,5 kW	500 - 2500 m <sup>3</sup> /h
- N 40, 2,2 kW	500 - 4000 m <sup>3</sup> /h
Potencia del motor*	
Revoluciones**	
Tensión / Fases**	
<u>Frecuencia*</u>	
Corriente nominal**	
<u>Peso</u>	
- N 16	13 kg
- N 24	17 kg
- N 29, 1,5 kW	28 kg
- N 29, 2,2 kW	32 kg
- N 40, 1,5 kW	25 kg
- N 40, 2,2 kW	29 kg
<u>Temperatura</u>	
Temp. ambiente	-30°C h. +40°C
Temp. flujo aire	máxima 60°C
<u>Nivel de ruidos***</u>	
- N 16	74 - 76 dB(A)
- N 24	75 - 79 dB(A)
- N 29	70 - 80 dB(A)
- N 40	60 - 80 dB(A)
Reciclaje del material	95 % del peso

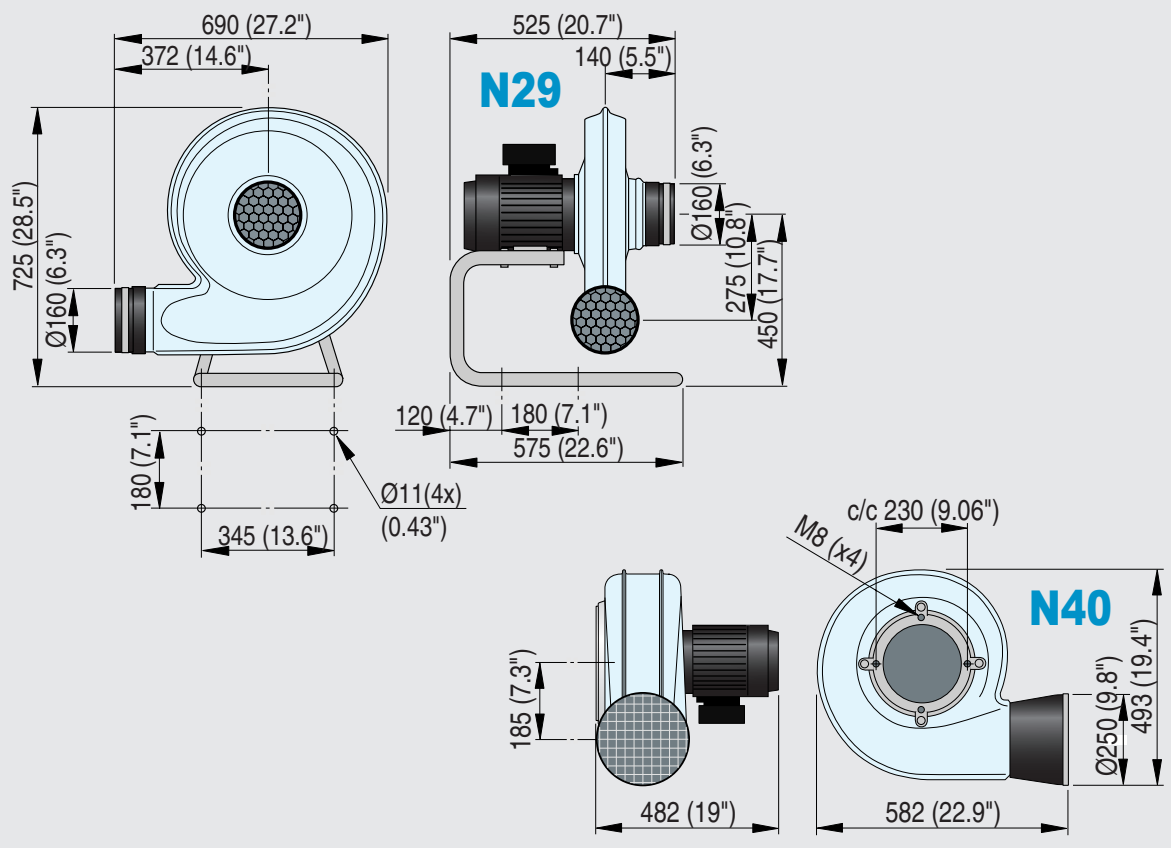
\* véase la placa de características

\*\* véase la placa del motor

\*\*\* según ISO 11203, con conducto conectado a la entrada y salida

Dimensions  
Abmessungen  
Dimensions  
Dimensiones  
Dimensioni  
Afmetingen  
Mitat  
Dimensioner





**GB ENGLISH**

To guarantee a correct function and a minimal service, it is important to read and understand the information in this instruction manual.

The manual contains important warning directions which have to be read and followed.

**D DEUTSCH**

Um optimale Funktion und minimalen Servicebedarf zu gewährleisten, ist es wichtig, daß Sie die Informationen in dieser Betriebsanleitung sorgfältig durchlesen.

Die Bedienungsanleitung enthält wichtige Sicherheitsvorschriften, die gelesen und befolgt werden müssen.

**FR FRANÇAIS**

Pour assurer le bon fonctionnement du matériel et réduire les entretiens, lire attentivement et respecter scrupuleusement les informations contenues dans ce manuel.

Le manuel contient des avertissements importants qui devront être lus et respectés.

**ES ESPAÑOL**

Para garantizar un funcionamiento correcto y una mínima necesidad de servicio, es importante leer este manual de instrucciones.

El manual contiene reglas de seguridad importantes que deben ser leídas y respetadas.

**IT ITALIANO**

Per garantire il corretto funzionamento e ridurre al minimo la manutenzione, è importante leggere attentamente e capire le informazioni contenute in questo manuale.

Il manuale contiene avvertenze importanti che devono essere lette attentamente e rispettate.

**NL NEDERLANDS**

Om een correcte werking en een minimum aan onderhoud te garanderen, is het belangrijk dat u de informatie in deze handleiding leest en begrijpt.

De handleiding bevat belangrijke aanwijzingen die moeten worden gelezen en nageleefd.

**FI SUOMI**

Oikean toiminnan ja mahdollisimman vähäisen huoltotarpeen varmistamiseksi on tärkeää perehtyä tässä ohjekäsikirjassa annettuihin tietoihin.

Käsikirja sisältää varoitusmääräyksiä, joiden lukeminen ja noudattaminen on tärkeää.

**SE SVENSKA DK DANSK**

För att säkerställa (sikre) rätt (korrekt) funktion och minimalt servicebehov (vedligeholdelse) är det viktigt att taga del av (läse og forstå) informationen i denna instruktionsmanual (betjeningsvejledning).

Manualen (vejledningen) innehåller viktiga varningsföreskrifter (advarselvejledninger) som måste läsas och följas.

**GB ENGLISH**

This product is designed to meet the requirements of the relevant EC directives. To maintain this status all installation, repair and maintenance work must be carried out by qualified personnel using only original spare parts. Contact your nearest authorised dealer or AB Ph. Nederman & Co. for advice on technical service or if you require spare parts.

**D DEUTSCH**

Dieses Produkt wurde unter Berücksichtigung der in den EG-Richtlinien festgelegten Anforderungen entwickelt. Um diesen Qualitätsanforderungen zu entsprechen, dürfen Installationen, Reparatur- und Wartungsarbeiten nur von Fachleuten unter Anwendung von Original-Ersatzteilen ausgeführt werden. Wenden Sie sich bei technischen Fragen oder bei Bedarf an Ersatzteilen an den nächstgelegenen autorisierten Fachhändler oder an AB Ph. Nederman & Co.

**FR FRANÇAIS**

Ce produit est conçu pour répondre aux normes des directives européennes. Dans ce cadre, l'installation, la réparation et la maintenance ne doivent être effectuées que par un personnel qualifié en n'utilisant que des pièces d'origine. Pour toute assistance technique et la fourniture de pièces détachées, veuillez vous adresser à votre revendeur le plus proche ou AB Ph. Nederman & Co.

**ES ESPAÑOL**

Este producto está diseñado y construido para cumplir con los requerimientos de las directivas de la Comunidad Europea que lo abarcan. Para mantener este estado, es necesario que la instalación, reparación y mantenimiento sólo sean efectuados por personal cualificado y utilizando repuestos originales. Para asesoría técnica o adquisición de repuestos, tengan la amabilidad de ponerse en contacto con el concesionario más cercano o AB Ph. Nederman & Co.

**IT ITALIANO**

Questo prodotto è costruito in conformità alle norme previste dalla direttiva CE. Per conservare queste condizioni, l'installazione, le riparazioni e la manutenzione devono essere eseguite solo da personale competente utilizzando ricambi originali. Contattare il rivenditore autorizzato più vicino o AB Ph. Nederman & Co. per consulenze in caso di interventi tecnici o di necessità di ricambi.

**NL NEDERLANDS**

Dit product is zo vervaardigd dat het voldoet aan de eisen in de EEG-richtlijnen. Om deze status te behouden mogen installatie, reparatie en onderhoud slechts worden uitgevoerd door vakkundig personeel en met gebruik van originele reserveonderdelen. Neem contact op met de dichtstbijzijnde geautoriseerde wederverkoper of AB Ph. Nederman & Co. voor adviezen bij technische service of voor reserveonderdelen.

**FI SUOMI**

Tämä tuote on suunniteltu ja valmistettu täyttämään asianmukaisen EY-direktiivien vaatimukset. Tämän tason säilyttämiseksi on asennuksessa, korjauksessa ja huollossa käytettävä asiantuntevaa henkilöstöä ja alkuperäisiä varaosia. Valmistaja AB Ph. Nederman & Co, maahantuoja Oy Tecalemit Ab ja lähin jälleenmyyjä antavat teknistä neuvontaa ja toimittavat varaosia.

**SE SVENSKA DK DANSK**

Denna produkt är konstruerad för att uppfylla kraven i de EG-direktiv den omfattas av. För att behålla (opretholde) denna status får installation, reparation och underhåll (vedligeholdelse) endast (kun) utföras av kompetent personal och med användning (brug) av original reservdelar. Kontakta närmaste auktoriserad återförsäljare (forhandler) eller AB Ph. Nederman & Co. för rådgivning vid teknisk service eller vid behov av reservdelar.



**Declaration of conformity**

We, AB Ph Nederman & Co., declare under our sole responsibility that the product **Fan N16 / N24 / N29 / N40** to which this declaration relates is in conformity with the following standards, directives or other normative documents:  
98/37/EC, 89/336/EEC, 73/23/EEC.

**Konformitätserklärung**

Wir, AB Ph Nederman & Co., erklären in alleiniger Verantwortung, dass das Produkt **Ventilator N16 / N24 / N29 / N40**, auf das sich diese Erklärung bezieht, mit den folgenden Normen, Bestimmungen oder normativen Dokumenten übereinstimmt:  
98/37/EC, 89/336/EEC, 73/23/EEC.

**Déclaration de conformité**

Nous, AB Ph. Nederman & Co., déclarons sous notre seule responsabilité que le produit **Ventilateur N16 / N24 / N29 / N40** auquel se réfère cette déclaration est conforme aux normes, directives ou autres documents normatifs: 98/37/EC, 89/336/EEC, 73/23/EEC.

**Dichiarazione di conformità**

Noi, AB Ph Nederman & Co., dichiariamo sotto la nostra esclusiva responsabilità che il prodotto **Elettroventilatore N16 / N24 / N29 / N40** al quale questa dichiarazione si riferisce è conforme alla seguente norma, direttiva o ad altri documenti normativi:  
98/37/EC, 89/336/EEC, 73/23/EEC.

**Overeenkomstigheidsverklaring**

Wij, AB Ph Nederman & Co., verklaren geheel onder eigen verantwoordelijkheid dat het produkt **Ventilator N16 / N24 / N29 / N40** waarop deze verklaring betrekking heeft, in overeenstemming is met de volgende normen, bepalingen of andere normatieve documenten: 98/37/EC, 89/336/EEC, 73/23/EEC.

**Vaatimustenmukaisuusvakuutus**

Me, AB Ph Nederman & Co., vakuutamme yksinomaan omalla vastuullaamme, että seuraava tuote: **Puhallin N16 / N24 / N29 / N40**, johon tämä vakuutus liittyy, on seuraavien standardien, direktiivin tai muiden normatiivisten asiakirjojen vaatimusten mukainen 98/37/EC, 89/336/EEC, 73/23/EEC.

### Declaración de Conformidad

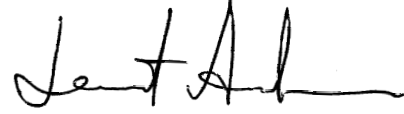
Nosotros, AB Ph. Nederman & Co. declaramos bajo nuestra exclusiva responsabilidad la conformidad del producto **Ventilador N16 / N24 / N29 / N40** al que se refiere esta declaración, con las normas, directivas u otros documentos normativos: 98/37/EC, 89/336/EEC, 73/23/EEC.

### Försäkran (erklæring) om överensstämmelse

Vi, AB Ph Nederman & Co., försäkrar (erklærer) under eget ansvar att produkten **Fläkt (ventilator) N16 / N24 / N29 / N40** som omfattas (dekkes) av denna försäkran (erklæring) är i överensstämmelse med följande standarder, direktiv eller andra regelgivande (normative) dokument: 98/37/EC, 89/336/EEC, 73/23/EEC.

**Nederman**® **CE**

**AB Ph. Nederman & Co.**  
Sydhamngatan 2  
S-252 28 Helsingborg  
Sweden  
2003-09-01



Lennart Andersson, Product Manager

## Mounting Instruction

- Ensure the fan unit has not been damaged during transport.
- Fans without stand are designed to be mounted directly on other Nederman products.

### WARNING!

#### Risk of personal injuries!



- Guard nets must be mounted on the inlet and outlet of the fan, unless the fan is fixed mounted and/or directly connected to ducting system (see fig.)
- A duct or a hose must always be fitted on the N40 fan inlet (see fig.).

- If the fan is fitted with stand (see accessories, last page) on wall or in ceiling, vibration secured fixing bolts suitable for the wall or ceiling material should be used. The bolts must each stand a torque force of minimum 800 N.
- If the fan is to be used indoors, and is not mounted on another Nederman product, it should be mounted as near the outlet in the room as possible, in order to give under-pressure in the ductwork.

## Montageanleitung

- Kontrollieren auf Transportschäden.
- Ventilatoren ohne Rohrgestell sind für die Direktmontage an andere Nederman-Produkte vorgesehen.

### WARNUNG!

#### Verletzungsgefahr!



- Schutzgitter am Ventilator-Einlass und -Auslass montieren, wenn der Ventilator nicht fest montiert und/oder direkt an das Kanalsystem angeschlossen ist (siehe Abbildung).
- Für Ventilator N40, immer sicherstellen, daß saugseitig ein Schlauch oder ein Rohrleitung angeschlossen ist (siehe Abbildung).

- Ist der Ventilator mit einem Rohrgestell (siehe Zubehör, letzte Seite) an der Wand oder in der Decke ausgerüstet, vibrationsfeste Schrauben und Muttern passend zu Wand oder Deckenaufbau benutzen. Zugkraft der Verschraubung mind. 800 N/Bolzen.
- Wenn der Ventilator im Innenraum benutzt werden soll und nicht an einem anderen Nederman-Produkt montiert ist, muss er so nahe wie möglich am Auslass im Raum angebracht werden, damit in den Luftkanälen ein Unterdruck herrscht.

## Instructions de montage

- Contrôler que le ventilateur n'a pas subi de dommages en cours de transport.
- Les ventilateurs sans berceau sont conçus pour être montés directement sur d'autres produits Nederman.

### ATTENTION!

#### Risque de blessure!



- Des grilles de protection doivent être montées sur l'entrée et la sortie du ventilateur, sauf si le ventilateur n'est pas monté fixement et/ou connecté directement à une tuyauterie (voir illustration).
- Une conduite ou un tuyau doivent toujours être montés sur l'entrée du ventilateur N40 (voir illustration).
- Si le ventilateur est équipé d'un berceau (voir accessoires, dernière page) sur un mur ou au plafond, utiliser des boulons et écrous anti-vibratoires convenant à la structure du mur/plafond. Les boulons devront tolérer un couple de torsion de 800 N.
- S'il est utilisé à l'intérieur, et n'est pas monté sur un autre produit Nederman, le ventilateur devra être monté le plus près possible de l'orifice d'évacuation du local pour assurer une pression normale dans le réseau aéraulique.

### Instrucciones de montaje

- Comprobar que el ventilador no haya sufrido daños durante el transporte.
- Los ventiladores sin soporte están diseñados para ser montados directamente en otros productos Nederman.

#### ¡ADVERTENCIA!

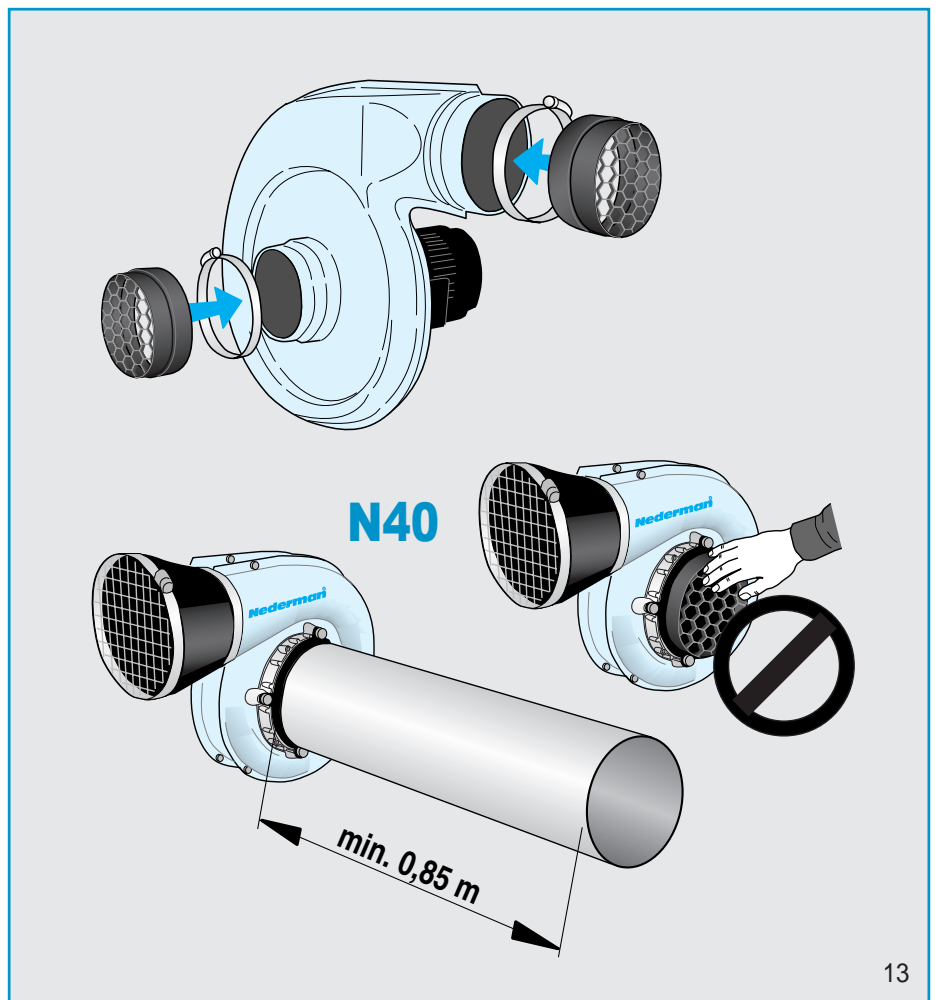
##### ¡Peligro de daños personales!



- Se deben montar rejillas protectoras en la entrada y salida del ventilador, a menos que éste no esté montado de forma permanente y/o conectado directamente al sistema de conductos (ver la figura).
- En la entrada del ventilador N40 se debe montar siempre un conducto o una manguera (ver la figura).

• Si el ventilador se fija con un soporte (ver "Accesorios" en la última página) en la pared o el techo, utilizar tornillos de montaje anti-vibración adecuados para el material de la pared/techo. Los tornillos deben soportar cada uno una fuerza de torsión de 800 N como mínimo.

• Para el uso en interiores, y si no está montado en otro producto Nederman, el ventilador debe colocarse lo más cerca posible de la salida para crear una presión negativa en el sistema de conductos.



## Montageinstruktion

- Kontrollera att fläkten (ventilatorenheden) inte är transportskadad.
- Fläktar (ventilatorer) utan stativ är avsedda att monteras direkt på andra Nederman-produkter.

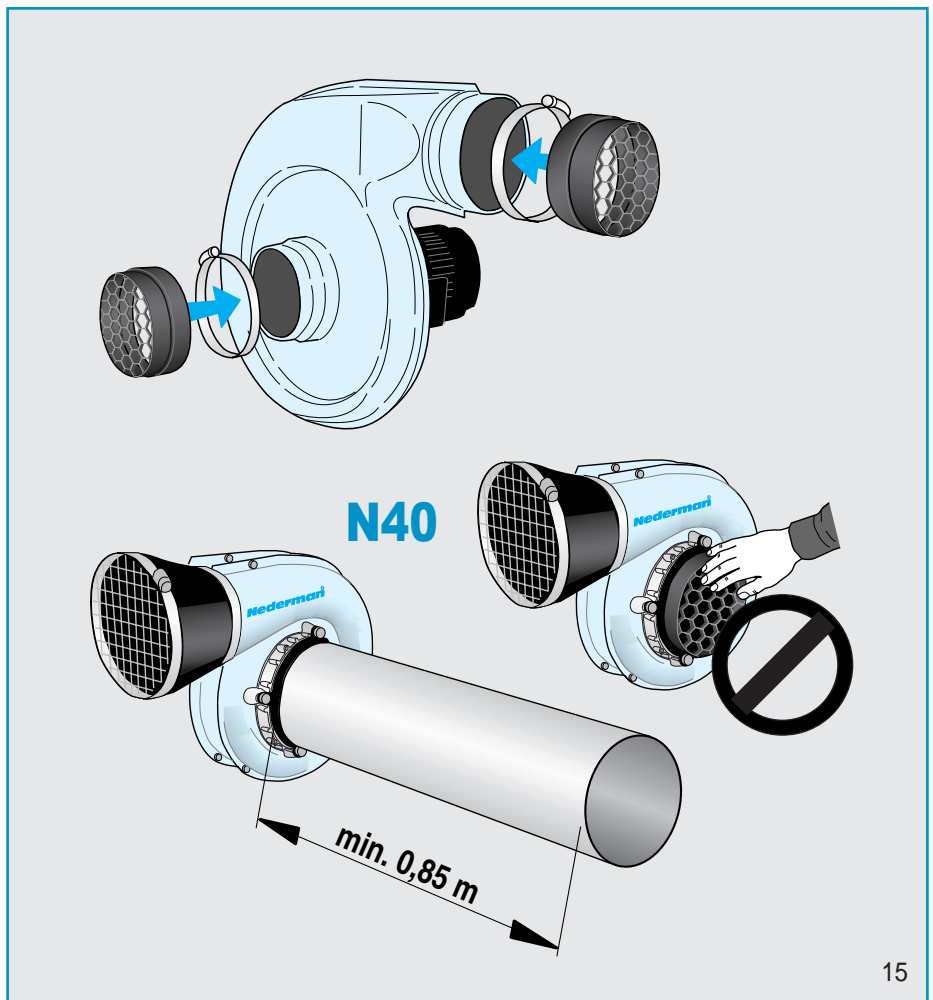
### VARNING (ADVARSEL)!



#### Risk för personskador!

- Skyddsgaller (beskyttelsenet) skall monteras på fläktens (ventilatorens) inlopp (indgang) och utlopp (udgang) om inte (for so vidt) fläkten används i fasta installationer och/eller är ansluten (forbundet) direkt till ett kanal(rør)system.
- Anslut alltid kanal (rør) eller slang till N40-fläktens (-ventilatorens) inlopp (indgang).

- Om fläkten (hvis ventilatoren) monteras med stativ (se tillbehör sista sidan) på vägg eller i tak (loft) skall vibrationssäkra fästelement (monteringsbolte) som passar underlaget användas (der egner sig til væg/loftsmaterialet). Fästbultarna skall vardera (hver især) klara en drag(træk)kraft på minst 800 N.
- Om fläkten (hvis ventilatoren) används inomhus och inte är monterad på annan Nederman-produkt, skall den monteras så nära (tæt på) utloppet (rørudgangen) i lokalen som möjligt för att ge undertryck i kanal(rør)systemet.



## Electrical installation

**IMPORTANT! All electrical work must be done by a qualified electrician according to local regulations.**

Check that the mains voltage is the same as on the fan's sign plate. Then connect the fan according to wiring diagram in the fan's junction box.

It is recommended to supply the fan with a lockable safety switch on the mains connection cable.

A motor overload protector should always be included in the electrical installation.

Variable speed drive is not possible on 1-phase fans with standard motors. For 3-phase fans a frequent converter can be used (max. frequency = rated frequency).

### Starting Instructions

- Check the cable connections for tightness.
- Check the earthing of the electric motor.
- Start the fan and check that it operates without any excessive vibration and noise.
- **IMPORTANT!** On 3-phase fans it is recommended to check that the motor shaft rotates in the right direction (see rotation arrow on the motor). If the shaft rotates in the wrong direction, two of the connection cable conductors must be reversed.

## Elektrische Installation

**WICHTIG! Alle Elektrikarbeiten müssen unter Beachtung der lokalen Vorschriften von einem qualifizierten Elektriker ausgeführt werden.**

Überprüfen, ob die aktuelle Netzspannung mit der Nennspannung des Ventilators übereinstimmt. Danach Ventilator gemäß Anleitung an die Ventilatoranschlußdose anschließen.

Es wird empfohlen, den Ventilator über einen verriegelbaren Sicherheitsschalter am Netzanschlusskabel mit Strom zu versorgen.

Die Elektroinstallation sollte stets einen Motor-Überlastschutz beinhalten.

Ein drehzahlveränderlicher Antrieb ist bei 1-Phasen-Ventilatoren mit Standardmotor nicht möglich. Bei 3-Phasen-Ventilatoren kann ein Frequenzumrichter verwendet werden (max. Frequenz = Nennfrequenz).

### Startanleitungen

- Kontrollieren, ob alle Kabelverbindungen fest angezogen sind.
- Erdung des Ventilators kontrollieren.
- Den Ventilator starten und sicherstellen, dass er ohne übermäßige Schwingungen und Geräusche läuft.
- **WICHTIG!** Bei 3-Phasen-Ventilatoren muß kontrolliert werden, ob die Motorwelle die richtige Drehrichtung hat (siehe Pfeil am Motor). Dreht sich die Motorwelle in die falsche Richtung, müssen zwei Phasen getauscht werden.

## Installation électrique

**IMPORTANT! Les travaux électriques sont réservés à des électriciens qualifiés, conformément à la législation locale.**

S'assurer que la tension réseau correspond à la tension nominale du ventilateur, puis brancher celui-ci en suivant les connexions indiquées dans le boîtier de connexion.

Il est recommandé d'équiper le ventilateur d'un interrupteur de sécurité verrouillable sur le câble de connexion au réseau.

Une protection contre la surcharge du moteur doit toujours être comprise dans l'installation électrique.

Les ventilateurs monophasés avec moteur standard ne permettent pas un entraînement à vitesse variable. Pour les ventilateurs triphasés, un convertisseur de fréquence peut être utilisé (fréquence max. = fréquence nominale).

### Instructions de mise en marche

- Contrôler que les connexions de câble sont correctement serrés.
- Contrôler la mise à la terre du moteur.
- Démarrer le ventilateur et contrôler qu'il fonctionne sans excès de vibration et de bruit.
- **IMPORTANT!** Pour les ventilateurs triphasés, s'assurer que l'axe moteur tourne dans le sens de la flèche indiquée sur le moteur. Dans le cas inverse, intervertir deux des phases.

### Instalación eléctrica

**¡IMPORTANTE!** Todos los trabajos eléctricos deben ser realizados por un electricista cualificado conforme a las regulaciones locales.

Controlar que la tensión de la red coincida con la placa de características del ventilador. Conectar después el ventilador según el diagrama de la caja de conexiones.

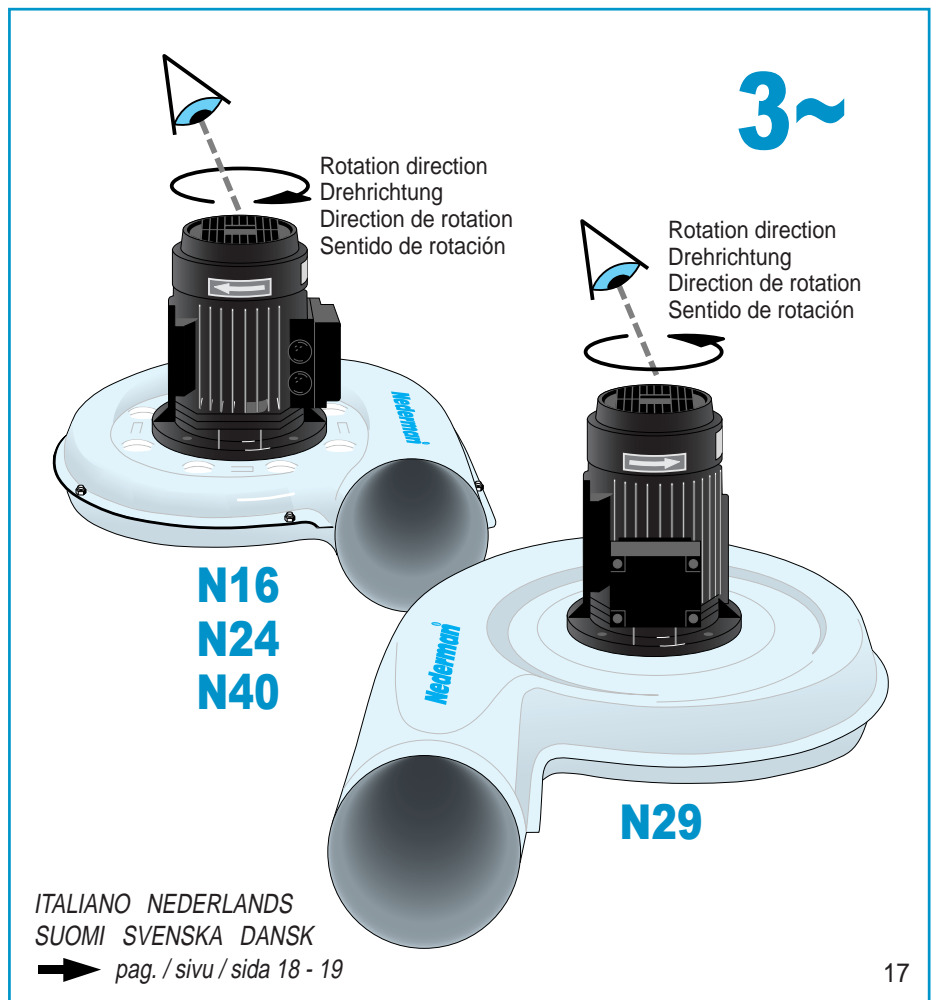
Se recomienda equipar el ventilador con un interruptor de seguridad bloqueable en el cable de conexión a la red.

La instalación eléctrica siempre debe incluir una protección contra sobrecargas del motor.

El accionamiento con velocidad variable no es posible en ventiladores monofásicos con motores estándar. Para ventiladores trifásicos se puede utilizar un convertidor de frecuencia (frecuencia máx. = frecuencia nominal).

### Instrucciones de arranque

- Controlar que las conexiones de cables estén bien apretadas.
- Controlar la conexión a tierra del motor.
- Arrancar el ventilador y comprobar que funcione sin exceso de vibraciones y ruidos.
- **¡IMPORTANTE!** En los ventiladores trifásicos hay que controlar que el eje del motor gira en el sentido correcto (véase la flecha indicadora en el motor). Si el eje gira en dirección equivocada, dos de los cables conductores deberán ser invertidos.



## Installazione elettrica

**IMPORTANTE!** Tutti i lavori sull'impianto elettrico devono essere effettuati da un elettricista qualificato nel rispetto delle norme locali.

Controllare che la tensione della rete sia la stessa della tensione indicata sul ventilatore. Collegare poi il ventilatore in base al diagramma fili nella scatola connessioni del ventilatore.

Si consiglia di dotare il ventilatore di un interruttore di sicurezza bloccabile sul cavo di rete.

L'installazione elettrica deve sempre comprendere una termica motore.

I ventilatori a 1 fase con motore standard non possono funzionare a velocità variabile. Per i ventilatori a 3 fasi può essere utilizzato un convertitore di frequenza (frequenza max = frequenza nominale).

## Istruzioni per l'avviamento

- Controllare che le viti siano serrate.
- Controllare la messa a terra del motore.
- Avviare il ventilatore e controllare che non presenti vibrazioni o rumori anomali.
- **IMPORTANTE!** Con i ventilatori a 3 fasi si deve controllare che l'asse motore ruoti nella direzione giusta (vedi freccia di rotazione sul motore). In caso di errata rotazione del motore, occorre invertire due delle fasi.

## Elektrische installatie

**BELANGRIJK!** Alle werkzaamheden aan elektronica dienen door gekwalificeerde elektriciens te worden uitgevoerd volgens de plaatselijk geldende verordeningen.

Controleer of de netspanning ter plaatse overeenkomt met de spanning op de kenplaat van de ventilator. Sluit vervolgens de ventilator aan volgens de aanwijzingen in de aansluitdoos van de ventilator.

Het wordt aanbevolen de ventilator te voorzien van een te blokkeren veiligheidschakelaar op de hoofdkabel.

Er moet altijd een overstroombeveiliging bij de elektrische installatie zitten.

Bij 1-fase ventilatoren met een standaard motor is geen regelaandrijving mogelijk.

Bij 3-fase ventilatoren kan een frequentie-omzetter gebruikt worden (max. frequentie = nominale frequentie).

## Startinstructies

- Controleer of de schroefverbindingen goed vastzitten.
- Controleer de aarding van de ventilatormotor.
- Start de ventilator en controleer of deze geen overmatige trillingen of geluiden voortbrengt.
- **NB!** Bij 3-fase ventilatoren dient eveneens de draairichting gecontroleerd te worden (zie de pijl op de motor). Indien de draairichting onjuist is dienen twee van de fasen met elkaar verwisseld te worden.

## Sähköasennus

**TÄRKEÄÄ!** Kaikki sähkötyöt saa tehdä vain pätevä sähköasentaja paikallisten määräysten mukaisesti.

Tarkista, että verkon jännite on sama, kuin puhaltimen arvokilvessä. Tämän jälkeen suorita puhaltimen oleyntä puhaltimen kytkentärasiasa olevan kytkentäkaavion osoittamalla tavalla.

On suositeltavaa varustaa puhaltimen verkkokaapeli lukittavalla turvakylimellä. Moottoriin tulisi aina asentaa ylikuorimitussuoja.

Puhaltimen kierrosluvun säätö ei ole mahdollista 1-vaihepuhaltimissa, joissa on vakimoottorit. 3-vaihepuhaltimissa voidaan käyttää taajuusmuunninta (maks. taajuus = nimellistaajuus).

## Käynnistysohjeet

- Tarkasta ruuviliitosten kireys.
- Tarkasta sähkömoottorin maadoitus.
- Käynnistä puhallin ja tarkasta, ettei se tärisä eikä ääntele epänormaalisti.
- **TÄRKEÄÄ!** Puhaltimissa, jotka käyttävät kolmevaihesähköä, on syytä tarkistaa, että moottorin akseli pyörii oikeaan suuntaan (katso moottoriin merkittyä pyörimissuuntaa osoittavaa nuolta). Jos akseli pyörii väärään suuntaan, on kaksi vaihetta käännettävä päinvastaiseksi.



## Elektrisk installation

**VIKTIGT! Allt elektriskt arbete måste (må kun) utföras av en behörig elektriker enligt gällande lokala föreskrifter.**

Kontrollera att aktuell nätspänning stämmer med fläktens (ventilatorens) märkspänning. Koppla sedan in fläkten efter kopplingsanvisningen (ledningsdiagrammet) i fläktens kopplingsdosa (tillslutningsdåse).

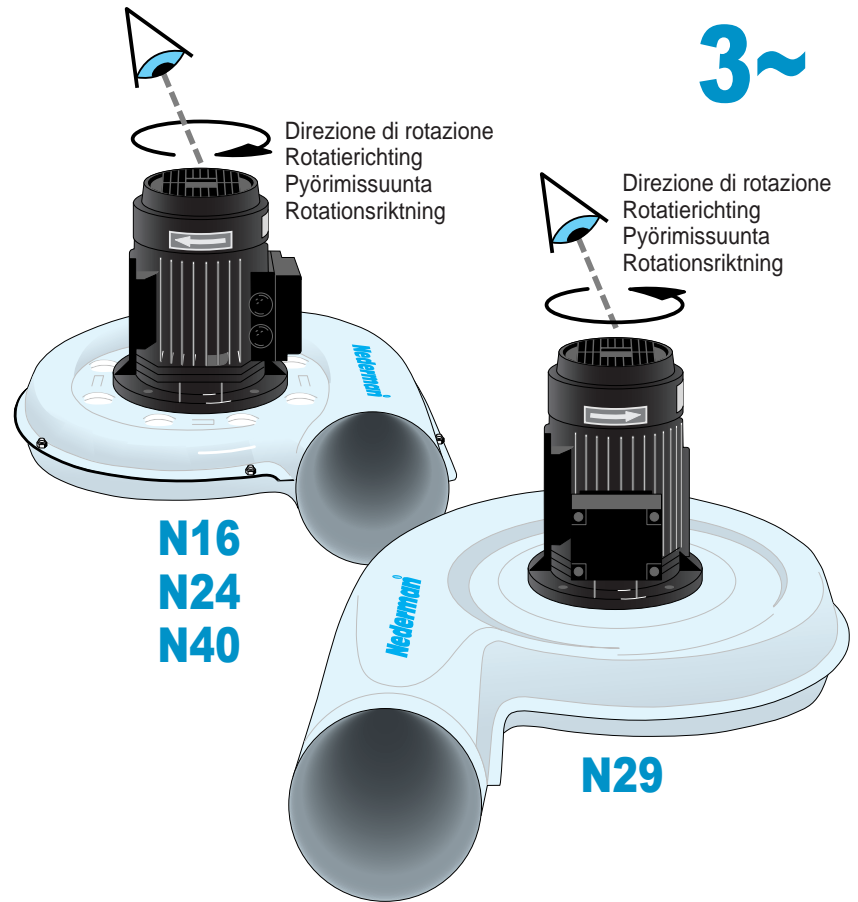
Fläkten (ventilatoren) bör förses (forsynes) med en låsbar (aflåselig) säkerhetsbrytare på nätanslutningskabeln (netkablet).

Motorskydd (beskyttelseanordning mod överbelastning) skall alltid ingå i den elektriska installationen.

Varvtalsstyrning (variabel hastighed) kan inte utföras (er ikke mulig) på 1-fas-fläktar (-ventilatoren) med standardmotorer. För (ved) 3-fas-fläktar kan frekvensomriktare användas (max frekvens = nominell frekvens).

### Startinstruktioner

- Kontrollera att kabelanslutningarna (ledningsförbindelserne) är fast åtdragna (sidder fast).
- Kontrollera fläktmotorns jordning.
- Starta fläkten (ventilatoren) och kontrollera att den inte vibrerar på ett onormalt sätt.
- **VIKTIGT!** På 3-fas-fläktar skall kontrolleras att motoraxeln roterar i rätt riktning (rigtige retning) (se rotationspil på motorn). Om axeln roterar åt fel håll (i forkerte retning) skall två av inkopplingskabelns (-ledningens) ledare byta plats med varandra (byttes rundt).



**Outdoor use / Draining**

If the fan shall be used without any protection outdoors or under other circumstances where moisture and condensation can be present, it must be checked that the motor is provided with draining holes. Make sure these holes are open. In the lowest level in one of the fan casings a draining hole must be drilled (approx. Ø 5 mm) Then treat the hole with anticorrosive agent.

If the motor is not provided with draining holes the fan must be protected with a suitable cover.

**Betrieb im Freien / Entleerung**

Wenn der Ventilator ungeschützt im Freien oder unter Bedingungen angewendet werden soll, wo Feuchtigkeit oder Kondensat entstehen kann, muss sichergestellt werden, dass der Motor über Ablauföffnungen verfügt. Sicherstellen, dass diese Öffnungen unverschlossen sind. Am niedrigsten Punkt muss in eines der Ventilatorgehäuse eine Ablauföffnung gebohrt werden (ca. Ø 5 mm). Anschließend die Öffnung mit Korrosionsschutzmittel behandeln.

Sind im Motor keine Ablauföffnungen vorhanden, so muss der Ventilator durch eine geeignete Abdeckung geschützt werden.

**Utilisation extérieure / Drainage**

Pour utiliser le ventilateur non protégé, au dehors ou dans tout endroit où l'humidité ou la condensation peuvent se produire, contrôler que le moteur comporte des trous d'évacuation et s'assurer qu'ils sont ouverts. Percer un trou d'évacuation (Ø 5 mm env.) au niveau inférieur de l'un des logements du ventilateur. Puis appliquer un agent anti-rouille sur le trou.

Si le moteur ne comporte pas de trous d'évacuation, le ventilateur doit être protégé à l'aide d'un carter approprié.

**Utilizzo in esterni / Drenaggio**

Se il ventilatore deve essere utilizzato senza protezione all'esterno oppure in altre circostanze, in presenza di umidità o di condensa, controllare che il motore sia dotato di fori di spurgo e che i fori siano pervi. E' necessario praticare un foro di spurgo nel livello inferiore di uno dei carter del ventilatore (circa Ø 5 mm). Applicare quindi al foro anticorrosivo.

Se il motore non è dotato di fori di spurgo, proteggere il ventilatore con un coperchio adatto.

**Gebruik buitenshuis / Afwatering**

Indien de ventilator zonder bescherming buitenshuis wordt gebruikt of in een vochtige omgeving waar condens kan ontstaan, moet worden gecontroleerd of de motor is voorzien van afwateringsgaten. Zorg ervoor dat deze gaten open zijn. Er moet een afwateringsgat geboord worden (ongeveer Ø 5mm) op het laagste niveau in een van de ventilatorbehuizingen. Behandel het gat daarna met een roestweermiddel.

Indien de motor niet is voorzien van afwateringsgaten, moet de ventilator worden beschermd met een geschikte kap.

**Käyttö ulkotiloissa / Valumaveden ohjaus**

Jos puhallinta käytetään ulkoilmassa ilman suojaa, tai muissa olosuhteissa joissa kosteutta voi tiivistyä, on tarkastettava, että moottorissa on valumaveden ohjausreiät. Varmista, että nämä reiät ovat auki. Poraa yhteen puhallinkoteloista mahdollisimman alas reikä (noin Ø 5 mm) ja käsittele se ruosteenestoaineella.

Jos moottorissa ei ole valumaveden ohjausreikiä, puhallin on suojattava sopivalla suojakotelolla.

### Uso en exteriores / Drenaje

Si el ventilador se utiliza sin protección al aire libre o en condiciones en las que pueden formarse humedad o condensaciones, se debe comprobar que el motor tenga agujeros de drenaje. Asegurarse de que los agujeros estén abiertos. En el nivel inferior de una de las carcasas del ventilador, se debe perforar un agujero de drenaje (aprox. Ø 5 mm). Después, tratar el agujero con agente anticorrosión.

Si el motor no tiene agujeros de drenaje, debe ser protegido con una cubierta adecuada.

### Utomhusbruk / Dränering (afløb)

Om fläkten (hvis ventilatoren) skall användas oskyddad utomhus (udendørs), eller under andra förhållanden där fukt eller kondens kan uppstå, skall kontrolleras att motorn är försedd (forsynet) med dräneringshål (afløbshuller). Se till (kontrollér) att dessa är öppna (åbne).

I en av fläktkåpornas lägsta nivå (på det laveste sted i et af ventilatorens kabinetter) skall borrar ett dräneringshål (afløbshul) (ca. Ø 5 mm) som sedan skall rostskyddsbehandlas.

Om (hvis) motorn saknar (ikke har) dräneringshål (afløbshuller) skall fläkten skyddas med lämplig överbyggnad (passende kappe).

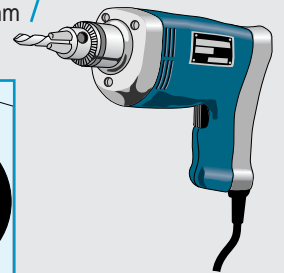
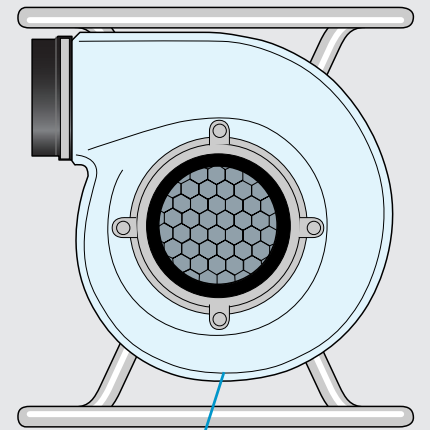
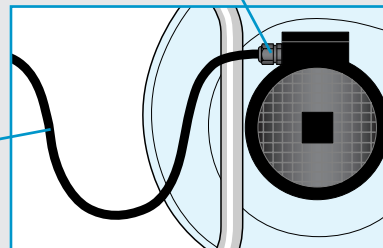
Recommended protection class  
Empfohlene Schutzklasse  
Classe de protection recommandé  
Grado de protección recomendado  
Protezione consigliata  
Aanbevolen veiligheidsklasse  
Suositeltava kotelointiluokka  
Rekommenderad skyddsklass

IP 68

Ø 5 mm

#### N.B.

Cable with loop  
Kabel mit Schleife  
Câble avec boucle  
Cable con bucle  
Cavo non teso  
Kabel met kringloop  
Kaapelisilmukka  
Slack kabel



**WORK SAFETY REGULATIONS**

**Risk of personal injury, fire or explosion.**

- The fan must not be installed in an environment with danger of explosion or be used for transporting inflammable or explosive dust or gases.
- The fan must not be used without ductwork connected, unless the in- and outlet are equipped with approved guard nets.
- Always disconnect the fan motor from mains with the isolator before starting any maintenance or repair work.
- Always use a breathing mask when repairing and servicing the system.
- Ear protectors should be used when working near the fan.

**SICHERHEITS-VORSCHRIFTEN**

**Gefahr für Personenschäden, Feuer oder Explosion.**

- Der Ventilator darf nicht an einem Ort installiert werden, an dem Explosionsgefahr besteht, oder zur Absaugung entflammbarer oder explosiver Staube/Gase eingesetzt werden!
- Der Ventilator darf nicht benutzt werden, wenn keine Kanäle angeschlossen sind, es sei denn, sowohl Einlaß- als auch Auslaßöffnung sind mit zugelassenen Schutznetzen versehen.
- Vor Beginn von Wartungsarbeiten oder Reparaturen immer zuerst den Ventilatormotor durch Drücken des Sicherheitsschalters vom Netz trennen.
- Bei Wartungs- und Reparaturarbeiten am System immer eine Staubschutzmaske tragen.
- Beim Aufenthalt in der Nähe des Ventilators Ohrenschutz tragen.

**CONSIGNES DE SÉCURITÉ**

**Risque de blessures personnelles ou d'incendie et d'explosion.**

- Le ventilateur ne doit pas être installé dans des environnements à risque d'explosion ou utilisé pour le transport de gaz/poussières inflammables ou explosifs.
- Le ventilateur ne devra pas être utilisé tant que les tuyaux ne sont pas connectés, à moins que les arrivées et sorties d'écoulement soient protégées par des grilles de protection appropriées.
- Toujours arrêter le ventilateur à l'aide de l'interrupteur avant de procéder à des réparations ou des travaux d'entretien.
- Toujours utiliser un masque contre la poussière lors de réparations ou de travaux d'entretien sur le système.
- Des protecteurs d'oreilles devront être utilisés à proximité du ventilateur.

**INSTRUCCIONES DE SEGURIDAD**

**Riesgo de daños personales, incendio y explosión.**

- El ventilador no debe ser instalado en entornos con riesgo de explosión ni ser utilizado para transportar polvos o gases inflamables ni explosivos.
- No utilizar el ventilador si no tiene conectados los conductos, a menos que la entrada y la salida estén equipadas con rejillas protectoras aprobadas.
- Desactivar siempre el motor del ventilador de la red con el aislador antes de comenzar los trabajos de mantenimiento o reparación.
- Utilizar siempre mascarilla con filtro al reparar y mantener el sistema.
- Utilizar protección auricular al estar cerca del ventilador.

**Maintenance**

*(is recommended at least once a year)*

- Listen for noise and touch the fan casings with the hand and notice if the fan vibrates in an abnormal way. If necessary, disconnect the fan from mains, dismount the fan and clean the impeller (not possible on N29 fan) Use breathing mask.
- Check the fan's suction capacity. On 3-phase fans, check that the motor shaft rotates in the right direction (see page 16). Check that the ducts are not blocked. Clean if necessary (use breathing mask).
- Check the electrical installation.
- Check that the mains connection cable is not worn or damaged.
- If the fan has been mounted with stand on wall or in ceiling, check the fitting.
- Check and tighten any loose duct connections.
- Check that the guard nets are in position.

**Wartung**

*(wird mindestens einmal jährlich empfohlen)*

- Auf Geräusche hören und die Ventilatorgehäuse mit der Hand berühren, um festzustellen, ob abnormale Schwingungen vorhanden sind. Ggf. den Ventilator vom Netz trennen, demontieren und das Laufrad reinigen (beim Ventilator N29 nicht möglich). Atemschutzmaske tragen.
- Die Saugleistung des Ventilators prüfen. Bei 3-Phasen-Ventilatoren muss kontrolliert werden, ob die Motorwelle die richtige Drehrichtung hat (siehe Seite 16). Sicherstellen, dass die Rohrleitungen nicht blockiert sind. Ggf. reinigen (Atemschutzmaske tragen).
- Elektroinstallation kontrollieren.
- Sicherstellen, dass das Netzanschlusskabel weder verschlissen noch gequetscht ist.
- Bei Wand- oder Deckenmontage des Ventilators mit einem Rohrgestell die Montagevorbereitung kontrollieren.
- Alle Kanalschlüsse überprüfen und, wenn nötig, festziehen.
- Sicherstellen, dass die Schutzgitter fest montiert sind.

**Entretien**

*(rec. au moins une fois par an)*

- Écouter pour détecter les éventuels bruits anormaux et toucher les boîtiers du ventilateur avec la main pour détecter les éventuelles vibrations anormales. Si nécessaire, déconnecter le moteur du ventilateur du réseau, démonter le ventilateur et nettoyer la turbine (impossible sur le ventilateur N29). Utiliser un masque respiratoire.
- Contrôler la capacité d'aspiration du ventilateur. Pour les ventilateurs triphasés, s'assurer que l'axe moteur tourne dans le sens (voir page 16). Contrôler que les conduites ne sont pas bloquées. Nettoyer si nécessaire (utiliser un masque respiratoire).
- Contrôler l'installation électrique.
- Contrôler que le câble de connexion au réseau n'est pas usé ou coincé.
- Si le ventilateur est monté avec un berceau sur le mur ou au plafond, contrôler les fixations.
- Contrôler et serrer les raccords de tuyaux.
- Contrôler que les grilles de protection sont montées fixement.

**Mantenimiento**

*(se recomienda como mínimo una vez al año)*

- Escuchar si hay ruido y tocar las carcassas del ventilador para controlar si se producen vibraciones anormales. Si es necesario, desconectar el ventilador de la red, desarmar el ventilador y limpiar la turbina (no es posible en el ventilador N29). Utilizar mascarilla protectora.
- Comprobar al capacidad de aspiración del ventilador. En los ventiladores trifásicos comprobar que el eje del motor gire en el sentido correcto (ver la pág. 17). Comprobar que los conductos no estén bloqueados. Limpiar si es necesario (utilizar mascarilla protectora).
- Controlar la instalación eléctrica.
- Comprobar que el cable de conexión de la red no esté gastado ni aprisionado.
- Si el ventilador ha sido montado con soporte en la pared o el techo, comprobar la sujeción.
- Controlar y apretar las conexiones flojas de los conductos.
- Comprobar que las rejillas protectoras estén montadas firmemente.

**Spare parts**

When ordering parts always state:  
 - Part no. and control no. (from the type label of the product).  
 - Detail no. of the spare part and the name (as per list below).  
 - Quantity of the parts required.

1. Motor
2. Protection cover and cooling fan for motor
2. Stand (N29 only)
3. Connecting ring
3. Motor (N29 only)
4. Capacitor (1-phase fans only)
4. Outlet connection (N29 only)
5. Guard net (N29 only)
8. Casing, motorside
9. Casing, inlet side
10. Impeller
11. Gasket
11. Casings / Impeller (N29 only)
12. Spacing plate (N40 only)
13. Inlet connection / Guard net
14. Outlet connection / Guard net
14. Protection cover (N29 only)
15. Cooling fan for motor (N29 only)

**Ersatzteile**

Bei der Bestellung immer angeben:  
 - Modell- und Kontrollnummer (s. Typenschild).  
 - Ersatzteilnummer mit Beschreibung (s. Liste unten).  
 - Anzahl erforderlicher Ersatzteile.

1. Motor
2. Abdeckung und Kühlventilator für den Motor
2. Rohrgestell (nur N29)
3. Anschlußring
3. Motor (nur N29)
4. Kondensator (nur 1-Phasen-Ventilator)
4. Auslaßstutzen (nur N29)
5. Schutzgitter (nur N29)
8. Gehäuse, Motorseite
9. Gehäuse, Ansaugseite
10. Laufrad
11. Dichtung
11. Gehäuse / Laufrad (nur N29)
12. Distanzblech (nur N40)
13. Einlaßstutzen / Schutzgitter
14. Auslaßstutzen / Schutzgitter
14. Abdeckung (nur N29)
15. Kühlventilator für den Motor (nur N29)

**Pièces de rechange**

Lors de la commande toujours spécifier:  
 - Numéro modèle et de contrôle (sur la plaque signalétique).  
 - Numéro et désignation de la pièce détachée (voir liste).  
 - Quantités des pièces requises.

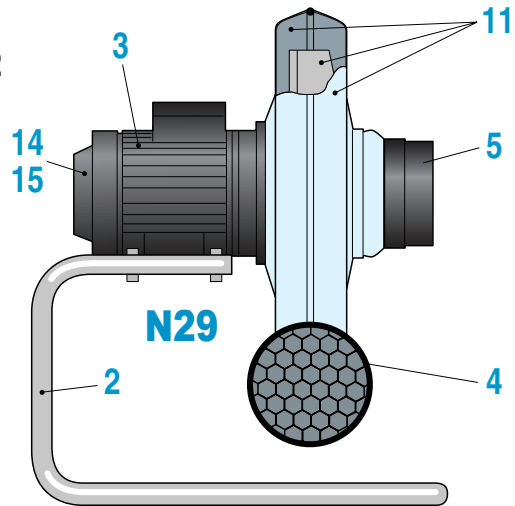
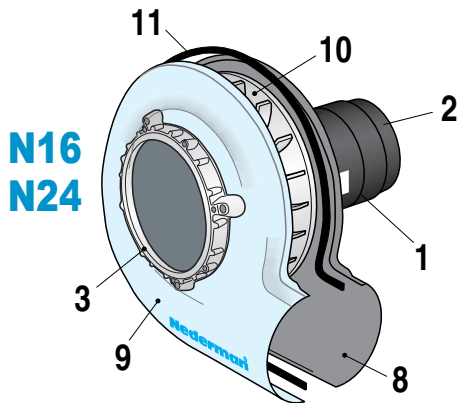
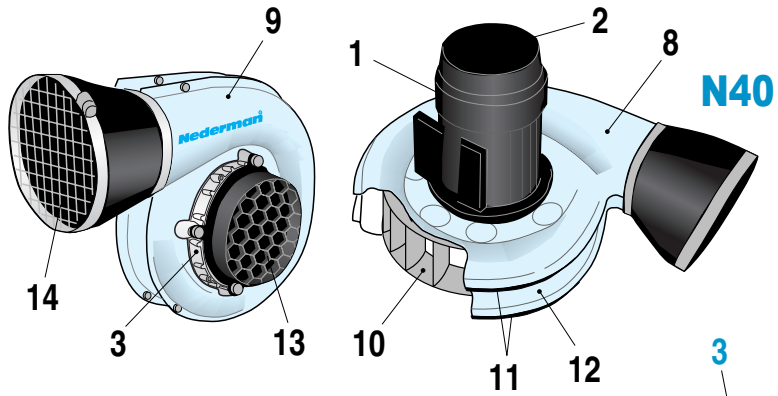
1. Moteur
2. Couvercle et ventilateur de refroidissement du moteur.
2. Berceau (N29 seulement)
3. Bague de connexion
3. Moteur (N29 seulement)
4. Condensateur (seulement ventilateur monophasé)
4. Manchette de refoulement (N29 seulement)
5. Grille de protection (N29)
8. Boîtier, côté moteur
9. Boîtier, côté entrée
10. Turbine
11. Joint d'étanchéité
11. Boîtiers / Turbine (N29)
12. Tôle d'écartement (N40)
13. Connexion d'entrée/ Grille de protection
14. Connexion de sortie / Grille de protection
14. Couvercle protecteur (N29)
15. Ventilateur de refroidissement pour moteur (N29 seulement)

**Piezas de repuesto**

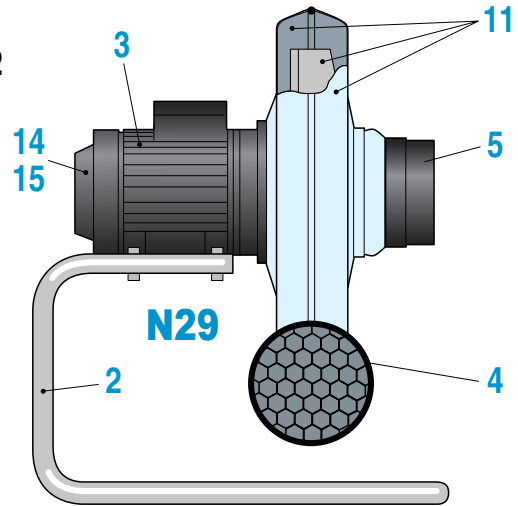
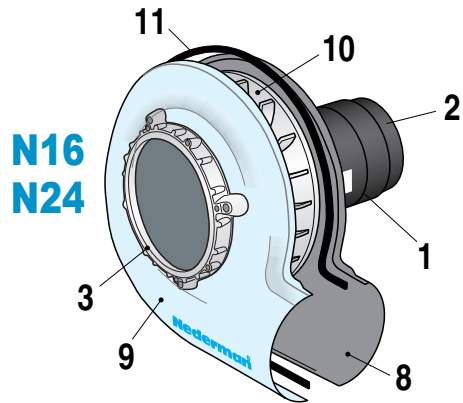
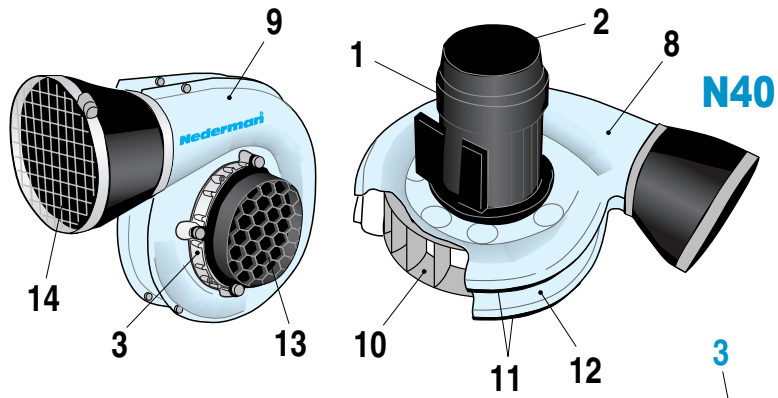
Cuando pida repuestos especifique siempre:  
 - N° del modelo/control de fabricación (ver placa de características).  
 - N° de despiece del repuesto y descripción (ver la lista más adelante).  
 - Cantidad de repuestos requeridos.

1. Motor
2. Cubierta protectora y ventilador de refrigeración para el motor
2. Soporte (sólo N29)
3. Anillo de conexión
3. Motor (sólo N29)
4. Condensador (sólo extractores monofásicos)
4. Boca salida (sólo N29)
5. Rejilla protectora (sólo N29)
8. Carcasa, lado motor
9. Carcasa, lado entrada
10. Turbina
11. Junta
11. Carcasas / Turbina (sólo N29)
12. Placa distanciadora (sólo N40)
13. Boca entrada / Rejilla protectora
14. Boca salida / Rejilla protectora
14. Cubierta protectora (sólo N29)
15. Ventilador de refrigeración para el motor (sólo N29)

Spare parts  
Ersatzteile  
Pièces de rechange  
Piezas de repuesto



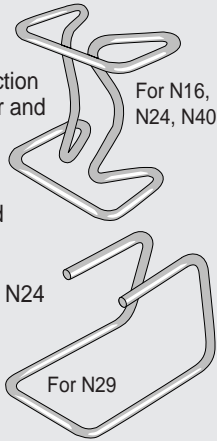
Parti di ricambio  
Reserveonderdelen  
Varaosat  
Reservdelar





**Stand**

Made of a galvanised tubular steel frame. The stand serves the dual function of protecting the fan motor and enabling easy positioning and handling of the fan unit. Fan with stand can also be fixed mounted on wall, floor or ceiling.



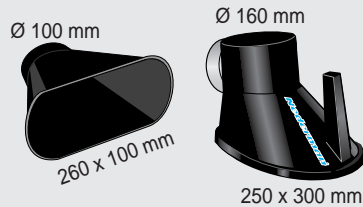
**Part no.**

- 14510126 For fan N16 or N24
- 14510226 For fan N40
- 14321745 For fan N29

**Welding nozzles**

**Part no.**

- 14500226 Aluminium, with magnet, 250 x 30 mm, Ø100 mm
- 14501226 Polycarbonate, with magnet, 260 x 100 mm, Ø100 mm
- 10371410 Polycarbonate, with magnet, 250 x 300 mm, Ø160 mm



**PVC-hoses**

supplied with two hose clamps

**Part no.**

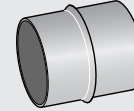
- 10500727 Ø75 mm, length 5 m, white
- 10500427 Ø100 mm, length 5 m, black
- 10500527 Ø125 mm, length 5 m, black
- 10500627 Ø150 mm, length 5 m, black
- 10511026 Ø160 mm, length 5 m, black

**Joining tubes**

To joint two hoses together

**Part no.**

- 14503626 Ø75 mm
- 14504626 Ø100 mm
- 14505626 Ø125 mm
- 14506626 Ø150 mm
- 14511326 Ø160 mm

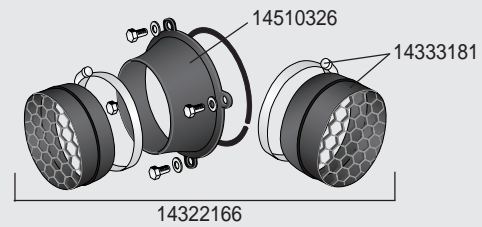


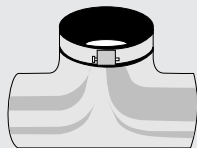
**Guard nets,**

**inlets and outlets**

**Part no.**

- 14510326 Inlet for fan N16/N24
- 14322166 Inlet and outlet incl. guard nets for fan N16/N24
- 14333181 Guard net for fan N16/N24





**Split intakes**

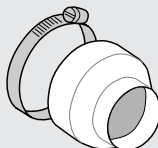
**Part no.**

- 14500526 Inside Ø125 mm - 2 pcs. outside Ø100 mm
- 14500726 Inside Ø125 mm - 2 pcs. outside Ø125 mm
- 14500826 Inside Ø125 mm - 2 pcs. outside Ø75 mm
- 14510726 Inside Ø160 mm - 2 pcs. outside Ø100 mm
- 14510826 Inside Ø160 mm - 2 pcs. outside Ø125 mm
- 14510926 Inside Ø160 mm - 2 pcs. outside Ø75 mm

**Adapters**

**Part no.**

- 14341077 Ø125 mm - Ø100 mm
- 14341080 Ø125 mm - Ø75 mm
- 14510426 Inside Ø160 mm - outside Ø75 mm
- 14510526 Inside Ø160 mm - outside Ø100 mm
- 14510626 Inside Ø160 mm - outside Ø125 mm
- 14511126 Ø150 mm - Ø125 mm
- 14511226 Ø160 mm - Ø150 mm



**Silencer**

**Part no.**

- 14502126 For fan when mounting on Fume Extractor Original or Teleopic
- 14502626 For fan when mounting on Fume Extractor 5000
- 14502926 For fan when mounting on Fume Extractor Original XL and NEX HD
- 14502226 For fan when mounting on Filterbox
- 14343089 Wallbracket for silencer



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## PERFORMANCE DATA

Revision: 20070111

**N Series Fan**  
**N40, 3Phase**

DATE

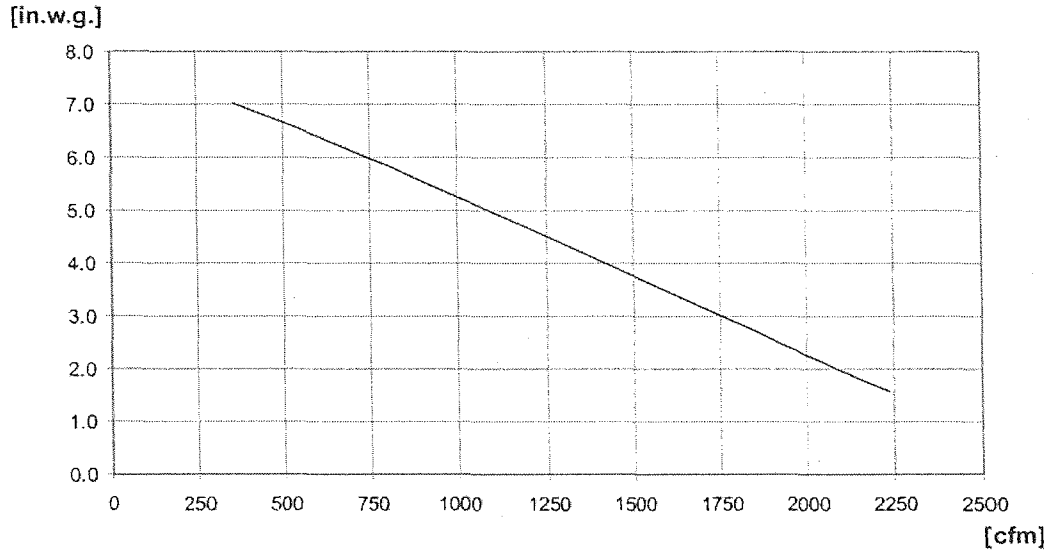
PROJECT

LOCATION

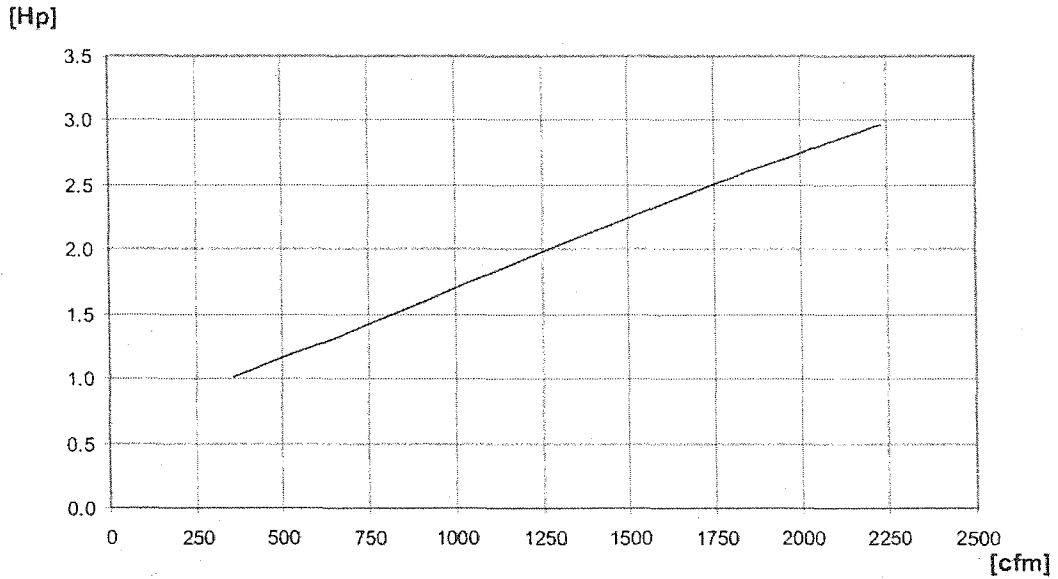
ARCH/ENG

REP. NAME

**Airflow**



**Power**



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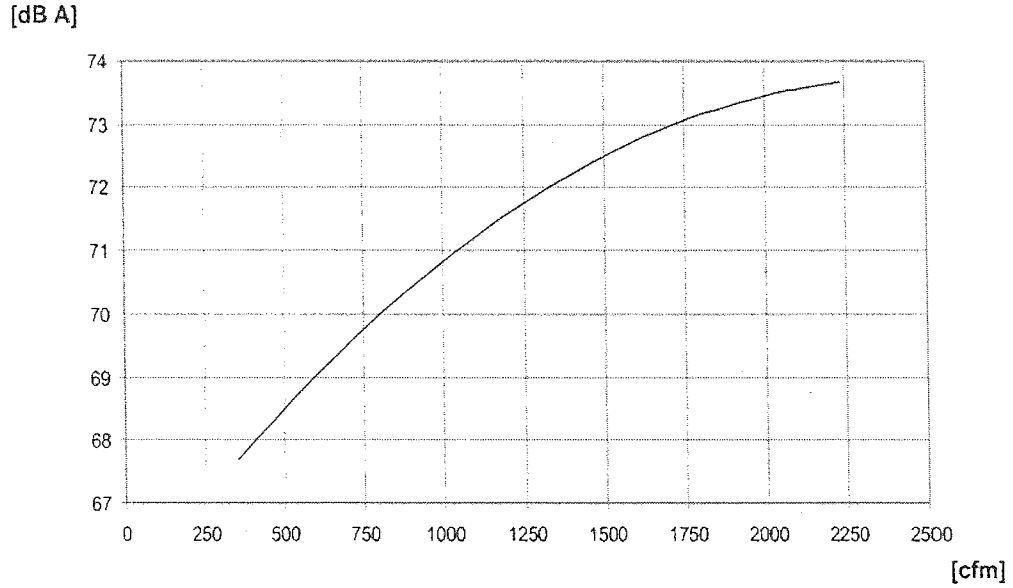
## PERFORMANCE DATA

Revision: 20070111

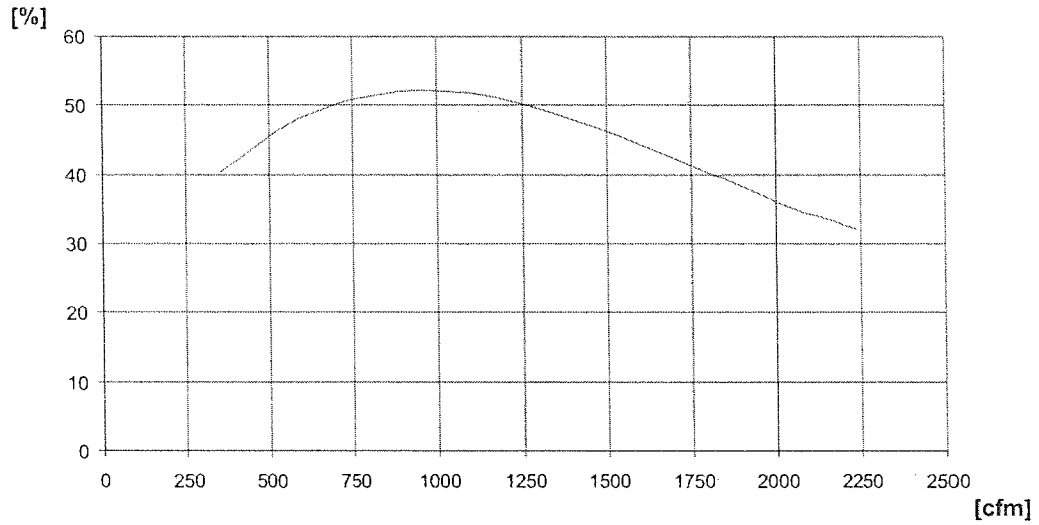
**N Series Fan**  
**N 40, 3Phase**

DATE
PROJECT
LOCATION
ARCH/ENG
REP. NAME

### Sound level



### Efficiency



### ADDITIONAL DATA

Model	Part Number	Power [HP]	Current [A]	Voltage [V]	Speed [RPM]	Phase	Weight	Material Recovery [%]
N40	14510223	3.0	8.0/4.0	230/460	3400	3	64	95

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 3516 2.2 ENGINE EXHAUST SYSTEMS

Submittal Number: 1

Item: Exhaust Fan

Manufacturer: Greenheck

Model #: SF-1

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No



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## Installation, Operation and Maintenance Manual

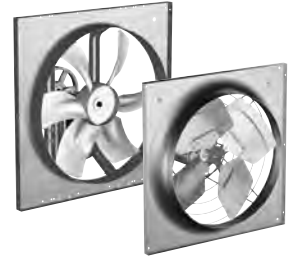
Please read and save these instructions for future reference. Read carefully before attempting to assemble, install, operate, or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage!

### Sidewall Propeller Fans

Greenheck's sidewall propeller fan line is the ideal choice for factory and warehouse applications where high volumes of air and low pressures are required. From general ventilation to industrial duty, the range of construction and performance capabilities offered represent the most comprehensive sidewall propeller fan line in the industry.

Performance spans the range between 300 to 87,000 cfm (510 to 147,814 m<sup>3</sup>/hr) with static pressures to 1.25 in. wg (249 Pa). Fan sizes range from 8 to 54 inches (203 to 1372 mm) for direct drive and 20 to 72 inches (508 to 1829 mm) for belt drive. Regardless of fan size, performance or duty level, all Greenheck sidewall propeller fans are built to perform with the same high standards of reliability and durability. All models are available in exhaust or supply arrangements.

Models SE1, SS1, SE2, SS2, SCE3, SCS3, SCR3, SBE-1, SBS-1, SBE-2, SBS-2, SBE-3, SBS-3, SBCE, SBCE, and SBCR.



### Filtered Supply

Filtered supply wall housings are available in seven sizes for fans ranging from size 24 to 54 inches (610 to 1372 mm). They are designed with the draw-thru concept to achieve the highest filter and fan efficiencies. Permanent 2 inch (51 mm) washable filters are accessed through a bolted panel and can be easily removed for cleaning.



### General Safety Information

Only qualified personnel should install this fan. Personnel should have a clear understanding of these instructions and should be aware of general safety precautions. Improper installation can result in electric shock, possible injury due to coming in contact with moving parts, as well as other potential hazards. Other considerations may be required if high winds or seismic activity are present. If more information is needed, contact a licensed professional engineer before moving forward.

#### DANGER

Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury.

#### CAUTION

When servicing the fan, motor may be hot enough to cause pain or injury. Allow motor to cool before servicing.

#### CAUTION

Precaution should be taken in explosive atmospheres.

1. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC) and the National Fire Protection Agency (NFPA), where applicable. Follow the Canadian Electric Code (CEC) in Canada.
2. The rotation of the propeller is critical. It must be free to rotate without striking or rubbing any stationary objects.
3. Motor must be securely and adequately grounded.
4. Do not spin fan propeller faster than max cataloged fan RPM. Adjustments to fan speed significantly effects motor load. If the fan RPM is changed, the motor current should be checked to make sure it is not exceeding the motor nameplate amps.
5. Do not allow the power cable to kink or come in contact with oil, grease, hot surfaces, or chemicals. Replace cord immediately if damaged.
6. Verify that the power source is compatible with the equipment.
7. Never open access doors to a duct while the fan is running.

## Receiving

Upon receiving the product, check to make sure all items are accounted for by referencing the bill of lading to ensure all items were received. Inspect each crate for shipping damage before accepting delivery. Notify the carrier if any damage is noticed. The carrier will make notification on the delivery receipt acknowledging any damage to the product. All damage should be noted on all the copies of the bill of lading which is countersigned by the delivering carrier. A Carrier Inspection Report should be filled out by the carrier upon arrival and reported to the Traffic Department. If damaged upon arrival, file a claim with carrier. Any physical damage to the unit after acceptance is not the responsibility of Greenheck Fan Corporation.

## Unpacking

Verify that all required parts and the correct quantity of each item have been received. If any items are missing, report shortages to your local representative to arrange for obtaining missing parts. Sometimes it is not possible that all items for the unit be shipped together due to availability of transportation and truck space. Confirmation of shipment(s) must be limited to only items on the bill of lading.

Note: The filtered supply unit ships with all ordered components completely factory assembled. The optional weatherhood ships knocked down for field assembly and installation.

## Storage

Fans are protected against damage during shipment. If the unit cannot be installed and operated immediately, precautions need to be taken to prevent deterioration of the unit during storage. The user assumes responsibility of the fan and accessories while in storage. The manufacturer will not be responsible for damage during storage. These suggestions are provided solely as a convenience to the user.

### INDOOR

The ideal environment for the storage of fans and accessories is indoors, above grade, in a low humidity atmosphere which is sealed to prevent the entry of blowing dust, rain or snow. Temperatures should be evenly maintained between 30° to 110°F (-1° to 43°C), wide temperature swings may cause condensation and “sweating” of metal parts. All accessories must be stored indoors in a clean, dry atmosphere.

Remove any accumulations of dirt, water, ice, or snow and wipe dry before moving to indoor storage. To avoid “sweating” of metal parts allow cold parts to reach room temperature. To dry parts and packages use a portable electric heater to remove any moisture build up. Leave coverings loose to permit air circulation and to allow for periodic inspection.

The unit should be stored at least 3½ inches (89 mm) off the floor on wooden blocks covered with moisture proof paper or polyethylene sheathing. Aisles between parts and along all walls should be provided to permit air circulation and space for inspection.

### OUTDOOR

Fans designed for outdoor applications may be stored outdoors, if absolutely necessary. Roads or aisles for portable cranes and hauling equipment are needed.

The fan should be placed on a level surface to prevent water from leaking into the fan. The fan should be elevated on an adequate number of wooden blocks so it is above water and snow levels and has enough blocking to prevent it from settling into soft ground. Locate parts far enough apart to permit air circulation, sunlight and space for periodic inspection. To minimize water accumulation, place all fan parts on blocking supports so rain water will run off.

Do not cover parts with plastic film or tarps as these cause condensation of moisture from the air passing through heating and cooling cycles. Fan wheels should be blocked to prevent spinning caused by strong winds.

## Inspection and Maintenance During Storage

While in storage, inspect fans once per month. Keep a record of inspection and maintenance performed.

If moisture or dirt accumulations are found on parts, the source should be located and eliminated. At each inspection, rotate the wheel by hand ten to fifteen revolutions to distribute lubricant on motor. If paint deterioration begins, consideration should be given to touch-up or repainting. Fans with special coatings may require special techniques for touch-up or repair.

Machined parts coated with rust preventive should be restored to good condition promptly if signs of rust occur. Immediately remove the original rust preventive coating with petroleum solvent and clean with lint-free cloths. Polish any remaining rust from surface with crocus cloth or fine emery paper and oil. Do not destroy the continuity of the surfaces. Thoroughly wipe clean with Tectyl® 506 (Ashland Inc.) or the equivalent. For hard to reach internal surfaces or for occasional use, consider using Tectyl® 511M Rust Preventive, WD-40® or the equivalent.

## Removing From Storage

As fans are removed from storage to be installed in their final location, they should be protected and maintained in a similar fashion until the fan equipment goes into operation.

## Pre-Installation Checks

- Check chart below for correct wall opening dimensions.
- Check motor voltage and amperage rating for compatibility with electrical supply. Supply wiring must be properly fused and conform to local and national codes.
- Motor load amperage must be checked and compared to nameplate rating to avoid serious damage to motor when speed is increased.

## Wall Opening Requirements

Wall opening size and propeller-to-damper distance are two important dimensions for fan installation.

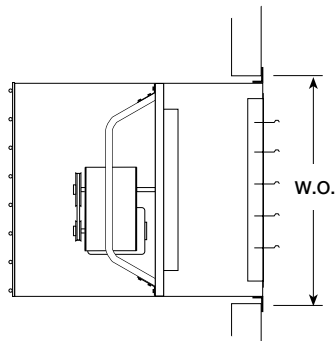


Figure 1 - Wall Housing Installation

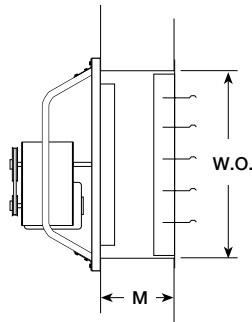


Figure 3 - Direct to Wall Installation

Fans mounted to the wall require a different wall opening (W.O.) size than those mounted in collars or wall housings. Propeller-to-damper distance (M) is important to reduce turbulence and damper flutter which may lead to premature damper failure.

Figure 1 and 2 show the wall opening (W.O.) required for installations with either a wall housing or collar.

Figure 3 shows the recommended wall opening (W.O.) and the minimum distance (M) suggested between the fan and damper for direct to wall installations.

Figure 4 shows the dimensions and wall opening (W.O.) required for installations with a filtered supply wall housing.

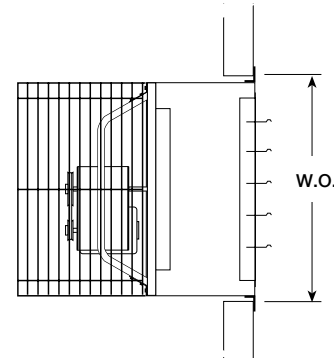


Figure 2 - Wall Collar Installation

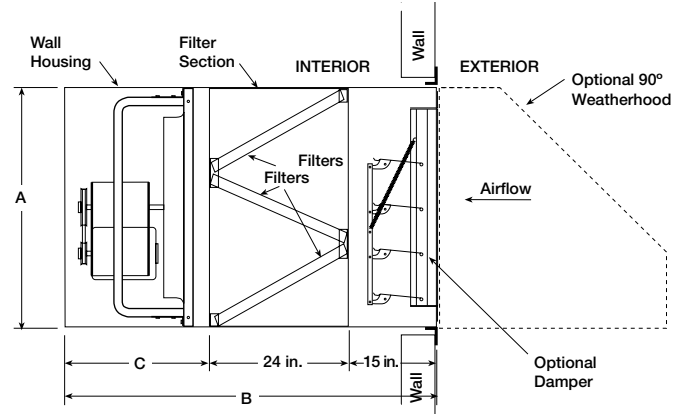


Figure 4 - Filtered Supply Wall Housing Installation

Fan Size	Damper Size Square	Recommended Wall Opening (W.O.) Square			M Minimum	Filtered Supply Wall Housing Only				
		Figures 1 and 2	Figure 3	Figure 4		A	B	C	Filter Quantity & Size	
8	10 (254)	14¼ (362)	10½ (267)	-	6 (152)	-	-	-	-	-
10	12 (305)	16¼ (413)	12½ (318)	-	6 (152)	-	-	-	-	-
12	14 (356)	19¼ (489)	14½ (368)	-	7 (178)	-	-	-	-	-
14	16 (406)	21¼ (540)	16½ (419)	-	8 (203)	-	-	-	-	-
16	18 (457)	23¼ (591)	18½ (470)	-	9 (229)	-	-	-	-	-
18	20 (508)	25¼ (641)	20½ (521)	-	10 (254)	-	-	-	-	-
20	22 (559)	27¼ (692)	22½ (572)	-	12 (305)	-	-	-	-	-
24	26 (660)	33¼ (857)	26½ (673)	33¼ (857)	13 (330)	32¼ (819)	63 (1600)	24 (610)	4	23¼ x 16¼ (591 x 413)
30	32 (813)	39¼ (1010)	32½ (826)	39¼ (1010)	13 (330)	38¼ (972)	65 (1651)	26 (660)	4	24¾ x 19¼ (625 x 489)
36	38 (965)	45¼ (1162)	38½ (978)	45¼ (1162)	14 (356)	44¼ (1124)	67¼ (1708)	28¼ (718)	6	23¼ x 22½ (591 x 562)
42	44 (1118)	51¼ (1314)	44½ (1130)	51¼ (1314)	15 (381)	50½ (1273)	72⅞ (1851)	34 (864)	6	24½ x 25½ (613 x 638)
48	50 (1270)	57¼ (1467)	50½ (1283)	57¼ (1467)	16 (406)	56½ (1426)	72⅞ (1851)	34 (864)	12	23¼ x 18¾ (591 x 476)
54	56 (1422)	63¼ (1619)	56½ (1435)	63¼ (1619)	17 (432)	62⅞ (1584)	79⅛ (2024)	40⅛ (1033)	12	23¼ x 20¾ (591 x 527)
60	62 (1575)	69¼ (1772)	62½ (1588)	-	19 (483)	-	-	-	-	-
72	74 (1880)	84¼ (2153)	74½ (1892)	-	19 (483)	-	-	-	-	-

All dimensions given in inches (millimeters). Filters are 2 inch (51 mm) nominal thickness. Above filter sizes are actual dimensions.

## WARNING

Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury.

### Typical Installation

Move fan to the desired location and determine the method by which the fan is to be mounted as shown in Figures 1-4 shown on page 3. Optional wall mount housings (Figure 1) and wall mount collars (Figure 2) provide a convenient means of mounting sidewall propeller fans while maintaining the proper distance between propeller and damper.

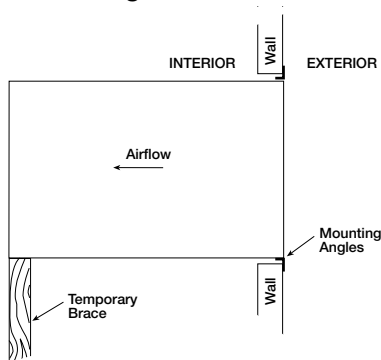
Attach the fan by inserting a suitable fastener through each of the prepunched mounting holes in the fan panel. Care should be taken not to bend or distort the fan panel or drive components during installation.

### Support Braces

Wall Housing sizes 42 and larger with heavy motors and all Filtered Supply Wall Housings need additional bracing.

### Filtered Supply Wall Housing Installation

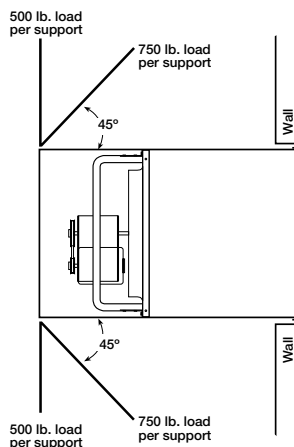
#### Step 1 Install Housing



Install housing through wall opening from outside. Temporarily brace end of unit until permanent support braces are installed.

Secure through prepunched holes in angles with suitable fasteners.

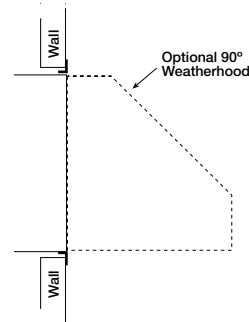
#### Step 2 Install Support Braces



Choose method of support. Attach support to end of unit (above or below housing) with rods, cable, angle, etc. (supplied by others) as shown.

Vertical braces must carry a minimum load of 500 pounds per support, and angled (45°) braces a minimum of 750 pounds per support based on two supports.

#### Step 3 Install Weatherhood

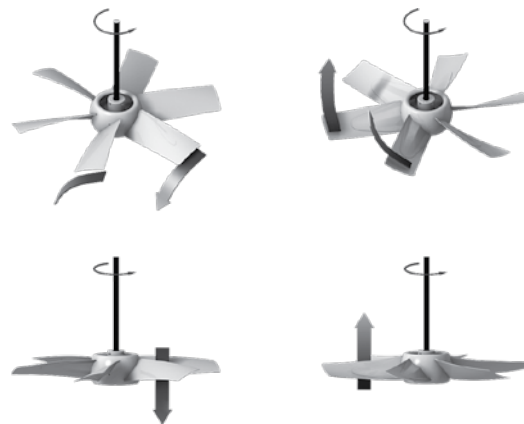


Position weatherhood over end of wall housing and fasten through mounting holes with self-tapping screws. Caulk, flash and complete electrical hook-up to finish installation.

### Pre-Starting Checks

Check all fasteners and setscrews for tightness. This is especially important for bearing setscrews.

The propeller should rotate freely and not rub on the fan panel venturi. Rotation direction of the propeller should be checked by momentarily turning the unit on. Propeller blade should cup and throw the air when rotating in the correct rotation as shown in the figure below. Rotation should be in the same direction as the rotation decal affixed to the unit.



For 3-phase installations, fan rotation can be reversed by simply interchanging any two of the three electrical leads. For single-phase installations follow the wiring diagram located on the motor.

For Belt Drive Fans: The adjustable motor pulley is preset at the factory for the specified fan RPM. Fan speed can be increased by closing or decreased by opening the adjustable pulley. Two or three groove variable pitch pulleys must be adjusted an equal



number of turns open. Any increase in fan speed represents a substantial increase in horsepower required from the motor. Always check motor load amperage and compare to nameplate rating when changing fan speed.

### Routine Maintenance

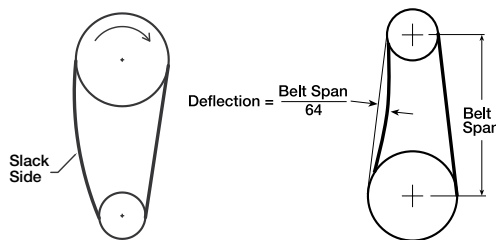
Once the fan has been put into operation, a periodic maintenance program should be set up to preserve the reliability and performance of the fan. Items to be included in this program are: Belts, Bearings, Fasteners and Setscrews, Lubrication, and Removal of Dust and Dirt.

**WARNING**

Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury.

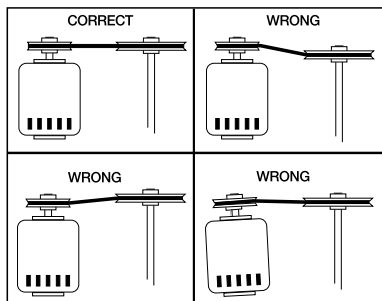
### Belts

Premature belt failures are frequently caused by improper belt tension (either too tight or too loose) or misaligned pulleys. The proper tension for operating a V-belt is the lowest tension at which the belts will not slip at peak load conditions. For initial tensioning, the proper belt deflection halfway between pulley centers is 1/64 inch (0.4 mm) for each inch of belt span. For example, if the belt span is 64 inches (1626 mm), the belt deflection should be one inch (25 mm) using moderate thumb pressure at midpoint of the drive. See figure shown below.



Check belt tension two times during the first 24 hours of operation and periodically thereafter. To adjust belt tension, simply loosen four fasteners (two on each side of the motor plate) and slide the motor plate away from the fan shaft until proper belt tension is attained. On some fans, fasteners attaching the motor to the motor plate must be loosened in order to adjust the belt.

It is very important that the drive pulleys remain in proper alignment after adjustments are made. Misalignment of pulleys will result in premature belt wear noise, vibration and power loss.



### Bearings (For belt drive fans only)

Bearings are the most critical moving part of the fan and should be inspected at periodic intervals. Locking collars and setscrews, in addition to fasteners attaching the bearings to the bearing plate, must be checked for tightness. In a clean environment and temperatures above 32°F (0°C) and below 200°F (93°C), fan shaft bearings with grease fittings should be lubricated semi-annually using a high-quality lithium based grease. If unusual environmental conditions exist, temperatures below 32°F (0°C) and above 200°F (93°C), moisture or contaminants, more frequent lubrication is required.

With the unit running, add grease very slowly with a manual grease gun until a slight bead of grease forms at the seal. Be careful not to unseat the seal by over lubricating or using excessive pressure. Bearings without grease fittings are lubricated for life.

### Fasteners and Setscrews

Any fan vibration has a tendency to loosen mechanical fasteners. A periodic inspection should include checking all fasteners and setscrews for tightness. Particular attention should be paid to setscrews or taper-lock bushings attaching the propeller to the motor shaft and the motor shaft to the bearings. Loose bearing setscrews will lead to premature failure of the fan shaft. In addition, check all fasteners attaching the motor to the motor plate.

### Lubrication

Refer to the paragraph on bearings for bearing lubrication. Many fractional horsepower motors installed on the smaller fans are lubricated for life and require no further attention. Motors equipped with oil holes should be oiled in accordance with the manufacturer's instructions printed on the motor. Use a high grade SAE 20 machine oil and use caution not to over lubricate. Motors supplied with grease fittings should be greased according to directions printed on the motor.

### Removal of Dust and Dirt

Dirt clogs cooling openings on the motor housing, contaminates bearing lubricant and collects on propeller blades causing severe imbalance if left unchecked. The exterior surface of the motor, fan panel and entire propeller should be thoroughly cleaned periodically. Use caution and do not allow water or solvents to enter the motor or bearings. Motors or bearings must not be sprayed with steam or water.

The filters also require periodic cleaning. The 2 inch (51 mm) washable aluminum filters are accessed through the bolted access panel.

## Troubleshooting

**WARNING:** Before taking any corrective action, make certain unit is not capable of operation during repairs.

PROBLEM	CAUSE	CORRECTIVE ACTION
Too Much Airflow	Resistance lower than designed	Decrease fan speed.
Reduced Airflow	System resistance too high	Check backdraft dampers for proper operation. Remove obstructions in ductwork. Clean dirty filters. Check for adequate supply air for exhaust fans or exhaust air for supply fans.
	Fan too close to damper	Increase distance between fan and damper.
	Fan speed too low	Increase fan speed.
	Excessive dirt buildup on propeller	Clean propeller.
Excessive Noise	Bearings	Tighten collars and fasteners. Lubricate bearings. Replace defective bearings.
	V-Belt drive	Tighten pulleys on motor and fan shaft. Adjust belt tension. Align pulleys properly. Replace worn belts or pulleys. See Maintenance.
	Excessive vibration	Clean dirt buildup from propeller. Check all setscrews and fasteners for tightness. Check for worn bearing. Correct propeller imbalance. Check for loose dampers, guards or ductwork.
	Defective motor	Replace motor.
	Variable Frequency Drive (VFD)	Check VFD for drive setting, some controllers are able to be adjust to lower the harmonic noises sometimes heard during operation by adjusting a simple setting on the controller.
	Debris	Remove all debris from the fan.
Fan Does Not Operate	Electrical Supply	Check fuses/circuit breakers. Check for switches turned off or disconnected. Check for correct supply voltage.
	Drive	Check for broken or worn belts. Tighten loose pulleys.
	Motor	Assure motor is correct horsepower and not tripping overload protector.

## Maintenance Documentation

### Job Information

Job Name: \_\_\_\_\_ Service Organization: \_\_\_\_\_  
 Address: \_\_\_\_\_ Address: \_\_\_\_\_  
 City: \_\_\_\_\_ City: \_\_\_\_\_  
 State: \_\_\_\_\_ Zip: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_  
 Phone: \_\_\_\_\_ Phone: \_\_\_\_\_  
 Contact Person: \_\_\_\_\_ Work Done By: \_\_\_\_\_

### Nameplate Information

Model: \_\_\_\_\_  
 Volts: \_\_\_\_\_ Hertz: \_\_\_\_\_ Phase: \_\_\_\_\_  
 Amps: \_\_\_\_\_ Mark: \_\_\_\_\_  
 Supply hp: \_\_\_\_\_ Exhaust hp: \_\_\_\_\_  
 Serial Number: \_\_\_\_\_  
 Model Voltage: \_\_\_\_\_  
 Motor Amperage: \_\_\_\_\_  
 Fan RPM: \_\_\_\_\_

### Field Start-Up Documentation

Actual Voltage: \_\_\_\_\_ Hertz: \_\_\_\_\_ Phase: \_\_\_\_\_  
 Actual Amperage: \_\_\_\_\_  
 Blower Rotation: \_\_\_\_\_  
 Air Volume: Design cfm: \_\_\_\_\_  
 Actual cfm: \_\_\_\_\_  
 Level of fan (L or H): \_\_\_\_\_  
 Fan RPM Range (min.) \_\_\_\_\_ (max.) \_\_\_\_\_



# Parts List

## NOTE

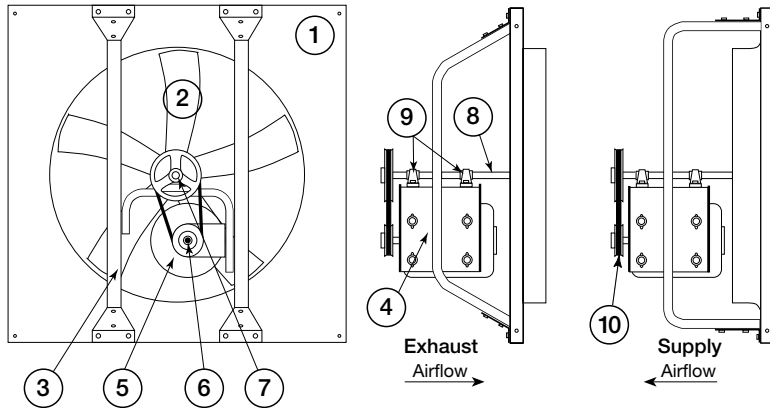
Each fan bears a manufacturer's nameplate with model number and serial number embossed. This information will assist the local Greenheck representative and the factory in providing service and replacement parts. Before taking any corrective action, make certain unit is not capable of operation during repairs.

## CAUTION

A fan manufactured with an explosion resistant motor does not certify the entire unit to be explosion proof.

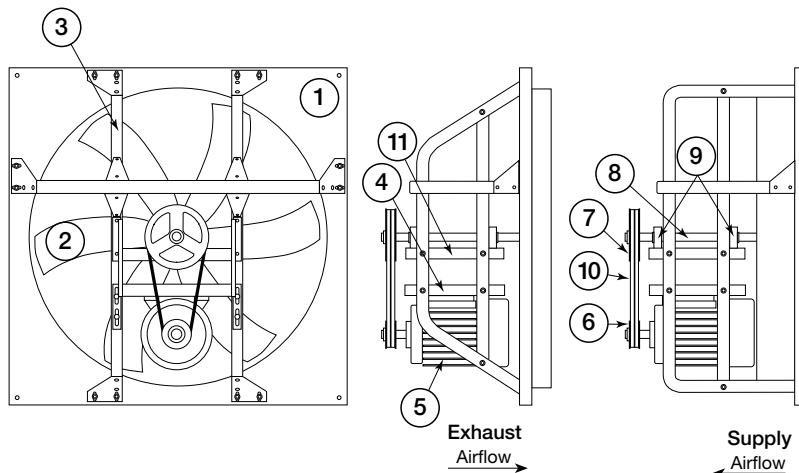
## Parts List - Belt Drive

### SBE-1, SBS-1, SBE-2 and SBS-2 (L and H propellers)



1. Fan Panel
2. Propeller
3. Drive Frame Channel (2)
4. Motor / Bearing Plate
5. Motor
6. Motor Pulley
7. Shaft Pulley
8. Fan Shaft
9. Bearings (2)
10. Belt

### SBE-3, SBS-3, SBCE, SBCE, and SBCR (L and H propellers)

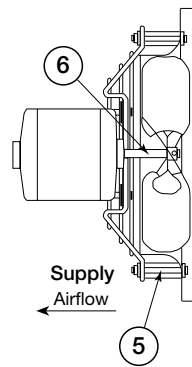
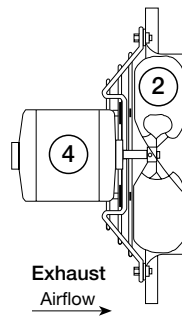
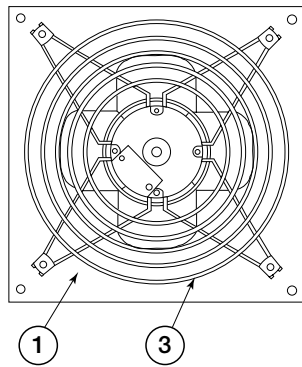


1. Fan Panel
2. Propeller
3. Drive Frame Channel (2)
4. Motor Plate
5. Motor
6. Motor Pulley
7. Shaft Pulley
8. Fan Shaft
9. Bearings (2)
10. Belt
11. Bearing Plate



## Parts List - Direct Drive

### SE1 and SS1 (Sizes 8 thru 12 - D, G and E motor speeds)

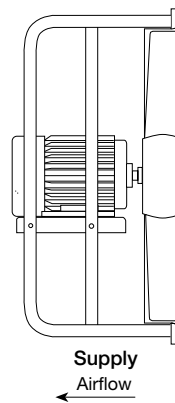
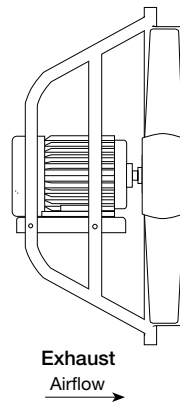
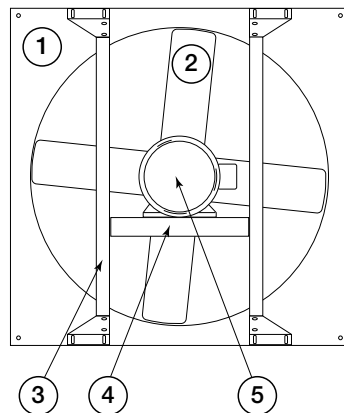


1. Fan Panel
2. Propeller
3. Drive Frame/Motor Support
4. Motor
5. Riser Blocks (4) - supply fan only
6. Shaft Extension- supply fan only

### SE1 and SS1 (Sizes 12 thru 24 - A, B and C motor speeds)

### SE2 and SS2

### SCE3, SCS3 and SCR3



1. Fan Panel
2. Propeller
3. Drive Frame Channels (2)
4. Motor Plate
5. Motor

## Warranty

Greenheck warrants this equipment to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at our option when returned to our factory, transportation prepaid. Motors are warranted by the motor manufacturer for a period of one year. Should motors furnished by Greenheck prove defective during this period, they should be returned to the nearest authorized motor service station. Greenheck will not be responsible for any removal or installation costs.

*As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.*

Greenheck Catalog Sidewall Propeller Fans provides additional information describing the equipment, fan performance, available accessories, and specification data.

AMCA Publication 410-96, Safety Practices for Users and Installers of Industrial and Commercial Fans, provides additional safety information. This publication can be obtained from AMCA International, Inc. at: [www.amca.org](http://www.amca.org).

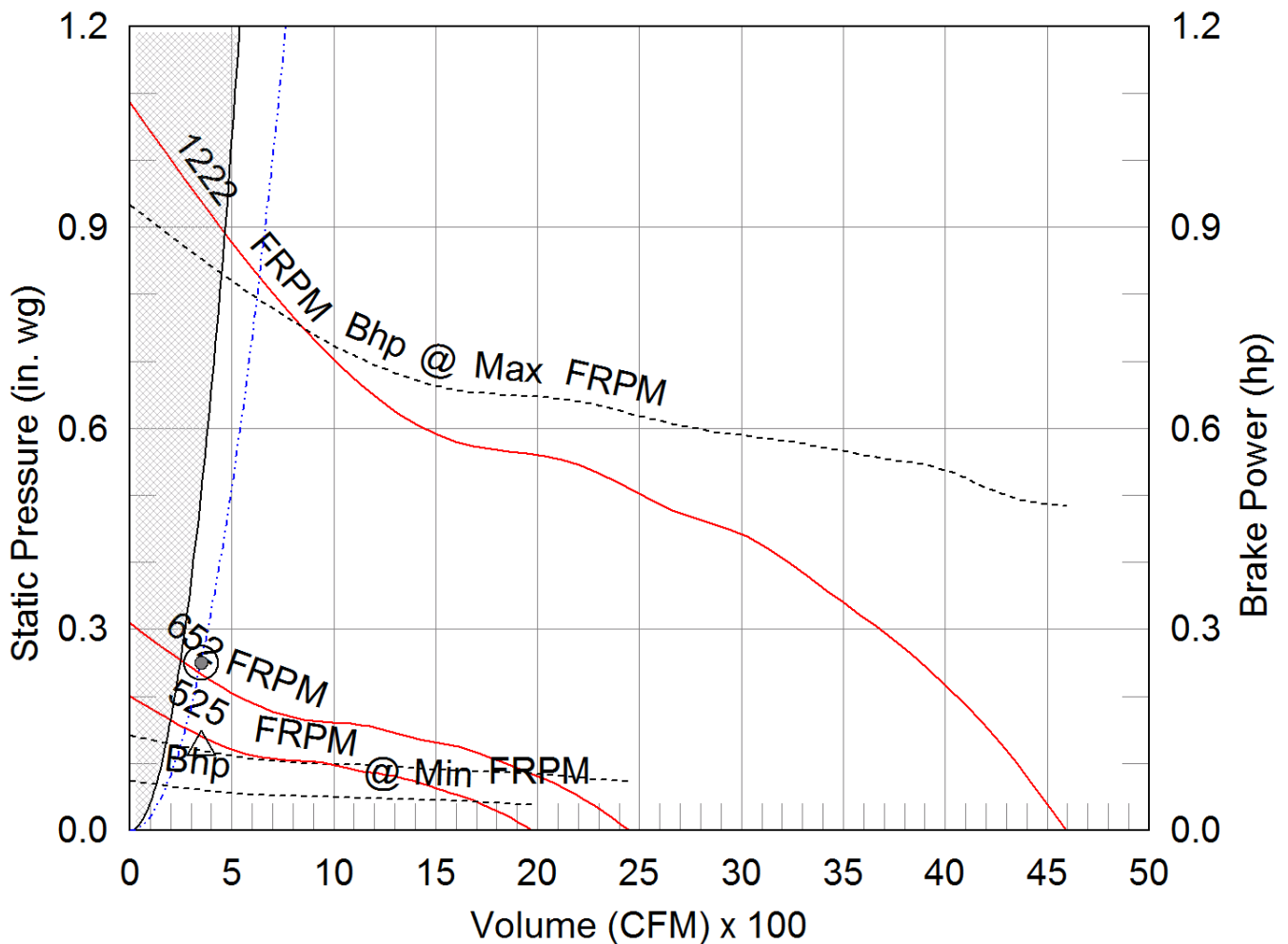


SBS-1H20-4

Min/Max Fan Curve

Performance

Requested Volume (CFM)	Actual Volume (CFM)	External SP (in. wg)	Total SP (in. wg)	Fan RPM	Operating Power (hp)
350	350	0.25	0.25	652	0.12



- △ Operating Bhp point
- Operating point at Total SP
- Operating point at External SP
- Fan curve
- System curve
- Brake horsepower curve

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 3516 2.4 ENGINE EXHAUST SYSTEMS

Submittal Number: 1

Item: Exhaust Hose Reel

Manufacturer: Nederman

Model #: 865 SD

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

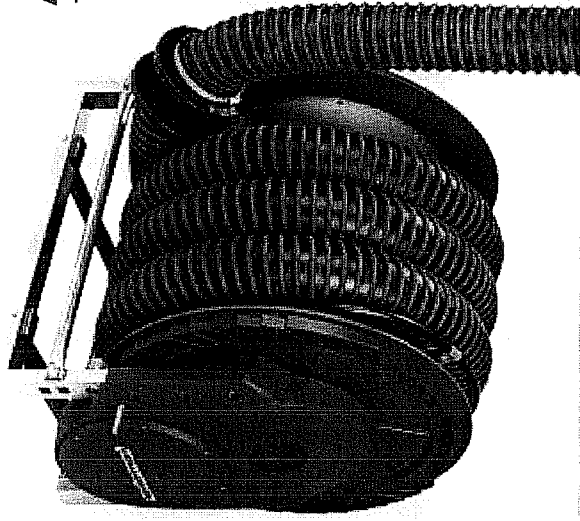
Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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# EXHAUST HOSE REEL



**Nederman®**  
*Improving your workspace*

**SER. 865**

**INSTRUCTION MANUAL**

No. 148466/02

# EXHAUST HOSE REEL

## SPRING RECOIL

This product is designed to meet the requirements of the relevant EC directives. To maintain this status all installation, repair and maintenance work must be carried out by qualified personnel using only original spare parts. Contact your nearest authorised dealer or Nederman, Inc. for advice on technical service or if you require spare parts.

### Applications

Nederman Exhaust Reel is designed for stationary use only and can, depending on hose diameter, be connected to cars, trucks or other vehicles with similar motor sizes.

The following airflows are recommended.

#### Reels for Cars:

3" - 4" Hose  
235 - 350 cfm

#### Reels for Trucks:

5" - 6" Hose  
470 - 700 cfm

### **WARNING!**

**Risk of explosion!**  
The reel must not be used for other purposes than exhaust extraction.



## Technical Data

### Weights

#### Short Reel:

- without hose: 51 lbs.
- with hose and nozzle: 66-82 lbs.

#### Wide Reel:

- without hose: 68 lbs.
- with hose and nozzle: 82-110 lbs.

### Recommended Mounting Height

Maximum 20 ft.

### Duct Connection

Ø 6.3 in.

### Recommended Airflows

**cars, 3"-4" hose:**

235 - 350 cfm

**trucks, 5"-6" hose:**

470 - 700 cfm

### Operating Temperature

15 °F to + 120 °F

### Hose Temperature Resistance

**Hose NR-CP or NR-B:**

300 °F continuously

**Hose NFC-3:**

570 °F continuously

### Noise Level

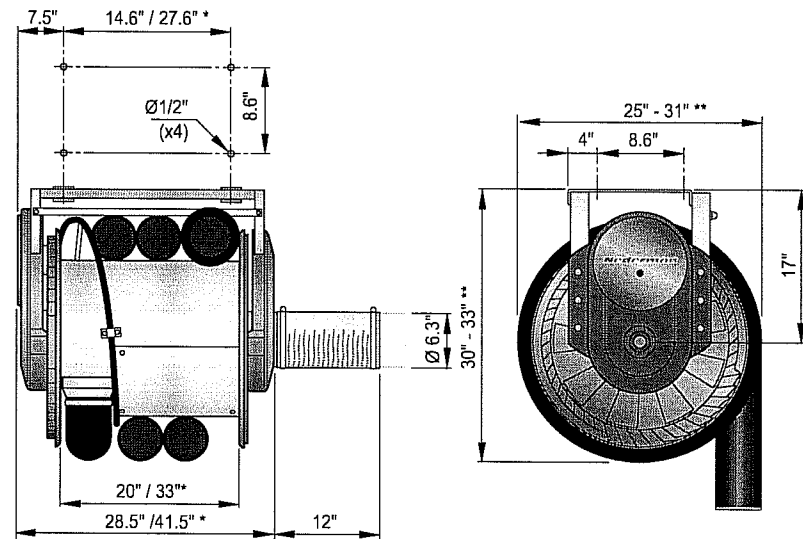
Measured according to ISO 11201.

< 70 dB(A).

### Material Recycling

Reels without hose: 100 weight-%

## Dimensions



\* short / wide reel respectively

\*\* depending on hose diameter

### Mounting Instruction

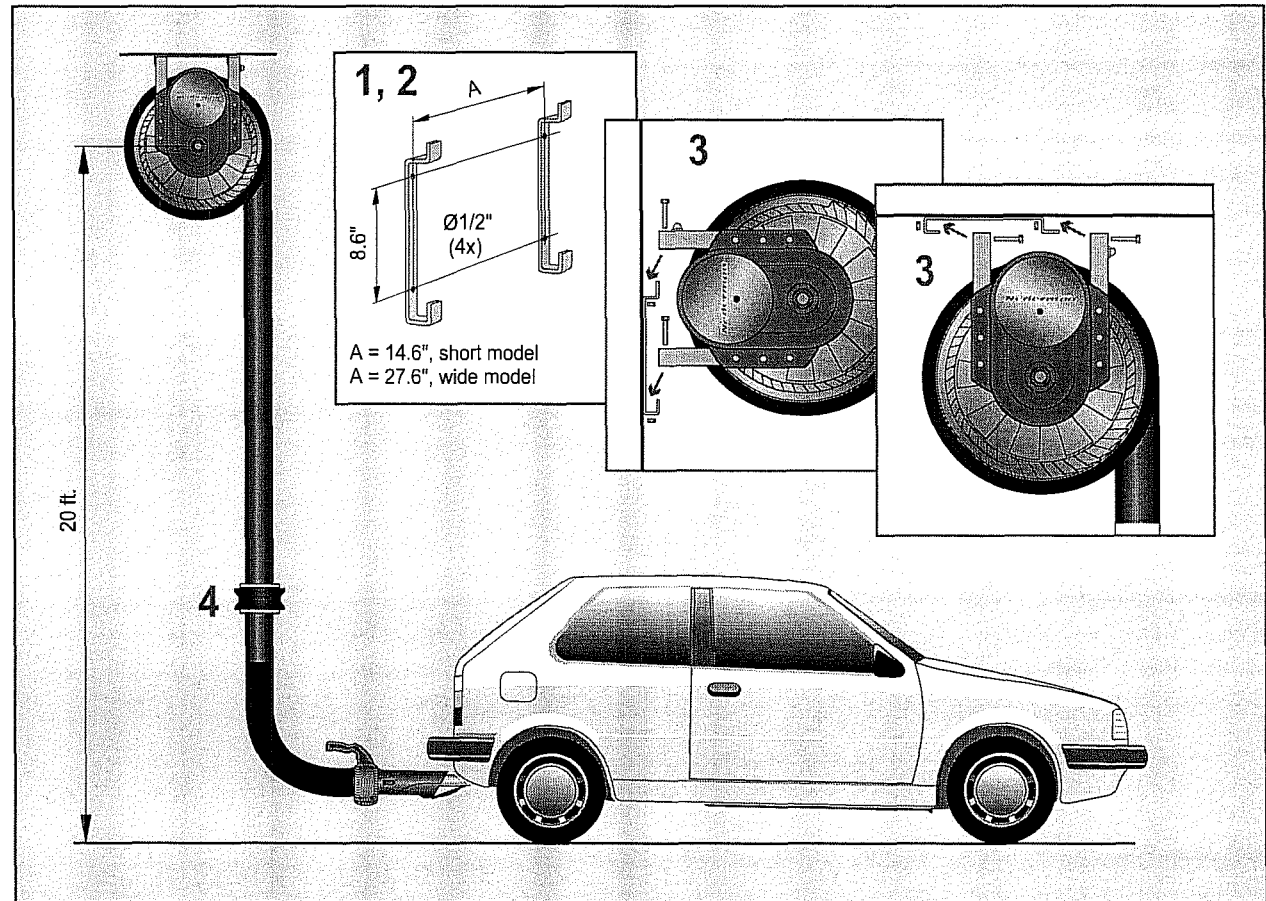
Maximum mounting height for the reel is 20 ft. (see picture).

1. Make sure that the surface, on which to mount the reel, is level. Drill 4 holes, using the hole template which comes in the package.

2. Fit the mounting brackets in such a way that will make the reel hang horizontally. Ensure that suitable fixing bolts are used considering the ceiling or wall construction material. The bolts must each stand a tractive force of minimum 1460 lbf.

3. Use approved lifting equipment to lift the reel. Fasten the reel in the brackets.

4. Fit the hose stop on the hose in such a position that the nozzle stops in a desired position when the hose is recoiled.





## Safety Lock

### WARNING !

#### Risk of personal injury.

The reel is equipped with a safety lock which should be used during service or repair work on the reel, for example when mounting or changing the hose.

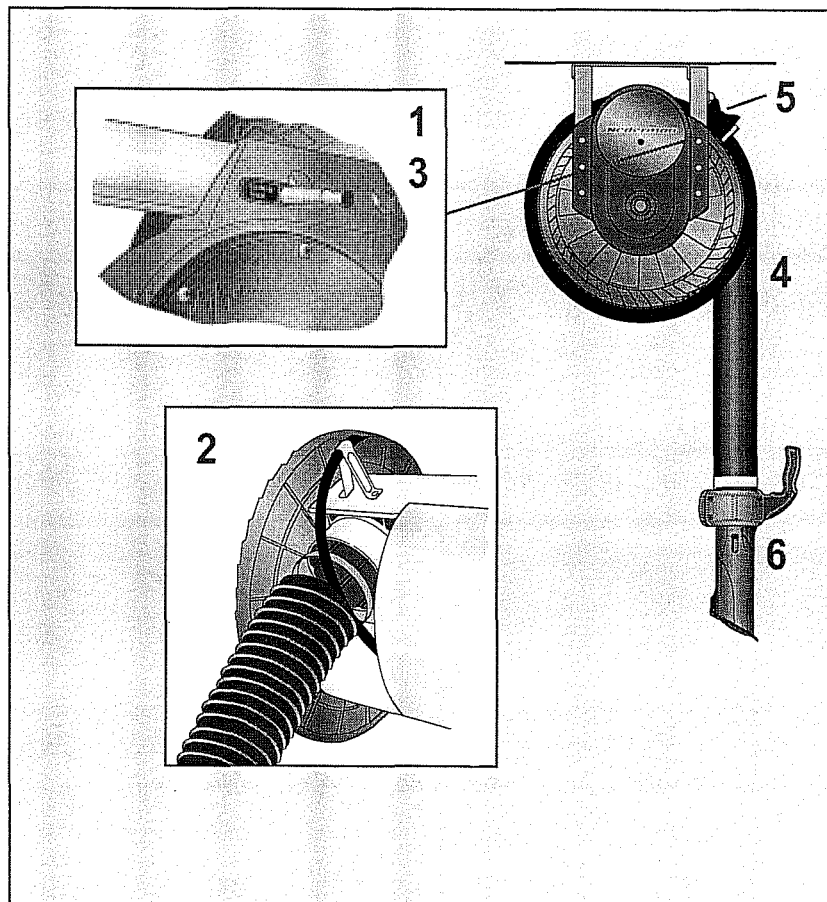
**Note!** When changing the spring, the spring power must be completely neutralized (instruction is delivered together with the spare part spring).



## Mounting the Hose

When the reel has been mounted on wall or ceiling, the hose is mounted in the following way (concerning reels delivered without hose only):

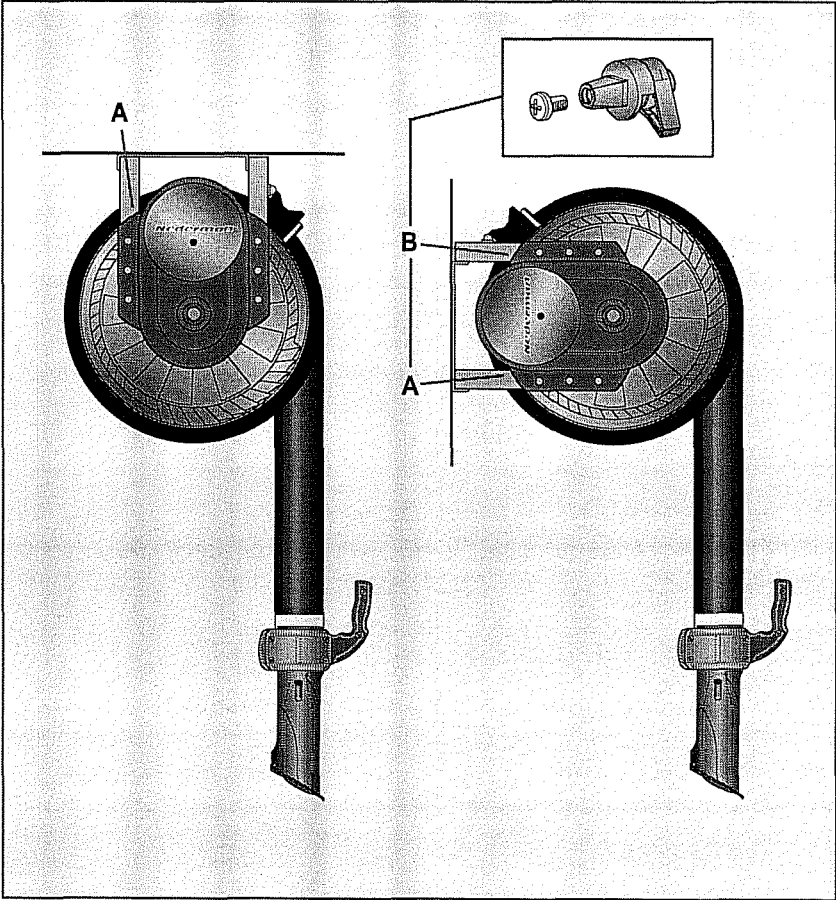
1. Check that the safety lock is pressed down.
2. Fasten the hose with a hose clip on the connecting piece inside the drum.
3. Pull out the safety lock.
4. Let the hose slowly recoil to the drum. Ensure that the hose only forms one layer on the drum.
5. Fit the hose stop on the hose in such position that the nozzle stops in a desired position when the hose is recoiled.
6. Fit the nozzle.



**Ratchet Device**

The reel is fitted with a ratchet device which lock's the hose in the desired position. The ratchet is released when the hose is pulled out slightly further and the hose is then automatically recoiled.

The ratchet is factory set for ceiling mounting of the reel (position A). When mounting the reel on wall, the ratchet must be moved from position A to B. **Note!** The ratchet must, after it has been mounted, point towards the center of the reel.

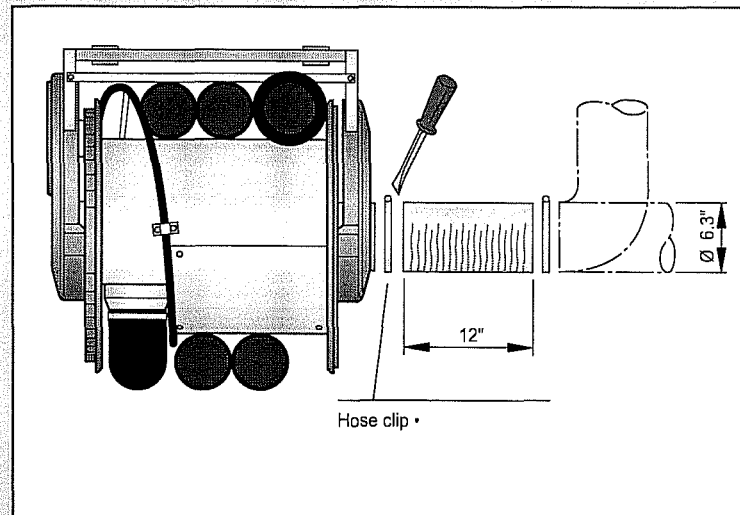


### Connecting Duct

The connection hose supplied with the reel, should be used for connecting the reel to duct systems and a central fan. **Note! The duct must be fitted with hose clips. Do not drill or fit with screws.**

### Fan positioning

A suitable fan can be selected from the Nederman fan range. To avoid leakage in the ducting system, the fan should be positioned outdoors or as near the duct outlet in the room as possible.



### **Adjustment of Spring Tension**

The reel has factory set basic spring tension which after mounting the reel with hose and nozzle could require adjustment.

**Note: Do not tension the spring more than is needed to exactly roll the hose to its position of rest.**

#### **Increasing the spring tension**

(mounted reel):

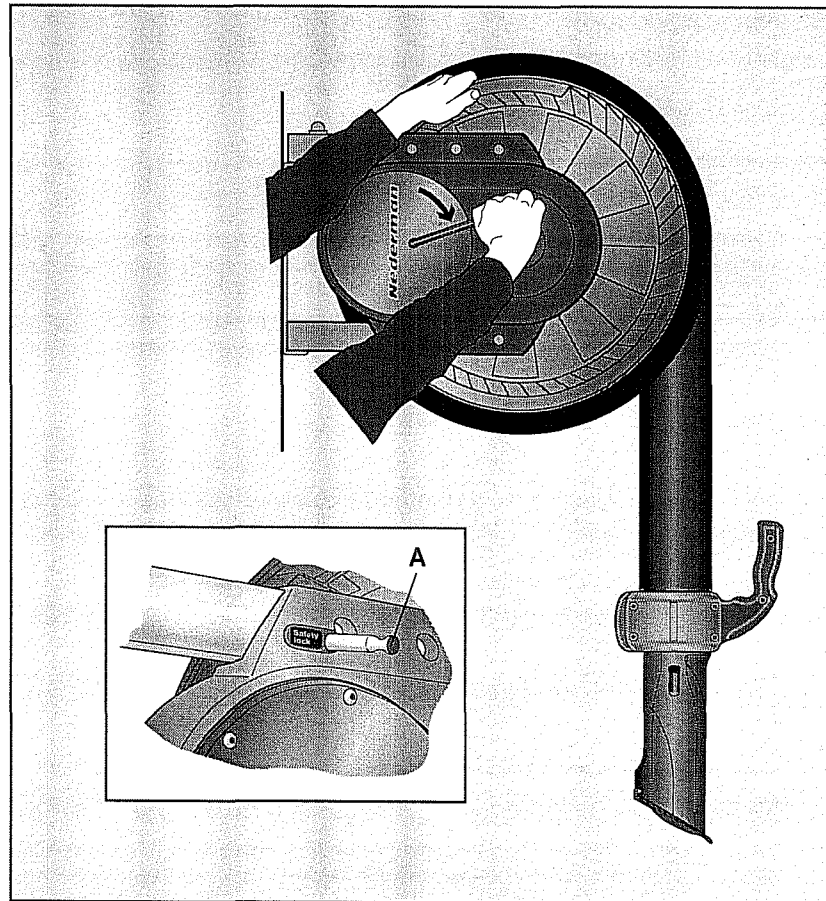
1. Make sure that the hose is in place and fully recoiled on the reel.
2. Use the socket head cap spanner which comes with the reel. Turn in the direction of the arrow as shown in the picture.
3. Tension the spring in small steps and test the coiling operation gradually.

**Check that the hose can be fully uncoiled without stretching the spring to its maximum.**

#### **Decreasing the spring tension**

(mounted reel):

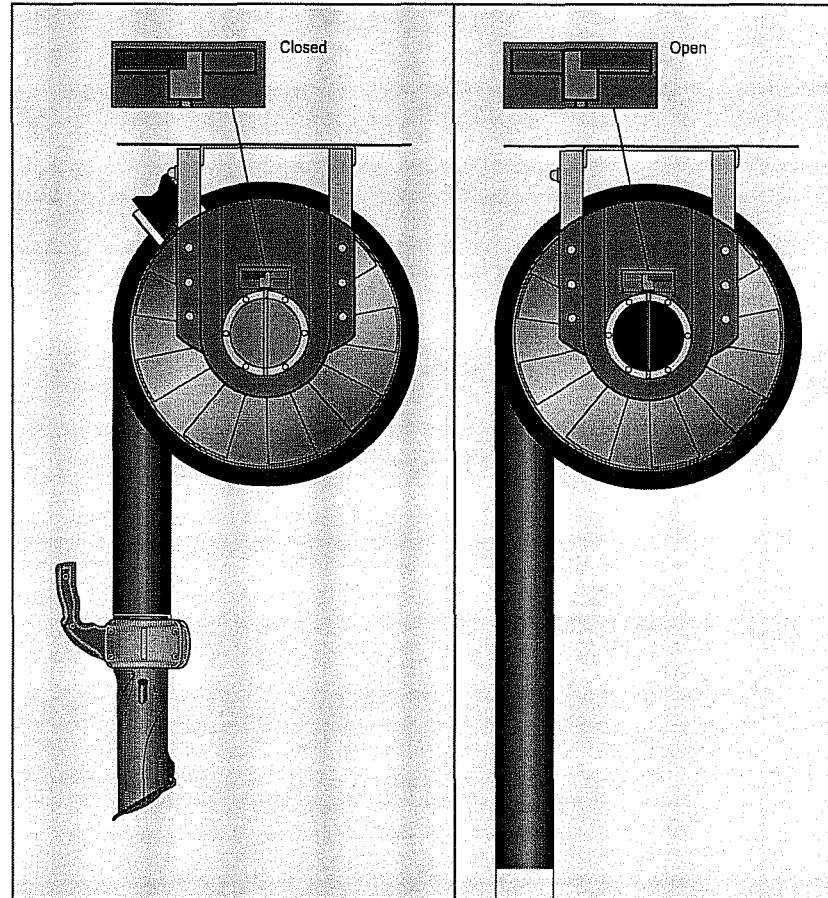
1. Make sure that the hose is in place and fully recoiled on the reel.
2. Push the safety catch (A).
3. Remove the hose stop and nozzle.
4. Remove one coil of hose.
5. Refit the hose stop and nozzle.
6. Draw out the safety catch (A).



### Damper Function

The reel is fitted with a mechanical damper which automatically opens when the hose is pulled out. The damper closes when the hose is rewound.

The damper is equipped with a green and red mark which shows if the damper is open or closed.



## Direction of Use

### Connection

Pull the hose out to the desired position and make sure that it is in engaged position. Connect the nozzle to the vehicle exhaust pipe.



### WARNING!

#### Risk of severe personal injury.

- Check that there is enough suction in the exhaust hose before it is connected to the vehicle's exhaust pipe. If not, check the fan's rotation direction and/or damper function. If necessary check installation of fan start switch.
- An exhaust gas detector is recommended.

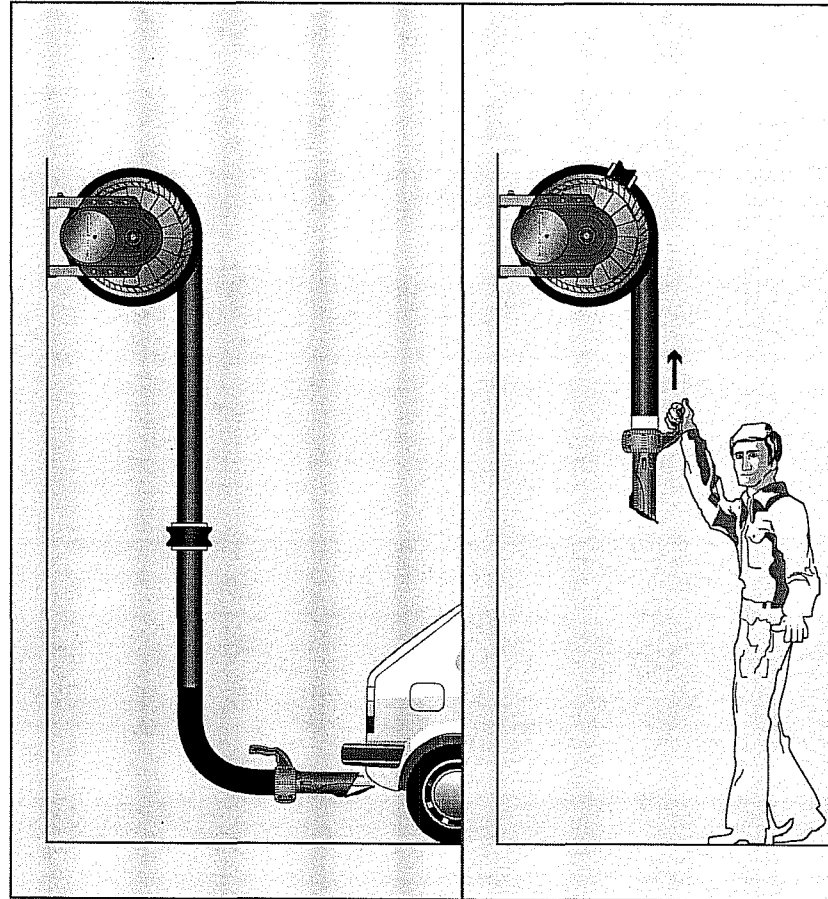
### Disconnection

Disconnect the nozzle from the vehicle exhaust pipe. Draw the hose out a little to disengage the ratchet. The hose now recoils to the drum and **should be held by hand** until it has moved to its end position. Make sure that the hose only forms one layer on the drum.

### IMPORTANT!

If the hose is pulled out too far, the ratchet could unfortunately become permanently locked. It may be released by the following procedure.

1. Take a steady grip in the drum end plate and turn a little in the outdraw direction until the ratchet is disconnected.
2. Hold the end plate and hose at the same time, then slowly release until the hose has been recoiled.
3. Fit the ratchet in the other mounting position.



## Service Instruction

Check the following points at least once a year. Take actions when necessary.

- Check that the reel is secured in the ceiling or on the wall.
- Check the duct connections for leakage.
- Check the hose for damage.
- Check the coiling function of the hose. Adjust the spring power when necessary.
- Check the hose connection in the connection piece inside the drum.
- Check operation of the damper. The damper should open automatically when the hose is pulled out.
- Check that there is enough suction in the exhaust hose. If not, check the fan's rotation direction and/or damper function. Check the hose for holes.

## Accessories

### Hoses / Nozzles

The Nederman range of hoses and nozzles can meet most requirements.

### Fans

A suitable fan can be selected from the Nederman NIF Series Collection

### Fan bracket

For mounting the fan on the reel.

### On/off switch

Controls the fan when the hose is coiled and uncoiled.

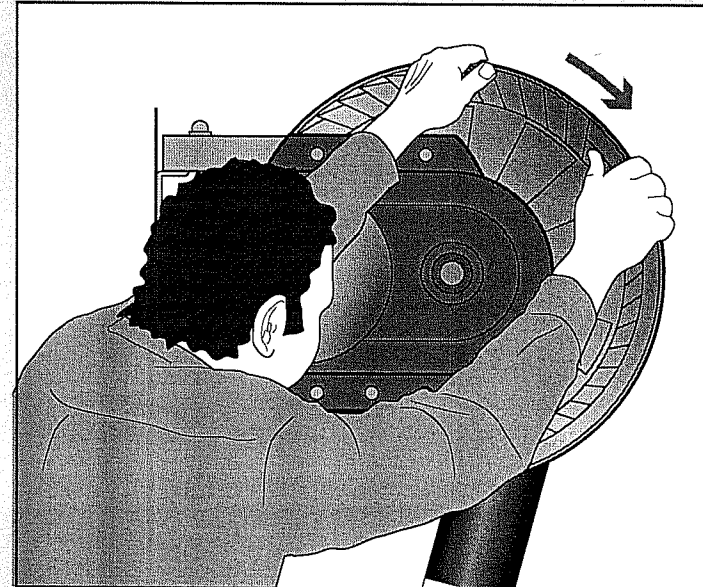
### Fan control devices

#### Transformer

For fan operation.

#### Automatic damper

Regarding accessories, please contact a Nederman representative for brochures and technical advice.

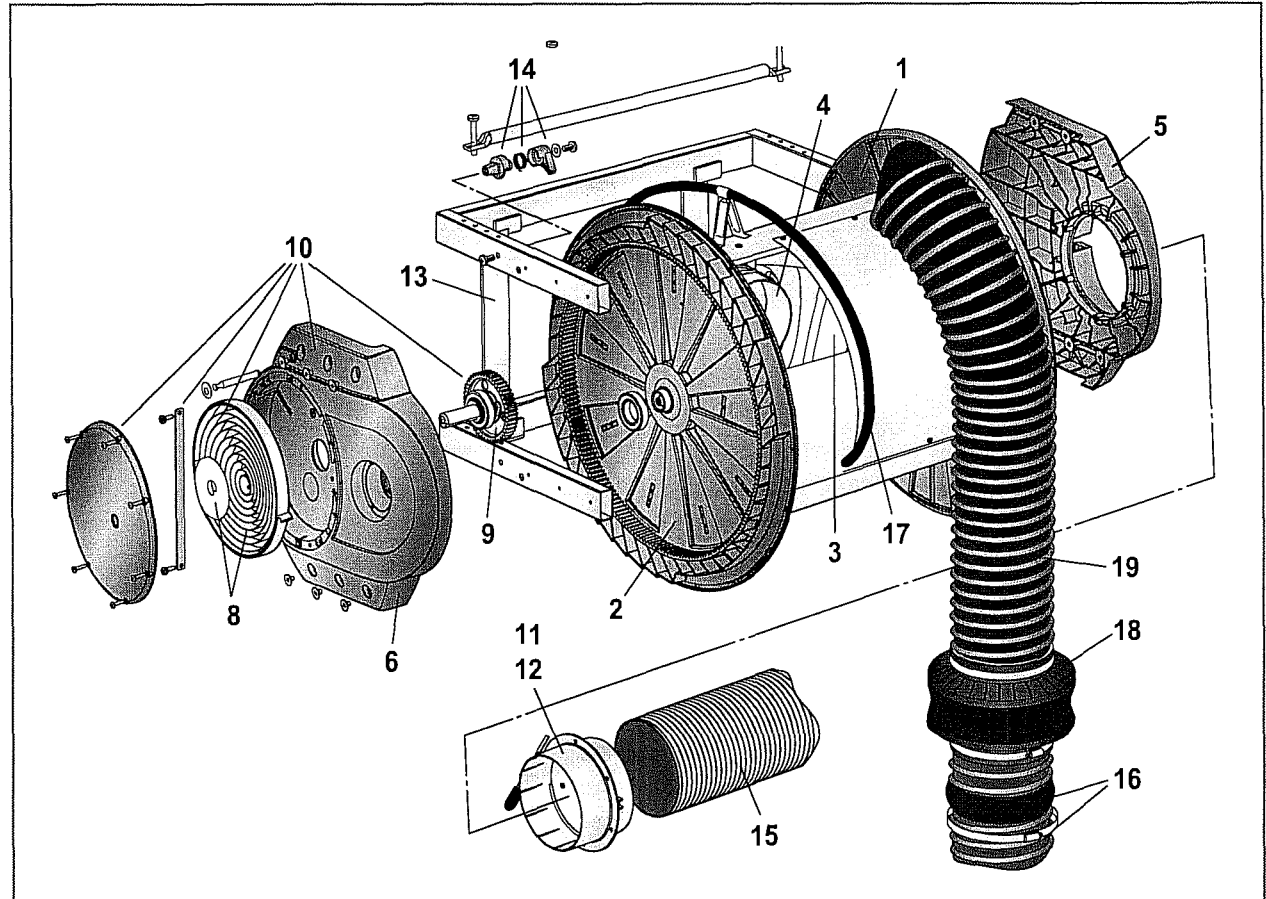


### Spare parts

When ordering parts  
always state:

- Part Number and Control Number (from  
the type label of the product).
- Detail Number. of the spare part and  
the name (as per list below).
- Quantity of the parts required.

- 1 Drum end plate, swivel side
- 2 Drum end plate, spring side
- 3 Inner tube
- 4 Connecting piece
- 5 Gable, swivel side
- 6 Gable, spring side
- 8 Spring
- 9 Spring hub, complete
- 10 Spring side, complete
- 11 Bearing
- 12 Bearing incl. damper
- 13 Suspension brackets, pair
- 14 Ratchet device
- 15 Connecting hose
- 16 Rubber cover / Hose clip
- 17 Hose guide
- 18 Hose stop
- 19 Hose





ENGLISH

**Declaration of conformity**

We, AB Ph. Nederman & Co., declare under our sole responsibility that the product **Exhaust hose reel serial 865** to which this declaration relates is in conformity with the following standards or other normative documents:

EN 292-1:1991, EN 292-2:1991,  
following the provisions of Directive:  
98/37/EC.

**Nederman<sup>®</sup>** **CE**

**AB Ph. Nederman & Co.**  
Sydhamngatan 2  
S-252 28 Helsingborg  
Sweden  
2002-08-01

*Lars Fagerberg*  
Lars Fagerberg, Product Manager

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 3700 2.5 AIR INLETS AND OUTLETS

Submittal Number: 1

Item: Louvers

Manufacturer: Ruskin

Model #: ELF 6375DX

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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3900 Dr. Greaves Rd.  
Kansas City, MO 64030  
(816) 761-7476  
FAX (816) 765-8955  
www.ruskin.com

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**FIELD ASSEMBLY  
AND  
INSTALLATION INSTRUCTIONS  
FOR  
EXTRUDED ALUMINUM  
STATIONARY LOUVERS**

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## FIELD ASSEMBLY AND INSTALLATION INSTRUCTIONS FOR EXTRUDED ALUMINUM STATIONARY BLADE LOUVERS

*This booklet is provided to offer basic assembly and installation instructions for standard Ruskin extruded aluminum stationary blade louvers. While these instructions should be useful for most standard models and applications, "special" louver designs or installation conditions may not be covered. If job-specific submittal/shop drawings were generated for the order, refer to them for special field assembly and installation details. Ruskin louvers are designed to withstand 20 psf windloads unless otherwise instructed. Since Ruskin louvers may be installed in a variety of substrates, installation fasteners to anchor the louver to the substrate are typically not designed or provided by Ruskin. Consult the Engineer of Record on your project for the size, type and quantity of fasteners required.*

### RECEIVING/INSPECTION

Upon delivery, inspect shipping containers and contents closely. If shipping containers are damaged, contents could also be damaged. Note any damage on trucker's delivery receipt. Contact the freight company within 24 hours for inspection. All products are shipped f.o.b. Ruskin plant; receiver of the shipments is responsible for filing freight claims with the freight company.

### STORAGE

Store in an orderly manner at a safe location away from construction traffic, material, etc. to prevent damage. Cover with plastic sheeting to protect from excessive moisture, dirt and debris.

### DRAWING EXPLANATION

This booklet contains several drawings that are provided for use in field assembly of multiple section louvers. Field assembly generally consists of joining frames and hidden vertical blade supports (HVBS) together. The style of construction dictates what type and how many of these joint connections are required. Ruskin extruded stationary blade louvers are constructed in two typical construction types: Visible Mullion and Architectural Style. Visible Mullion construction is typical with most drainable blade models. This construction utilizes perimeter frames and side frames on all louver sections. They may or may not have intermediate top and bottom frames on all sections. Architectural Style construction is typical with most non-drainable models. This construction utilizes frames only at the perimeter of the louver. Frames are not used on intermediate section joints. Both construction types typically utilize intermediate HVBS members within individual sections for windload support.

After the assembly and installation sections, exploded views of Visible Mullion and Architectural Style construction louvers with detail drawing callouts are provided. Following the exploded drawings are the detail drawings they reference which depict the louver frame and HVBS connections required for each. Identify which type of louver construction applies to your order and utilize the appropriate details to assemble the louvers.

## PRE-ASSEMBLY

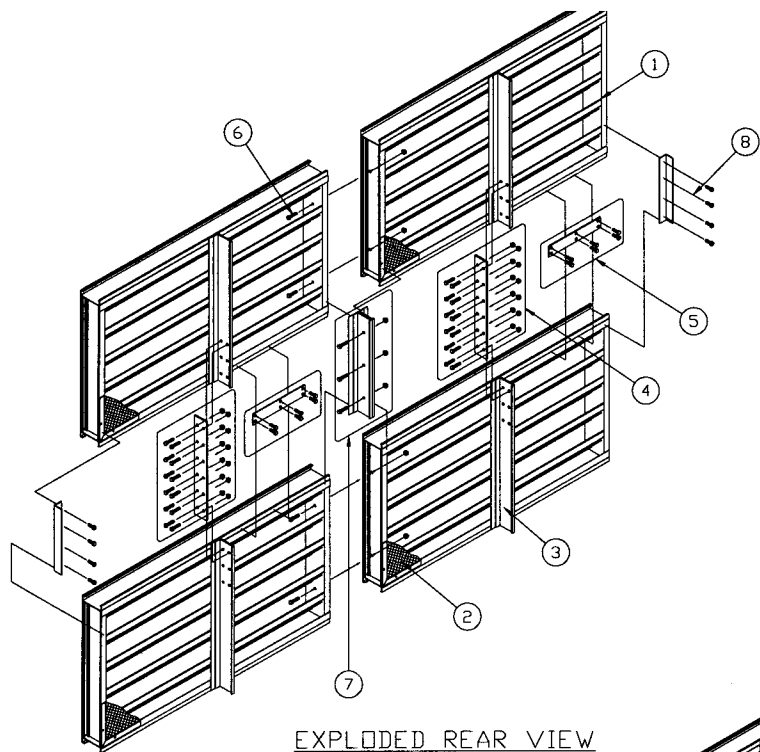
1. Remove louvers and accessories from shipping containers and inspect for damage. Single section units will be shipped fully assembled. Multiple section units will be shipped in shipping sections to be assembled at the job site. Large multiple section units may be packaged in more than one shipping crate. Reference the crate identification tags and bill of lading to determine crate contents. Care must be taken when handling components. Lift louver sections carefully by the supports or frames; avoid lifting by the louver blades. Do not apply excessive force to any one point of the section. Lift at multiple points, if necessary, to avoid deformation or racking of components.
2. Inspect louvers and components after removal from containers. Verify that all components and fasteners are accounted for. Use the exploded drawings and details found in this booklet to identify parts. Report any shortages immediately to the Ruskin plant that manufactured the louver(s).
3. Inspect the openings that the louvers will be installed in. Verify that the openings are square and that the unit will fit prior to installation. Check available installation depth for possible HVBS interference. **IF HVBS must be notched or modified for installation, secure the HVBS to a suitable substrate as close to the modification as possible to maintain structural integrity.** Contact your local Ruskin representative if you have questions pertaining to this or other field modifications.

## SINGLE SECTION INSTALLATION

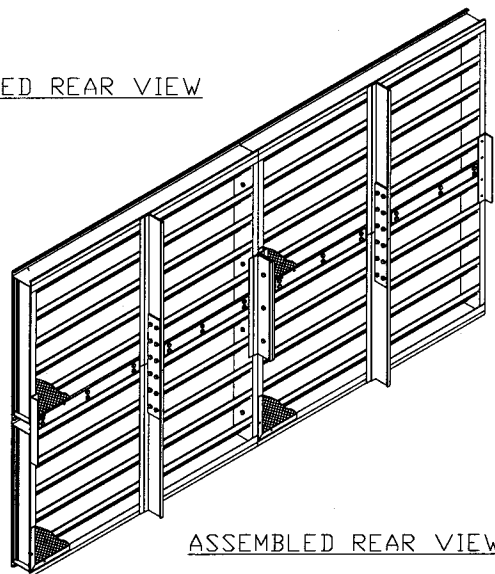
1. Install head and/or extended sill flashing in opening, if applicable (fasteners not provided by Ruskin). Caulk the heads of penetrating fasteners and any flashing joints.
2. If perimeter clip or continuous angles are utilized in installation, locate and anchor them in the opening.
3. Place the louver assembly in the opening.
4. Using shims, level the louver assembly both horizontally and vertically in the opening (shims are not provided by Ruskin). Position the louver in the opening so that the desired sealant joint will be maintained around the perimeter.
5. When louver is level and in proper position, install fasteners through the installation angles into the louver. If the louver is to be installed with fasteners through the frames into substrate or with glazing adapters into window frames, make these connections now.
6. After louver is secured, install backer rod and sealant around louver perimeter (backer rod and sealant is not provided by Ruskin).

## MULTIPLE SECTION ASSEMBLY/INSTALLATION

1. Install head and/or extended sill flashing in opening, if applicable (fasteners not provided by Ruskin). Long lengths of flashing will be provided in sections. Apply a continuous bead of caulk at heads of penetrating fasteners and any section seam where moisture could seep.
2. Locate loose-shipped hardware required for louver assembly.
3. Position the louver sections face down on a level, non-abrasive surface in the configuration they will be assembled in. Reference the tag numbers on each section to ensure the sections are in the correct order.
4. Fasten the sections together at the frame and HVBS joints. Refer to appropriate exploded and detail drawings in this booklet for splice hardware identification and location.
5. If perimeter clip or continuous angles are utilized in installation, locate and anchor them in the opening.
6. Carefully lift the assembled louver and place it in the opening. **Be careful to lift by frames and HVBS members only; do not lift by louver blades.**
7. Using shims, level the louver assembly both horizontally and vertically in the opening (shims are not provided by Ruskin). Position the louver in the opening so that the desired sealant joint will be maintained around the perimeter.
8. On architectural style units, check blade alignment at the vertical joints. Loosen section-connecting hardware and adjust the position of the sections as required to achieve good blade-to-blade alignment. When alignment is complete, tighten all section-connecting hardware.
9. When louver is level and in proper position, install fasteners through the installation angles into the louver. If the louver is to be installed with fasteners through the frames into substrate or by glazing adapters into window frames, make these connections now.
10. After louver is secured, install backer rod and sealant around louver perimeter (backer rod and sealant is not provided by Ruskin). Also apply backer rod and sealant at section joints where possible.



EXPLODED REAR VIEW



ASSEMBLED REAR VIEW

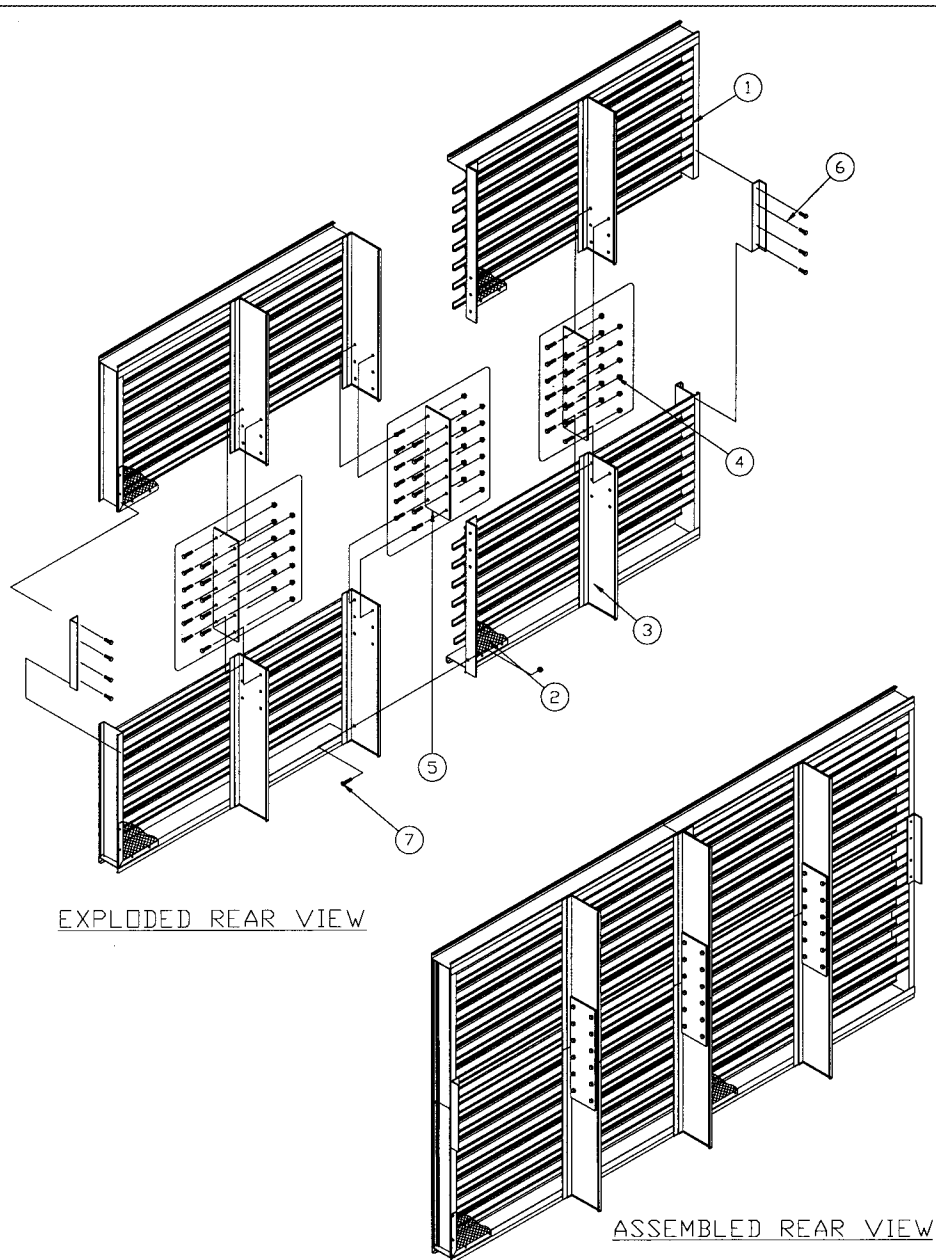
## LEGEND

- ① LOUVER SECTION
- ② BIRD OR INSECT SCREEN (PARTIAL VIEW)
- ③ HIDDEN VERTICAL BLADE SUPPORT (H.V.B.S.)
- ④ HVBS SPLICE PLATE & FASTENERS, REF. DETAIL 163
- ⑤ HORIZONTAL FRAME SPLICE PLATE & FASTENERS, REF. DETAIL 904
- ⑥ VISIBLE VERTICAL MULLION SPLICE BOLT & NUT, REF. DETAIL 143 (SEE NOTES BELOW)
- ⑦ VISIBLE VERTICAL MULLION SPLICE MEMBER & FASTENERS (2 X 2 ASSEMBLY ONLY), REF. DETAIL 300
- ⑧ PERIMETER FRAME SPLICE ANGLE & FASTENERS (BY OTHERS) REF. DETAIL 165

## NOTES

- 1) THE DETAIL NUMBERS REFERENCED ABOVE CORRESPOND WITH THE LAST THREE(3) DIGITS IN THE APPLICABLE DETAIL DRAWINGS IN THIS BOOKLET.  
EXAMPLE: 163 ABOVE = DWG. #70-020163-00B
- 2) FOR LOUVERS WITH BLADE CENTER TO CENTER SPACING OF 2" OR LESS, AND ALL CHEVRON STYLE MODELS, FRAME SPLICE PLATES & FASTENERS (REF. DETAIL 258) WILL BE PROVIDED IN PLACE OF MULLION SPLICE BOLTS.



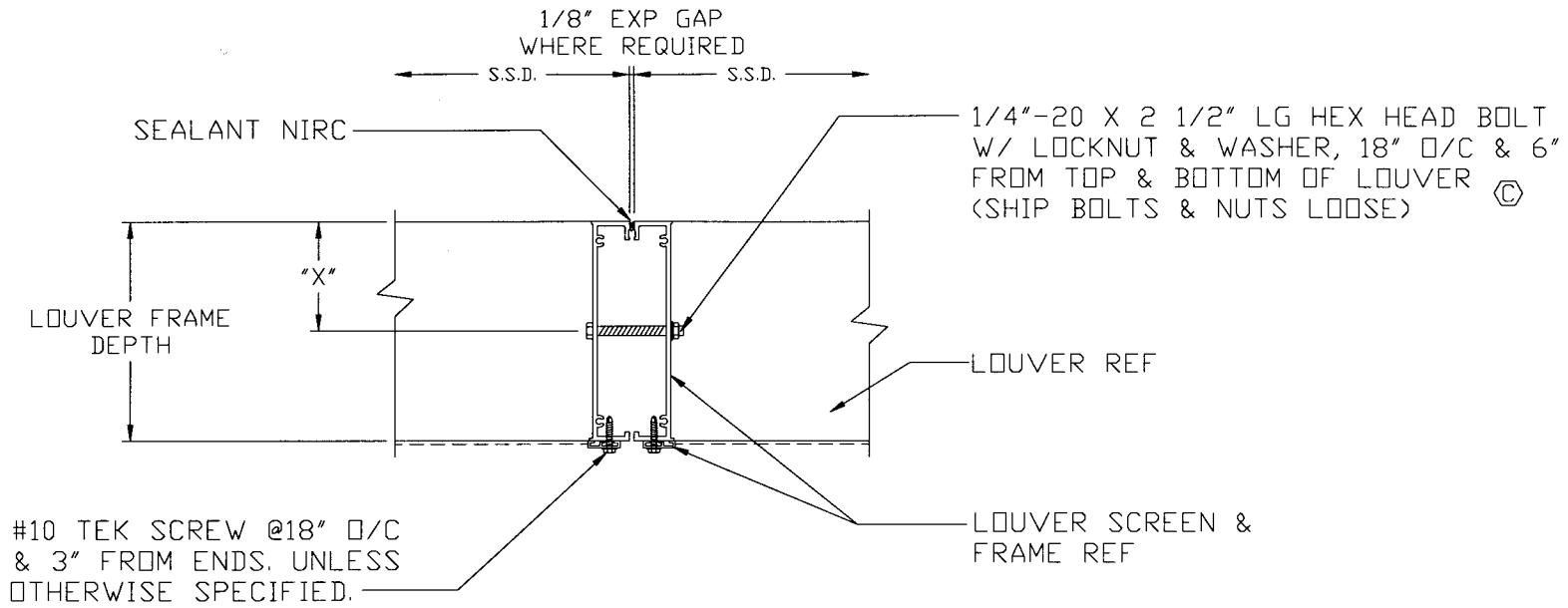


## LEGEND

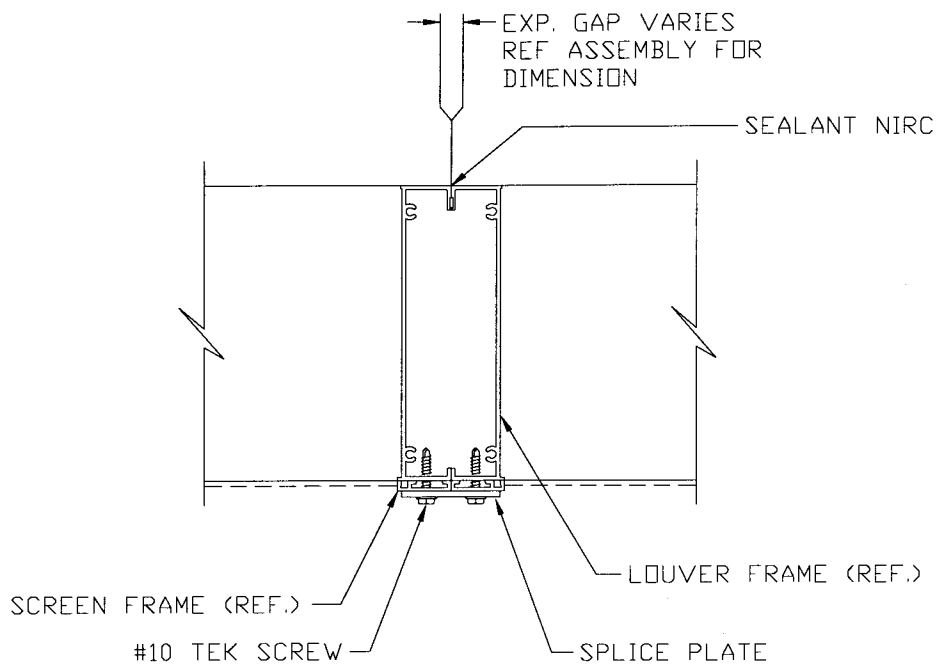
- ① LOUVER SECTION
- ② BIRD OR INSECT SCREEN (PARTIAL VIEW)
- ③ HIDDEN VERTICAL BLADE SUPPORT (H.V.B.S.)
- ④ HVBS SPLICE PLATE & FASTENERS, REF. DETAIL 163
- ⑤ HVBS VERTICAL & HORIZONTAL SPLICE PLATE & FASTENERS, REF DETAIL 164.
- ⑥ PERIMETER FRAME SPLICE ANGLE & FASTENERS (BY OTHERS) REF. DETAIL 165
- ⑦ ARCHITECTURAL JOINT CONNECTION BOLT, REF. DETAIL 162

## NOTES

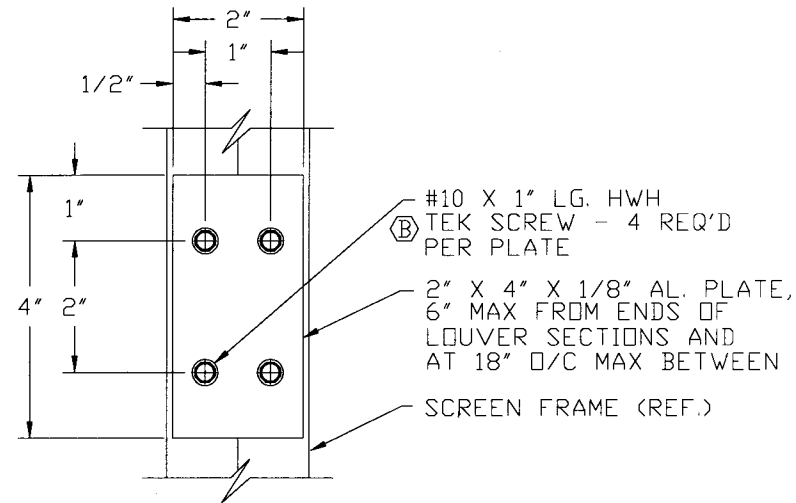
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Ⓢ	REV. WHIZNUT TO BE LOCKNUT & WASHER	JKS	G.L.	JKS		9/11/98
Ⓡ	REV'D JAMB FRAMES	GSL	VMA	DLH		2/17/95
Ⓐ	ADDED TEK SCREW SPEC.	DLH	GSL	VMA		1-3-95
CHANGE LETTER	REVISION DESCRIPTION	DWN. BY:	CHK'D. BY:	APPV'D. BY:	APPV'D. BY:	DATE
DWN. BY: JAL	CHK. BY: VMA	APPV'D. BY: LH	APPV'D. BY:	<b>RUSKIN Mfg.</b>		PLOT SCALE
DATE: 10-7-92	DATE: 03-15-93	DATE: 03-16-93	DATE:	air handling specialties		DWG. CERTIFIED
				3900 DR. GREAVES RD. GRANDVIEW MD 64030		BY: _____
				TITLE		DATE: _____
				EXTRUDED LOUVER VERTICAL MULLION BOLTED CONNECTION		DWG. NO.
						70-020143-00B



1 PLAN VIEW  
N.T.S.

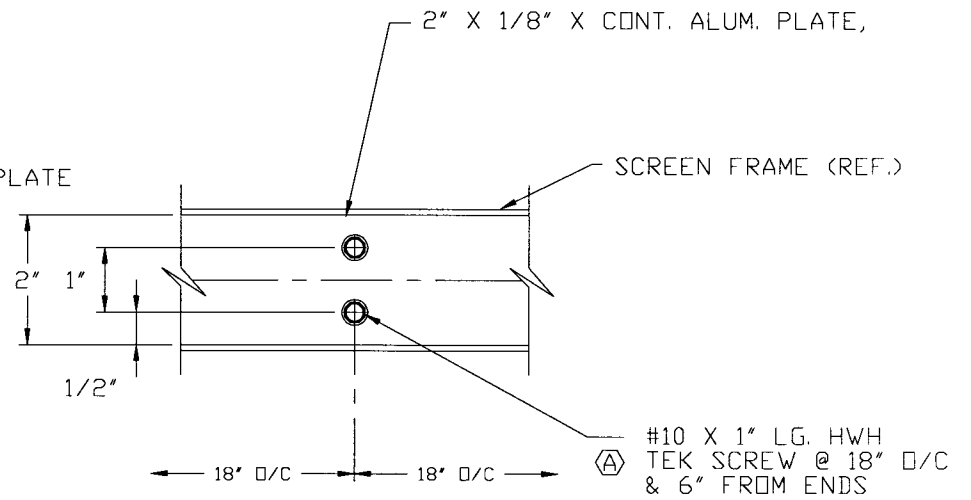
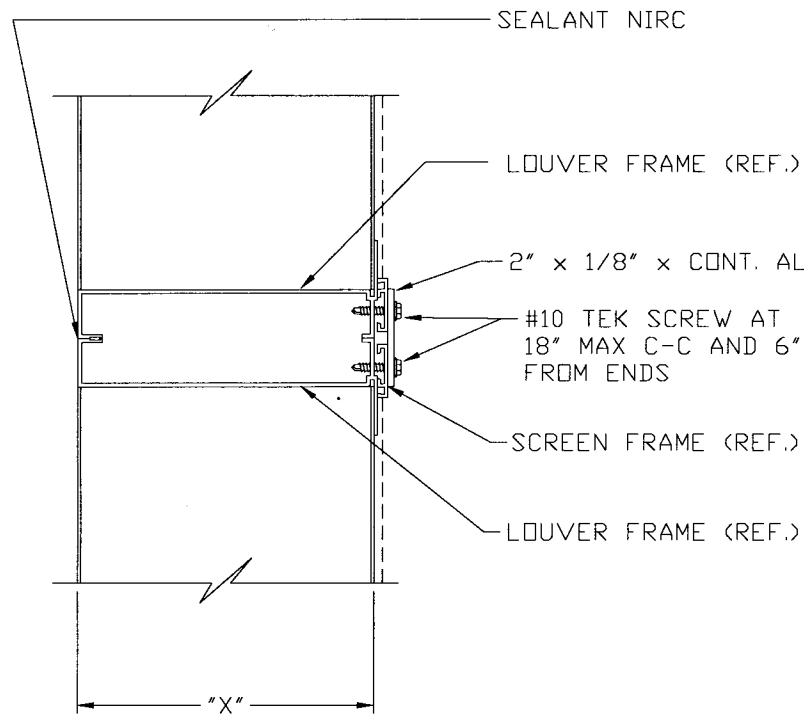


A SPLICE PLATE ELEVATION  
N.T.S.

NOTES

- SCREWS MUST NOT INTERFERE WITH MOVABLE BLADE LINKAGE ON ADJUSTABLE LOUVERS.

CHANGE LETTER	REVISION DESCRIPTION	DWN. BY:	CHK'D. BY:	APPV'D. BY:	APPV'D. BY:	DATE
Ⓟ	REV. NOTE	GW				
Ⓐ	REV'D LOUVER FRAMES	GSL				
<b>RUSKIN Mfg.</b> air handling specialties 3900 DR. GREAVES RD. GRANDVIEW MD 64030		PLOT SCALE	DWG. CERTIFIED			
TITLE		NONE		BY: _____		
EXTRUDED LOUVER FRAME CONNECTION DETAIL		DWG. NO.		DATE: _____		
		70-020258-00B				



1A SPLICE PLATE ELEVATION  
N.T.S.

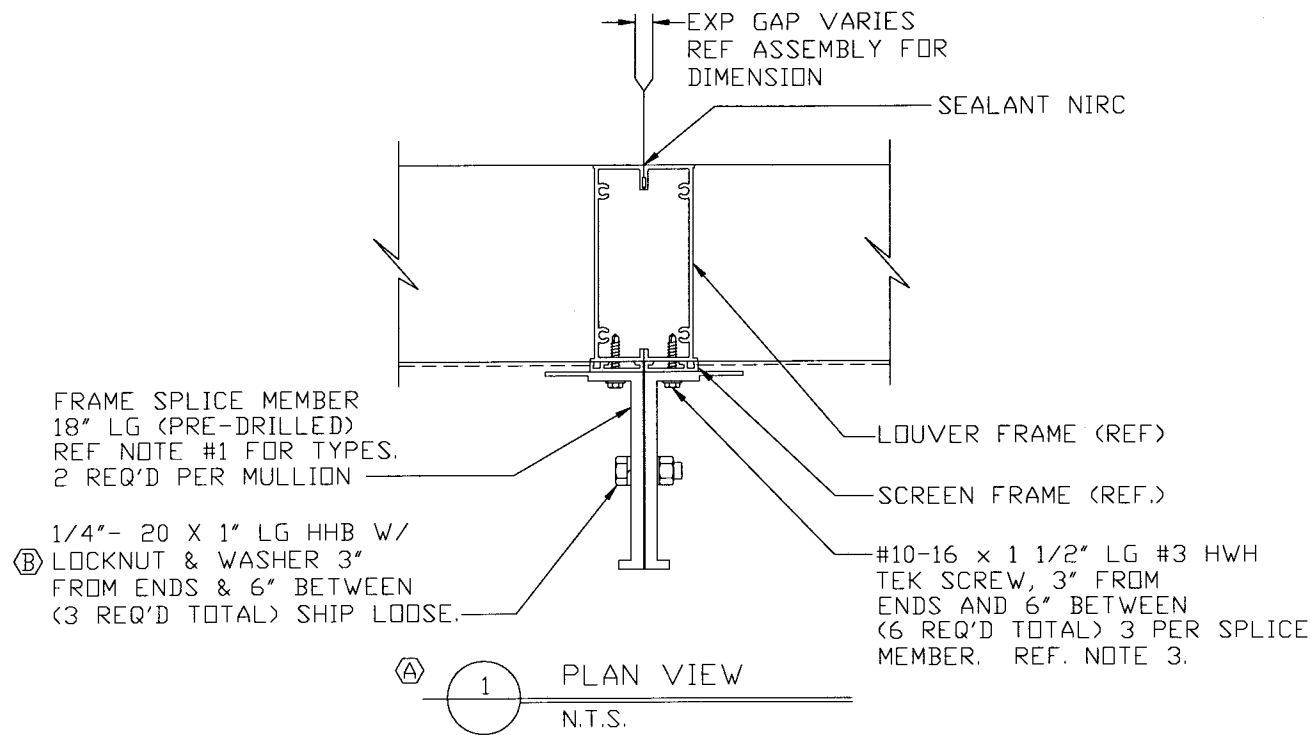
1 VERTICAL SECTION  
N.T.S.

NOTE:

1. DIMENSION "X" = LOUVER FRAME DEPTH.

DWN. BY: MK	CHK. BY:	APPV'D. BY:	APPV'D. BY:
DATE: 3-25-98	DATE:	DATE:	DATE:

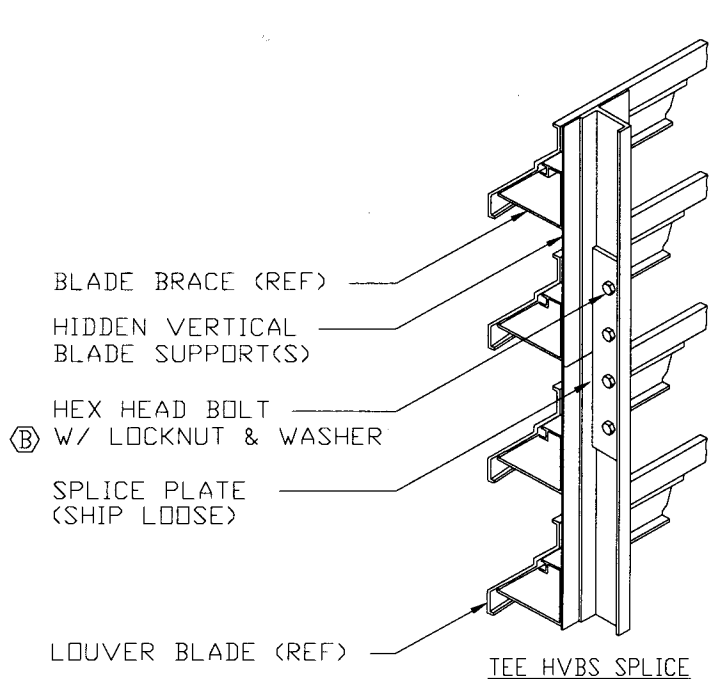
(A)	REV. NOTE	GW				
CHANGE LETTER	REVISION DESCRIPTION	DWN. BY:	CHK'D. BY:	APPV'D. BY:	APPV'D. BY:	DATE
	<b>RUSKIN Mfg</b> Grandview, MD *	PLOT SCALE		DWG. CERTIFIED		
	PROPRIETARY INFORMATION	NONE		BY: _____		
TITLE		DWG. NO.		DATE: _____		
EXTRUDED LOUVER HORIZONTAL MULLION CONNECTION DETAIL		70-020904-00B				



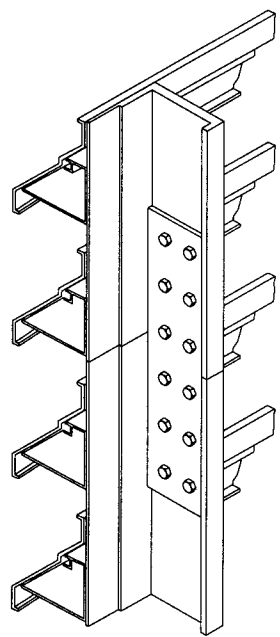
NOTES:

1. 2- 2" X 2" X 1/4" ALUM SUPPORT SPLICE ANGLES FOR 1 1/4", 1 1/2" & 2" DP. LOUVERS, 2- 70-020087-00B SUPPORT SPLICE CHANNELS FOR 3" & 4" DP. LOUVERS, AND 2- 70-020059-00B SUPPORT SPLICE CHANNELS FOR 5" & 6" DP. LOUVERS.
2. INSTALLER MUST REMOVE THE FACTORY INSTALLED SCREEN FRAME SCREWS PRIOR TO INSTALLING SPLICE MEMBERS.
3. ON MOVABLE LOUVERS LOCATE SCREWS TO AVOID INTEFERANCE W/CONCEALED LINKAGE.

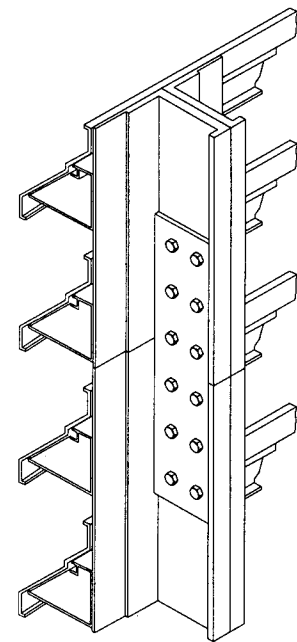
B	REV. SERRATED FLG. NUT TO BE LOCKNUT & WASHER	KDH	G.L.	JKS		9/11/98
A	REV'D FRAMES & SPLICE SUPPORTS	GSL	VMA	DLH		2/17/95
CHANGE LETTER	REVISION DESCRIPTION	DWN. BY:	CHK'D. BY:	APPV'D. BY:	APPV'D. BY:	DATE
DWN. BY: JAL	CHK. BY: VMA	APPV'D. BY: LH	APPV'D. BY:	<b>RUSKIN Mfg.</b> <i>air handling specialties</i> 3900 DR. GREAVES RD. GRANDVIEW MD 64030 TITLE		
DATE: 10-7-92	DATE: 3-15-93	DATE: 3-16-93	DATE:	PLOT SCALE	DWG. CERTIFIED	
				NONE	BY: _____	
					DATE: _____	
				DWG. NO.	70-020300-00B	
					EXTRUDED LOUVER VISIBLE MULLION SPLICE DETAIL	



TEE HVBS SPLICE



SINGLE CHANNEL HVBS SPLICE



DOUBLE CHANNEL HVBS SPLICE

NOTES

1. HVBS = HIDDEN VERTICAL BLADE SUPPORT.
2. REF ORDER OR DWGS FOR HVBS TYPE, OR INSPECT LOUVER ASSEMBLIES.  
REF DETAIL DWGS BELOW FOR SPLICE PLAN VIEW AND SPLICE PLATE PART DWGS.

BLADE SUPPORT (HVBS) TYPE	DETAIL DWG #
(1) 70-020097-00B 3" TEE	70-020166-00B
(1) 70-020088-00B 3" CHANNEL	70-020167-00B
(1) 70-020087-00B 4" CHANNEL	70-020168-00B
(1) 70-020059-00B 6" CHANNEL	70-020169-00B
(2) 70-020088-00B 3" CHANNELS	70-020170-00B
(2) 70-020087-00B 4" CHANNELS	70-020171-00B
(2) 70-020059-00B 6" CHANNELS	70-020172-00B
3" & 4" CHANNELS	70-020173-00B
3" & 6" CHANNELS	70-020174-00B
4" & 6" CHANNELS	70-020175-00B

(A)

DWN. BY: JAL	CHK. BY: VMA	APPV'D. BY:	APPV'D. BY:
DATE: 9-16-92	DATE: 2-17-93	DATE:	DATE:

(B)	REV. FLANGENUT TO BE LOCKNUT & WASHER	JKS	G.L.	JKS		9/11/98
(A)	REV'D TITLE BLOCK & REMV'D DWG 70-020255-00B	JKS	G.L.	VMA		2/20/95
CHANGE LETTER	REVISION DESCRIPTION	DWN. BY:	CHK'D. BY:	APPV'D. BY:	APPV'D. BY:	DATE
<b>RUSKIN Mfg.</b> air handling specialties 3900 DR. GREAVES RD. GRANDVIEW MO 64030		PLOT SCALE	DWG. CERTIFIED			
TITLE		NONE	BY: _____			
1X2 VERT ARCH STYLED SPLICE CONFIG. FOR EXTRUDED LOUVERS		DWG. NO.	DATE: _____			
		70-020163-00B				

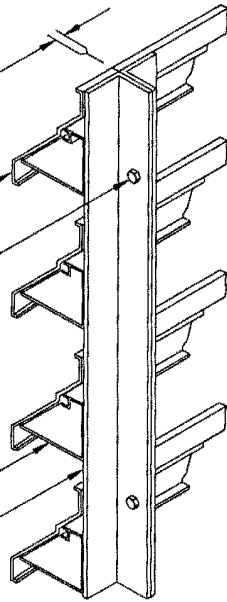
VARIABLES, REF.  
ASSEMBLY FOR  
DIMENSION

LOUVER BLADE (REF)

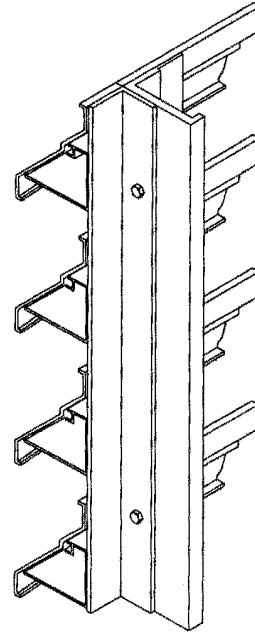
1/4"-20 X 1" HEX  
HEAD BOLT W/ LOCKNUT  
& WASHER, 3" MAX FROM  
TOP AND BOTTOM OF  
LOUVER SECTIONS & AT  
18" O/C MAX BETWEEN

BLADE BRACE (REF)

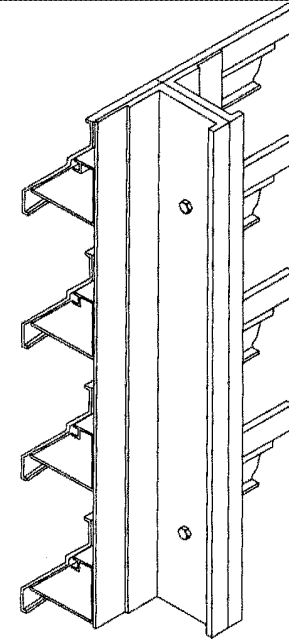
HIDDEN VERTICAL  
BLADE SUPPORT(S)  
(& ANGLE WHERE  
REQ, SEE NOTE 2)



ANGLE HVBS



SINGLE CHANNEL HVBS



DOUBLE CHANNEL HVBS

NOTES

1. HVBS = HIDDEN VERTICAL BLADE SUPPORT.
2. REF ORDER OR DWGS FOR HVBS TYPE, OR INSPECT LOUVER ASSEMBLIES. REF DETAIL DWGS BELOW FOR BOLT LOCATION DIMENSIONS (PLANT ONLY).
3. LOUVERS WITH SINGLE ANGLE OR CHANNEL HVBS SHALL HAVE AN ANGLE ON ONE SIDE OF THE SHIP SECTION TO CONNECT WITH HVBS.
4. PLACE EXPANSION GAP SHIMS BETWEEN HVBS MEMBERS AND/OR ANGLES AT SHIP SECTIONS WHERE REQ. (SHIMS BY OTHERS)

BLADE SUPPORT (HVBS) TYPE	DETAIL DWG #
2" X 2" 1/8" ALUM ANGLE	70-020466-00B
(1) 70-020088-00B 3" CHANNEL	70-020177-00B
(1) 70-020087-00B 4" CHANNEL	70-020178-00B
(1) 70-020059-00B 6" CHANNEL	70-020179-00B
(2) 70-020088-00B 3" CHANNELS	70-020180-00B
(2) 70-020087-00B 4" CHANNELS	70-020181-00B
(2) 70-020059-00B 6" CHANNELS	70-020182-00B
3" & 4" CHANNELS	70-020183-00B
3" & 6" CHANNELS	70-020184-00B
4" & 6" CHANNELS	70-020185-00B

(A)

DWN. BY:	CHK. BY:	APPV'D. BY:	APPV'D. BY:
JAL	VMA		
DATE:	DATE:	DATE:	DATE:
9-21-92	2-1-93		

(B)	REV. WHIZNUT TO BE LOCKNUT & WASHER	JKS	G.L.	JKS		9/11/98
(A)	REV'D TITLE & REM'D DWG 176 & ADDED DWG 466	JKS	G.L.		VMA	2/20/95
CHANGE LETTER	REVISION DESCRIPTION	DWN. BY:	CHK'D. BY:	APPV'D. BY:	APPV'D. BY:	DATE
<b>RUSKIN Mfg.</b> <i>air handling specialties</i> 3900 DR. GRAVES RD. GRANDVIEW MD. 64030		PLOT SCALE		DWG. CERTIFIED		
TITLE		NONE		BY:		
2X1 HORIZ ARCH STYLED SPLICE CONFIG FOR EXTRUDED LOUVERS		DWG. NO.		DATE:		
		70-020162-00B				

VARIABLES, REF. ASSEMBLY FOR DIMENSION

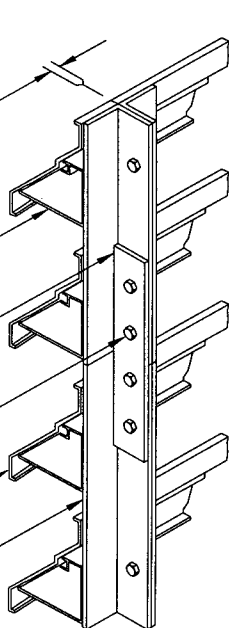
BLADE BRACE (REF)

SPLICE PLATE (SHIP LOOSE)

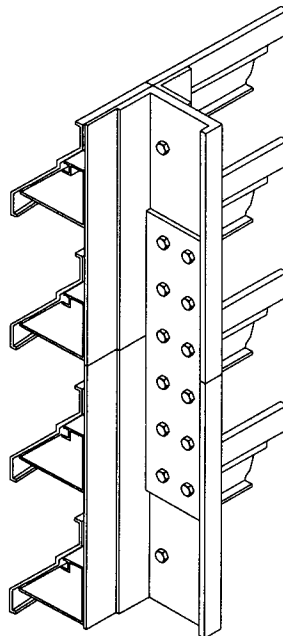
HEX HEAD BOLT W/ LOCKNUT & WASHER

LOUVER BLADE (REF)

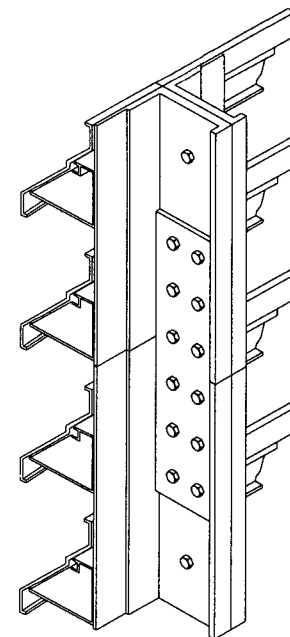
HIDDEN VERTICAL BLADE SUPPORT(S) (& ANGLE WHERE REQ, SEE NOTE 2)



ANGLE HVBS



SINGLE CHANNEL HVBS



DOUBLE CHANNEL HVBS

NOTES

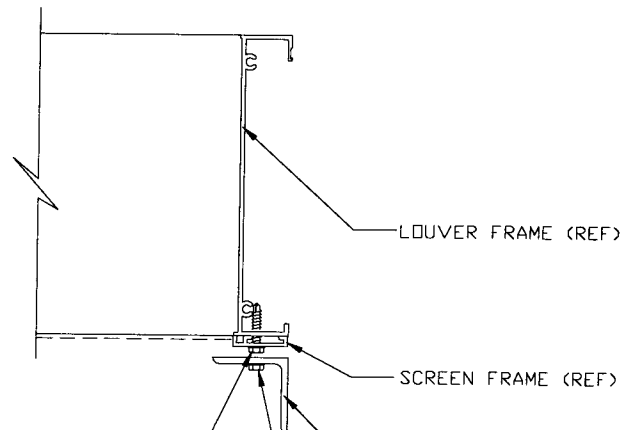
1. HVBS = HIDDEN VERTICAL BLADE SUPPORT.
2. REF ORDER OR DWGS FOR HVBS TYPE, OR INSPECT LOUVER ASSEMBLIES, REF DETAIL DWGS BELOW FOR BOLT LOCATION DIMENSIONS (PLANT ONLY).
3. LOUVERS WITH SINGLE ANGLE OR CHANNEL HVBS SHALL HAVE AN ANGLE ON ONE SIDE OF THE SHIP SECTION TO CONNECT WITH HVBS.
4. PLACE EXPANSION GAP SHIMS BETWEEN HVBS MEMBERS AND/OR ANGLES AT SHIP SECTIONS WHERE REQ. (SHIMS BY OTHERS)

BLADE SUPPORT (HVBS) TYPE	DETAIL DWG #
(1) 70-020088-00B 3" CHANNEL	70-020273-00B
(1) 70-020087-00B 4" CHANNEL	70-020274-00B
(1) 70-020059-00B 6" CHANNEL	70-020275-00B
(2) 70-020088-00B 3" CHANNELS	70-020276-00B
(2) 70-020087-00B 4" CHANNELS	70-020277-00B
(2) 70-020059-00B 6" CHANNELS	70-020278-00B
3" & 4" CHANNELS	70-020279-00B
3" & 6" CHANNELS	70-020280-00B
4" & 6" CHANNELS	70-020281-00B

(A)	REV. FLANGENUT TO BE LOCKNUT & WASHER	JKS	G.L.	JS		9/11/98
	REV'D TITLE BLOCK & REMV'D DWG 70-020272-00B	JKS	G.L.	VMA		2/20/95
CHANGE LETTER	REVISION DESCRIPTION	DWN. BY:	CHK'D. BY:	APPV'D. BY:	APPV'D. BY:	DATE
DWN. BY: JAL DATE: 9-21-92	CHK. BY: VMA DATE: 2-18-93	APPV'D. BY: DATE:	APPV'D. BY: DATE:	PLOT SCALE: NONE DWG. CERTIFIED BY: _____ DATE: _____		TITLE: 2X2 HORIZ/VERT ARCH STYLED SPLICE CONFIG FOR EXTRUDED LOUVERS DWG. NO. 70-020164-00B

**RUSKIN Mfg.**  
 air handling specialties  
 3200 DR. GREAVES RD. GRANDVIEW MO 64030





#10 SCREW AT 18" MAX C-C AND 3" FROM CORNERS UNLESS OTHERWISE SPECIFIED. (INSTALLER MUST REMOVE THE FACTORY INSTALLED SCREEN FRAME SCREWS PRIOR TO INSTALLING SPLICE ANGLE.)

SPLICE ANGLE (NOT BY RUSKIN, UNLESS OTHERWISE SPECIFIED)

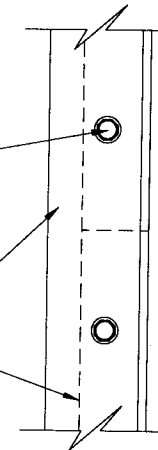
#10-16 x 1" LG HWH #3 TEK SCREW AT 3" MAX C-C AND 1 1/2" FROM CORNERS UNLESS OTHERWISE SPECIFIED.

1 PLAN VIEW  
N.T.S.

#10-16 X 1" LG HWH #3 TEK SCREW, 1 1/2" FROM ENDS OF SPLICE ANGLE AND 3" O/C BETWEEN (NOT BY RUSKIN, UNLESS OTHERWISE SPECIFIED)

1 1/2" X 1 1/2" X 1/8" THICK X 12" LONG AL SPLICE ANGLE (NOT BY RUSKIN UNLESS OTHERWISE SPECIFIED)

LOUVER FRAME (REF)



A SPLICE ANGLE ELEVATION  
N.T.S. SCREEN AND SCREEN FRAME NOT SHOWN FOR CLARITY

NOTES:

- INSTALLER MUST REMOVE THE FACTORY INSTALLED SCREEN FRAME SCREWS PRIOR TO INSTALLING SPLICE ANGLE.

C	REV'D SPLICE ANGLE LENGTH	GSL	VMA	JKS		3-31-97
B	REV'D LOUVER FRAME	GSL	VMA			2-20-95
A	ADDED TEK SCREW CALL-OUT	DLH	GSL	VMA		1-3-95

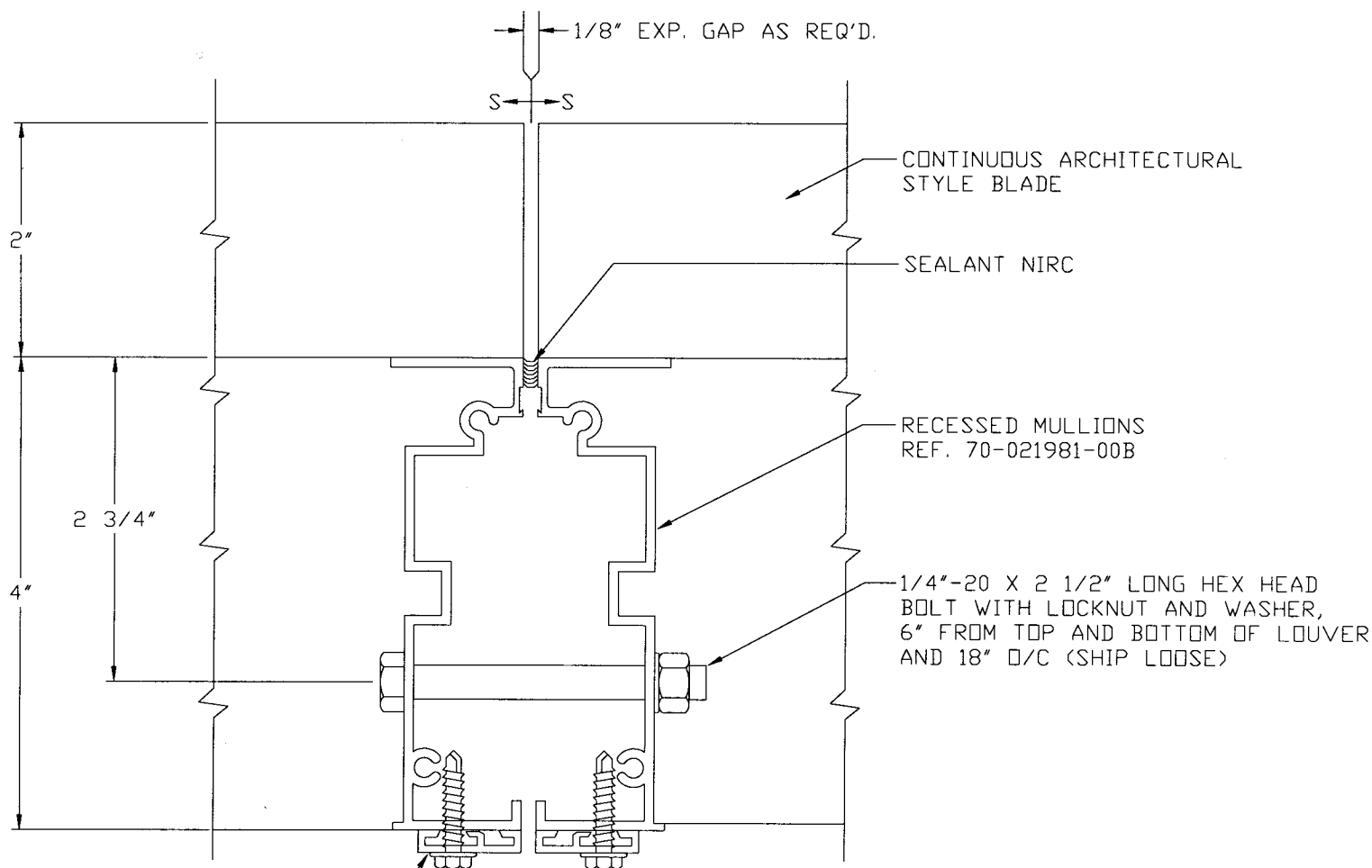
CHANGE LETTER	REVISION DESCRIPTION	DWN. BY:	CHK'D. BY:	APPV'D. BY:	APPV'D. BY:	DATE

DWN. BY: JAL	CHK. BY: VMA	APPV'D. BY: LH	APPV'D. BY:
DATE: 10-7-92	DATE: 03-15-93	DATE: 03-16-93	DATE:

**RUSKIN Mfg.**  
air handling specialties  
3900 DR. GREAVES RD. GRANDVIEW MD 64030

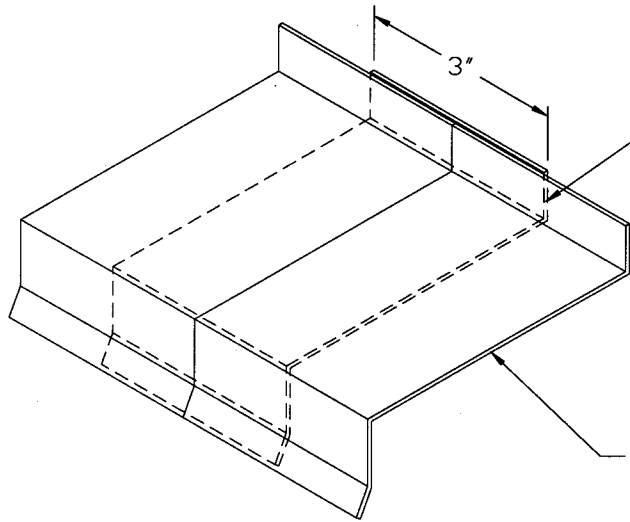
PLOT SCALE	DWG. CERTIFIED
NONE	BY: _____
	DATE: _____

TITLE	DWG. NO.
EXTRUDED LOUVER FRAME SPLICE DETAIL	70-020165-00B



LOUVER SCREEN FRAME AS REQ'D.  
ATTACH WITH #10 TEK SCREWS,  
3" FROM ENDS AND 18" O/C  
UNLESS OTHERWISE SPECIFIED

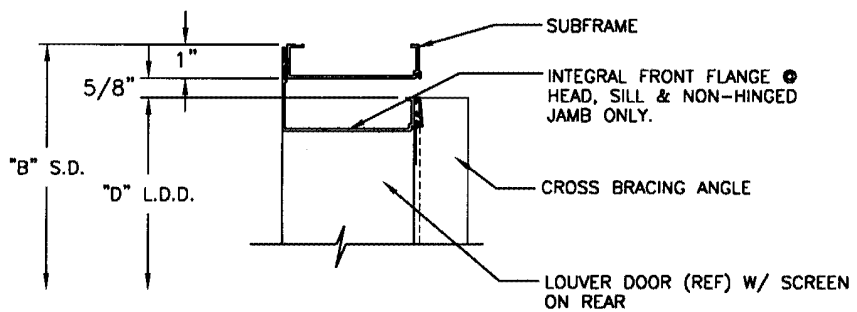
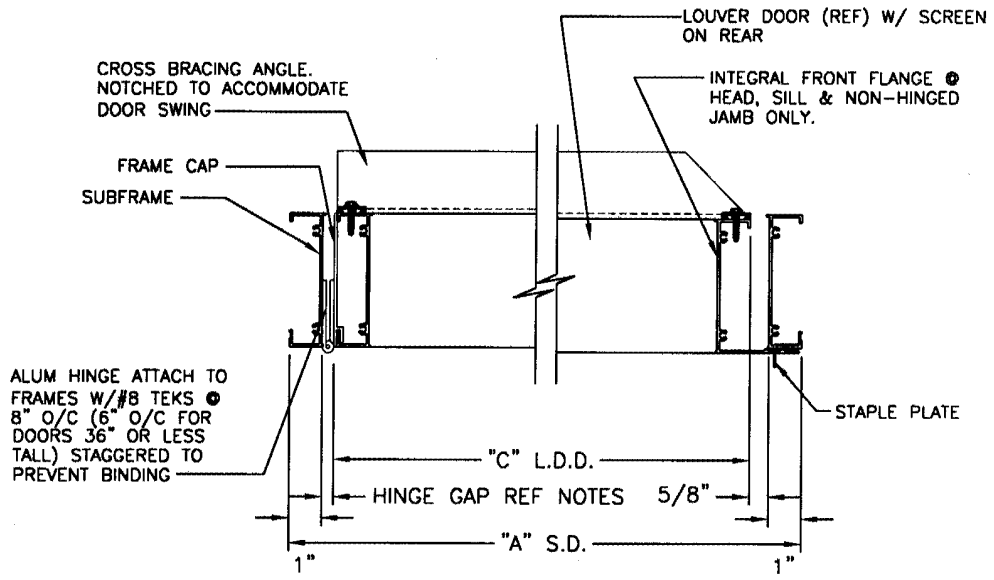
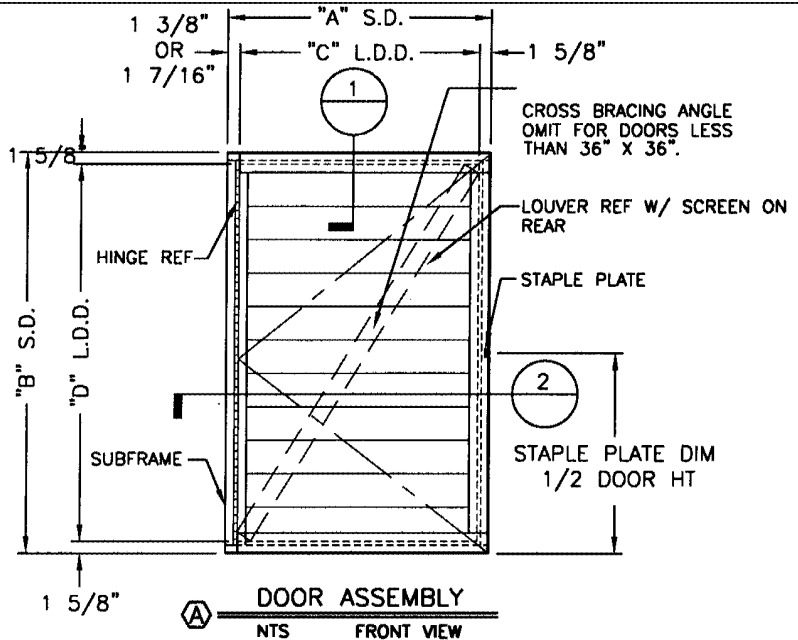
CHANGE LETTER	REVISION DESCRIPTION				DWN. BY:	CHK'D. BY:	APPV'D. BY:	APPV'D. BY:	DATE
	DWN. BY: GW	CHK. BY:	APPV'D. BY:	APPV'D. BY:	<b>RUSKIN Mfg.</b> air handling specialties 3900 DR. GREAVES RD. GRANDVIEW MD 64030		PLOT SCALE 1" = 1"		DWG. CERTIFIED
	DATE: 1-4-02	DATE:	DATE:	DATE:	TITLE ELF6425DD LOUVER RECESSED MULLIONS CONNECTION DETAIL		BY: _____ DATE: _____		DWG. NO. 60-021807-00B



ALUMINUM LAP STRIP, TO BE FURNISHED AT EACH INTERMEDIATE JOINT, FINISH TO MATCH LOUVER, SHIP LOOSE SEALANT IS BY OTHERS

ALUMINUM EXTENDED SILL REF. 70-020477-00B

CHANGE LETTER		REVISION DESCRIPTION			DWN. BY:	CHK'D. BY:	APPV'D. BY:	APPV'D. BY:	DATE	
DWN. BY:	GW	CHK. BY:	APPV'D. BY:	APPV'D. BY:	RUSKIN <i>Mfg</i> Grandview, MD	PLOT SCALE		DWG. CERTIFIED		
DATE:	1-4-02	DATE:	DATE:	DATE:		PROPRIETARY INFORMATION	NONE		BY: _____	
					TITLE	DWG. NO.				
					EXTENDED SILL INSTALLATION DETAIL AT JOINT	60-021808-00B				



2 HORIZONTAL SECTION  
NTS

- HINGE NOTE:
- 1A) FOR DOORS THAT ARE 48" TALL. HINGE GAP = 3/8"
  - 1B) FOR DOORS THAT ARE 49" TO 72" TALL. HINGE GAP = 3/8"
  - 1C) FOR DOORS THAT ARE 73" TO 96" TALL. HINGE GAP = 7/16".  
FOR INSTALLATION WELD THESE HINGES IN ADDITION TO SCREWING.
- MAXIMUM LOUVER DOOR WIDTH = 36" WIDE. IF DOOR IS TO BE WIDER THAN 36", THEN THE ORDER MUST GO THROUGH ENGINEERING

1 HEAD DETAIL (SILL SIM)  
NTS

- NOTES:
- 1) DIMENSIONS SHOWN ARE ACTUAL SIZE.
  - 2) CONTRACTOR TO VERIFY SIZE & CONFIGURATION PRIOR TO FABRICATTION
  - 3) IF LOUVER DOOR IS ADJACENT TO STATIONARY LOUVER SECTIONS. THEN BLADES IN LOUVER DOOR ARE TO ALIGN W/ FIXED LOUVER SECTIONS
  - 4) NIRC = NOT IN RUSKINS CONTRACT  
S.D. = SUBFRAME DIMENSION  
L.D.D. = LOUVER DOOR DIMENSION

CHANGE LETTER	REVISION DESCRIPTION	DWN. BY:	CHK'D. BY:	APP'V'D. BY:	APP'V'D. BY:	DATE
DWN. BY: JAL		CHK. BY:	APP'V'D. BY:	APP'V'D. BY:	PLOT SCALE	
DATE: 3-6-02		DATE:	DATE:	DATE:	NONE	
TITLE					DWG. NO.	
STANDARD EXT. LVR DOOR W/ HINGE ON LEFT FRONT (HINGE ON RIGHT OPP)					60-021338-01B	
RUSKIN Mfg. Grandview, MO PROPRIETARY INFORMATION					DWG. CERTIFIED BY: _____ DATE: _____	

## **LIMITED PRODUCT WARRANTY**

Products manufactured by Ruskin are warranted to be free from defects in material and workmanship for a period of 12 months after being installed or placed in service, but in no instance shall the period of warranty be longer than 18 months from the date of original shipment by Ruskin. Ruskin warrants only that it will furnish replacement material, or at its option, repair any product of its manufacture that is proven to Ruskin's satisfaction to be defective in material or workmanship during this described warranty period. To determine defects Ruskin may require material claimed defective to be returned freight prepaid to the Ruskin factory that originally shipped the product. If any defects are determined by Ruskin, freight charges relative to replacement material will be paid by Ruskin (limited to the 48 contiguous United States).

Products not manufactured by Ruskin will be warranted by Ruskin only to the extent that they are warranted to Ruskin by their manufacturer. Electric motor warranties and claims are administered by the motor manufacturer only. Ruskin shall have no responsibility for the operation or performance of any products in any manner other than that which the product is usually tested and applied under industry standards, nor for any damage to a product from abuse, misapplication, unauthorized repairs, abrasion, erosion, corrosion, or the like due to abnormal temperatures, or the influence of foreign matter, nor for the design or operation of any system of which any product may be made a part, or for the suitability of any product for any particular application. Ruskin shall not be liable for any cost or expense, including without limitation, labor expenses, in connection with removal or replacement of alleged defective equipment or any part or portion thereof nor for incidental or consequential damages of any kind, or under any circumstances for any damage beyond the price of the goods sold.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES EXCEPT THAT OF TITLE, WHETHER WRITTEN, ORAL OR IMPLIED, IN FACT OR IN LAW (INCLUDING ANY WARRANTY OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE). Correction of non-conformities, whether patent or latent, in the manner and within the period of time provided above, shall constitute fulfillment of all liabilities of Ruskin whether based on contract, tort, strict liability or other legal theory with respect to Ruskin's products. Ruskin neither assumes, nor does it authorize any other person to assume on its behalf, any other liability in connection with the sale of its products.

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 5223 2.2 CAST IRON BOILERS

Submittal Number: 1

Item: B-1 Boiler

Manufacturer: Well-McLain

Model #: H-680 Cast Iron sectional Water Boiler

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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B-1  
WMBP

WEIL

B-1 BOILER

Weil-McLain Model H-680 Cast Iron Sectional Water Boiler, 787 MBH  
Input, 634



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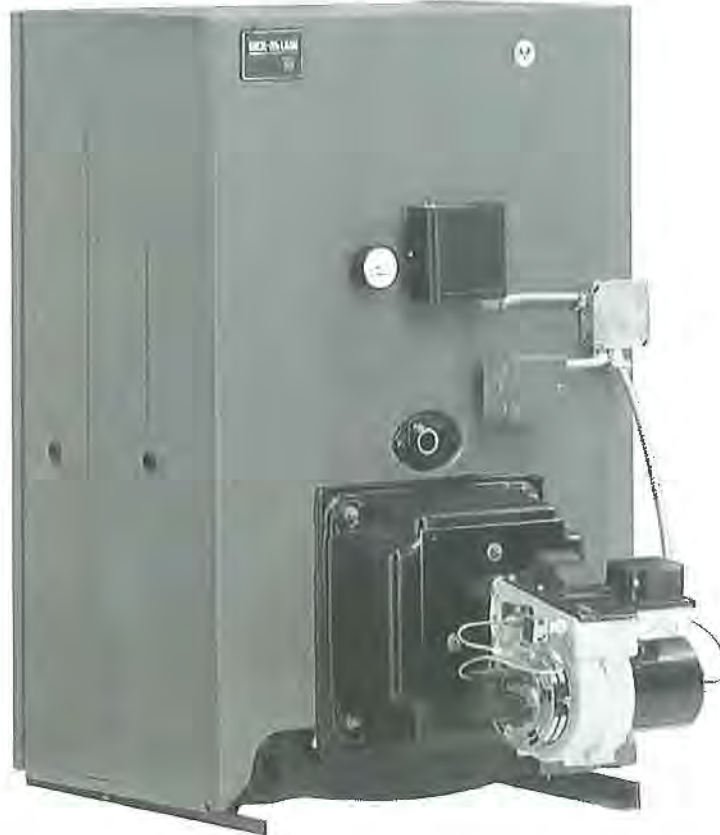
# - 80 -

## Water & Steam Boilers

For Gas, Light Oil, & Gas/Light Oil-Fired Burners

# Boiler Manual

- Installation
- Maintenance
- Startup
- Parts



### WARNING

This manual must only be used by a qualified heating installer/service technician. Read all instructions before installing. Follow all instructions in proper order. Failure to comply could result in severe personal injury, death or substantial property damage.

### INSTALLER

- Consider piping and installation when determining boiler location.
- Any claims for damage or shortage in shipment must be filed immediately against the transportation company by the consignee.
- This manual is for use only by your qualified heating installer/service technician.
- Boiler and burner must be installed by a qualified service technician.
- We recommend regular service by a qualified service technician, at least annually.

### USER

### NOTICE

When calling or writing about the boiler— Please have the boiler model number from the boiler rating label and the CP number from the boiler jacket.



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4. Perform hydrostatic pressure test .....	8
5. Complete block assembly .....	9
6. Install flue collector .....	10
7. Connect water boiler piping .....	14
8. Connect steam boiler piping .....	16
9. Install jacket .....	20
10. Pipe tankless heaters .....	27
11. Install water boiler controls .....	28
12. Install steam boiler controls .....	29
13. Connect breeching and venting system .....	31
14. Install burner .....	32
15. Wiring and fuel piping .....	32
16. Make final adjustments .....	32
17. Dimensions and ratings .....	34
18. Parts .....	36
Handling ceramic fiber and fiberglass materials .....	38

## Hazard Definitions

The following defined terms are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning the life of the product.



Indicates presence of hazards that **will cause severe** personal injury, death or substantial property damage if ignored.



Indicates presence of hazards that **can cause severe** personal injury, death or substantial property damage if ignored.



Indicates presence of hazards that **will or can cause minor** personal injury, death or substantial property damage if ignored.



Indicates special instructions on installation, operation or maintenance that are important but not related to personal injury.



Read all instructions before installing. Failure to follow all instructions in proper order can cause severe personal injury, death or substantial property damage.



Do not use petroleum-based cleaning or sealing components in boiler system. Severe damage to system components can result, causing substantial property damage.





# 1 Before installing boiler

## Installation must comply with —

- State, provincial and local plumbing, heating and electrical codes.
- Regulations of servicing utilities.
- National codes where applicable.

## Before selecting boiler location

1. Check for nearby connections to:
  - a. Fuel supply
  - b. Electrical power
  - c. System water or steam piping
  - d. Venting systems - see page 31
  - e. Combustion and ventilation air supply — see “Provide combustion and ventilation air supply openings” on page 4.
2. Check area around boiler. Remove any combustible materials, gasoline and other flammable vapors and liquids.

**⚠ WARNING**

Failure to keep boiler area clear and free of combustible materials, gasoline and other flammable liquids and vapors can result in severe personal injury, death and substantial property damage.

## Provide clearance around boiler

- Provide minimum clearances to combustible materials:
  1. Single-wall vent pipe — 18 inches.
  2. Double-wall vent pipe — refer to vent pipe manufacturer’s recommendations for vent pipe clearances.
  3. Boiler top — 24 inches.
  4. Boiler front — 48 inches.
  5. Boiler flue — 9 inches.
  6. Boiler rear — 9 inches.
  7. Boiler sides — 6 inches.
- Boiler may be installed on combustible flooring.
- See pages 34 and 35 for boiler dimensions.

**NOTICE**

Flue pipe/breeching clearances take precedence over jacket clearances.

- Left side — for cleaning and tankless heater removal — 34 inches.
- Allow sufficient space on remaining sides for cleaning, servicing and burner installation. See burner literature for length and recommended service clearances.

## Lay a foundation, if needed:

Floor construction and condition must be suitable for weight of boiler when filled with water. See page 34 for approximate boiler operating weight.

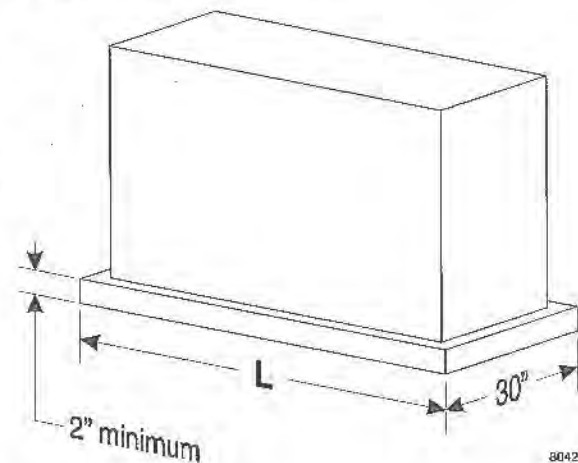
A level concrete or brick foundation (constructed per Table 1 and Figure 1) is required when:

1. A floor could possibly become flooded.
2. Non-level conditions exist.

**Table 1** Boiler foundation (see Figure 1)

Boiler model number	“L” Length (inches)	Boiler model number	“L” Length (inches)
380	23	880	58
480	30	980	65
580	37	1080	72
680	44	1180	79
780	51	1280	86

**Figure 1** Boiler foundation



8042



# 1 Before installing boiler (continued)

## Provide combustion and ventilation air openings:

### **WARNING**

Do not install an exhaust fan in boiler room. Adequate combustion and ventilation air must be provided to assure proper combustion and prevent possibility of flue gas leakage and carbon monoxide emissions, causing severe personal injury or death.

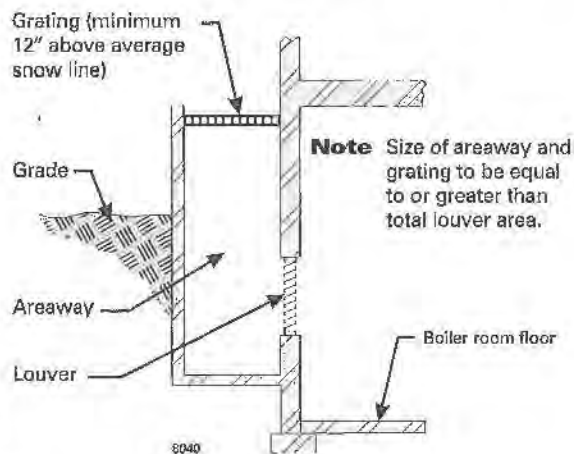
Opening sizes must comply with state, provincial or local codes. In their absence, use the following when boiler is in a confined room:

- Provide two permanent openings in boiler room — one within 12 inches of ceiling, one within 12 inches of floor. Minimum dimension of each opening is 3 inches.
  1. When all air is taken from within building, each opening should be at least one square inch/1,000 Btuh boiler input and freely connect with areas having adequate infiltration from outside.
  2. When all air is taken from outdoors, each opening should connect directly or by ducts from outdoors or crawl or attic spaces that freely connect with outdoors and sized as listed below:
    - a. through outside wall or vertical ducts - at least one square inch/4,000 Btuh boiler input.
    - b. through horizontal ducts - at least one square inch/2,000 Btuh boiler input.
    - c. where ducts are used, they should be same cross-sectional area as free area of openings they are connected to.
    - d. compensate for louver, grille or screen blockage when calculating free air openings. Refer to their manufacturer's instructions for size. If unknown, use:
      - wood louvers - 20-25% free air.
      - metal louvers or grilles - 60-75% free air.
      - screens - not less than ¼ inch mesh.

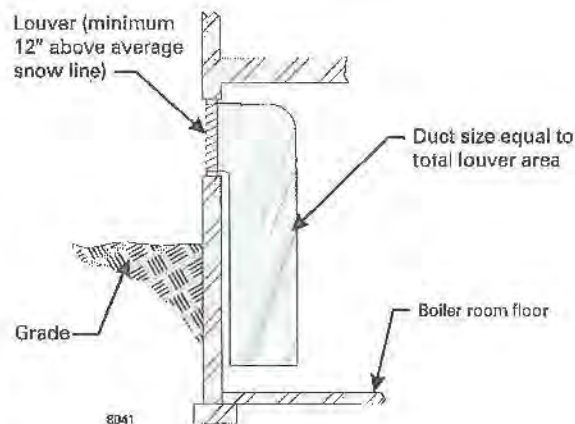
Lock louvers in open position, or interlock with equipment to prove open before boiler operation.

When combustion and ventilation air enters through sidewall openings, ensure openings comply with Figures 2 and 3.

**Figure 2** Combustion and ventilation air openings — Boiler room below grade



**Figure 3** Combustion and ventilation air openings — Boiler room partially or completely above grade







# 2 Set boiler in place

## For packaged boiler:

1. Remove top jacket panels. Set aside until after boiler is piped.

**▲WARNING** The boiler contains ceramic fiber and fiberglass materials. Use care when handling these materials per instructions on page 38 of this manual. Failure to comply could result in severe personal injury.

2. Remove lag screws (2 in front, 2 in rear) from shipping rails.
3. Remove boiler from skid. Cables are already attached to block assembly. See Table 2 for lifting weight.
  - Using crane — hook middle of each cable to eye of crane.
  - Using hoist — hook middle of each cable to hoist. Raise boiler off skid. Use pipe rollers under skid angles to roll boiler.
4. Place boiler in final position. Center boiler on foundation, if used.
5. Level boiler. Shim under skid angles, if necessary.
6. Cut off cables.

**▲WARNING** Cables are not intended for long-term usage. Cables may corrode inside boiler, weakening their lifting strength. Failure to remove cables can result in severe personal injury, death or substantial property damage.

7. Proceed to “Perform hydrostatic pressure test,” page 8.

## For block assembly:

1. Remove lag screws (2 in front, 2 in rear) from shipping rails.
2. Remove boiler from skid. Cables are already attached to block assembly. See Table 2 for lifting weight.
  - Using crane — attach free end of cables to eye of crane.
  - Using hoist — attach free end of cables to hoist. Raise boiler off skid. Use pipe rollers under steel skid angles to roll boiler.
3. Place boiler in final position. Center boiler on foundation, if used.
4. Level boiler. Shim under skid angles, if necessary.
5. Cut off cables.

**▲WARNING**

Cables are not intended for long-term usage. Cables may corrode inside boiler, weakening their lifting strength. Failure to remove cables can result in severe personal injury, death or substantial property damage.

6. Inspect block assembly for disjointed sections. Check gas-tight seal of flue collector hood and cleanout plates.

**▲WARNING**

Gas tight seal must be maintained to prevent possible flue gas leakage and carbon monoxide emissions, resulting in severe personal injury or death.

- a. Check inside section assembly for any light passing through unsealed areas.
  - b. Mark all unsealed areas.
  - c. At unsealed areas, check for:
    - damaged gaskets.
    - sealing rope not in place.
    - loose bolts or nuts.
  - d. Correct all conditions and repeat step b. If unsealed areas still exist, contact your Weil-McLain distributor or sales office before continuing installation.
7. Proceed to “Perform hydrostatic pressure test,” page 8.

**Table 2** Lifting weights

Boiler model number	Packaged boiler lbs.	Assembled block lbs.
380	1355	1150
480	1615	1385
580	1875	1620
680	2130	1855
780	2390	2090
880	2650	2325
980	2910	2560
1080	3165	2795
1180	3425	3030
1280	3680	3265



# 3 Assemble block

**WARNING** Sections are top heavy. Unbolted sections may fall if not supported, resulting in severe personal injury or death.

## Install back refractory blanket

1. Lay back section on floor with ports face up.
2. Apply adhesive to blanket.
3. Press blanket against back target wall as shown in Figure 4.
4. Using knife, cut hole through blanket to expose observation port opening.

## Prepare back section

1. Apply  $\frac{1}{8}$ " continuous bead of sealing rope adhesive in sealing rope grooves. See Figure 4. **Do not get any adhesive on machined port surfaces.**
2. Place  $\frac{1}{2}$ " sealing rope in groove. Around curves, grasp at 1" intervals and push together. Do not stretch.

**WARNING** Do not pre-cut rope. Gas tight seal must be maintained to prevent possibility of flue gas leakage and carbon monoxide emissions, causing severe personal injury or death.

3. Remove any grit from port machined surfaces with clean rag.

**WARNING** Do not use petroleum-based cleaning or sealing compounds in boiler system. Severe damage to system components can result, causing substantial property damage.

4. Place  $7\frac{1}{2}$ " and  $3\frac{1}{2}$ " sealing rings in appropriate port openings. See Figure 4. If sealing ring slips out of groove, stretch ring gently for several seconds, then reposition in groove.
5. Apply continuous bead of silicone sealant no larger than  $\frac{1}{16}$ " around entire outside edge of **outer** machined surface of port. Refer to Figure 5. **Do not apply silicone sealant on, next to or under sealing ring.**

**WARNING** Silicone sealant applied as specified above prevents unburned oil vapors from coming in contact with sealing ring. Vapor contact can damage rings, resulting in severe damage to boiler and substantial property damage.

6. Position section upright on foundation (if used) and screw 3" pipe at least 22" long into 3" return tapping.
7. Place a block under pipe to hold section upright.

Figure 4 Sealing rope installation

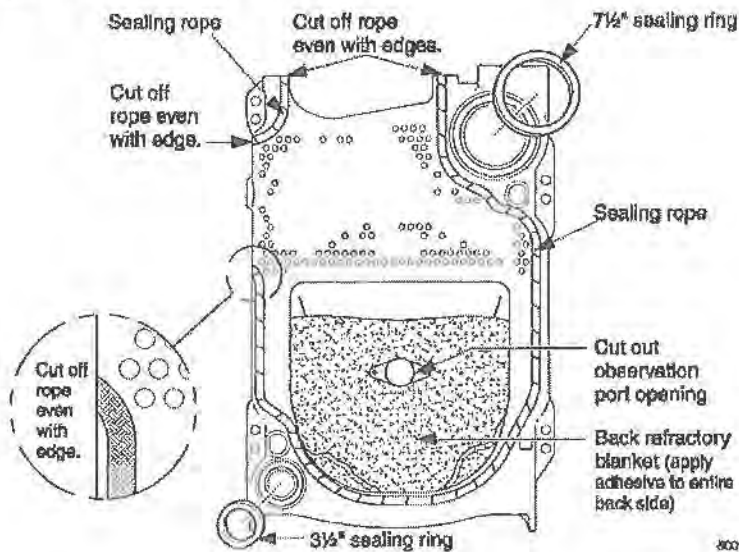
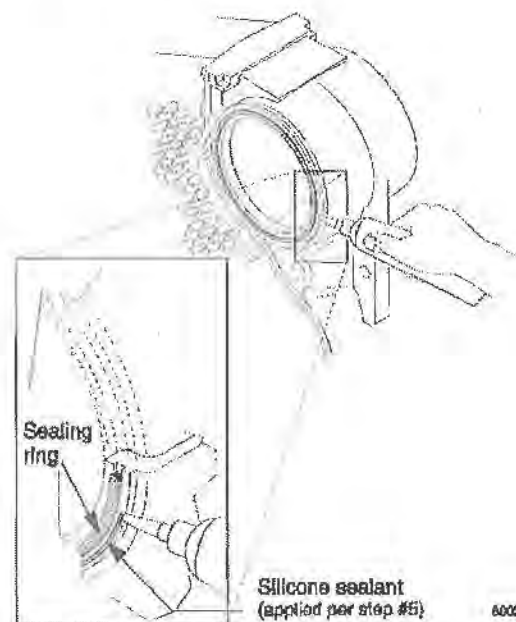


Figure 5 Silicone sealant







# 3 Assemble block (continued)

## Install intermediate sections

**WARNING** Sections are top heavy. Unbolted sections may fall if not supported, resulting in severe personal injury or death.

1. Remove and discard 3/8" diameter shipping tie rods.
2. Remove grit from port machined surfaces with clean rag.

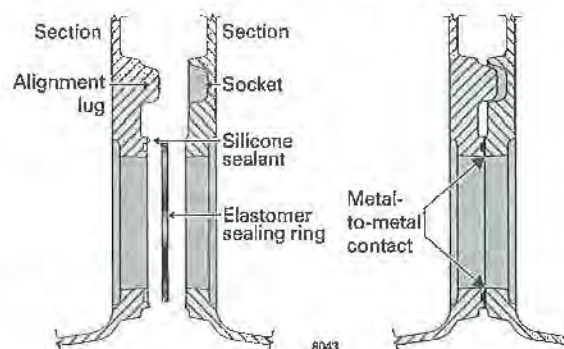
**WARNING** Do not use petroleum-based cleaning or sealing compounds in boiler system. Severe damage to system components can result, causing substantial property damage.

3. Position intermediate section so aligning lugs fit into sockets of next section. See Figure 6.
4. Install TI (tankless intermediate) and SI (supply intermediate) sections (when used) in order shown in Table 3.
5. Draw sections together until metal-to-metal contact is made around machined port openings (see Figure 6):
  - a. Oil threads on 4 draw rods. Install washer and nut at end to be tightened. Use nut only on other end.
  - b. Uniformly draw sections together, starting at washer/nut end.

**NOTICE** **Important** — Leave an equal amount of thread on each end of the draw rod. This is needed to allow securing the jacket support brackets in place (see pages 20 and 21).

- c. Draw rods should be torqued to a range of 90 to 100 ft. - lbs. Do not back off draw rods.
  - d. Metal-to-metal contact will be achieved around port openings. See Figure 6. If gap occurs, it should be no greater than .032". Check with feeler gauge.
  - e. If, for any reason, gap around machined port opening exceeds .032", check for rope extending from rope grooves, dirt on port openings or sockets, or misaligned lugs. If corrections are made and gap still exists, contact your Weil-McLain distributor or sales office before continuing installation.
6. **CAUTION** After erecting first intermediate section, check both sections for plumb. Failure to plumb sections can cause misaligned piping and breeching, possibly resulting in property damage.
  7. Repeat steps 1-5 from "Prepare back section," page 6.

**Figure 6** Sealing ring installation and port alignment



**Table 3** Section arrangement

Boiler model number	Max. number of heaters	Section arrangement (all heaters must be on left side of boiler)
380 W&S	1	F-TI-B
460 W&S	1	F-TI-I-B
580 W&S	2	F-TI-I-TI-B
660 W&S	2	F-TI-I-TI-I-B
780 W&S	2	F-TI-I-TI-I-I-B
880 W&S	3	F-TI-I-TI-I-I-TI-B
980 W&S	3	F-TI-I-TI-I-TI-I-I-B
1080 W	3	F-TI-I-TI-I-I-TI-I-I-B
1080 S	3	F-TI-I-TI-SI-I-TI-I-I-B
1180 W	4	F-TI-I-TI-I-I-TI-I-TI-B
1180 S	4	F-TI-I-TI-I-SI-I-TI-I-TI-B
1280 W	4	F-TI-I-TI-I-I-I-TI-I-TI-B
1280 S	4	F-TI-I-TI-I-SI-I-I-TI-I-TI-B

W = water / S = steam  
 F = front / B = back / I = Intermediate  
 TI = tankless intermediate  
 SI = supply intermediate for steam boilers.  
 "I" sections can be substituted for "TI" sections.

## Install bottom refractory blanket on combustion chamber floor inside section block

1. Unroll blanket only to depth of back section and first intermediate section.
2. Spread adhesive on bottom side of blanket.
3. Press blanket into center bottom of sections.
4. Unroll and install blanket per steps 2 and 3 as each intermediate and front section are installed.
5. At front section, cut off blanket 2 1/2" from burner opening. Discard unused blanket.

## Prepare remaining sections

1. Follow "Prepare intermediate section" for remaining intermediate and front sections:
  - a. Remove any grit from threads inside tapped holes with clean rag.

**WARNING** Do not use petroleum-based cleaning or sealing compounds in boiler system. Severe damage to system components can result, causing substantial property damage.

- b. Check each section for proper sealing rope position before proceeding to next section.

**WARNING** Failure to position sealing rope properly can cause boiler to not seal gas-tight. Gas tight seal prevents possible flue gas leakage and carbon monoxide emissions, resulting in severe personal injury or death.

## If using tankless heater (TI) sections

1. Install tankless heaters and gaskets or heater cover plates and gaskets. Use 3/8" x 3/4" studs, washers and nuts.





# 4 Perform hydrostatic pressure test

## Prepare boiler and test:

1. See pages 28 and 29 for tapping locations. Install:
  - a. Boiler drain (not furnished).
  - b. Water pressure gauge — for test only. Be sure gauge can handle test pressure — see step 3.
  - c. Air vent in upper tapping (K).
2. Plug remaining tappings.

**CAUTION** Do not pressure test with any control installed. Damage to control can occur due to overpressure.

3. Fill boiler. Vent all air. Pressure test at least 10 minutes at a pressure not less than the following:

**Steam boiler:**

Between 45 and 55 psig.

**Water boiler:**

1½ times maximum allowable working pressure (MAWP) stamped on the boiler nameplate, located on boiler jacket front panel.

**NOTICE** Do not exceed above test pressures by more than 10 psig.

**WARNING** Do not leave boiler unattended. Cold water fill could expand and cause excessive pressure, resulting in severe personal injury, death or substantial property damage.

4. Check for maintained gauge pressure and leaks. Repair if found.

**WARNING** Leaks must be repaired at once. Failure to do so can damage boiler, resulting in substantial property damage.

**WARNING** Do not use petroleum-based cleaning or sealing compounds in boiler system. Severe damage to system components can result, causing substantial property damage.

5. Drain boiler and remove air vent, boiler drain and gauge. Remove plugs from tappings that will be used for controls and accessories.



# 5 Complete block assembly

## Install burner mounting plate on front section

1. Install four  $\frac{1}{2}$ " x  $4\frac{3}{4}$ " studs to secure burner mounting plate to section:
  - a. Thread and lock together two nuts on rounded end of stud. Thread flat end of stud into one of four holes located around opening.
  - b. Remove nuts.
  - c. Repeat steps a and b for remaining studs.
2. Install burner mounting plate:
  - a. Apply  $\frac{1}{8}$ " continuous bead of sealing rope adhesive in groove around opening in section.
  - b. Position  $\frac{1}{2}$ " sealing rope in groove. Overlap ends at least one inch.
  - c. Install burner mounting plate. Use  $\frac{1}{2}$ " washers and nuts.

## Install observation port assemblies on front and back sections:

1. Install front observation port assembly:
  - a. Apply  $\frac{1}{8}$ " continuous bead of sealing rope adhesive in groove on observation port.
  - b. Position  $\frac{3}{8}$ " sealing rope in groove.
  - c. Secure assembly to section. Use  $\frac{3}{16}$ " - 18 x  $\frac{1}{4}$ " slotted head screws.
2. Repeat above steps for back observation port assembly.

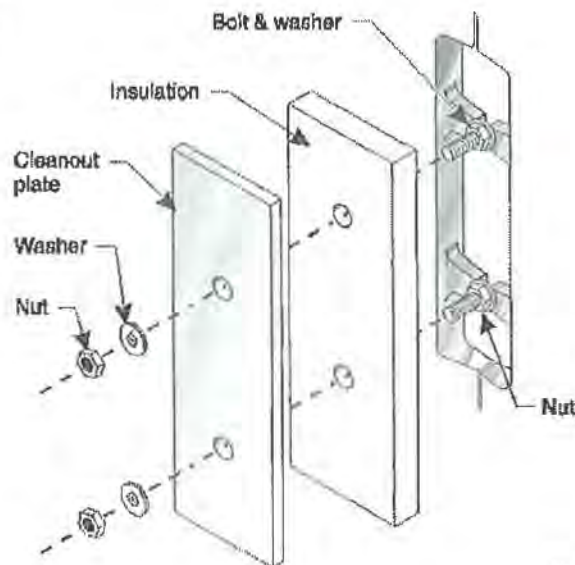
## Install cleanout plates

**WARNING** Cleanout plates must be installed gas-tight to prevent possibility of flue gas leakage and carbon monoxide emissions, resulting in severe personal injury or death.

1. See Figure 7. Position two  $\frac{1}{4}$ " x  $1\frac{3}{4}$ " carriage bolts in cleanout opening. Secure with washers and nuts.
2. Place blanket insulation piece against cleanout plate.
3. Mount cleanout plate over opening. Secure with nuts and washers.
4. Repeat steps 1 through 3 for remaining cleanout plates.

**WARNING** The boiler contains ceramic fiber and fiberglass materials. Use care when handling these materials per instructions on page 38 of this manual. Failure to comply could result in severe personal injury.

Figure 7 Cleanout plate assembly



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# 6 Install flue collector

## Flue collector assembly

- Figure 10, page 11, shows flue collector components and locations. Figure 11, page 13, shows collector hoods for all models. Follow all instructions in this manual to ensure correct installation of the flue collector.
- Model 80 boilers are available with either rear flue or top flue. Verify that you have the correct components for your application. You can convert a Model 80 from rear to top or top to rear flue using a flue conversion kit, available from your Weil-McLain distributor.

**NOTICE** The flue outlet for top flue models must be located as shown in this manual.

## Install collector hold-down bolts

- Figure 10, lower left — Install a collector hold-down bolt assembly at each section joint, and on both sides of the boiler section assembly. Set aside the flanged nuts for securing the collector assembly when it is ready.
- Each hold-down bolt assembly consists of a  $\frac{3}{16}$ " x 2" carriage bolt, flat washer, regular hex nut and a flanged nut as shown.

## Prepare flue collector hood assembly

**WARNING** Make sure gaskets are intact, not torn or otherwise damaged. These conditions can cause possible flue gas leakage and carbon monoxide emissions, resulting in severe personal injury or death.

**WARNING** The boiler contains ceramic fiber and fiberglass materials. Use care when handling these materials per instructions on page 38 of this manual. Failure to comply could result in severe personal injury.

- Stand flue collector hood front module (item 4) on end as in Figure 8, left side.

- Wipe all flanged surfaces with clean rag.
- Lay flue collector hood gasket (item 2) on flange.
- Place flue collector end cap (item 1) on gasket. Align bolt holes. Secure with seven  $\frac{5}{16}$ " x  $\frac{3}{8}$ " flanged bolts and flanged nuts. **Tighten to between 30 and 35 inch-pounds torque.** (See **WARNING** on page 12, top right column.)
- For 880 - 1280:
  - Stand remaining hood module on end, as in Figure 8, right side.
  - Wipe all flanged surfaces with clean rag.
  - Lay gasket on flange.
  - Carefully place open end of first module on top of gasket, aligning flanged surfaces.
  - Secure with seven  $\frac{5}{16}$ " x  $\frac{3}{8}$ " flanged bolts and flanged nuts. **Tighten to between 30 and 35 inch-pounds torque.** (See **WARNING** on page 12.)

- Attach flat-stitched sealing rope to hood assembly. See Figure 9:

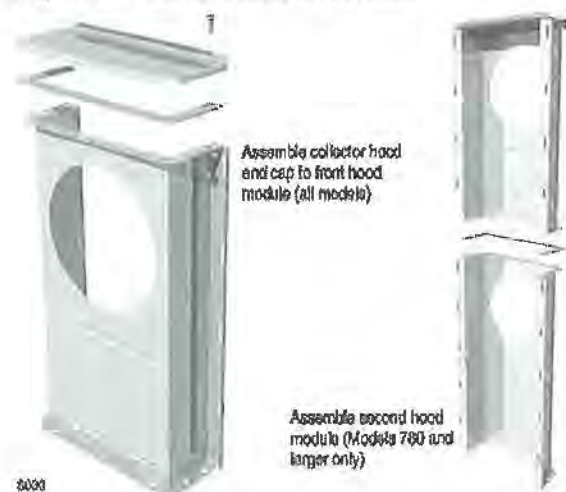
- Lay hood on floor with flanged side up.
- Wipe flanged surface with clean rag to remove dirt and oil.
- Apply double-faced tape to flanged surface.
- Apply rope to tape beginning on one side of open end of hood, leaving  $\frac{1}{4}$ " extending past edge. Bend rope around corners. **DO NOT cut or stretch rope.**

**WARNING** Do not pre-cut rope. All collector hood joints must be sealed gas-tight to prevent possible flue gas leakage and carbon monoxide emissions, resulting in severe personal injury or death.

- Continue around entire flange. At other open end, leave  $\frac{1}{4}$ " rope extending past edge of flange. Cut off excess rope.

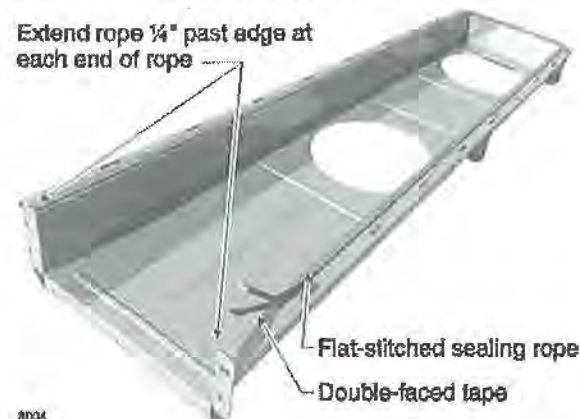
**NOTICE** Double-faced tape serves only to hold sealing rope in place during installation. It will disintegrate over time. If collector hood and sealing rope are removed for any reason, install new tape and new gasket.

**Figure 8** Collector hood preparation



**Figure 9** Flue collector sealing rope installation

Extend rope  $\frac{1}{4}$ " past edge at each end of rope





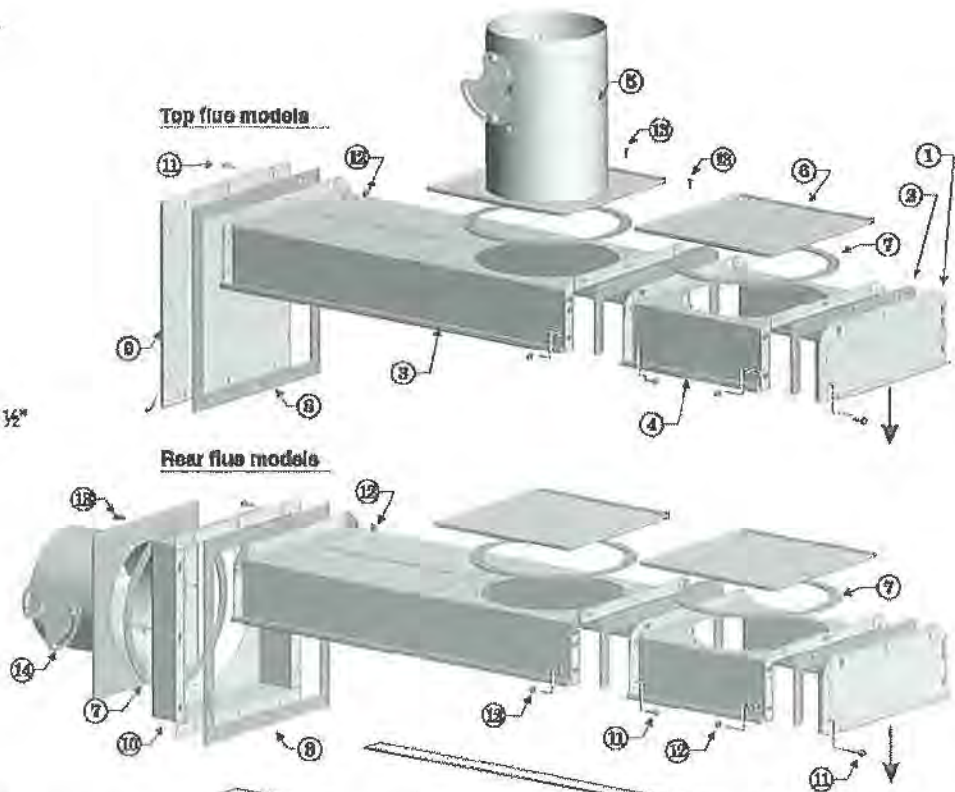


# 6 Install flue collector (continued)

**Figure 10** Flue collector components, typical (Model 880 collector configurations shown)

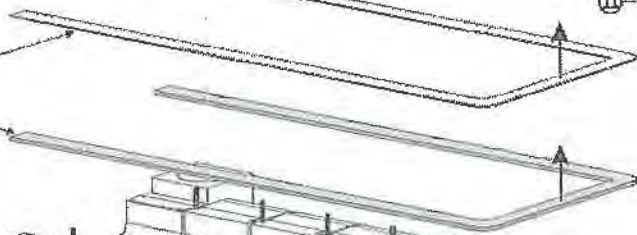
**Flue collector components**

- 1 Flue collector end cap
- 2 Flue collector hood gasket
- 3 Flue collector hood, rear
- 4 Flue collector hood, front
- 5 Flue damper assembly, top flue
- 6 Flue cap (top)
- 7 Circular flue collector gasket
- 8 Rectangular flue collector gasket
- 9 Flue cap, rear
- 10 Flue collector hood transition
- 11 Flanged bolts, 5/16" x 5/8"
- 12 Flanged nuts, 5/16"
- 13 Sheet metal screw, AB pan head Phillips #10 x 1/2"
- 14 Flue damper assembly, rear flue

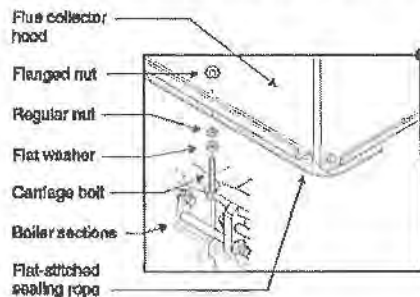


**Sealing flue collector to section assembly**

- Double-faced tape (applied to flue collector after cleaning)
- Flat-stitched sealing rope (applied over tape)

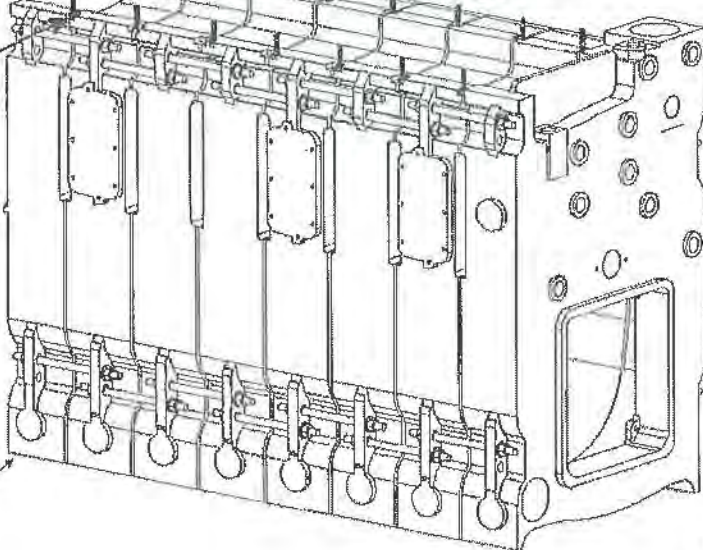


**Flue collector hold-down bolt installation**



**Section assembly, typical**

Flue collector bolts to section assembly as shown (Model 880 shown)







# 6 Install flue collector (continued)

## Before installing flue collector

1. See Figure 10, page 11, for general assembly of flue collector components.
2. See Figure 11, page 13 for the placement of flue collector hoods on each model.
3. Prepare mounting holes in boiler rear section.
  - a. The boiler rear section has tapped holes for mounting rear flue collector component.
  - b. Remove any grit from threads inside tapped holes with clean rag.

## Rear flue boilers only:

1. See Figure 10, page 11 and Figure 11, page 13.
2. Place collector hood transition on rear section:
  - a. Wipe item 10, Figure 10, collector hood transition flange surfaces with a clean rag.
  - b. Apply a few pieces of double-faced tape on the collector hood transition flange.
  - c. Place the collector hood transition gasket (item 8, Figure 10) on the collector hood transition flange. Align holes in gasket with holes in flange. Press gasket firmly in place.
  - d. Position collector hood transition on back of boiler rear section, aligning collector hood transition flange holes with tapped holes in boiler rear section.
  - e. Insert a 5/16" x 5/8" flanged bolt through the bottom center hole and finger tighten to hold transition in place.
  - f. Install six remaining bolts securing collector hood transition to rear section. **Finger-tighten only.**
3. Place collector hood assembly on sections:
  - a. Carefully set collector hood assembly on top of section assembly. Align slotted holes in collector hood flanges with the hold-down bolts in the sections.
  - b. Place the collector hood assembly so its rear flange is against the collector hood transition flange gasket.
  - c. Thread flanged nuts onto hold-down bolts and **finger-tighten only.**
  - d. Insert five 5/16" x 5/8" flanged bolts through holes in collector hood transition and collector hood assembly rear flange. Thread on nuts and **finger-tighten only.**
4. Tighten flue collector bolts and nuts:
  - a. Gradually tighten all bolts and nuts on flue collector assembly and boiler. **Tighten to between 30 and 35 inch-pounds torque.** See **WARNING**, upper right.
  - b. Alternate locations as you tighten the fasteners to ensure all parts are evenly drawn down, with no gaps or distortion of parts.
5. Install damper and flue caps:
  - a. Wipe item 5, Figure 10, flue damper flange surface with a clean rag.
  - b. Apply a few pieces of double-faced tape to the flue damper flange. Position flue collar gasket on damper and press firmly in place. Align all holes before securing.
  - c. Position flue damper assembly against collector hood transition. Insert a #10 x 1/2" screw through the top center hole. Lightly tighten to hold flue damper in position.
  - d. Insert remaining #10 screws into flue damper flange and lightly tighten. Alternate from screw to screw and tighten all screws evenly and securely.
  - e. Install flue caps on flue collector top opening(s) using steps 5a through 5d.

## WARNING

DO NOT overtighten bolts in flue collector hood assembly. Gasket material could extrude, causing possible flue gas leakage and carbon monoxide emissions, resulting in severe personal injury or death.

## Top flue boilers only:

1. See Figure 10, page 11 and Figure 11, page 13.
2. Place rear flue cap on rear section:
  - a. Wipe item 9, Figure 10, rear flue cap gasket surface with a clean rag.
  - b. Apply a few pieces of double-faced tape on the rear flue cap gasket surface.
  - c. Place the rectangular gasket (item 8, Figure 10) on the flue cap, aligning holes in gasket with holes in rear flue cap. Press firmly in place.
  - d. Position rear flue cap on back of boiler rear section, aligning rear flue cap holes with tapped holes in boiler rear section.
  - e. Insert a 5/16" x 5/8" flanged bolt through the bottom center hole and finger tighten to hold rear flue cap in place.
  - f. Install six remaining bolts securing rear flue cap to rear section. **Finger-tighten only.**
3. Place collector hood assembly on sections:
  - a. Carefully set collector hood assembly on top of section assembly. Align slotted holes in collector hood flanges with the hold-down bolts in the sections.
  - b. Place the collector hood assembly so its rear flange is against the rear flue cap gasket.
  - c. Thread flanged nuts onto hold-down bolts and **finger-tighten only.**
  - d. Insert five 5/16" x 5/8" flanged bolts through holes in rear flue cap and collector hood assembly rear flange. Thread on nuts and **finger-tighten only.**
4. Tighten flue collector bolts and nuts:
  - a. Gradually tighten all bolts and nuts on flue collector assembly and boiler. **Tighten to between 30 and 35 inch-pounds torque.** See **WARNING**, above.
  - b. Alternate locations as you tighten the fasteners to ensure all parts are evenly drawn down, with no gaps or distortion of parts.
5. Install damper and flue caps (see Figure 11, page 13):
  - a. Wipe item 5, Figure 10, flue damper flange surface and flue collector assembly surfaces with a clean rag.
  - b. Position round gasket (item 7, Figure 10) on flue collector assembly *in the flue location shown in Figure 11, page 13.* Align bolt holes.
  - c. Place flue damper assembly on gasket. (See **NOTICE**, below.) Insert #10 x 1/2" screws through the holes. Alternate from screw to screw and tighten all screws evenly and securely.

## NOTICE

Model 380 top flue applications — always mount the damper assembly with the damper adjustment plate pointed toward the rear of the boiler as shown in Figure 11. Otherwise, the jacket top panels may be difficult to install.

- e. Install flue cap on remaining top opening (if any) using steps a through c, above.

## After installing flue collector, ALL BOILERS

1. Check for gas-tight seal of all flue collector hood components.

## WARNING

All collector hood joints must be sealed gas-tight to prevent possible flue gas leakage and carbon monoxide emissions, resulting in severe personal injury or death.

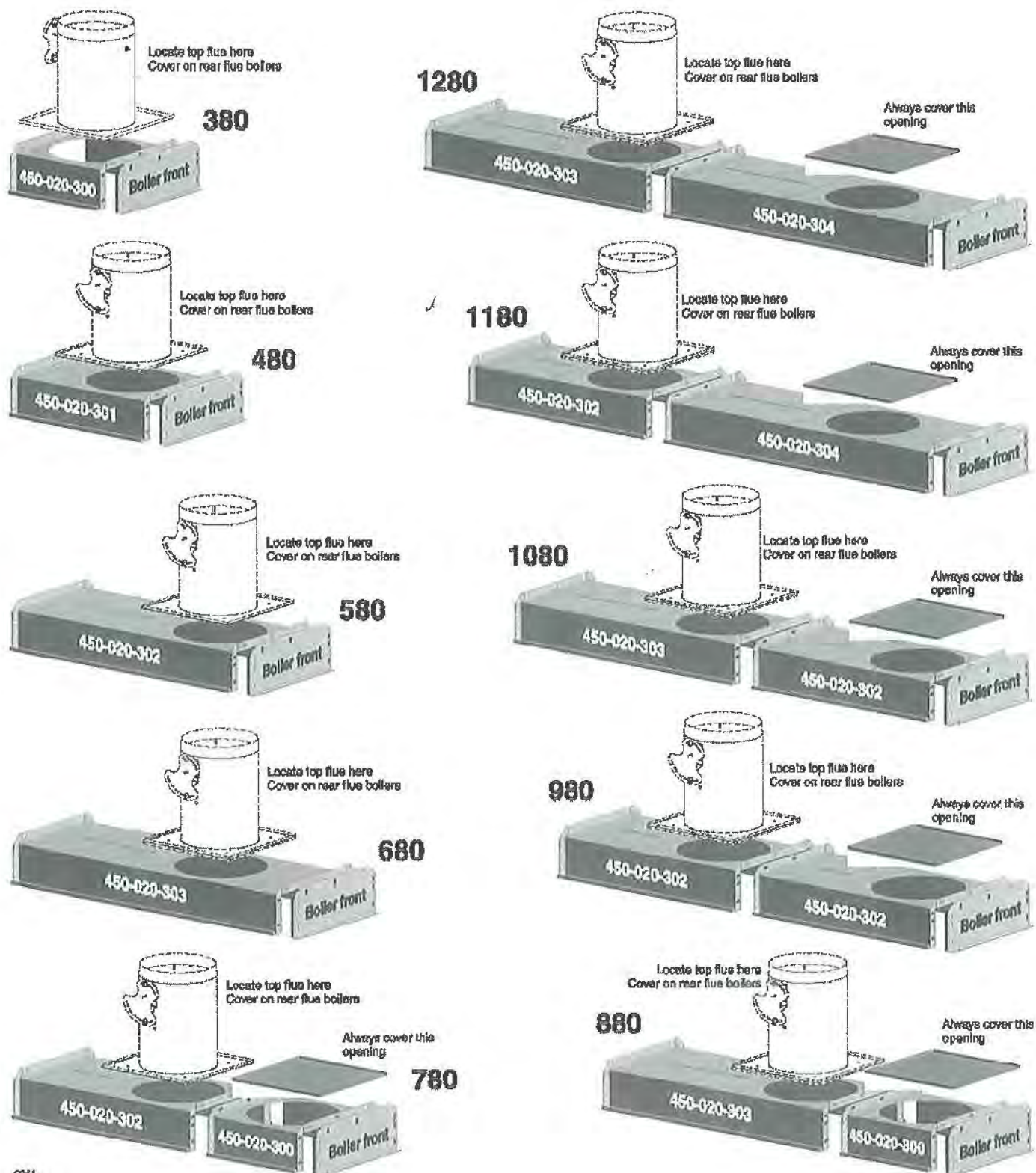
- a. Open flue damper. Visually inspect inside section assembly and flue collector assembly for any light passing through unsealed areas.
- b. Mark all unsealed areas.
- c. Check unsealed areas for cause — damaged gaskets, sealing rope not in place, or loose bolts or nuts.
- d. Correct all conditions and repeat inspection procedure.
- e. If unsealed areas cannot be eliminated, discontinue the boiler installation. Contact your Weil-McLain distributor or sales office for assistance.





# 6 Install flue collector (continued)

Figure 11 Flue collector components by model (see Figure 10, page 11 for flue collector components not shown below)



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# 7 Connect water boiler piping

## General water piping information:

- System water supply and return piping should be installed and piping connections attached to boiler before erecting jacket or installing controls.
- Do not pipe in through supply and out through return. This creates reverse water flow through boiler that must not be used.
- When three-way valves are used for temperature modulation, install slow-opening (minimum 10-minute) valves and boiler mixing pump to minimize potential of boiler thermal shock. See W-M Bulletin AE-8402.

## Install piping:

Install piping as shown in Figure 12 for single boilers. For multiple boilers, see Figure 13, page 15.

**CAUTION** Improperly piped systems or undersized piping can contribute to erratic boiler operation and possible boiler or system damage.

1. Connect supply and return piping:
  - a. Size according to tables below.
    - 1) For **unknown flow rates**, size piping per Table below, using 20°F temperature rise through boiler.
    - 2) For **known flow rates or higher flow rate** through boiler, size piping per Table below.

**WARNING** Flow at higher rates than shown in Table below for pipe size can damage boiler, causing substantial property damage.

- b. Locate circulator in supply piping.
  - c. For return piping, use full diameter pipe for 10 times that diameter before making any reduction. For example, a 4-inch return should not be reduced any closer to boiler return tapping than 40 inches.
  - d. Install system blow-off (drain) valve in lowest part of return piping close to boiler. ASME minimum size requirements are shown in Table 6.
2. Install expansion tank:
    - a. **Closed type** – connect to 1" tapping "K" (refer to pages 28 and 29). Use 1" N.P.T. piping. Any horizontal piping must pitch up toward tank at least 1 inch per each 5 feet of piping.
    - b. **Diaphragm type** – Refer to tank manufacturer's literature for location. Install automatic air vent in "K" lapping.
    - c. Connect cold water fill to expansion tank piping. See Figure 12, page 14. Also shown are recommended valves and water meter, when used. Water meter will detect added make-up water, indicating leaks in system.

**Table 4** Recommended minimum pipe sizes when flow rate is not known (see Figure 12)

Boiler model number	Supply pipe size A	Return pipe size B
380	2"	2"
480	2½"	2½"
580 – 680	3"	3"
780 – 1280	4"	4"

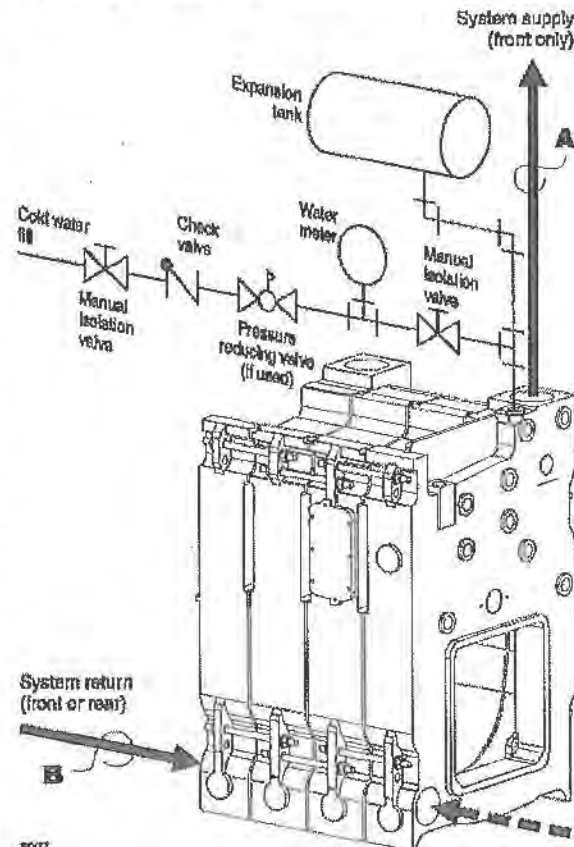
**Table 5** Recommended minimum pipe sizes for known flow rates.

Water flow rate GPM	Supply pipe size A	Return pipe size B
Up to 35	2"	2"
36–50	2½"	2½"
51–77	3"	3"
78–142	4"	4"

**Table 6** ASME drain valve size

Boiler model number	Valve size
380 – 480	¾"
580 – 1180	1"
1280	1¼"

**Figure 12** Water boiler piping, typical



# 7 Connect water boiler piping (continued)

3. Piping for multiple boilers (see Figure 13):

**A** Size secondary boiler pump GPM based on following formulas:

$$\frac{\text{Gross output}}{\text{Temperature rise} \times 500} = \text{GPM}$$

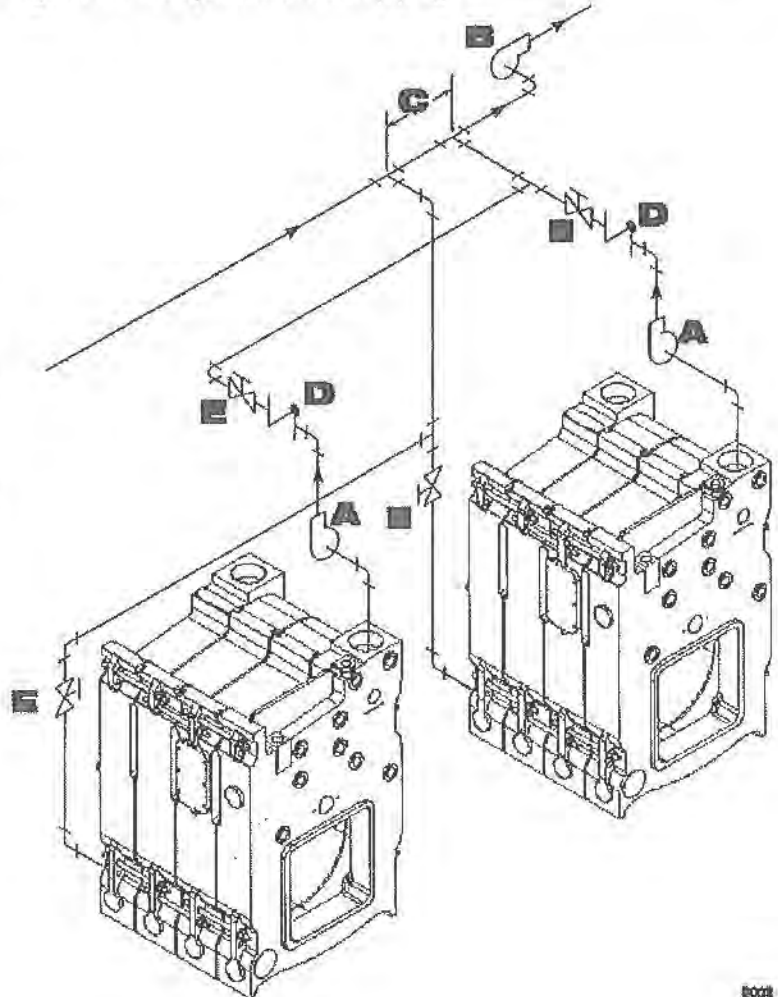
Temperature rise, °F = 230°F - Return water temperature  
Gross output is in Btu/h.

Calculate only secondary piping circuit resistance. Boiler resistance will be about equal to three 90 degree elbows of secondary pipe size. Operate each boiler and its secondary pump from a Weil-McLain boiler control panel. **Do not** maintain boiler at predetermined water temperature.

- B** Primary pump GPM and head calculation should not include secondary boiler circuits. Primary pump can operate continuously during heating season.
- C** Space 12" maximum or as close as practical.
- D** Check valve.
- E** Hand valve.

Expansion tank(s), relief valves and other accessories are required but not shown.

Figure 13 Multiple water boiler piping



8002





# 8 Connect steam boiler piping

## General steam piping information:

- Hartford loop piping arrangement and wet return are required for steam boilers. Use the Hartford loop for both pumped-return and gravity-return systems.
- Maintain 24-inch minimum from waterline to bottom of header (56¼" from bottom of section).
- When using condensate receiver, feed pump must be energized by boiler-mounted pump controller. Install piping:

Install piping as shown on pages 16 through 18 for single boilers. See page 19 for additional requirements when piping multiple boilers.

**CAUTION**

Improperly piped systems or undersized piping can contribute to erratic boiler operation and possible boiler or system damage. Piping system must be installed as shown, using pipe sizes shown. Pipe sizes shown are for two-pipe, pumped-return systems. Adjust pipe sizing as needed when connecting to gravity-return systems. Consult local Weil-mcLain distributor or sales office before installing alternate piping.

1. Connect supply and return piping:
  - a. See Table 7.
    - 1) Size condensate return piping by pump.
    - 2) Size gravity condensate return same as equalizer "J" pipe size.
  - b. Install system drain valve in lowest part of return piping close to boiler. ASME size requirements are shown in Table 6, page 14.
  - c. Connect cold water fill piping as shown in Figure 14.

Also shown are recommended valves and water meter, if used. Water meter will detect added makeup water, indicating leaks in system.

2. Condensate piping:
  - a. Satisfactory operation of any steam heating system depends on adequate return of condensate to maintain steady water level.
  - b. Avoid adding excessive amounts of raw make-up water.
  - c. Where condensate return is not adequate, a low water cutoff with pump control, condensate receiver, and condensate boiler feed pump should be installed. Refer to page 18, Figure 18 for piping and Table 8 for sizing.
3. Multiple steam boiler piping
  - a. See page 19.

Figure 14 Cold water fill piping

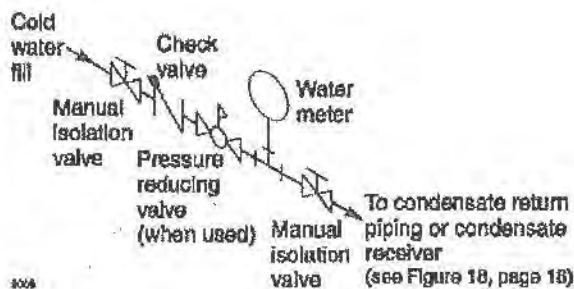


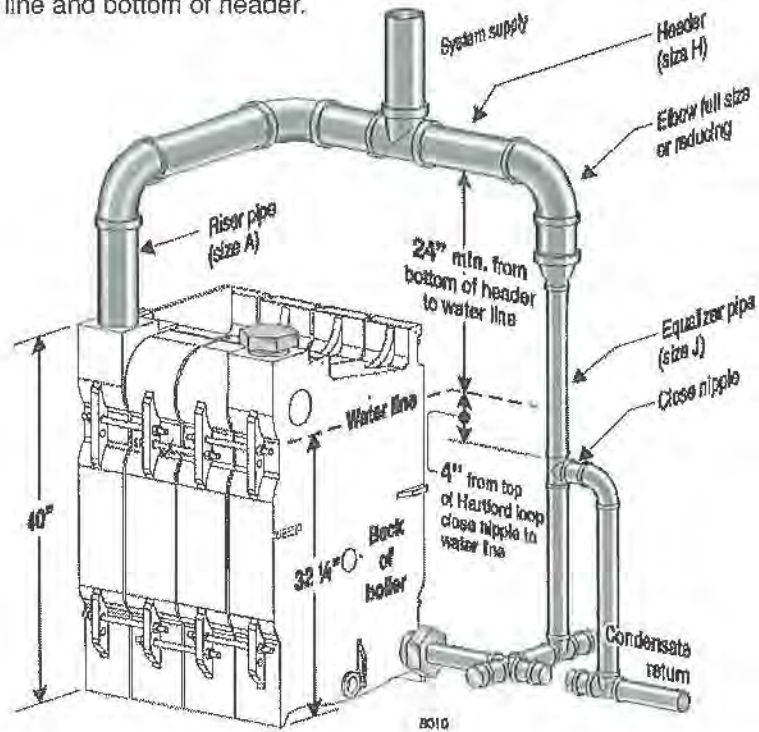
Table 7 Steam boiler pipe size for typical 2-pipe steam systems

Figure number	Boiler model number	Riser pipe size inches Note 1			"H" Header inches Note 2	"J" Equalizer inches
		A	B	C		
16	380	3	--	-	3	2
	480	4	--	-	4	2
	580	4	--	-	4	2½
18	680	3	3	-	4	2½
	780	4	4	-	4	2½
	880	4	4	-	4	3
	980	4	4	-	8	3
17	1080 - 1280	4	4	4	6	3

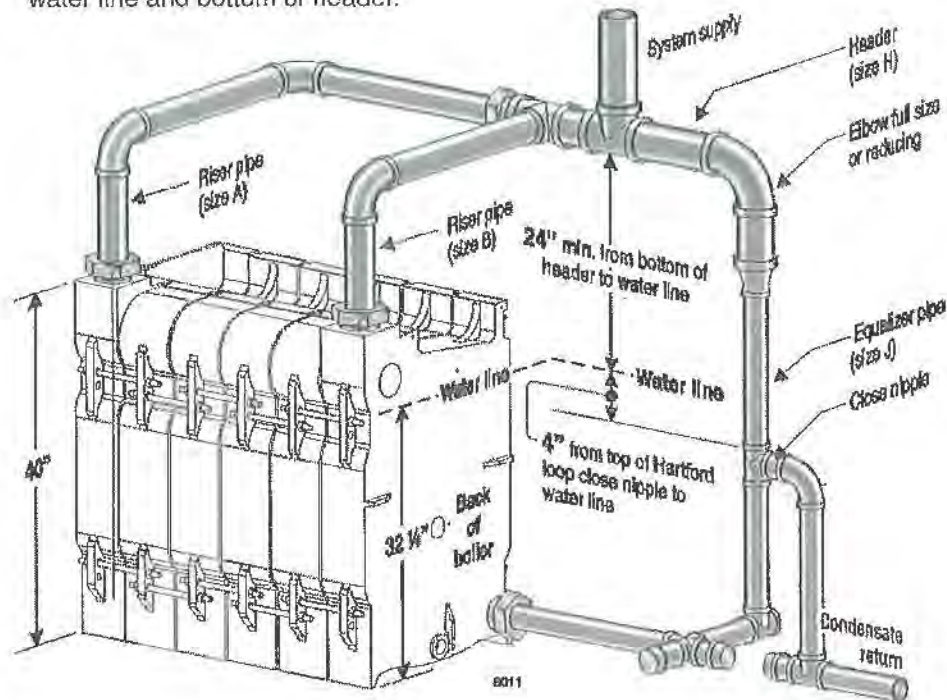
Notes:  
 1. Based on ASHRAE Handbook recommendations, allowing ½ oz. pressure drop per 100 feet of pipe for dry return.  
 2. Based on ASHRAE Handbook recommendations, allowing 2 oz. pressure drop per 100 feet of pipe at 3.5 psig. Maintain minimum 24" height from waterline to header.

# 8 Connect steam boiler piping (continued)

**Figure 15** Model 380 through 580 steam boiler piping — NOTE minimum 24 inches between boiler water line and bottom of header.



**Figure 16** Model 680 through 980 steam boiler piping — NOTE minimum 24 inches between boiler water line and bottom of header.

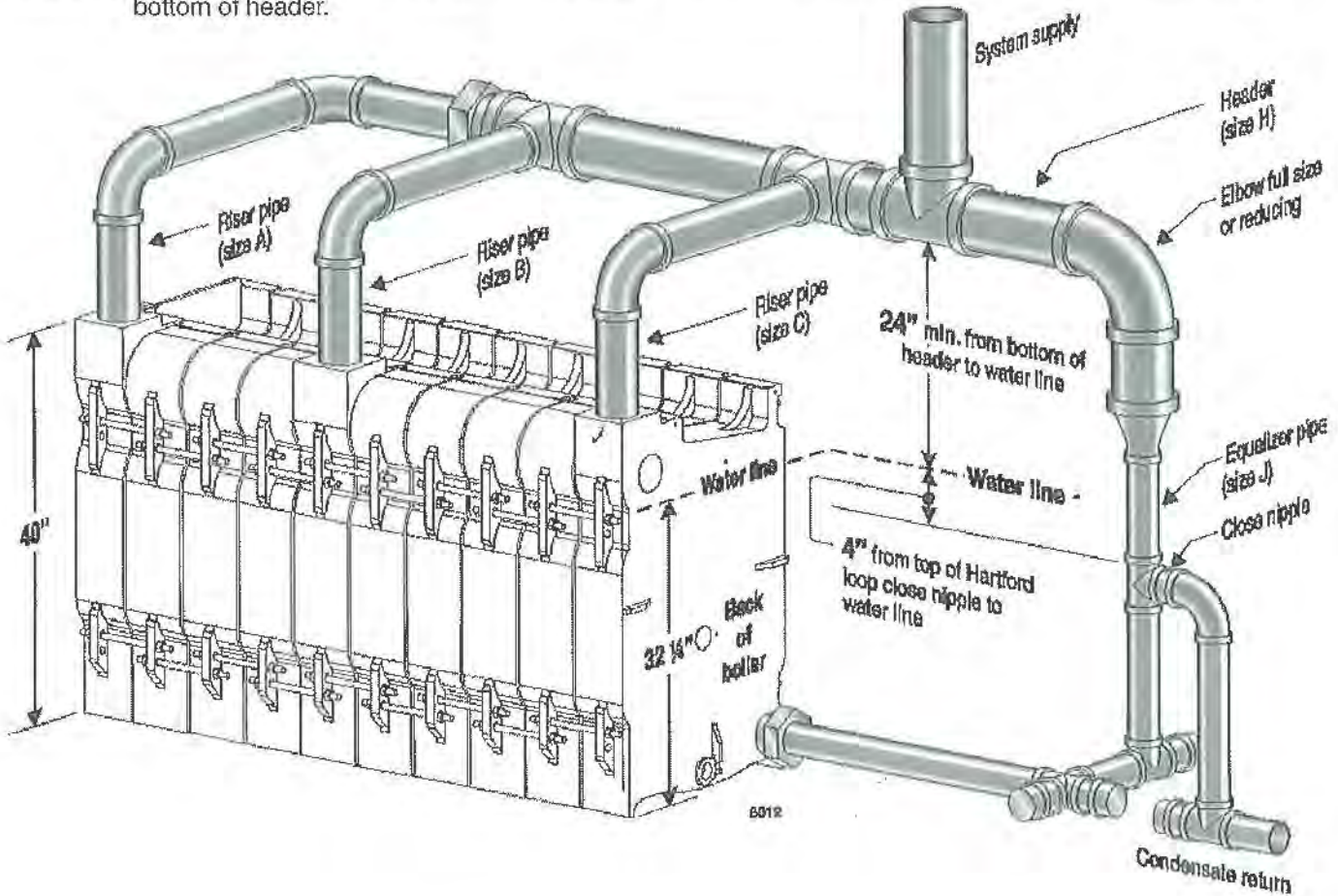




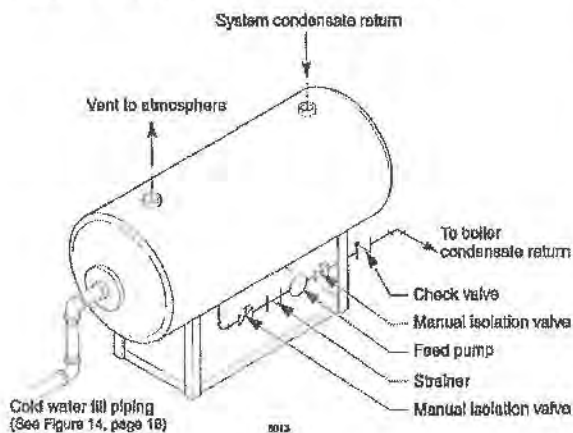


# 8 Connect steam boiler piping (continued)

**Figure 17** Model 1080 through 1280 steam boiler piping — NOTE minimum 24 inches between boiler water line and bottom of header.



**Figure 18** Condensate piping to boiler



**Table 8** Condensate receiver capacity

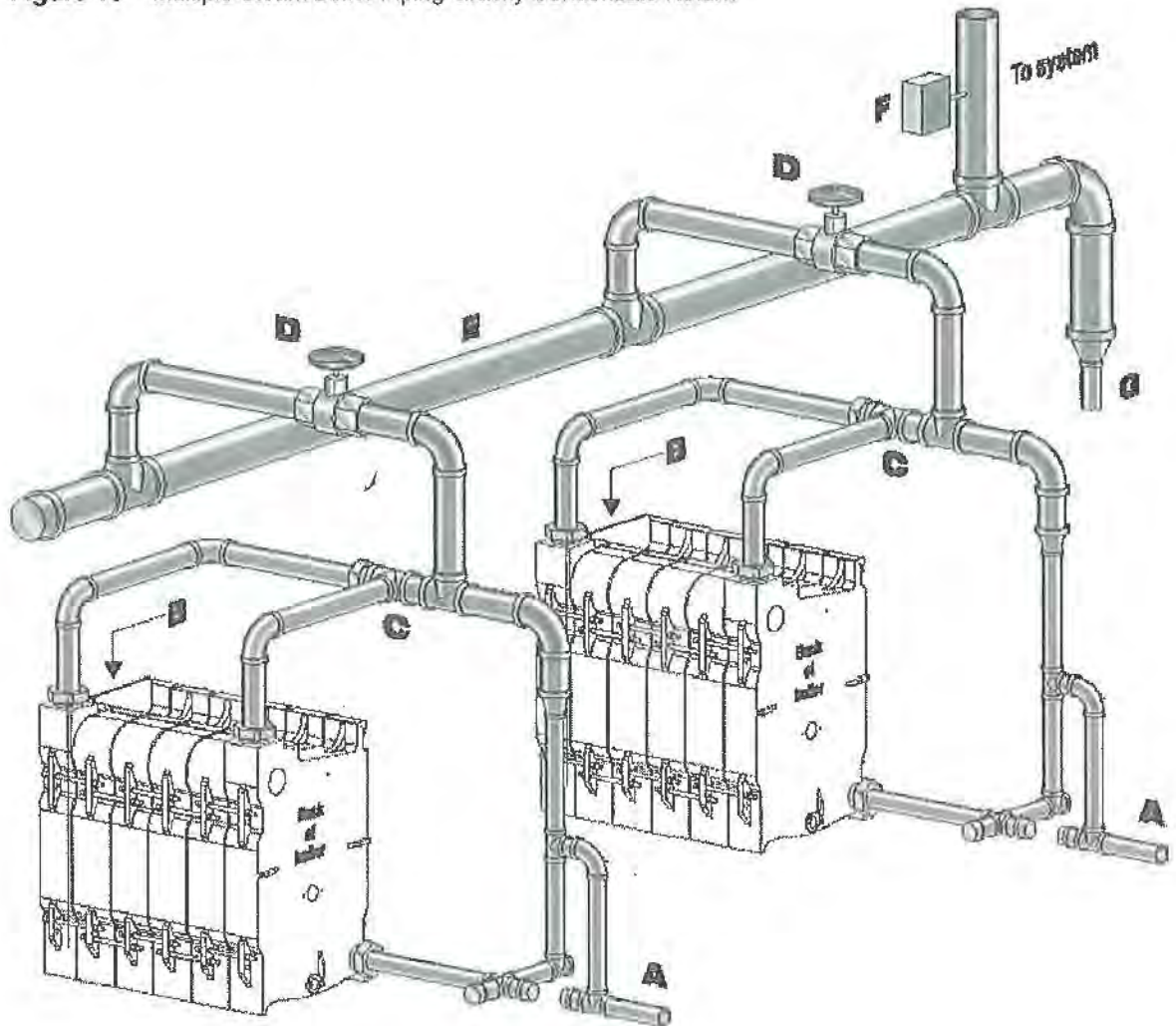
Boiler model number	I=B=R gross output (lbs steam per hour)	Gallons condensate per hour	Minimum condensate receiver capacity (gallons) (Note 1)				Recommended condensate feed pump capacity GPM at 15 PSI
			15-minute boiler operation	30-minute boiler operation	45-minute boiler operation	60-minute boiler operation	
380	278	33	11	21	31	41	1.2
480	398	48	15	29	43	58	1.8
580	515	62	19	38	56	75	2.1
680	634	76	23	46	68	92	2.6
780	753	90	28	55	82	109	3.1
880	872	105	32	63	95	128	3.5
980	991	119	36	72	108	143	4.0
1080	1110	133	40	80	120	160	4.5
1180	1229	148	45	89	133	178	5.0
1280	1348	162	49	98	146	195	5.4

Note 1 — Maximum time to when condensate returns to boiler.



# 8 Connect steam boiler piping (continued)

Figure 19 Multiple Steam Boiler Piping Gravity Condensate Return



**A** Pipe as shown for gravity return systems, connecting point **A** to the wet gravity return.

For pumped-return systems, install boiler water level control on each boiler with body mark at level indicated in Figure 30 on page 30. Provide at point **A** either:

- Separate feed pumps and check valves for each boiler, or ...
- Single feed pump, with separate solenoid valve for each boiler.

**B** For pumped-return systems, install a combination float and thermostatic trap on each boiler to prevent flooding of one boiler while other boiler is firing. Install trap in skim tapping (see page 29). Connect traps to condensate receiver.

Gravity-return systems are self-levelling if the wet returns are piped to the common system wet return.

**C** Install boiler piping as shown in this manual (pages 16 through 19).

**D** Install stop valves per ASME code requirements.

For pump-return systems, if using automatic steam valves, use only slow-opening automatic valves. Use a Weil-McLain Boiler Control System (such as a BCP panel) to open each steam valve automatically before firing burner.

**E** Construct common supply drop header with pipe size at least same size as largest boiler header size.

**F** Use:

- A Weil-McLain Boiler Control System (such as a BCP panel) with header-mounted pressure control(s) to sequence boilers, or ...
- A steam pressure controller.

**G** Install drip line in common supply drop header.

Gravity-return: Pipe drip line to wet return.

Pumped-return: Use combination float and thermostatic trap and drain to condensate receiver.



# 9 Install jacket

## Before installing jacket

1. Packaged boilers
  - Install top jacket panels per instructions in this manual.
2. Non-packaged boilers
  - Follow the instructions in this section to install all jacket panels.
  - Make sure the following are completed before installing jacket:
    - Boiler hydrostatically pressure-tested. See page 8.
    - Plugs for unused tappings installed. See control tapping table, page 28 or 29.
    - Supply and return piping installed. See pages 14 through 19.
    - Cleanout plates, flue collar and flue collector hood installed. See pages 9 through 13.
3. These parts must be on boiler:
  - plugs for unused tappings
  - supply and return piping
  - steam supply header
  - cleanout plates
  - tankless heater(s) (when used)
  - tankless heater cover plate(s) (when used)
  - tankless heater piping (when used)
  - flue damper assembly
  - flue collector hood
  - observation port assemblies
4. These parts may be on boiler:
  - burner mounting plate
  - burner
5. These parts must be off boiler:
  - water or steam gauge
  - limit control
  - low water cutoff
  - gauge glass and gauge glass cocks
  - tri-cocks
  - drain cock

### WARNING

The boiler contains ceramic fiber and fiberglass materials. Use care when handling these materials per instructions on page 38 of this manual. Failure to comply could result in severe personal injury.

## Remove jacket parts from cartons

1. Locate jacket cartons.
2. Remove jacket parts from cartons as needed. Leave in cartons as long as possible to avoid damage.

## Install support brackets and rails

1. Place upper and lower support brackets over draw rods as shown in Figure 20, page 21.
2. Fasten securely with  $\frac{5}{8}$ " nuts where shown.

### NOTICE

Models 380, 480, 580, 680 and 780 do not require lower support brackets. Only upper brackets are required.

3. Space the brackets along the length of the boiler so there are close to an equal number of sections on either side of the bracket(s).
4. Attach the upper and lower rails on each side of the boiler by securing with #10 x  $\frac{1}{2}$ " Phillips pan head screws. **DO NOT** tighten the screws more than finger-tight.

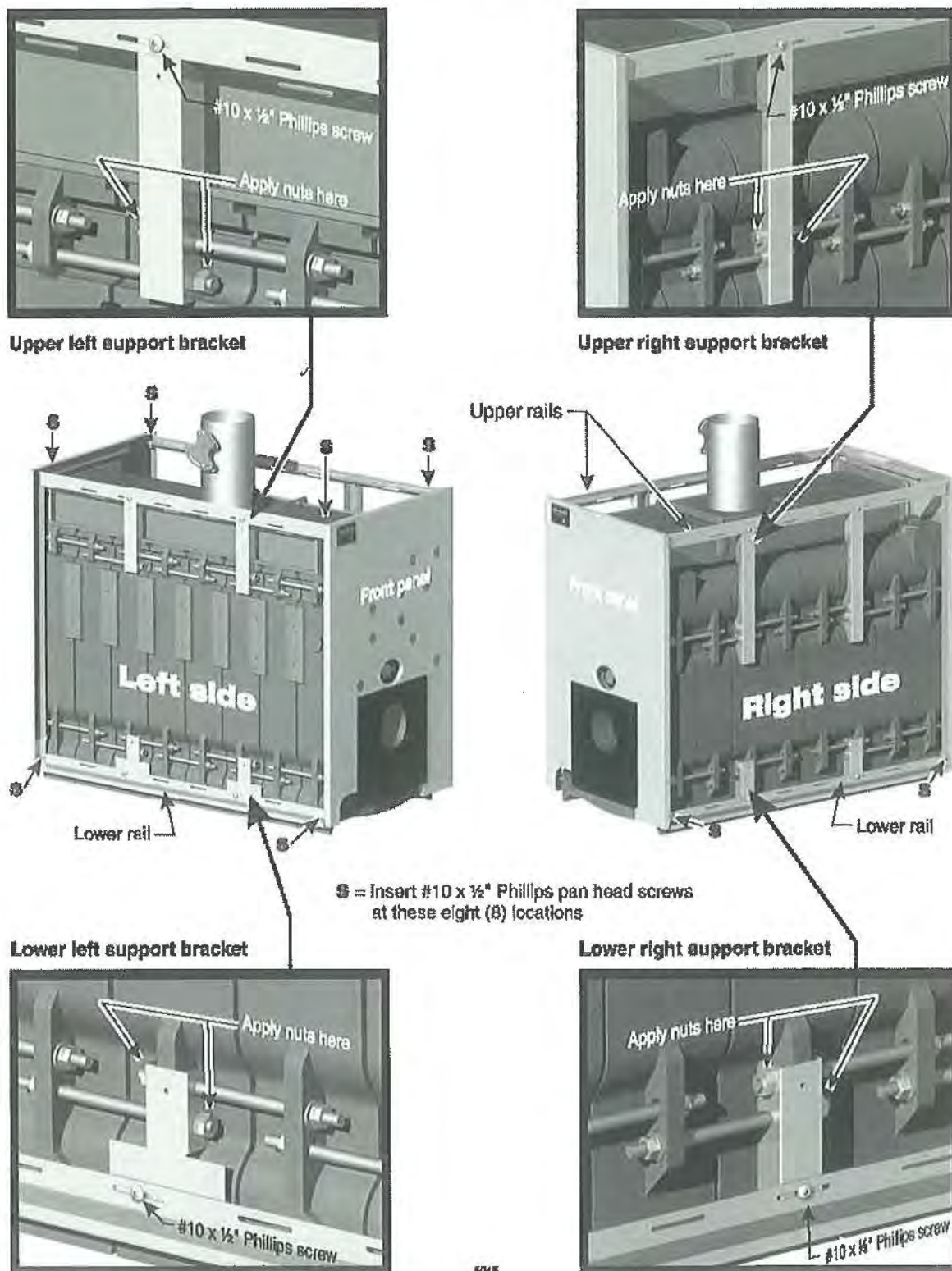
## Install jacket front and rear panels

1. Attach the front and rear jacket panels to the upper and lower channels using #10 x  $\frac{1}{2}$ " Phillips pan head screws, as shown in Figure 20.
2. **Rear flue boilers only** — remove rear jacket panel flue collector transition knockout with tin snips before installing on boiler.



# 9 Install jacket (continued)

**Figure 20** Installing jacket support brackets and rails and jacket front and rear panels



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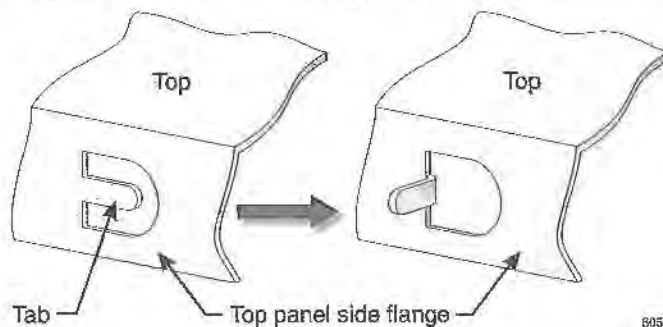
# 9 Install jacket (continued)

## Install jacket side panels

1. Remove jacket side panels from cartons.
2. Insert a plastic plug (provided in jacket cartons) in the 1-inch hole in the center of each of the jacket side panels.
3. Before installing side panels, square up the jacket support rails.
  - Place any of the jacket side panels on the rails as shown in Figure 21.
  - Butt the side panel against the jacket front panel.
  - Push/pull on the upper and lower rails until the fit-up of the side panel, front panel and rails is square.
  - Place a jacket top panel in position against the jacket front panel to ensure the top alignment is square. Adjust the jacket support rails forward or backward if needed for square alignment.
  - Tighten the screws securing the upper and lower rails to the support brackets.
  - Tighten the screws securing the front and back panels to the rails.
4. Apply all jacket side panels in the order shown in Figures 22, 23 or 24.
  - Remove jacket knockouts as required for tankless heaters.
  - Note that panel sequence is not important for boilers not equipped with tankless heater intermediate sections.

## Install jacket top panels

1. Place jacket top panels as shown in Figure 25, page 26.
  - Remove knockouts for riser pipes or flue outlet using tin snips.
2. Fold out tab in top panel side flange next to top flue knockout to prevent top panel from sagging (see below).

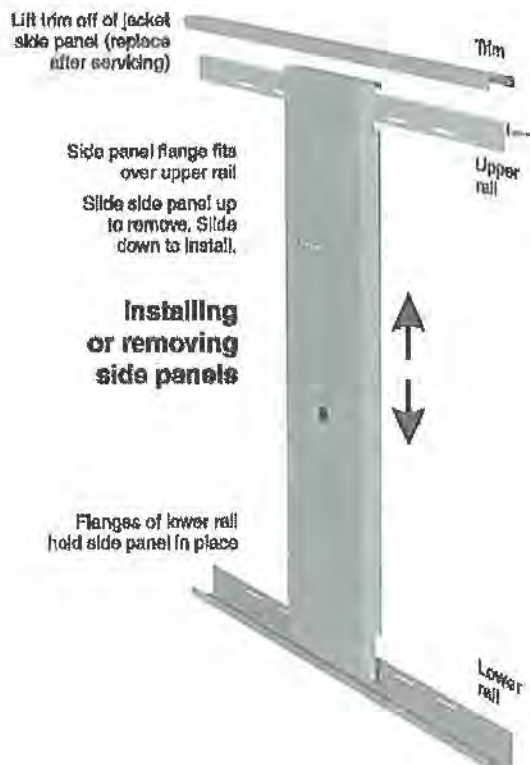


3. Install trim collar around damper assembly on top flue boilers.

## Install jacket trim

1. Press jacket trim over jacket side panels as shown in Figure 21. Place each jacket trim so the side of the trim with small holes faces toward the boiler.

Figure 21 Installing (removing) jacket side panels and top panels

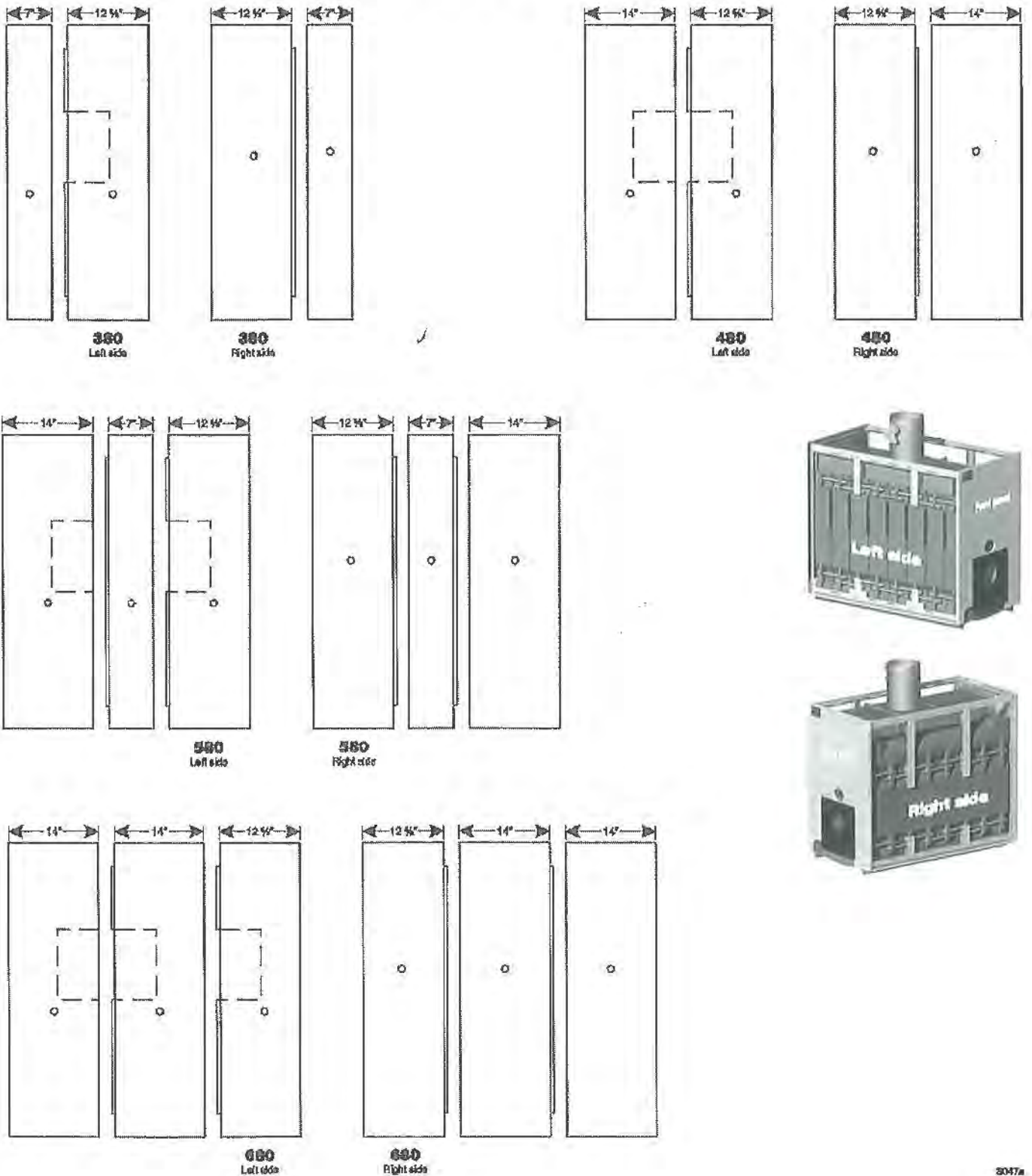






# 9 Install jacket (continued)

Figure 22 Jacket side panel placement — Models 380, 480, 580 and 680

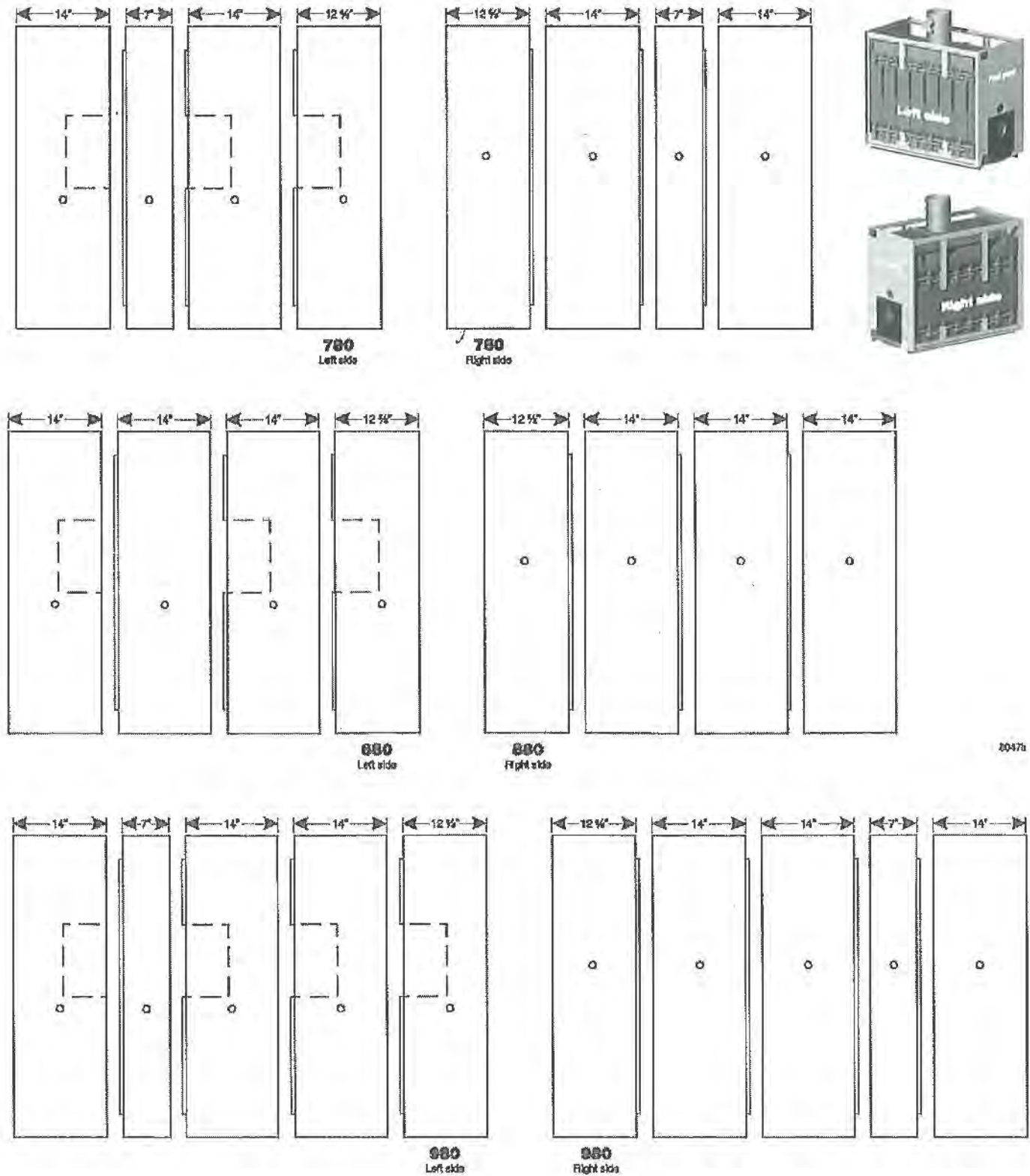






# 9 Install jacket (continued)

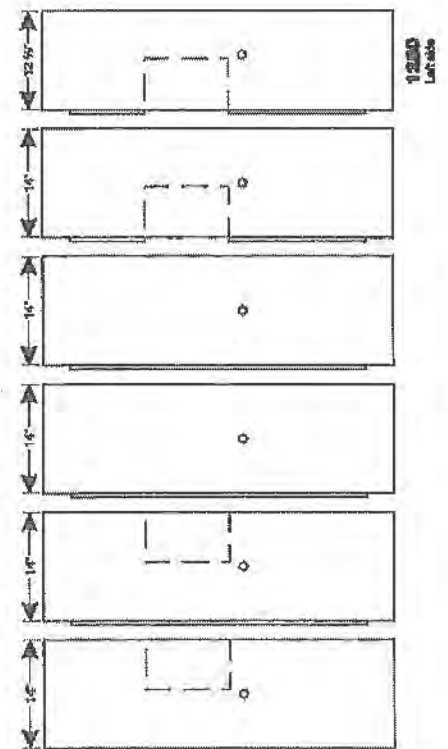
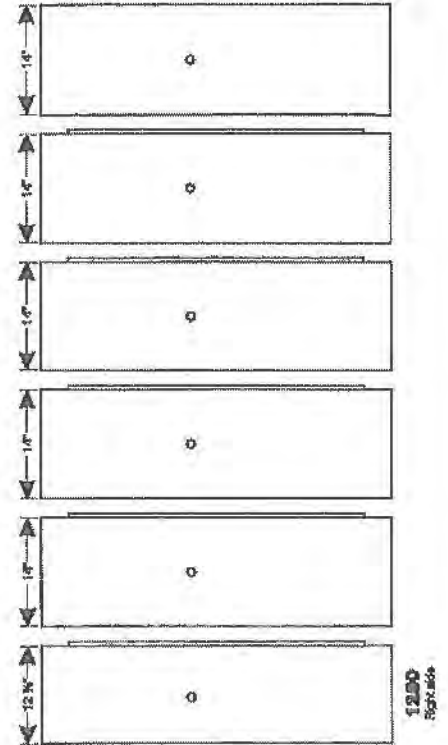
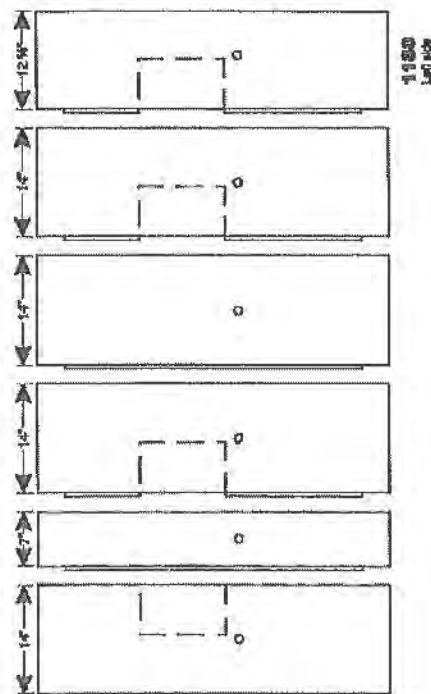
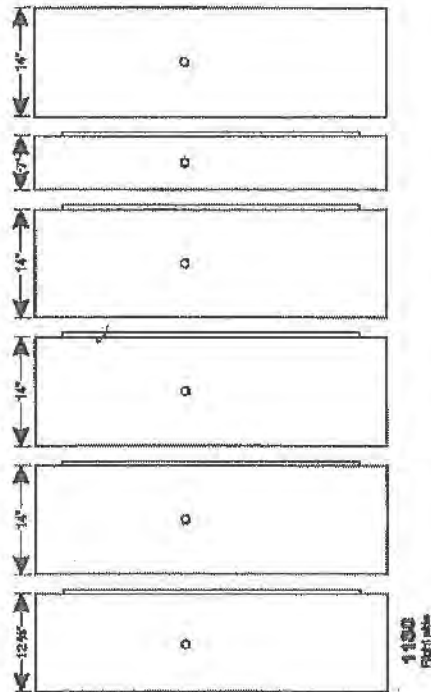
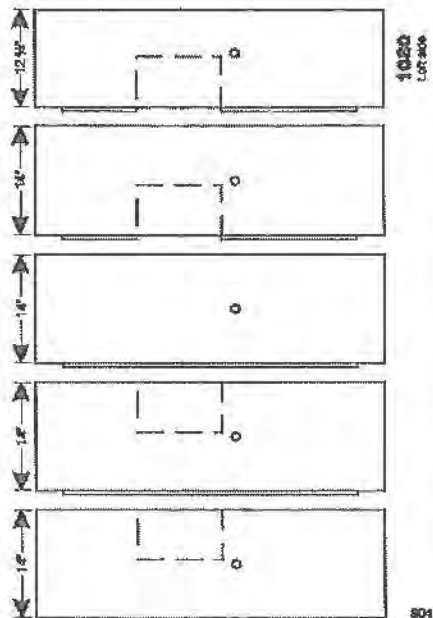
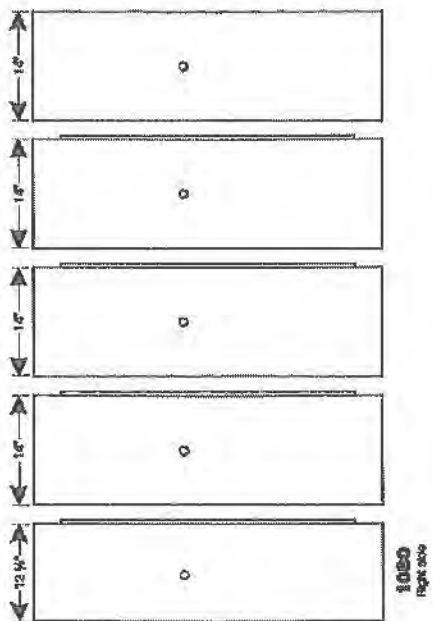
**Figure 23** Jacket side panel placement — Models 780, 880 and 980





# 9 Install jacket (continued)

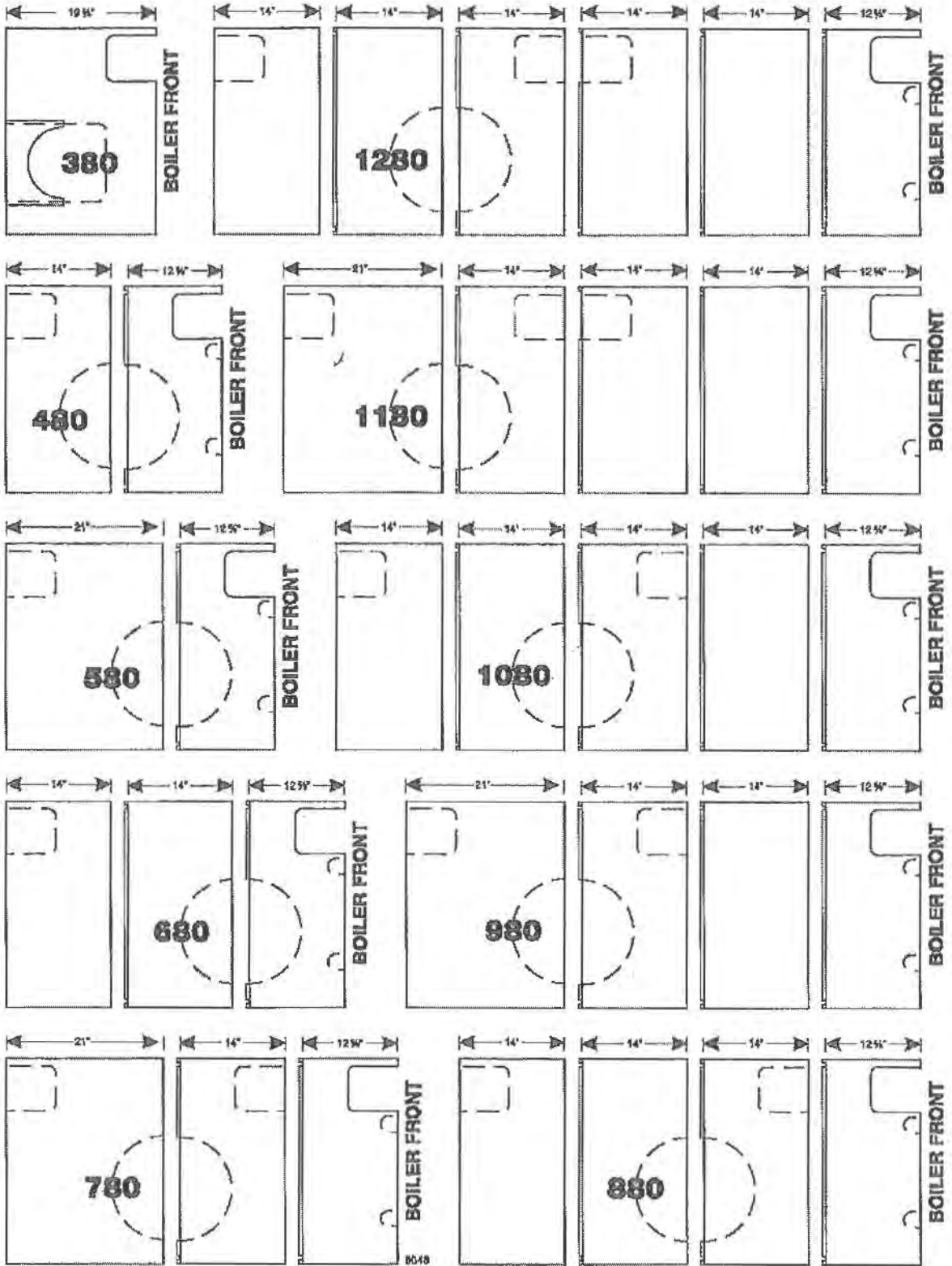
Figure 24 Jacket side panel placement — Models 1080, 1180, and 1280





# 9 Install jacket (continued)

Figure 25 Jacket top panel placement







# 10 Pipe tankless heaters

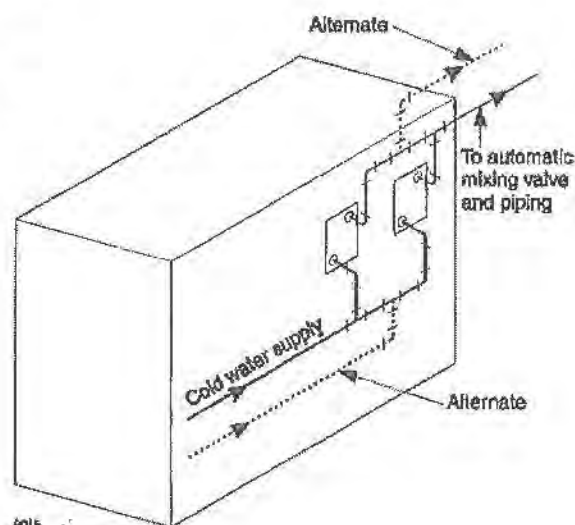
## To pipe tankless heaters:

1. Size piping no smaller than heater inlet and outlet.
2. Automatic mixing valve must be installed. See Figure 26. Follow manufacturer's instructions to install.
3. Flow regulating valve must be installed. Size according to continuous draw of heater. See Table 9. Follow manufacturer's instructions to install.
4. Operating control with small adjustable differential scale is recommended. Install in temperature control tapping in heater plate.
5. Multiple tankless heaters (see Figure 26):
  - a. Use cold water supply header with individual risers to each heater. Size header by increasing one pipe size for each additional heater.
  - b. Use hot water outlet header with individual risers to each heater. Size header by increasing one pipe size for each additional heater.
  - c. Do not pipe multiple heaters in series.
6. In hard water areas, soften cold domestic water supply to heaters to prevent lime build-up.

**Table 9** Tankless Heater Ratings

Tankless heater model	Continuous draw (no recovery period) GPM	Inlet and outlet tappings
78-24	6.5	3/4"

**Figure 26** Tankless Heater Piping



**⚠ DANGER**

**Hot water can scald!**

- Consumer Product Safety Commission and some states recommend domestic hot water temperature of 130°F or less.
- When installing an automatic mixing valve, selection and installation **must** comply with valve manufacturer's recommendations and instructions.
- Water heated to a temperature suitable for clothes washing, dish washing and other sanitizing needs will scald and cause injury.
- Children, elderly, infirm or physically handicapped persons are more likely to be injured by hot water. Never leave them unattended in or near a bathtub, shower or sink. Never allow small children to use a hot water faucet or draw their own bath. If anyone using hot water in the building fits this description, or if state laws or local codes require certain water temperatures at hot water faucets, take special precautions:
  - Install automatic mixing valve set according to those standards.
  - Use lowest practical temperature setting.
  - Check water temperature immediately after first heating cycle and after any adjustment.



# 11 Install water boiler controls

## Install controls:

1. Install furnished controls where shown in Table 10 and Figure 27.

**WARNING** Failure to properly install, pipe and wire boiler controls can result in severe damage to boiler, building and personnel; and is not covered by boiler warranty.

2. Relief valve must be installed with spindle in vertical position. Use fittings provided with boiler. Do not make any other connection in that piping.

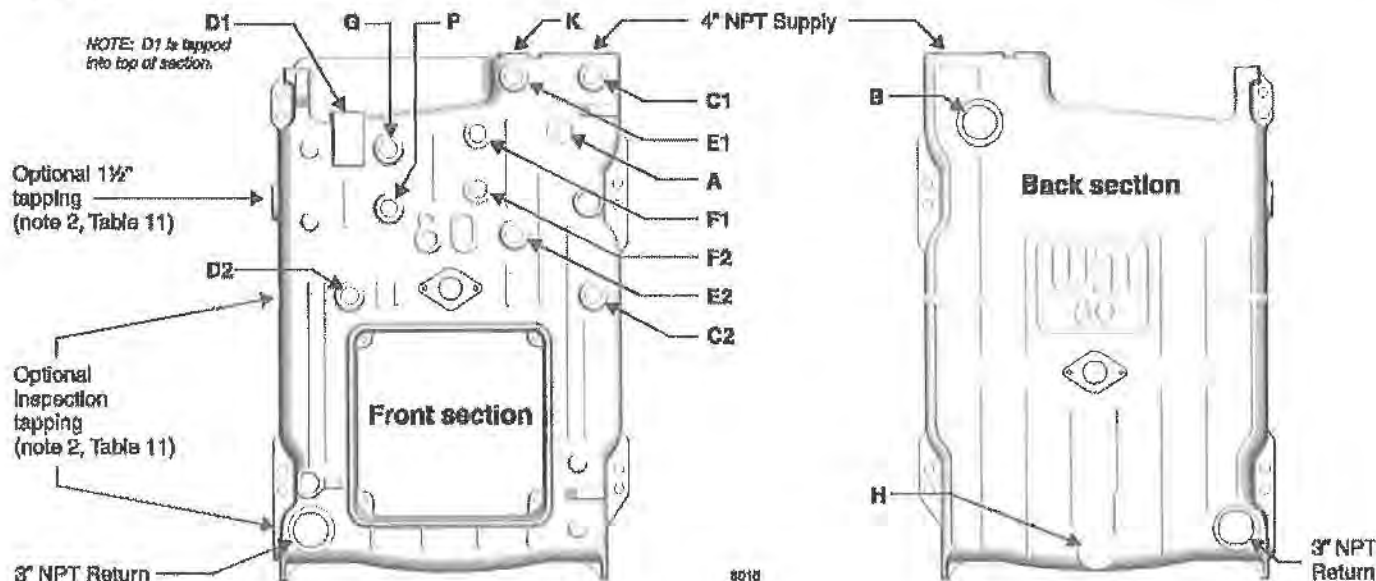
**WARNING** Relief valve discharge line must be piped using rigid material suitable for 375°F, threaded one end, near floor close to drain to eliminate potential of severe burns. Do not pipe to any area where freezing could occur. Do not plug, valve or place any obstruction in discharge line.

3. When installing low water cutoff
  - a. Must be installed if boiler is located above radiation level.
  - b. May be required on water boilers by certain state, local or territorial codes or insurance companies.
  - c. Install low water cutoff designed for water installations where shown in Table 10 and Figure 27.
4. If installation is to comply with ASME installation requirements, an additional high temperature limit is needed. Purchase and install in supply line between boiler and isolation valve or in tapping "A."
5. Dual limit control settings:
  - **Low** – set according to design requirements.
  - **High** – at least 20° higher than low limit, 240°F maximum.
6. Install optional controls per control manufacturer's instructions.

Table 10 Water control tapings (see Figure 27)

Tapping	Size (NPT)	Water boilers, with water level controls:		
		Probe-type primary Probe-type secondary	Float-type primary Probe-type secondary	Float-type primary Float-type secondary
A	1½" Note 1	Combination high/low limit control		
B	3"	Water relief valve		
C1	1"	Firing rate control	Primary water level control	
C2	1"	Not used	Primary water level control	
D1	1"	Not used	Not used	Secondary level control
D2	1"	Not used	Not used	Secondary level control
E1	1"	Not used	Not used	Not used
E2	1"	Additional high/low limit control.		
F1	1"	Primary level control	Not used	
F2	1"	Not used	Firing rate control	
G	1"	Pressure-temperature gauge		
H	1½"	Boiler drain		
K	1"	Expansion tank piping or automatic air vent		
P	1"	Secondary level control		Not used
Notes:	1. 1½" plug provided with boiler. 2. By special request only.			

Figure 27 Water control locations







# 12 Install steam boiler controls

## Install controls:

1. Install controls where shown in Table 11 and Figure 28.

**WARNING** Failure to properly install, pipe and wire boiler controls can result in severe damage to boiler, building and personnel; and is not covered by boiler warranty.

a. Install steam pressure operating and high limit controls and pressure gauge. See Figure 28, this page, and Figure 29, page 30.

Pressure limit control settings:

- **Low** – set according to design requirements.
- **High** – set at least 2 psi higher than low limit, 15 psi maximum.

b. Relief valve must be installed with spindle in vertical position. Use fittings provided with boiler. Do not make any other connection in that piping.

**WARNING** Pipe relief valve discharge through vertical piping to atmosphere. Use rigid material suitable for 375°F, threaded one end only. Install drain pan elbow to drain condensate. Pipe near floor close to floor drain to eliminate potential of severe burns. Do not pipe to any area where freezing could occur. Do not plug, valve or place any obstruction in discharge line.

c. Install water level controls and gauge glass as shown in Figure 30 and Table 12, page 30.

1. Fittings for controls to be furnished by others.
2. If water level control is not shown in Table 12, page 30, locate casting mark on control and install per manufacturer's instructions.

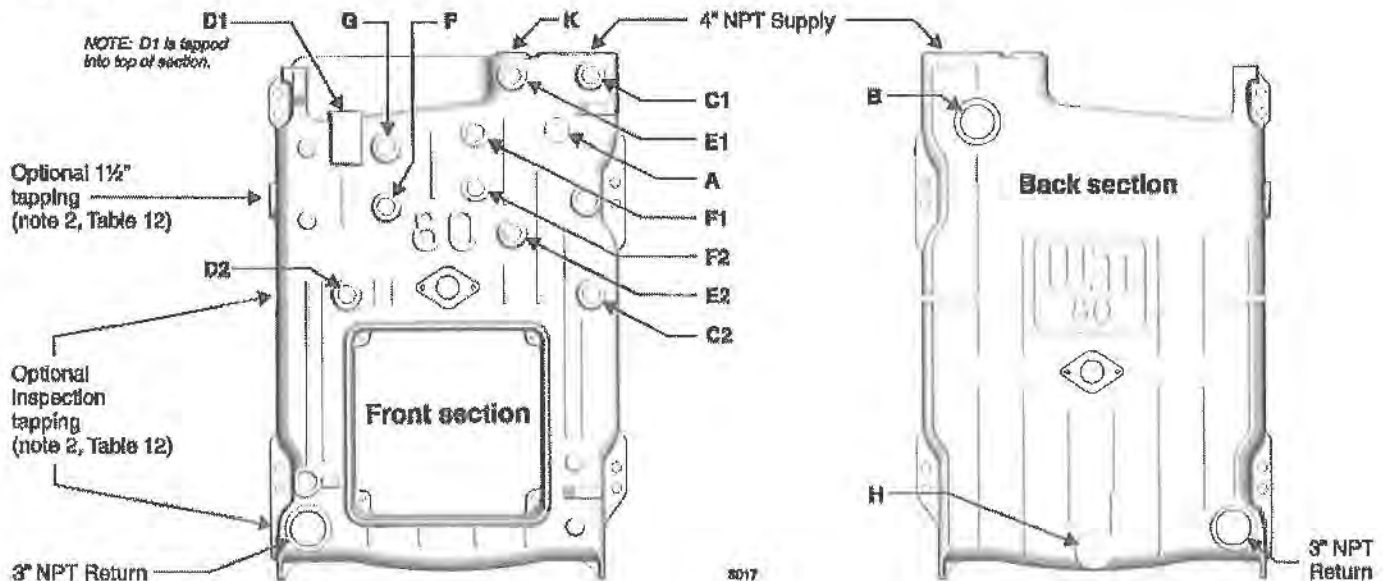
**NOTICE** Do not use water level controls with quick hook-up fittings. Nuisance shutdowns will occur.

**Table 11** Steam control tappings (see Figure 28)

Tapping	Size (NPT)	Steam boilers, with water level controls:	
		Float-type primary Probe-type secondary	Float-type primary Float-type secondary
A	1½" Note 1	Skim tapping (Pipe skim piping to side of boiler)	
B	3"	Steam relief valve	
C1	1"	Primary water level control	
C2	1"	Primary water level control	
D1	1"	Not used	Secondary level control
D2	1"	Not used	Secondary level control
E1	1"	Gauge glass	
E2	1"	Gauge glass	
F1	1"	Try cock tapping	
F2	1"	Try cock tapping	
G	1"	Control tree: Limit control, operating control, and pressure gauge	
H	1½"	Boiler drain	
K	1"	Not used	
P	1"	Secondary level control	Not used

Notes: 1. 1½" plug provided with boiler. 2. By special request only.

**Figure 28** Steam control locations





# 12 Install steam boiler controls (continued)

Figure 29 Steam control siphon and fittings

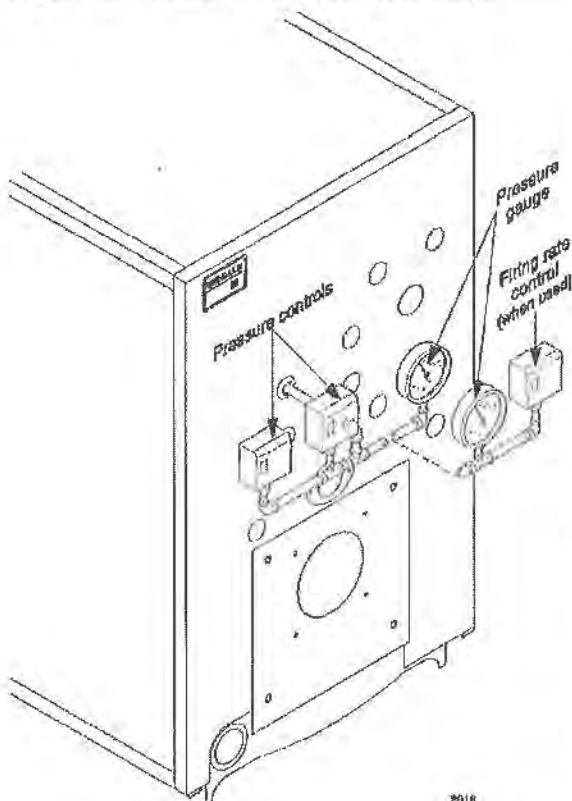
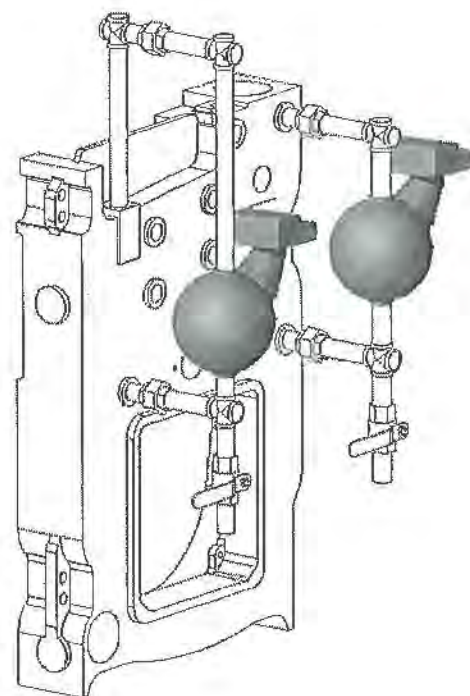
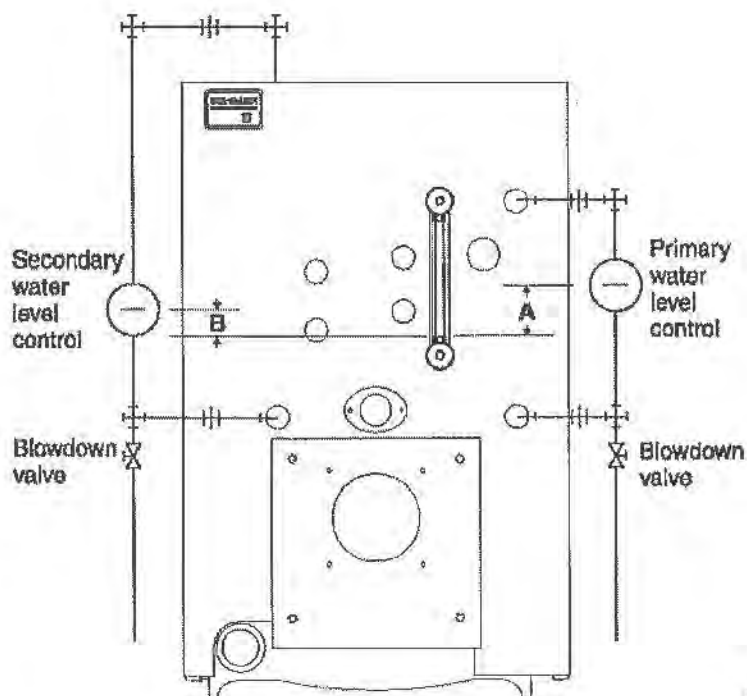


Table 12 Water level control locations

Primary water level control	Casting line height above bottom of gauge glass	Back-up water level control	Casting line height above bottom of gauge glass	Back-up (only) probe-type water level control in "P" tapping
Note 1	"A"	Note 1	"B"	
61, 63	1½"	61, 63	½"	MM PS801-120 or Hydrolevel 45-550
42, 150MD, 167MD (see Notes 2 & 3)	2½"	61, 63	½"	
83, 183 (see Notes 2 & 3)	1¾"	61, 63	½"	
61-2 & 61-S-2 (see Notes 2 & 3)	2½"	61, 63	½"	

**Notes:**  
 1. Other manufacturer's controls providing similar function may be used, if properly located and selected.  
 2. Cannot be used as back-up water level controls.  
 3. When pump control is used with feed water tank, install pump control on boiler and makeup water feeder on tank. Use separate low water cutoff on boiler when back-up is needed. Do not install combination low water cutoff and feeder as back-up control on boiler. Feeder will operate before pump control operates.

Figure 30 Water level control locations (see Table 12)







# 13 Connect breeching and venting systems

## General venting information

- Model 80 boilers operate with positive overfire pressure. Adjust damper assembly (see page 33) during burner start-up to achieve 0.1" W.C. positive pressure at damper sample hole.

## Select type of venting system

### Forced draft

Boiler, breeching and stub vent operate at positive pressure. Entire system must be gas-tight to prevent leaks. Stub vent height must be limited to prevent negative draft with 3-foot minimum stub vent height above roof. See Figures 31 and 32.

### Balanced draft

Boiler operates with positive pressure overfire. Chimney may provide excess draft which may require a barometric draft control installed and set to provide minimum draft to maintain 0.1" positive pressure at flue collar. Minimum chimney height above roof is 3 feet. See Figures 33 and 34.

## Construct metal breeching:

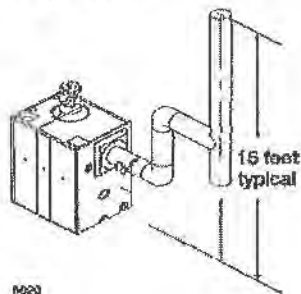
- See Table 13 or Table 14 for minimum breeching diameter.
- Select material type and thickness in compliance with local codes.

**WARNING** Conventional flue pipe should not be used as it could leak flue gases and carbon monoxide emissions through seams and joints, resulting in severe personal injury or death.

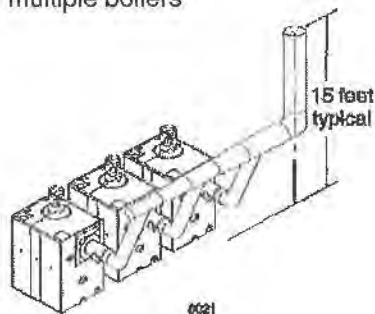
- Refer to ASHRAE Guide for chimney and breeching calculations and construction and lining.

**WARNING** Long horizontal breechings, excessive number of tees and elbows or other obstructions restricting combustion gas flow can result in possibility of condensation, flue gas leakage and carbon monoxide emissions, causing severe personal injury or death.

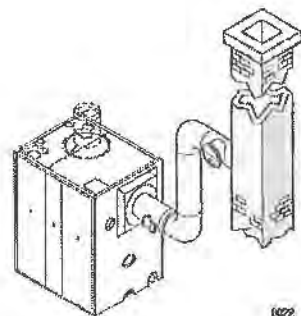
**Figure 31**  
Stub vent – forced draft — single boiler



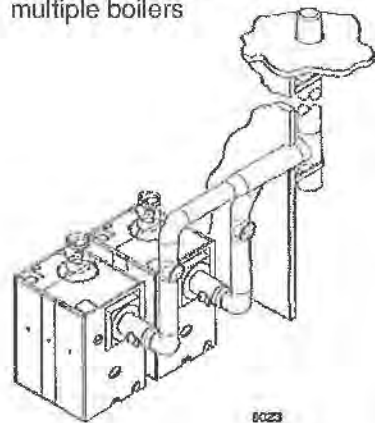
**Figure 32**  
Stub vent – forced draft — multiple boilers



**Figure 33**  
Conventional chimney – balanced draft with barometric draft control when required — single boiler



**Figure 34**  
Conventional chimney – balanced draft with barometric draft control when required — multiple boilers



**Table 13** Minimum breeching diameter — forced draft venting

Boiler model number	I=B=R recommended minimum vent diameter	Flue collar outlet diameter
	inches	Inches
380	6	8
480	7	8
580	8	8
680	8	8
780	9	10
880	10	10
980	10	10
1080	10	10
1180	10	10
1280	12	12

**Table 14** Minimum breeching diameter — balanced draft venting

Boiler model number	I=B=R round vent diameter	I=B=R rectangular chimney size	Minimum chimney/vent height	Flue collar outlet diameter
	inches	Inches	feet	inches
380	8	8 x 12	15	8
480	10	8 x 12	15	8
580	10	12 x 12	15	8
680	11	12 x 16	15	8
780	12	12 x 16	15	10
880	15	12 x 16	15	10
980	15	16 x 16	15	10
1080	15	16 x 16	15	10
1180	15	18 x 16	15	10
1280	15	20 x 16	15	12





# 14 Install burner

## To install burner:

1. Unpack burner.
2. Place gasket around air tube and against burner mounting flange. If sealing rope is used, apply  $\frac{1}{8}$ " continuous bead of rope adhesive around burner mounting flange and apply sealing rope to make gas-tight seal.
3. Mount burner into opening in burner mounting plate.

### CAUTION

Maintain gas-tight seal between burner mounting flange and plate to prevent damage to air tube.

4. Level burner using burner support brackets where required.
5. Secure with furnished bolts.
6. Retain burner information packet. Keep with boiler.

# 15 Wiring and fuel piping

### WARNING

Electric shock hazard. Can cause severe personal injury or death if power source is not disconnected before installing or servicing boiler and burner.

## To wire burner and boiler controls:

1. Install all wiring in compliance with:
  - National Electrical Code ANSI/NFPA 70.
  - Any additional national, state, or local codes.
2. Follow burner manual and wiring diagram found in burner information packet.
3. Use 14 ga. wire for operating and safety circuit wiring.
4. Where burner motor voltage differs from control voltage, supply proper voltage to each. Size fused disconnect(s) and conductors per National Electrical Code ANSI/NEPA 70.

## To install gas and/or oil piping:

1. Install all piping in compliance with:
  - Local, state or national codes and regulations.
  - Separate burner manual provided with burner.
2. Use pipe joint compound (pipe dope) resistant to corrosive action of fuel oil or liquified petroleum gases. Apply sparingly to male threads of pipe joints. Do not use any kind of pipe tape.
3. Oil piping – use flate-type fittings, not compression type.

### DANGER

Do not use compression or soldered fittings. No safe repair can be made. Severe personal injury, death or substantial property damage will result.

### WARNING

Propane boilers — see WARNING on page 39 regarding propane gas odorant.

# 16 Make final adjustments

## To fill water boilers:

1. Close manual air vents and drain cocks.
2. Fill to correct system pressure. Correct pressure will vary with each installation.
3. Starting on lowest floor, open air vents one at a time until water squirts out. Close vent. Repeat with remaining vents.
4. Refill boiler to correct pressure.

## To fill steam boilers:

1. Do not fill (except for leakage test) until boiler is ready to be fired.
2. Fill to normal waterline, halfway up gauge glass.
3. Recommend boiler water pH 7.0 to 8.5.

## Adjust burner and damper assembly:

1. Lock open flue transition damper.

### WARNING

Make final burner adjustments using combustion test equipment to assure proper operation. Do not fire boiler without water. Sections will overheat, damaging boiler and resulting in severe property damage.

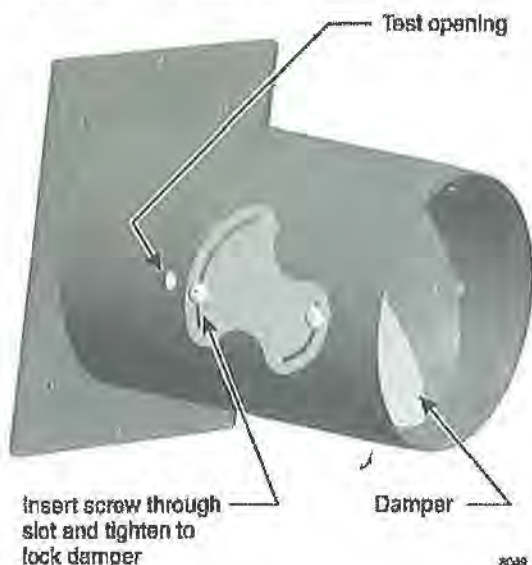
2. Refer to burner manual for start-up and service.
3. Let burner advance to high fire. Heat boiler to design conditions.
4. Using combustion test equipment, adjust burner for:
  - a. 12% ( $\pm$  ¼%) CO<sub>2</sub> for No. 2 fuel oil, 0 smoke.
  - b. 9 – 10% CO<sub>2</sub> natural gas; CO in flue gas not to exceed 50 ppm (0.01%).
5. Adjust damper assembly (Figure 35, page 33) to ensure 0.1" W.C. positive pressure at test opening. Tighten screws to secure in position. Plug test opening with 3/8" bolt provided with damper assembly.
6. Adjust barometric draft control, when used, to design conditions.
7. Repeat steps 4 through 6. Adjust as required.





# 16 Make final adjustments (continued)

Figure 35 Flue damper assembly, typical



## Skim steam boilers:

**NOTICE**

Clean all newly installed steam boilers to remove oil. Failure to properly clean can result in violent water level fluctuations, water passing into steam mains, or high maintenance costs on strainers, traps and vents. Skim boiler only. Do not clean old piping or leaks can occur.

**WARNING**

Do not use petroleum-based cleaning or sealing compounds in boiler system. Severe damage to system components can result, causing substantial property damage.

1. Remove 1½" plug from skim tapping tapping "A" – Figure 28, page 29). Provide 1½" skim piping from tapping to floor drain (pipe to side of boiler).
2. Raise waterline to midpoint of skim piping.
3. Fire burner to maintain temperature below steaming rate during skimming process.
4. Feed in water to maintain water level. Cycle burner to prevent rise in steam pressure.
5. Continue skimming until discharge is clear. This may take several hours.
6. Drain boiler. While boiler is warm **but not hot**, flush all interior surfaces under full pressure until drain water runs clear.
7. Remove skim piping. Re-insert plug at boiler skim tapping.
8. Close drain cock. Fill with fresh water to normal water line. Start burner and steam for 15 minutes to remove dissolved gases. Stop burner.
9. Check traps and air vents for proper operation.

## Determine if water treatment is needed (water boilers only):

**WARNING**

Do not use petroleum-based cleaning or sealing compounds in boiler system. Severe damage to system components can result, causing substantial property damage.

Continual make-up water will reduce boiler life. Minerals can build up in sections, reducing heat transfer, overheating cast iron and causing section failure.

For unusually hard water areas or low pH conditions (less than 7.0) consult local water treatment company.

## Freeze protection (when used):

1. Use antifreeze especially made for hydronic systems. Inhibited propylene glycol is recommended.

**WARNING**

Do not use automotive, ethylene glycol or undiluted antifreeze. Severe personal injury or death can result.

2. 50% solution provides protection to about -30°F.
3. Local codes may require back-flow preventer or actual disconnect from city water supply.
4. Determine quantity according to system water content. Boiler water content is listed on page 34. Percent of solution will affect sizing of heat distribution units, circulator and expansion tank.
5. Follow antifreeze manufacturer's instructions.

## Check boiler for gas-tight seal:

**WARNING**

Boiler must be sealed gas-tight to prevent possible flue gas leakage and carbon monoxide emissions, resulting in severe personal injury or death.

1. Remove boiler jacket side and top panels.
- WARNING** The boiler contains ceramic fiber and fiberglass materials. Use care when handling these materials per instructions on page 38 of this manual. Failure to comply could result in severe personal injury.
2. Start burner. Observe all sealing points and chalk mark any not gas-tight.
  3. To seal all chalk-marked areas:
    - a. use silicone sealant on section flueways.
    - b. check gaskets and sealing rope placement.
  4. Reinstall all jacket panels.





# 17 Dimensions and ratings



Boiler model number	Data				Dimensions (inches)						
	Supply tappings Qty-size (see Note)		Return tappings Qty-size (see Note)		A	B	D	F	H	W	L
	Water	Steam	Water	Steam							
380	2-4"	2-4"	2-3"	2-3"	13 1/4	--	8	12 3/4	13 1/2	20 1/2	21 1/2
480	2-4"	2-4"	2-3"	2-3"	20 1/4	--	8	13 1/2	20 1/2	27 1/2	28 1/2
580	2-4"	2-4"	2-3"	2-3"	27 1/2	--	8	13 1/2	27 1/2	34 1/2	35 1/2
680	2-4"	2-4"	2-3"	2-3"	34 1/2	--	8	13 1/2	34 1/2	41 1/2	42 1/2
780	2-4"	2-4"	2-3"	2-3"	41 1/2	--	10	27 1/2	41 1/2	48 1/2	49 1/2
880	2-4"	2-4"	2-3"	2-3"	48 1/2	--	10	27 1/2	48 1/2	55 1/2	56 1/2
980	2-4"	2-4"	2-3"	2-3"	55 1/2	--	10	41 1/2	55 1/2	62 1/2	63 1/2
1080	2-4"	3-4"	2-3"	2-3"	62 1/2	27 1/2	10	41 1/2	62 1/2	69 1/2	70 1/2
1180	2-4"	3-4"	2-3"	2-3"	69 1/2	34 1/2	10	55 1/2	69 1/2	76 1/2	77 1/2
1280	2-4"	3-4"	2-3"	2-3"	76 1/2	34 1/2	12	55 1/2	76 1/2	83 1/2	84 1/2

Note: Use piping connections shown in Manual, pages 14 through 19.

Boiler model number	I=B=R burner capacity		Gross I=B=R output MBH	Net I=B=R ratings			Boiler H.P.	Net firebox volume Cu. ft	Stack gas volume CFM	Positive pressure in firebox Inches W.C.	Flue outlet diameter Inches	Boiler water content (gallons)		Packaged boiler weight (less water) Lbs	Approx. operating weight (with water) Lbs
	Light oil GPH	Gas MBH		Steam Sq. Ft	Steam MBH	Water MBH						Water boiler	Steam to matches		
Notes: 1	2	3, 4	5, 6		5	5		7	8						
380	2.40	346	278	867	208	242	8.3	2.61	139	0.28	8	37.5	27.5	1058	1170
480	3.40	491	396	1238	297	344	11.8	3.97	198	0.28	8	49.0	36.0	1203	1411
580	4.45	639	515	1608	386	448	15.4	5.33	259	0.28	8	60.5	44.5	1448	1752
680	5.50	787	634	1983	476	551	18.9	6.69	320	0.27	8	72.0	53.0	1843	2093
780	6.50	935	753	2354	565	655	22.5	8.05	378	0.27	10	83.5	61.5	2088	2434
880	7.50	1082	872	2725	654	758	26.0	9.41	436	0.27	10	95.0	70.0	2317	2774
980	8.50	1230	991	3098	743	862	29.6	10.77	494	0.27	10	106.5	78.5	2678	3115
1080	9.60	1378	1110	3471	833	965	33.2	12.13	558	0.26	10	118.0	87.0	2923	3456
1180	10.60	1528	1229	3842	922	1069	36.7	13.49	616	0.26	10	129.5	95.5	3088	3697
1280	11.60	1674	1348	4242	1018	1172	40.3	14.85	675	0.26	12	141.0	104.0	3313	4038

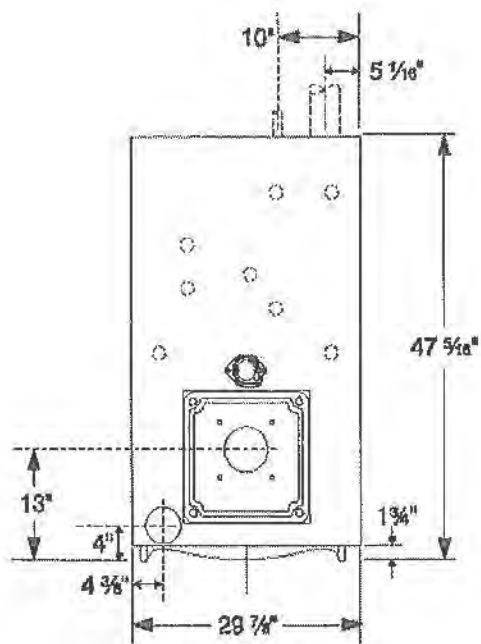
**Notes**

1. Burner input based on maximum of 2,000 feet altitude. For higher altitudes consult local Weil-McLain representative.
2. No. 2 fuel oil Commercial Standard Spec. CS75-56. Heat value of oil — 140,000 Btu/Gal.
3. Consult Weil-McLain Burner Specifications and Data Sheet for gas pressures required.
4. MBH refers to thousands of Btu per hour.
5. Gross I=B=R ratings have been determined under the I=B=R provision forced draft boiler-burner units.
6. Net I=B=R ratings are based on net installed radiation of sufficient quantity for the requirements of the building and nothing need be added for normal piping and pickup. Water ratings are based on a piping and pickup allowance of 1.15. Steam ratings are based on the following allowances: 380 thru 1180 — 1.333; 1280 — 1.321. An additional allowance should be made for gravity hot water systems or for unusual piping and pickup loads. Consult local Weil-McLain representative.
7. Stack gas volume at outlet temperature.
8. With 0.10" W.C. positive pressure at flue collar.

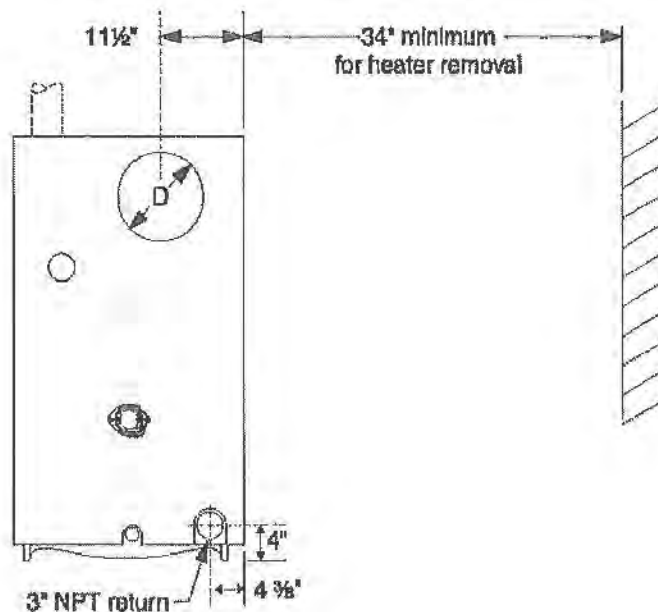
**NOTICE:** Boiler sections are tested for 80 PSIG working pressure. Water boilers are supplied with 30 PSIG relief valve standard.



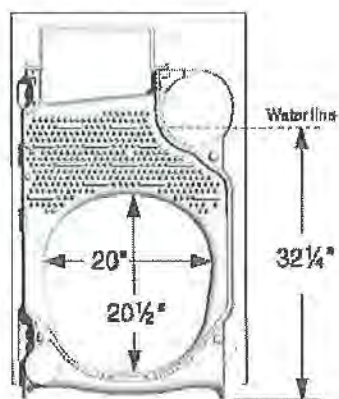
# 17 Dimensions and ratings (continued)



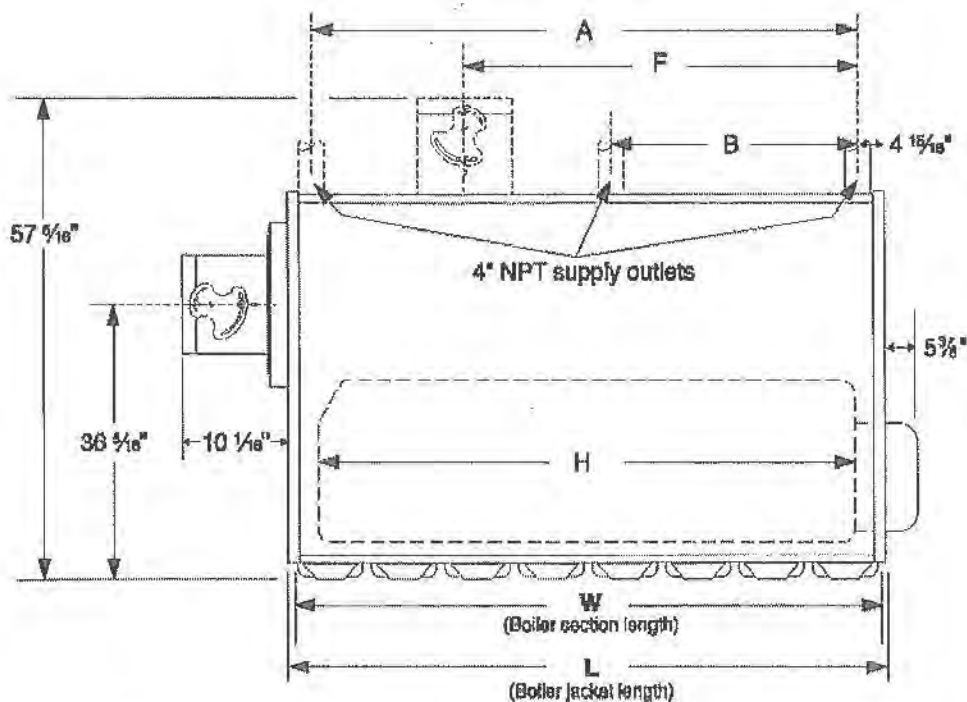
**FRONT**



**BACK**



**INTERMEDIATE**



**SIDE**

3029



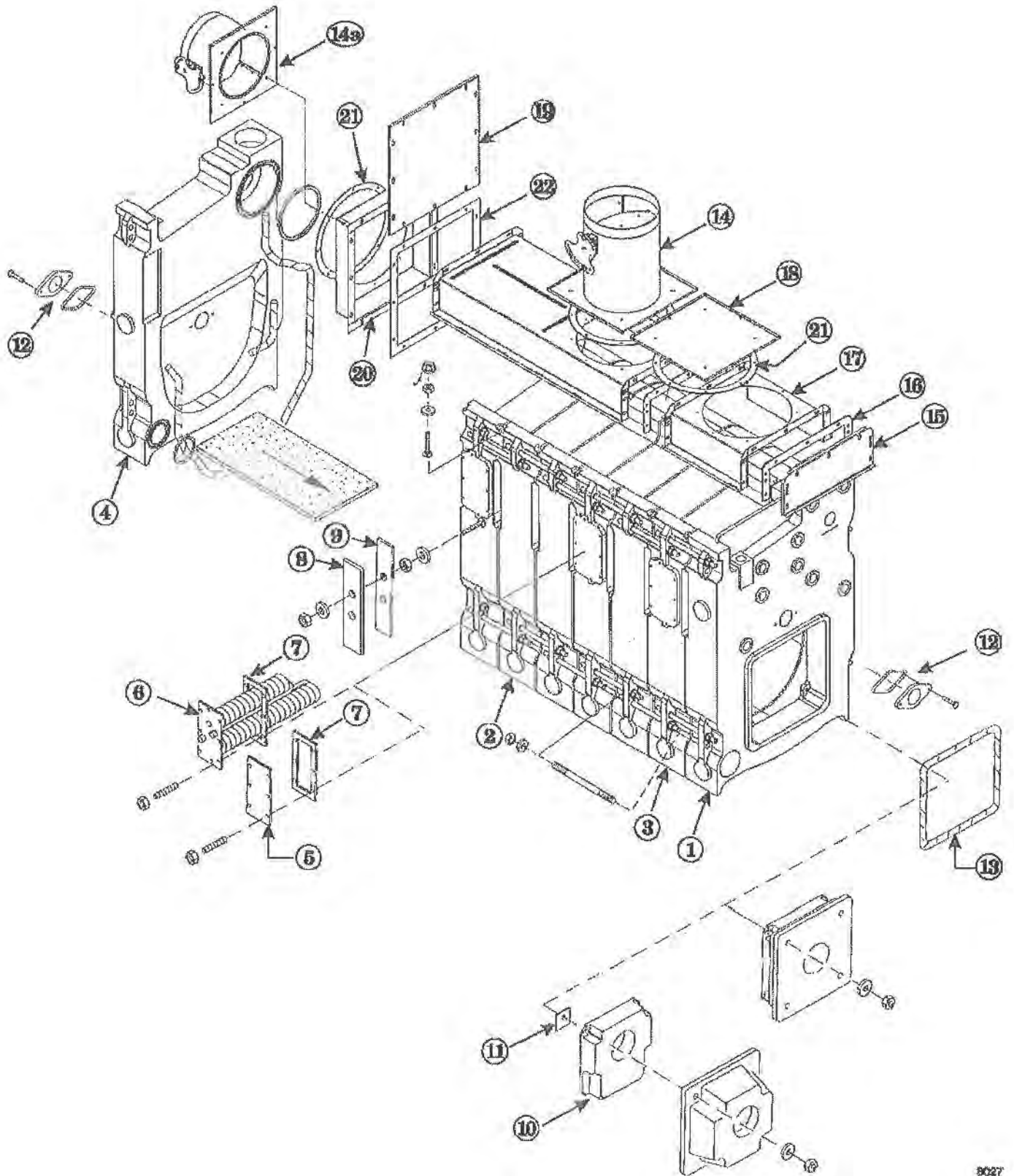


# 18 Parts

Item number	Description	Well-McLain part number
1	Front section	315-700-100
2	Intermediate section, regular Intermediate section with special side tappings Intermediate section, supply (steam boilers)	315-700-120 315-700-130 315-700-150
3	Intermediate section, tankless	315-700-140
4	Back section	315-700-110
not shown	Section assembly kit (includes for one joint: sealing rope, sealing rope adhesive, sealing rings, silicone sealant)	385-800-205
5	Heater cover plate carton (includes: cover plate, gasket, studs, nuts)	385-700-200
6	Tankless heater carton (includes tankless heater, gasket, studs, nuts)	590-921-917
7	Heater gasket	590-317-550
8	Cleanout plate	450-030-928
9	Cleanout plate gasket	590-317-303
10	Burner mounting plate, front refractory 4½" burner opening 6½" burner opening	591-000-070 591-000-072
11	Refractory retainer clip	562-650-105
12	Observation port assembly (includes: observation port assembly, sealing rope, screws)	385-600-099
13	Sealing rope	590-735-140
not shown	Combustion chamber kit (includes: back refractory blanket, bottom refractory blanket, adhesive, sealing rope, sealing rope adhesive)	385-700-220
14	Flue damper assembly, top flue boilers 8" 10" 12"	425-800-080 425-800-081 425-800-082
14a	Flue damper assembly, rear flue boilers 8" 10" 12"	425-800-098 425-800-097 425-800-098
not shown	Flue collector hood hardware kit (includes: flue collector hardware plus collector hood gasket kit, below)	385-800-215
15	Flue collector hood end cap	463-000-003
Not shown	Collector hood gasket kit (includes: (2) flue collector hood gasket, (3) circular collector hood gaskets, (1) rectangular collector hood gasket, flat-stitched sealing rope, double-faced tape)	385-800-218
16	Flue collector hood gasket	Included in gasket kit
17	Flue collector hoods	450-020-300 450-020-301 450-020-302 450-020-303 450-020-304
18	Flue cap	Included with flue damper assembly
19	Flue cap rear	
20	Rear flue transition box	
21	Circular collector hood gasket	Included in gasket kit
22	Rectangular collector hood gasket	Included in gasket kit



# 18 Parts (continued)







## Handling ceramic fiber and fiberglass materials

### **WARNING**

This symbol is used in this addendum to indicate presence of hazards that can cause severe personal injury, death or substantial property damage.

### REMOVAL OF COMBUSTION CHAMBER LINING OR BASE PANELS

### **WARNING**

The combustion chamber lining or base insulation panels in this product contain ceramic fiber materials. Ceramic fibers can be converted to cristobalite in very high temperature applications. The International Agency for Research on Cancer (IARC) has concluded, "Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1).":

- Avoid breathing dust and contact with skin and eyes.
  - Use NIOSH certified dust respirator (N95). This type of respirator is based on the OSHA requirements for cristobalite at the time this document was written. Other types of respirators may be needed depending on the job site conditions. Current NIOSH recommendations can be found on the NIOSH web site at <http://www.cdc.gov/niosh/homepage.html>. NIOSH approved respirators, manufacturers, and phone numbers are also listed on this web site.
  - Wear long-sleeved, loose fitting clothing, gloves, and eye protection.
- Apply enough water to the combustion chamber lining or base insulation to prevent airborne dust.
- Remove combustion chamber lining or base insulation from the boiler and place it in a plastic bag for disposal.
- Wash potentially contaminated clothes separately from other clothing. Rinse clothes washer thoroughly.

#### **NIOSH stated First Aid.**

- Eye: Irrigate immediately
- Breathing: Fresh air.

### REMOVAL OF FIBERGLASS WOOL — OR —

### INSTALLATION OF FIBERGLASS WOOL, COMBUSTION CHAMBER LINING OR BASE PANELS:

### **WARNING**

This product contains fiberglass jacket insulation and ceramic fiber materials in combustion chamber lining or base panels in gas fired products. Airborne fibers from these materials have been listed by the State of California as a possible cause of cancer through inhalation.

- Avoid breathing dust and contact with skin and eyes.
  - Use NIOSH certified dust respirator (N95). This type of respirator is based on the OSHA requirements for fiberglass wool at the time this document was written. Other types of respirators may be needed depending on the job site conditions. Current NIOSH recommendations can be found on the NIOSH web site at <http://www.cdc.gov/niosh/homepage.html>. NIOSH approved respirators, manufacturers, and phone numbers are also listed on this web site.
  - Wear long-sleeved, loose fitting clothing, gloves, and eye protection.
- Operations such as sawing, blowing, tear out, and spraying may generate airborne fiber concentration requiring additional protection.
- Wash potentially contaminated clothes separately from other clothing. Rinse clothes washer thoroughly.

#### **NIOSH stated First Aid.**

- Eye: Irrigate immediately
- Breathing: Fresh air.



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## Propane boilers — propane gas odorant

**▲WARNING**

Propane boilers only — Your propane supplier mixes an odorant with the propane to make its presence detectable. In some instances, the odorant can fade and the gas may no longer have an odor.

- Propane gas can accumulate at floor level. Smell near the floor for the gas odorant or any unusual odor. If you suspect a leak, do not attempt to light the burner.
- Use caution when attempting to light a propane burner (or pilot burner). This should be done by a qualified service technician, particularly if flame outages (or pilot outages) are common.
- Periodically check the odorant level of your gas.
- Inspect boiler and system at least yearly to make sure all gas piping is leak-tight.
- Consult your propane supplier regarding installation of a gas leak detector. There are some products on the market intended for this purpose. Your supplier may be able to suggest an appropriate device.





Weil-McLain  
500 Blaine Street  
Michigan City, IN 46360-2388  
<http://www.weil-mclain.com>

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 5223 2.3 CAST IRON BOILERS

Submittal Number: 1

Item: Start Up Report & Warranty

Manufacturer:

Model #:

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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# START UP REPORT

**DATE:** August 20<sup>th</sup>, 2015

**PROJECT:** Haines Vocational Technology Bldg. Mechanical Upgrades

**SYSTEM STARTUP:** WEIL MCLAIN MODEL 80 BOILER

**START UP PROCEDURE:** TEST AND REPAIR ANY LEAKS IN BOILER SECTIONS. FIRE BOILER AND PERFORM COMBUSTION ANALYSYS.

**FUEL TYPE:** # 2 FUEL OIL

## **COMBUSTION ANALYSYS REPORT:**

Oxygen: 4.5% " Oxygen:

Carbon Dioxide: 11.5%

Stack Temp: 80+ AFUE 330° F to 385° F

Draft (Stack) -0.02"WC/0.04"WC

Carbon Monoxide: < 50 ppm (diluted)

Smoke spot #0 to #1

Oil Pressure 125 psi

**TESTED BY:** Clinton Melin, Project Plumbing Foreman, Custom Mechanical Systems

**SIGNED:**   
\_\_\_\_\_

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# Weil-McLain® Cast Iron Gas Boiler and Oil Boiler

## Models 80, 88, and 94

### Limited Warranty for Commercial Use

Please register your purchase of this Weil-McLain Product at [www.weil-mclain.com](http://www.weil-mclain.com).  
Retain proof of purchase and installation date.

To learn how to properly care for and maintain your Product, please review the printed information provided with your Product. You can also obtain this information at [www.weil-mclain.com](http://www.weil-mclain.com).

#### A. What Does This Limited Warranty Cover?

This Limited Warranty for Commercial Use covers any defects in material and workmanship in your Weil-McLain Cast Iron Gas or Oil Boiler Model 80, 88, or 94 (the "Product").

#### B. How Long Does The Coverage Last?

There are two separate coverage periods under this Limited Warranty: (1) the Heat Exchanger Limited Warranty Period, and (2) the Parts Limited Warranty Period. The Heat Exchanger Limited Warranty Period runs for ten years from the date your Product was installed. The Parts Limited Warranty Period runs for one year from the date your Product was installed and applies to all parts of your Product except the heat exchanger.

Item	Coverage
Heat Exchanger	10 years
All Other Parts	1 year

#### C. Who Can Make Claims Under This Limited Warranty?

This Limited Warranty is available to you if you are the original retail purchaser or a subsequent owner and the Product has been used at any time for business purposes. A Product used at all times solely for personal, family, or household purposes is covered by the Limited Warranty for Residential Use for the Weil-McLain Cast Iron Gas Boiler and Oil Boiler Models 80, 88, and 94.

#### D. What Will Weil-McLain Do To Correct Problems?

If Weil-McLain determines during the Heat Exchanger Limited Warranty Period that a heat exchanger section is defective in material or workmanship, then Weil-McLain will provide a replacement heat exchanger section. If Weil-McLain determines during the Parts Limited Warranty Period that any part other than a heat exchanger section is defective in material or workmanship, then Weil-McLain will provide a replacement part.

Weil-McLain will provide replacement heat exchanger sections and other parts free of charge. Weil-McLain will furnish replacement heat exchanger sections from the closest comparable boiler model available from Weil-McLain at the time of the replacement.

If Weil-McLain provides a replacement heat exchanger section, then that replacement heat exchanger section will be covered under this Limited Warranty for the time remaining in the original Heat Exchanger Limited Warranty Period. If Weil-McLain provides a replacement for any part other than a heat exchanger section, then that replacement part will be covered under this Limited Warranty for the time remaining in the original Parts Limited Warranty Period.

#### E. What Will Weil-McLain Not Do To Correct Problems?

Weil-McLain will not pay for the labor to remove any heat exchanger section or other part that is the subject of your warranty claim or to install replacements provided under this Limited Warranty. Additionally, Weil-McLain will not pay for the cost of any tools, repair materials, or travel necessary to perform the removal or installation.

#### F. What Is Not Covered Under This Limited Warranty?

This Limited Warranty does not cover any Product that has been moved from its original installation site; any components that are not supplied by Weil-McLain; and any burner supplied by Weil-McLain. (Burners supplied by Weil-McLain are covered by a separate manufacturer's warranty.) Additionally, this Limited Warranty does not cover claims you make if the failure, malfunction, or unsatisfactory performance of, or damage to, your Product resulted from or is attributable to:

- (1) Inaccurate or incomplete information or data supplied or approved by any party other than Weil-McLain;
- (2) The failure to properly size the Product for its use;
- (3) Installation not done in accordance with manufacturer's instructions;



**Weil-McLain® Cast Iron Gas Boiler and Oil Boiler**  
**Models 80, 88, and 94**

**Limited Warranty for Commercial Use**

- (4) Services provided by and workmanship of the installer of the Product;
- (5) Components that are not supplied by Weil-McLain;
- (6) Improper or negligent operation, adjustment, control settings, repair, care, or maintenance of the Products, or the failure to adjust, set the controls of, repair, care for, or maintain the Products;
- (7) Operation with combustion air contaminated by chemical vapors, with improper fuel additives, or with water conditions that have caused deterioration or unusual deposits in the heat exchanger;
- (8) Freezing, accident, fire, flood, or other acts of God; abuse or misuse; unauthorized alteration; or power surges or failures; and
- (9) Normal wear and tear.

**WEIL-McLAIN'S MAXIMUM LIABILITY SHALL NOT EXCEED THE ACTUAL PURCHASE PRICE PAID BY YOU FOR YOUR PRODUCT. IN NO EVENT SHALL WEIL-McLAIN BE RESPONSIBLE FOR INDIRECT, INCIDENTAL, CONSEQUENTIAL (INCLUDING WITHOUT LIMITATION DAMAGE TO OR LOSS OF OTHER PROPERTY), OR PUNITIVE DAMAGES, WHETHER SUCH CLAIM OR ACTION IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, STRICT LIABILITY, OR ANY OTHER LEGAL THEORY. ALL IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE DISCLAIMED IN THEIR ENTIRETY.**

**G. How Do You Make A Warranty Claim?**

If you believe you have a claim under this Limited Warranty, please contact a qualified heating or plumbing contractor of your choice. Your contractor will perform a diagnosis and advise you as to whether you may have a claim covered by this Limited Warranty. If your contractor advises you that you may have a claim covered by this Limited Warranty, then the contractor will file the claim on your behalf. You must make all parts that are subject to a warranty claim available to your contractor for return to Weil-McLain. If you have questions about this process or the status of your claim, you may call the **Weil-McLain Warranty Call Center at 855-627-6003**. In addition to the information provided here, you can find complete warranty details and procedures at [www.weil-mclain.com](http://www.weil-mclain.com).

**H. How Can You Register Your Purchase?**

Please register your purchase at [www.weil-mclain.com](http://www.weil-mclain.com). Registration is not required to activate your warranty, but you should retain proof of purchase and installation date.

\* \* \*

If you have any questions about your coverage under this Limited Warranty, please contact Weil-McLain using the contact information provided above.



**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 5223 2.3 CAST IRON BOILERS

Submittal Number: 1

Item: Start Up Report & Warranty

Manufacturer:

Model #:

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 7313 2.2 CAST AIR HANDLING UNIT

Submittal Number: 1

Item: VU-1

Manufacturer: Daikin Applied

Model #: CAH 003-090C

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 7313 2.3 AIR HANDLING UNIT

Submittal Number: 1

Item: Start Up Report & Warranty

Manufacturer:

Model #:

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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## Air Handling Equipment Warranty Registration Form

To comply with the terms of Daikin Applied Warranty, complete and return this form within 10 days to Daikin Applied, Warranty Department

Check, test, and start procedure for air handling units with or without heat recovery.

Job Name: Haines HS Vocational Bldg Upgrades Daikin Applied S.O. No.: \_\_\_\_\_  
 Daikin Applied G.O. No.: \_\_\_\_\_

Installation address: Mile 0 Haines Hwy  
 City: Haines State: Alaska

Purchasing contractor: Custom Mechanical Systems, Inc.  
 City: Wasilla State: Alaska

Name of person doing start-up (print): Robert Hearn  
 Company name: Custom Mechanical Systems, Inc.  
 Address: 500 N. Main Street  
 City/State/Zip: Wasilla, AK 99654

Unit model number: CAH012GHGC Unit serial number: FBOU150600957  
 SF VFD model number: ACH550-FDR-024A-2 Serial number: \_\_\_\_\_  
 RF VFD model number: N/A Serial number: N/A

Circle Yes or No. If not applicable to the type of unit, circle N/A.

**I. INITIAL CHECK**

- A. Is any shipping damage visible? ..... Yes  No  N/A
  - B. Are fan drives properly aligned and belts properly adjusted? ..... Yes  No  N/A
  - C. Tightened all setscrews on pulleys, bearings and fans? ..... Yes  No  N/A
  - D. Have the hold-down bolts been backed off on spring mounted fan isolators? ..... Yes  No  N/A
  - E. With the power off, do fans turn freely by hand? ..... Yes  No  N/A
  - F. Electrical service corresponds to unit nameplate? ..... Yes  No  N/A
- Volts 208 Hertz 63 Phase 3
- G. Is the main disconnect adequately fused and are fuses installed? ..... Yes  No  N/A
  - H. Are all electrical power connections tight? (Check compressor, electrical box.) ..... Yes  No  N/A
  - I. Is the condensate drain trapped? ..... Yes  No  N/A
  - J. Fill the drain pan. Does water drain freely? ..... Yes  No  N/A
  - K. Is the unit mounted level? ..... Yes  No  N/A

**II. FAN DATA**

- A. Check rotation of supply fan? ..... Yes  No  N/A
- B. Voltage at supply fan motor: 1-2 208 V 2-3 208 V 1-3 208 V
- C. Supply fan motor amp draw per phase: L1 7.3 L2 7.1 L3 7.3
- D. Overload amp setting: 30
- E. What is the supply fan rpm? 1750
- F. Check rotation of return fan? ..... Yes  No  N/A
- G. Voltage at return fan motor: 1-2 N/A V 2-3 \_\_\_\_\_ V 1-3 \_\_\_\_\_ V
- H. Return fan motor amp draw per phase: L1 N/A L2 N/A L3 N/A
- I. Overload amp setting: N/A
- J. What is the return fan rpm? N/A
- K. Record supply static pressure at unit: .26 inches of H<sub>2</sub>O
- L. Record return static pressure at unit (with outside air dampers closed) .79 inches of H<sub>2</sub>O

13%

Air Handling Equipment Warranty Registration Form (continued)

III. DAMPERS

- A. Are blades and seals present? .....  Yes No N/A
- B. Do damper open smoothly and shut tight? .....  Yes No N/A

IV. ELECTRIC HEAT

- A. Electrical heat service corresponds to unit nameplate? ..... Yes No  N/A  
 Volts \_\_\_\_\_ Hertz \_\_\_\_\_ Phase \_\_\_\_\_
- B. Are there any signs of physical damage to the electric heat coils? ..... Yes No  N/A
- C. Have all electrical terminals been tightened? ..... Yes No  N/A
- D. Does sequence controller stage contactors properly? ..... Yes No  N/A
- E. Electric heater voltage across each phase: \_\_\_\_\_ L1 \_\_\_\_\_ L2 \_\_\_\_\_ L3
- F. Amp draw across each phase at each heating stage:  

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Phase L1: _____	_____	_____	_____	_____	_____	_____
Phase L2: _____	_____	_____	_____	_____	_____	_____
Phase L3 _____	_____	_____	_____	_____	_____	_____
- G. FLA: L1 \_\_\_\_\_ L2 \_\_\_\_\_ L3 \_\_\_\_\_
- H. Operate electric heat with fans off. Electric heat must cycle on high limit control ..... Yes No  N/A

V. CHILLED WATER

- A. Pressure test OK? ..... Yes No  N/A
- B. Drain pan draining OK? ..... Yes No  N/A

VI. HOT WATER COIL

- A. Pressure test OK? .....  Yes No N/A

VI. HEAT RECOVERY

- A. Heat wheel rotates freely? ..... Yes No  N/A
- B. Heat wheel VFD operates properly? ..... Yes No  N/A
- C. Heat wheel VFD: Model # \_\_\_\_\_ Serial # \_\_\_\_\_
- D. Check for air bypass around heat wheel. .... Yes No  N/A

Comments:

Performed by: Custom Mechanical Systems, Inc. Title: President

Signature: Robert Hearn Date of start-up: 8/19/15

Return completed form by mail to:

Daikin Applied Warranty Department  
13600 Industrial Park Boulevard  
Minneapolis, MN 55441

or by email to:

[AAH.Wty\\_WAR\\_forms@DaikinApplied.com](mailto:AAH.Wty_WAR_forms@DaikinApplied.com)

Please list any additional comments that could affect the operation of this unit; e.g., shipping damage, failed components, adverse installation applications, etc., on a separate sheet and attach to this form or within the email message.



Quality Assurance Survey Report

To whom it may concern:

Please review the items below upon receiving and installing our product. Mark N/A on any item that does not apply to the product.

Job Name: Haines HS Vocational Bldg Upgrades Daikin Applied G.O. No.

Installation address: Mile 0 Haines Hwy

City: Haines State: Alaska

Purchasing contractor: Custom Mechanical Systems, Inc.

City: Wasilla State: Alaska

Name of person doing start-up (print): Robert Hearn

Company name: Custom Mechanical Systems, Inc.

Address: 500 N. Main Street

City/State/Zip: Wasilla, AK 99654

1. Is there any shipping damage visible? Yes No N/A

Location on unit

2. How would you rate the overall appearance of the product; i.e., paint, fin damage, etc.?

Excellent Good Fair Poor

3. Did all sections of the unit fit together properly? Yes No N/A

4. Did the cabinet have any air leakage? Yes No N/A

Location on unit

5. Were there any refrigerant leaks? Yes No N/A

From where did it occur? Shipping Workmanship Design

6. Does the refrigerant piping have excessive vibration? Yes No N/A

Location on unit

7. Did all of the electrical controls function at start-up? Yes No N/A

Comments

8. Did the labeling and schematics provide adequate information? Yes No N/A

9. How would you rate the serviceability of the product?

Excellent Good Fair Poor

10. How would you rate the overall quality of the product?

Excellent Good Fair Poor

11. How does the quality of Daikin Applied products rank in relation to competitive products?

Excellent Good Fair Poor

Comments

Please list any additional comments which could affect the operation of this unit; i.e., shipping damage, failed components, adverse installation applications, etc. If additional comment space is needed, write the comment(s) on a separate sheet, attach the sheet to this completed Quality Assurance Survey Report, and return it to the Warranty Department with the completed preceding "Equipment Warranty Registration Form".



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People and ideas you can trust.™

### ***Daikin Applied Training and Development***

Now that you have made an investment in modern, efficient Daikin equipment, its care should be a high priority. For training information on all Daikin HVAC products, please visit us at [www.DaikinApplied.com](http://www.DaikinApplied.com) and click on Training, or call 540-248-9646 and ask for the Training Department.

### ***Warranty***

All Daikin equipment is sold pursuant to its standard terms and conditions of sale, including Limited Product Warranty. Consult your local Daikin Applied representative for warranty details. To find your local Daikin Applied representative, go to [www.DaikinApplied.com](http://www.DaikinApplied.com).

### ***Aftermarket Services***

To find your local parts office, visit [www.DaikinApplied.com](http://www.DaikinApplied.com) or call 800-37PARTS (800-377-2787). To find your local service office, visit [www.DaikinApplied.com](http://www.DaikinApplied.com) or call 800-432-1342.

This document contains the most current product information as of this printing. For the most up-to-date product information, please go to [www.DaikinApplied.com](http://www.DaikinApplied.com).

Products manufactured in an ISO Certified Facility.

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 7313 2.2 CAST AIR HANDLING UNIT

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2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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## Installation and Maintenance Manual

**IM 672-10**

Group: **Applied Air Systems**

Part Number: **IM 672**

Date: **March 2014**

## Vision™ Air Handler

Models CAC/CAH 003—090 C



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## General Information

Vision® indoor air handlers are not designed to be weather resistant. Do not install them outdoors.

The system design and installation must follow accepted industry practice as described in the ASHRAE Handbook, the National Electric Code, and other applicable standards. This equipment must be installed in accordance with regulations of authorities having jurisdiction and all applicable codes.

Installation and maintenance must be performed by qualified personnel familiar with applicable codes and regulations and experienced with this type of equipment. Sheet metal parts, self-tapping screws, clips, and such items inherently have sharp edges; the installer should exercise caution.

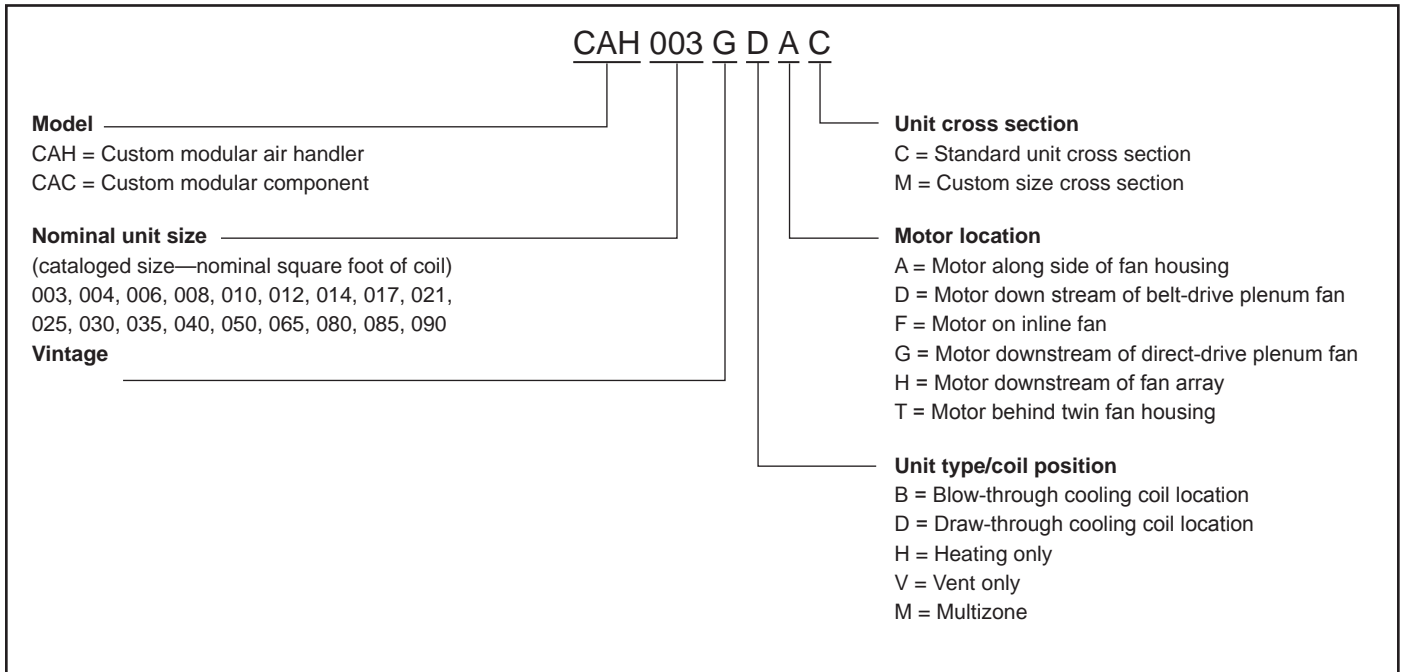
**⚠ CAUTION**

Sharp edges and coil surfaces are a potential injury hazard. Avoid contact with them.

## Receiving and Handling

1. Carefully check items against the bills of lading to verify all crates and cartons have been received. Carefully inspect all units for shipping damage. Report damage immediately to the carrier and file a claim.
2. Vision air handler units are constructed of galvanized or painted steel and are inspected thoroughly before leaving the factory. Take care during installation to prevent damage to units.
3. Take special care when handling the blower section. All fans are dynamically balanced before leaving the factory. Rough handling can cause misalignment or a damaged bearings or shaft. Carefully inspect fans and shaft before unit installation to verify this has not happened.
4. Handle the zone damper of the multi-zone units with special care. Zone dampers are set and inspected before leaving the factory, but should be checked on arrival to the job to verify the bell arm and connecting rod set screws did not become loose in shipment.

## Nomenclature



## Unit Storage

- Store on a level surface in a clean, dry location where temperature can be controlled if possible.
- Pack fan and motor bearings (unless motor bearings are sealed) with compatible grease with the shaft stationary. After grease has been installed, rotate shaft about 10 rotations.
- Isolate unit from shock and vibration.
- Once a month, rotate shaft a minimum of 10 revolutions. Insure the stopped position is different than the original position.
- Coat shafts with lubricant as needed to prevent corrosion.
- A desiccant bag may be hung in the interior of the unit to minimize corrosion in humid storage environments. Do not clean galvanized steel surfaces with oil dissolving chemicals. This may remove the protective coating and accelerate corrosion.
- Do not allow coverings to trap moisture on galvanized surfaces.

## Belt-Driven fans

- Reduce belt tension by at least 50% or remove the belts. Remove belts if they will be subjected to temperatures exceeding 85° F to avoid deterioration.
- Remove belt guard when adjusting belts
- Reduce belt tension prior to removing or installing belts.
- Removing or installing tensioned belts may cause personal injury and damage to the sheaves, belts, bearings or shafts.
- Adjustable sheaves should be opened as wide as possible and the adjustment threads lubricated so they do not corrode. Be careful not to put lubricant on the belt running surface

## Prior to start up

- Set screws on bearings, fan wheels, and sheaves need to be checked for proper torque. Also check bolt torque for any taper lock hubs either on the wheel or sheaves.
- Check sheaves for corrosion. Significant corrosion can cause belt or sheave failure.
- Purge old grease from fan bearings while rotating the shaft to distribute the new grease evenly and prevent bearing seal failure.
- Correctly align and tension belts. See [General Rules of Tensioning on page 42](#).

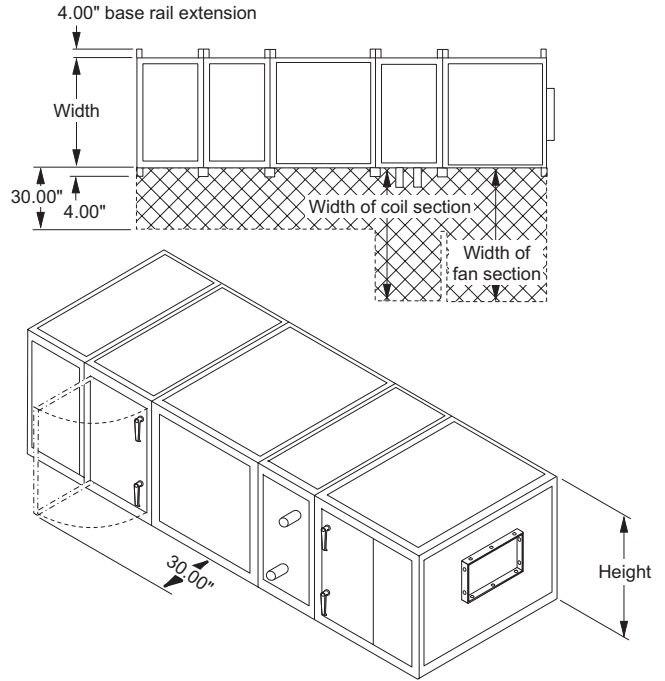
## Service Clearances

In addition to providing adequate space around the unit for piping coils and drains, access to at least one side of the unit is always required to allow for regular service and routine maintenance, which includes filter replacement, drain pan inspection and cleaning, fan bearing lubrication, and belt adjustment. Provide sufficient space—at least equal to the length of the coil—on the side of the unit for shaft removal and coil removal. Space, at least equal to the length of the side coil, is required for coil removal. Space, at least equal to the fin height, is required for top coil removal. See [Figure 1](#) for servicing space requirements.

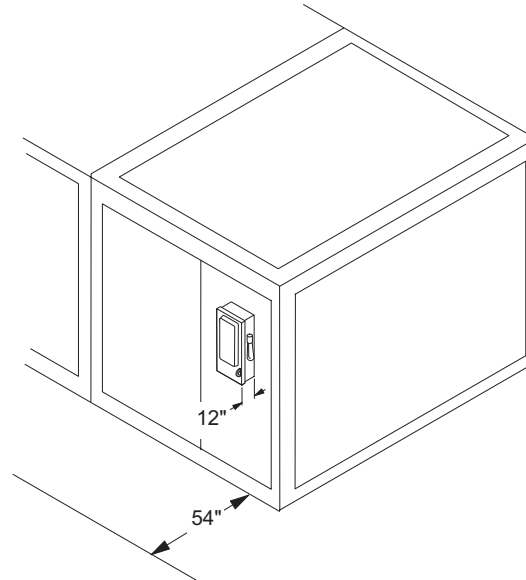
For routine maintenance purposes, access normally is obtained through the access doors or by removing panels. Fan and filter sections are always provided with a service door on one side of the unit. If requested, doors can be provided on both sides of the unit. Optional service doors are available for most section types and are provided based on customer request.

If component replacement is required, the top panel also can be removed. If necessary, the unit can be disassembled. Maintain at least 54" of clearance in front of electrical power devices (starters, VFDs, disconnect switches and combination devices). Electrical power devices that are mounted on the side of the unit typically are up to 12" deep ([Figure 2](#)). Fan sections with multiple fans have motor control boxes up to 16" deep when supplied with VFDs.

**Figure 1: Servicing Space Requirements**



**Figure 2: Service Clearance for Electrical Power Devices**



## Rigging

**WARNING**

Use all lifting points. Improper lifting can cause severe personal injury and property damage.

**CAUTION**

Lifting points may not be symmetrical to the center of gravity of the unit. Ballast or unequal cable lengths maybe required.

**DANGER**

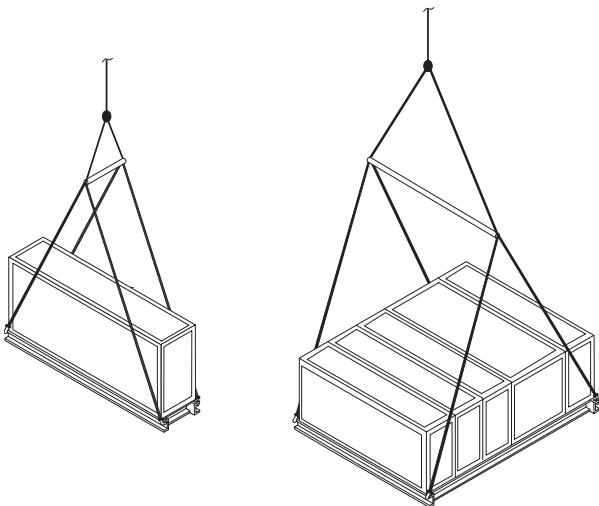
DO NOT LIFT FROM 2" HOLES AT ENDS OF UNIT. Failure to comply may result in personal injury or death.

Vision air handlers ship as separate sections, completely assembled, or in modules of assembled sections. The unit must be rigged as it ships from the factory. Do not rig units after assembly. When a unit is provided with a factory-installed base rail, it can be lifted using the 2" diameter lifting holes located in the corners of each shipping section (Figure 3). If a unit does not have a base rail, rig it using straps or a sling. Fasten the strapping under the skid that ships with the section (Figure 4).

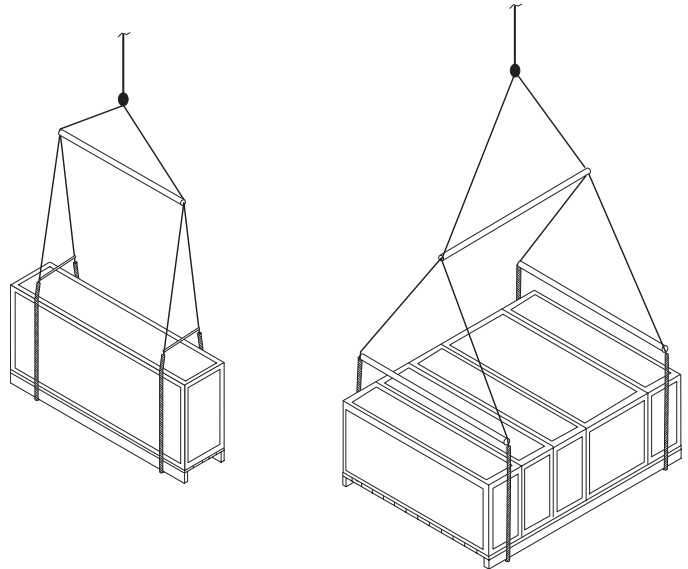
To prevent damage to the unit cabinetry, use spreader bars. Position spreader bars to prevent cables from rubbing the frame or panels. Before hoisting into position, test lift for stability and balance. Avoid twisting or uneven lifting of the unit.

A fan array or coil section might have a tall, thin aspect ratio. The center of balance on these sections can be high and make the section prone to tipping during the lift. Care should be taken when lifting units with a tall, thin aspect ratio.

**Figure 3: Units on Base Rails**

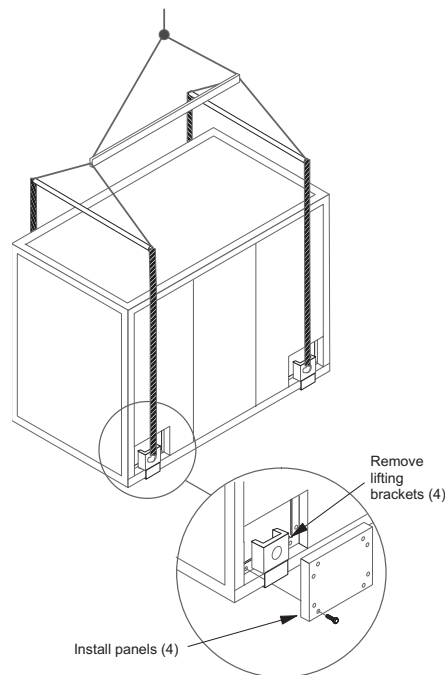


**Figure 4: Units on Skids**



Fan sections greater than 108" wide that are stacked on another section that are not Class II plenum fans are constructed with internal fan support frames that have integral lifting brackets (Figure 5). After the fan section is placed in position, remove and discard the lifting brackets. Install the small panels provided to complete the unit cabinet areas where the lifting brackets were located.

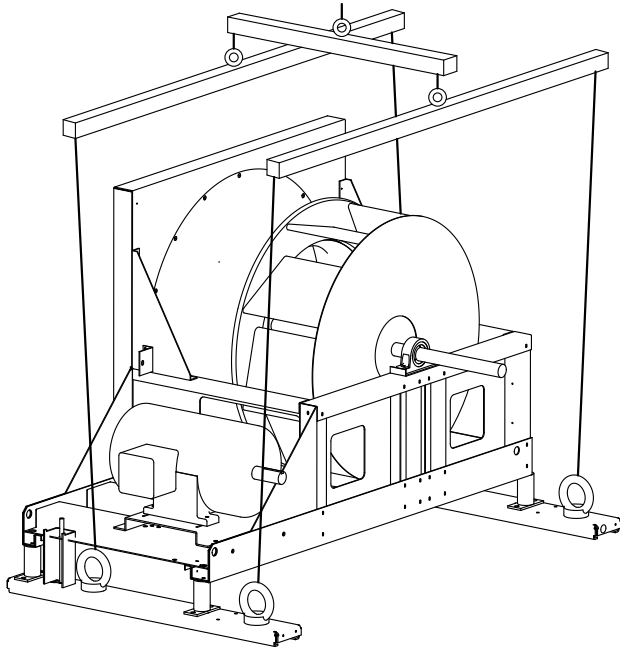
**Figure 5: Large Fan Sections Stacked on Top of a Lower Section**



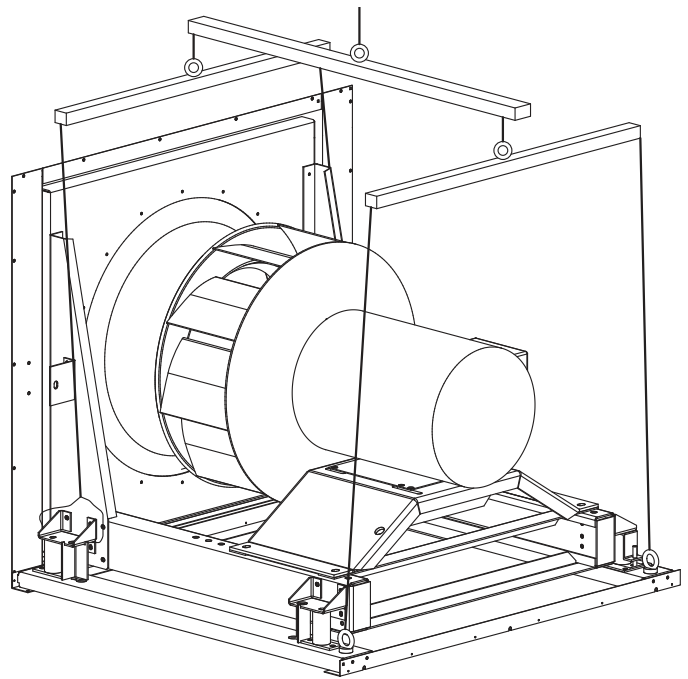
Class II plenum fans that are stacked on another section may be lifted using the methods shown in the following figures. The shipping brackets must remain in place and be tight in order to lift using this method. **Figure 6** shows a belt-drive fan with field supplied eye bolts that are screwed into factory installed hex AVK fasteners in the main channels supporting the fan. **Figure 7** shows a direct-drive fan with field supplied eye bolts on the motor end and straps around the spring bracket on the inlet end. When factory installed hex AVK fasteners are installed, they should be used for lifting. When they are not installed, it is acceptable to lift from the shipping brackets on the fan. **Figure 8** shows dual fans being lifted in a similar manner as the single direct-drive fan. An eight point lift must be used for dual fans to make sure both fans are supported properly and the cabinet structure does not become overloaded along the center.

If the fan section is connected to another section such as a plenum or access section, then **DO NOT** attempt to lift both sections using just the fan section. The other section(s) must be supported separately using straps.

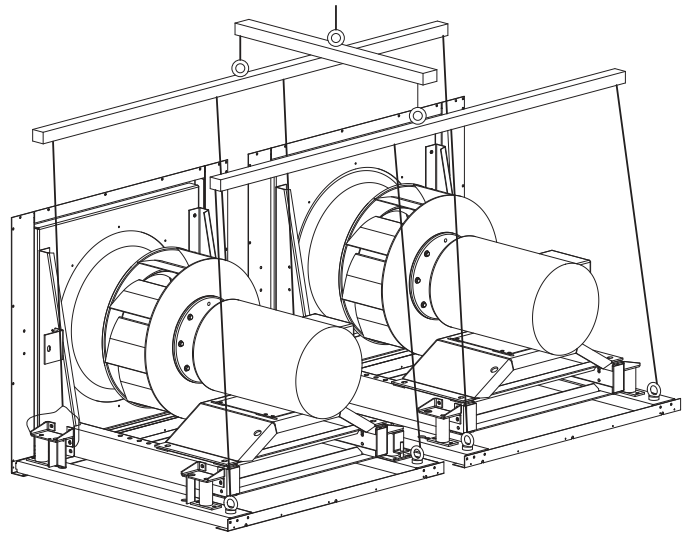
**Figure 6: Belt-Drive Class II Plenum Fan Stacked Unit**



**Figure 7: Direct-Drive Class II Plenum Fan Stacked Unit**



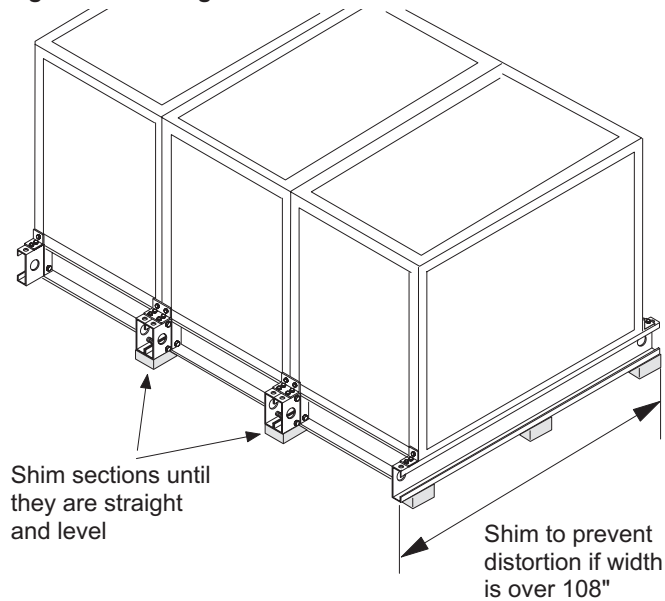
**Figure 8: Direct-Drive Class II Dual Plenum Fan Stacked Unit**



## Unit Leveling

Place the equipment on a flat and level surface. Where the surface irregularities could cause the equipment to distort, use a shim so the base of the unit is a straight line. Uneven or distorted sections cause misfit or binding of the doors and panels and improper draining of drain pans. Units that are over 108" wide must rest on a flat surface for the entire width of the base rails or must be shimmed at one or more points along the length of the rails to prevent distortion or sagging of the support rails (Figure 9).

**Figure 9: Leveling the Unit**



## Assembling Sections

### External Section-to-Section Mounting

Vision air handling units can ship fully assembled or as separate shipping sections. Rig units that require field assembly of shipping sections into position first. Shipping sections are provided with a connection splice joint attached on the leaving air side of the shipping section. The splice joint is insulated and provides an air-tight seal between two sections once they are assembled together. If the splice joint was bent during shipping or rigging, restore it to its original position. (Figure 19 on page 12).

### Horizontal Airflow Section Mounting

1. Rig the unit into position and lineup shipping sections in the direction of air flow. Pull sections together to fasten. Use a furniture clamp or straps and a ratchet to help pull the sections together securely (Figure 10).
2. If the unit has a factory-installed base rail, first fasten base rails together using the 3/8"-16 x 5" bolts located in the splice kit provided with the unit.
  - a. To fasten two shipping sections together, four bolts are needed (two on each side of the unit). The bolts are run from one base rail into the other and fastened with a nut. Complete each section bottom and top before attaching additional sections.
3. If no base rail is provided, fasten the unit in the same manner on the bottom and top frame channels.
4. Once the sections are positioned together, remove the fastener in each of the channel corners (on the mating edges in the channel piece).
5. Place a flat section joining plate (found in the splice kit) over the two coned holes in the channels, so that the plate spans the two sections.
6. Replace the fasteners in their original position, through the joining plate.
7. For certain Custom Air Handler units, use the provided section joining plates to fasten sections together. Space them as shown in Figure 11. Using the provided 1/4"-14 x 1" self tapping screws, drill screw the joining plates into the frame channel on each section, keeping unit sections tight together. Follow instruction drawing included in the assembly kit.



Figure 10: Horizontal Joining Sections

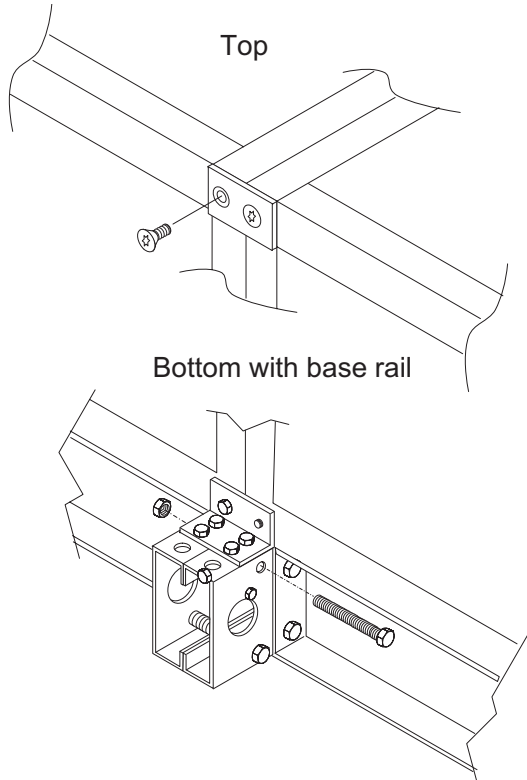
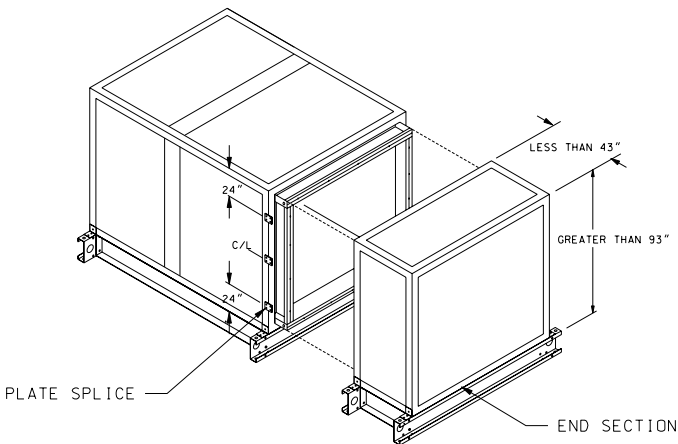


Figure 11: Frame Channel Stiffener Plates (Custom Air Handler Units Only)



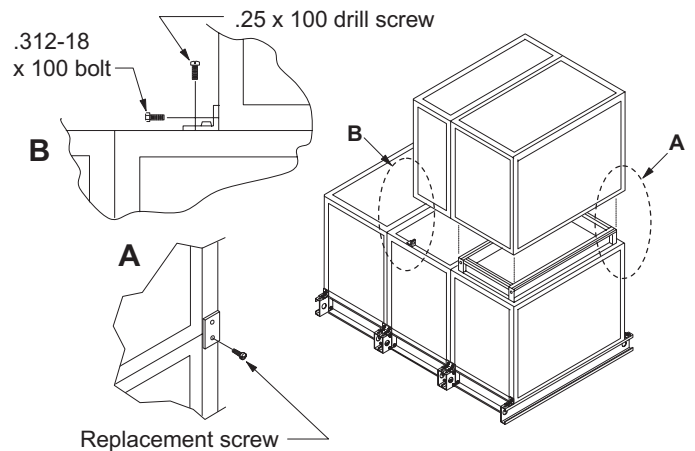
## Vertical Inverted Airflow Section Mounting

For vertical or inverted arrangements, before lifting any top mounting sections into place, rig into place and fasten together the bottom tier of sections. Once bottom level sections are in place and secured, lift stacked components and fasten using the following procedure:

NOTE: See [Face and Bypass Section Mounting on page 14](#) for the exception to this procedure.

1. The vertical/inverted section has a splice joint extending out the top of the bottom joining section. Lower the section that is to be positioned over the opening over the splice joint to seal the connection between the two sections.
2. The two sections are fastened together at the four bottom corners of the mating edge. To fasten the corners located on the end of the unit (where bottom section and top section walls are flush with each other), remove the flat head fasteners in the corners of both sections.
3. Cover the coned holes with a flat joining plate and replace the flat head fasteners in the holes to secure the joining plate to both sections (Figure 12).
4. When one section is deeper than the other, secure the two sections using an L-shaped joining plate. To secure the L-shaped bracket, remove the flat head fastener from the corner, position the bracket over the hole, and replace the flathead fastener with a 5/16"-18 x 1" bolt. Once the bolt is in place, secure the bracket to the adjoining section with a 1/4" x 1" drill screw. Repeat the same procedure on both corners of the unit (Figure 12).

Figure 12: Vertical/Inverted Joining Sections

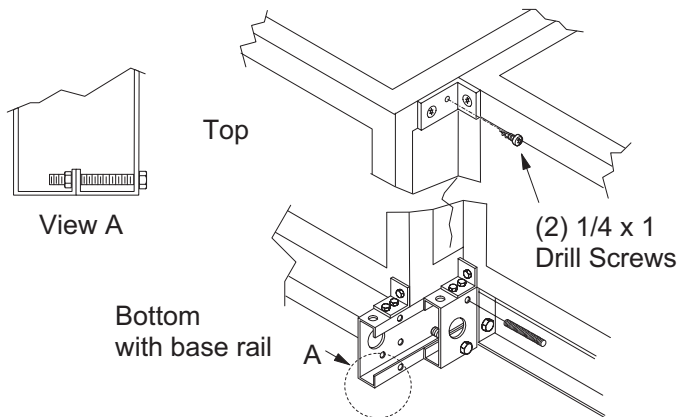


## Extended Coil Section Mounting

The extended coil section is 6" wider than all other sections of the same unit size. The extension is always located on the coil connection side of the unit. Because the extended coil section is wider than other sections, it always ships as a separate shipping section, and must be joined to other sections in the field. To join an extended coil section to other components, first follow the Horizontal Airflow Section Mounting, page 7 steps to secure the opposite connection side. To fasten the connection side, use the following procedure:

1. If the unit has a factory-installed base rail, the extended coil section base rail is also 6" wider than the adjoining base rail. Extended coil section base rails on the connection side are fastened together using the 3/8"-16 by 3" bolts located in splice kit provided with the unit (Figure 13).
2. If no base rail is provided, the section is fastened in the same manner on the bottom and top. Once the sections are positioned together, remove the fastener in the corner of the channel piece of the section mating to the extended coil section (Figure 13).
3. Place an L-shaped section joining plate (located in the splice kit) over the coned hole in the channel.
4. Replace the flat head fastener originally used in the corner with a 5/16"-18 1" bolt and fasten it through the L-shaped joining plate.
5. Position the L-shaped joining plate so it butts up against the extended coil section frame channel. To secure the plate to the extended coil section, run two 1/4" x 1" drill screws through the joining plate and into the frame channel.

**Figure 13: Extended Coil Section Joining**

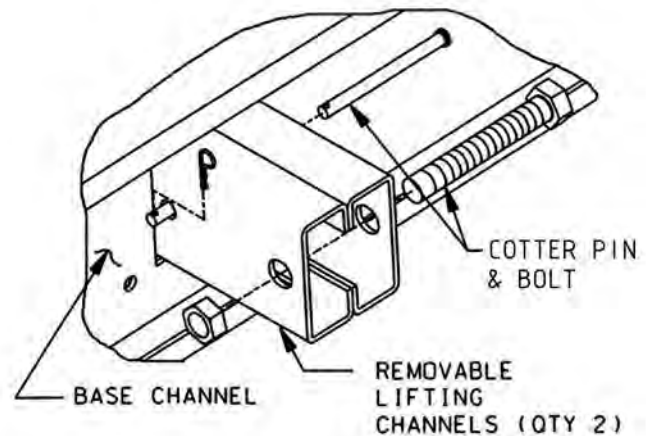


## Side-by-Side Heatwheel Section Joining

The side-by-side heatwheel will have two individual sections parallel in the direction of airflow to be attached to either side. Each section will attach to the heatwheel section and then to the other parallel section.

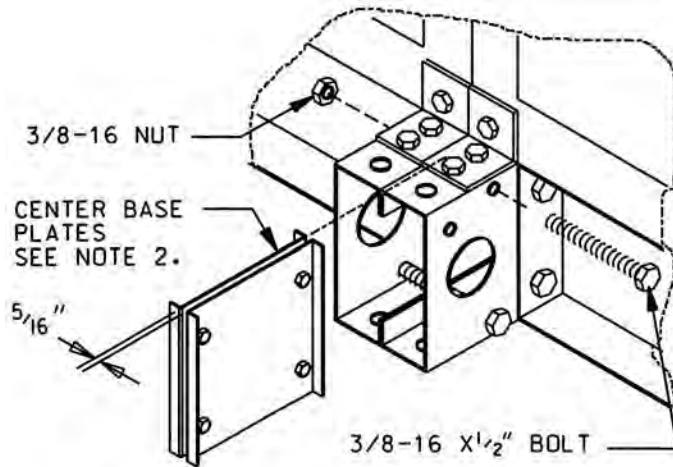
1. Rig the unit into position and line shipping sections up in direction of air flow. Sections must be pulled together to fasten using a furniture clamp or straps.
  - a. If the heatwheel section width is greater than 143", then rig the section into position using the two removable lifting channels. After section is properly placed, remove cotter pin and bolts from lifting channel and discard as seen in Figure 14

**Figure 14: Cotter Pin and Bolt Detail**



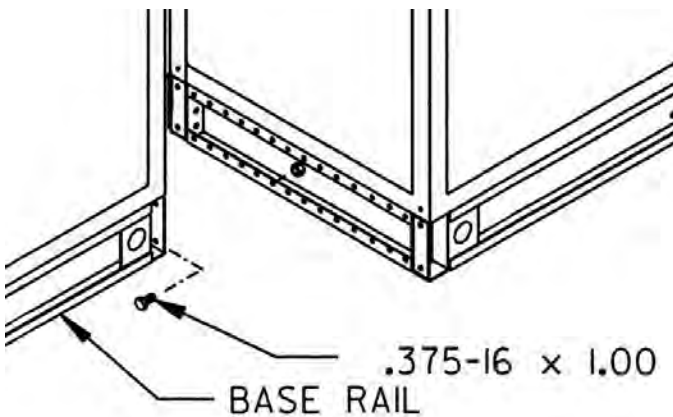
2. If included, remove center base plates that are attached to the base channels and save for Step 4.
3. If the unit has a factory installed base rail, fasten the base rails together using the 3/8"-16 x 5" bolts located in the splice kit provided with the unit.
  - a. To fasten two shipping sections together, two bolts are required on the one side. The bolts are run from one base rail into the other and fastened with a nut. Complete each section bottom and top before attaching additional sections.
4. Assemble the center base plates as show in Figure 15, leaving a 5/16" space between each plate to slide onto section base channels to center point of section width.
5. Once the sections are positioned together, remove the fastener in each of the channel corners (on the mating edges in the channel piece).
6. Place a flat section joining plate (found in the splice kit) over the two coned holes in the channels, so the plate spans the two sections.

**Figure 15: Base Plate Detail**

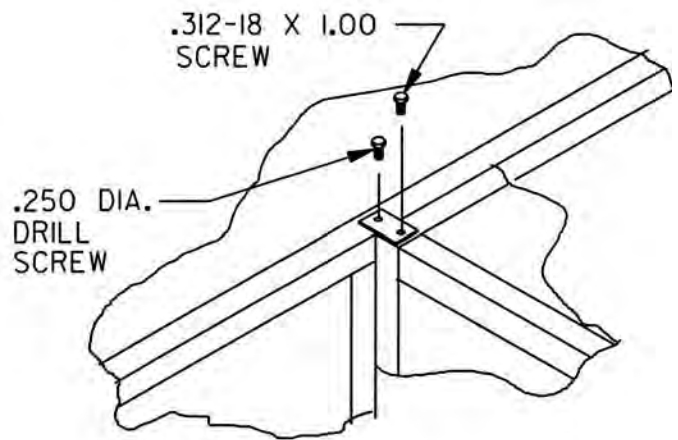


7. Replace the fasteners in their original position, through the joining plate.
8. Assemble the next section parallel to the assembled section by following Steps 1 – 7 above.
9. Using the 3/8"-16 x 1" bolts provided, fasten the two parallel sections' bases together as seen in [Figure 16](#).
10. Using appropriate safety equipment if necessary, remove the fastener in each of the channel corners on the top between the two parallel sections and discard.
11. Use the 2 x 2 holed splice plate with 2 x 5/16"-18 x 1" screws and 2 x 1/4" drill screws. The 2 x 5/16"-18 x 1" screws will go into the frame channel holes and the 2 x 1/4" drill screws will go into the heatwheel frame channel as show in [Figure 17](#).

**Figure 16: Base Section Detail**



**Figure 17: Frame Channel Detail**



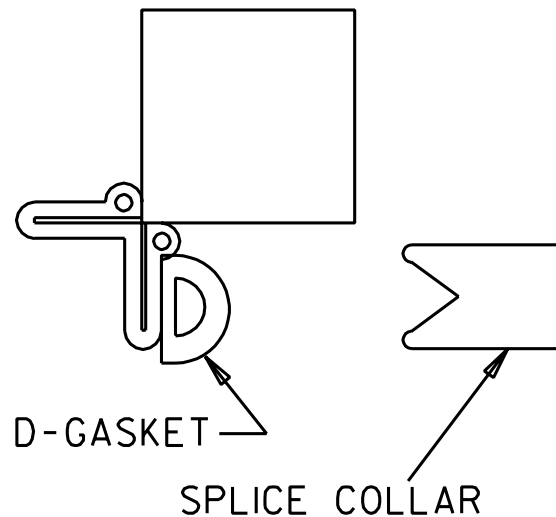
### Internal Section-to-Section Mounting

If desired, shipping sections can be fastened together internally. To fasten internally, run field-provided #10 sheet metal screws or drill screws (4" long maximum) through the interior frame channel of one unit into the splice joint of the neighboring section.

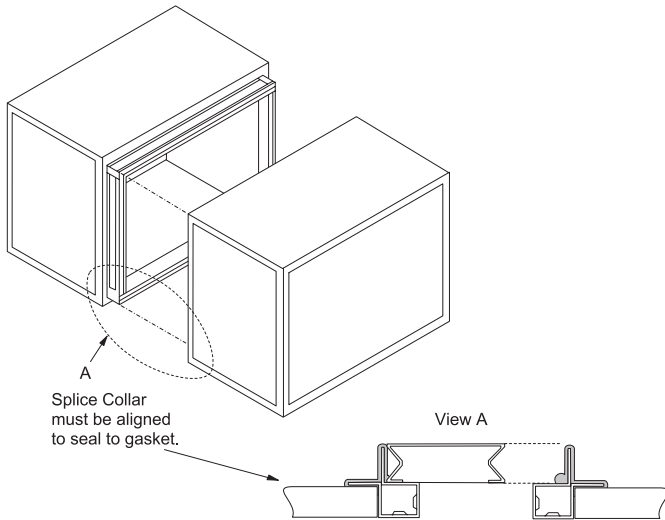
The section-to-section splice joint is always provided on the leaving air side of a shipping section and seals against the frame channel on the entering-air side of the adjoining section. Align the splice joint to seat into the mating gasket to provide an air seal. If the splice joint was bent during shipping or rigging, restore it to its original position ([Figure 19](#)).

For Custom Air Handler units, ensure that the D-gasket is attached to the entering air side frame channel ([Figure 18](#)). If it has dislodged during shipping, restore to original location.

**Figure 18: D-Gasket Placement Detail (Custom Air Handler Units only)**



**Figure 19: Internal Fastening**



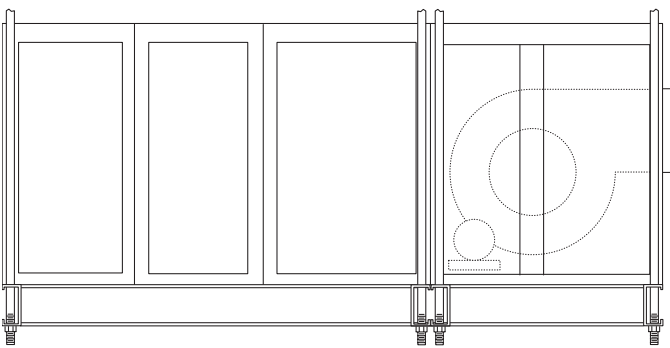
**Ceiling Hung**

When a unit is ceiling hung, support it with a base rail, angle iron, or channel. The Vision air handler is not designed to be suspended from the top of the unit. Before hanging, rig and completely assemble the unit. See [Assembling Sections on page 8](#).

**Ceiling Hung Using Base Rail**

The optional base rail provided by the factory has 5/8" diameter holes in each corner to run hanger rods through. To properly support the unit and maintain unit integrity, support each shipping section with hanger rods in each corner ([Figure 20](#)).

**Figure 20: Ceiling Suspended with Base Rail**



**Ceiling Hung Using Angle Iron Channel**

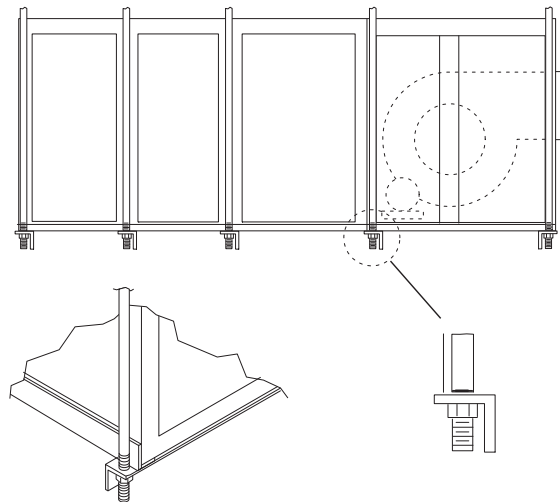
Install field-provided angle iron or channels per SMACNA guidelines. When a unit is unitized (ships in one piece), channel support each component under the unit width ([Figure 21](#)).

**NOTE:** The supporting angle iron must fully support the 2" frame channel at each section joint.

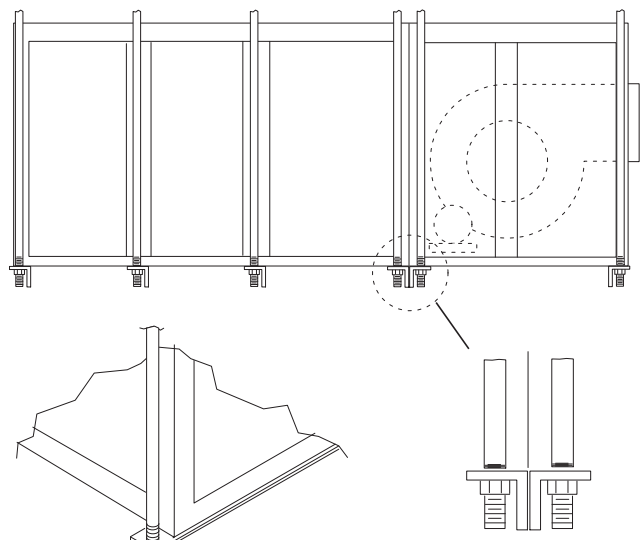
When a unit is sectionalized (ships in multiple sections), channel support each component under the unit width and provide support under the full length of the unit base ([Figure 22](#)). Locate hanger rods so they do not interfere with access into the unit.

**Ceiling suspension using the unit base rails is limited to unit cabinet widths less than 108".** Support units with cabinets 108" wide and greater with structural members designed to support the unit at the ends and at intermediate points along the base rails.

**Figure 21: Ceiling Suspended w/o Base Rail—Unitized Construction**



**Figure 22: Ceiling Suspended w/o Base Rail—Modular Construction**



## Panels, Frame Channels, and Doors

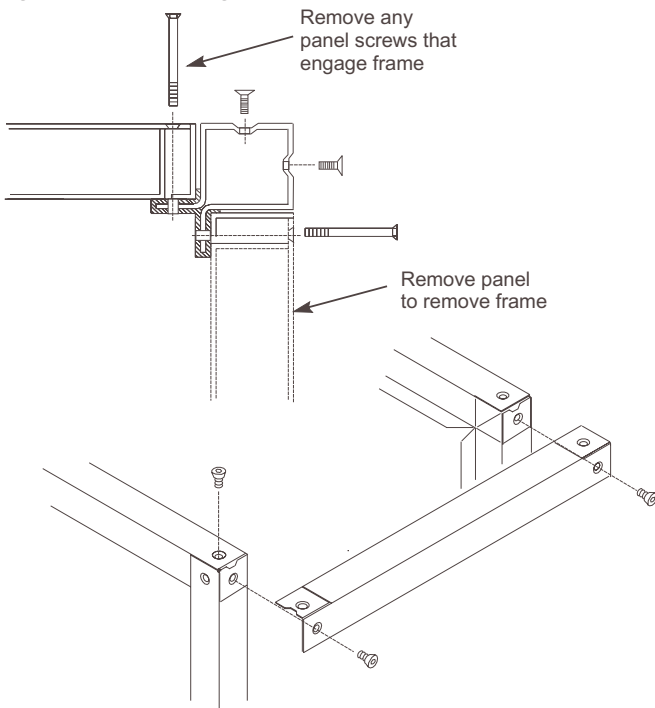
### Panel Removal

To remove a side or top panel, remove the flat head Torx 30 fasteners along the sides of the panel. Lift off the panel after removing all fasteners.

### Frame Channel Removal

Frame channels that run the length of the unit along the top can be removed to allow access to both the side and top of the unit. To remove the frame channel, first remove the side panel(s). Once the side panel is off, remove the flat head Torx 30 fasteners in the corner of the frame channels. Then pull the frame channel out the side. Remove any panel screws that are within one inch of the of the frame since they are engaged into the gasketed flange of the frame (Figure 23).

**Figure 23: Removing Panel Screws**



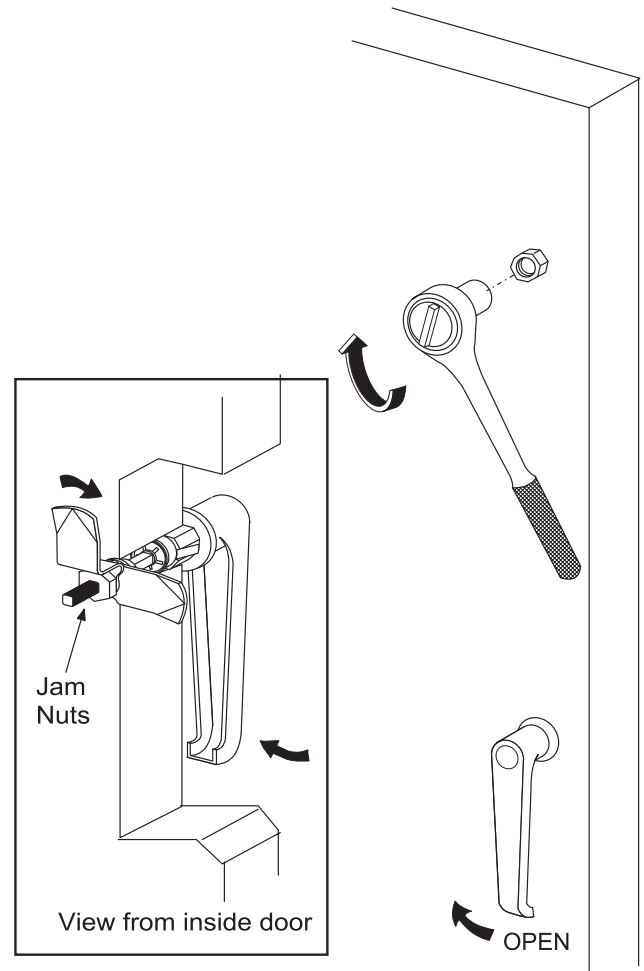
### Fan Section Doors

**⚠ CAUTION**

Sharp edges and coil surfaces are a potential injury hazard. Avoid contact with them.

**NOTE:** Opening fan section doors requires using a 1/2" socket wrench (Figure 24), which satisfies ANSI standards and other codes that require the "use of tools" to access compartments containing moving parts or electrical wiring.

**Figure 24: Opening Fan Section Door**






## Injected-Foam Insulated Panels

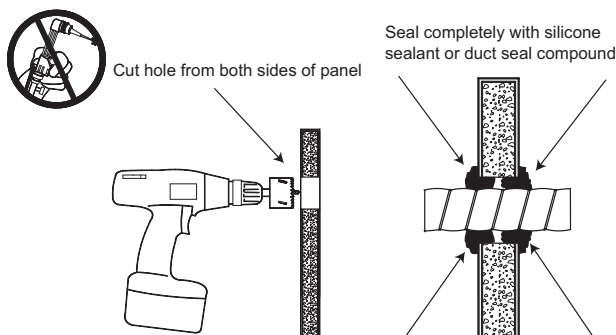
Vision air handlers are furnished with double-wall, injected-foam insulated panels. Foam panels are stronger, more rigid, and lighter than panels with fiberglass insulation. The insulation R-value is improved to 13. However, foam insulation can burn when exposed to flame or other ignition sources and release toxic fumes. Take care in cutting and sealing all field-cut openings in these panels.

### Panel Cutting Procedure

<b>⚠ WARNING</b>	
	<p><b>Flame and smoke can cause equipment damage, severe personal injury, or death.</b></p> <p>Before operating unit, seal all piping and wiring holes on both inner and outer panels with an industrial grade silicone sealant or duct seal compound. <b>Do not use a cutting torch or expose panel to fire.</b> Panel damage can occur.</p>

1. Determine the number and location of holes required for electrical conduit, piping, and control wiring as follows (also refer to [Figure 25](#)):
  - a. Check that adequate space is available inside the unit for conduit or pipe routing.
  - b. Do not locate holes in a panel that provides access to key maintenance components such as filters and fan assemblies.
  - c. Do not locate where the conduit or piping blocks airflow or obstructs hinged access doors.
2. Once a proper location is determined, drill a small pilot hole completely through the panel. Then use a sharp hole saw or a saber saw and cut from each side of the panel.
3. Seal the double-wall panel on each side with an industrial/ commercial grade silicone sealant or duct seal compound. It is extremely important to seal each panel hole or penetration securely so that it is airtight, watertight, and that there is no exposed foam insulation.

**Figure 25: Cutting/Sealing Injected-Foam Insulated panels**



Prop 65—Substances in fuel or from fuel combustion can cause personal injury or death, and are known to the State of California to cause cancer, birth defects or other reproductive harm.

## Field Mounting Junction Boxes and Other Components

For field mounting 4" × 4" or smaller junction boxes to the standard panel exterior, use a minimum quantity of four, 3/16" diameter pop rivets. **DO NOT** use self-tapping drill screws. They will not tighten nor secure properly and panel damage can occur.

If larger, heavier components require mounting on unit panels, use through-bolts with flat washers through both outer and inner panels. To maintain panel integrity, seal both ends with an industrial/commercial grade silicone sealant or duct seal compound.

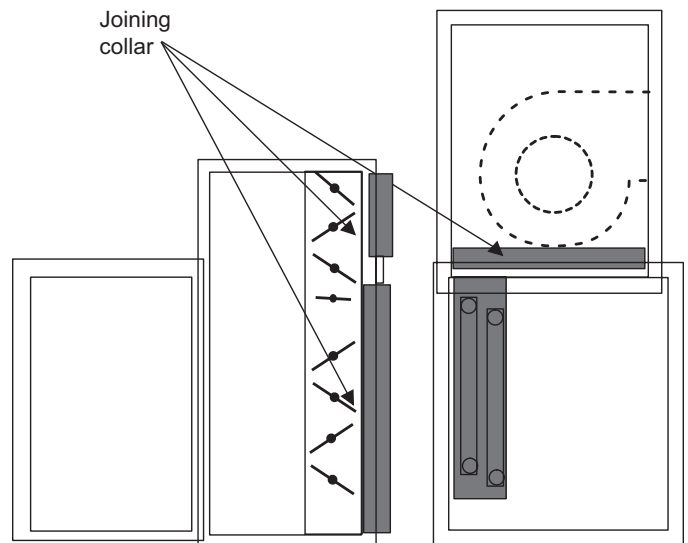
The unit frame channel is another excellent location for securing heavier components; self-tapping screws are not acceptable. Ensure that the location permits the full operation of all access doors and panels and does not interfere with other vital components.

## Face and Bypass Section Mounting

Internal face and bypass, and external face and bypass for sizes 003 to 035 are mounted together using the instructions for horizontal components and do not require additional instruction.

For all size units that bypass directly into a vertical fan section and for sizes 040 to 090 with external face and bypass, use the following instructions.

**Figure 26: Assembly of Fan Coil Sections**



## Bypass Into a Vertical Fan Section

Vertical coil sections and the top mounted fan section always ship separately and must be mounted together at the job site. The vertical coil section and the bypass duct each has a joining collar mounted on the leaving air side of the section and duct, respectively (Figure 26). The mounting collar fits into the side (bypass) and bottom (vertical coil section) openings in the fan section. To correctly position the collars in the fan openings, assemble the fan and coil section first. Use the steps below for assembly.

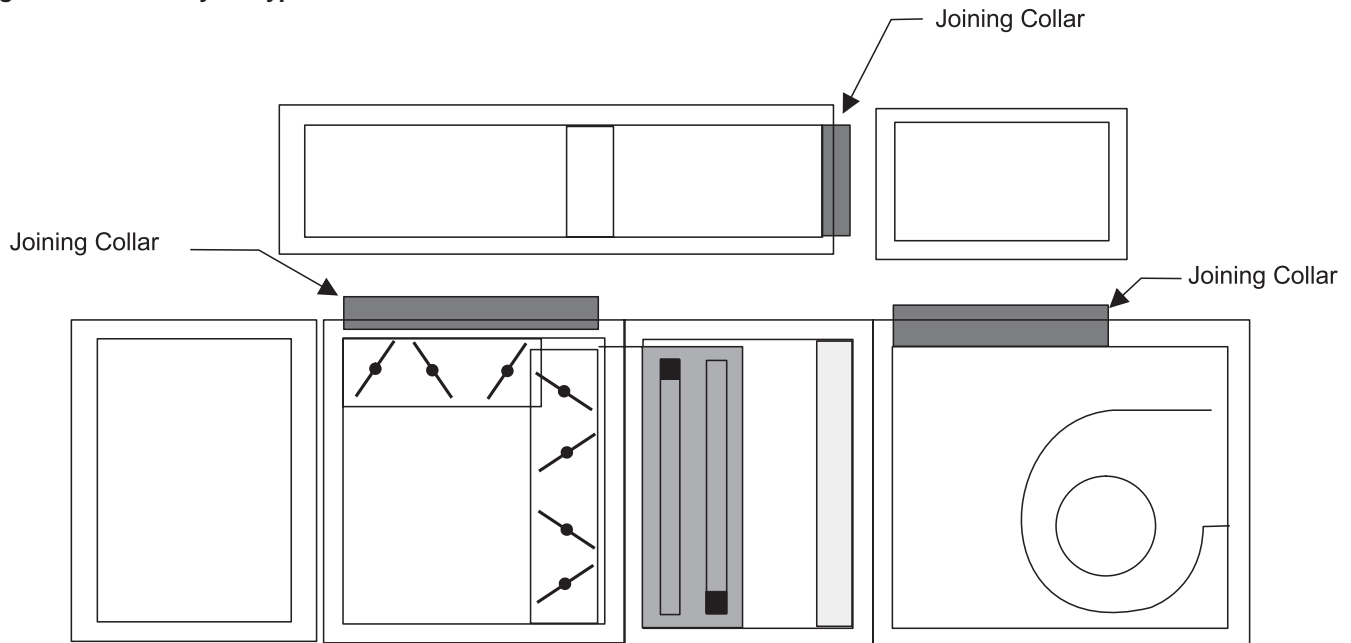
1. Place the vertical coil section in position. If an access section is positioned downstream from the coil section and not already assembled to the coil section, secure the two sections together.
2. Lift the fan section on top of the vertical coil section, taking care to line up the joining collar in the bottom of the fan section.
3. For sizes 003 to 035, the bypass duct is integral to the unit construction and does not require attachment to the bypass section. For sizes 040 to 090, position and assemble the bypass duct to the bypass section before joining to the fan.
4. Once the fan is positioned on top of the vertical coil section and the bypass duct and bypass section are assembled, position the two assemblies and line up the joining collars with the openings in the fan and vertical coil section.
5. Once the sections are lined up and in position, secure the unit together by fastening joining plates to the unit.

## External Face and Bypass Duct Assembly (Sizes 040 to 090)

When unit sizes 040 to 090 are ordered with external face and bypass, the bypass duct ships separately and must be attached to the unit in the field. The joining of the bypass duct to the unit must be done after the unit is assembled. Also, if the bypass duct is over 90" long, the duct does not ship in one piece and must be field assembled. The field assembly of the bypass duct to the unit requires the following steps (also refer to Figure 27).

1. Position the unit shipping sections together and assemble in the equipment room.
2. After the unit is assembled, lift the duct into position over the unit. Joining collars are shipped factory assembled to the unit and duct. There is a joining collar located in the top of the bypass opening and in the leaving air side of the bypass duct. These joining collars are used to provide air seals. Line up the duct with the top openings in the unit.
3. If the bypass duct is longer than 90", the duct ships in more than one piece and must be field assembled. Place the piece of duct that has the joining collar on the bottom on top of the unit first. Once it is in place, position the other piece of duct. Take care to fit the splice collar into the first piece of duct and then lower the other end into the bypass opening.
4. Once the duct is positioned correctly, fasten the duct pieces together with the joining plate provided. To do this, remove the fasteners in the corners of the duct assemblies, place the plate over the holes in the corners, and then replace the fasteners (Figure 10 on page 9).

Figure 27: Assembly of Bypass Duct to Unit





## Multizone Assembly

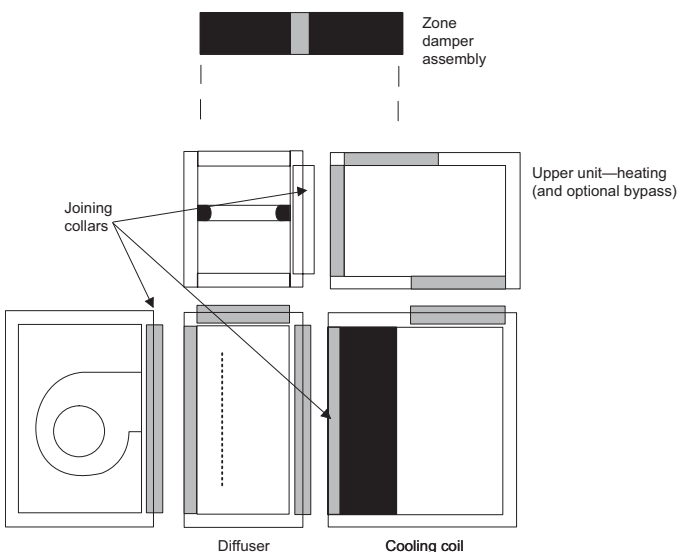
The multizone section may ship completely assembled or it may ship in numerous pieces. Whether the section ships in a single piece or multiple pieces depends on customer requirements and the unit size. When a multizone section is over 90" high or 90" wide, split it into sections for shipping.

The unit may ship in 1, 2, 3, 4, or 5 separate pieces, see [Figure 29](#). Typically, the multizone damper assembly ships separately (see [Multizone Damper Assembly](#) and [Figure 29](#)) and must be attached at the job site. Attach the damper after the other components are assembled. Use the instructions below for assembling the multizone section (also refer to [Figure 29](#)).

1. If the diffuser and the cold deck section ship separately, join them together first. The joining collar mounted in the diffuser fits into the entering air side of the coil section. Line up the two sections and fasten together.
2. Once the diffuser and cold deck sections are joined, lift the hot deck and bypass sections in place on top of the diffuser/ cold deck section. If possible, assemble the hot deck and bypass section (if there is one) together before lifting on top. There always is a joining collar in the diffuser. The joining collar provides the seal between the sections joints. It is important to line up and fit the collar in the hot deck and bypass section. For vertical applications, the cold deck also has a joining collar in the bottom of the discharge opening. This collar fits in the bottom of the vertical bypass section.
3. After the components in the multizone are fitted together, fasten the joining plates to the corners in the unit exterior.
4. If a damper was ordered, assemble it to the section (see [Multizone Damper Assembly](#) and [Figure 29](#)).

**NOTE:** Verify that the joining collars are aligned to seat into the gasket. Straighten any collars distorted from shipping or from rigging.

**Figure 28: Multizone Sections Assembly**



## Multizone Damper Assembly

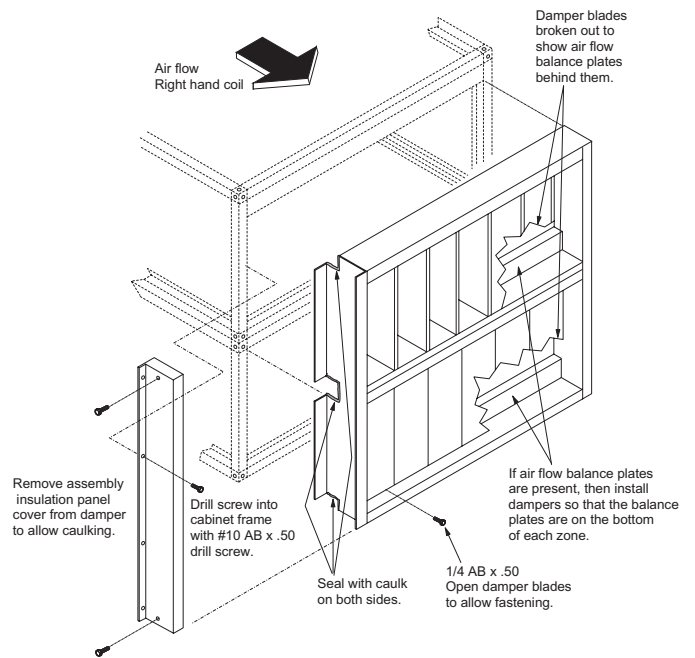
When a multizone unit is ordered with dampers, depending on the multizone configuration and size, the damper assembly may ship separately (all horizontal and units with a total height over 90").

When the dampers are not factory assembled to the unit, they ship to the job site on a skid. An assembly kit with screws and an instruction drawing are included with the damper for field assembly to the unit.

To assemble:

1. First remove the side plate that encloses insulation from both sides of the damper assembly.
2. Lift the damper assembly into position ([Figure 29](#)).
3. Fasten the assembly to the frame channels within the multizone openings.
4. Use caulking to seal up the areas around the unit frame channel to prevent any air leakage.
5. After caulking, put the side plates back in place and secure. Damper shaft extensions are provided on both ends of the damper assembly for actuation. The dampers are linked together by a linkage bar on both ends of the damper. The linkage bar is cut at the time of installation to divide the damper into the required number of zones (refer to [Multizone Damper Adjustment](#) on page 17).

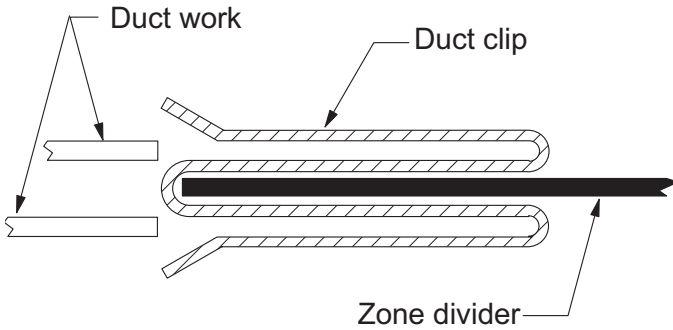
**Figure 29: Multizone Damper Assembly**



## Duct Connections

Use flexible connectors on the outlet and inlet duct connections of all units. Each zone divider has a W-shaped duct clip. Insert ductwork into this clip (Figure 30).

Figure 30: Duct Connectors



NOTE: Before connecting to ductwork, refer to Multizone Damper Adjustment below.

## Multizone Damper Adjustment

The installer must clear the damper assemblies of construction dirt and debris. These materials result in higher torque requirements and may bend or damage damper components.

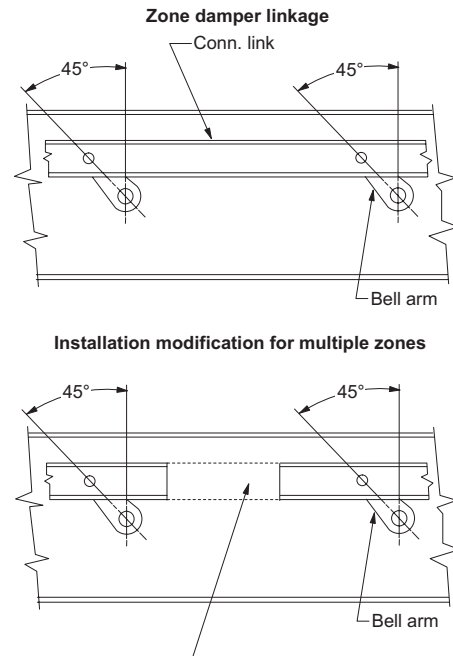
Before you begin:

1. Verify that dampers are square and operating smoothly before ducting.
2. Install duct access panels on the downstream damper for inspection and maintenance.

If multizone dampers do not close properly, adjust the blades as follows:

1. Loosen set screws in bell arms for all zones.
2. Close all cold deck dampers tightly.
3. Move bell arms so they are at a 45° angle to the vertical center when viewing the zone dampers from the cold deck end of the damper section (Figure 31).
  - a. Two-deck zone dampers—The cold deck closes when the bell arms are 45° from the vertical center. The hot deck closes when the bell arms are 45° clockwise from the vertical center.
  - b. Three-deck zone dampers—The cold deck closes when the bell arms are 45° clockwise from the vertical center. The hot deck closes when the bell arms are 45° counterclockwise from the vertical center.
4. Tighten set screws on bell arms while holding the dampers closed.
5. All zone damper blades should close properly. If one or a few zones do not close completely, repeat the procedure for these zones.

Figure 31: Bell Arms at 45° Angle to Vertical Center



To divide the damper section into multiple zones, cut and remove sufficient connecting link to allow adjacent zones to operate independently.

NOTE: The damper blades on two-deck dampers seal through several degrees of shaft rotation. The damper blades can rotate 360° and do not engage a stop. The hot deck blades are mounted at a 90° to the cold deck blades. Before installing the zone duct, set up linkages and dampers and adjust. If adjustment is required and access to the blades is restricted, observe the cold deck blade position by removing the cabinet panel on the coil section.

## Multizone, Mixing Box and Economizer Damper Torque Requirements

On multizone units, the actuator must drive the connection link for proper damper actuation. Do not activate multiple dampers must from the shaft extension opposite the connection link.

## Mounting Actuators

### CAUTION

Maximum damper rotation is 70°. Maximum shaft torque is 205 inches/pound. Greater rotation or torque can cause equipment damage.

The installing contractor is responsible for the mounting of all field-installed actuators. No provisions are made for the location of these actuators due to the number of options and arrangements available and the variety of specific applications. Typically, actuators are mounted inside the cabinet. Provide proper support for the actuator to avoid excessive stress in the cabinet, linkage, or damper shafts.

Fresh air and return air dampers can be linked together and driven from the same actuator if the dampers are the same size. If the dampers are different sizes, they must be driven by separate actuators and controlled appropriately. Exhaust dampers are always driven by a separate actuator.

A typical rotary electric actuator can handle up to 40 sq. ft. of damper. For pneumatic actuators, allow 5 in-lb per square foot of damper area.

## Face Bypass Damper Torque Requirements

Face and bypass dampers may or may not be linked together. When dampers are placed before a single bank of coils, they always are linked together and require a single actuator. When dampers bypass a stacked or staggered coil, the dampers are not linked and require multiple actuators. Unit sizes 040 to 090 provided with external face and bypass require three actuators. Other arrangements with stacked or staggered coils require two actuators. A damper shaft extension is provided. Normally, the shaft extension is located on the drive side of the unit, but it can be moved to the other side.

Face and bypass dampers have a torque requirement of 10 in-lbs per square foot of damper face area.

## Isolation Dampers for Multiple Fans

Optional isolation dampers can be provided on multiple fans to prevent backflow through a fan that is turned off for service. These isolation dampers are not intended to be used to control flow through the fan. The isolation damper for a fan that is going to be started must be positioned in the full open position before the fan is started. Do not start a fan with the damper located at the inlet with the damper fully or partially closed. This can cause airflow, vibration, and sound problems that can lead to failure.

Isolation dampers can be provided with actuators that are mounted in the airstream. Actuator sizing for the isolation dampers should be based on 9 in-lb per square foot of damper.

## Piping and Coils

When designing and installing piping:

- Follow applicable piping design, sizing, and installation information in ASHRAE handbooks.
- Observe all local codes and industry standards.
- Do not apply undue stress at the connection to coil headers; **always use a backup pipe wrench.**
- Support pipework independently of the coils.

## Water Cooling Coils

- Water supply, water return, drain, and vent connections extend through the end panel of the coil section. All connections are labeled on the end panel.
- Water supply and water return connections are typically male NPT iron pipe.
- When installing couplings, do not apply undue stress to the connection extending through unit panel. **Use a backup pipe wrench to avoid breaking the weld between coil connection and header.**
- Follow recommendations of the control manufacturer regarding types, sizing, and installation of controls.

## Direct Expansion Coils

- The coil distributor and suction connection extend through the end panel of the coil section.
- Check nozzle in distributor for proper tonnage.
- When a field supplied thermostatic expansion valve is used, it is located outside the unit and connected directly to the distributor. Do not apply heat to the body of the expansion valve.
- The thermostatic expansion valve must be of the external equalizer tube type. Connect the 1/4" diameter external equalizer tube provided on the coil to connection on expansion valve.
- Use care when piping the system to see that all joints are tight and all lines are dry and free of foreign material. For typical refrigerant piping, see condensing unit product manual.

## Steam Coils

### Piping (see [Figure 32](#))

- All steam coils in units are pitched toward return connection.
- Steam supply and steam return connections typically are male NPT iron pipe and are labeled on the end panel of coil section. Connections extend through the coil section end panel.
- When installing couplings, do not apply undue stress to the connection extending through unit panel. **Use a backup pipe wrench to avoid breaking the weld between coil connection and header.**
- Support piping independently of coils and provide adequate piping flexibility. Stresses resulting from expansion of closely coupled piping can cause serious damage.
- Do not reduce pipe size at the coil return connection. Carry return connection size through the dirt pocket, making the reduction at the branch leading to the trap.

### Coils

- Install vacuum breakers on all application to prevent retaining condensate in the coil. Generally, the vacuum breaker is connected between the coil inlet and the return main. The vacuum breaker should be open to the atmosphere, and the trap design should allow venting of large quantities of air.
- Do not drip supply mains through the coil.
- Do not attempt to lift condensate when using modulating or on/off control.

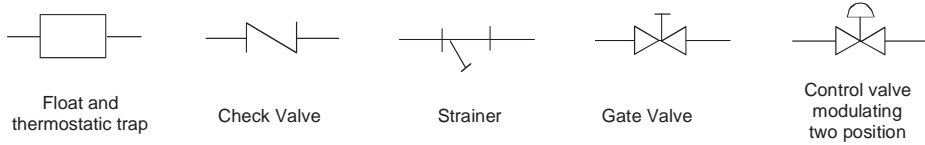
## Traps

- Size traps in accordance with the manufacturers' recommendations. Make sure that the required pressure differential is always available. Do not undersize.
- Use float and thermostatic or bucket traps for low pressure steam. On high pressure steam, use bucket traps. Use thermostatic traps only for air venting.
- Use bucket traps for on/off control only.
- Locate traps at least 12 inches below the coil return connection.
- Multiple coil installation
- Individually trap each coil or group of coils that is controlled individually trapped.
- Coils in series—use separate traps for each coil, or bank of coils.
- Coils in parallel—a single trap can be used, but an individual trap for each coil is preferred.
- Do not attempt to lift condensate when using modulating or on/off control.
- With coils arranged for series airflow, use a separate control on each bank or coil in the direction of airflow.

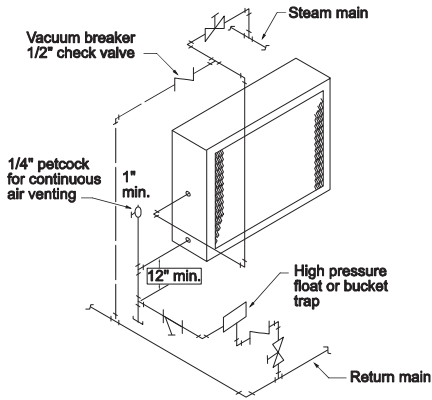
## Valves

- Do not use modulating steam valves on high pressure systems.
- Properly size modulating valves. **Do not undersize.**
- Freezing conditions (entering air temperatures below 35°F).
- Daikin strongly recommends 5JA, 8JA, 5RA and 8RA coils.
- Supply 5 psi steam to coils at all times.
- Do not use modulating valves. Provide control by face and bypass dampers.
- Consider using two or three coils in series with two position steam control valves on the coil or coils that handle 35°F or colder air. Use a modulating valve on the downstream coil to provide the desired degree of control.
- Thoroughly mix fresh air and return air before it enters the coil. Also, to obtain true air mixture temperatures, properly locate temperature control elements.
- As additional protection against freeze-up, install the trap sufficiently below the coil to provide an adequate hydrostatic head to remove condensate during an interruption in the steam pressure. Estimate three feet for each 1 psi of trap differential required.
- On startup, admit steam to coil ten minutes before admitting outdoor air.
- Close fresh air dampers if steam supply pressure falls below the minimum specified.

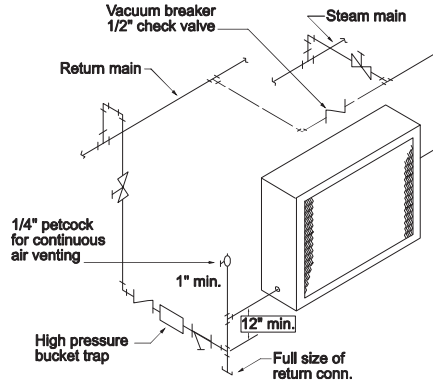
**Figure 32: Piping Arrangements**



**High Pressure (over 25 psi)**

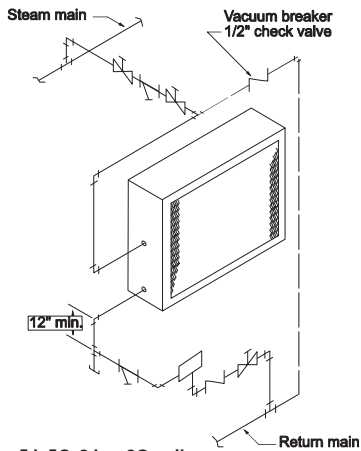


**5GA or 8GA coils.** Note that the addition of a vacuum breaker to permit the coil to drain during shutdown.

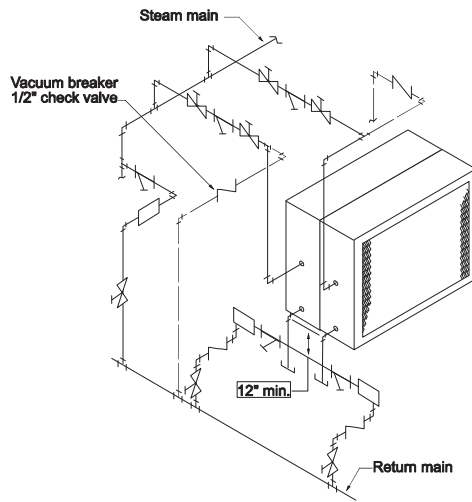


**5TA, 8TA, or 5HA coils.** Condensate is lifted to overhead return main

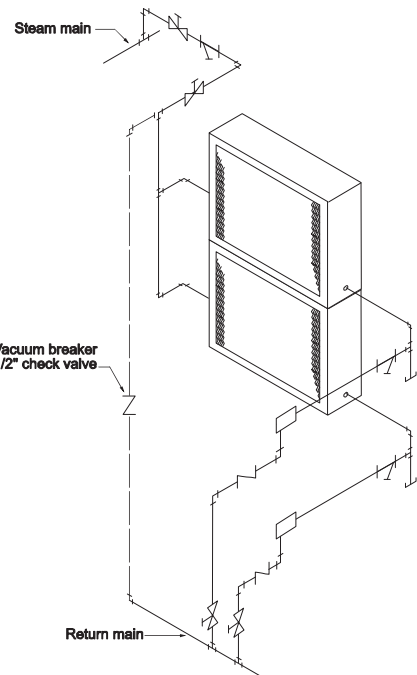
**Low Pressure (to 25 psi)**



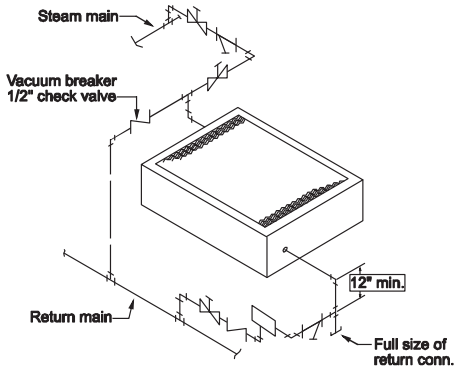
**5J, 5G, 8J or 8G coils.**



**5JA or 8JA coil.** Installed in series. Note that each coil must have a separate control valve and trap.



**5RA, 8RA, or 5SA coils.** Banked two high, individual trapping of each coil as shown is preferred.



**5RA, 8RA, or 5SA coils.** Installed

## Water Heating Coils

**⚠ CAUTION**

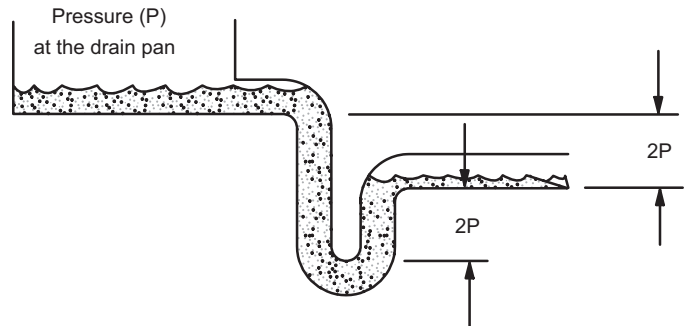
Improper installation, use, or maintenance of water heating coils can cause equipment damage. Read and follow instructions carefully.

- Water supply and water return connections extend through the end panel of the coil section. All connections are labeled on the end panel.
- Water supply and water return connections are male NPT iron pipe.
- When installing couplings, do not apply undue stress to the connection extending through unit panel. Use a backup pipe wrench to avoid breaking the weld between the coil connection and header.
- Follow recommendations of the control manufacturer regarding types, sizes, and installation of controls.
- Do not use hot water coils with entering air below 40°F.
- If fresh air and return air are to be heated by a hot water coil, carefully design the system to provide thorough mixing before air enters the coil.
- To prepare coils for winter operation, see [Winterizing Water Coils on page 44](#).

## Drain Pan Traps

Run drain lines and traps full size from the drain pan connection. Install drain pan trap to allow condensate to drain freely. On both blow-through and draw-through units, the trap depth and the distance between the trap outlet and the drain pan outlet must be twice the static pressure in the drain pan section under normal operation so the trap remains sealed ([Figure 33](#)).

**Figure 33: Allow Adequate Distance Between Trap Outlet and Drain Pan Outlet**





## Internal Isolation Assembly Adjustment

On units with internally isolated fan and motor assemblies, the assemblies are secured for shipment.

### Before Operating the Unit

Remove the shipping brackets and tie-down bolts (refer to [Figure 35](#), [Figure 36](#) and ) and discard. The shipping brackets located on the opposite drive side of the unit are difficult to access from the drive side of the unit. Either remove them before the unit is assembled, or remove the panel on the opposite drive side to gain access.

The spring isolators under the four corners of the fan and motor assembly are factory adjusted while the fan was not running. With the unit operating at normal cfm and static pressure, all the isolators should be at the same height opening ([Table 1](#) through [Table 5](#)). If adjustments are required, loosen the 1/2" cap screw on top of the isolator and turn the adjusting bolt to lower or raise the fan and motor base. Retighten the cap screw when adjustments are completed.

**Table 1: Motor Beside Fan Spring Mount Adjustments**

Spring Mount Adjustment at Rest			
Isolator Position	Top or Bottom Horizontal H	Downblast H	Upblast H
Unit Sizes 003 – 035			
1	3.75	3.75	4.25
2	4.25	3.75	4.25
3	4.25	3.75	4.25
4	3.75	3.75	4.25
Unit Sizes 040 – 090			
1	6.00	6.00	6.50
2	6.50	6.00	6.50
3	6.50	6.00	6.50
4	6.00	6.00	6.50

**Table 2: Motor Behind Fan Spring Mount Adjustments**

Spring Mount Adjustment at Rest			
Isolator Position	Top or Bottom Horizontal H	Downblast H	Upblast H
Unit Sizes 003 – 035			
1	6.75	6.75	6.75
2	6.75	6.75	6.75
3	6.75	6.75	6.75
4	6.75	6.75	6.75
Unit Sizes 040 – 090			
1	6.75	6.75	6.75
2	6.75	6.75	6.75
3	6.75	6.75	6.75
4	6.75	6.75	6.75

For models 040 through 090 with housed fans, the isolators should be at equal height (6") during fan operation. Center the fan outlet in the outlet panel opening. If adjustment is required, loosen the bolt on top of the isolator assembly ( ). Turn the adjustment nut below the fan frame to lower or raise the fan motor and frame assembly. Retighten the bolt on top of the isolator assembly.

**Table 3: Class II Belt-Drive Plenum Fan Spring Height**

Fan Size	Isolator Type	Operating Height (in.)
13–16	Standard 2" Deflection	4.5
18–36	Standard 2" Deflection	4.0
13–36	Seismic	4.0
40–60	All	6.75

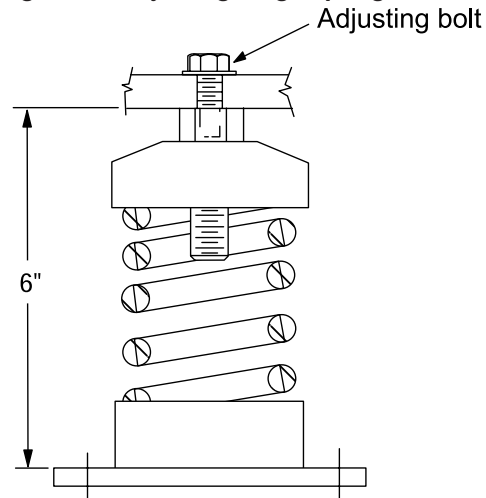
**Table 4: Class III Plenum Fan Spring Height**

Cabinet Width (in.)	Isolator Type	Operating Height (in.)
Width < 108	All	4.0
Width ≥ 108	All	6.75

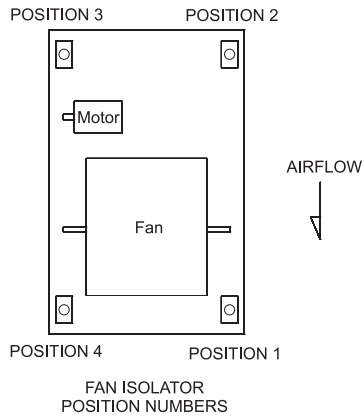
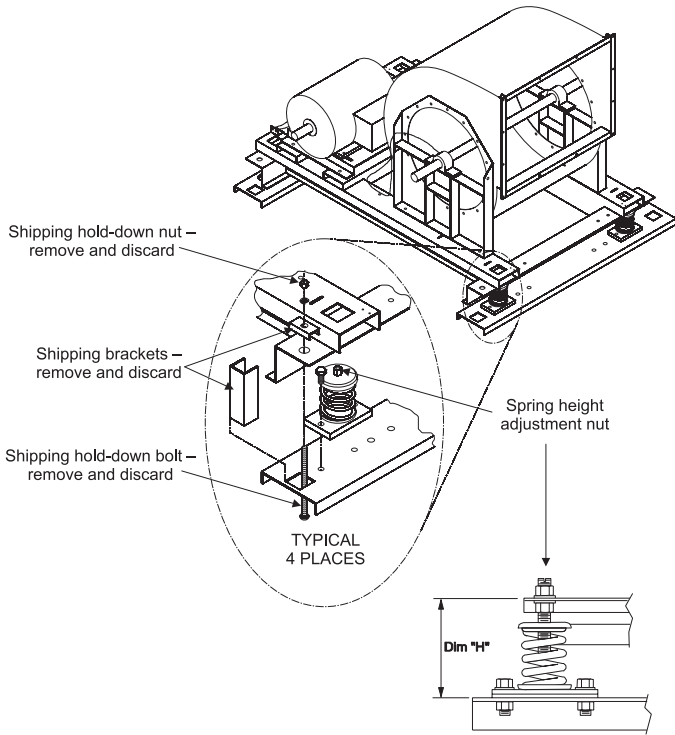
**Table 5: Class II Direct-Drive Plenum Fan Spring Height**

Fan Size	Isolator Type	Operating Height (in.)
11–36	All	4.0
40–44	All	6.75

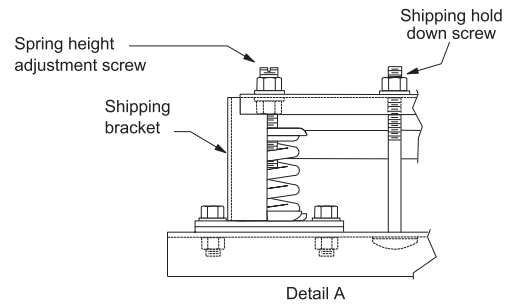
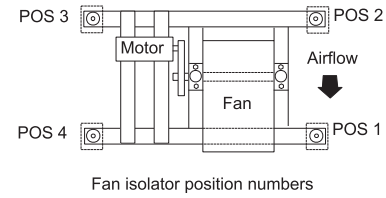
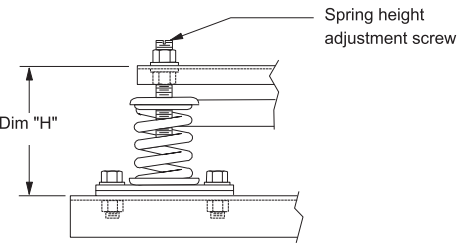
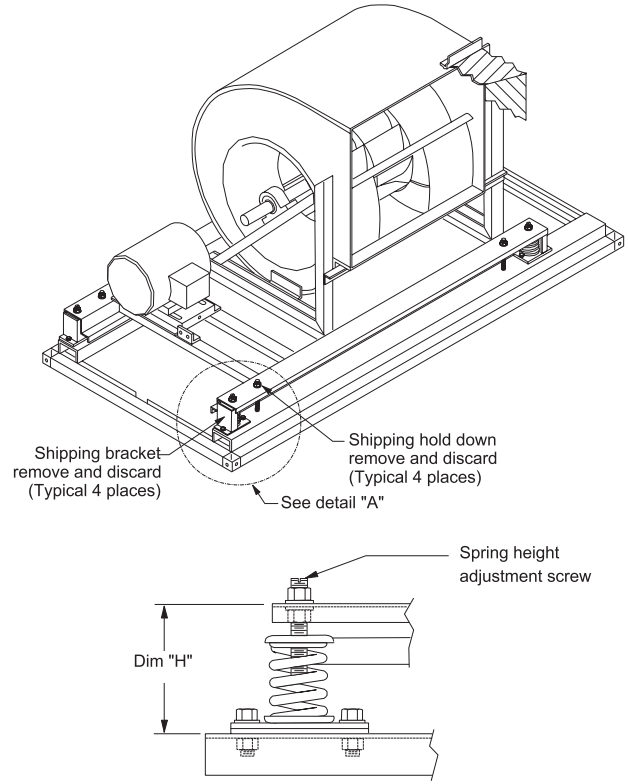
**Figure 34: Adjusting Large Spring Mount Assembly**



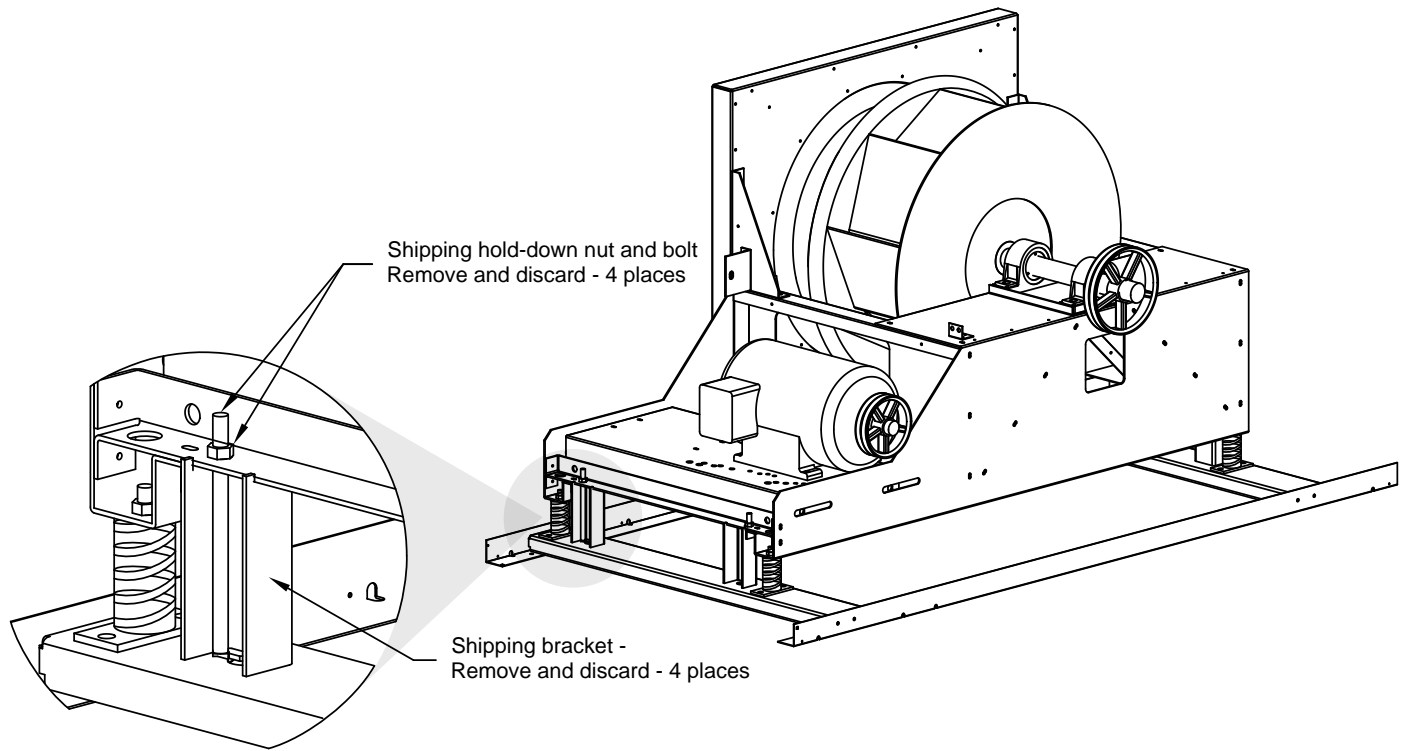
**Figure 35: Removing "Motor Behind" Shipping Brackets**



**Figure 36: Removing "Motor Beside" Shipping Brackets**



**Figure 37: Plenum Fan Typical Shipping Brackets**



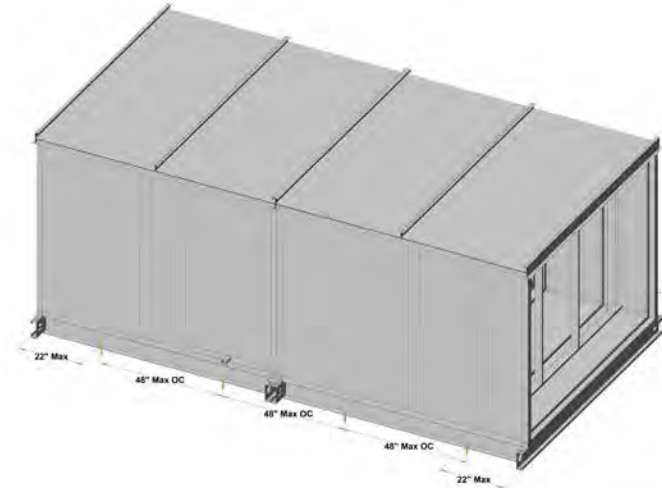
## OSHPD Seismic Anchoring/Mounting

For seismic stability of the unit, additional anchoring and mounting procedures are required. The anchoring options and corresponding spectral response acceleration are given in [Table 6](#). Holes in the Vision/Skyline base frame are to be field drilled. Any mounting hardware is to be field supplied.

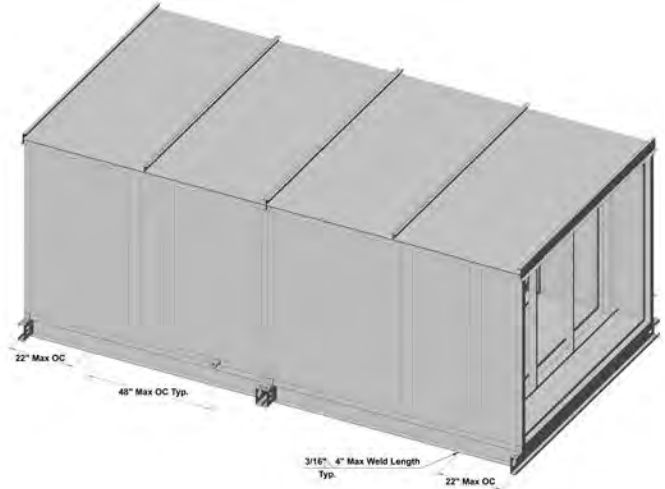
**Table 6: OSHPD Mounting**

Attachment Method	SDS	Attachment System (by Others)	
		Spacing	System
Bolted attachment to steel ( <a href="#">Figure 38</a> )	1.93	48	5/8" DIA SAE Grade 5
Welded attachment to steel ( <a href="#">Figure 39</a> )	1.84	48	3/16" Weld Leg and 4" welded length
Bolted attachment to Concrete ( <a href="#">Figure 40</a> )	1.68	24	Hilti HAD-P M16 x 190/40 with 4-3/4" embedment

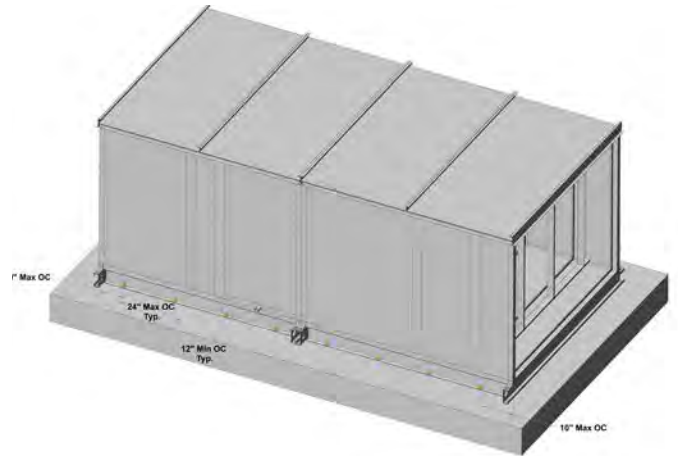
**Figure 38: Unit with Base Frame Mounted on Steel**



**Figure 39: Unit with Base Frame Welded**



**Figure 40: Unit with Base Frame Mounted on Concrete**



## Wiring

### DANGER

**Capacitor Hazardous Voltage!** Failure to disconnect power and discharge capacitors before servicing will result in serious injury or death.

Disconnect all electric power (including remote disconnects) before servicing. Perform lockout/tagout procedures to ensure that power can not be energized. For variable frequency drives, or other energy storing components that have been furnished and mounted by either Daikin, or by others, refer to the specific manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify capacitors have been discharged using an appropriate voltmeter.

### CAUTION

**Use copper conductors only!** Failure to use copper conductors can result in equipment damage.

- Electrical service to each fan must correspond to the rated voltage on the motor or electrical panel nameplate and conform to the National Electric Code and local restrictions.
- Connect each fan section metal frame to the building electrical ground.
- A door electrical interlock is not provided as standard.
- Thermal motor protection is external to the unit. Unless the unit is provided with a variable frequency drive (VFD) or a unit mounted starter, thermal protection and a disconnect switch provision per electric codes are provided by others.
- When the unit is factory provided with a disconnect switch, starter or a variable frequency drive (VFD), the components are mounted on the outside of the unit cabinet. Factory wiring is provided from the device to the unit internal motor.
- All electrical components must be grounded to the building central ground. Suitable ground wires and/or (bonding) lugs are provided for all motors, disconnect switches, starters, and variable frequency drives. Provide dedicated ground (bonding) copper conductors in accordance with local and national codes.
- For units provided with a motor only or with an external junction box, wire connections are made with suitable wire nuts or connectors for the gauge wires provided.
- For units provided with a disconnect switch or starter, field wiring will be terminated to lugs. Wire size and lug torque requirements are shown on the unit electrical schematic provided in the component print pocket. All power supply wire connections must be torqued as shown.

- When the unit is provided with a VFD only, refer to the VFD manual for wire size and torque requirements. For instances where multiple motors are being driven by a single VFD, be sure to set up the VFD and size the wiring according to the power requirements of all motors that are being driven by that VFD.
- When not being serviced, close and secure electrical panel doors to prevent ingress of moisture and airborne contaminants.

## Control Wiring

- Access to the VFD is through the fan cabinet access door for single fans. Provide shielded cable only as described in the provided VFD manual. Route wire through the panel so that it does not interfere with other components or access doors. Do not drill through drip pans or drain pans. Refer to the provided VFD installation manual for detailed control wiring instructions.
- For multiple fans in parallel, the VFD(s) are mounted inside of the electrical enclosure, which is mounted on the exterior of the fan section. When multiple fan sections are provided with multiple VFDs, they must be set up so that the fans always start simultaneously and are set to ramp up and down together. Do not attempt to run fans in parallel at different speeds as this can result in uneven airflow that can cause performance, sound, and vibration problems that can lead to failure. Provided that the fan is capable of running fast enough and the motor is sized appropriately, VFDs may be operated up to a maximum recommended frequency of 90 Hertz for 1800 RPM and slower motors. Motors that are 3600 RPM may be operated up to a maximum speed of 4000 RPM or 66.7 Hertz provided the fan is rated that high. Operation above 4000 RPM can damage motor bearings and is not recommended.

## Startup Checks

When performing startup and service, always take thorough safety precautions. Only trained, experienced personnel should perform these functions.

**⚠ WARNING**

**ROTATING FAN**

Can cause severe injury or death. Before servicing fans, lockout and tag out power.

**⚠ WARNING**

**FIRE/ELECTRIC SHOCK HAZARD**

Can cause property damage, personal injury or death. Wire fan power supply and ground motor frame in accordance with local electric codes.

**⚠ WARNING**

**Fan motor requires overload protection.**

Failure to provide motor overload protection can result in fire, property damage, electric shock, personal injury, or death. Connect motor to an overload protective device rated in compliance with local electric codes.

**⚠ CAUTION**

**DO NOT OVERHEAT FAN MOTOR**

High air temperatures in the fan section can cause the fan motor to burnout. On draw-through air handlers or air handlers with the fan section down the air stream from the heating section, the discharge air temperature of the heating section must not exceed 104°F (40°C).

## Before Starting the Unit

**⚠ CAUTION**

Equipment damage due to loose fasteners represents improper start-up and equipment abuse. It is not covered by the warranty.

Before entering fan section, make sure that fan electrical power source is disconnected and locked in the OFF position.

1. Check that the unit is completely and properly installed with ductwork connected.
2. Check that all construction debris is removed and filters are clean.
3. Check that all electrical work is complete and properly terminated.
4. Check that all electrical connections are tight and that the proper voltage is connected. Phase imbalance must not exceed 2%.
5. Do not grease ball bearings on the fan shaft and motor before startup. They are prelubricated.
6. Check tightness of screws in bearings and fan wheel(s). If retightening is needed, position the fan wheel(s) per [Table 7, page 29](#) through [Table 9, page 30](#) and [Table 10 through Table 12, page 31](#). Torque set screws per [Table 13 and , page 31](#).
7. Check alignment of fan and motor sheaves and belt tension. Adjust if necessary. Check tightness of sheave setscrews and/or capscrews (refer to [, page 31](#)).
8. Leak test the thermal system to verify that connections are tight.
9. Check that the condensate drain is trapped.
10. Rotate the shaft by hand to be sure it is free.
11. If multiple fans are supplied with a block off plate and it is installed on one of the fans, make sure to only start the fans without the block off plate. Do not start any fan that has the block off plate installed on it.
12. If multiple fans are supplied with isolation dampers, make sure the isolation dampers are fully open before starting the fans.

## VFD Setup

Fans ordered with VFDs that were factory installed are setup and tested prior to shipment. Prior to starting the fan(s), double check the VFD settings according to the recommendations in the VFD manual.

Once the correct VFD settings are verified, the fans should be run through a sweep of the full range of operating speeds that are expected to check for any vibration issues. If any areas of concern are located, it is recommended to lock out those frequencies using the VFD (see lock out frequencies or skip frequencies in the VFD manual). This will ensure that the fans will never operate continuously at those points, but will rather pass through them to get to the desired points of operation.

## Fan Startup

Start and run fan. See [on page 30](#) for proper fan rotation. Observe the rotation. If the fan operates backward, reverse two legs of the three-phase supply power.

NOTE: Variable pitch fan drives usually are provided for operation in the mid-speed adjustment range. However, the drives usually ship with the adjustment opened up for minimum fan speed. Adjust the drives for the proper airflow. See [Fan Drive Adjustments on page 38](#).

## After 48 Hours of Operation

**⚠ WARNING**

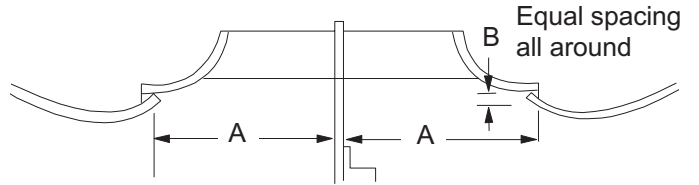
**ROTATING FAN**

Can cause severe injury or death. Before servicing fans, lockout and tag out power.

1. Disconnect and lock electrical power source.
2. Check tightness of all bearing, wheel, and sheave setscrews (or capscrews). Refer to [Table 13](#).
3. Recheck belt tension and adjust if necessary. Belts tensioned sufficiently to slip one to two seconds at startup will perform satisfactorily, extending life and reducing

## Fan Wheel Alignment

**Figure 41: Wheel-to-Inlet Funnel Relationship— Fan Wheels (Housed)**



**Table 7: Wheel-to-Inlet Funnel Relationship— Fan Wheels(Housed)**

Airfoil <sup>1</sup> (in.)					
Unit sizes 003 to 035			Unit sizes 040 to 090		
Diameter	A <sup>2</sup> (mm)	B <sup>3</sup> (mm)	Diameter	A <sup>2</sup> (mm)	B <sup>3</sup> (mm)
13.22	4.56 (116)	0.21 (5.33)	20.00	7.19 (183)	0.31 (7.87)
14.56	5.06 (129)	0.21 (5.33)	22.25	7.69 (195)	0.33 (8.38)
16.18	5.62 (143)	0.21 (5.33)	24.50	8.56 (217)	0.31 (7.87)
17.69	6.90 (175)	0.22 (5.59)	27.00	9.47 (241)	0.63 (16.00)
21.56	7.59 (193)	0.24 (6.10)	30.00	10.47 (266)	0.39 (9.91)
24.00	8.45 (215)	0.23 (5.84)	33.00	11.75 (298)	0.38 (9.65)
—	—	—	36.50	325 (12.78)	0.38 (9.65)
—	—	—	40.25	363 (14.31)	0.50 (12.70)

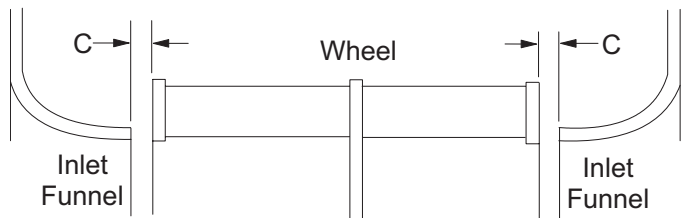
Note:

<sup>1</sup>To obtain rated air performance, dimensional relationship must be held.

<sup>2</sup>To obtain dimension A, loosen setscrews in wheel hub(s), shifting wheel(s) axial as needed, retightening setscrews.

<sup>3</sup>To obtain dimension B, loosen screw and washer fasteners around periphery of funnel(s), shifting funnel radially as required, re-torquing fasteners.

**Figure 42: Wheel-to-Inlet Funnel Relationship— Forward Curved Fan Wheels**



**Figure 43: Wheel-to-Inlet Funnel Relationship— Forward Curved Fan Wheels**

Forward Curved <sup>1</sup> (in.)			
Unit sizes 003 to 035		Unit sizes 040 to 090	
Diameter	C <sup>2</sup> (mm)	Diameter C <sup>2</sup> (mm)	
9x4	0.25 (6.35)	20 (Class 1 & 2)	0.24 (6.10)
9x7	0.13 (3.30)	22.38 (Class 1 & 2)	0.41 (10.41)
9x9	0.25 (6.35)	25 (Class 1 & 2)	0.47 (11.94)
10	0.22 (5.59)	27.62 (Class 1 & 2)	0.47 (11.94)
12	0.35 (8.89)	30 (Class 1 & 2)	0.47 (11.94)
15	0.44 (11.18)	33 (Class 1 & 2)	0.50 (12.70)
18	0.25 (6.35)	36 (Class 1 & 2)	0.75 (19.05)
20 (Class 1 & 2)	0.73 (8.54)	—	—
22½ (Class 1 & 2)	0.59 (14.99)	—	—
24½ (Class 1 & 2)	0.56 (14.22)	—	—

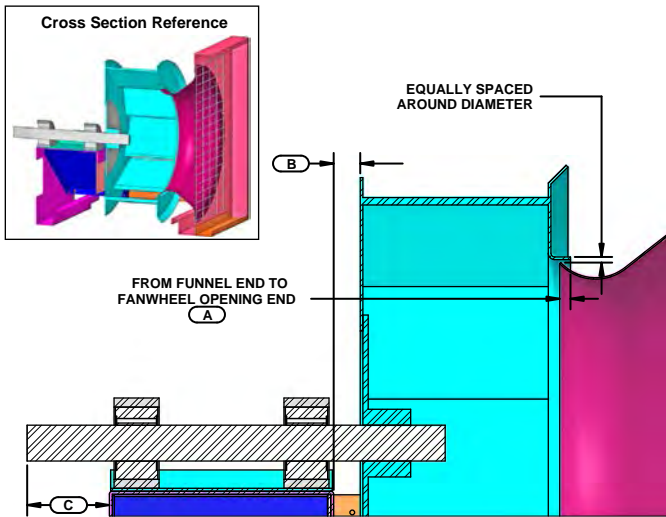
Note:

<sup>1</sup>To obtain rated air performance, dimensional relationship must be vibration. If retensioning is necessary, be certain to retain held.

<sup>2</sup>Adjust dimension C by loosening wheel hub setscrews, shifting sheave alignment wheel(s) axial as needed, and retightening setscrews.



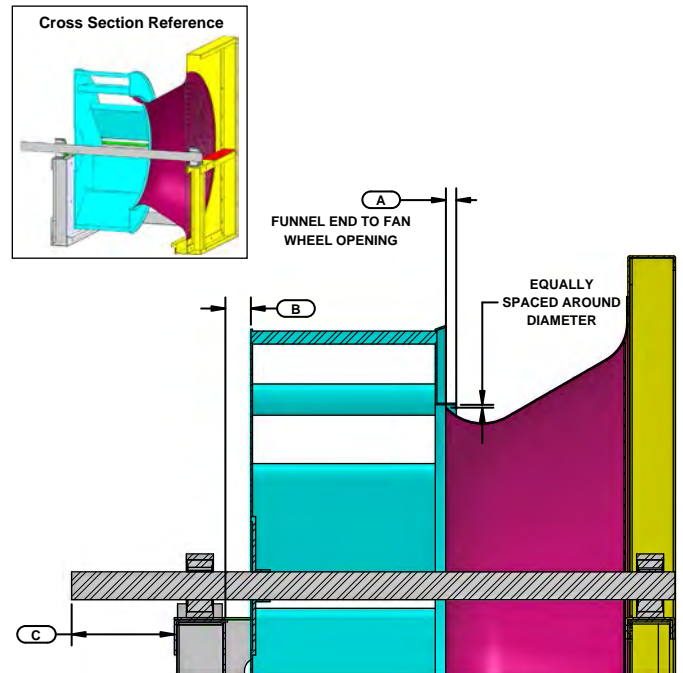
**Figure 44: Wheel-to-Inlet Funnel Relationship—  
13 to 36 Belt-Drive Plenum Fans**



**Table 8: Wheel-to-Inlet Funnel Relationship—  
13 to 36 Belt-Drive Plenum Fan**

Wheel-Funnel Parameters			
Size	A	B	C
13	0.25	0.91	3.50
15	0.25	0.91	3.50
16	0.25	0.91	3.50
18	0.38	0.86	3.88
20	0.42	1.11	3.88
22	0.45	1.11	3.88
24	0.51	1.11	3.88
27	0.55	1.36	4.50
30	0.62	1.36	4.50
33	0.55	1.50	5.00
36	0.63	1.50	5.00

**Figure 45: Wheel-to-Inlet Funnel Relationship—  
40 to 60 Belt-Drive Plenum Fans**



**Table 9: Wheel-to-Inlet Funnel Relationship—  
40 to 60 Belt-Drive Plenum Fan**

Wheel-Funnel Parameters			
Size	A	B	C
40	0.82	2.00	4.88
44	0.91	2.25	5.50
49	1.00	2.50	5.50
54	1.10	2.50	5.50
60	1.23	3.00	5.50

Setscrews on MPQ fan wheels must be installed using a calibrated torque wrench to the value listed below,  $\pm 5\%$ . The fasteners must be periodically checked to satisfy agency requirements for components on rotating machinery.

Figure 46: Fan Wheel Rotation

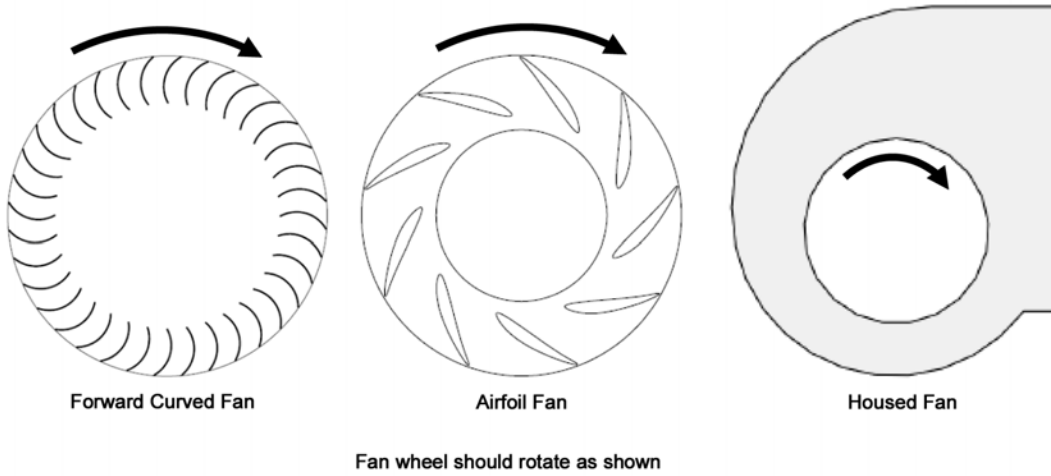


Figure 47: Wheel-to-Inlet Funnel Relationship—  
Inline Fans Overlap

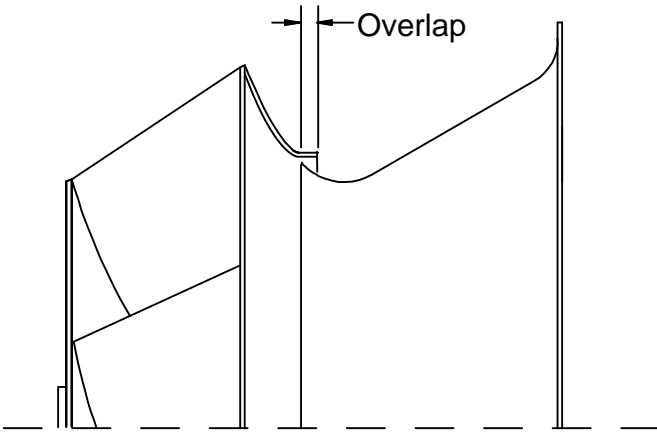


Table 10: Wheel-to-Inlet Funnel Relationship—Inline Fans

Wheel—Funnel Overlap	
Size	Overlap
150	.375
165	.438
182	.562
200	.625
222	.688
245	.750
270	.812
300	.875
330	1.000
365	1.125
402	1.250
445	1.375

Table 11: Wheel-to-Inlet Funnel Relationship—  
Direct-Drive Fans Only Class II fans

Fan Size	Overlap (in.)
11	0.25
12	0.25
15	0.25
16	0.38
18	0.38
20	0.41
22	0.45
24	0.50
27	0.55
30	0.61
33	0.67
36	0.75
40	0.82
44	0.91

Table 12: Wheel-to-Inlet Funnel Relationship—  
Direct-Drive Class III fans

Fan Size	Overlap (in.)
13	0.12
15	0.19
16	0.25
18	0.31
20	0.38
22	0.44
24	0.50
27	0.56
30	0.62
33	0.75
36	0.81
40	0.88
44	0.94
49	1.0
54	1.06
60	1.12

**Table 13: Setscrew Torque Specifications—  
Class II Plenum**

Fan Size	Setscrew Size	Torque (ft.-lb)	
		Aluminum	Steel
11/12/13	3/8	19.2	N/A
15	3/8	19.2	N/A
16	3/8	19.2	N/A
18	3/8	19.2	N/A
20	3/8	19.2	N/A
22	3/8	19.2	N/A
24	3/8	19.2	N/A
27	3/8	19.2	22
30	1/2	41.7	55
33	1/2	41.7	55
36	1/2	41.7	55
40	1/2	41.7	55
44	1/2	41.7	55
49	1/2	41.7	55
54	1/2	41.7	55
60	3/4	115	150

**Table 14: Bearing Collar and Wheel Hub Set Screw Torque  
(All Fans Except Class II Plenum Fans)**

Set Screw Diameter (in)	Minimum torque ft/lbs (kg/m)
1/4	5.5 (0.76)
1/16	10.5 (1.45)
3/8	19.0 (2.63)
7/16	29.0 (4.01)
1/2	42.0 (5.81)
5/8	92.0 (12.72)

## Fan Array

The Daikin Fan Array is available with optional, factory mounted VFDs. See OM manuals OM 1190 and 1191 for details on the Daikin supplied VFD.

Care should be taken when programming and synchronizing the drives in the Daikin Fan Array such that all fans turn at the same speed. Fans running at unequal speeds can produce vibration and could stall a fan. Definition of fan numbering is given in Figure 48.

The Daikin Fan Array is standard with a manual block off plate. The unit will ship with one block off plate that will come installed on fan 1A. This block off plate is to be removed before unit operation and stored outside of the air tunnel. In the event of a lost fan motor, the block off plate is installed on the non-functional fan to prevent air re-circulation. This is designed to be a temporary measure until this fan and/or motor is replaced. After fan and/or motor replacement the block off plate is to be removed and stored outside of the air tunnel.

The Daikin Fan Array has an optional gravity actuated block off damper. These dampers are equipped with counter weights.

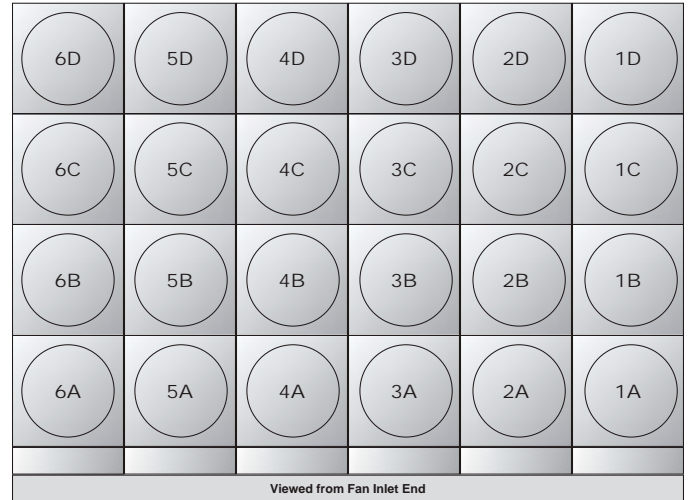
The Daikin Fan Array has an optional actuated block off damper. These dampers are designed to prevent air recirculation in the event of a lost fan. Care should be taken that the damper actuator only be given a close signal if the fan is not operational (motor burnout for example).

The Daikin Fan Array can be equipped with a fan blank off plate. See Figure 49 with a block off plate mounted to fan 3C. If the unit is ordered with the manual block off plate, it will be installed to fan 1A. This plate has to be removed before start up.

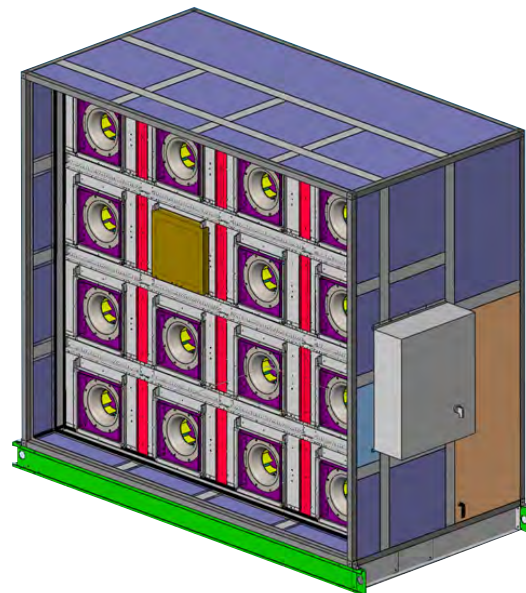
**WARNING**

Closing the damper on an operational fan could send the fan into surge that could produce fans stall, excessive vibration, unit damage, or personnel injury.

**Figure 48: Daikin Fan Array Configuration**



**Figure 49: Fan Array with Block Off Plate**



## Optional Piezometer Ring Airflow Measurement Device

Piezometer rings are available as an option on direct drive plenum fans to measure airflow through the fan. The device consists of a piezometer ring mounted in the throat of the funnel and a static pressure tap mounted near the inlet of the funnel. The pressure drop is measured from the tap located near the inlet of the funnel to the piezometer ring in the throat. The inlet tap is connected to the high-pressure side of the transducer and the piezometer ring is connected to the low-pressure side.

Below are the equations and factors required to calculate flow using the piezometer ring:

### Non-Standard Density Method

The following equation is used to measure the flow for non-standard density:

$$ACFM = C1 \times A \times \sqrt{(\Delta P/\rho)}$$

where: A = Inlet funnel throat area (square feet) - from Table 2

$\Delta P$  = The differential in static pressure from the piezometer ring and the inlet pressure tap (inches w.g.)

$\rho$  = Air density (pounds mass/cubic foot)

C1 = Value from Table 1 below

### Standard Density Method

The equation can be simplified by assuming standard density and assuming funnel dimensions match the drawing dimensions. Table 16 shows the factor (F) for each fan size and type. The equation then becomes the following:

For standard air ( $\rho = 0.075 \text{ lb/ft}^3$ ):

$$ACFM = F \times \sqrt{(\Delta P)}$$

where: F = factor from Table 2

$\Delta P$  = The differential in static pressure from the piezometer ring and the front pressure tap (inches w.g.)

**Table 15: DDPL Factors For Free and Ducted Inlet—  
Non Standard Density Method**

Product	C1 Free Inlet	C1 Ducted Inlet
DDPL Size 11-16	753.06	794.06
DDPL Size 18-44	692.03	740.14

**Table 16: DDPL Factors For Free and Ducted Inlet—  
Standard Density Method**

DDPL Size	Free Inlet F	Ducted Inlet F	Area A
11 and 12	944.92	996.36	0.344
15	1206.40	1272.08	0.439
16	1518.58	1601.26	0.552
18	1821.92	1948.58	0.721
20	2185.80	2337.76	0.865
22	2713.93	2902.60	1.074
24	3285.02	3513.39	1.300
27	3997.61	4275.53	1.582
30	4945.21	5289.01	1.957
33	5968.62	6383.56	2.362
36	7290.21	7797.03	2.885
40	8869.55	9486.16	3.510
44	10827.92	11580.68	4.285

### Optional Transducer for Piezometer Rings

A transducer is available for Piezometer rings. Factory mounting locations for the fan transducer is shown in Figure 50 for direct-drive plenum fans. Figure 51 shows the installation for fan array. Wiring for the transducer is field-supplied and installed.

Figure 50: Direct-drive Plenum Fan Installation

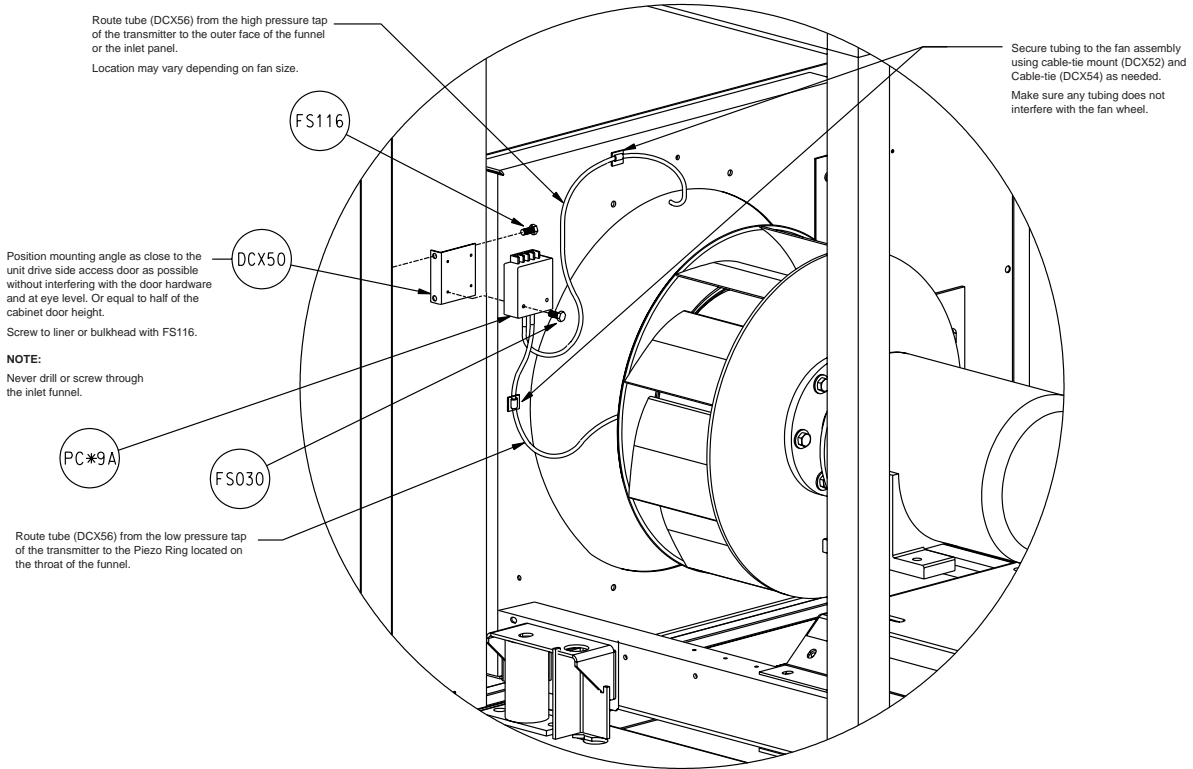
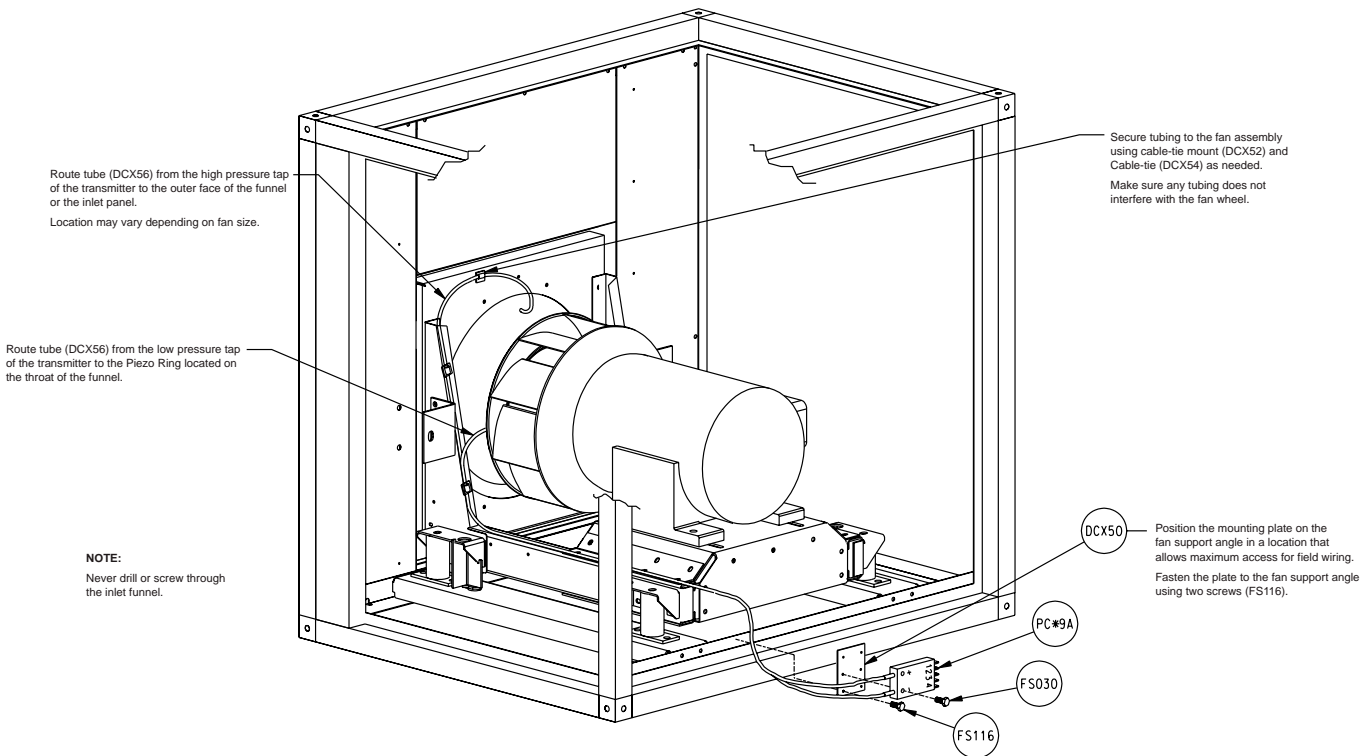


Figure 51: Fan Array Installation



## Operating Limits

Do not exceed the operating limits in Table 17 through Table 21. A fan wheel operated beyond the rpm and temperature limits shown can suffer permanent distortion or fracture. The resulting unbalance can cause severe unit vibration.

**Table 17: Fan Operating Limits—Unit Sizes 003 to 035**

Forward Curved—Housed										Airfoil—Housed						
Diameter	9x4	9x7	9x9	10.62	12.62	15	18	20	22.25	24.50	13.22	14.56	16.19	19.69	21.56	24.00
Max. RPM Class I	N/A	2189	2223	1934	1614	1328	1155	1050	944	858	3000	3000	2300	2000	1700	1500
Max. RPM Class II	2244	2854	2896	2518	2091	1725	1450	1200	1030	910	4335	3918	3457	2858	2427	2255

**Table 18: Fan Operating Limits—Unit Sizes 040–090**

Forward Curved—Housed							Airfoil—Housed							
Diameter	20	22.38	25	27.62	30.25	33	36	20	22.25	24.5	27	30	33	36.5
Max. RPM Class I	1010	930	790	690	650	600	560	2077	1875	1691	1479	1328	1209	1073
Max. RPM Class II	1281	1178	1011	910	835	763	715	2703	2413	2199	1928	1730	1579	1401

**Table 19: Fan Operating Limits—Belt-Drive Plenum Fans**

Belt-Drive Plenum fans																
Size	13	15	16	18	20	22	24	27	30	33	36	40	44	49	54	60
Max. RPM Class II	3909	3468	2820	2930	2674	2403	2183	1860	1783	1620	1465	1329	1202	1091	986	891
Max. RPM Class III	4000	4000	3887	3735	3409	3065	2780	2423	2182	1984	1759	1598	1447	1314	1178	1071

**Table 20: Fan Operating Limits—Direct-Drive Plenum Fans**

Direct-Drive Plenum Fans																		
Size	11	12	13	15	16	18	20	22	24	27	30	33	36	40	44	49	54	60
Max. RPM Class II	4000	4000	—	3909	3650	3650	2674	2403	2183	1981	1783	1620	1465	1329	1202	—	—	—
Max. RPM Class III	—	—	4000	4000	3887	3735	3409	3065	2780	2423	2182	1984	1759	1598	1447	1314	1178	1071

**Table 21: Fan Operating Limits—Inline Fans, Twin Fans**

Inline Fans/Twin Fans													
Diameter	18.25	20	22.25	24.5	27	30	33	36.5	40.25	44.50	49	54.25	
Max. RPM Class I	2727	2488	2236	2041	1835	1665	1476	1330	1208	1072	973	880	
Max. RPM Class II	3409	3111	2796	2551	2294	2082	1846	1662	1510	1340	1216	1100	
Twin Fans													
Diameter	9x9	10.62	12.62	15	18.12	20							
Max. RPM	2575	2400	2000	1700	1400	1200							
Max. HP	10	15	15	30	40	40							

## Fan Vibration Levels

Each unit as shipped is trim balanced to operate smoothly. To provide satisfactory operation after shipping and installation, use the accepted industry guidelines for field balancing fans. See Table 22.

**Table 22: Vibration Levels**

Fan Speed (RPM)	Vibration
800 or less	5 mils maximum displacement
801 or greater	0.20 in/sec. maximum velocity

Note:  
Excessive vibration from any cause contributes to premature fan and motor bearing failure. Monitor overall vibration levels every six months of operation. An increase in levels is an indication of potential trouble.

### Vibration Causes

- Wheel imbalance.
  - Dirt or debris on wheel blades.
  - Loose set screws in wheel hub or bearing-to-shaft.
  - Wheel distorted from overspeed.
- Bent shaft.
- Drive faulty.
  - Variable pitch sheaves—axial and radial runout of flanges; uneven groove spacing; out of balance. Also similar faults in driven sheave.
  - Bad V-belts; lumpy, or mismatched; belt tension too tight or too loose.
- Bad bearings, loose bearing hold-down bolts.
- Motor imbalance.
- Fan section not supported evenly on foundation.



## Periodic Maintenance

1. Check all moving parts for wear every six months.
2. Check bearing collar, sheave, and wheel hub setscrews, sheave capscrews, and bearing hold-down bolts for tightness every six months.
3. Annually check and snug all electrical connections. Inspect for signs of water damage such as corrosion and repair if necessary. Check ground conductor and connection integrity and correct if needed.

## Ball Bearing Lubrication

### CAUTION

Bearing overheating potential. Can damage the equipment. Do not over lubricate bearings. Use only a high grade mineral grease with a 200°F safe operating temperature. See below for specific recommended lubricants.

## Motor Bearings

Supply and return fans—Supply and return fan motors should have grease added after every 2000 hours of operation. Using the following procedure, re-lubricate the bearings while the motor is warm, but not running. Use one of the greases shown in [Table 23](#).

1. Remove and clean upper and lower grease plugs.
2. Insert a grease fitting into the upper hole and add clean grease ([Table 23](#)) with a low pressure gun.
3. Run the motor for five minutes before replacing the plugs.

**NOTE:** Direct-Drive Class II fans that are supplied with TECO motors have double shielded bearings on frame sizes 140T-280T. These bearings are pre-packed with a long life grease and are not regreaseable. Larger frame size TECO motors are regreaseable and follow the same lubrication recommendations as all other motors.

**Table 23: Recommended Lubricants and Amounts for Fan Motor Bearings**

Manufacturers' Grease	NEMA Size	Amount to Add (oz.)
Texaco, Polystar or Polyrex EM (Exxon Mobile) or Rykon Premium #2 or Penzoil Pen 2 Lube	56 to 140	0.08
	140	0.15
	180	0.19
	210	0.30
	250	0.47
	280	0.61
	320	0.76
	360	0.81
	400	1.25
	440	2.12

**NOTE:** Specific greasing instructions are located on a tag attached to the motor. If special lubrication instructions are on the motor, they supersede all other instructions.

## Fan Shaft Bearings

### CAUTION

For safety, stop rotating equipment. Add one half of the recommended amount shown in [Figure 24](#). Start bearing, and run for a few minutes. Stop bearing and add the second half of the recommended amount. A temperature rise, sometimes 30°F (1°C) after lubrication is normal. Bearing should operate at temperature less than 200°F (94°C) and should not exceed 225 (107°C) for intermittent operation. For a lubrication schedule, see [Table 22](#). For applications that are not in the range of the table, contact Daikin.

### CAUTION

[Table 24](#), [Table 25](#) and [Table 26](#) state general lubrication recommendations based on our experience and are intended as suggested or starting points only. For best results, specific applications should be monitored regularly and lubrication intervals and amounts adjusted accordingly.

Any good quality lithium or lithium complex base grease, using mineral oil, conforming to NLGI grade 2 consistency, and an oil viscosity of 455-1135 SUS at 100°F (100-200 cSt at 40°C) may be used for re-lubrication.

Compatibility of grease is critical. Lubricatable bearings are supplied with grease fittings or zerks for ease of lubrication with hand or automatic grease guns. Always wipe the fitting and grease nozzle clean.

**Table 24: Lubrication Intervals**

Speed	Bearing Temperature	Cleanliness	Lubrication Intervals
(Use NLGI #2 Lithium or Lithium Complex Grease)			
100 RPM	Up to 120°F (50°C)	Clean	6 to 12 months
500 RPM	Up to 150°F (65°C)	Clean	2 to 6 months
1000 RPM	Up to 210°F (100°C)	Clean	2 weeks to 2 months
1500 RPM	Over 210°F (100°C) to 250°F (120°C)	Clean	Weekly
Above 1500 RPM	Up to 150°F (65°C)	Dirty/Wet	1 week to 1 month
Max Catalog Rating	Over 150°F (65°C) to 250°F (120°C)	Dirty/Wet	Daily to 2 weeks
	Above 250°F (120°C)		Contact Browning

**Table 25: Recommended Lubricants for Fan Shaft Ball Bearings**

Name	Temperature	Base	Thickener	NLGI Grade
Texaco, Premium RB	30° to 350°F (34° to 177°C)	Parafinic Mineral Oil	Lithium	2
Mobil, AW2	40° to 437°F (40° to 175°C)	Mineral Oil	Lithium	2
Mobil, SHC 100	68° to 356°F (50° to 180°C)	Synthetic	Lithium	2
Chevron, Altiplex Synthetic	60° to 450°F (51° to 232°C)	Synthetic	Lithium	2
Exxon, Ronex MP	40° to 300°F (40° to 149°C)	Mineral Oil	Lithium	2

Note:  
Temperature ranges over 225°F are shown for lubricants only. High temperature applications are not suitable for standard air handler components.

**Table 26: Recommended Fan Lubrication Grease Charge**

Shaft Size in Inches (mm)	Weight in Ounces (grams)
1/2 to 3/4 (20)	0.03 (0.85)
7/8 to 1-3/16 (25-30)	0.10 (2.84)
1-1/4 to 1-1/2 (35-40)	0.15 (4.25)
1-11/16 to 1-15/16 (45-50)	0.20 (5.67)
2 to 2-7/16 (55-60)	0.30 (8.51)
2-1/2 to 2-15/16 (65-70)	0.50 (15.59)
3 to 3-7/16 (75-80)	0.85 (24.10)
3-1/2 to 4 (85-105)	1.50 (42.53)

## Fan Drive Adjustments

### ⚠ WARNING

Before servicing fans, lock out and tag out all power to the unit. Fans or belts can cause severe personal injury or death.

### ⚠ WARNING

Do not open the hinged access door and screw-fastened access panels while the unit is operating. Moving parts and strong suction forces can cause severe personal injury or death.

Upon completion of the air balance, replace the variable pitched motor sheave with a properly sized, fixed sheave. A matching fixed sheave provides longer belt and bearing life and minimizes vibration. Initially, it is best to have a variable pitched motor sheave for the purpose of air balancing. Once the balance is achieved, fixed sheaves maintain balancing and alignment more effectively. Replace the adjustable sheaves with fixed sheaves.

With the electrical power disconnected, locked and tagged out, measure the diameter of the V-belt outer surface where it passes around the sheave (pitch diameter). Calculate fan speed from the motor nameplate rpm.

$$\text{Fan RPM} = \text{motor RPM} \times \frac{\text{Measured diameter at motor sheave}}{\text{Measured diameter at fan sheave}}$$

## VM/VP Variable Pitch Key Type Sheaves

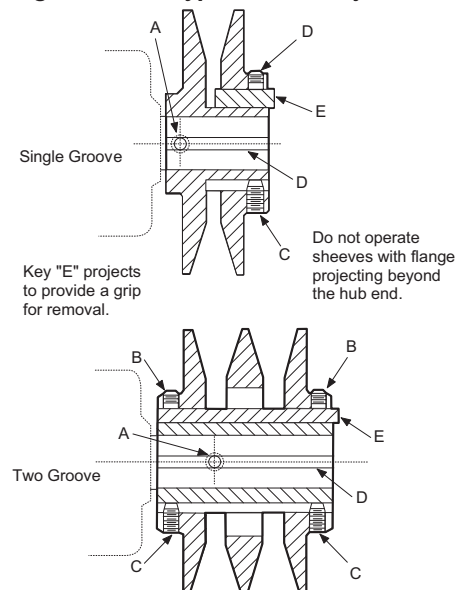
### Mounting:

1. Mount all sheaves on the motor or driving shaft with the setscrews **A** toward the motor.
2. Verify that both driving and driven sheaves are in alignment and that shafts are parallel.
3. Fit internal key **D** between sheave and shaft and lock setscrew **A** securely in place.

### Adjusting:

1. Loosen setscrews **B** and **C** in moving parts of sheave and pull out external key **E**. (This key projects a small amount to provide a grip for removing.)
2. To adjust sheave pitch diameter for desired speed, open moving parts by half or full turns from closed position. **Do not open more than five full turns for A belts or six full turns for B belts.**
3. Replace external key **E** and securely tighten setscrews **B** over key and setscrews **C** into keyway in fixed half of the sheave.
4. Put on belts and adjust tension. **Do not force belts over grooves.** See [Fan Drive Belt on page 42](#).
5. Make future adjustments by loosening the belt tension and increasing or decreasing the pitch diameter of the sheave by half or full turns as required. Readjust belt tension before starting drive.
6. To provide the same pitch diameter, adjust both halves of the two-groove sheaves by the same number of turns from closed position.
7. Verify that all keys are in place and that all setscrews are tight before starting drive. Check setscrews and belt tension after 24 hours service.

**Figure 52: VP Type Sheave Adjustment**



## LVP Variable Speed Sheaves

### Mounting:

1. Slide sheave on motor shaft so that the side of the sheave with setscrew **A** is next to the motor when setscrew **A** is in the hub or barrel of the sheave.
2. When setscrew **A** is at an angle in the center flange **B**, mount it away from the motor so that the outer locking ring and flange can be removed to get to the setscrew.
3. To remove the flange and locking ring:
  - a. Loosen setscrews **D**.
  - b. Loosen but do not remove capscrews **E**.
  - c. Remove key **F**.

NOTE: This key projects a small amount to provide a grip for removing.

- d. Rotate the flange counterclockwise until it disengages the threads on the sheave barrel.
4. Verify that the driving and driven sheaves are in alignment and the shafts are parallel. When aligning two-groove sheaves, allow room between the sheave and motor to access capscrews **E**.
  5. Insert key **C** between the sheave and the shaft and tighten setscrew **A** securely.
  6. If flange and locking ring have been removed, when replacing them make sure that the inner and outer flanges are open from the closed position by the same amount as the other flange. Determine this by accurately measuring the top width of the grooves.
  7. Insert key **F**.
  8. Tighten setscrews **D** and capscrews **E**.
  9. Put on belts and adjust belt tension. Do not force belts over grooves. See [Fan Drive Belt](#).
  10. Before starting the drive, ensure that all keys are in place and all setscrews and all capscrews are tight. Check and retighten all screws and retension belts after approximately 24 hours of service.

### Adjusting:

1. Slack off belt tension if belts have been installed.
2. Loosen setscrews **D**.
3. Loosen but do not remove capscrews **E**.
4. Remove key **F**.

NOTE: This key projects a small amount providing a grip for removing.

5. Adjust pitch diameter by opening or closing the movable flanges by half or full turns.

NOTE: Two-groove sheaves are supplied with both grooves set at the same pitch diameter. To provide the same pitch diameter for satisfactory operation, move both movable flanges the same number of turns. Do not open sheaves more than five turns for A belts or six turns for B belts.

6. Replace key **F**.
7. Tighten setscrews **D** and capscrews **E**
8. If belts have been installed, readjust belt tension. If belts have not been installed, install them and adjust belt tension. **Do not force belts over grooves.** See [Fan Drive Belt on page 42](#).
9. Before starting the drive, ensure that all keys are in place and all setscrews and all capscrews are tight. Check and retighten all screws and retension belts after approximately 24 hours of operation.
10. Replace variable speed sheaves for 15 hp motors and greater with a fixed pitch sheave after air balancing to maintain fan balance integrity. Fixed sheaves furnished by others.

## MVP Variable Speed Sheaves

### Mounting:

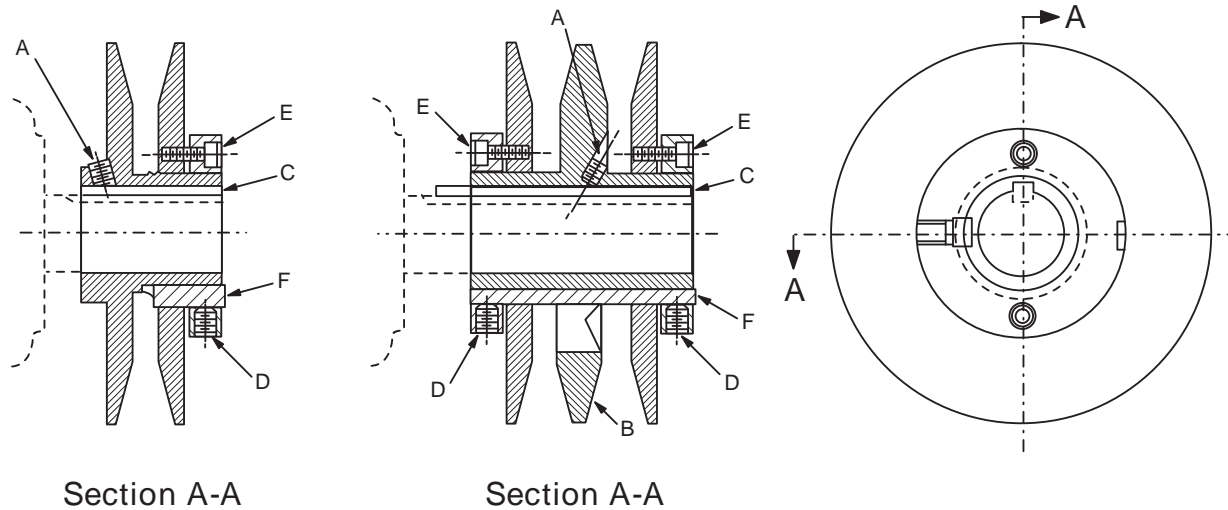
1. Verify both driving and driven sheaves are in alignment and the shafts are parallel. The centerline of the driving sheave must be in line with the centerline of the driven sheave (Figure 54).
2. Verify that all setscrews are torqued to the values shown in Table 27 before starting drive. Check setscrew torque and belt tension after 24 hours of service.

### Adjusting:

1. Adjust motor base forward to release belt tension. Remove the belts for easier adjustment.
2. Loosen, but do not remove both of the locking setscrews **A** in the outer locking ring by using a hex key or torque wrench with a hex bit.
3. Adjust sheave to desired pitch diameter by turning the outer locking ring, using a spanner wrench or drift inserted into the three holes that are located 120° apart on the ring.

4. Any pitch diameter can be obtained within the sheave range. One complete turn of the outer locking ring changes the pitch diameter 0.233".
5. Do not open sheaves more than the following
  - a. Do not open **B** sheaves more than 4-3/4 turns for the **A** belts or 6 turns for the **B** belts.
  - b. Do not open **C** sheaves more than 9-1/2 turns.
  - c. Do not open **5V** sheaves more than 6 turns.
  - d. Do not open **8V** sheaves more than 8 turns.
6. Tighten BOTH locking screws **A** in the outer locking ring before operating the drive. Use a torque wrench and tighten to the value shown in Table 27.
7. Replace belts and adjust the motor base to tension the belts properly. See Fan Drive Belt on page 42.
8. Do not loosen any screws other than the two locking screws **A** in the outer locking ring when adjusting the sheave pitch. Do not operate the drive until the locking screws have been set to the torque specifications.

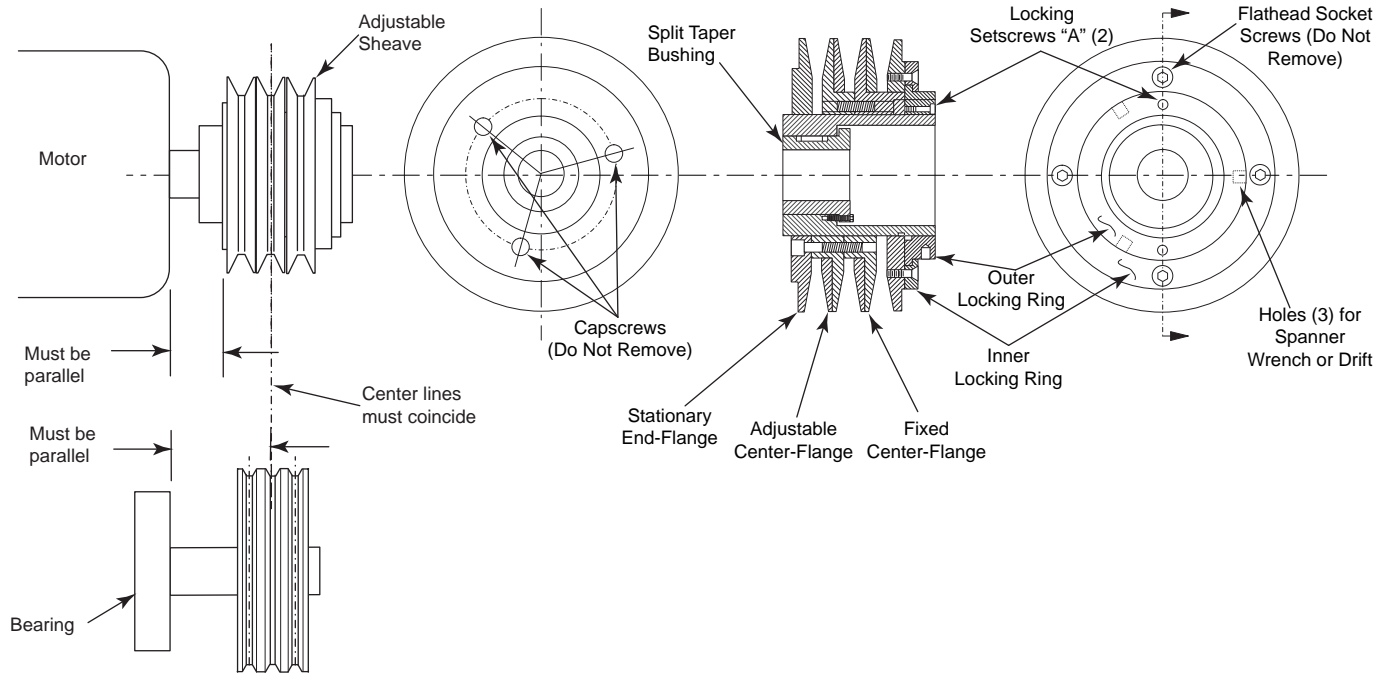
Figure 53: LVP Type Sheave Adjustment



**Table 27: Screw Torque Values**

Nominal Screw Size (dia-thds/in)	Socket Head Cap Screws		Flat Head Socket Screws	Hollow Head Set Screws Only			
	Seating Torque		Seating Torque	Lengths Equal or Greater Than Dia.		For Lengths (L) Less Than Dia.	
	(in-lbs)	(in-lbs)	(in-lbs)	Seating Torque	Seating Torque	Length (L)	Seating Torque
1/4-20NC	150	12.5	100	87	7.3	3/16	50
5/16-11NC	305	25.4	200	165	13.8	1/4	90
3/8-16NC	545	45.4	350	290	24.2	1/4, 5/16	150, 250
1/2-13NC	1300	108.3	N/A	620	51.7	N/A	N/A
5/8-11NC	N/A	N/A	N/A	1225	102.1	N/A	N/A

**Figure 54: MVP Sheave Adjustment**



## Fan Drive Belt

### General Rules of Tensioning

1. The ideal tension is the lowest tension at which the belt does not slip under peak load conditions.
2. Check tension frequently during the first 24 to 48 hours of operation.
3. Over tensioning shortens belt and bearing life.
4. Keep belts free from foreign material that can cause slippage.
5. Inspect V-drive on a periodic basis. Adjust tension if the belt is slipping. Do not apply belt dressing. This can damage the belt and cause early failure.

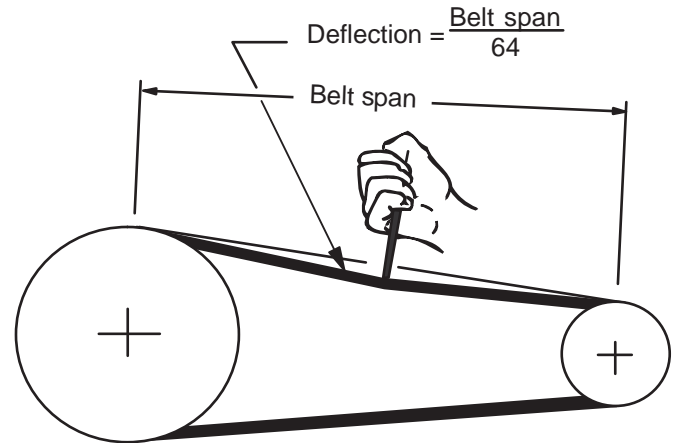
### Tension Measurement Procedure

1. Measure the belt span (Figure 55).
2. Place belt tension checker squarely on one belt at the center of the belt span. Apply force to the checker, perpendicular to the belt span, until the belt deflection equals belt span distance divided by 64. Determine the force applied while in this position.
3. Compare this force to the values in Table 28.

**Table 28: Belt Deflection Force (per Browning Specifications)**

Cross Section	Small Sheave Diameter (in)	Number of Belts (Deflection Force lbs)					
		1		2		3 +	
		Min	Max	Min	Max	Min	Max
A, AX	0.0 to 3.5	3.0	5.0	2.5	4.0	2.0	3.5
	3.6 to 4.4	3.5	5.0	3.0	4.5	2.0	4.0
	4.5 +	4.0	5.5	3.0	5.0	2.5	4.5
B, BX	0.0 to 5.4	5.5	8.0	4.5	7.0	3.5	5.5
	5.5 to 7.6	5.5	8.5	4.5	7.5	3.5	5.5
	7.7 +	6.5	9.0	5.0	8.0	4.0	6.5
5V, 5VX	0.0 to 8.5	7.0	11.0	5.5	9.0	4.0	7.0
	8.6 to 12.0	8.5	13.0	6.5	10.5	5.0	8.0
	12.1 +	10.0	15.0	7.5	11.5	5.5	9.0

**Figure 55: Drive Belt Adjustment**



### WARNING

Moving belt and fan can cause severe personal injury or death.

During installation and filter maintenance:

- Verify that the belt and fan guards on plenum fan units are always in place.
- Lock and tag out fans to prevent accidental start up.
- Do not enter the filter compartment until the fan is completely stopped.
- Use approved equipment for reaching filters located above normal reach. Do not step on filter frames or unit components.
- Floor surfaces must be dry and free of oil or grease.

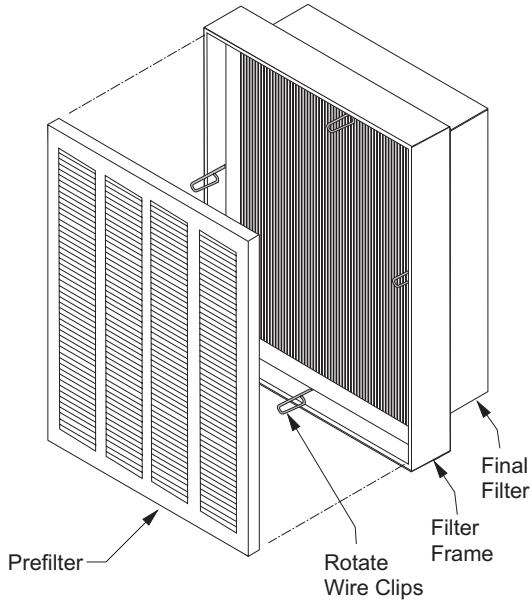
# Filters

## Front Load Filter Option

Front loaded filter options require that the filters be removed and replaced from inside the unit.

To remove filters, rotate the wire clips. This releases both the prefilter and the final filter. When installing clean filters, check to verify the filters are fully seated in the frame (Figure 56).

Figure 56: Frame and Filters with Holding Clips



## Filter Gauges

Filter gauges indicate pressure drop for installed filters. If prefilters are present, the gauge will indicate the pressure drop for both pre- and final filters.

Table 29 shows the typical filter pressure drop for clean filters at rated air flow. The tables also show a final pressure drop for front loaded filters.

Where a single filter gauge is used, the prefilters can be removed to check the pressure drop of the final filters.

Figure 57: Filter Gauge

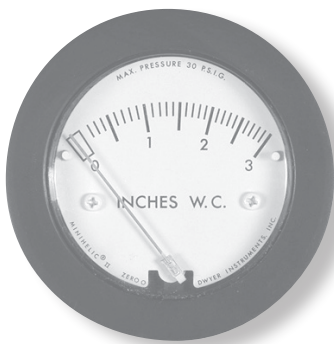


Table 29: Filter Pressure Drops

Bag filters—DriPak 2000				
Efficiency	45%	65%	85%	95%
Rated velocity (FPM)	625	500	500	500
Initial pressure drop	0.20–0.26	0.21–0.30	0.34–0.48	0.50–0.70
Initial pressure drop	1.0	1.0	1.0	1.0
Cartridge filters—Varicel II MH, 4.25" deep				
Efficiency	65%	85%	95%	
Rated velocity (FPM)	500	500	500	
Initial pressure drop	0.43	0.61	0.70	
Final pressure drop	1.5	1.5	1.5	
Cartridge filters—Varicel SH, 12" deep				
Efficiency	70%			
Rated velocity (FPM)	500			
Initial pressure drop	0.39			
Final pressure drop	1.2			
Pleated panel filters				
Type	Perfect pleat	AMAir 1300 4"		
Efficiency	30%	30%		
Rated Velocity (FPM)	500	625		
Initial Pressure Drop	0.36	0.36		
Final Pressure Drop	1.0	1.0		
5700 filters				
Efficiency	N/A			
Rated velocity (FPM)	500			
Initial pressure drop	0.25			
Final pressure drop	1.0			
Pleated 62 Plus filters				
Size	2"	4"		
Efficiency	70%	70%		
Initial pressure drop	0.42	0.37		
Final pressure drop	1.0	1.0		



## Coils

**⚠ CAUTION**

Sharp fin edges are a potential injury hazard. Avoid contact with them.

1. To obtain maximum performance, the coil must be clean. Check once a year under normal operating conditions and, if dirty, brush or vacuum clean. Use a chemical coil cleaner on multiple row coils. Read and follow the chemical cleaner's instructions as some cleaners may contain harsh chemicals. Take care not to damage fins while cleaning. **CAUTION—Fin edges are sharp.**
2. Drain pans in any air conditioning unit may have some moisture. Algae, etc., can grow due to airborne spores and bacteria. Periodic cleaning is necessary to prevent this buildup from plugging the drain and causing the drain pan to overflow. Also, keep the drain pans clean to prevent the spread of disease. Cleaning should be performed by qualified personnel.
3. Dirt and lint can clog the condensate drain, especially with dirty filters. Inspect twice a year to help avoid overflow.

## Winterizing Water Coils

**⚠ WARNING**

Mold can cause personal injury. Clean drain pan regularly so mold does not develop.

Coils can freeze due to air stratification or failure of outdoor air dampers and/or preheat controls. Drain all coils as thoroughly as possible and then treat in the following manner.

- Fill each coil independently with an antifreeze solution using a small circulating pump and again thoroughly drain.
- Check freezing point of antifreeze before proceeding to next coil. Due to a small amount of water always remaining in each coil, there is a diluting effect. The small amount of antifreeze solution remaining in the coil must always be sufficient enough to prevent freeze-up.

**NOTE:** Carefully read instructions for mixing antifreeze solution used. Some products have a higher freezing point in their natural state when mixed with water. Daikin is not responsible for the freezing of coils.

## Removing and Replacing Components

**⚠ WARNING**

Before removing any component, lock out and tag out all power to the unit. Fans and belts can cause severe personal injury or death.

### Removing a Side or Top Panel

1. Remove the flat head fasteners located along the sides of the panel.
2. Once all fasteners are removed, lift off the panel.

### Removing a Frame Channel

Frame channels that run the length of the unit along the top can be removed to allow access to both the side and top of the unit.

1. First remove any adjoining side and top panel(s).
2. Once the side panel is off, remove the flat head fasteners in the corner of the frame channels.
3. Pull the frame channel out the side.
4. If any top panel fastens into the frame channel (when the frame channel is 24" or wider in direction of air flow), remove the fasteners in the top panel before pulling out the channel.

## Removing the Fan Section

The fan shaft, motor, and any drive components can be removed and replaced through the access door opening. If required, the side panel can be removed for additional access.

If fan replacement is required, the entire fan assembly can be pulled out the side of the cabinet for housed fan assemblies. The fan assembly includes the fan housing, the bearing support, and the fan base.

1. Remove the side panels and any intermediate supports (follow instructions for side panel removal).
2. Once the panels and any intermediate supports are removed, disconnect the neoprene bulk head seal that is attached to the fan discharge.
3. Remove the four discharge angles that hold the neoprene canvas in place around the discharge opening.
4. Disconnect the fan sled from each of the corner mounts and pull the entire assembly out the side of the unit.
5. After the fan sled is out, loosen the fan bearings and pull out the shaft.
6. Disconnect the fan housing from the fan sled, and bearing support by removing the attaching bolts.
7. Replace the new fan, reconnect the shaft and bearings and put the fan assembly in the cabinet.
8. Replace panels and fasteners.

For plenum fan assemblies, the entire fan cabinet may need to be removed to replace the entire fan assembly depending on the length of the fan section. In some cases, the fan section is not long enough for the assembly to fit out the side of the cabinet. For those cases where it will fit, follow the above steps except the neoprene seal is a D-gasket on the inlet side that needs to be removed for plenum fans. Otherwise, the entire fan cabinet must be removed from the other sections and then the fan assembly can be removed out the discharge side of the cabinet.

## Removing and Replacing the Coil

The coil can be removed by the side, top, or a combination of both. The size and configuration of the coil affects how the coil can be removed. Single banks of coil are fastened only on the connection side of the unit. Stacked and staggered coils are fastened on both ends of the coil. See the instructions below for details to remove each coil type.

Before removing the coil, disconnect all piping. The instructions below assume the coil is mounted in a sectionalized coil section where the frame channel can be removed without affecting other components. If the coil section is unitized with other components, removing the top frame channel requires removing additional panels.

### Removing Single Coils

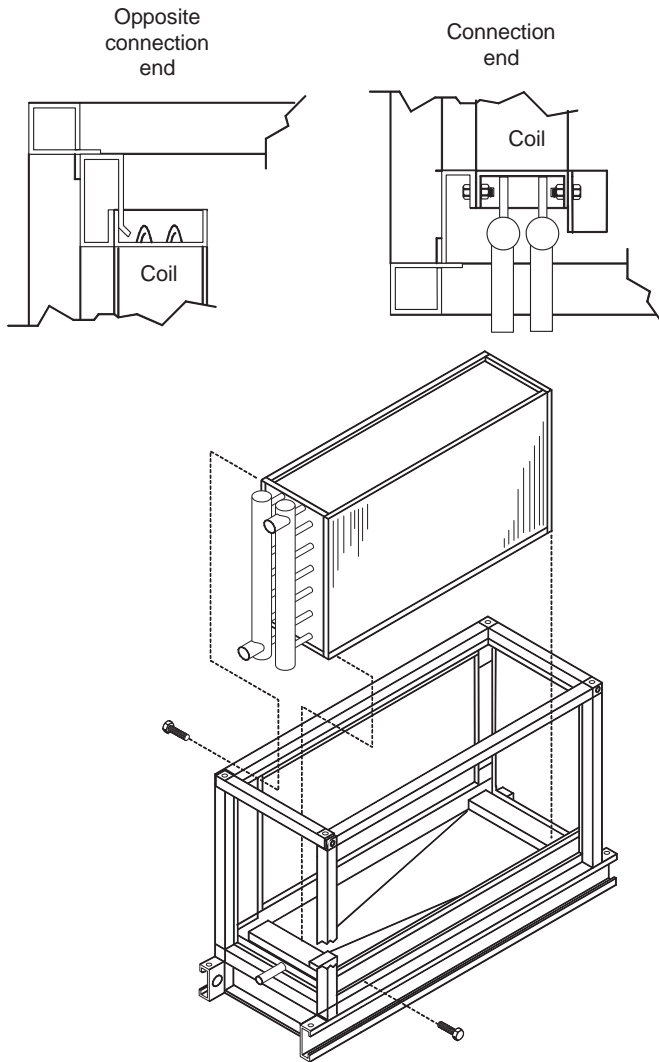
NOTE: Single coils are bolted to the unit on the connection end. The connection end is held in place with a clamp.

1. Disconnect all piping and remove the brass plugs for the vents and drains located in the connections.
2. Remove all screws and remove the access panel.
3. Remove the screws holding the coil in place.
4. Lift and pull the coil out the side.

### Installing Single Coils

1. Slide the coil through the opening in the coil section onto the bottom coil rests.
2. To prevent any air bypass around the coil, place coils up against the coil bulkheads (refer to [Figure 58](#)).
3. Once the coil is in place, fasten the coil to the section.
4. Caulk the seams between the coil casings and bulkheads (refer to [Figure 58](#)).
5. If this is an additional coil being installed and not a replacement, locate the coil supply and return connections dimensionally. Carefully drill holes in the end panels of the unit.
6. Remove the brass plugs for the vents and drains on the connections.
7. Slip the panel over the connections.
8. Replace the brass plugs and panel fasteners.

**Figure 58: Single Coil Removal**



**Installing Stacked Coils**

1. Slide the bottom coil through the opening in the coil section onto the bottom coil rests.
2. Place the coil up against the coil bulkheads to prevent any air bypass around the coil.
3. Once the coil is in place, bolt the coil to the section.
4. Caulk the mounting surface of the steel plate and install the plate on the coils.
5. Caulk the mounting surface of the drain trough and install the drain trough on the coils.
6. Caulk the seams between the coil casings and blockoffs.
7. Connect all piping and install the brass plugs for the vents and drains located in the connections.
8. Install the access panel.

**Removing and Installing Staggered Coils**

Staggered coils have two banks of coils positioned a few inches apart in the direction of airflow. Both coils are secured to the unit on the connection and opposite connection end of the unit.

1. Disconnect all piping and remove the brass plugs for the vents and drains located in the connections.
2. To access bolts holding the coils in place, remove the panels on both the connection and opposite connection end of the coil section.
3. Each coil is held in place with bolts located in the corners of the coil side plates. Remove the bolts and then lift and pull the coil out the side.
4. The bottom coil is fastened to the air block off plate. Remove the screws attaching this plate to the coil.
5. Once the fasteners holding the coil in place are removed, pull out the coil from either side of the unit.
6. Install the coils in reverse order of removal.

**Removing Stacked Coils**

**NOTE:** Top and bottom stacked coils are held together with steel plate and screws on one side and drain trough and screws on the other side. Remove the plate and trough before removing the coils. The coils cannot be removed attached together.

1. Disconnect all piping and remove the brass plugs for the vents and drains located in the connections.
2. Remove all screws and remove the access panel.
3. Remove the bolts holding the coil in place and then lift and pull out the coil from the side.
4. Remove the steel plate and the drain trough that hold the coils together.
5. Remove the bolts on both ends of the top coil holding it in place and then lift and slide the coil out.
6. Remove the bolts on both ends of the bottom coil holding it in place and then lift and slide the coil out.

## Replacement Parts

When writing to Daikin for service or replacement parts, refer to the model number and serial number of the unit stamped on the serial plate attached to the unit. If replacement parts are required, mention the date of installation of the unit and date of failure, along with an explanation of the malfunctions and a description of the replacement parts required.

## Warranty

Consult your local Daikin Representative for warranty details. Refer to Form 933-430285Y. To find your local Daikin Representative, go to [www.DaikinApplied.com](http://www.DaikinApplied.com).

## Warranty Return Material Procedure

Defective material may not be returned without permission of authorized factory service personnel of Daikin in Minneapolis, Minnesota, (763) 553-5330. A "Return Goods" tag must be included with the returned material. Enter the required information to expedite handling and prompt issuance of credits. All parts must be returned to the appropriate Daikin facility, designated on the "Return Goods" tag. Transportation charges must be prepaid.

The return of the part does not constitute an order for replacement. Therefore, a purchase order must be entered through the nearest Daikin representative. The order should include part number, model number, and serial number of the unit involved.

Credit will be issued on customer's purchase order following an inspection of the return part and upon determination that the failure is due to faulty material or workmanship during the warranty period.

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 8108 2.4 Cabinet Unit Heaters

Submittal Number: 1

Item: Cabinet Unit Heaters

Manufacturer: Zehnder

Model #: RFFC-410-03

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 8108 2.1 Terminal Heat Transfer Units

Submittal Number: 1

Item: Unit Heaters

Manufacturer: Zehnder

Model #: RH-108

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No





### General Information:

Installation and service instructions in this manual are applicable to the steam/hot water unit heaters which should be installed in their proper applications for their most effective function as overhead heating units. The copper coils are warranted for operation at steam or hot water pressures up to 180 psig, and/or temperatures up to 360°F. National Electric Code (NEC) or Canadian Electric Code (CEC) ignition temperature rating T3B for grain dust.

**DO NOT REMOVE OUTLET FAN GUARD FROM MODEL RV UNITS.**

### Inspection on Arrival:

1. Inspect unit upon arrival. In case of damage, report immediately to transportation company and your local Rittling Sales Representative.
2. Check rating plate on unit and motor to verify that power input and motor specification meet available electric power at point of installation.
3. Inspect unit received for conformance with description of product ordered (including specifications where applicable).



### INSTALLER'S RESPONSIBILITY

***Installer Please Note:*** This equipment has been test fired and inspected. It has been shipped free from defects from our factory. However, during shipment and installation, problems such as loose wires, leaks, or loose fasteners may occur. ***It is the Installer's responsibility to inspect and correct any problems that may be found.***

## Installation:

### SPECIAL PRECAUTIONS

1. Disconnect power supply before making wiring connections to prevent electrical shock and equipment damage. All units must be wired strictly in accordance with wiring diagram furnished with unit.
2. Units should not be installed in atmospheres where corrosive fumes or sprays are present.
3. Units with power codes 01, 02, or 05 must not be installed in potentially explosive or flammable atmospheres.
4. Be sure no obstructions block air intake or air discharge of unit heater.
5. Do not install unit above recommended maximum mounting heights or below the minimum height of eight feet.

### UNIT SUSPENSION

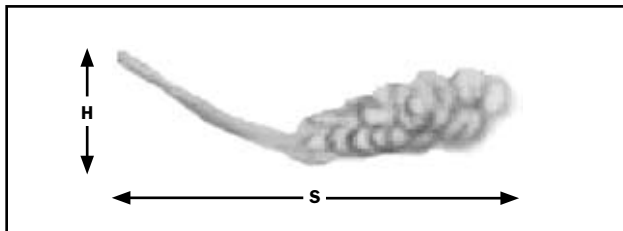
#### Horizontal Delivery Units, Model RH Series

All horizontal delivery units have two tapped holes (3/8"-16) in the top for unit suspension. Piping support hangers or clamps are recommended and should be placed as close to the unit heater as possible. For other models, independent suspension can be made with threaded rods, pipes, or ceiling hanger brackets.

#### Vertical Delivery Units, Model RV Series

Models RV-42 through RV-161 have 4 tapped holes (1/2"-13) on the top surface for unit suspension. Suspension can be made with threaded rods, pipes, or ceiling hanger brackets. Models RV-193 through V-610 have angle-iron frame mounting brackets for heavy-duty installation with applicable hardware.

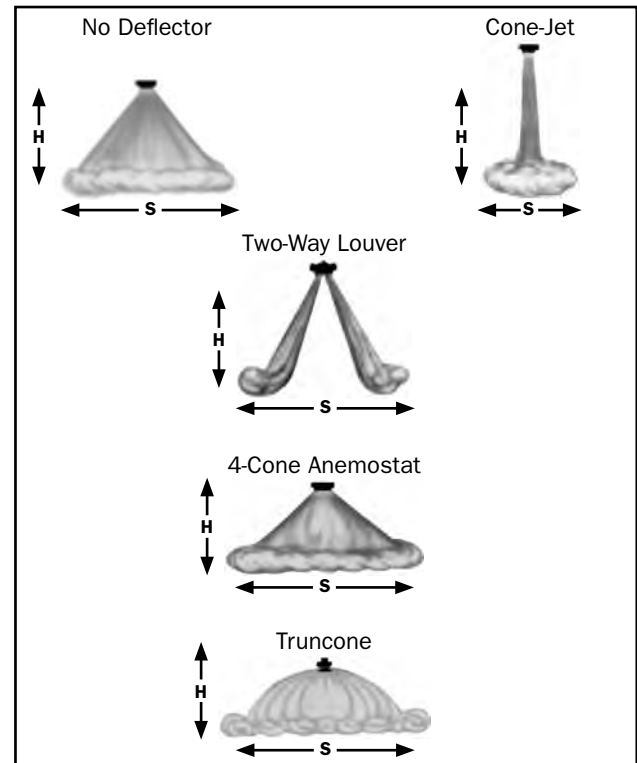
#### Horizontal Air Delivery



## Unit Heater Mounting Height:

Do not install unit above recommended maximum mounting heights or below the minimum height of eight feet. The height at which unit heaters are installed is critical. Maximum mounting heights for all units are listed below. Maximum mounting heights for Model RV is given for units with or without air diffusion accessories. Locate horizontal delivery unit heaters so air streams of individual units wipe the exposed walls of the building with either parallel or angular flow without blowing directly against the walls. Heaters should be spaced so the air stream from one supports the air stream from another heater. Locate vertical delivery unit heaters in the center area of the space to be heated, using horizontal delivery unit heaters along the walls where heat loss is usually greatest. See Mounting Height.

#### Vertical Air Delivery



## MAXIMUM MOUNTING HEIGHTS

Horizontal Type			Vertical Type														
Model Number	Height - Ft.		Model Number	No Deflector		Cone-Jet		Truncone		One-Way Louvers		Two-Way Louvers		3-Cone Anemostat		4-Cone Anemostat	
	H	S		Height - Ft.	Height - Ft.	Height - Ft.	Height - Ft.	Height - Ft.	Height - Ft.	Height - Ft.	Height - Ft.	Height - Ft.	Height - Ft.	Height - Ft.	Height - Ft.	Height - Ft.	
	H	S		H	S	H	S	H	S	H	S	H	S	H	S	H	S
RH-18	9	17	RV-42	11	17	15	11	8	19	13	11	8	22	8	22	8	28
RH-24	9	18	RV-59	13	20	18	13	9	25	16	14	10	28	9	28	8	35
RH-33	10	20	RV-78	14	22	19	14	11	26	17	15	11	30	11	30	8	30
RH-47	12	25	RV-95	16	24	21	16	11	26	17	15	11	30	11	30	8	30
RH-63	14	29	RV-139	18	27	24	18	13	32	21	18	13	36	13	36	9	45
RH-86	15	31	RV-161	21	31	28	21	14	35	23	20	14	40	14	40	10	50
RH-108	15	32	RV-193	23	34	31	23	16	39	25	22	15	44	16	44	12	55
RH-121	16	33	RV-212	25	37	33	25	16	39	25	22	15	44	16	44	12	55
RH-165	17	34	RV-247	26	39	34	26	17	46	30	26	18	52	17	52	13	65
RH-193	18	37	RV-279	30	45	37	30	18	53	35	30	21	60	18	60	13	75
RH-258	19	40	RV-333	30	45	37	30	17	53	35	30	21	60	17	60	13	75
RH-290	20	44	RV-385	30	45	36	30	17	53	35	30	21	60	17	60	13	75
RH-340	20	46	RV-500	37	56	44	37	19	65	42	37	26	74	19	74	13	93
			RV-610	36	54	43	36	19	63	41	41	25	72	-	-	-	-

### Installation:

Suggested Piping Arrangements

#### PIPING INSTALLATION

#### Horizontal and Vertical Unit Heaters

Note: Only make piping connections using two (2) pipe wrenches. One wrench is used as a “back-up” while the other wrench is used for applying force necessary to tighten the fitting.

The illustrations, on right, suggest four (4) different piping configurations. Refer to the ASHRAE Guide & Specialty Manufacturer for selection of filter, piping traps and other specialty sizing. Piping is typical for unit heaters.

#### Wiring Instructions

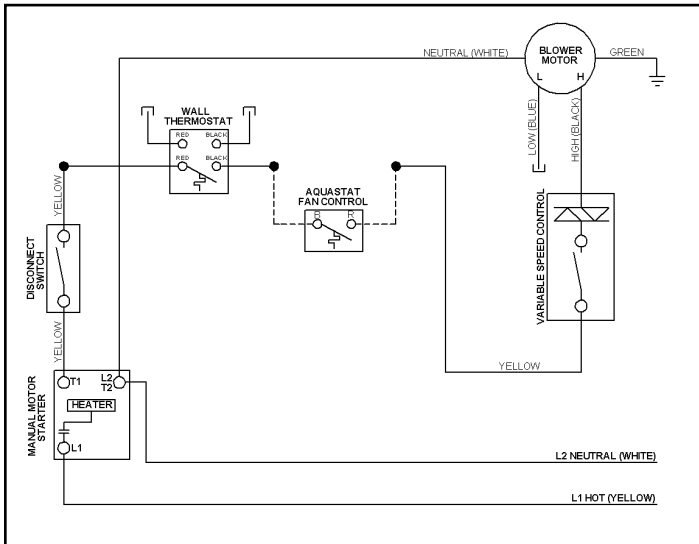
Disconnect power supply before making wiring connections to prevent electrical shock and equipment damage. All units must be wired strictly in accordance with wiring diagram.

All wiring must be done in accordance with the National Electric Code and applicable local codes. In Canada, wiring must conform to the Canadian Electric Code. It is recommended that all wiring be adequately grounded.

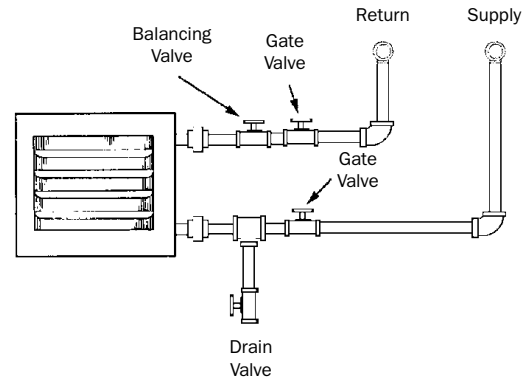
Electric wiring must be sized to carry the full load amp draw of the motor, starter, and any controls that are used with the unit heater. All units with power code 05 (polyphase motors) must be provided with suitable overcurrent protection in circuit supplying heater at installation. Overcurrent protectors should be sized based on motor current rating shown on the unit serial plate, and applicable national electric code procedures.

All units should be installed with an electrical junction box. Junction boxes are either integral to the motor or to be attached to the unit casing. Units with explosion-proof motors have an explosion-proof junction box attached to the motor. Any damage to or failure of Rittling units caused by incorrect wiring of the units is not covered by Rittling’s standard warranty.

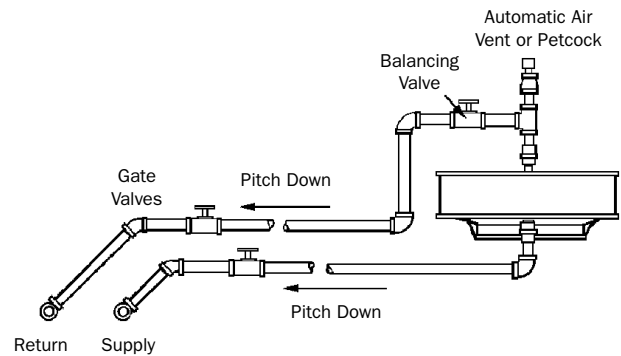
## Standard Wiring Schematic - 120V Power Source



## Hot Water Systems



**Horizontal Unit Heater Connected to Overhead Hot Water Mains**



**Vertical Unit Heater Connected to Lower Hot Water Mains**

## Operation:

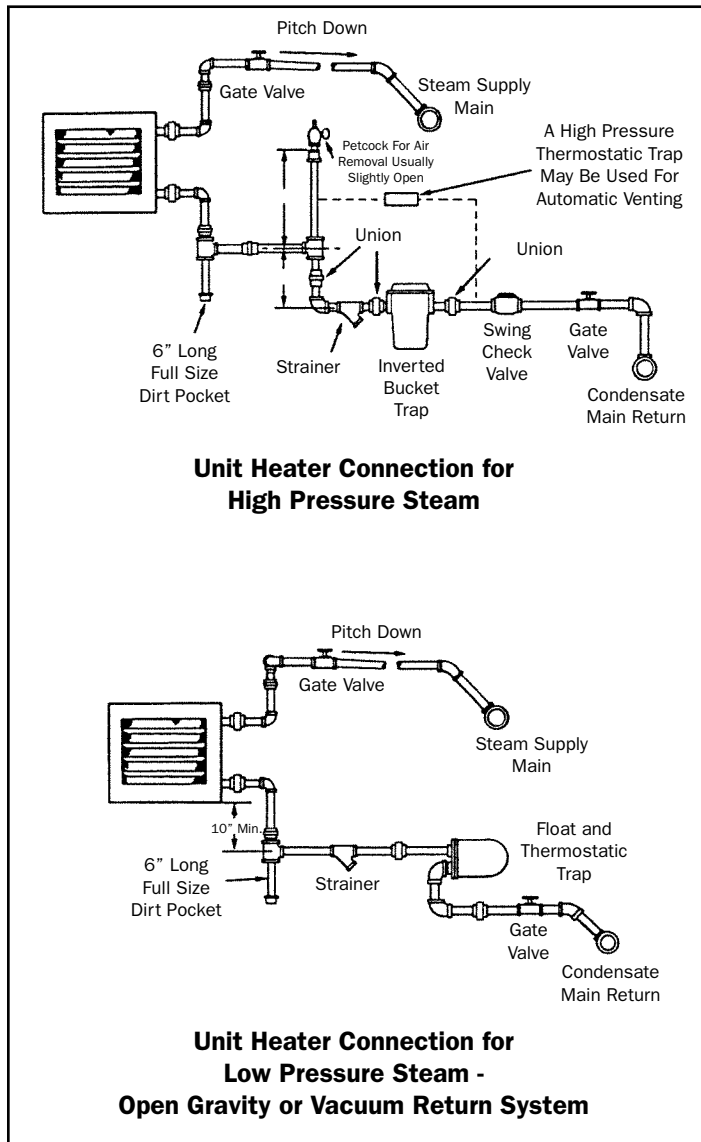
### Prior to Operation

1. Check all electrical connections to assure they are secure.
2. Check rigidity of unit mounting. Tighten all fasteners, if necessary.
3. Inspect piping, strainers, traps, fittings, etc.

### Initial Start-Up

1. Set thermostat to lowest position.
2. Turn on power supply to unit.
3. Open return gate valve, and then open supply gate valve to unit.
4. Raise thermostat setting to desired position.
5. Adjust louvers (if provided) for desired heat distribution.
6. To ensure proper sequence of operation, cycle unit on and off a few times by raising and lowering thermostat setting.
7. Check for proper rotation of fan. All fans must rotate in a counterclockwise direction when viewed from the back (RH) of the unit heater.

## Steam Systems



## Maintenance:

### Inspect Regularly

Under average conditions, it is recommended that unit heaters be inspected before every heating season — more often in locations where air is contaminated with corrosive fumes, dust, soot or oil spray. Check for dirty, clogged coils, excessive vibration and loose connections. Inspect piping, strainers, traps, fittings, etc.

### MOTORS

#### A. Cleaning

Remove grease and dirt on motor during each inspection or lubrication. Open frame motors should be blown clean every heating season, or whenever coils are cleaned, whichever is sooner.

#### B. Lubrication

Motors do not have oil fittings. These motors are lubricated for long life and do not require further lubrication.

#### C. Overload Protection

A change in line voltage higher or lower than motor nameplate rating may cause overheating and serious motor damage. Check plant voltage conditions. A separate manual starter with thermal overload protection device is recommended for those units that do not have motors with built in overload protection.

### CASINGS

#### A. Cleaning

Periodic cleaning of casings is recommended to remove dirt, grease and corrosive substances that may injure finish. Rusted or corroded spots should be cleaned and repainted.

#### B. General Inspection

Tighten fan guard and motor bracket. Check fan for proper clearance, free rotation and firm connection to shaft. When servicing is complete, tag unit to indicate date of inspection and cleaning.



## Maintenance: (con't.)

### COILS

#### A. Cleaning

Clean coil at least once a year, more often under unfavorable conditions. Unless coil is kept reasonably free of dirt, lint and grease, its original heating capacity will be reduced — possibly to a serious degree, and motor damage may result. Two commonly used cleaning methods are:

1. Loosen dirt by brushing fins on side where air enters coil and then turn on fan to blow dirt from unit.
2. Use high-pressure air hose to loosen dirt by blowing from side where air leaves coil (side adjacent to louvers on blow-through units (RH); side adjacent to fan on draw-through units (RV)). For thorough cleaning of coil, remove motor and fan and spray a mild alkaline cleaning solution over the coil. After a few minutes, follow by a hot water rinse. (A steam gun can be used for spraying cleaning solution and hot water.) Coils subjected to corrosive fumes should be checked and cleaned frequently.

#### B. Internal Corrosion Safeguards

Provide controlled water treatment — don't use excess of boiler compounds. Contact your boiler compound supplier for proper usage or the services of a water treatment laboratory. Periodic internal flushing of the coils is recommended in areas where water supply is suspected of causing scale. Use an alkaline-chelant solution and introduce it at the main pump of the hydronic system. Flush thoroughly.

WARNING: USING INORGANIC OR MINERAL ACIDS SUCH AS MURIATIC (HYDROCHLORIC) ACID, EVEN THOUGH INHIBITED, MAY LEAD TO SEVERE DAMAGE, INCLUDING CORROSION AND LEAKAGE.

De-aerate boiler feed-water (particularly if large amount of new water is used). Ensure rapid continuous and adequate condensate drainage by properly sized and installed traps and piping. Check traps for sticking. Clean strainers ahead of traps. (When traps don't work, condensate accumulates in unit heater coil; water hammer results.) Adequately vent each unit. Use low-pressure steam when possible.

THE EQUIPMENT COVERED IN THIS MANUAL SHOULD BE INSTALLED, MAINTAINED AND SERVICED BY A QUALIFIED LICENSED TECHNICIAN. FOR SERVICE, CONTACT YOUR LOCAL LICENSED QUALIFIED INSTALLATION AND SERVICE CONTRACTOR OR APPROPRIATE UTILITY COMPANY.

## WARRANTY

Hydro-Air Components, Inc., manufacturer of the Rittling product line, guarantees this product to be free from defects in material and workmanship for a period of two years from date of shipment from our Buffalo, New York factory.

Should there be any defects in the good(s), the purchaser should promptly notify Hydro-Air Components, Inc. and upon receipt of written consent from Hydro-Air Components, Inc., the purchaser shall return the defective good(s) to the factory for inspection with freight prepaid. If inspection shows the goods to be defective, Hydro-Air Components, Inc. will at its discretion repair or replace the said item(s).

Defects arising from damage due to shipment, improper installation, negligence or misuse by others are not covered by this warranty.

This warranty is extended only to the original purchaser from Hydro-Air Components, Inc.

*Hydro-Air Components Inc., in its continuous product improvement program, reserves the right to change any and all information provided in this document without notice.*



100 Rittling Blvd. • Buffalo, NY 14220  
Phone: 716-827-6510 • Fax: 716-827-6523  
Toll-Free: 800-FIN-TUBE (800-346-8823)  
E-mail: sales@rittling.com • www.Rittling.com



UH\_IOM\_0309

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 23 8108 2.4 Cabinet Unit Heaters

Submittal Number: 1

Item: Cabinet Unit Heaters

Manufacturer: Zehnder

Model #: RFFC-410-03

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No



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# Console Fan Coil and Cabinet Unit Heaters

## Installation, Operation and Maintenance

Heating

Cooling

Fresh Air

Clean Air

### General information

Take care to ensure this equipment is properly installed and serviced. This will ensure trouble-free service and performance.

Check unit carefully to be sure no damage was incurred during shipping. Any concealed or visible damage should be noted and repaired prior to installation.

### General start-up and checklist

- Ensure that all field wiring meets national and local electrical codes.
- Make sure all piping connections are tested for leaks before startup.
- Be sure unit has filter medium installed correctly prior to start up. **Do not operate unit without filter installed.**
- Go to electrical panel box and turn breaker on.
- Test speed switch on each setting (OFF, HI, MED, LO).
- Set unit to desired position for operation.

### Installation instructions

- All units come pre-assembled.
- Remove the front cover to allow access to the (4) key-holed mounting slots located on the back of the unit. Using 1/4" hardware, fasten the unit to an appropriate mounting surface. On ceiling units the front cover is not removable and must be opened to access the mounting slots.
- Install trim frame on recessed units using (10) TEK screws provided with units. Trim shall be installed prior to mounting unit or, where applicable, after unit is installed where clearance around unit allows proper access. Coils are shipped with lefthanded connections unless otherwise specified. All electrical components aside from valve packages are wired opposite piping connection.



**Model FFRC**  
Console Fan Coil, Fully Recessed Ceiling Unit



**Model RS**  
Cabinet Unit Heater, Sloped Top Floor Unit

- Complete the wiring in accordance with national and local codes. Floor and wall units come pre-wired with four-position speed switch.
- Motors are 115 volt, 60 Hertz, single phase, with a permanent split capacitor, internal electrical overload, and permanently lubricated bearings. Wiring information for standard controls are included on separate sheets.

# Operation and maintenance

## **WARNING**

Disconnect power supply from unit before servicing.

### Motors

Standard motors on all fan coils and cabinet unit heaters have permanently lubricated bearings. **Do not lubricate.**

### Coils

Clean the coil at every inspection. Compressed air can be used to blow out the element. If thorough cleaning is needed, remove the element and spray with a mild alkali cleaning solution. Rinse the element thoroughly before installation.

### Fan

The fan should be cleaned at every inspection. Remove any dust or debris that may accumulate on the fan or motor. Tighten any fasteners that may have loosened due to vibration.

### Filter

The filter should be checked at every inspection. If an excessive amount of dust has accumulated on filter, replace with a new filter.

## Warranty

Zehnder Rittling guarantees its products to be free from defects in material and workmanship for a period of two years from date of shipment from our factory.

Should there be any defects in the goods; the purchaser should promptly notify Zehnder Rittling. Upon receipt of written consent from Zehnder Rittling, the purchaser shall return the defective goods to the factory for inspection with freight prepaid. If inspection shows the goods to be defective, Zehnder Rittling will at its discretion, repair or replace the said items.

Defects arising from damage due to shipment, improper installation, negligence or misuse by others are not covered by this warranty.

This warranty is extended only to the original purchaser from Zehnder Rittling.

Zehnder Rittling works continually to improve its products. As a result, the design and specifications of each product at the time of order may be changed without notice and may not be as described herein. Please contact Zehnder Rittling's Sales Support staff at 716-827-6510 for specific information on the current design and specifications. Statements and other information contained herein are not express warranties and do not form the basis of any bargain between the parties, but are merely Zehnder Rittling's opinion or commendation of its products. The latest version of this document is available at [www.zehnder-rittling.com](http://www.zehnder-rittling.com).

© Zehnder Rittling June 2012, English, subject to change without notice

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: Appendix A – Test Reports

Submittal Number: 1

Item: Hydronic, Domestic & Air Balancing

Manufacturer:

Model #:

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

# HAINES HS VOCATIONAL EDUCATION BUILDING UPGRADES

## OPERATION & MAINTENANCE

### INDEX

APPENDIX A: TEST REPORTS.....Tab L

1. Hydronic Systems Test Report
2. Domestic Water Test Report
3. Alaska Air Balancing Test Report

# TEST REPORT

**DATE:** August 19<sup>th</sup>, 2015

**PROJECT:** Haines Vocational Technology Bldg. Mechanical Upgrades

**SYSTEM TESTED:** HYDRONIC SYSTEM

**TEST PROCEDURE:** Hydrostatic test at 1 ½ times working pressure to test for leaks. Flush and inject TSP detergent. Run at system temperature for 24 hours. Flush and fill with 50/50 glycol

**DURATION:** Hydrostatic tested for 4 hours. Repair leaks. Circulate Cleaning agent for 24 hours at 160 degree. Flush all and fill system with glycol.

**TEST RESULTS:** All tests OK

**TESTED BY:** Clinton Melin, Project Plumbing Foreman, Custom Mechanical Systems

**SIGNED:** 

# TEST REPORT

**DATE:** August 30<sup>th</sup>, 2015

**PROJECT:** Haines Vocational Technology Bldg. Mechanical Upgrades

**SYSTEM TESTED:** Domestic Water System

**TEST PROCEDURE:** Hydrostatic test at 1 ½ times working pressure to test for leaks. Flush and disinfect with chlorine to min 50 PPM. After 24 hours test for min 25 PPM. Flush and test for residual of less than 4 PPM

**DURATION:** Hydrostatic tested for 4 hours. Disinfection for 24 hours

**TEST RESULTS:** All tests OK

**TESTED BY:** Clinton Melin, Project Plumbing Foreman, Custom Mechanical Systems

**SIGNED:** 





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3060 Lazy Eight Court #10 -Wasilla, Alaska 99654

Phone: (907) 373-1090

Fax: (907) 373-3586

## TEST AND BALANCING REPORT

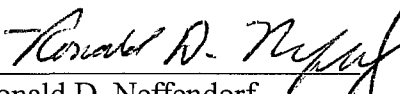
Subject Job: Vocational Technical Building  
Mechanical & Electrical Upgrades  
Haines, Alaska

Architect:

Engineer: Murray & Associates P.C.  
P.O. Box 21081  
Juneau, Alaska 99802

Contractor: Custom Mechanical Inc.  
2030 East Bradley Circle  
Wasilla, Alaska 99654

Certified By:

  
Ronald D. Neffendorf  
Certification Number 2955  
Expires March 31, 2016



Date:

Sept. 15, 2015

The data presented in this report is a record of the system measurements and final adjustments that have been obtained in accordance with the current edition of the NEBB procedural standards for the testing, adjusting, and balancing of the environmental systems. Any variances from the design quantities, which exceed NEBB tolerances, are noted in the test-adjust-balance report project summary (Job Inspection Report).



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Phone: (907) 373-1090  
September 15, 2015

## **JOB INSPECTION REPORT**

### **Vocational Technology Building Mechanical and Electrical Upgrades Haines, Alaska**

#### **VU-1**

1. This fan was balanced to design cfm at 46 hertz (76.7%).
2. The Ebtron flow measuring device on the outside air was not operational at time of testing. With the fan at 46 hertz and the outside air damper at 13% per the controls we measured 780 cfm. Once the control contractor has fixed the Ebtron and can program it with the airflow we measured and set the different outside air settings with the different exhaust fan per the control schedule.
3. The minimum cfm of 3,500 was achieved at 27 hertz (45%).

#### **EF-1, EF-2, EF-3, & EF-4**

1. All of these fans tie into the same discharge plenum and the airflows for these fans varies depending on how many of the fans are running.

#### **EF-1**

1. Within design cfm when running by itself, however it is low of design when all fans are running.

#### **EF-3**

1. Fan is high of design when running by itself, however it is within design cfm when all fans are running.
2. This fan serves 4 Welding Booths each booth has 2 outlets, one at the ceiling and one at the welding table. No cfm's were given on the mechanical plans. We were instructed by the mechanical engineer to divide the total cfm evenly between these outlets. The dampers serving the ceiling outlets are existing and cannot be locked into place.

#### **EF-4**

1. Fan is within design cfm when running by itself, however it is low of design cfm with all the fans running. There is not enough duct on outlet #1 for a traverse. The cfm for outlet 1 was determined by subtracting the cfm from outlet 2 from the fan total.

**EF-5**

1. Fan has a design cfm of 400 and is doing 265 cfm with its speed selector turned all the way up and its motor at rated amperage. The ductwork for this fan goes from a 10" round to a 4" round at the laser cutter.

**TEF-1 & TEF-2**

1. Balanced fans to within design cfm.

**P-1**

1. Three speed pump set at speed one to meet design gpm.

**P-2**

1. Design for pump is 50 gpm, system total is 62.8 gpm.
2. Pump was balanced with VFD at 62 hertz and a differential set point of 15 psi. However the differential pressure sensor is across the control valve on the bypass loop. This is probably giving an inaccurate measurement and should be moved. Once the differential pressure sensor is moved then the control contractor can determine the correct pressure set point by putting the pump to 62 hertz and putting the system on a full call for heating.
3. The bypass loop was set with the 2 UH's in the Wood Shop valved off.

# ALASKA AIR BALANCING INC.

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3060 Lazy Eight Court #10-Wasilla Alaska 99654

Phone: (907) 373-1090

Date: September 16, 2015

## AIR MOVING EQUIPMENT DATA SHEET

PROJECT NAME : Vocational Technology Building - Mechanical & Electrical Upgrades

LOCATION : Haines, Alaska

<b>System</b>	VU-1 High Speed	VU-1 Low Speed
<b>Equip. Location</b>	Fan Mezzanine	Fan Mezzanine
<b>Area Served</b>	Voc. Shop	Voc. Shop
<b>Equip. Manufacturer</b>	Daikin	Daikin
<b>Model</b>	AF22DD	AF22DD
<b>Serial Number</b>	FB0U150600957	FB0U150600957

	Required	Actual	Required	Actual
<b>Motor Manufacturer</b>		Teco		Teco
<b>Motor HP</b>	7.5	7.5	7.5	7.5
<b>Motor RPM</b>	1750	1750	1750	1750
<b>Phase</b>	3	3	3	3
<b>Voltage</b>	208	207 208 208	208	207 208 208
<b>Amperage</b>	20.70	7.30 7.10 7.30	20.70	
<b>Starter Heaters</b>	VFD		VFD	

<b>Fan RPM</b>	1750	N/A	810	N/A
<b>Motor Sheave</b>	Direct Drive		Direct Drive	
<b>Fan Sheave</b>				
<b>Belts</b>				

	Required	Actual	Required	Actual
<b>Total CFM - Fan</b>	6,000	6,047	3,500	3,524
<b>Total Static Pressure</b>	2.98	1.05	1.50	N/A
<b>Suction</b>		0.79		
<b>Discharge</b>		0.26		

Remarks: VU-1 VFD at 46 hertz. VFD at low speed is 27 hertz (45%).

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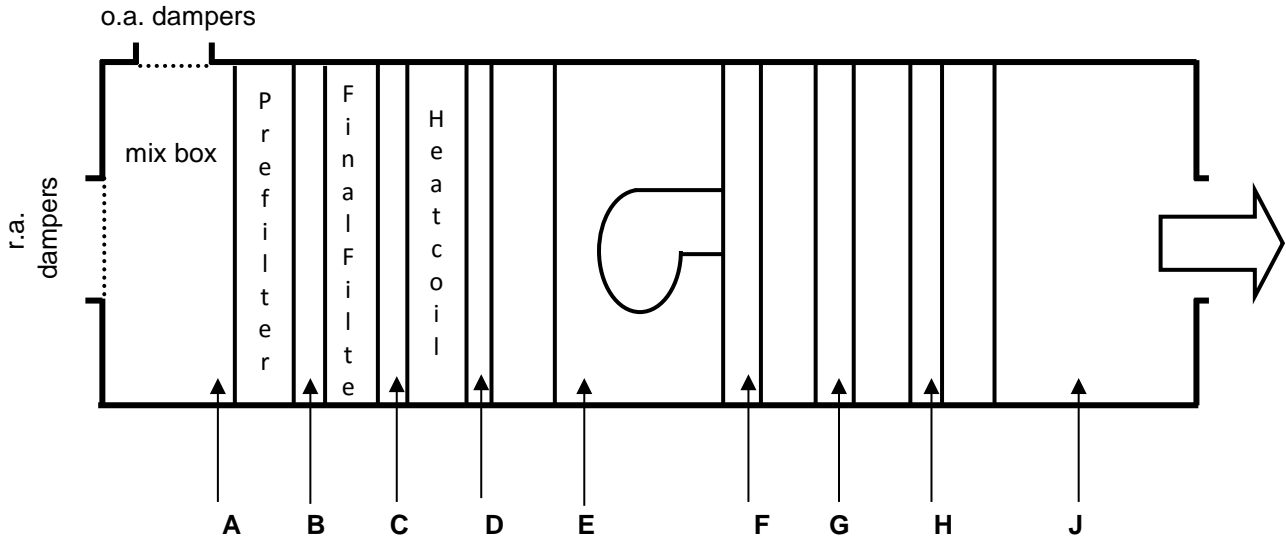
Phone: (907) 373-1090

Date: September 16, 2015

## STATIC PRESSURE PROFILE

PROJECT NAME : Vocational Technology Buiding - Mechanical & Electrical Upgrades

LOCATION : Haines, Alaska



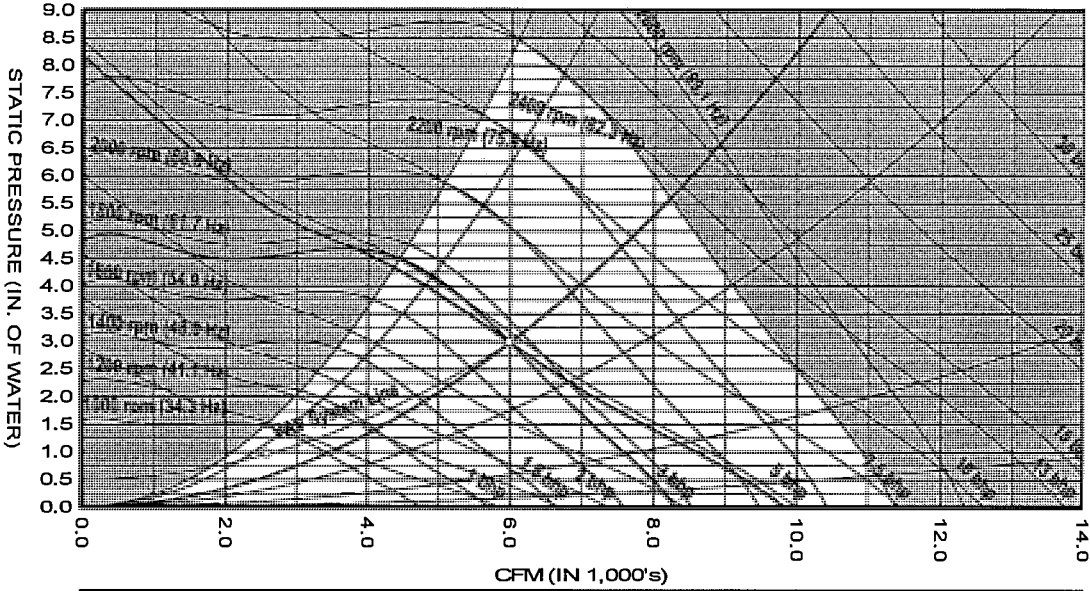
Unit	A	B	C	D	E	F	G	H	J
VU-1	-0.24	N/A	-0.64		0.79				0.26

Remarks: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

TAB Technician: Ron Neffendorf

Date Balanced: 9/14/15

Daikin AHU Fan Curve



AF 22 DD PLENUM 12BL (79% Width) 1x1 Supply Fan at Standard Conditions					
Air volume	6000	cfm	Fan speed	1750	rpm
Total static	2.98	insWg	Max speed	2403	rpm
Brake horsepower	4.8	bhp	Efficiency	59.1	%
Minimum CFM	2591	cfm	Minimum Fan Speed	810	rpm
Approx VFD Setting	60.0	Hz	Motor Speed	1750	rpm
Unit tagging	VJ-1		Date	April-29-2015	
Job name	Haines Vocational Education Bldg Upgrad			Time	11:15



# ALASKA AIR BALANCING INC.

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Phone: (907) 373-1090

Date: August 31, 2015

## AIR MOVING EQUIPMENT DATA SHEET

PROJECT NAME : Vocational Technology Building - Mechanical & Electrical Upgrades

LOCATION : Haines, Alaska

<b>System</b>	EF-1	EF-2
<b>Equip. Location</b>	Mechanical Mezzanine	Mechanical Mezzanine
<b>Area Served</b>	General Duty	Welding Exhaust
<b>Equip. Manufacturer</b>	Greenheck	Greenheck
<b>Model</b>	SWB-113-5-CCW	11-1PA-SD-10
<b>Serial Number</b>	14156424 15G	141562 156

	Required	Actual	Required	Actual
<b>Motor Manufacturer</b>		WEG		Baldor
<b>Motor HP</b>	1/2	1/2	2	2
<b>Motor RPM</b>	1750	1750	1750	1725
<b>Phase</b>	1	1	3	3
<b>Voltage</b>	115	119	208	207 208 208
<b>Amperage</b>	8.00	7.50	5.70	5.70 5.70 5.50
<b>Starter Heaters</b>	At Breaker		Square D 6-18 at 6	

<b>Fan RPM</b>	1458	1491	1553	1511
<b>Motor Sheave</b>	TBW VP 34 x 5/8		TBW AK QT x 7/8	
<b>Fan Sheave</b>	TBW AK 34 x 3/4		TBW 4.8 1B SDS x 1 11/16	
<b>Belts</b>	Carlisle AP-27		Carlisle AP-44	

	Required	Actual	Required	Actual
<b>Total CFM - Fan</b>	1,600	1,554	1,500	160
<b>Total Static Pressure</b>	0.50	0.37	4.50	5.00
<b>Suction</b>		0.33		N/A
<b>Discharge</b>		0.04		

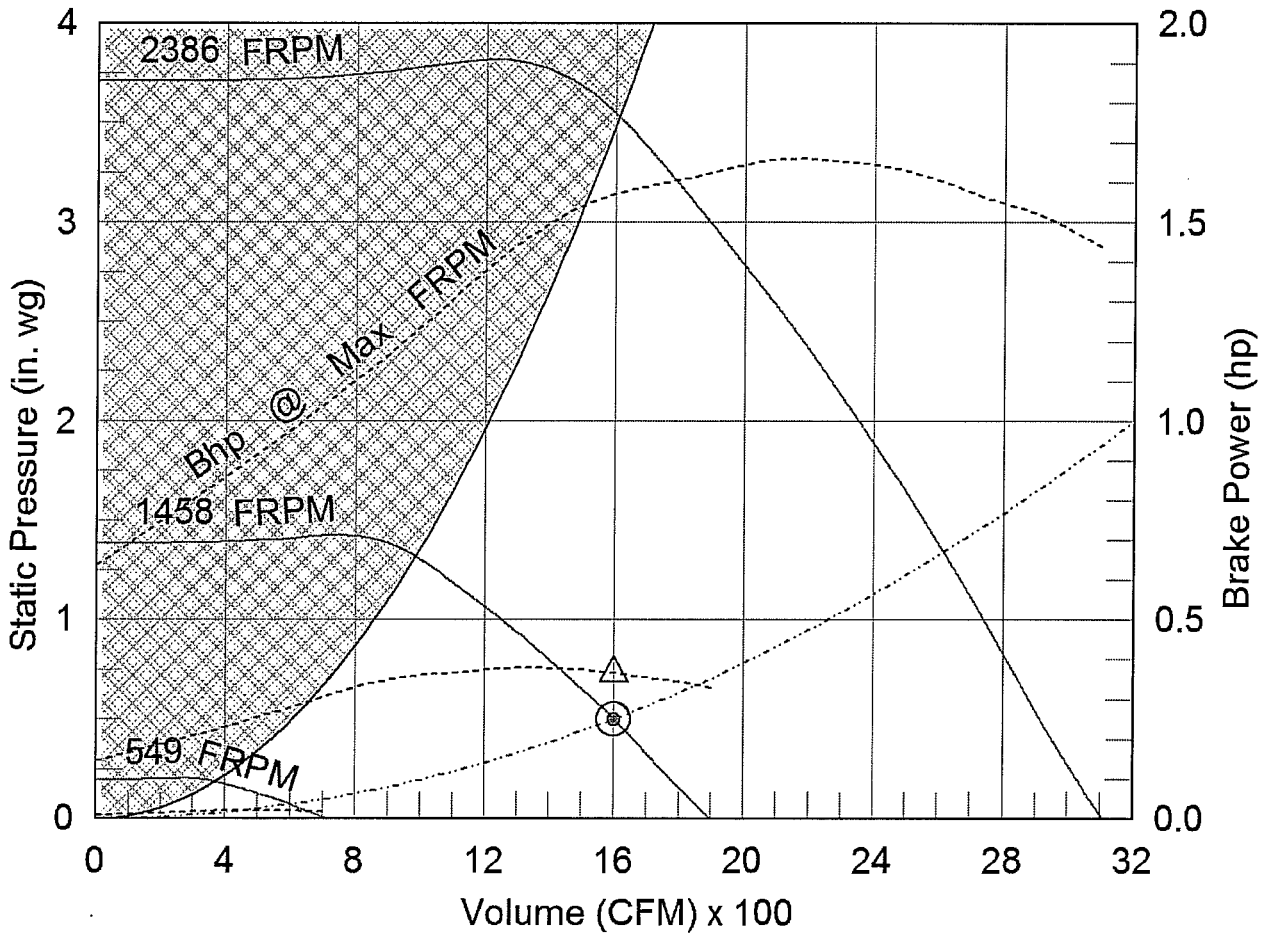
Remarks: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

SWB-113-5

Min/Max Fan Curve

Performance

Requested Volume (CFM)	Actual Volume (CFM)	External SP (in. wg)	Total SP (in. wg)	Fan RPM	Operating Power (hp)
1,600	1,600	0.5	0.5	1458	0.36



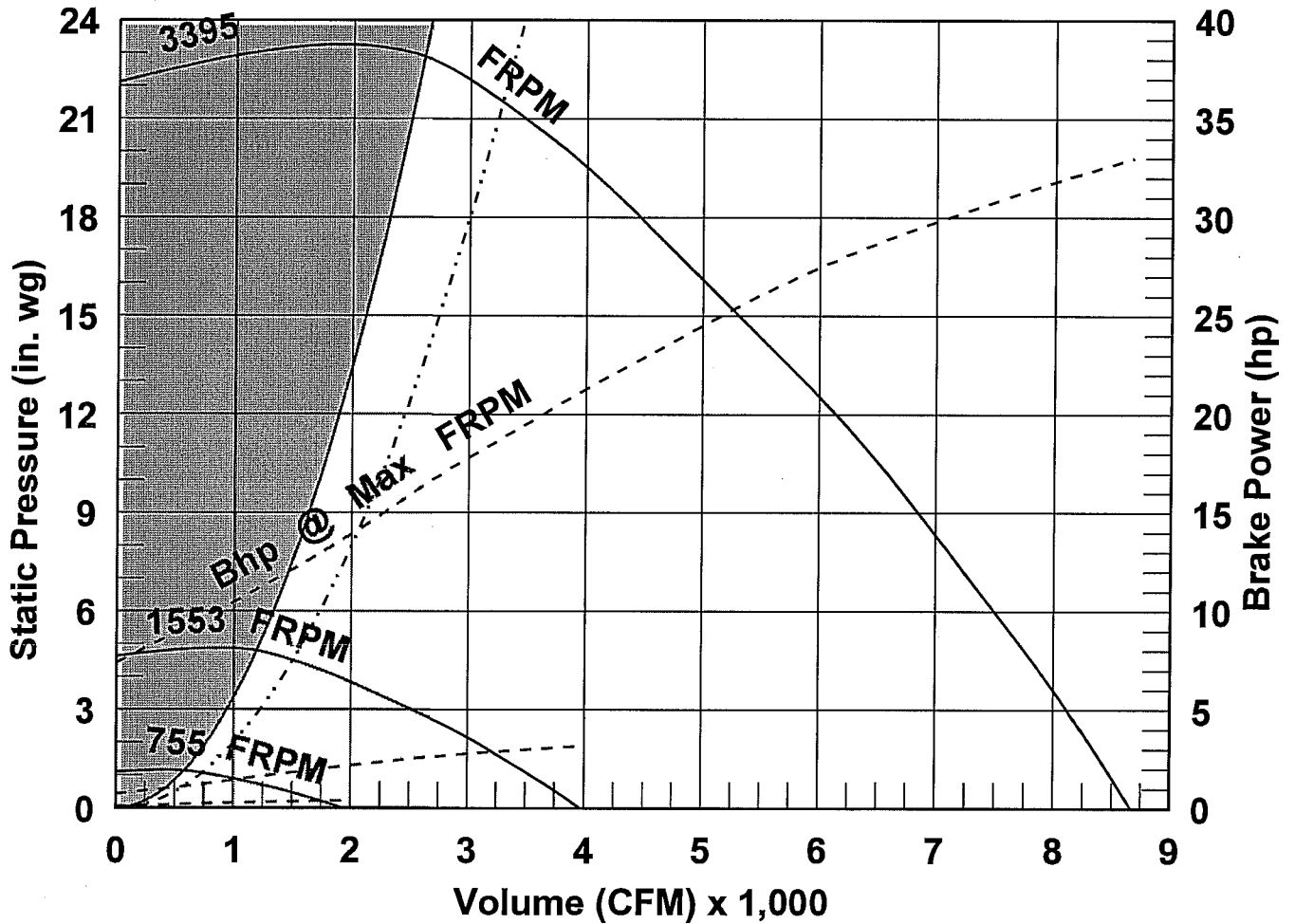
- △ Operating Bhp point
- Operating point at Total SP
- Operating point at External SP
- Fan curve
- - - System curve
- ..... Brake horsepower curve

11-IPA

Min. / Max Fan Curve

PERFORMANCE (Elevation ft = 138, Airstream Temperature F = 70)

Actual Volume (CFM)	External SP (in. wg)	Total SP (in. wg)	FRPM (RPM)	Operating Power (hp)
1,500	4.5	4.5	1553	1.79



- Fan curve
- - - - - System curve
- · - · - Brake horsepower curve

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Phone: (907) 373-1090

Date: August 31, 2015

## AIR MOVING EQUIPMENT DATA SHEET

PROJECT NAME : Vocational Technology Building - Mechanical & Electrical Upgrades

LOCATION : Haines, Alaska

<b>System</b>	EF-3	EF-4
<b>Equip. Location</b>	Mechanical Mezzanine	Mechanical Mezzanine
<b>Area Served</b>	Welding Exhaust	Vehicle Exhaust
<b>Equip. Manufacturer</b>	Greenheck	Nederman
<b>Model</b>	11-1PA-SD-10	N/A
<b>Serial Number</b>	14156263 156	

	Required	Actual	Required	Actual
<b>Motor Manufacturer</b>		Baldor		WEG
<b>Motor HP</b>	2	2	3	3
<b>Motor RPM</b>	1750	1725	3480	3480
<b>Phase</b>	3	3	3	3
<b>Voltage</b>	208	209 209 208	208	209 209 208
<b>Amperage</b>	5.70	5.70 5.70 5.70	5.70	4.60 4.40 4.60
<b>Starter Heaters</b>	Square D 6-128 at 6		Breaker Protected	

<b>Fan RPM</b>	1553	1499	N/A	N/A
<b>Motor Sheave</b>	TBW AK 44 QT x 7/8		Direct Drive	
<b>Fan Sheave</b>	TBW 4.8 1B SDS x 1 11/16			
<b>Belts</b>	Carlisle AP-4			

	Required	Actual	Required	Actual
<b>Total CFM - Fan</b>	1,500	1,607	800	803
<b>Total Static Pressure</b>	4.50	4.36	6.00	5.88
<b>Suction</b>		1.23		5.86
<b>Discharge</b>		3.13		0.02

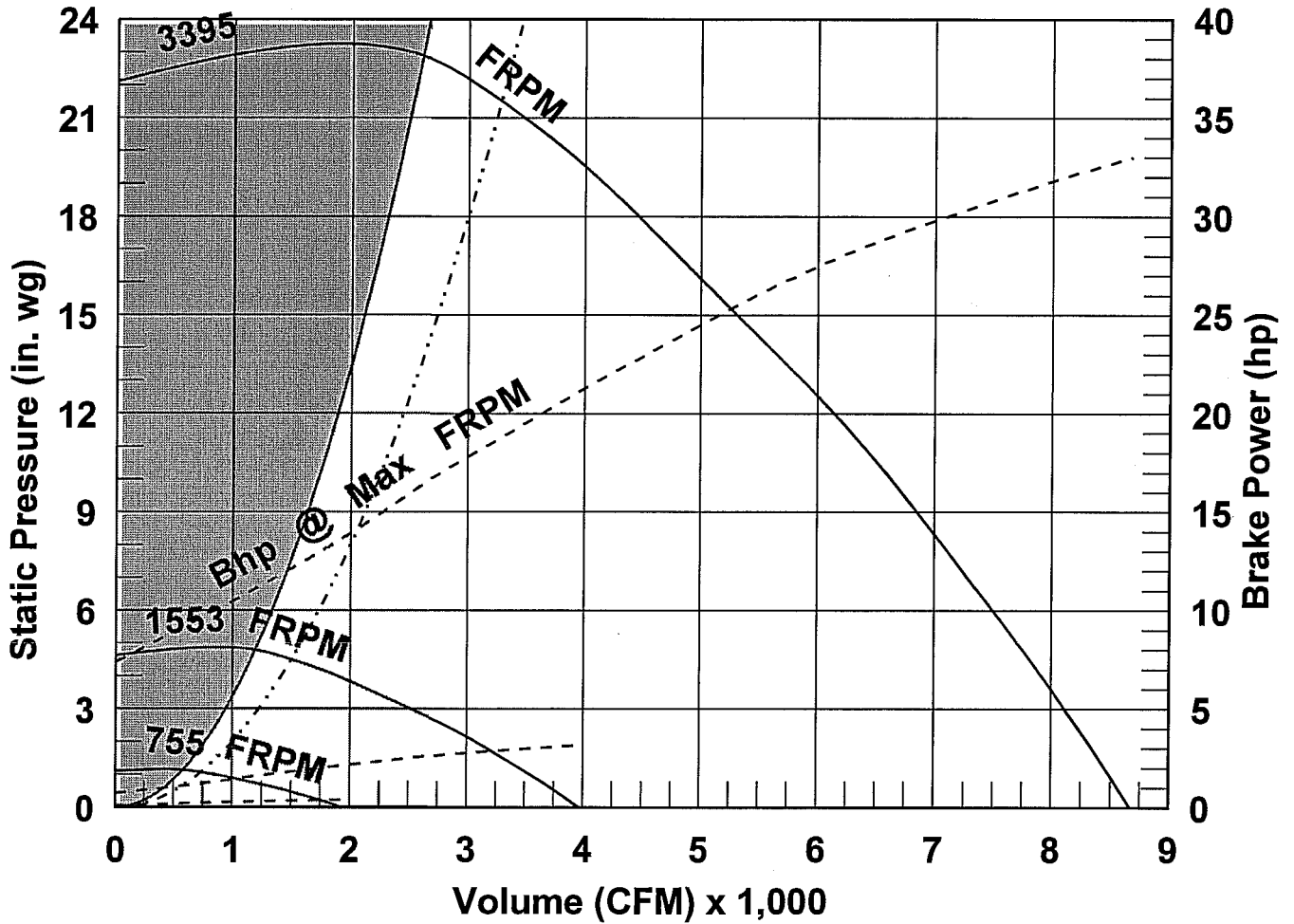
Remarks: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

11-IPA

Min. / Max Fan Curve

PERFORMANCE (Elevation ft = 138, Airstream Temperature F = 70)

Actual Volume (CFM)	External SP (in. wg)	Total SP (in. wg)	FRPM (RPM)	Operating Power (hp)
1,500	4.5	4.5	1553	1.79



- Fan curve
- - - - - System curve
- ..... Brake horsepower curve

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Date: August 31, 2015

## AIR MOVING EQUIPMENT DATA SHEET

PROJECT NAME : Vocational Technology Building - Mechanical & Electrical Upgrades

LOCATION : Haines, Alaska

<b>System</b>	EF-5	
<b>Equip. Location</b>		
<b>Area Served</b>	Laser Cutter	
<b>Equip. Manufacturer</b>	Greenheck	
<b>Model</b>	CW-101HP-UG-5-X	
<b>Serial Number</b>	14155796 156	

	Required	Actual	Required	Actual
<b>Motor Manufacturer</b>		Vari Green		
<b>Motor HP</b>	1/2	1/2		
<b>Motor RPM</b>	2500	2500		
<b>Phase</b>	1	1		
<b>Voltage</b>	115	119		
<b>Amperage</b>	4.00	4.00		
<b>Starter Heaters</b>	Thermally Protected			

<b>Fan RPM</b>	2499	N/A		
<b>Motor Sheave</b>	Direct Drive - Variable Speed			
<b>Fan Sheave</b>				
<b>Belts</b>				

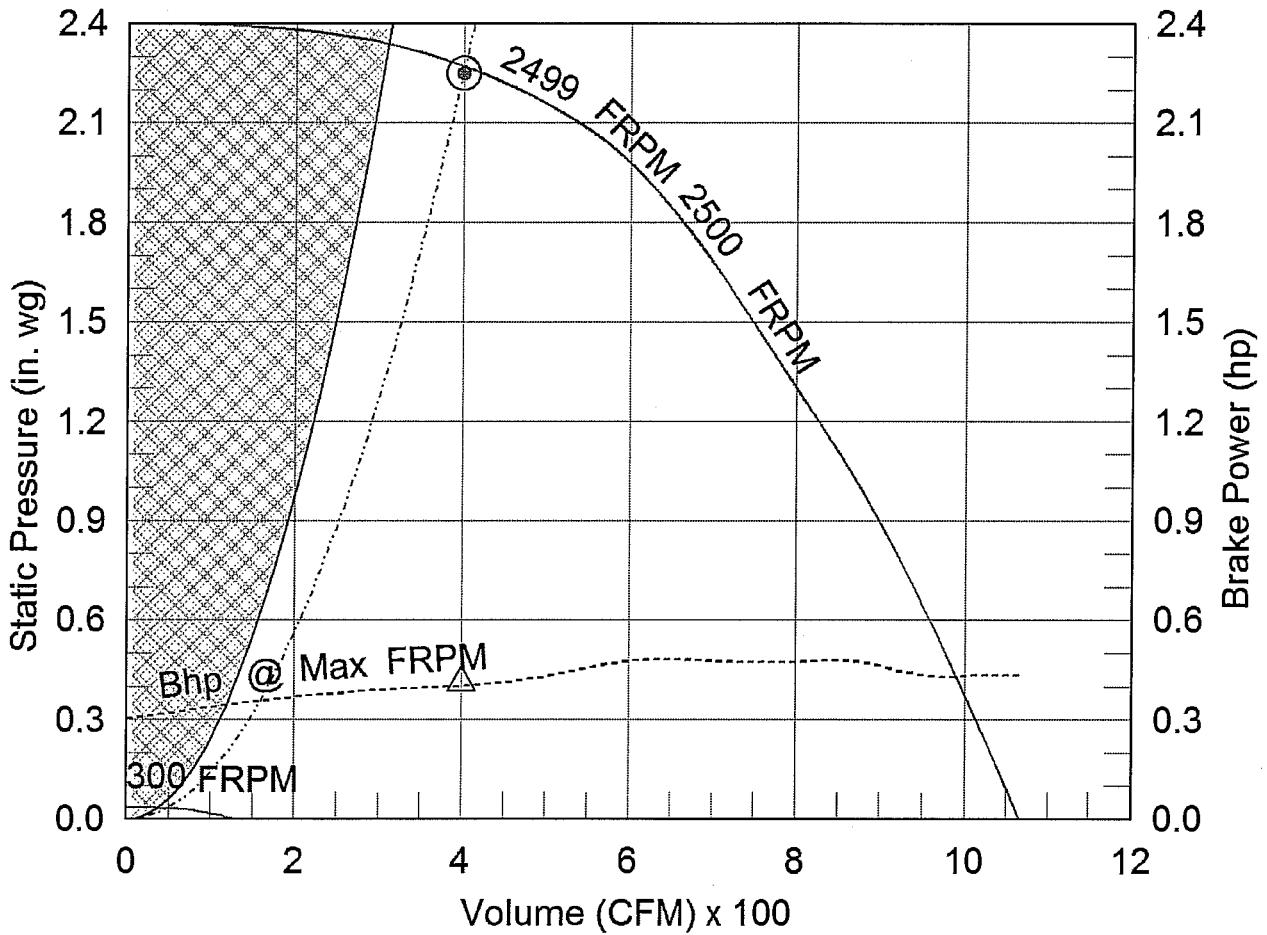
	Required	Actual	Required	Actual
<b>Total CFM - Fan</b>	400	265		
<b>Total Static Pressure</b>	2.50	N/A		
<b>Suction</b>		2.36		
<b>Discharge</b>		N/A		

Remarks: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

CW-101HP-VG Min/Max Fan Curve

Performance

Requested Volume (CFM)	Actual Volume (CFM)	External SP (in. wg)	Total SP (in. wg)	Fan RPM	Operating Power (hp)
400	400	2.25	2.25	2499	0.41



- △ Operating Bhp point
- Operating point at Total SP
- Operating point at External SP
- Fan curve
- - - System curve
- · · Brake horsepower curve



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Phone: (907) 373-1090

Date: August 31, 2015

## AIR MOVING EQUIPMENT DATA SHEET

PROJECT NAME : Vocational Technology Building - Mechanical & Electrical Upgrades

LOCATION : Haines, Alaska

<b>System</b>	TEF-1	TEF-2
<b>Equip. Location</b>	Mechanical Mezzanine	Mechanical Mezzanine
<b>Area Served</b>	Toilet Exhaust	Toilet Exhaust
<b>Equip. Manufacturer</b>	Panasonic	Panasonic
<b>Model</b>	FV-11VF2	FV-11VF2
<b>Serial Number</b>	412	412

	Required	Actual	Required	Actual
<b>Motor Manufacturer</b>		Panasonic		Panasonic
<b>Motor HP</b>	N/A	N/A	N/A	N/A
<b>Motor RPM</b>	N/A	N/A	N/A	N/A
<b>Phase</b>	1	1	1	1
<b>Voltage</b>	120	119	120	119
<b>Amperage</b>	0.77	0.70	0.77	0.70
<b>Starter Heaters</b>	Thermally Protected		Thermally Protected	

<b>Fan RPM</b>	N/A	N/A	N/A	N/A
<b>Motor Sheave</b>	Direct Drive		Direct Drive	
<b>Fan Sheave</b>				
<b>Belts</b>				

	Required	Actual	Required	Actual
<b>Total CFM - Fan</b>	95	100	95	100
<b>Total Static Pressure</b>	0.25	N/A	0.25	N/A
<b>Suction</b>				
<b>Discharge</b>				

Remarks: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

# Specification Data

## Panasonic Ventilation Fan

**Panasonic**

*WhisperFit™*  
VENTILATION FAN



**FV-11VF2 (110 CFM)**

### Description

Ventilating fan shall be Low Noise ceiling mount type rated for continuous run. Fan shall be ENERGY STAR rated and certified by the Home Ventilation Institute (HVI). Evaluated by Underwriters Laboratories and conform to both UL and cUL safety standards.

### Motor/Blower:

- Four-pole totally enclosed condenser motor rated for continuous run.
- Power Rating shall be 120 volts and 60 Hz.
- Fan shall be UL and cUL listed for tub/shower enclosure when used with a GFCI branch circuit wiring.
- Motor equipped with thermal-cutoff fuse.
- Removable with permanently lubricated plug-in motor.

### Housing:

- Rust proof paint, galvanized steel body.
- 4" diameter duct with optional 3" adapter included.
- Built in backdraft damper.
- Double hanger bar system allowing for ideal positioning.

### Grille:

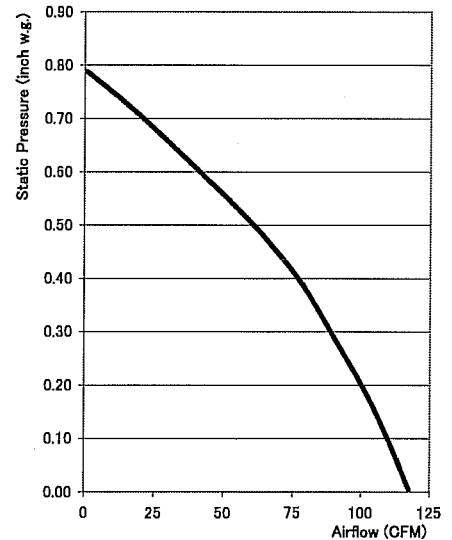
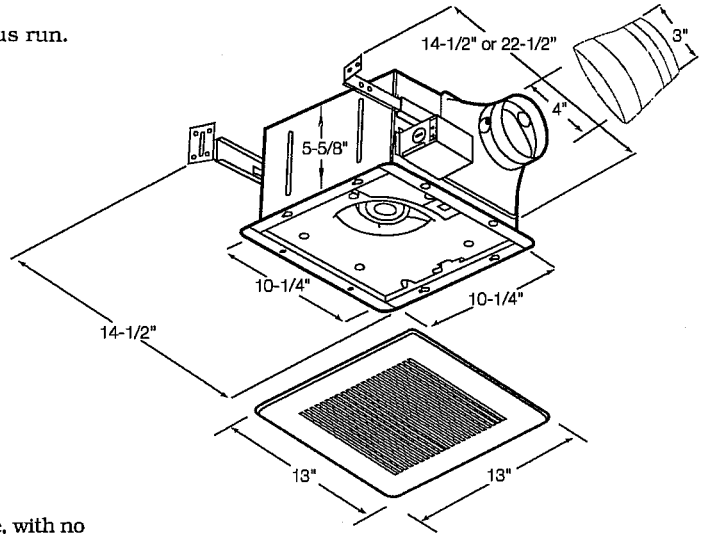
- Attractive design using PP material.
- Attaches directly to housing with torsion springs.

### Warranty:

- The factory warranty shall be a minimum of 3 years limited warranty on parts.

### Typical Specifications:

Ventilating fan shall be of the ceiling mount. ENERGY STAR rated type, with no less than 110 CFM and no more than 1.5 sones as certified by the Home Ventilating Institute (HVI) at 0.1 static pressure in inches of water gauge when used with the 4" duct. Power consumption shall be no greater than 33.5 watts and ENERGY STAR rated with efficiency rating of no less than 3.3 CFM/watt. The motor shall be totally enclosed, four pole condenser type engineered to run continuously. Power shall be 120v/60Hz. 3" duct adapter available with performance specifications as listed in the specification chart below. Fan shall be UL and cUL listed for tub/shower enclosure when used with GFCI branch circuit wiring. Fan shall be California Title-24 compliant.



### Specifications:

<b>FV-11VF2</b>		<b>4" Duct (Standard)</b>		<b>3" Duct (Optional)</b>	
Ventilation Fan Characteristics (HVI Certified Data)	Static Pressure (inches w.g.)	0.1	0.25	0.1	0.25
	Air Volume (CFM)	110	94	90	78
	Noise (sones)	1.5	NA	1.5	NA
	Power Consumption (Watts)	33.5	33.2	33.8	33.5
	Energy Efficiency (CFM/Watts)	3.3	2.8	2.7	2.3
	Speed (RPM)	830	1000	1029	1128
	Current (amps)	0.28	0.28	0.28	0.28
	Power Rating (V/Hz)	120/60			

As of 11/06



For Complete Installation Instructions Visit [www.panasonic.com/building](http://www.panasonic.com/building)

Model	Quantity	Comments	Project:
			Location:
			Architect:
			Engineer:
			Contractor:
			Submitted by:
			Date:

# ALASKA AIR BALANCING INC.

A Member of the NEBB

3060 Lazy Eight Court #10-Wasilla Alaska 99654

Phone: (907) 373-1090

Date: August 31, 2015

## AIR BALANCING REPORT - CONSTANT VOLUME

**PROJECT NAME : Vocational Technology Building - Mechanical & Electrical Upgrade**

**LOCATION : Haines, Alaska**

Location & Room No.	Outlet Size	Outlet AK	Veloc. Req'd	Design CFM	OUTLET READINGS		
					Initial Reading	Final Reading	Final CFM
<b>VU-1 Max</b>					46 HZ		
Storage	24 x 24	1.00	120	120	115		115
Office	24 x 24	1.00	120	120	120		120
Wood Shop	24 x 36	5.69	592	3370	604		3437
Auto Shop	18 x 36	4.22	545	2300	563		2375
<b>Total VU-1 Max CFM</b>				<b>5910</b>			<b>6047</b>
<b>VU-1 Return</b>							
Auto Shop	16 x 36	3.73	541	2020	428	555	2070
Work Shop	24 x 36	5.69	543	3090	473	564	3209
Outside Air				800			768
<b>Total VU-1 Return CFM</b>				<b>5910</b>			<b>6047</b>
<b>VU-1 Min</b>					27 HZ		
Storage	24 x 24	1.00			60		60
Office	24 x 24	1.00			75		75
Wood Shop	24 x 36	5.69			333		1895
Auto Shop	18 x 36	4.22			354		1494
<b>Total VU-1 Min CFM</b>				<b>3500</b>			<b>3524</b>
<b>EF-1</b>							
Traverse	14" Rnd	1.07	1495	<b>1600</b>	879	1451	<b>1553</b>
General Exhaust	18 x 36	4.20	381	<b>1600</b>	370		<b>1554</b>
<b>EF-1 All Fans Running</b>							
Traverse	14" Rnd	1.07	1495	<b>1600</b>	879		<b>940</b>
<b>EF-2</b>							
Traverse 1	14" Rnd	1.07	701	750	743		795
2	14" Rnd	1.07	701	750	757		810
<b>Total EF-2 CFM</b>				<b>1500</b>			<b>1605</b>

Remarks:

# ALASKA AIR BALANCING INC.

A Member of the NEBB

3060 Lazy Eight Court #10-Wasilla Alaska 99654

Phone: (907) 373-1090

Date: August 31, 2015

## AIR BALANCING REPORT - CONSTANT VOLUME

**PROJECT NAME :** Vocational Technology Building - Mechanical & Electrical Upgrade

**LOCATION :** Haines, Alaska

Location & Room No.	Outlet Size	Outlet AK	Veloc. Req'd	Design CFM	OUTLET READINGS		
					Initial Reading	Final Reading	Final CFM
<b>EF-3</b>							
Traverse	16" Rnd	1.40	1071	<b>1500</b>	1344	1170	<b>1638</b>
Booth 1 Table	6" Rnd	0.20	940	188	973		195
** Ceiling	8" Rnd	0.35	537	188	579		203
Booth 2 Table	6" Rnd	0.20	940	188	945		189
** Ceiling	8" Rnd	0.35	537	188	580		203
Booth 3 Table	6" Rnd	0.20	940	188	1033		207
** Ceiling	8" Rnd	0.35	537	188	578		202
Booth 4 Table	6" Rnd	0.20	940	188	1015		203
** Ceiling	8" Rnd	0.35	537	188	587		205
<b>Total EF-3 CFM</b>				<b>1504</b>			<b>1607</b>
<b>EF-3 Just EF Running</b>							
Traverse	16" Rnd	1.40	1071	<b>1500</b>	1314		<b>1840</b>
<b>EF-4</b>							
Traverse	12" Rnd	0.785	1019	<b>800</b>	1023		<b>803</b>
Hose Reel 1	10" Rnd	0.545	734	400	N/A		413
* 2	10" Rnd	0.545	734	400	715		390
<b>Total EF-4 CFM</b>				<b>800</b>			<b>803</b>
<b>EF-4 All Fans Running</b>							
Traverse	12" Rnd	0.785	1019	<b>800</b>	918		<b>720</b>
<b>*** EF-5</b>							
Traverse	10" Rnd	0.55	727	<b>400</b>	481		<b>265</b>
<b>TEF-1</b>							
Toilet Exhaust	10 x 10	1.00	95	<b>95</b>	100		<b>100</b>
<b>TEF-2</b>							
Toilet Exhaust	10 x 10	1.00	95	<b>95</b>	100		<b>100</b>

Remarks: \* Not enough room to traverse this line, outlet #1 cfm is determined by fan traverse total minus outlet #2 cfm.

\*\* Dampers are existing and cannot be locked into position. \*\*\* Fan is low of design and at rated motor amperage amperage and at highest speed setting, duct reduces from a 10" round to a 4" round at Laser Cutter.

TAB Technician: Chris Stratton

Date Balanced: 8/25/15-8/27/15

# ALASKA AIR BALANCING INC.

A Member of the NEBB

3060 Lazy Eight Court #10-Wasilla Alaska 99654

Phone: (907) 373-1090

Date: September 16, 2015

## PUMP DATA SHEET

**PROJECT NAME : Vocational Technical Building - Mechanical & Electrical Upgrade**

**LOCATION : Haines, Alaska**

Pump No.	P-1		
Manufacturer	Grundfos		
Size	UPS 32-80F		
Impeller	N/A		
Service	Heating System		
<b>TEST DATA</b>	<b>GPM</b>	<b>FT. HD.</b>	
Design	40.00	15.00	
Actual	42.00	N/A	
Discharge	No Ports / No Gauges		
Suction			
$\Delta p$	x 2.31 = Ft/Hd		
<b>BLOCK OFF</b>			
Discharge	No Ports / No Gauges		
Suction			
$\Delta p$	x 2.31 = Ft/Hd		
<b>MOTOR MFG.</b>	Grundfos		
FRAME	N/A		
H.P.	N/A		
RPM	N/A		
RATED AMPS	0.58		
MEASURED AMPS	0.50	0.50	0.51
VOLTS	208		
MEASURED VOLTS	209	209	209
OVERLOAD HTRS	Square D 1.5-4.5 at 1.5		

Remarks: Three speed pump at speed one.

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TAB Technician: Chris Stratton

Pump No.	P-2		
Manufacturer	Grundfos		
Size	UPS 32-80F		
Impeller	N/A		
Service	Heating System		
<b>TEST DATA</b>	<b>GPM</b>	<b>FT. HD.</b>	
Design	50.00*	25.00	
Actual	64.00	N/A	
Discharge	No Ports / No Gauges		
Suction			
$\Delta p$	x 2.31 = Ft/Hd		
<b>BLOCK OFF</b>			
Discharge	No Ports / No Gauges		
Suction			
$\Delta p$	x 2.31 = Ft/Hd		
<b>MOTOR MFG.</b>	Grundfos		
FRAME	N/A		
H.P.	N/A		
RPM	N/A		
RATED AMPS	2.50		
MEASURED AMPS	2.50	2.40	2.40
VOLTS	208		
MEASURED VOLTS	209	209	209
OVERLOAD HTRS	VFD		

Remarks: VFD at 62 hertz.

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Differential set point 15 psi.

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\* System total is 62.80 gpm.

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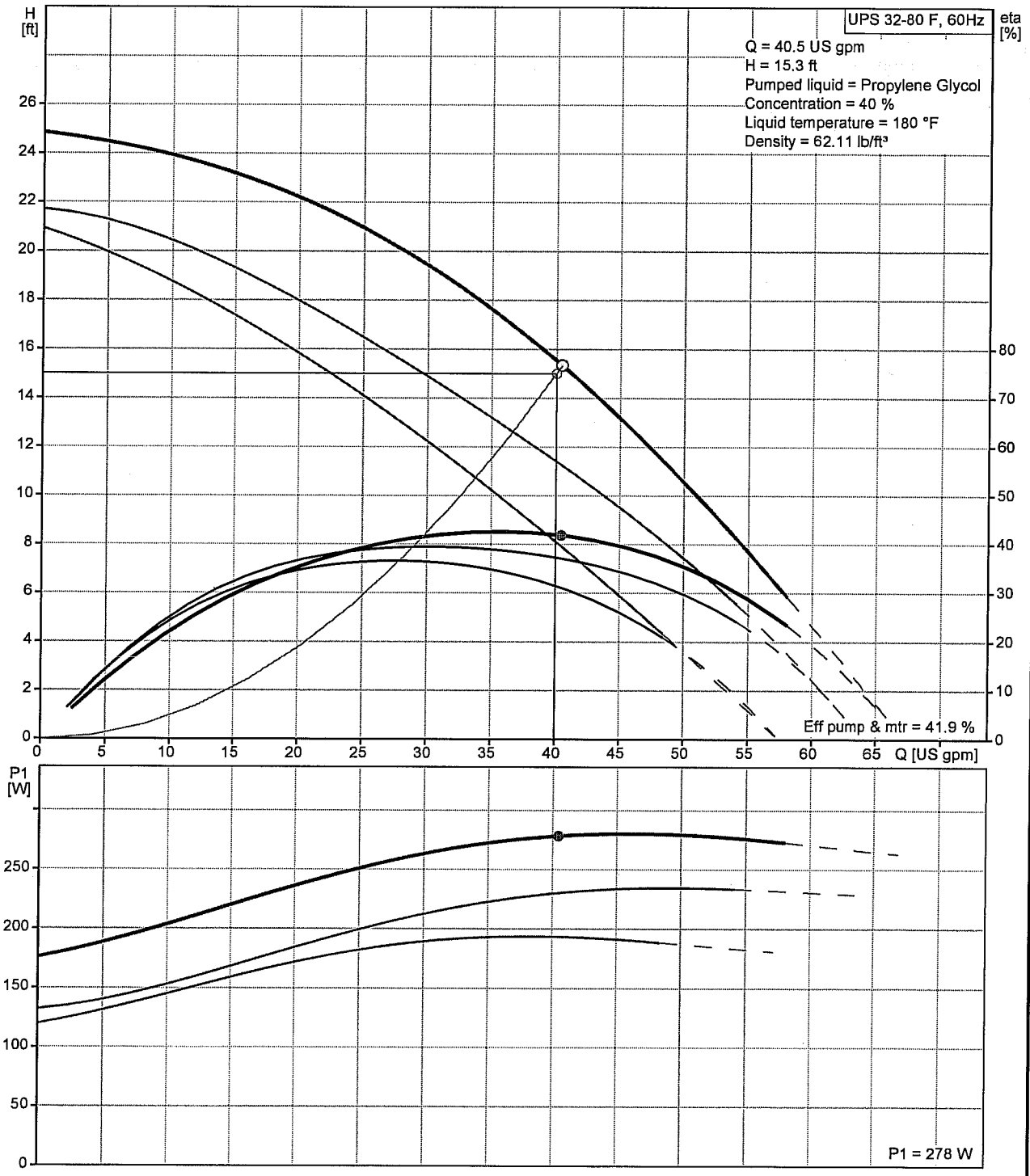
Date Balanced: 8/25/15-8/27/15

# GRUNDFOS®



Company name: -  
 Created by: -  
 Phone: -  
 Fax: -  
 Date: -

## 96402710 UPS 32-80 F 60 Hz

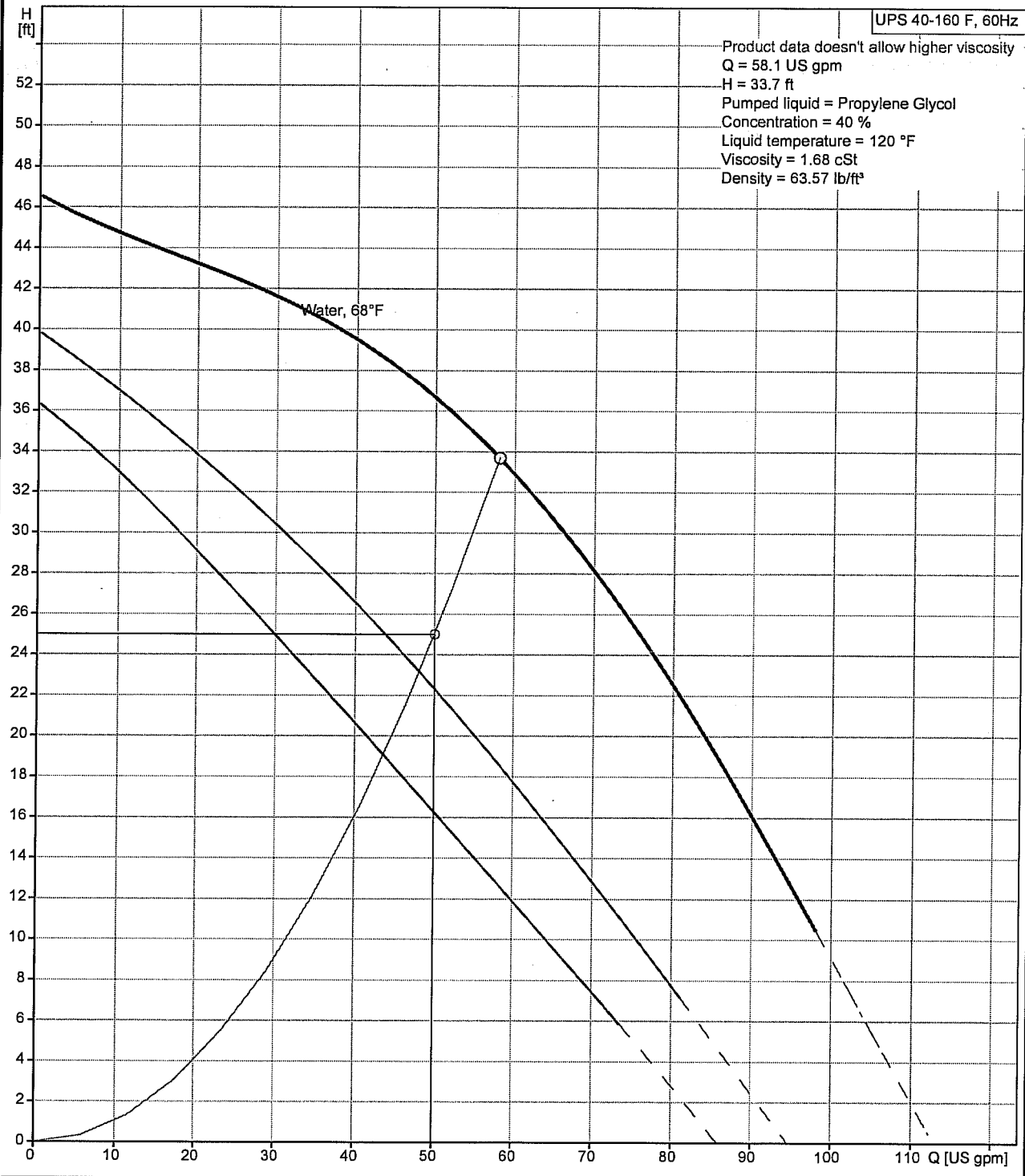


# GRUNDFOS®



Company name: -  
Created by: -  
Phone: -  
Fax: -  
Date: -

## 96402784 UPS 40-160 F 60 Hz







# ALASKA AIR BALANCING INC.

A Member of the NEBB

3060 Lazy Eight Court #10-Wasilla Alaska 99654

Phone: (907) 373-1090

Date: September 16, 2015

## HEAT COIL DATA SHEET

PROJECT NAME : Vocational Technical Building - Mechanical & Electrical Upgrade

LOCATION : Haines, Alaska

<b>System</b>	HC-1			
<b>Location</b>	VU-1			
<b>Service</b>	Reheat			
<b>Manufacturer</b>				

	Design	Actual	Design	Actual	Design	Actual	Design	Actual
<b>CFM</b>	6000	6047						
<b>GPM</b>	30.0	31.0						
<b>EWT Degrees F.</b>	180	126						
<b>LWT Degrees F.</b>	150	117						
<b>EAT DB Degrees F.</b>	-5	67.8						
<b>LAT DB Degrees F.</b>	60	94.6						

<b>System</b>				
<b>Location</b>				
<b>Service</b>				
<b>Manufacturer</b>				

	Design	Actual	Design	Actual	Design	Actual	Design	Actual
<b>CFM</b>								
<b>GPM</b>								
<b>EWT Degrees F.</b>								
<b>LWT Degrees F.</b>								
<b>EAT DB Degrees F.</b>								
<b>LAT DB Degrees F.</b>								

Remarks: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_



A Member of the NEBB

3060 Lazy Eight Court #10-Wasilla, Alaska 99654

Phone: (907) 373-1090

## TERMS & ABBREVIATIONS

<b>AC or ACU:</b> Air Conditioner or Air Conditioning Unit	<b>TDH:</b> Pressure Difference across the entering and leaving side of the pump
<b>AH or AHU:</b> Air Handler or Air Handler Unit	<b>HEPA:</b> High Efficiency Particulate Arrestance
<b>AVG:</b> Average	<b>HP:</b> Horsepower
<b>BHP:</b> Brake Horsepower	<b>HVAC:</b> Heating Ventilation and Air Conditioning
<b>B.V.:</b> Balance Valve	<b>HWS:</b> Heating Water Supply
<b>CAV:</b> Constant Air Volume	<b>HWR:</b> Heating Water Return
<b>CBV:</b> Calibrated Balancing Valve	<b>HX:</b> Heat Exchanger
<b>CC:</b> Cooling Coil	<b>HZ:</b> Hertz, cycle per second
<b>CFM:</b> Cubic Feet per Minute	<b>In.:</b> Inches
<b>CH:</b> Chiller	<b>In w.g.:</b> Inches of water gauge
<b>CHWS:</b> Chilled Water Supply	<b>A.K.:</b> Correction factor to the free area need to calculate cfm
<b>CHWR:</b> Chilled Water Return	<b>KW:</b> Kilowatts
<b>CP:</b> Circulating Pump	<b>LAT:</b> Leaving Air Temperature
<b>CR:</b> Ceiling Register	<b>LWG:</b> Low Wall Grille
<b>CRAC:</b> Computer Room Air Conditioner	<b>LWR:</b> Low Wall Register
<b>CRU:</b> Computer Room Unit	<b>LWT:</b> Leaving Water Temperature
<b>CT:</b> Cooling Tower	<b>MAU:</b> Make-up Air Unit
<b>CU:</b> Condenser Unit	<b>MBH:</b> 1,000 BTUH
<b>CUH:</b> Cabinet Unit Heater	<b>N/A:</b> Not Available
<b>CWS:</b> Condenser Water Supply	<b>N/R:</b> Not Required
<b>CWR:</b> Condenser Water Return	<b>OSA:</b> Outside Air
<b>D.A.:</b> Duct Area	<b>OBD:</b> Opposed Blade Damper
<b>DAT:</b> Discharge Air Temperature	<b>ΔP:</b> Pressure Drop
<b>DB:</b> Dyr Bulb	<b>PH:</b> Phase
<b>DD:</b> Direct Drive	<b>PSI:</b> Pounds per Square Inch
<b>DDC:</b> Direct Digital Controls	<b>RA:</b> Return Air
<b>Des.:</b> Design	<b>RAT:</b> Return Air Temperature
<b>Dia.:</b> Diameter	<b>RF:</b> Return Fan
<b>Disch.:</b> Discharge	<b>RH:</b> Relative Humidity
<b>EA:</b> Exhaust Air	<b>RHC:</b> Reheat Coil
<b>EAT:</b> Entering Air Temperature	<b>RPM:</b> Revolutions per Minute
<b>Economizer:</b> Controls and components that allow an air handler to logically utilize outdoor air for cooling as opposed to the use of mechanical cooling.	<b>RTU:</b> Roof Top Unit
<b>EF:</b> Exhaust Fan	<b>SA:</b> Supply Air
<b>EG:</b> Exhaust Grille	<b>SAT:</b> Supply Air Temperature
<b>EMCS:</b> Energy Management Control System	<b>S.F.:</b> Service Factor
<b>ERU:</b> Energy Recovery Unit	<b>SF:</b> Supply Fan
<b>E.S.P.:</b> External Static Pressure	<b>SFD:</b> Smoke/Fire Damper
<b>F.C.:</b> Flow Coefficient	<b>SP:</b> Static Pressure
<b>HRC:</b> Heat Recovery Coil	<b>Sq. ft.:</b> Square Feet
<b>EWT:</b> Entering Water Temperature	<b>Suct.:</b> Suction
<b>FCU:</b> Fan Coil Unit	<b>SWG:</b> Sidewall Grille
<b>FD:</b> Fire Damper	<b>SWR:</b> Sidewall Register
<b>FLA:</b> Full Load Amperage: Maximum amperage a motor can draw.	<b>TAB:</b> Test Adjust and Balance
<b>Flow Hood:</b> Instrument that captures air and converts the reading to cfm.	<b>TSP:</b> Total Static Pressure: Difference between the entering and leaving static pressure of fan.
<b>FPB:</b> Fan Powered Box	<b>UH:</b> Unit Heat
<b>FPM:</b> Feet per Minute	<b>VAV:</b> Variable Air Volume: box that contains a motorized damper that modulates airflow.
<b>FR:</b> Field Report Data	<b>VD:</b> Volume Damper
<b>FTU:</b> Fan Terminal Unit	<b>VFD:</b> Variable Frequency Drive
<b>GPM:</b> Gallons per Minute	<b>Velgrid:</b> Instrument that reads used velocity in feet per minute.
<b>HC:</b> Heat Coil	<b>VVT:</b> Variable Volume Terminal
<b>TDH:</b> Pressure Difference across the entering and leaving side of the pump	<b>WC:</b> Water Column
	<b>W.G.:</b> Water Gauges
	<b>WB:</b> Wet Bulb

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: Appendix B – OPERATING INSTURCTIONS

Submittal Number: 1

Item:

Manufacturer:

Model #:

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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**HAINES HS VOCATIONAL EDUCATION BUILDING UPGRADES**

**OPERATION & MAINTENANCE**

**INDEX**

APPENDIX B: OPERATING INSTRUCTIONS

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## OPERATING INSTRUCTIONS

- A. **BOILER (B-1) ENABLE:** DDC system shall enable boiler continuously when boiler control switches are in AUTO mode. DDC system shall monitor heating supply header temperature and report reset temperature in heating supply main where shown. Alarm sent to BAS when burner fails to operate or any safety functions shutdown a respective burner.
1. Separate Packaged Reset Schedule Provided under Boiler Section: Boilers shall operate to maintain heating supply temperature in heating distribution main according to the following schedule: 190F HS temperature at 20F OSA temperature modulating to 150F HS temperature at 60F OSA temperature. Alternate can be DDC type boiler set back system upon approval of Engineer and Owner with local/remote switch to go between local controls and DDC.
  2. All WORK required for a complete operating boiler control system included hereunder, including entire line voltage electrical installation,, low voltage electrical installation, and integration with burner controls. Coordinate provision of sensors, wiring, and connection points with electrical division and burner controls for a complete system. Coordinate provision with Mechanical Contractor during Bidding.
  3. Provide heating supply and return sensor for BAS monitoring of building hot water return temperature. Display on Graphics.
- B. **BOILER HEATING RETURN TEMPERATURE CONTROL:** Immersion thermostat in heating return piping for boiler shall modulate open P-2 bypass valve to maintain a minimum 135F return water temperature.
- C. **BOILER PRIMARY HEATING PUMP (P-1):** A manual starter with on-off switch provides direct power for the burner motor through their safeties.
- D. **BUILDING SECONDARY HEATING PUMP (P-2):** A variable frequency drive (VFD) provides direct power for the pump motor. When the VFD is in the AUTO position, the BAS shall operate and modulate the speed of the pump to maintain the hydronic static pressure sensor pressure differential setpoint. Sensor located between the heating mains where shown. Pressure differential required at pressure sensing location determined by the Adjustment and Control Contractors. Initially set pressure differential at 6 psi. When the VFD is in HAND position, a digital speed control integral with the VFD panel provides manual speed control. When VFD is in BYPASS mode, the pump operates at full speed (60 HZ). Activate an alarm when a VFD generated status alarm occurs due to low current. Include VFD speed and VFD fault alarm inputs to the BAS. Display actual speed, alarms, and status on Graphics.
1. Pressure Differential Sensor located where shown.
  2. DDC Display: Indicate heating water main temperature setpoint, reset schedule, pump speed, operation status, and alarms.
  3. Bypass Valve: Automatic valve shall modulate open when pressure is above setpoint of 15 gpm to maintain a minim flow though pump. Flow to be set and measured during TAB work.



E. GENERAL FAN UNIT NOTES: The following controls apply to the various ventilation systems outlined in this section, as indicated within each fan system description or listed below as typical for all fan units.

1. Smoke Sensors: Furnished and installed under the ELECTRICAL division.
2. Filter Alarm: Differential pressure sensor across filter to send filter alarm to BAS whenever the differential pressure exceeds an adjustable 0.50 inches water column for pre-filters. Analog input signal with set point adjustable at the BAS. Alarm is to be sent to the BAS for confirmation.
3. Low-limit control: Averaging bulb thermostat at the discharge of the heating coil to stop the fan below an adjustable 40°F upon a time delay of 45 seconds. Mixing dampers repositioned to full recirculation position and automatic valve positioned to full open heating. Fan automatically reset on temperature rise above set point. Alarm is to be sent to the BAS for confirmation.
4. Fan operation status Differential pressure sensor installed across supply fans units to send signal to BAS when in operation. Alarm is to be sent to the BAS for confirmation when fan does not operate when commanded on. Current sensor not acceptable.
5. In HAND position all AHU fan shall operate in occupied mode and at the command of the smoke sensor.
6. All Exhaust Fans operation status: Current sensor to send fan operation signal to BAS. Alarm is to be sent to the BAS for confirmation when fan does not operate when commanded on.
7. Exhaust Fan Automatic Damper: Where exhaust fan has an automatic damper, an end switch shall be utilized so that fan unit will not start until damper is mostly open. This control shall work in either Auto or Hand position through use of relay. A programmed delay start is not acceptable.
8. AHU coil minimum flow: When OSA drops below 32F, AHU AV-2 minimum flow rate shall be set at 10% open when fan unit is off to reduce chance of freeze-up.

F. AIR HANDLING UNIT (AHU-1): A variable frequency drive (VFD) located on the mounting board, provides direct power for the respective fan motor. When the VFD is in the AUTO position, the BAS shall operate each fan unit at the speed required to meet design CFM (as verified with TAB Contractor). When the VFD is in HAND position, a digital speed control integral with the VFD panel provides manual speed control. When VFD is in BYPASS mode, the fan operates at full speed (60 HZ). Activate an alarm when a VFD generated status alarm occurs due to low current or other alarm. Include VFD speed and VFD fault alarm inputs to the BAS. Display speed, alarms, and status on Graphics. In the AUTO, HAND, or BYPASS positions, the fan units operate according safety functions such as the low-limit thermostat and the smoke sensor.

1. Schedule of Operation:
  - a. Normal Occupied Schedule: See General Fan Notes (Schedule) above for hours of operation. During normal operation, AHU-1 fan to provide minimum outdoor air as scheduled below.
  - b. Unoccupied Mode: AHU-1 shall remain OFF in Unoccupied mode.
  - c. Night Setback Mode: AHU-1 does not have a Night Setback mode.

2. During the Occupied schedule, Minimum outside air damper (OAD-1) to open to minimum position to provide the required minimum outside air. Minimum OSA volume is as follows and is to be manually verified during initial adjustment of mechanical systems. Air monitoring station installed in OSA duct to monitor OSA air volume. Damper to continue to open when additional exhaust fans and dust collector are operating as follows:

- a. AHU-1 Occupied Minimum OSA: 800 CFM
- b. AHU-1 Occupied Minimum OSA with Dust Collector On: Add 2500 CFM OSA.
- c. AHU-1 Occupied Minimum OSA with either welding exhaust fan On: Add 1500 OSA CFM.
- d. AHU-1 Occupied Minimum OSA with Vehicle exhaust fan On: Add 1000? CFM

3. Dampers (OAD-A, OAD-B, RAD-1, RAD-2, EAD-1, EAD-2D): Supply air sequence control to modulate the modulating outside air damper (OAD-B), the recirculating air dampers (RAD-1 and RAD-2), and exhaust air damper (EAD-1, EAD-2) to maintain the adjustable supply air setpoint provided minimum outdoor air volume is attained and the carbon dioxide control sequence is satisfied. Dampers to modulate cooperatively, with the modulating outside air damper OAD and the exhaust air damper EAD closed when the recirculating air damper RAD is open. Dampers to position to the full recirculating positions when the unit is not operating. Exhaust air damper (EAD-1, EAD-2) shall modulate independently with separate control signal as needed to maintain building pressure.

4. Supply air temperature: Supply air discharge sensor to control the heating coil automatic valve and mixing dampers in order to supply an adjustable air discharge temperature set by the supply air reset schedule; 62°F supply air at 62°F outside air temperature modulating to 66°F supply air at 20°F outside air temperature and below. Heating coil automatic valve to close to heating on an outside air temperature above an adjustable 62°F OSA.

7. Building pressure sensor. Outdoor pressure reference sensor located on exterior of Service 105 north wall. Duct pressure sensor located in each shop. Provide input to BAS system.

8. SF VFD Speed: When the VFD is in the AUTO position, the BAS shall operate fan unit at the speed required (constant speed) to meet design CFM (as verified with TAB Contractor). Air measuring station on fan inlet to display CFM on BAS and on AHU cabinet display.

9. Provide Low-Limit Control, Filter Alarms, Air Measuring Station(s) for SA, RA, and OSA, Fan Operation Status, and AHU Minimum Coil Flow: See above for descriptions.

- G. EXHAUST FAN (EF-1): Manual starter with ON\_OFF switch shall control operation of EF-1 through hazardous gas control panel.
- H. EXHAUST FAN (EF-2, EF-3): Manual starter with ON\_OFF switch shall control operation of EF-2 Welding.
- I. EXHAUST FAN (EF-4): Manual starter with ON\_OFF switch shall control operation of EF-4 Vehicle Exhaust.
- J. EXHAUST FAN (EF-5): A manual starter with an ON-OFF switch is located adjacent to the unit.

- K. COMBUSTION AIR CAD-1: Combustion air damper actuator to open whenever burner operates. Provide relays and connections as required.
  
- L. UNIT HEATER ZONE CONTROL: room thermostat to modulate respective radiant zone valve and operate unit heater blower to maintain setpoint, initially set at 65F. Room thermostats and automatic valves to be provided hereunder.

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: Appendix C – DIRECTORY

Submittal Number: 1

Item: Equipment / Valve

Manufacturer:

Model #:

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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# HAINES HS VOCATIONAL EDUCATION BUILDING UPGRADES

## OPERATION & MAINTENANCE

### INDEX

#### APPENDIX C: DIRECTORIES

1. Equipment Directory
2. Valve Directory

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# HAINES VOCATION TECHNOLOGY BUILDING

## EQUIPMENT SCHEDULE

TAG	LOCATION	FUNCTION	EQUIPMENT MODEL	SWITCH LOCATION	SWITCH POSITION	MOTOR HP, VOLTAGE, PHASE, FULL LOAD AMPERAGE
B-1	BOILER ROOM	HEATING SYSTEM PLANT	WEIL McLAIN	BOILER ROOM, ADJACENT TO BOILER	NORMAL ON	BURNER – BECKET CF 800 OIL FIRED BURNER, 1/3 HP/120 V/ 1PH /
ET-1	BOILER ROOM	HEATING SYSTEM EXPANSION	AMTROL EX-420	-	-	-
GT-1	BOILER ROOM	GLYCO MAKE UP TANK	AXIOM	PLUG IN RECEPTACLE ABOVE GT-1	NORMALLY PLUGGED IN	PUMP MOTO 115/60/1 to 24 VDC 50 watts AC R -
P-1	BOILER ROOM	BOILER CIRC PUMP	GRUNDFOS 32-80	ADJACENT TO THE BOILER	NORMALLY ON	¾ HP / 208 V / 3 PH /
P-2	BOILER ROOM	HEATING MAIN CIRC PUMP	GRUNDFOS 32-160	VFD ADJACENT TO THE BOILER	NORMALLY ON	1 HP / 208 V / 3 PH
VU-1	MEZZANINE	AIR HANDLING UNIT	DAIKIN CAH	VFD ADJACENT TO VU-1	NORMALLY ON	7.5 HP / 208V / 3 PH / 11 AMPS
EF-1	MEZZANINE	GENERAL DUTY EXHAUST FAN	GREENHECK SWB-113-5	OFFICE RM NEXT TO AUTO SHOP DOOR	ON AS REQUIRED AND WHEN CO DETECTOR ENERGIZES	½ HP / 12 V / 1 PH
EF-2	MEZZANINE	WELDING BOOTH EXHAUST FAN	GREENHECK 11-IPA	OFFICE RM NEXT TO AUTO SHOP DOOR	ON AS REQUIRED	2 HP / 208 V / 3 PH
EF-3	MEZZANINE	WELDING BOOTH EXHAUST FAN	GREENHECK 11-IPA	OFFICE ROOM	ON AS REQUIRED	2 HP / 208 V / 3 PH





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# HAINES VOCATION TECHNOLOGY BUILDING

## VALVE SCHEDULE

TAG #	LOCATION	FUNCTION	VALVE MODEL
1	BOILER ROOM	BOILER SUPPLY ISO.	FNW 421
2	BOILER ROOM	BOILER RETURN ISO	FNW 421
3	BOILER ROOM	CIRC PUMP P-1 ISO	FNW 421
4	BOILER ROOM	CIRC PUMP P-1 ISO	FNW 421
5	BOILER ROOM	HEAT MAIN BALANCING	B & G
6	BOILER ROOM	HEAT MAIN RETURN	FNW 421
7	BOILER ROOM	BYPASS ISOLATION	FNW 421
8	BOILER ROOM	BYPASS ISOLATION	FNW 421
9	BOILER ROOM	BYPASS CONTROL VALVE	BELIMO
10	BOILER ROOM	EXPANSION TANK ISOLATION	FNW 421
11	BOILER ROOM	GLYCOL TANK ISOLATION	FNW 421
12	BOILER ROOM	AIR SEPERATOR DRAIN	FNW 421
13	BOILER ROOM	FUEL OIL FILTER ISO	FNW 421
14	BOILER ROOM	FUEL OIL FILTER ISO	FNW 421
15	BOILER ROOM	DOM. WATER HOSE BIBB	WATTS 1236
16	BOILER ROOM	HEATING MAIN DRAIN	WATTS 1236
17	BOILER ROOM	BOILER DRAIN	WATTS 1236
18	MEZZANINE FAN ROOM	VU-1 COIL SUPPLY	FNW 421
19	MEZZANINE FAN ROOM	VU-1 COIL RETURN	FNW 421
20	MEZZANINE FAN ROOM	VU-1 BALANCING VALVE	FNW 421
21	MEZZANINE FAN ROOM	VU-1 COIL DRAIN	FNW 421
22	MEZZANINE FAN ROOM	VU-1 STRAINER BLOW DOWN	FNW 421
23	MEZZANINE FAN ROOM	CUH SUPPLY	FNW 421
24	MEZZANINE FAN ROOM	CUH RETURN	FNW 421
25	MEZZANINE FAN ROOM	CUH CONTROL VALVE	BELIMO
26	MEZZANINE FAN ROOM	DOM. HOT WATER HEATER	NIBCO
27	MEZZANINE FAN ROOM	EYE WASH – AUTO SHOP COLD	NIBCO
28	MEZZANINE FAN ROOM	EYE WASH AUTO SHOP HOT	NIBCO
29	MEZZANINE FAN ROOM	EYE WASH AUTO TEMPERING	POWERS
30	MEZZANINE FAN ROOM	EYE WASH AUTO BACKFLOW	WATTS
31	MEZZANINE FAN ROOM	EYE WASH WOOD SHOP COLD	NIBCO
32	MEZZANINE FAN ROOM	EYE WASH WOOD SHOP HOT	NIBCO
33	MEZZANINE FAN ROOM	EYE WASH WOOD SHOP COLD	NIBCO
34	MEZZANINE FAN ROOM	EYE WASH WOOD TEMPERING	NIBCO
35	MEZZANINE FAN ROOM	EYE WASH WOOD BACKFLOW	NIBCO
36	WOOD SHOP	UNIT HEATER 1 SUPPLY	FNW 421
37	WOOD SHOP	UNIT HEATER 1 RETURN	FNW 421
38	WOOD SHOP	UNIT HEATER 2 SUPPLY	FNW 421
39	WOOD SHOP	UNIT HEATER 2 RETURN	FNW 421
40	AUTO SHOP	UNIT HEATER 3 SUPPLY	FNW 421
41	AUTO SHOP	UNIT HEATER 3 SUPPLY	FNW 421
42	AUTO SHOP	UNIT HEATER 4 SUPPLY	FNW 421
43	AUTO SHOP	UNIT HEATER 4 RETURN	FNW 421

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: Appendix D - AS-BUILTS

Submittal Number: 1

Item: AS-BUILTS

Manufacturer:

Model #:

Installing Contractor: Custom Mechanical Systems, Inc  
2752 N. Cottonwood Loop  
Wasilla, AK 99654  
Phone: (907) 376-8270  
Fax: none

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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**HAINES HS VOCATIONAL EDUCATION BUILDING UPGRADES**

**OPERATION & MAINTENANCE**

**INDEX**

APPENDIX D: ASBUILTS



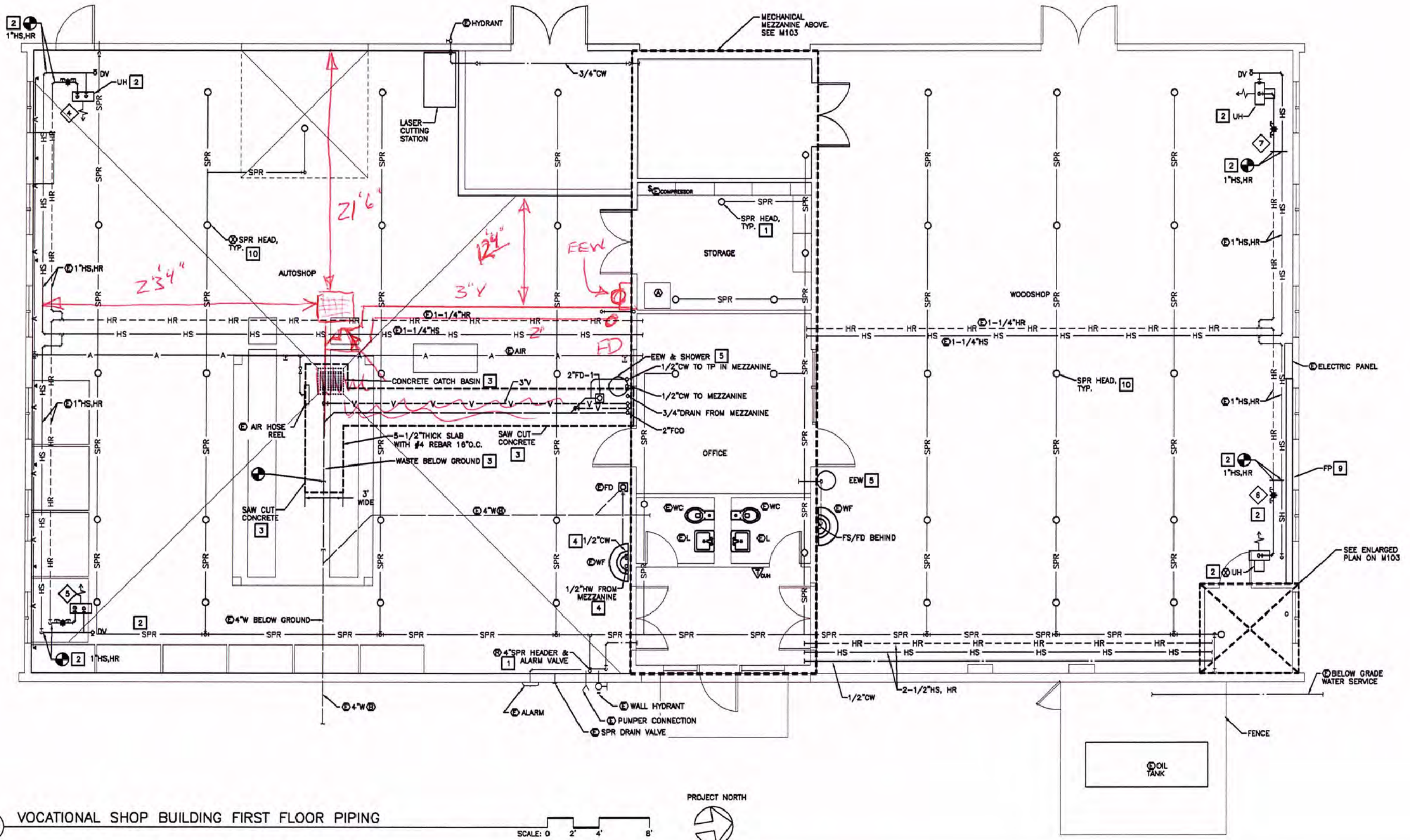
**TASK NOTES:**

- 1 MODIFY EXISTING SPRINKLER HEADER. RAISE ALARM WET ALARM ASSEMBLY APPROX. 3 FEET. INSTALL 4" SIZE REDUCED PRESSURE BACK FLOW PREVENTER & (2) TAMPER SWITCHES ON ISOLATION VALVES. CONNECT 4" SPR TO RAISED WET ALARM ASSEMBLY.
- 2 REPLACE UNIT HEATERS. INSTALL NEW FLOWSETTERS, CONTROL VALVES, ISOLATION VALVES, AND APPURTENANCES.

- 3 INSTALL NEW OIL WATER SEPARATOR. OIL WATER SEPARATOR WILL BE AN ENCLOSED, VENTED TANK. SAWCUTTING AND EXCAVATION WILL BE REQUIRED FOR THE INSTALLATION OF THE OIL WATER SEPARATOR, VENT, AND WASTE. BACKFILL AND REPLACE CONCRETE FLOOR.
- 4 CONNECT 1/2" CW & HW TO EXISTING SUPPLIES ABOVE FIXTURE

- 5 REPLACE EMERGENCY EYEWASH AND EYEWASH/SHOWER COMBINATION UNITS IN SAME LOCATIONS. NEW UNITS TO BE INSTALLED WITH WATER TEMPERING MEANS TO TEMPER OUTLET WATER TO 80°F AS REQUIRED BY OSHA REGULATIONS. UNIT SHALL BE ADA COMPLIANT.
- 6 PREPARE FOR INSTALLATION OF NEW CUH. CUT AND PATCH FINISHES AS REQUIRED.
- 7
- 8

- 9 REMOVE AND REPLACE FINNED PIPE, ASSOCIATED PIPING, AND CONTROLS.
- 10 REPLACE ALL SPRINKLER HEADS.



1

VOCATIONAL SHOP BUILDING FIRST FLOOR PIPING

SCALE: 0 2' 4' 8'

PROJECT NORTH



**MURRAY & ASSOCIATES, P. C.**  
CONSULTING ENGINEERS  
MURRAYPC.COM



**HAINES SCHOOL DISTRICT**  
VOCATIONAL TECHNOLOGY BUILDING  
MECHANICAL AND ELECTRICAL UPGRADES

SHEET TITLE:  
VOCATIONAL SHOP BUILDING FIRST FLOOR PIPING

SCALE: AS SHOWN  
DATE: MARCH 2017  
DRAWN: [Name]  
DESIGNED: [Name]  
CHECKED: [Name]

SHEET NO.

M10

JOB NO. M-46















**MURRAY & ASSOCIATES, P. C.**  
 CONSULTING ENGINEERS  
 MURRAYPC.COM

**HAINES SCHOOL DISTRICT**  
 VOCATIONAL TECHNOLOGY BUILDING  
 MECHANICAL AND ELECTRICAL UPGRADES

SHEET TITLE:  
 VOCATIONAL SHOP BUILDING FIRST FLOOR DUCTWORK

SCALE: AS SHOWN  
 DATE: MARCH  
 DRAWN:  
 DESIGNED:  
 CHECKED:

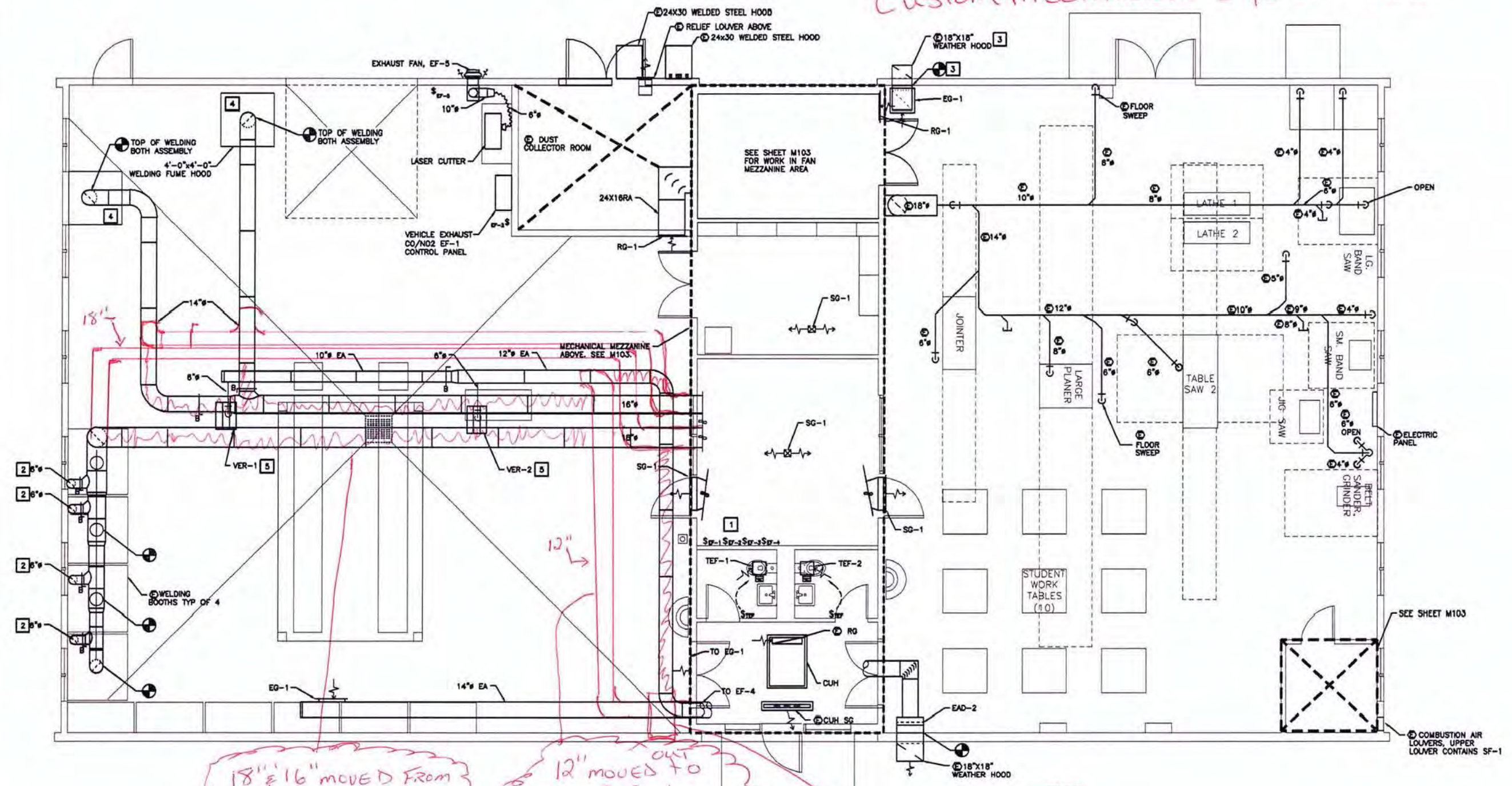
SHEET NO.  
**M20**

JOB NO. M-462

**CONSTRUCTION NOTES:**

- 1 ON-OFF SWITCH CONTROL OF EXHAUST FANS IN MEZZANINE. LABEL ALL FANS.
- 2 INSTALL 8" TO 12" ABOVE WORK SURFACE AT APPROX. 4'-0" AFF.
- 3 EXISTING WEATHERHOOD WITH NEW ELBOW DOWN, APPROXIMATELY 5- FEET TO RELIEF GRILLE IN CEILING. INSTALL 18"x18" RELIEF AIR AUTOMATIC DAMPER IN DUCT. TIE DIFFERENTIAL PRESSURE TO DAMPER OPERATION.
- 4 INSTALL WELDING BOOTH STATION WITH FUME ARM.
- 5 INSTALL VEHICLE EXHAUST REEL TO CEILING STRUCTURE USING CHANNEL FRAMING.
- 6 REPLACE GRILLE. CUT, PATCH, AND PATCH TO MATCH.

*HAINES Voc. TECH.*  
*ASBUILTS 10-5-2015*  
*CUSTOM MECHANICAL SYSTEMS INC.*



*18" & 16" MOVED FROM ABOVE AUTO LIFT*

*12" MOVED OUT TO ALLOW REROUTING OF 18" & 16" EX DUCTS*

*NEW LOCATION FOR AUTOSHOP RELIEF AIR HOOD & DUCT*

1 VOCATIONAL SHOP BUILDING FIRST FLOOR DUCTWORK



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**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

# **Tab E**

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 26 2416 1.6 PANEL BOARDS

Submittal Number: 1

Item: Panel Boards

Manufacturer: Square D

Model #:

Installing Contractor: Premier Electric, LLC  
2485 E ZAK Circle, STE D.  
Wasilla, AK 99654  
Phone: (907) 357-4220  
Fax: (907) 357-4225

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

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Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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# Haines HS Vocational Education Service Gear Submittal

Square D Factory Order #:

## Q2C 36403761



<input type="checkbox"/>	Approval	<input checked="" type="checkbox"/>	Operations & Maintenance Manual
<input type="checkbox"/>	Record		
<input type="checkbox"/>	Revision	<input type="checkbox"/>	Copies Provided

**Contractor / Installer:**

Premier Electric

**Consulting Engineer:**

Haight & Associates

**Distributor:**

Graybar Electric

**Sales Location:**

Anchorage, Alaska

**Schneider**  
Electric

**Project Specialist:**

Ty Bate

[ty.bate@graybar.com](mailto:ty.bate@graybar.com)

(907) 786-4230

Customer Service Information Center: 1-888-Square-D  
[www.SquareD.com](http://www.SquareD.com)

**Schneider**  
Electric

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# Square D Conditions of Sale

Coordinated Projects

**NOTE:** The following Conditions of Sale are subject to change. All transactions for all products sold by Square D Company, including Square D brand products and all Schneider Electric brand products, such as Merlin Gerin, Modicon and Telemecanique brand products, are subject to the latest published Conditions of Sale of the Square D Company and to any Special Conditions of Sale which may be contained in applicable Square D quotations and acknowledgments.

Square D Standard conditions of Sale will apply in all transactions between customers and Square D, unless Square D elects to use the Standard Coordinated Project Conditions of Sale. The Coordinated Project Conditions of Sale will be used on appropriate project jobs only.

**GOVERNING PROVISIONS AND ACCEPTANCE:** All quotations are subject to these conditions of sale. Acceptance of an order by Square D shall be expressly conditioned on Purchaser's assent to these conditions. Purchaser's direction to proceed with engineering, manufacture or shipment by Square D shall be deemed evidence of this assent. No modified or other conditions will be applicable unless those conditions are so stated in Square D's proposal or are specifically agreed to in writing and signed by an authorized official of Square D. Failure to object to provisions contained in any Purchase Order or other communication from the Purchaser (including, without limitation, penalty clauses of any kind) shall not be construed as a waiver of these Conditions nor an acceptance of any other provisions. These terms are a complete statement of the parties' agreement and may only be modified in writing signed by both parties. These terms may not be modified by course of dealing, course of performance or usage of trade. These terms supersede all previous written or oral quotations, statements or agreements. Any contract for sale by and between the parties shall be governed by and construed according to the laws of the State of Illinois without regard to its rules on the conflict of laws. The Convention on the International Sale of Goods is expressly excluded.

**QUOTATIONS:** Quotations shall be valid for no more than thirty (30) days from their date, unless otherwise stated in the quotation. All quotations are subject to change by Square D Company at any time upon notice to Purchaser. Quotations are made based on Square D's interpretation of the plans and specifications submitted to Square D by the Purchaser. It is Purchaser's obligation to review the quotation carefully and to immediately advise Square D of any differing interpretation Purchaser has so any necessary change can be made.

**ORDER ENTRY:** A complete, signed purchase order must be received before entry of an order into Square D's system. Considerable detail is involved in the manufacture of power equipment. To facilitate timely shipment, complete details and information, including Purchaser's requested on-site dates must be provided at the time of order entry. Shipment dates are approximate and are based upon timely receipt of all necessary information from the Purchaser. Lack of complete information may result in delays of drawings or manufacture. Such delays shall relieve Square D from compliance with the quoted delivery dates and may lead to price escalation. Failure to provide a complete signed purchase order within twenty (20) days of notification of award may result in renegotiation of price or shipment dates.

**APPROVAL DRAWINGS:** When required by a specific Purchase Order, drawings will be submitted for approval per agreed upon schedules to assure Square D has designed the equipment as described in Purchaser's specifications, as modified by Square D's quotation. If at time of drawing approval Square D has not designed the equipment to meet the specifications, as modified by Square D's quotation, Square D will make the appropriate changes at no charge to Purchaser. Where the Purchaser's specification is not definitive, Square D shall have the right to design the product in line with good commercial practice, without further obligation to Purchaser. If at drawing approval, Purchaser makes changes outside the design as stated in the specifications, such changes shall be treated as a change order as provided below.

**PRICE POLICY:** Quoted prices are firm provided: A) The order is received with complete engineering details and is released for manufacture within thirty (30) calendar days from the originally anticipated release date. B) All required approval drawings are returned and equipment released by Purchaser no later than thirty (30) calendar days from the original date of mailing of approval drawings by Square D. The returned drawings must be released for manufacture for shipment on the agreed date. Drawing re-submittals which are required for any reason other than to correct Square D errors will not extend the thirty (30) day deadline. If the Purchaser causes delay of shipment in any way or returns approval drawings beyond the time stated above, Purchaser may be subject to charges which shall not exceed 1% of the purchase order price for each full month or fraction thereof that shipment is delayed, as compensation to Square D for expenses created by such delay and not as a penalty. If shipment is delayed through the fault of Purchaser for more than 12 months from the originally anticipated release date, the price must be renegotiated.

**PRICING-PURCHASER CHANGES:** All prices cover a bill of material as described in Square D specifications or quotations to be designed and manufactured to Square D standard designs, unless otherwise agreed in writing between the parties. Purchaser may make minor changes not affecting the time or cost of performance without charge prior to the start of manufacture. If any changes are requested by the Purchaser after submission of the original Purchase Order which affect the cost or time of performance, additional billing will be made with the amount of price adder dependent on the change and status of the order when the change is made. Changes may also result in an extension of time for shipment. All changes will be agreed to by the parties, in writing, prior to implementation. Purchaser's rescheduling shipment will be considered a change. All expenses incurred by Square D in connection with the storage of equipment, including demurrage, packing, storage charges, insurance and handling charges by Square D will be paid by the Purchaser upon submission of invoices by Square D. Square D will issue price changes for any change requested by the Purchaser that affects modification of equipment, changes the bills of material, engineering or drawings or delivery schedule as follows: A) If Purchaser makes a change to an order prior to being released to engineering, the net price will be adjusted by re-pricing the equipment with prices in effect at the time of the change. A commensurate delay in the shipping date will be based on the changes involved. B) For changes made after the order is released to engineering, the net price and ship date will be adjusted as described in paragraph A above. An additional charge based on Square D standard engineering billing charges and cost of parts (\$250 minimum) will be made to cover any extra engineering and drafting, scrap or rework of parts, or cost of modification. C) If during the drawing approval process, the Purchaser makes changes outside the design covered by the specifications, Square D will be reimbursed as described in paragraph A and B above, plus any additional charges for any extra cost incurred as a direct result of the changes and allowed a commensurate delay in shipping date based on the changes involved. Changes to the order can not be processed until a formal change order is received from the Purchaser.

**SUBSTITUTION:** Square D may furnish suitable substitutes for material unobtainable because of priorities or regulations established by governmental authority or non-availability of materials from suppliers, provided such substitutions do not adversely affect the technical soundness of the equipment. Square D assumes no liability for deviation from published dimensions and descriptive information not essential to proper performance of the product.

**TAXES:** Any manufacturer's tax, retailer's tax, occupation tax, use tax, sales tax, excise tax, (except federal excise tax on vehicles), duty, customs, inspecting or testing fee, or other tax, fee or charge of any nature whatsoever, imposed by any governmental authority or measured by any transaction between Square D and Purchaser, shall be paid by the Purchaser in addition to the prices quoted or invoiced, and such charges will appear as a separate line item on the invoice. In the event Square D will be required to pay any such tax, fee, or charge, Purchaser shall reimburse Square D or, in lieu of such payment, Purchaser shall supply Square D at the time the order is submitted with an exemption certificate or other document acceptable to the tax authority. Purchase Orders must state the existence and amount of any such tax, fee or charge for which Purchaser claims an exemption.

**TERMS OF PAYMENT:** Acceptance of all Purchase Orders is subject to Purchaser meeting Square D credit standards. Terms are subject to change for failure to meet such standards. Terms are net thirty (30) days from date of invoice of each shipment, unless otherwise stated in Square D's quotation. For an authorized distributor or authorized reseller order, applicable terms of payment are stated in the quotation or applicable discount schedule. Square D reserves the right at any time to demand full or partial payment before proceeding with a contract of sale if, in its sole judgment, as a result of changes in the financial condition of the Purchaser the terms of payment originally specified are no longer justified.

**PAYMENTS:** If delivery is delayed or deferred by the Purchaser beyond the scheduled date, payment shall be due in full when Square D is prepared to ship. The equipment may be stored at the risk and expense of the Purchaser. If the Purchaser defaults when any payment is due, then the whole contract price shall become due and payable upon demand, or Square D at its option, without prejudice to other lawful remedies, may defer delivery or cancel the contract for sale. If Purchaser become insolvent, or bankrupt or in the event any proceeding is brought against the Purchaser, voluntarily or involuntarily under the bankruptcy or any insolvency law, Square D may cancel any order then outstanding at any time and recover its proper cancellation charges from the Purchaser or the Purchaser's estate.

#### DELIVERY:

**F.O.B. POINT OF SHIPMENT:** When the Square D quotation is based on delivery F.O.B. point of shipment, freight prepaid and allowed for delivery within the continental United States, Product is sold F.O.B. point of shipment, freight prepaid and allowed for orders over \$2000 net. Delivery by Square D to the point of shipment constitutes delivery to the Purchaser; and title and all risk of loss or damage in transit shall pass to the Purchaser at time of delivery at the F.O.B. point. Square D is not responsible for breakage or delays by carrier after having received "in good order" receipts from the carrier. Purchaser is responsible for pursuing any damage claims with the carrier. For orders under \$2000 net the above terms apply except freight is prepaid not allowed. No allowance will be made in lieu of transportation if the Purchaser accepts shipment at factory, warehouse or freight station or otherwise supplies its own transportation. Freight prepaid is defined as: a) Shipments to destinations within the continental United States to the accessible common carrier point nearest the first destination. b) Shipments to U.S. destinations outside the continental United States shall be to the common carrier free delivery point in the United States nearest the original port of embarkation. All charges associated with F.A.S., C.I.F., or other charges such as pier transfer, lift, ocean freight, and marine or war insurance shall be paid by the Purchaser, unless otherwise specifically agreed in a specific Purchase Order. In no event will Square D be responsible for demurrage or detention charges.

**DELIVERY F.O.B. DESTINATION:** When the Square D quotation is based on delivery F.O.B. Destination, for shipments for delivery within the continental United States, Square D will retain title and all risk of loss or damage in transit to the common carrier free delivery point in the United States nearest the first destination for a price addition of 2% of the net price. If the Purchaser elects this Option, Purchaser's obligations shall be as follows: a) Purchaser shall have the responsibility of inspecting the equipment for apparent loss or damage immediately upon its arrival at the free delivery point. b) In the event of apparent shipping loss or damage, Purchaser shall make written notation of the loss on the carrier's delivery receipt and, within 72 hours of delivery shall notify the Square D Customer Information Center. Purchaser shall not remove product from the point of examination and shall retain the shipping container and packing material. Purchaser shall request the carrier to make an inspection and send Square D a copy of the carrier's inspection report. c) In the event of concealed damage which occurred during transit and is discovered by the Purchaser after delivery, Purchaser shall report such damage immediately, but in no event later than 15 days after delivery, to the delivering carrier, and within 72 hours of discovery, shall notify the local Square D field office. If such notification is not made, Square D shall not be liable for loss or damage in transit.

**SHIPMENT AND ROUTING:** Square D shall select the point of origin of shipment, the method of transportation and the routing of the shipment. Purchasers that request expedited or special modes of transportation or routing involving air, premium or any other non-standard Square D shipping shall be assessed additional charges for shipping, handling, freight and expediting. Any rebates, allowances, discounts, or incentives received by Square D from its carriers shall be retained by Square D. All prices include domestic packaging only. When other than domestic packaging is required, contact your local Square D field office. Purchaser specified packaging and marking may be subject to additional charges.

**SHORTAGES:** Claims for shortages or errors must be submitted to Square D within 30 days after invoice date, and failure to give such notice shall constitute unqualified acceptance and a waiver of all such claims by the Purchaser.

**INSTALLMENTS:** Square D reserves the right to make shipments in installments, unless otherwise expressly stipulated in a specific Purchase Order; and all such installments when separately invoiced shall be paid for when due per invoice without regard to subsequent shipments. Delay in shipment of any installment shall not relieve Purchaser of its obligation to accept remaining shipments.

## Square D Conditions of Sale Coordinated Projects

**FORCE MAJEURE:** Square D shall not be liable for any damages as a result of any delays due to any causes beyond Square D's control, including, without limitation, an act of God; act of Purchaser or Square D supplier; embargo or other governmental act, regulation or request; fire; accident; strike; slowdown; flood; fuel or energy shortage; sabotage; war; riot; delay in transportation and inability to obtain necessary labor, materials or manufacturing facilities from usual sources. In the event of any such delay, the date of delivery shall be extended for a period of time reasonably necessary to overcome the effect of such delay.

**STANDARD WARRANTY:** Square D warrants equipment manufactured by it and sold through authorized sales channels to be free from defects in materials and workmanship for eighteen (18) months from date of invoice by Square D or its authorized sales channel. If within such period, any such equipment shall be proved to Square D's satisfaction to be non-conforming, such equipment shall be repaired or replaced at Square D's option. This warranty shall not apply (a) to equipment not manufactured by Square D, (b) to equipment that has been repaired or altered by other than Square D so as, in its judgment, to affect the same adversely, or (c) to equipment that has been subjected to negligence, accident, or damage by circumstances beyond Square D's control, or improper operation, maintenance or storage, or to other than normal use or service. With respect to equipment not manufactured by Square D, the warranty obligations of Square D shall in all respects conform and be limited to the warranty actually extended to Square D by its supplier. Non-conforming products must be returned at Square D's expense for evaluation unless this is waived in writing. Replacement products may be new or reconditioned. The foregoing warranties do not cover reimbursement for labor, transportation, removal, installation, temporary power, or any other expenses that may be incurred in connection with repair or replacement.

**OPTIONAL WARRANTIES:** (Only available on equipment to be located in the U.S.) Option 1-Extended-2 or 3 years from Shipment. If requested by the Purchaser and specifically accepted in writing by Square D, the standard warranty will be extended to two (2) years from date of invoice for a price addition of 1% of the net face value of the Purchase Order or will be extended for three (3) years from date of invoice for a price addition of 3% of the net face value of the Purchase Order. Option 2-Special Warranty: If requested by the Purchaser and specifically accepted in writing by Square D, the standard warranty will be extended, for a price addition of 3% of the net face value of the Purchase Order, to cover reimbursement of the direct costs of: a) Removal of non-conforming equipment or part thereof; b) Transporting equipment or parts to and from the place of repair; c) Off-loading of truck and reinstallation at the original site. Such special warranty, which may be chosen to cover a period not exceeding that of the standard or extended warranty (see above) selected, will not include the cost of providing temporary power or removing or replacing other apparatus or structures, or costs of transportation beyond a common carrier free delivery point in the continental United States. Further, the obligation of Square D for expenses and costs arising under this special warranty coverage will not exceed 50% of the net invoice price on the equipment being repaired. This warranty does not change or affect the allocation of risk or loss during shipment. Option 3-Extended Warranty-Preventative Maintenance Agreements: If requested by the Purchaser, and specifically accepted by Square D, a Preventative Maintenance Agreement is available to provide preventative maintenance on equipment covered by the agreement. Terms of the preventative maintenance agreement shall be as defined in a separate Services Agreement agreed to by the parties.

**SOFTWARE:** Any software or computer information, in whatever form, provided with equipment manufactured by Square D is licensed to Purchaser solely pursuant to standard licenses of Square D or its supplier of such software or computer information, which licenses are, hereby incorporated by reference. Square D does not warrant that such software or computer information will operate error free or without interruption, and warrants only that during the warranty period applicable to the equipment that the software will perform its essential functions. If such software or computer information fails to conform to such warranty, Square D will, at its option, provide an update to correct the non-conformance or replace the software or computer information with the latest available version containing a correction. Square D shall have no other obligation to provide updates or revisions.

**LIMITATIONS:** These disclaimers and limitations of remedies apply to all warranties offered to Purchaser and to all Purchase Orders. THE WARRANTIES SET FORTH ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS OR IMPLIED WARRANTIES (EXCEPT WARRANTIES OF TITLE), INCLUDING, BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Except as may be expressly provided in an authorized writing by Square D, Square D shall not be subject to any other obligations or liabilities whatsoever other than as stated above with respect to equipment sold or services rendered by Square D. Notwithstanding anything to the contrary herein contained SQUARE D COMPANY, ITS CONTRACTORS AND SUPPLIERS OF ANY TIER, SHALL NOT BE LIABLE IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY) OR OTHERWISE FOR LOST TIME, LOST PROFITS, OR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND WHATSOEVER. The remedies of the Purchaser are exclusive and the total cumulative liability of Square D, its contractors and suppliers of any tier, with respect to this contract or anything done in connection therewith, such as the use of any product covered by or furnished under the contract, whether in contract, in tort (including negligence or strict liability) or otherwise, shall not exceed the price of the product, part, or service on which such liability is based.

**INTELLECTUAL PROPERTY:** As to equipment proposed and furnished by Square D, Square D shall defend any suit or proceeding brought against Purchaser so far as based on a claim that such equipment constitutes an infringement of any copyright, trademark or patent of the United States.

This obligation shall be effective only if Purchaser shall have made all payments then due hereunder and if Square D is notified promptly in writing and given authority, information, and assistance at Square D's expense for the defense of the same. In the event the use of such equipment by Purchaser is enjoined in such a suit, Square D shall, at its expense, and at its sole option, either (a) procure for the Purchaser the right to continue using such equipment (b) modify such equipment to render it non-infringing (c) replace such equipment with non-infringing equipment, or (d) refund the purchase price (less depreciation) and the transportation and installation costs of such equipment. Square D will not be responsible for any compromise or settlement made without its written consent. The foregoing states the entire liability of Square D FOR patent, trademark or copyright infringement, and in no event shall Square D be liable if any infringement charge is based on the use of Square D equipment for a purpose other than that for which it was sold by Square D. As to any equipment furnished by Square D to Purchaser and manufactured in accordance with designs proposed by Purchaser, the Purchaser shall indemnify Square D against any award made against Square D for patent, trademark, or copyright infringements.

**WITNESS OF TESTS AND FACTORY INSPECTIONS:** Normal production schedules do not provide the opportunity for Purchaser to witness routine factory tests on equipment or make factory inspections. Witnessing of tests or factory inspections by the Purchaser may result in delays of production for which Square D will not be responsible. Witness testing and factory inspections must be requested at time of quotation and confirmed at order entry. Standard Square D factory testing and inspection will apply. Square D will notify Purchaser fourteen (14) calendar days prior to scheduled witness testing or inspection. In the event Purchaser is unable to attend, the Parties may mutually agree on a rescheduled date. However, Square D, at its sole option, may consider the witness tests and/or inspection waived, and ship and invoice the Products. Purchaser will be responsible for paying for all scheduled witness testing, whether or not Purchaser attends.

**RETURN OF EQUIPMENT:** NO EQUIPMENT MAY BE RETURNED WITHOUT FIRST OBTAINING SQUARE D'S WRITTEN PERMISSION AND A RETURNED MATERIAL IDENTIFICATION TAG. Returned equipment must be of current manufacture, in the original packaging, unused, undamaged and in saleable condition, securely packed to reach Square D without damage and labeled with the return authorization number. Any cost incurred by Square D to put equipment in first class condition will be charged to the Purchaser. Returns will be credited at price invoiced by Square D less a restocking fee of 25% invoice price. Special Order and Custom equipment is not returnable. Square D shall bear the cost of returns resulting from Square D error, and method and route of return will be at the discretion of Square D. Costs incurred by failure to follow Square D direction will be borne by the Purchaser.

**NUCLEAR APPLICATIONS TERMS AND CONDITIONS:** Unless otherwise agreed in writing by a duly authorized representative of Square D, products sold hereunder are not intended for use in or in connection with any nuclear facility or activity. If so used, Square D disclaims all liability for any damage, injury or contamination; and Purchaser shall indemnify Square D against any such liability, whether arising as a result of breach of contract, warranty or tort (including negligence) or otherwise.

**PATTERNS AND TOOLS:** Notice will be given if special patterns or tools are required to complete any order. Charges for such patterns or tools do not convey title thereto or the right to remove them from Square D's plant. If patterns or tools are not used for a period of two years, Square D shall have the right to scrap them without notice.

**PRODUCT NOTICES:** Purchaser shall promptly supply the user (including its employees) of the product with all Square D supplied product notices, warnings, instructions, recommendations and similar materials.

**ERRORS:** Square D reserves the right to correct errors or omissions in quotations, acknowledgments, invoices, or other documents.

**OSHA COMPLIANCE:** Compliance with OSHA or similar federal, state or local laws during the operation or use of the product(s) is the sole responsibility of the Purchaser.

**TERMINATION:** Any order may be terminated by the Purchaser only upon written notice to Square D and upon payment of reasonable and proper termination charges based on the price of the terminated order and reimbursement of all direct costs and expenses associated with the order caused by such termination and shall include a reasonable profit. Special or custom ordered equipment is not cancelable after commencement of manufacturing.

**CANCELLATION:** Square D shall have the right to cancel any order or contract at any time by written notice for any material breach of the contract by the Purchaser, including material delays in releasing equipment for manufacture or approval drawings and excessive changes to specifications or drawings.

0100PL0043R3/07 March 31, 2007

**NOTE:** The following Conditions of Sale are subject to change. All transactions for products sold by Square D Company are subject to the latest published Conditions of Sale of the Square D Company and to any Special Conditions of Sale which may be contained in applicable Square D quotations and acknowledgments.

1. **GOVERNING PROVISIONS AND ACCEPTANCE:** All quotations are subject to these conditions of sale. Acceptance of an order by Square D shall be expressly conditioned on Purchaser's assent to these conditions. Purchaser's direction to proceed with engineering, manufacture or shipment by Square D shall be deemed evidence of this assent. No modified or other conditions will be applicable unless those conditions are so stated in Square D's proposal or are specifically agreed to in writing and signed by an authorized official of Square D. Failure to object to provisions contained in any Purchase Order or other communication from the Purchaser (including, without limitation, penalty clauses of any kind) shall not be construed as a waiver of these Conditions nor an acceptance of any other provisions. These terms are a complete statement of the parties' agreement and may only be modified in writing signed by both parties. These terms may not be modified by course of dealing, course of performance or usage of trade. These terms supersede all previous written or oral quotations, statements or agreements. Any contract for sale by and between the parties shall be governed by and construed according to the laws of the State of Illinois without regard to its rules on the conflict of laws. The Convention on the International Sale of Goods is expressly excluded.
2. **QUOTATIONS:** Quotations shall be valid for no more than thirty (30) days from their date, unless otherwise stated in the quotation. All quotations are subject to change by Square D Company at any time upon notice to Purchaser. It is Purchaser's obligation to review the quotation carefully and to immediately advise Square D of any differing interpretation Purchaser has so any necessary change can be made.
3. **PRICE POLICY:** All prices are subject to change without notice. In the event of a net price change and unless otherwise agreed to in writing, prices for orders scheduled for immediate release shall be those in effect at time of order entry. Prices for orders placed for future shipment without an agreed price and ship date will be billed at the pricing in effect as of the shipment date. All clerical errors are subject to correction.
4. **SUBSTITUTION:** Square D may furnish suitable substitutes for material unobtainable because of priorities or regulations established by governmental authority or non-availability of materials from suppliers, provided such substitutions do not adversely affect the technical soundness of the equipment. Square D assumes no liability for deviation from published dimensions and descriptive information not essential to proper performance of the product.
5. **TAXES:** Any manufacturer's tax, retailer's tax, occupation tax, use tax, sales tax, excise tax, (except federal excise tax on vehicles), duty, customs, inspecting or testing fee, or other tax, fee or charge of any nature whatsoever, imposed by any governmental authority or measured by any transaction between Square D and Purchaser, shall be paid by the Purchaser in addition to the prices quoted or invoiced, and such charges will appear as a separate line item on the invoice. In the event Square D will be required to pay any such tax, fee, or charge, Purchaser shall reimburse Square D or, in lieu of such payment, Purchaser shall supply Square D at the time the order is submitted with an exemption certificate or other document acceptable to the tax authority. Purchase Orders must state the existence and amount of any such tax, fee or charge for which Purchaser claims an exemption.
6. **TERMS OF PAYMENT:** Acceptance of all Purchase Orders is subject to Purchaser meeting Square D credit standards. Terms are subject to change for failure to meet such standards. Terms are net thirty (30) days from date of invoice of each shipment, unless otherwise stated in Square D's quotation. For an authorized distributor or authorized reseller order, applicable terms of payment are stated in the quotation or applicable discount schedule. Square D reserves the right at any time to demand full or partial payment before proceeding with a contract of sale if, in its sole judgment, as a result of changes in the financial condition of the Purchaser the terms of payment originally specified are no longer justified.
7. **PAYMENTS:** If delivery is delayed or deferred by the Purchaser beyond the scheduled date, payment shall be due in full when Square D is prepared to ship. The equipment may be stored at the risk and expense of the Purchaser. If the Purchaser defaults when any payment is due, then the whole contract price shall become due and payable upon demand, or Square D at its option, without prejudice to other lawful remedies, may defer delivery or cancel the contract for sale. If Purchaser becomes insolvent, or bankrupt or in the event any proceeding is brought against the Purchaser, voluntarily or involuntarily under the bankruptcy or any insolvency law, Square D may cancel any order outstanding at any time and recover its applicable cancellation charges from the Purchaser or the Purchaser's estate.
8. **DELIVERY:**

**A: F.O.B. POINT OF SHIPMENT:** When the Square D quotation is based on delivery F.O.B. point of shipment, freight prepaid and allowed for delivery within the continental United States, product is sold F.O.B. point of shipment, freight prepaid and allowed. A shipping and handling charge of twenty-five dollars (\$25) will be added to all orders having a total net invoice price of less than one thousand dollars (\$1,000). Delivery by Square D to the point of shipment constitutes delivery to the Purchaser; and title and all risk of loss or damage in transit shall pass to the Purchaser at time of delivery at the F.O.B. point. Square D is not responsible for breakage after having received "in good order" receipts from the carrier. Purchaser is responsible for pursuing any damage claims with the carrier. No allowance will be made in lieu of transportation if the Purchaser accepts shipment at factory, warehouse or freight station or otherwise supplies its own transportation. Freight prepaid is defined as: A) Shipments to destinations within the continental United States to the accessible common carrier point nearest the first destination. B) Shipments to U.S. destinations outside the continental United States shall be to the common carrier free delivery point in the United States nearest the original port of embarkation. All charges associated with F.A.S., C.I.F., or other charges such as pier transfer, lift, ocean freight, and marine or war insurance shall be paid by the Purchaser, unless otherwise specifically agreed in a specific Purchase Order. In no event will Square D be responsible for demurrage or detention charges.

**B: DELIVERY: F.O.B. DESTINATION:** When the Square D quotation is based on delivery F.O.B. Destination, for shipments for delivery within the continental United States, Square D will retain title and all risk of loss or damage in transit to the common carrier free delivery point in the United States nearest the first destination for a price addition of 2% of the net price. If the Purchaser elects this option, Purchaser's obligations shall be as follows: A) Purchaser shall have the responsibility of inspecting the equipment for apparent loss or damage immediately upon its arrival at the free delivery point. B) In the event of apparent shipping loss or damage, Purchaser shall make written notation of the loss on the carrier's delivery receipt and, within 72 hours of delivery shall notify the Square D Customer Information Center. Purchaser shall not remove product from the point of examination and shall retain the shipping container and packing material. Purchaser shall request the carrier to make an inspection and send Square D a copy of the carrier's inspection report. C) In the event of concealed damage which occurred during transit and is discovered by the Purchaser after delivery, Purchaser shall report such damage immediately, but in no event later than 15 days after delivery, to the delivering carrier, and within 72 hours of discovery, shall notify the local Square D field office. If such notification is not made, Square D shall not be liable for loss or damage in transit.

**C: SHIPMENT AND ROUTING:** Square D shall select the point of origin of shipment, the method of transportation and the routing of the shipment. Purchasers that request expedited or special modes of transportation or routing involving air, premium or any other non-standard Square D shipping shall be assessed additional charges for shipping, handling, freight and expediting. Any rebates, allowances, discounts or incentives received by Square D from its carriers shall be retained by Square D. All prices include domestic packaging only. When other than domestic packaging is required, contact your local Square D field office. Purchaser specified packaging and marking may be subject to additional charges.
9. **SHORTAGES:** Claims for shortages or errors must be submitted to Square D within 30 days after invoice date, and failure to give such notice shall constitute unqualified acceptance and a waiver of all such claims by the Purchaser.
10. **INSTALLMENTS:** Square D reserves the right to make shipments in installments, unless otherwise expressly stipulated in a specific Purchase Order; and all such installments when separately invoiced shall be paid for when due per invoice without regard to subsequent shipments. Delay in shipment of any installment shall not relieve Purchaser of its obligation to accept remaining shipments.
11. **FORCE MAJEURE:** Square D shall not be liable for any damages as a result of any delays due to any causes beyond Square D's control, including, without limitation, an act of God; act of Purchaser or Square D supplier; embargo or other governmental act; regulation or request; fire; accident; strike; slowdown; flood; fuel or energy shortage; sabotage; war; riot; delay in transportation and inability to obtain necessary labor, materials or manufacturing facilities from usual sources. In the event of any such delay, the date of delivery shall be extended for a period of time reasonably necessary to overcome the effect of such delay.
12. **STANDARD WARRANTY:** Square D warrants equipment manufactured by it and sold through authorized sales channels to be free from defects in materials and workmanship for eighteen (18) months from date of invoice by Square D or its authorized sales channel. If within such period any such equipment shall be proved to Square D's satisfaction to be non-conforming, such equipment shall be repaired or replaced at Square D's option. This warranty shall not apply (a) to equipment not manufactured by Square D, (b) to equipment that has been repaired or altered by other than Square D so as, in its judgment, to affect the same adversely, or (c) to equipment that has been subjected to negligence, accident, or damage by circumstances beyond Square D's control, or improper operation, maintenance or storage, or to other than normal use or service. With respect to equipment not manufactured by Square D, the warranty obligations of Square D shall in all respects conform and be limited to the warranty actually extended to Square D by its supplier. Non-conforming products must be returned at Square D's expense for evaluation unless this is waived in writing. Replacement products may be new or reconditioned. The foregoing warranties do not cover reimbursement for labor, transportation, removal, installation, temporary power, or any other expenses that may be incurred in connection with repair or replacement.



## Square D Conditions of Sale Standard

13. **OPTIONAL WARRANTIES:** (Only available on equipment to be located in the U.S.) Option 1 - Extended - 2 or 3 years from Shipment. If requested by the Purchaser and specifically accepted in writing by Square D, the standard warranty will be extended to two (2) years from date of invoice for a price addition of 1% of the net face value of the Purchase Order or will be extended for three (3) years from date of invoice for a price addition of 3% of the net face value of the Purchase Order. Option 2 - Special Warranty: If requested by the Purchaser and specifically accepted in writing by Square D, the standard warranty will be extended, for a price addition of 3% of the net face value of the Purchase Order, to cover reimbursement of the direct costs of: A) Removal of non-conforming equipment or part thereof; B) Transporting equipment or parts to and from the place of repair; C) Off-loading of truck and reinstallation at the original site. Such special warranty, which may be chosen to cover a period not exceeding that of the standard or extended warranty (see above) selected, will not include the cost of providing temporary power or removing or replacing other apparatus or structures, or costs of transportation beyond a common carrier free delivery point in the continental United States. Further, the obligation of Square D for expenses and costs arising under this special warranty coverage will not exceed 50% of the net invoice price on the equipment being repaired. This warranty does not change or affect the allocation of risk or loss during shipment. Option 3 - Extended Warranty - Preventative Maintenance Agreements: If requested by the Purchaser, and specifically accepted by Square D, a Preventative Maintenance Agreement is available to provide preventative maintenance on equipment covered by the agreement. Terms of the Preventative Maintenance Agreement shall be as defined in a separate Services Agreement agreed to by the parties.
14. **RETURN OF EQUIPMENT: NO EQUIPMENT MAY BE RETURNED WITHOUT FIRST OBTAINING SQUARE D'S WRITTEN PERMISSION AND A RETURNED MATERIAL IDENTIFICATION TAG.** Returned equipment must be of current manufacture, in the original packaging, unused, undamaged and in saleable condition. Returned equipment must be securely packed to reach Square D without damage and labeled with the return authorization number. Any cost incurred by Square D to put equipment in first class condition will be charged to the Purchaser. Returns must originate from the original purchaser account number. Returns will be credited at the original price paid as indicated on the invoice or purchase order associated to the equipment being returned as provided by the Purchaser. If no invoice number or purchase order number is provided, then credit will be issued based on the into stock price in effect 12 months prior to date of return authorization and will also have an additional 25% processing fee applied.
- Square D stocked equipment (which is defined as equipment stocked within Square D's Distribution Center) and non-stocked equipment, which are listed in the current product list as returnable and which are accepted for credit, not involving a Square D error, shall be assessed a restocking fee of 25% of the invoice price.
- NOTE:** *Special Order and Custom equipment is not returnable.*
- Each line item returned must have an extended line item value of \$25.00 or greater.
- Square D shall bear the cost of returns resulting from Square D error, and method and route of return will be at the discretion of Square D. Costs incurred by failure to follow Square D direction will be borne by the Purchaser.
15. **SOFTWARE:** Any software or computer information, in whatever form that is provided with equipment manufactured by Square D, is licensed to Purchaser solely pursuant to standard licenses of Square D or its supplier of such software or computer information which licenses are hereby incorporated by reference. Square D does not warrant that such software or computer information will operate error free or without interruption, and warrants only that during the warranty period applicable to the equipment that the software will perform its essential functions. If such software or computer information fails to conform to such warranty, Square D will, at its option, provide an update to correct the non-conformance or replace the software or computer information with the latest available version containing a correction. Square D shall have no other obligation to provide updates or revisions.
16. **LIMITATIONS:** These disclaimers and limitations of remedies apply to all warranties offered to Purchaser and to all Purchase Orders. THE WARRANTIES SET FORTH ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESSED OR IMPLIED WARRANTIES (EXCEPT WARRANTIES OF TITLE), INCLUDING, BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Except as may be expressly provided in an authorized writing by Square D, Square D shall not be subject to any other obligations or liabilities whatsoever, other than as stated above with respect to equipment sold or services rendered by Square D. Notwithstanding anything to the contrary herein contained SQUARE D COMPANY, ITS CONTRACTORS AND SUPPLIERS OF ANY TIER, SHALL NOT BE LIABLE IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY) OR OTHERWISE FOR LOST TIME, LOST PROFITS, OR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND WHATSOEVER. The remedies of the Purchaser are exclusive and the total cumulative liability of Square D, its contractors and suppliers of any tier, with respect to this contract or anything done in connection therewith, such as the use of any product covered by or furnished under the contract, whether in contract, in tort (including negligence or strict liability) or otherwise, shall not exceed the price of the product, part, or service on which such liability is based.
17. **INTELLECTUAL PROPERTY:** As to equipment proposed and furnished by Square D, Square D shall defend any suit or proceeding brought against Purchaser so far as based on a claim that such equipment constitutes an infringement of any copyright, trademark or patent of the United States. This obligation shall be effective only if Purchaser shall have made all payments then due hereunder and if Square D is notified promptly in writing and given authority, information, and assistance at Square D's expense for the defense of the same. In the event the use of such equipment by Purchaser is enjoined in such a suit, Square D shall, at its expense, and at its sole option, either (a) procure for the Purchaser the right to continue using such equipment (b) modify such equipment to render it non-infringing (c) replace such equipment with non-infringing equipment, or (d) refund the purchase price (less depreciation) and the transportation and installation costs of such equipment. Square D will not be responsible for any compromise or settlement made without its written consent. The foregoing states the entire liability of Square D for patent, trademark or copyright infringement, and in no event shall Square D be liable if any infringement charge is based on the use of Square D equipment for a purpose other than that for which it was sold by Square D. As to any equipment furnished by Square D to Purchaser and manufactured in accordance with designs proposed by Purchaser, the Purchaser shall indemnify Square D against any award made against Square D for patent, trademark, or copyright infringements.
18. **WITNESS OF TESTS AND FACTORY INSPECTIONS:** Normal production schedules do not provide the opportunity for Purchaser to witness routine factory tests on equipment or make factory inspections. Witnessing of tests or factory inspections by the Purchaser may result in delays of production for which Square D will not be responsible. Witness testing and factory inspections must be requested at time of quotation, are subject to additional costs and must be confirmed at order entry. Standard Square D factory testing and inspection will apply. Square D will notify Purchaser fourteen (14) calendar days prior to scheduled witness testing or inspection. In the event Purchaser is unable to attend, the Parties may mutually agree on a rescheduled date. However, Square D, at its sole option, may consider the witness tests and/or inspection waived, and ship and invoice the Products and the witness testing charges. Purchaser will be responsible for paying for all scheduled witness testing, whether or not Purchaser attends.
19. **NUCLEAR APPLICATIONS TERMS AND CONDITIONS:** Unless otherwise agreed in writing by a duly authorized representative of Square D, products sold hereunder are not intended for use in or in connection with any nuclear facility or activity. If so used, Square D disclaims all liability for any damage, injury or contamination; and Purchaser shall indemnify Square D against any such liability, whether arising as a result of breach of contract, warranty or tort (including negligence) or otherwise.
20. **PATTERNS AND TOOLS:** Notice will be given if special patterns or tools are required to complete any order. Charges for such patterns or tools do not convey title thereto or the right to remove them from Square D's plant. If patterns or tools are not used for a period of two years, Square D shall have the right to scrap them without notice.
21. **PRODUCT NOTICES:** Purchaser shall promptly supply the user (including its employees) of the product with all Square D supplied product notices, warnings, instructions, recommendations and similar materials.
22. **ERRORS:** Square D reserves the right to correct errors or omissions in quotations, acknowledgments, invoices, or other documents.
23. **OSHA COMPLIANCE:** Compliance with OSHA or similar federal, state or local laws during the operation or use of the product(s) is the sole responsibility of the Purchaser.
24. **TERMINATION:** Any order may be terminated by the Purchaser only upon notice to Square D and upon payment of reasonable and proper termination charges based on the price of the terminated order and reimbursement of all direct costs and expenses associated with the order caused by such termination and shall include a reasonable profit. Special or custom ordered equipment is not cancelable after final acceptance of approval drawings for the commencement of manufacturing.
25. **CANCELLATION:** Square D shall have the right to cancel any order or contract at any time by written notice for any material breach of the contract by the Purchaser, including material delays in releasing equipment for manufacture or approval drawings and excessive changes to specifications or drawings.

**Q2C Number :** 36582663 **BOM Number:** 28691

**BOM Name:** HAINES HS VOC TECH BLDG **BOM Sub Name:**

Item Number	Quantity	Catalog Number / Details
2-00	1	<p><b>Designation:</b> PANEL B NQ ML PNLB (INT,BOX,TRIM) NQ Panelboard Consisting of 208Y/120V 3Ph 4W 60Hz SCCR: 10kA Fully Rated Main Lug Only: 200A Incoming Conductors: 1 - #6 - 350 kcmil Bus: Aluminum: Tin Plated CU Ground Bar 42 Circuit Interior Type 1,Box: 38H x 20W x 5.75D Incoming: Top Trim: Surface - Hinged Box Cat No: MH38BE Front Cat No: NC38SHR Ref. Drawing: PBA701HR Feeders: 2 - 15A/3P QOB 1 - 60A/2P QOB 4 - 50A/2P QOB 11 - 20A/1P QOB 6 - 20A/1P QOB-GFI 6 - 20A/1P QOB Prepared Space 1 - 30A/1P QOB 1 - 20A/1P QOB ST Optional Features: Ship Together,Blank Endwalls,Standard Solid Neutral,Copper Ground Bar Branch User Placement</p> <p><b>Estimated Ship Days (ARO): 15 Working Days</b></p>
3-00	1	<p><b>Designation:</b> PANEL A NQ ML PNLB (INT,BOX,TRIM) NQ Panelboard Consisting of 208Y/120V 3Ph 4W 60Hz SCCR: 10kA Fully Rated Main Lug Only: 100A Incoming Conductors: 1 - #6 - 2/0 AWG AL Ground Bar Bus: Aluminum: Tin Plated 18 Circuit Interior Type 1,Box: 26H x 20W x 5.75D Incoming: Top Trim: Flush - Hinged Box Cat No: MH26BE Front Cat No: NC26FHR Ref. Drawing: PBA701HR Feeders: 7 - 20A/1P QOB 9 - 20A/1P QOB Prepared Space 2 - 15A/1P QOB Optional Features: Ship Together,Blank Endwalls,Standard Solid Neutral,Standard Ground Bar Branch User Placement</p> <p><b>Estimated Ship Days (ARO): 15 Working Days</b></p>

<b>Q2C Number :</b> 36582663	<b>BOM Number:</b> 28691
<b>BOM Name:</b> HAINES HS VOC TECH BLDG	<b>BOM Sub Name:</b>

Item Number	Quantity	Catalog Number / Details
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4-00	1	<p><b>Designation:</b> PANEL P  NQ ML PNLB (INT,BOX,TRIM)  NQ Panelboard  Consisting of  208Y/120V 3Ph 4W 60Hz SCCR: 10kA  Fully Rated  Main Lug Only: 600A  Incoming Conductors: 1 - (2) 1/0-750 kcmil  AL Ground Bar  Bus: Copper: Silver/Tin Plated  30 Circuit Interior  Type 1,Box: 74H x 20W x 5.75D  Incoming: Top Trim: Surface - Hinged  Box Cat No: MH74BE Front Cat No: NC74VSHR  Ref. Drawing: PBA709HR  Feeder:  8 - 20A/1P QOB  14 - 20A/1P QOB Prepared Space  1 - 70A/2P QOB  2 - 100A/3P QOB  1 - Sub-Feed One: 225A/3P QB  1 - Sub-Feed Two: 200A/3P QB  Optional Features:  Ship Together,Blank Endwalls,Standard  Solid Neutral,Standard Ground Bar  Branch User Placement</p>
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**Estimated Ship Days (ARO): 15 Working Days**

5-00	1	<p><b>Designation:</b> PANEL D  NQ ML PNLB (INT,BOX,TRIM)  NQ Panelboard  Consisting of  208Y/120V 3Ph 4W 60Hz SCCR: 10kA  Fully Rated  Main Lug Only: 100A  Incoming Conductors: 1 - #6 - 2/0 AWG  AL Ground Bar  Bus: Aluminum: Tin Plated  42 Circuit Interior  Type 1,Box: 38H x 20W x 5.75D  Incoming: Top Trim: Surface - Hinged  Box Cat No: MH38BE Front Cat No: NC38SHR  Ref. Drawing: PBA701HR  Feeder:  4 - 15A/3P QOB  1 - 50A/3P QOB  2 - 30A/2P QOB  7 - 20A/1P QOB Prepared Space  10 - 20A/1P QOB  1 - 20A/3P QOB  1 - 40A/3P QOB  Optional Features:  Ship Together,Blank Endwalls,Standard  Solid Neutral,Standard Ground Bar  Branch User Placement</p>
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**Estimated Ship Days (ARO): 15 Working Days**



<b>Q2C Number :</b> 36582663	<b>BOM Number:</b> 28691
<b>BOM Name:</b> HAINES HS VOC TECH BLDG	<b>BOM Sub Name:</b>

Item Number	Quantity	Catalog Number / Details
6-00	1	<p><b>Designation:</b> EF-1            8536SAG11V02S            STARTER MOTOR CONTROL &lt;1000VAC            Class 8536 Starter            8536SAG11V02S            NEMA Size 00            Non-reversing single phase            2 pole device            Type 1 Enclosure            Melting alloy overload            Starter will require 1 thermal unit            Standard with NC overload contact            Specified for 115V 1Ph power system            Separate control source selected              with 120V 60Hz coil            Auxiliary contacts -              None            Control units supplied              None            Pilot lights supplied              None            Revision - 5/5/2015 - (150217P4/150427P4)              5/6/2015 3:18:27 PM</p>
7-00	2	<p><b>Designation:</b> EF-2, EF-3            8536SBG2V02H31S            Class 8536 Starter            Class 8536 Starter            8536SBG2V02H31S            NEMA Size 0            Non-reversing 3 phase            3 pole device              Selected for 2 HP @ 200V 3Ph            Type 1 Enclosure            H3xx - SSOLR - Class 10/20 trip              Range of 6-18 amps              Additional auxiliary alarm contact            Specified for 200V 3Ph power system            Separate control source selected              with 120V 60Hz coil            Auxiliary contacts -              None            Control units supplied              None            Pilot lights supplied              None            Revision - 5/5/2015 - (150217P4/150427P4)              5/6/2015 3:18:38 PM</p>

Q2C Number : 36582663

BOM Number: 28691

BOM Name: HAINES HS VOC TECH BLDG

BOM Sub Name:

Item Number	Quantity	Catalog Number / Details
8-00	1	<p><b>Designation:</b> EF-4 8536SBG2V02H31S Class 8536 Starter Class 8536 Starter 8536SBG2V02H31S NEMA Size 0 Non-reversing 3 phase 3 pole device Selected for 3 HP @ 200V 3Ph Type 1 Enclosure H3xx - SSOLR - Class 10/20 trip Range of 6-18 amps Additional auxiliary alarm contact Specified for 200V 3Ph power system Separate control source selected with 120V 60Hz coil Auxiliary contacts - None Control units supplied None Pilot lights supplied None Revision - 5/5/2015 - (150217P4/150427P4) 5/6/2015 3:19:34 PM</p>
9-00	1	<p><b>Designation:</b> EF-5 8536SBG1V02SY344 Class 8536 Starter Class 8536 Starter 8536SBG1V02SY344 NEMA Size 0 Non-reversing single phase 2 pole device Selected for 3/4 HP @ 115V 1Ph Type 1 Enclosure Melting alloy overload Starter will require 1 thermal unit Standard with NC overload contact Y344 - Additional NC alarm contact Specified for 115V 1Ph power system Separate control source selected with 120V 60Hz coil Auxiliary contacts - None Control units supplied None Pilot lights supplied None Revision - 5/5/2015 - (150217P4/150427P4) 5/6/2015 3:20:32 PM</p>

Item Number	Quantity	Catalog Number / Details
10-00	1	<p><b>Designation:</b> P-1  8538SBG32V84CFF4H318T  Class 8538 Fused Combination Starter  Class 8538 Fused Combination Starter  8538SBG32V84CFF4H318T  NEMA Size 0  Fused combination starter  with Class R fuse clips  (Fuses not included)  Non-reversing 3 phase  3 pole device  Selected for 3/4 HP @ 200V 3Ph  Type 1 Enclosure  H3xx - SSOLR - Class 10/20 trip  Range of 1.5-4.5 amps  Additional auxiliary alarm contact  Specified for 200V 3Ph power system  Fused control transformer selected  with 120V 60Hz coil  T - Standard capacity  208 Volt primary  120 Volt secondary  Fusing  F4 - 2 primary control fuses  F - 1 secondary control fuse  Auxiliary contacts -  None  Control units supplied  C - HAND-OFF-AUTO selector switch  Pilot lights supplied  None  Revision - 5/5/2015 - (150217P4/150427P4)  5/6/2015 3:37:14 PM</p> <p><b>Estimated Ship Days (ARO): 3 Working Days</b></p>
11-00	7	<p><b>Designation:</b> CUH, UH, TEF  2510FG1P  MANUAL STARTER 277VAC</p>
13-00	1	<p><b>Designation:</b> P-2  HU361  SWITCH NOT FUSIBLE HD 600V 30A 3P NEMA1</p>
14-00	1	<p><b>Designation:</b> P-2  GTK03  KIT EQUIPMENT GROUND CU/AL</p>
15-00	4	<p><b>Designation:</b> Combo Controls  9001KY1  30MM CONTROL STATION 1HOLE ALUMINUM</p>
16-00	4	<p><b>Designation:</b> Combo Controls  9001AS1  PUSHBUTTON +OPTIONS</p>

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REV	DESCRIPTION	BY	DATE	---	---	---
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CKT NO	ACCESSORIES	TYPE	RATING AMP/P	S/N	200A M/L			S/N	RATING AMP/P	TYPE	ACCESSORIES	CKT NO
					A	B	C					
1												2
3		QOB	15/3					15/3	QOB			4
5												6
7		QOB	60/2					50/2	QOB			8
9												10
11		QOB	50/2					50/2	QOB			12
13												14
15		QOB	50/2					20/1	QOB			16
17								20/1	QOB			18
19		QOB	20/1					20/1	QOB			20
21		QOB	20/1					20/1	QOB			22
23		QOB	20/1					20/1	QOB			24
25		QOB	20/1					20/1	QOB	PREPARED SPACE		26
27		QOB	20/1					20/1	QOB	ST 120Vac		28
29		QOB-GFI	20/1									30
31		QOB-GFI	20/1					20/1	QOB	PREPARED SPACE		32
33	PREPARED SPACE	QOB	20/1					20/1	QOB-GFI			34
35		QOB-GFI	20/1					20/1	QOB-GFI			36
37		QOB	20/1					20/1	QOB-GFI			38
39		QOB	30/1					20/1	QOB	PREPARED SPACE		40
41	PREPARED SPACE	QOB	20/1					20/1	QOB	PREPARED SPACE		42


### PHYSICAL DATA

ENCLOSURE Type 1  
 Surface - Hinged  
 FRONT CAT#: NC38SHR  
 BOX CAT#: MH38BE  
 DIMENSIONS:  
 38''H x 20''W x 5.75''D  
 WIRE BENDING SPACE:  
 TOP - 9.26  
 BOTTOM - 5  
 SIDE - 6.13  
 PBA: 701HR  
 BUSSING: Aluminum  
 Tin Plated  
 OPTIONAL FEATURES:  
 SHIP TOGETHER  
 BRANCH USER PLACEMENT  
 Copper GROUND BAR  
 BLANK ENDWALLS  
 ALUMINUM SOLID NEUTRAL

### ELECTRICAL DATA

SYSTEM: 208Y/120V 3Ph 4W 60Hz  
 System Ampacity: 200A  
 10kA SYMS. SCCR  
 MAIN: MAIN LUGS : 200A  
 Top FEED  
 INCOMING CONDUCTORS(S) PER NEC:  
 #6 - 350 kcmil  
 BRANCH MOUNTING TYPE: BOLT-ON  
 -----BRANCH SUMMATION-----  
 2 - 15A/3P QOB                      1 - 60A/2P QOB  
 4 - 50A/2P QOB                      11 - 20A/1P QOB  
 6 - 20A/1P QOB-GFI                 6 - 20A/1P-PS QOB  
 1 - 30A/1P QOB                        1 - 20A/1P QOB ST

**NQ PANEL BOARD  
 DESIGNATION: PANEL B**

JOB NAME:	HAINES HS VOC TECH BLDG	EQUIPMENT DESIGNATION:	<b>PANEL B</b>
JOB LOCATION:	HAINES AK	EQUIPMENT TYPE:	NQ (Circuit Breaker Type) PANEL 1 OF 1
DRAWN BY:	(Q2C)	DRAWING TYPE:	ONE LINE DIAGRAM
ENGR:		 <small>by Schneider Electric</small>	
DATE:	May 06 2015	DWG#	<b>036582663-01</b>
DRAWING STATUS:	QUOTE	PG	1 OF 1 REV -

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# NQ Circuit Breaker Panelboards

NQ PANEL BOARD  
DESIGNATION: PANEL B

Catalog  
1640CT0801  
**2008**  
Class 1640



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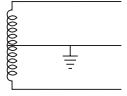
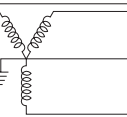
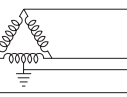
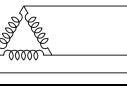
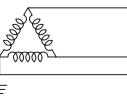


by Schneider Electric

## NQ Circuit Breaker Panelboards Standards and Ratings

### Standards and Ratings

**NQ PANEL BOARD  
DESIGNATION: PANEL B**

Voltage	System	System Diagram
120/240 Vac	1 $\phi$ 3W	
208Y/120 Vac	3 $\phi$ 4W	
240/120 Vac	3 $\phi$ 4W Delta	
240 Vac	3 $\phi$ 3W Delta	
240 Vac	3 $\phi$ 3W Grd. B $\phi$ Delta	

NQ circuit breaker panelboards meet US and Canadian standards, and are marked cULus. NQ circuit breaker panelboards accept QO<sup>®</sup> and QOB branch circuit breakers.

### Standards

NQ circuit breaker panelboards are designed, manufactured, and tested to comply with the following standards:

- UL 67—Standard for Panelboards
- UL 50—Enclosures for Electrical Equipment
- CSA C22.2, No. 29-M1989—Panelboards and Enclosed Panelboards
- CSA C22.2, No. 94-M91—Special Purpose Enclosures
- NEMA PB 1—Panelboards
- NFPA 70—National Electrical Code<sup>®</sup> (NEC<sup>®</sup>)
- Federal Specification W-P-115C Type I Class 1—Circuit Breaker Panelboards
- 2003 IBC, NFPA 5000, ASCE/SE17 Seismic Qualification

### Ratings

- Main Lugs 100–600 A
- Main Circuit Breaker 100–600 A



**Main Lug Interiors**



**225 A Maximum Main Lug Interior and Deadfront**

- Will accept plug-on or bolt-on branch circuit breakers.
- Top- or bottom-feed.
- 65k AIR maximum branch circuit breakers (fully-rated).
- 200k AIR maximum when supplied by remote I-Limiter® circuit breaker (series rated).
- 100 A and 225 A interiors are suitable for use as service entrance with back-fed QOB circuit breaker (USA only).
- Field-installable sub-feed lug kits for 100–400 A interiors.
- Factory installed main lugs on all interiors.
- 225–400 A main lug interiors are convertible to main circuit breaker by adding a main circuit breaker and adapter kit.
- Available with silver-plated copper or tin-plated aluminum bus (aluminum is standard). Tin-plated copper bus is available as an option. Branch connector fingers are all tin-plated copper; silver-plated branch connector fingers are optional.



100–225 A Maximum

600 A Maximum

**Main Lug Interiors**

Main lugs for MLO Interiors

**Table 4: Aluminum Main lugs for MLO Interiors**

Amperes	Catalog Number	Lug Wire Range for wire bending space
<b>Aluminum Mechanical</b>		
100	standard	(1) #6-350 kcmil
225	standard	(1) #6-350 kcmil
400	standard	(1) 1/0-750 kcmil, or (2) 1/0-350 kcmil
600	standard	(2) 1/0-750 kcmil
600 <sup>1</sup>	NQALM6A	(3) 1/0-250 kcmil
<b>Aluminum Compression</b>		
100	NQALV1	(1) #4-300 kcmil
225	NQALV2	(1) 250-350 kcmil
400	NQALV4	(2) 2/0-500 kcmil
600	NQALV6	(2) 2/0-500 kcmil

<sup>1</sup> Optional lug for 600 A. Can also be used for 400 A.

**Table 5: Copper Main lugs for MLO Interiors**

Amperes	Catalog Number	Lug Wire Range for wire bending space
<b>Copper Mechanical</b>		
100	NQCUM1	(1) #6-350 kcmil
225	NQCUM2	(1) #6-350 kcmil
400	NQCUM4	(1) 1/0-750 kcmil, or (2) 1/0-350 kcmil
600	NQCUM6	(2) 1/0-750 kcmil
<b>Copper Compression</b>		
100	NQCUV1	(1) #6-350 kcmil
225	NQCUV2	(1) #6-350 kcmil
400	NQCUV4	(1) 400-750 kcmil
600	NQCUV6	(2) 250-500 kcmil



**Type VCEL VERSAtile™ Compression Equipment Terminals**

**NQ Circuit Breaker Panelboards**  
**Branch Circuit Breakers (Bolt-on)**

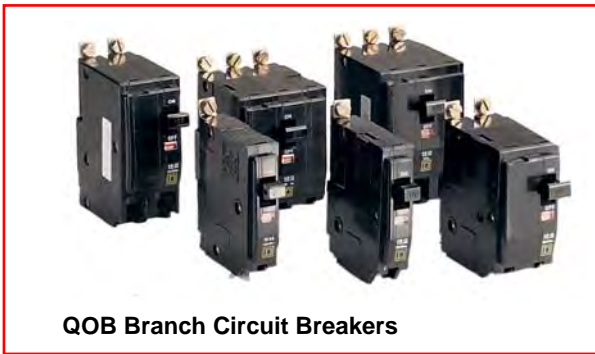
**NQ PANEL BOARD**  
**DESIGNATION: PANEL B**

**Branch Circuit Breakers (Bolt-on)**

**Table 8: Branch Circuit Breakers (Plug-on or Bolt-on) <sup>1</sup>**

10 k AIR	22 k AIR	65 k AIR	10 k AIR (240 Vac)	42 k AIR
QO, QOB	QO-VH, QOB-VH	QH, QHB	QO-H, QOB-H	QOH
1-Pole 10–70 A	1-Pole 15–30 A	1-Pole 15–30 A	2-Pole 15–100 A	2-Pole 35–125 A
2-Pole 10–125 A	2-Pole 15–150 A	2-Pole 15–30 A		
3-Pole 10–100 A	3-Pole 15–150 A	3-Pole 15–30 A		

<sup>1</sup> Series ratings are also available. Canada: See the Series Rating Guide (data bulletin #S1600PD0302EP) USA: See Switchboard/Panelboard Short-Circuit Current Ratings (data bulletin #2700DB9901), or the Digest



**Table 9: Branch Circuit Breaker Interrupting Data**

Circuit Breaker Catalog Prefix	Max. Vac Rating	Number of Poles	Ampere Rating	Interrupting Rating— RMS Symmetrical Amperes		
				Vac		
				120	120/240	240
QO, QOB	120/240	1	10-70	—	10k	—
	120/240	2	10-125	—	10k	—
	240	3	10-100	—	—	10k
QO-H, QOB-H	240	2	15–125	—	—	10k
QO-VH	120/240	1	15–30	—	22k	—
	120/240	2	15–125	—	22k	—
	240	3	15–100	—	—	22k
QOB-VH	120/240	1	15–30	—	22k	—
	120/240	2	15–150	—	22k	—
	240	3	15–150	—	—	22k
QOH-QOHB	120/240	2	35–125	—	42k	—
QH, QHB	120/240	1	15–30	—	65k	—
	120/240	2	15–30	—	65k	—
	240	3	15–30	—	—	65k

**Table 10: Additional Branch Circuit Breaker Information**

Circuit Breaker Type	Circuit Breaker Catalog Class
QO, QOB	730
QO-AFCI	760
QO-GFI, QOB-GFI	910

## Enclosures

**NQ PANEL BOARD  
DESIGNATION: PANEL B**

**MH38BE  
38H x 20W x 5.75D**



Interior Mounts to Box Studs



MH Box



Front (Type 1) Enclosure for 400-600 A Interiors



Mono-Flat Front (Type 1 Enclosure) for 100-250 A Interiors  
**NC38SHR - TRIM  
NEMA1 - TOP FEED  
SURFACE MOUNT**

### Indoor Enclosures

**Table 21: Enclosure Types**

Type	Environment	Protects Against
Type 1	Indoor	Contact with the enclosed equipment, falling dirt
Type 2	Indoor	Type 1, plus • Dripping and light splashing of non-corrosive liquids
Type 3R	Outdoor	Type 2, plus • Rain, snow, and sleet
Type 4	Indoor/outdoor	Type 3R, plus • Circulating dust, lint, fibers and flyings • Settling airborne dust, lint, fibers and flyings • Windblown dust • Hosedown and splashing water
Type 4X	Indoor/outdoor	Type 4, plus • Corrosive agents
Type 5	Indoor	Type 2, plus • Settling airborne dust, lint, fibers, and flyings
Type 12	Indoor	Type 2, plus • Circulating dust, lint, fibers, and flyings • Settling airborne dust, lint, fibers, and flyings • Oil and coolant seepage

### Indoor Enclosures (Types 1 and 2)

#### Boxes (MH):

- Galvanized steel with removable endwalls. One is provided with knockouts and the other is blank.
- Standard box sizes:
  - 20 in. (508 mm) wide x 5.75 in. (146 mm) deep, 600 A main lug interior max. or 400 A main circuit breaker max
  - 20 in. (508 mm) wide x 8.75 in. (223 mm) deep, 600 A main circuit breaker interior, factory-assembled only
- Box and interior mounting instructions are found in the information manual shipped with the interior.
- Interiors mount directly to studs in the MH box. Interior mounting brackets are not required.
- Type 2 enclosure includes a driphood.
  - Surface-mounted trim only.

**NOTE:** Also available with knockouts / blank endwalls both ends.

#### Trims:

- Finished with gray baked enamel electrodeposited over cleaned phosphatized steel (ANSI 49).
- Flush or surface mounted (Type 2 surface only).
- Door has flush lock. Uses NSR-251 key.
- Directory card located on the inside of the door.
- Mono-Flat® trims on 100-225 A interiors mount to the interior trim with trim screws. Both trim screws and door hinges are concealed. Trims are not removable with the door closed and locked.
- Trims for 400-600 A interiors are vented and mount to the enclosure with trim screws. Door hinges are concealed.
- Optional hinged trims are available. These meet door-in-door specs.



Flush Lock (standard)  
(Catalog No. PK4FL)



Key NSR-251  
(Catalog No. LP9618)



Sliding Vault Lock (optional)  
(Catalog No. PK5FL)



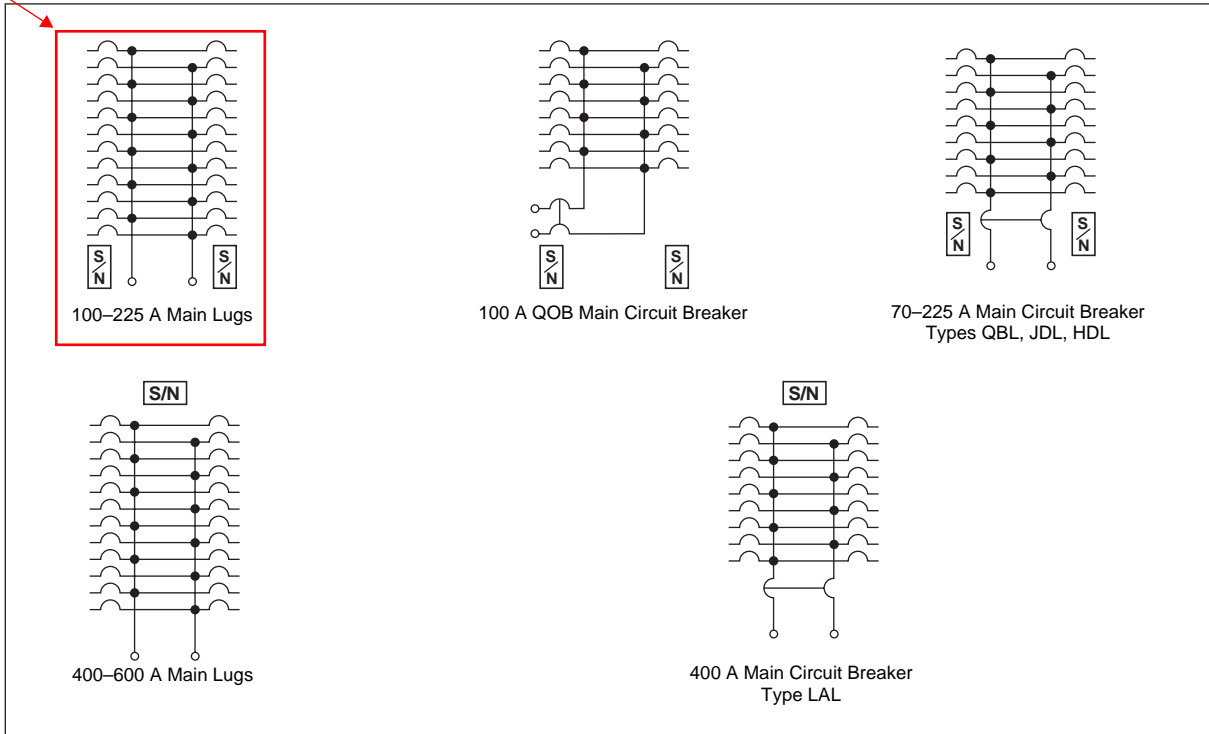
Concealed Hinge  
Used on 100-600 A Fronts

### Indoor Enclosure Accessories

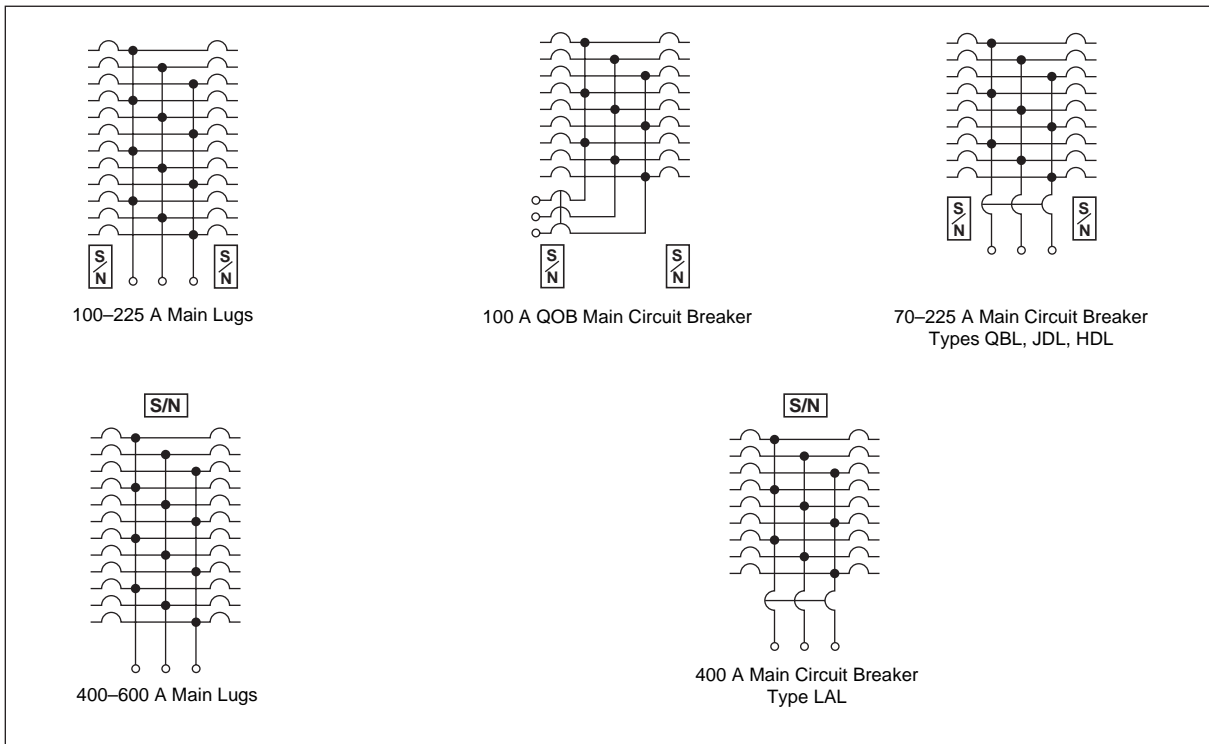
# NQ Circuit Breaker Panelboards Typical Wiring Diagrams

## Typical Wiring Diagrams

NQ PANEL BOARD  
DESIGNATION: PANEL B



**1-Phase, 3-Wire**



**3-Phase, 4-Wire**



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# NQ Circuit Breaker Panelboards

NQ PANEL BOARD  
DESIGNATION: PANEL A

Catalog  
1640CT0801  
**2008**  
Class 1640



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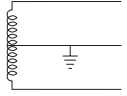
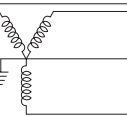
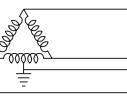
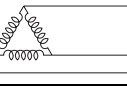
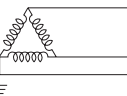
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by Schneider Electric

## NQ Circuit Breaker Panelboards Standards and Ratings

### NQ PANEL BOARD DESIGNATION: PANEL A

Voltage	System	System Diagram
120/240 Vac	1 $\phi$ 3W	
208Y/120 Vac	3 $\phi$ 4W	
240/120 Vac	3 $\phi$ 4W Delta	
240 Vac	3 $\phi$ 3W Delta	
240 Vac	3 $\phi$ 3W Grd. B $\phi$ Delta	

### Standards and Ratings

NQ circuit breaker panelboards meet US and Canadian standards, and are marked cULus. NQ circuit breaker panelboards accept QO<sup>®</sup> and QOB branch circuit breakers.

### Standards

NQ circuit breaker panelboards are designed, manufactured, and tested to comply with the following standards:

- UL 67—Standard for Panelboards
- UL 50—Enclosures for Electrical Equipment
- CSA C22.2, No. 29-M1989—Panelboards and Enclosed Panelboards
- CSA C22.2, No. 94-M91—Special Purpose Enclosures
- NEMA PB 1—Panelboards
- NFPA 70—National Electrical Code<sup>®</sup> (NEC<sup>®</sup>)
- Federal Specification W-P-115C Type I Class 1—Circuit Breaker Panelboards
- 2003 IBC, NFPA 5000, ASCE/SE17 Seismic Qualification

### Ratings

- Main Lugs 100–600 A
- Main Circuit Breaker 100–600 A



# NQ Circuit Breaker Panelboards Interiors

**NQ PANEL BOARD  
DESIGNATION: PANEL A**

## Main Lug Interiors



225 A Maximum Main Lug Interior and Deadfront

- Will accept plug-on or bolt-on branch circuit breakers.
- Top- or bottom-feed.
- 65k AIR maximum branch circuit breakers (fully-rated).
- 200k AIR maximum when supplied by remote I-Limiter<sup>®</sup> circuit breaker (series rated).
- 100 A and 225 A interiors are suitable for use as service entrance with back-fed QOB circuit breaker (USA only).
- Field-installable sub-feed lug kits for 100–400 A interiors.
- Factory installed main lugs on all interiors.
- 225–400 A main lug interiors are convertible to main circuit breaker by adding a main circuit breaker and adapter kit.
- Available with silver-plated copper or tin-plated aluminum bus (aluminum is standard). Tin-plated copper bus is available as an option. Branch connector fingers are all tin-plated copper; silver-plated branch connector fingers are optional.



100–225 A Maximum

600 A Maximum

## Main Lug Interiors

Main lugs for MLO Interiors

Table 4: Aluminum Main lugs for MLO Interiors

Amperes	Catalog Number	Lug Wire Range for wire bending space
<b>Aluminum Mechanical</b>		
100	standard	(1) #6-350 kcmil
225	standard	(1) #6-350 kcmil
400	standard	(1) 1/0-750 kcmil, or (2) 1/0-350 kcmil
600	standard	(2) 1/0-750 kcmil
600 <sup>1</sup>	NQALM6A	(3) 1/0-250 kcmil
<b>Aluminum Compression</b>		
100	NQALV1	(1) #4-300 kcmil
225	NQALV2	(1) 250-350 kcmil
400	NQALV4	(2) 2/0-500 kcmil
600	NQALV6	(2) 2/0-500 kcmil

<sup>1</sup> Optional lug for 600 A. Can also be used for 400 A.

Table 5: Copper Main lugs for MLO Interiors

Amperes	Catalog Number	Lug Wire Range for wire bending space
<b>Copper Mechanical</b>		
100	NQCUM1	(1) #6-350 kcmil
225	NQCUM2	(1) #6-350 kcmil
400	NQCUM4	(1) 1/0-750 kcmil, or (2) 1/0-350 kcmil
600	NQCUM6	(2) 1/0-750 kcmil
<b>Copper Compression</b>		
100	NQCUV1	(1) #6-350 kcmil
225	NQCUV2	(1) #6-350 kcmil
400	NQCUV4	(1) 400-750 kcmil
600	NQCUV6	(2) 250-500 kcmil



Type VCEL VERSAtile™ Compression Equipment Terminals

# NQ Circuit Breaker Panelboards Branch Circuit Breakers (Bolt-on)

**NQ PANEL BOARD  
DESIGNATION: PANEL A**

## Branch Circuit Breakers (Bolt-on)

Table 8: Branch Circuit Breakers (Plug-on or Bolt-on) <sup>1</sup>

10 k AIR	22 k AIR	65 k AIR	10 k AIR (240 Vac)	42 k AIR
QO, QOB	QO-VH, QOB-VH	QH, QHB	QO-H, QOB-H	QOH
1-Pole 10–70 A	1-Pole 15–30 A	1-Pole 15–30 A	2-Pole 15–100 A	2-Pole 35–125 A
2-Pole 10–125 A	2-Pole 15–150 A	2-Pole 15–30 A		
3-Pole 10–100 A	3-Pole 15–150 A	3-Pole 15–30 A		

<sup>1</sup> Series ratings are also available. Canada: See the Series Rating Guide (data bulletin #S1600PD0302EP) USA: See Switchboard/Panelboard Short-Circuit Current Ratings (data bulletin #2700DB9901), or the Digest

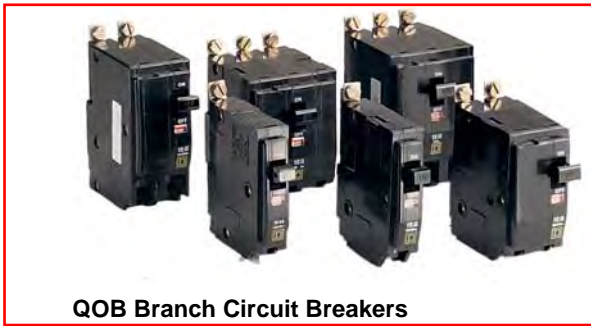


Table 9: Branch Circuit Breaker Interrupting Data

Circuit Breaker Catalog Prefix	Max. Vac Rating	Number of Poles	Ampere Rating	Interrupting Rating— RMS Symmetrical Amperes		
				Vac		
				120	120/240	240
QO, QOB	120/240	1	10-70	—	10k	—
	120/240	2	10-125	—	10k	—
	240	3	10-100	—	—	10k
QO-H, QOB-H	240	2	15–125	—	—	10k
QO-VH	120/240	1	15–30	—	22k	—
	120/240	2	15–125	—	22k	—
	240	3	15–100	—	—	22k
QOB-VH	120/240	1	15–30	—	22k	—
	120/240	2	15–150	—	22k	—
	240	3	15–150	—	—	22k
QOH-QOHB	120/240	2	35–125	—	42k	—
QH, QHB	120/240	1	15–30	—	65k	—
	120/240	2	15–30	—	65k	—
	240	3	15–30	—	—	65k

Table 10: Additional Branch Circuit Breaker Information

Circuit Breaker Type	Circuit Breaker Catalog Class
QO, QOB	730
QO-AFCI	760
QO-GFI, QOB-GFI	910

## Enclosures

**NQ PANEL BOARD  
DESIGNATION: PANEL A**

**Table 21: Enclosure Types**

Type	Environment	Protects Against
Type 1	Indoor	Contact with the enclosed equipment, falling dirt
Type 2	Indoor	Type 1, plus • Dripping and light splashing of non-corrosive liquids
Type 3R	Outdoor	Type 2, plus • Rain, snow, and sleet
Type 4	Indoor/outdoor	Type 3R, plus • Circulating dust, lint, fibers and flyings • Settling airborne dust, lint, fibers and flyings • Windblown dust • Hosedown and splashing water
Type 4X	Indoor/outdoor	Type 4, plus • Corrosive agents
Type 5	Indoor	Type 2, plus • Settling airborne dust, lint, fibers, and flyings
Type 12	Indoor	Type 2, plus • Circulating dust, lint, fibers, and flyings • Settling airborne dust, lint, fibers, and flyings • Oil and coolant seepage



Interior Mounts to Box Studs

**MH26BE  
26H x 20W x 5.75D**



MH Box



Front (Type 1) Enclosure for 400–600 A Interiors



Mono-Flat Front (Type 1 Enclosure) for 100–250 A Interiors

**NC38FHR TRIM  
FLUSH MOUNT  
TOP FEED**

### Indoor Enclosures

### Indoor Enclosures (Types 1 and 2)

#### Boxes (MH):

- Galvanized steel with removable endwalls. One is provided with knockouts and the other is blank.
- Standard box sizes:
  - 20 in. (508 mm) wide x 5.75 in. (146 mm) deep, 600 A main lug interior max. or 400 A main circuit breaker max
  - 20 in. (508 mm) wide x 8.75 in. (223 mm) deep, 600 A main circuit breaker interior, factory-assembled only
- Box and interior mounting instructions are found in the information manual shipped with the interior.
- Interiors mount directly to studs in the MH box. Interior mounting brackets are not required.
- Type 2 enclosure includes a driphood.
  - Surface-mounted trim only.

**NOTE:** Also available with knockouts / blank endwalls both ends.

#### Trims:

- Finished with gray baked enamel electrodeposited over cleaned phosphatized steel (ANSI 49).
- Flush or surface mounted (Type 2 surface only).
- Door has flush lock. Uses NSR-251 key.
- Directory card located on the inside of the door.
- Mono-Flat® trims on 100–225 A interiors mount to the interior trim with trim screws. Both trim screws and door hinges are concealed. Trims are not removable with the door closed and locked.
- Trims for 400–600 A interiors are vented and mount to the enclosure with trim screws. Door hinges are concealed.
- Optional hinged trims are available. These meet door-in-door specs.



Flush Lock (standard) (Catalog No. PK4FL)



Key NSR-251 (Catalog No. LP9618)



Sliding Vault Lock (optional) (Catalog No. PK5FL)



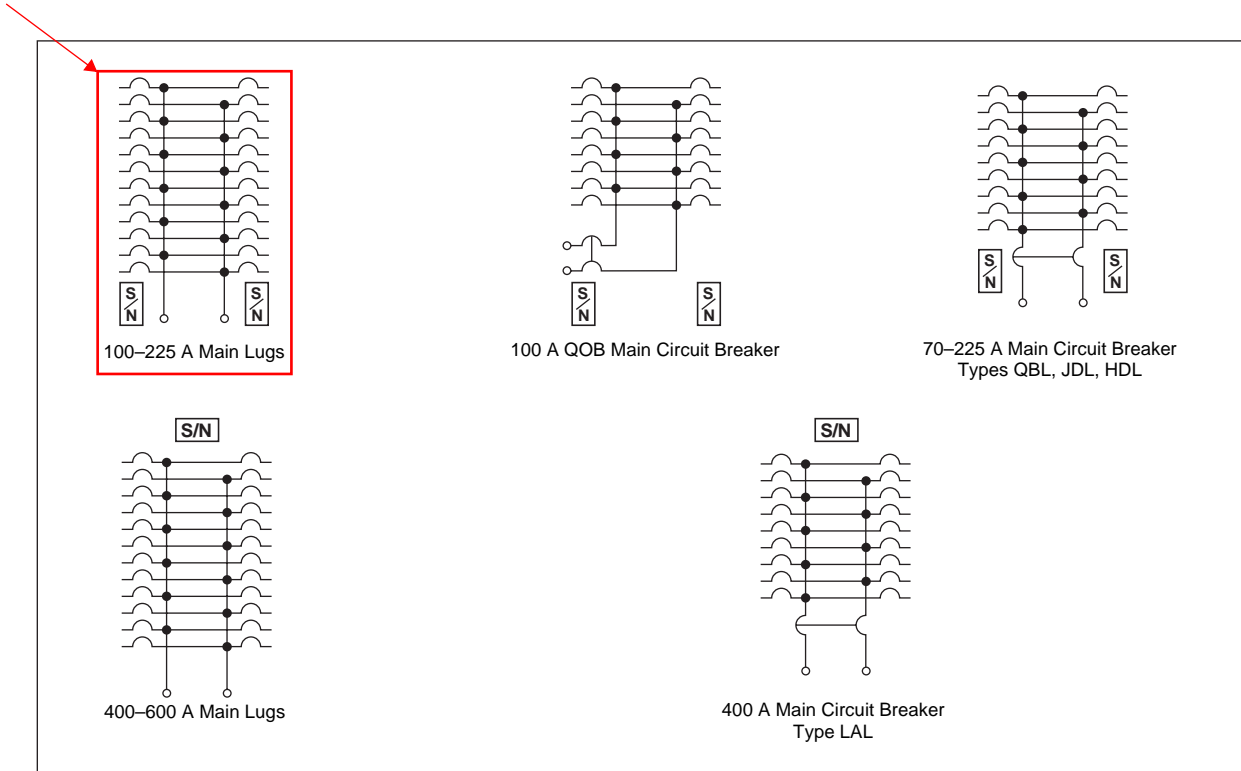
Concealed Hinge Used on 100–600 A Fronts

### Indoor Enclosure Accessories

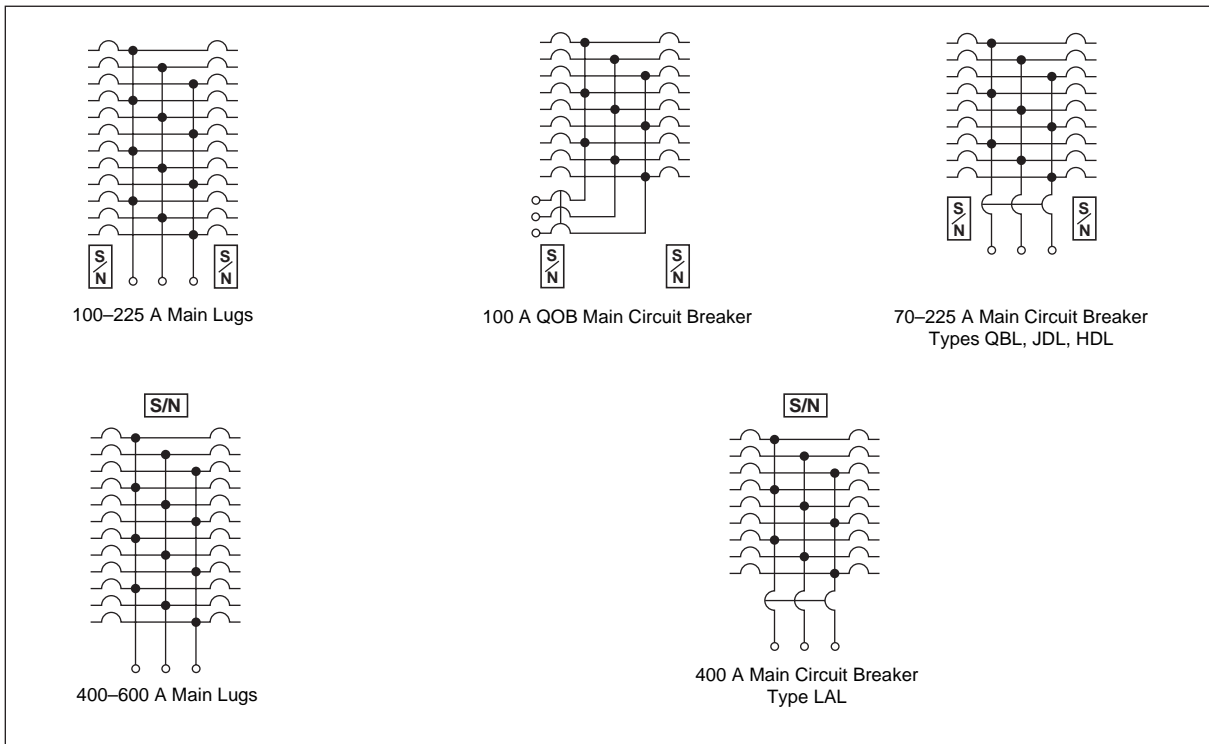
**NQ Circuit Breaker Panelboards**  
**Typical Wiring Diagrams**

**NQ PANEL BOARD**  
**DESIGNATION: PANEL A**

**Typical Wiring Diagrams**



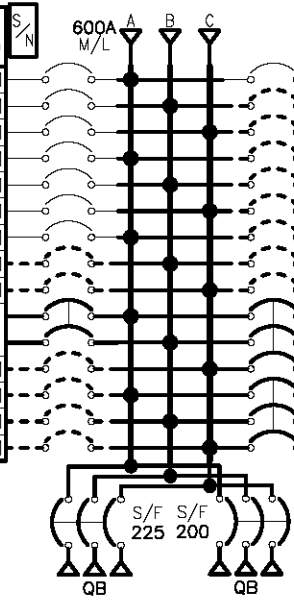
**1-Phase, 3-Wire**



**3-Phase, 4-Wire**

REV	DESCRIPTION	BY	DATE				
-							

CKT NO	ACCESSORIES	TYPE	RATING AMP/P	S/N		S/N	RATING AMP/P	TYPE	ACCESSORIES	CKT NO
1		QOB	20/1				20/1	QOB		2
3		QOB	20/1				20/1	QOB	PREPARED SPACE	4
5		QOB	20/1				20/1	QOB	PREPARED SPACE	6
7		QOB	20/1				20/1	QOB	PREPARED SPACE	8
9		QOB	20/1				20/1	QOB	PREPARED SPACE	10
11		QOB	20/1				20/1	QOB	PREPARED SPACE	12
13		QOB	20/1				20/1	QOB	PREPARED SPACE	14
15	PREPARED SPACE	QOB	20/1				20/1	QOB	PREPARED SPACE	16
17	PREPARED SPACE	QOB	20/1				20/1	QOB	PREPARED SPACE	18
19		QOB	70/2				100/3	QOB		20
21		QOB	70/2				100/3	QOB		22
23	PREPARED SPACE	QOB	20/1				100/3	QOB		24
25	PREPARED SPACE	QOB	20/1				100/3	QOB		26
27	PREPARED SPACE	QOB	20/1				100/3	QOB		28
29	PREPARED SPACE	QOB	20/1				100/3	QOB		30



PHYSICAL DATA

ENCLOSURE Type 1  
 Surface - Hinged  
 FRONT CAT#: NC74VSHR  
 BOX CAT#: MH74BE  
 DIMENSIONS:  
 74''H x 20''W x 5.75''D  
 WIRE BENDING SPACE:  
 TOP - 16.2  
 BOTTOM - 11  
 SIDE - 5.9  
 PBA: 709HR  
 BUSSING: Copper  
 Silver/Tin Plated  
 OPTIONAL FEATURES:  
 SHIP TOGETHER  
 BRANCH USER PLACEMENT  
 BLANK ENDWALLS  
 ALUMINUM SOLID NEUTRAL  
 ALUMINUM GROUND BAR

ELECTRICAL DATA

SYSTEM: 208Y/120V 3Ph 4W 60Hz  
 System Ampacity: 600A  
 10kA SYMS. SCCR  
 MAIN: MAIN LUGS : 600A  
 Top FEED  
 INCOMING CONDUCTORS(S) PER NEC:  
 (2) 1/0-750 kcmil  
 BRANCH MOUNTING TYPE: BOLT-ON  
 -----BRANCH SUMMATION-----  
 8 - 20A/1P QOB                      14 - 20A/1P-PS QOB  
 1 - 70A/2P QOB                      2 - 100A/3P QOB  
 1 - 225A/3P QB                      1 - 200A/3P QB

**NQ PANEL BOARD  
 DESIGNATION: PANEL P**

JOB NAME:	HAINES HS VOC TECH BLDG	EQUIPMENT DESIGNATION:	<b>PANEL P</b>
JOB LOCATION:	HAINES AK	EQUIPMENT TYPE:	NQ (Circuit Breaker Type) PANEL 1 OF 1
DRAWN BY:	(Q2C)	DRAWING TYPE:	ONE LINE DIAGRAM
ENGR:			
DATE:	May 06 2015	DWG#	<b>036582663-01</b>
DRAWING STATUS:	QUOTE	PG	1 OF 1 REV -

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# NQ Circuit Breaker Panelboards

NQ PANEL BOARD  
DESIGNATION: PANEL P

Catalog  
1640CT0801  
**2008**  
Class 1640



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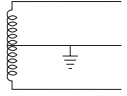
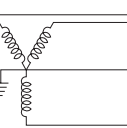
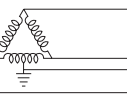
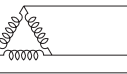
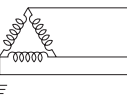
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by Schneider Electric

## NQ Circuit Breaker Panelboards Standards and Ratings

### NQ PANEL BOARD DESIGNATION: PANEL P

Voltage	System	System Diagram
120/240 Vac	1 $\phi$ 3W	
208Y/120 Vac	3 $\phi$ 4W	
240/120 Vac	3 $\phi$ 4W Delta	
240 Vac	3 $\phi$ 3W Delta	
240 Vac	3 $\phi$ 3W Grd. B $\phi$ Delta	

### Standards and Ratings

NQ circuit breaker panelboards meet US and Canadian standards, and are marked cULus. NQ circuit breaker panelboards accept QO<sup>®</sup> and QOB branch circuit breakers.

### Standards

NQ circuit breaker panelboards are designed, manufactured, and tested to comply with the following standards:

- UL 67—Standard for Panelboards
- UL 50—Enclosures for Electrical Equipment
- CSA C22.2, No. 29-M1989—Panelboards and Enclosed Panelboards
- CSA C22.2, No. 94-M91—Special Purpose Enclosures
- NEMA PB 1—Panelboards
- NFPA 70—National Electrical Code<sup>®</sup> (NEC<sup>®</sup>)
- Federal Specification W-P-115C Type I Class 1—Circuit Breaker Panelboards
- 2003 IBC, NFPA 5000, ASCE/SE17 Seismic Qualification

### Ratings

- Main Lugs 100–600 A
- Main Circuit Breaker 100–600 A



# NQ Circuit Breaker Panelboards Interiors

**NQ PANEL BOARD  
DESIGNATION: PANEL P**

## Main Lug Interiors



225 A Maximum Main Lug Interior and Deadfront

- Will accept plug-on or bolt-on branch circuit breakers.
- Top- or bottom-feed.
- 65k AIR maximum branch circuit breakers (fully-rated).
- 200k AIR maximum when supplied by remote I-Limiter<sup>®</sup> circuit breaker (series rated).
- 100 A and 225 A interiors are suitable for use as service entrance with back-fed QOB circuit breaker (USA only).
- Field-installable sub-feed lug kits for 100–400 A interiors.
- Factory installed main lugs on all interiors.
- 225–400 A main lug interiors are convertible to main circuit breaker by adding a main circuit breaker and adapter kit.
- Available with silver-plated copper or tin-plated aluminum bus (aluminum is standard). Tin-plated copper bus is available as an option. Branch connector fingers are all tin-plated copper; silver-plated branch connector fingers are optional.



100–225 A Maximum

600 A Maximum

## Main Lug Interiors

Main lugs for MLO Interiors

**Table 4: Aluminum Main lugs for MLO Interiors**

Amperes	Catalog Number	Lug Wire Range for wire bending space
<b>Aluminum Mechanical</b>		
100	standard	(1) #6-350 kcmil
225	standard	(1) #6-350 kcmil
400	standard	(1) 1/0-750 kcmil, or (2) 1/0-350 kcmil
600	standard	(2) 1/0-750 kcmil
600 <sup>1</sup>	NQALM6A	(3) 1/0-250 kcmil
<b>Aluminum Compression</b>		
100	NQALV1	(1) #4-300 kcmil
225	NQALV2	(1) 250-350 kcmil
400	NQALV4	(2) 2/0-500 kcmil
600	NQALV6	(2) 2/0-500 kcmil

<sup>1</sup> Optional lug for 600 A. Can also be used for 400 A.

**Table 5: Copper Main lugs for MLO Interiors**

Amperes	Catalog Number	Lug Wire Range for wire bending space
<b>Copper Mechanical</b>		
100	NQCUM1	(1) #6-350 kcmil
225	NQCUM2	(1) #6-350 kcmil
400	NQCUM4	(1) 1/0-750 kcmil, or (2) 1/0-350 kcmil
600	NQCUM6	(2) 1/0-750 kcmil
<b>Copper Compression</b>		
100	NQCUV1	(1) #6-350 kcmil
225	NQCUV2	(1) #6-350 kcmil
400	NQCUV4	(1) 400-750 kcmil
600	NQCUV6	(2) 250-500 kcmil



Type VCEL VERSAtile™ Compression Equipment Terminals

**NQ Circuit Breaker Panelboards  
Branch Circuit Breakers (Bolt-on)**

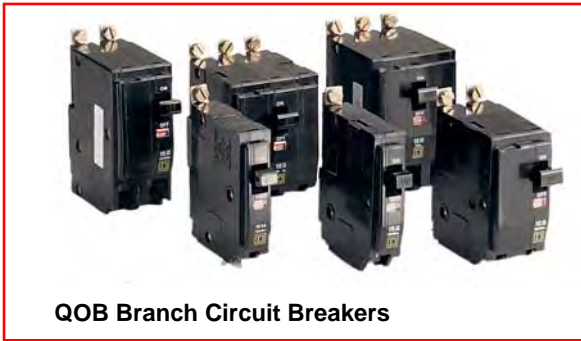
**NQ PANEL BOARD  
DESIGNATION: PANEL P**

**Branch Circuit Breakers (Bolt-on)**

**Table 8: Branch Circuit Breakers (Plug-on or Bolt-on) <sup>1</sup>**

10 k AIR	22 k AIR	65 k AIR	10 k AIR (240 Vac)	42 k AIR
QO, QOB	QO-VH, QOB-VH	QH, QHB	QO-H, QOB-H	QOH
1-Pole 10–70 A	1-Pole 15–30 A	1-Pole 15–30 A	2-Pole 15–100 A	2-Pole 35–125 A
2-Pole 10–125 A	2-Pole 15–150 A	2-Pole 15–30 A		
3-Pole 10–100 A	3-Pole 15–150 A	3-Pole 15–30 A		

<sup>1</sup> Series ratings are also available. Canada: See the Series Rating Guide (data bulletin #S1600PD0302EP) USA: See Switchboard/Panelboard Short-Circuit Current Ratings (data bulletin #2700DB9901), or the Digest



**Table 9: Branch Circuit Breaker Interrupting Data**

Circuit Breaker Catalog Prefix	Max. Vac Rating	Number of Poles	Ampere Rating	Interrupting Rating— RMS Symmetrical Amperes		
				Vac		
				120	120/240	240
QO, QOB	120/240	1	10-70	—	10k	—
	120/240	2	10-125	—	10k	—
	240	3	10-100	—	—	10k
QO-H, QOB-H	240	2	15–125	—	—	10k
QO-VH	120/240	1	15–30	—	22k	—
	120/240	2	15–125	—	22k	—
	240	3	15–100	—	—	22k
QOB-VH	120/240	1	15–30	—	22k	—
	120/240	2	15–150	—	22k	—
	240	3	15–150	—	—	22k
QOH-QOHB	120/240	2	35–125	—	42k	—
QH QHB	120/240	1	15–30	—	65k	—
	120/240	2	15–30	—	65k	—
	240	3	15–30	—	—	65k

**Table 10: Additional Branch Circuit Breaker Information**

Circuit Breaker Type	Circuit Breaker Catalog Class
QO, QOB	730
QO-AFCI	760
QO-GFI, QOB-GFI	910

## Enclosures

**NQ PANEL BOARD  
DESIGNATION: PANEL P**

**Table 21: Enclosure Types**

Type	Environment	Protects Against
Type 1	Indoor	Contact with the enclosed equipment, falling dirt
Type 2	Indoor	Type 1, plus • Dripping and light splashing of non-corrosive liquids
Type 3R	Outdoor	Type 2, plus • Rain, snow, and sleet
Type 4	Indoor/outdoor	Type 3R, plus • Circulating dust, lint, fibers and flyings • Settling airborne dust, lint, fibers and flyings • Windblown dust • Hosedown and splashing water
Type 4X	Indoor/outdoor	Type 4, plus • Corrosive agents
Type 5	Indoor	Type 2, plus • Settling airborne dust, lint, fibers, and flyings
Type 12	Indoor	Type 2, plus • Circulating dust, lint, fibers, and flyings • Settling airborne dust, lint, fibers, and flyings • Oil and coolant seepage



Interior Mounts to Box Studs



MH74BE  
74H x 20W x 5.75D

MH Box



Front (Type 1) Enclosure for 400–600 A Interiors



Mono-Flat Front (Type 1 Enclosure) for 100–250 A Interiors

**NC74VSHR TRIM  
NEMA 1 SURFACE  
BOTTOM FEED**

### Indoor Enclosures

### Indoor Enclosures (Types 1 and 2)

#### Boxes (MH):

- Galvanized steel with removable endwalls. One is provided with knockouts and the other is blank.
- Standard box sizes:
  - 20 in. (508 mm) wide x 5.75 in. (146 mm) deep, 600 A main lug interior max. or 400 A main circuit breaker max
  - 20 in. (508 mm) wide x 8.75 in. (223 mm) deep, 600 A main circuit breaker interior, factory-assembled only
- Box and interior mounting instructions are found in the information manual shipped with the interior.
- Interiors mount directly to studs in the MH box. Interior mounting brackets are not required.
- Type 2 enclosure includes a driphood.
  - Surface-mounted trim only.

**NOTE:** Also available with knockouts / blank endwalls both ends.

#### Trims:

- Finished with gray baked enamel electrodeposited over cleaned phosphatized steel (ANSI 49).
- Flush or surface mounted (Type 2 surface only).
- Door has flush lock. Uses NSR-251 key.
- Directory card located on the inside of the door.
- Mono-Flat® trims on 100–225 A interiors mount to the interior trim with trim screws. Both trim screws and door hinges are concealed. Trims are not removable with the door closed and locked.
- Trims for 400–600 A interiors are vented and mount to the enclosure with trim screws. Door hinges are concealed.
- Optional hinged trims are available. These meet door-in-door specs.



Flush Lock (standard)  
(Catalog No. PK4FL)



Key NSR-251  
(Catalog No. LP9618)



Sliding Vault Lock (optional)  
(Catalog No. PK5FL)



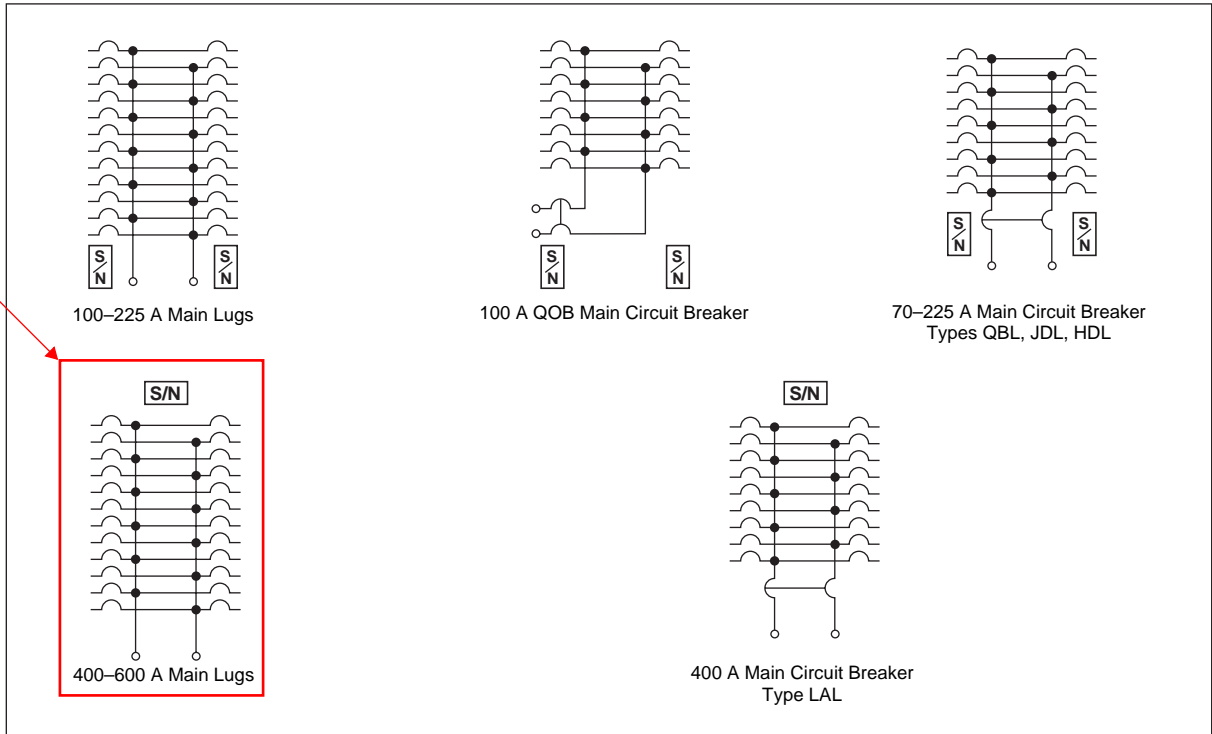
Concealed Hinge  
Used on 100–600 A Fronts

### Indoor Enclosure Accessories

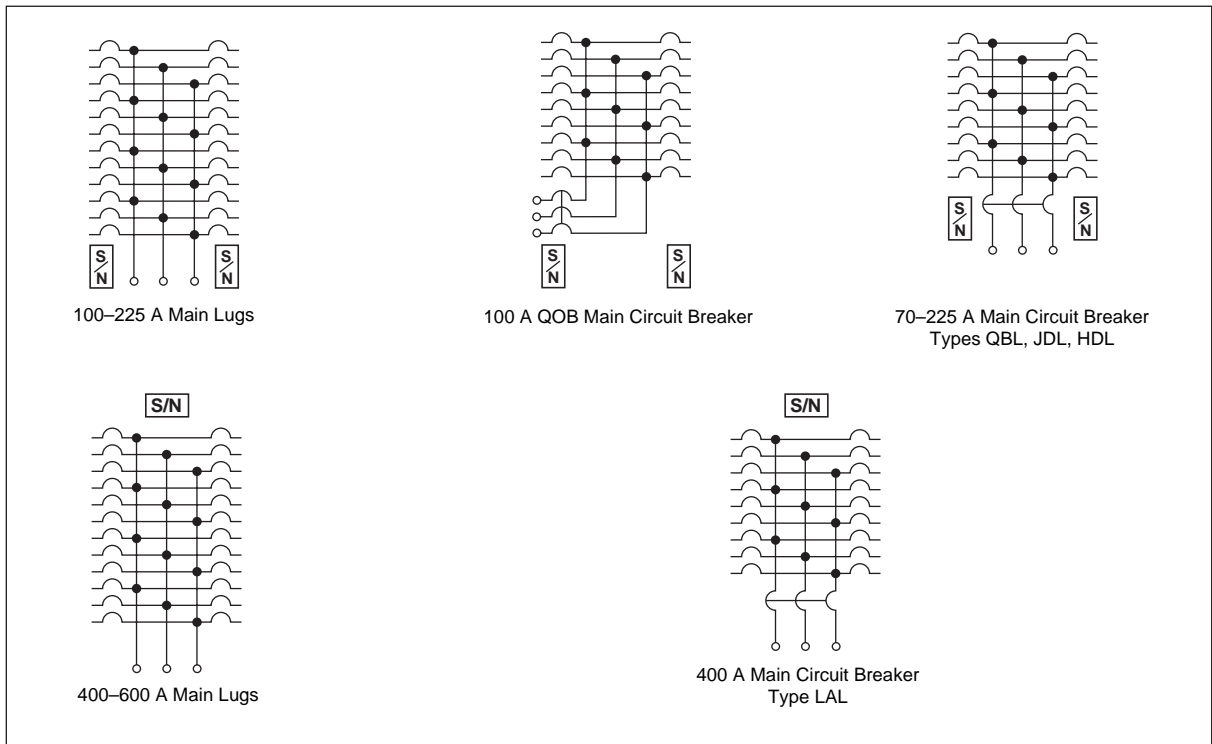
# NQ Circuit Breaker Panelboards Typical Wiring Diagrams

**NQ PANEL BOARD  
DESIGNATION: PANEL P**

## Typical Wiring Diagrams



**1-Phase, 3-Wire**



**3-Phase, 4-Wire**



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# NQ Circuit Breaker Panelboards

NQ PANEL BOARD  
DESIGNATION: PANEL D

Catalog  
1640CT0801

2008

Class 1640



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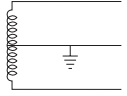
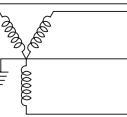
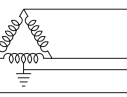
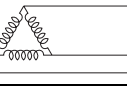
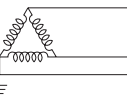
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by Schneider Electric

## NQ Circuit Breaker Panelboards Standards and Ratings

### NQ PANEL BOARD DESIGNATION: PANEL D

Voltage	System	System Diagram
120/240 Vac	1 $\phi$ 3W	
208Y/120 Vac	3 $\phi$ 4W	
240/120 Vac	3 $\phi$ 4W Delta	
240 Vac	3 $\phi$ 3W Delta	
240 Vac	3 $\phi$ 3W Grd. B $\phi$ Delta	

### Standards and Ratings

NQ circuit breaker panelboards meet US and Canadian standards, and are marked cULus. NQ circuit breaker panelboards accept QO<sup>®</sup> and QOB branch circuit breakers.

### Standards

NQ circuit breaker panelboards are designed, manufactured, and tested to comply with the following standards:

- UL 67—Standard for Panelboards
- UL 50—Enclosures for Electrical Equipment
- CSA C22.2, No. 29-M1989—Panelboards and Enclosed Panelboards
- CSA C22.2, No. 94-M91—Special Purpose Enclosures
- NEMA PB 1—Panelboards
- NFPA 70—National Electrical Code<sup>®</sup> (NEC<sup>®</sup>)
- Federal Specification W-P-115C Type I Class 1—Circuit Breaker Panelboards
- 2003 IBC, NFPA 5000, ASCE/SE17 Seismic Qualification

### Ratings

- Main Lugs 100–600 A
- Main Circuit Breaker 100–600 A



# NQ Circuit Breaker Panelboards Interiors

**NQ PANEL BOARD  
DESIGNATION: PANEL D**

## Main Lug Interiors



**225 A Maximum Main Lug Interior and Deadfront**

- Will accept plug-on or bolt-on branch circuit breakers.
- Top- or bottom-feed.
- 65k AIR maximum branch circuit breakers (fully-rated).
- 200k AIR maximum when supplied by remote I-Limiter<sup>®</sup> circuit breaker (series rated).
- 100 A and 225 A interiors are suitable for use as service entrance with back-fed QOB circuit breaker (USA only).
- Field-installable sub-feed lug kits for 100–400 A interiors.
- Factory installed main lugs on all interiors.
- 225–400 A main lug interiors are convertible to main circuit breaker by adding a main circuit breaker and adapter kit.
- Available with silver-plated copper or tin-plated aluminum bus (aluminum is standard). Tin-plated copper bus is available as an option. Branch connector fingers are all tin-plated copper; silver-plated branch connector fingers are optional.



100–225 A Maximum

600 A Maximum

## Main Lug Interiors

Main lugs for MLO Interiors

**Table 4: Aluminum Main lugs for MLO Interiors**

Amperes	Catalog Number	Lug Wire Range for wire bending space
<b>Aluminum Mechanical</b>		
100	standard	(1) #6-350 kcmil
225	standard	(1) #6-350 kcmil
400	standard	(1) 1/0-750 kcmil, or (2) 1/0-350 kcmil
600	standard	(2) 1/0-750 kcmil
600 <sup>1</sup>	NQALM6A	(3) 1/0-250 kcmil
<b>Aluminum Compression</b>		
100	NQALV1	(1) #4-300 kcmil
225	NQALV2	(1) 250-350 kcmil
400	NQALV4	(2) 2/0-500 kcmil
600	NQALV6	(2) 2/0-500 kcmil

<sup>1</sup> Optional lug for 600 A. Can also be used for 400 A.

**Table 5: Copper Main lugs for MLO Interiors**

Amperes	Catalog Number	Lug Wire Range for wire bending space
<b>Copper Mechanical</b>		
100	NQCUM1	(1) #6-350 kcmil
225	NQCUM2	(1) #6-350 kcmil
400	NQCUM4	(1) 1/0-750 kcmil, or (2) 1/0-350 kcmil
600	NQCUM6	(2) 1/0-750 kcmil
<b>Copper Compression</b>		
100	NQCUV1	(1) #6-350 kcmil
225	NQCUV2	(1) #6-350 kcmil
400	NQCUV4	(1) 400-750 kcmil
600	NQCUV6	(2) 250-500 kcmil



**Type VCEL VERSAtile™ Compression Equipment Terminals**

**NQ Circuit Breaker Panelboards  
Branch Circuit Breakers (Bolt-on)**

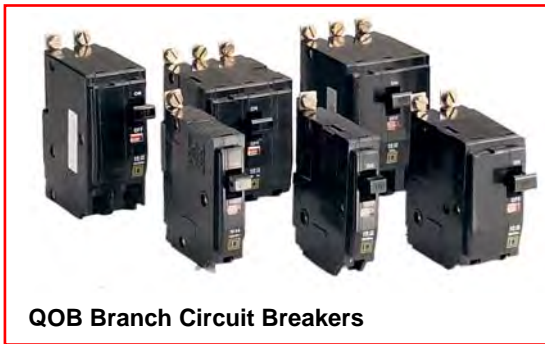
**NQ PANEL BOARD  
DESIGNATION: PANEL D**

**Branch Circuit Breakers (Bolt-on)**

**Table 8: Branch Circuit Breakers (Plug-on or Bolt-on) <sup>1</sup>**

10 k AIR	22 k AIR	65 k AIR	10 k AIR (240 Vac)	42 k AIR
QO, QOB	QO-VH, QOB-VH	QH, QHB	QO-H, QOB-H	QOH
1-Pole 10–70 A	1-Pole 15–30 A	1-Pole 15–30 A	2-Pole 15–100 A	2-Pole 35–125 A
2-Pole 10–125 A	2-Pole 15–150 A	2-Pole 15–30 A		
3-Pole 10–100 A	3-Pole 15–150 A	3-Pole 15–30 A		

<sup>1</sup> Series ratings are also available. Canada: See the Series Rating Guide (data bulletin #S1600PD0302EP) USA: See Switchboard/Panelboard Short-Circuit Current Ratings (data bulletin #2700DB9901), or the Digest



**Table 9: Branch Circuit Breaker Interrupting Data**

Circuit Breaker Catalog Prefix	Max. Vac Rating	Number of Poles	Ampere Rating	Interrupting Rating— RMS Symmetrical Amperes		
				Vac		
				120	120/240	240
QO, QOB	120/240	1	10-70	—	10k	—
	120/240	2	10-125	—	10k	—
	240	3	10-100	—	—	10k
QO-H, QOB-H	240	2	15–125	—	—	10k
QO-VH	120/240	1	15–30	—	22k	—
	120/240	2	15–125	—	22k	—
	240	3	15–100	—	—	22k
QOB-VH	120/240	1	15–30	—	22k	—
	120/240	2	15–150	—	22k	—
	240	3	15–150	—	—	22k
QOH-QOHB	120/240	2	35–125	—	42k	—
QH, QHB	120/240	1	15–30	—	65k	—
	120/240	2	15–30	—	65k	—
	240	3	15–30	—	—	65k

**Table 10: Additional Branch Circuit Breaker Information**

Circuit Breaker Type	Circuit Breaker Catalog Class
QO, QOB	730
QO-AFCI	760
QO-GFI, QOB-GFI	910

## Enclosures

NQ PANEL BOARD  
DESIGNATION: PANEL D

**Table 21: Enclosure Types**

Type	Environment	Protects Against
Type 1	Indoor	Contact with the enclosed equipment, falling dirt
Type 2	Indoor	Type 1, plus • Dripping and light splashing of non-corrosive liquids
Type 3R	Outdoor	Type 2, plus • Rain, snow, and sleet
Type 4	Indoor/outdoor	Type 3R, plus • Circulating dust, lint, fibers and flyings • Settling airborne dust, lint, fibers and flyings • Windblown dust • Hosedown and splashing water
Type 4X	Indoor/outdoor	Type 4, plus • Corrosive agents
Type 5	Indoor	Type 2, plus • Settling airborne dust, lint, fibers, and flyings
Type 12	Indoor	Type 2, plus • Circulating dust, lint, fibers, and flyings • Settling airborne dust, lint, fibers, and flyings • Oil and coolant seepage



Interior Mounts to Box Studs



Front (Type 1) Enclosure for 400–600 A Interiors



### Indoor Enclosures (Types 1 and 2)

#### Boxes (MH):

- Galvanized steel with removable endwalls. One is provided with knockouts and the other is blank.
- Standard box sizes:
  - 20 in. (508 mm) wide x 5.75 in. (146 mm) deep, 600 A main lug interior max. or 400 A main circuit breaker max
  - 20 in. (508 mm) wide x 8.75 in. (223 mm) deep, 600 A main circuit breaker interior, factory-assembled only
- Box and interior mounting instructions are found in the information manual shipped with the interior.
- Interiors mount directly to studs in the MH box. Interior mounting brackets are not required.
- Type 2 enclosure includes a driphood.
  - Surface-mounted trim only.

**NOTE:** Also available with knockouts / blank endwalls both ends.

#### Trims:

- Finished with gray baked enamel electrodeposited over cleaned phosphatized steel (ANSI 49).
- Flush or surface mounted (Type 2 surface only).
- Door has flush lock. Uses NSR-251 key.
- Directory card located on the inside of the door.
- Mono-Flat® trims on 100–225 A interiors mount to the interior trim with trim screws. Both trim screws and door hinges are concealed. Trims are not removable with the door closed and locked.
- Trims for 400–600 A interiors are vented and mount to the enclosure with trim screws. Door hinges are concealed.
- Optional hinged trims are available. These meet door-in-door specs.

### Indoor Enclosures



Flush Lock (standard)  
(Catalog No. PK4FL)



Key NSR-251  
(Catalog No. LP9618)



Sliding Vault Lock (optional)  
(Catalog No. PK5FL)



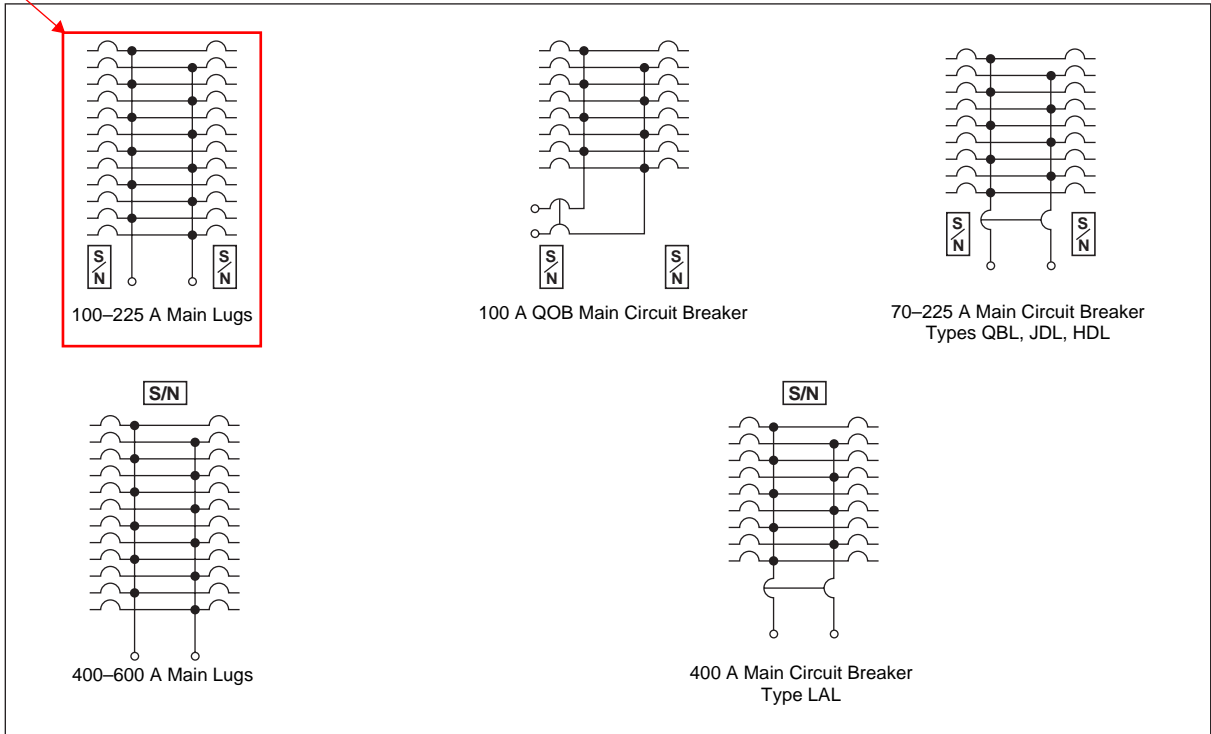
Concealed Hinge  
Used on 100–600 A Fronts

### Indoor Enclosure Accessories

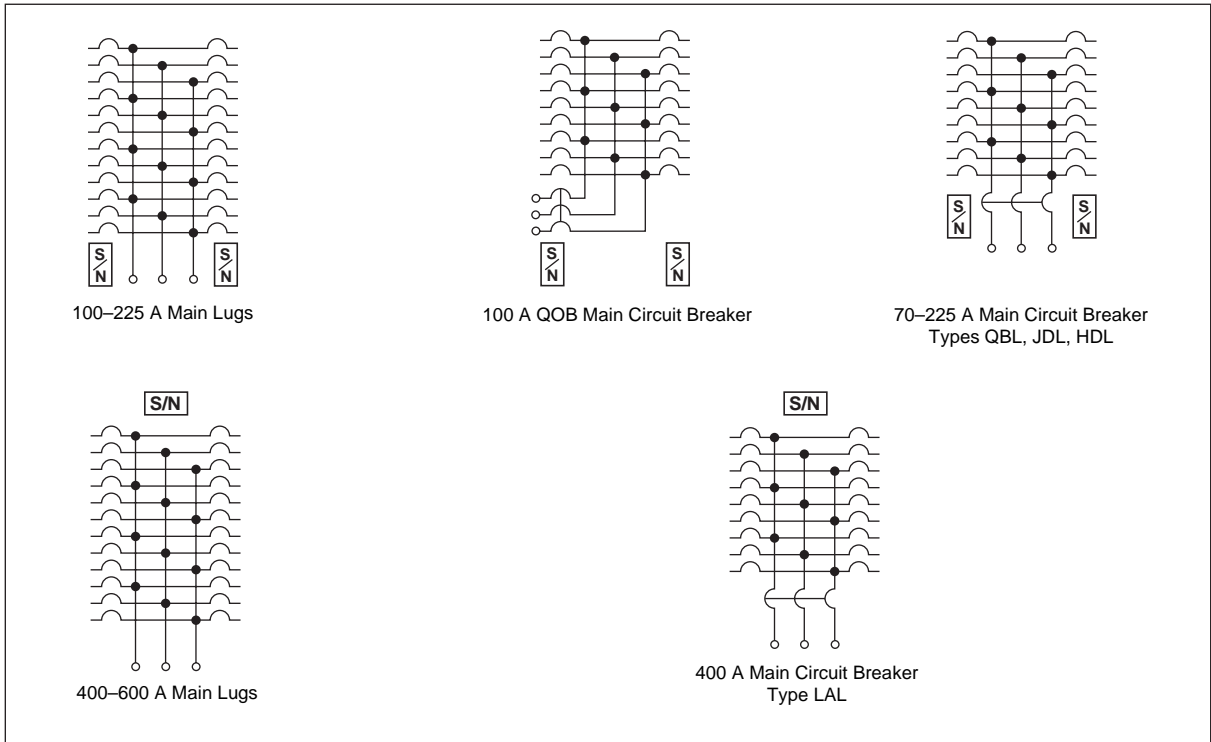
# NQ Circuit Breaker Panelboards Typical Wiring Diagrams

## Typical Wiring Diagrams

NQ PANEL BOARD  
DESIGNATION: PANEL D



**1-Phase, 3-Wire**



**3-Phase, 4-Wire**

# NQ/NQM Panelboards and QONQ Load Centers

## Information Manual

### Class 1640

Instruction Bulletin

80043-712-05

Retain in the directory card  
pocket for future use.



**SQUARE D**

by **Schneider** Electric

## HAZARD CATEGORIES AND SPECIAL SYMBOLS

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

### **DANGER**

**DANGER** indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

### **WARNING**

**WARNING** indicates a potentially hazardous situation which, if not avoided, can result in death or serious injury.

### **CAUTION**

**CAUTION** indicates a potentially hazardous situation which, if not avoided, can result in minor or moderate injury.

### **CAUTION**

**CAUTION**, used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, can result in property damage.



Provides additional information to clarify or simplify a procedure.

### PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

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## Introduction

This bulletin contains instructions for installing Square D® brand NQ circuit breaker panelboards and QONQ load centers. These panelboards and load centers are Underwriters Laboratories (cULus) listed and accept QO® and QOB branch circuit breakers.



For technical support on the installation of this panelboard, contact the Square D/Schneider Electric Customer Information Center at 1-888-SquareD (1-888-778-2733).



See the labels on the equipment for rating and safety information. Additional equipment labels are provided with this document.

## Safety Precautions

### **⚠ DANGER**

#### **HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- Read and understand this entire instruction bulletin and the included NEMA PB 1.1 standards publication before installing, operating, or maintaining this equipment.
- Local codes vary, but are adopted and enforced to promote safe electrical installations. A permit may be needed to do electrical work, and some codes may require an inspection of the electrical work.
- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Turn OFF all power supplying this equipment before working on or inside the equipment.
- Always use a properly-rated voltage sensing device to confirm all power is OFF.
- Replace all devices, doors and covers before turning ON power to this equipment.

**Failure to follow these instructions will result in death or serious injury.**

## Installation

This section provides instructions for the following NQ panelboard and QONQ load center procedures:

- “Interior Mounting for Square D Brand Enclosures” on page 6
- “Neutral Bonding Strap/Cable Installation” on page 9
- “QO and QOB Circuit Breaker Installation and Removal” on page 12
- “Circuit Breaker Reset Instructions” on page 15
- “Interior Trim Preparation” on page 16

### Interior Mounting for Square D Brand Enclosures

A separate standards publication, titled “General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less” (NEMA PB1.1), has been provided with this equipment. Familiarize yourself with the content of this document before proceeding with any of the following procedures.

If you did not receive a copy of this document, or if you have any questions regarding this equipment, contact your local distributor or Schneider Electric representative.

#### **CAUTION**

##### **HAZARD OF EQUIPMENT DAMAGE**

- Ensure all connections are properly tightened.
- Refer to the torque information label provided on the panelboard before tightening the connections.

**Failure to follow these instructions can result in equipment damage.**

To properly mount and install the NQ panelboard or QONQ load center interior, please refer to the NEMA PB 1.1 standards publication, and follow the instructions below for either “Surface Mounting (Enclosure Mounted on Wall)” or “Flush Mounting (Enclosure Recessed in Wall).”

### Surface Mounting (Enclosure Mounted on Wall)

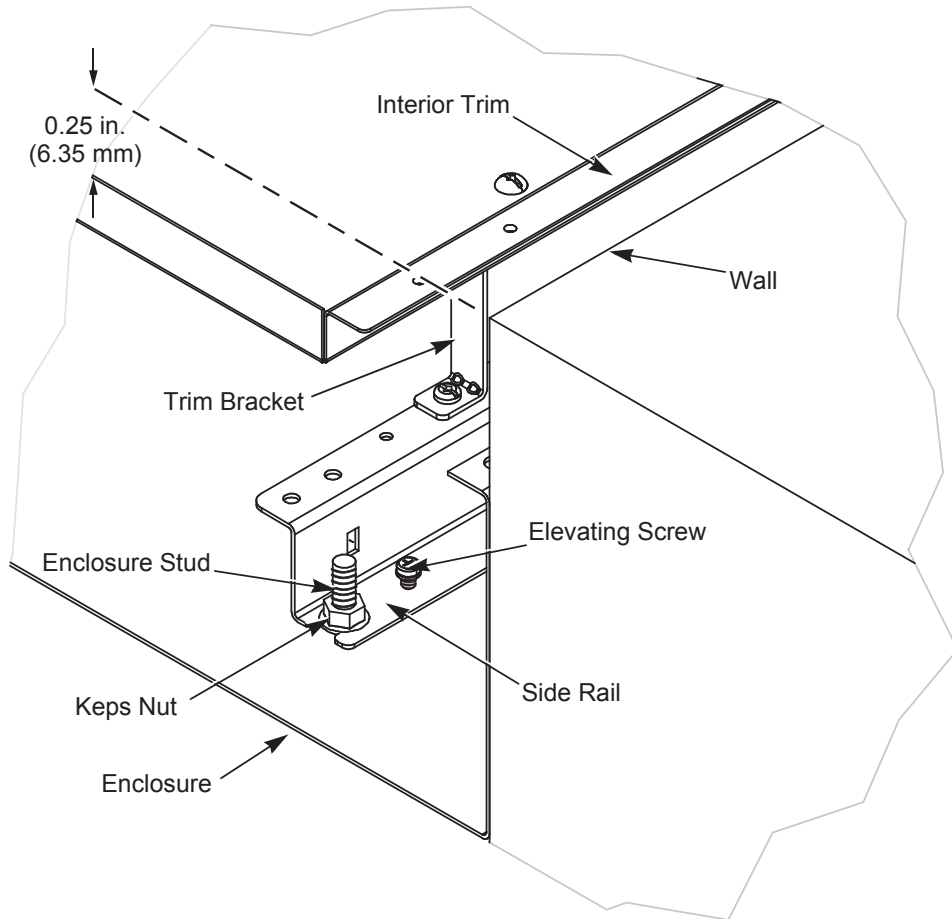
1. Mount the enclosure as instructed in the NEMA PB 1.1 standards publication.
2. Remove the interior trim from the trim brackets.
3. Install the interior as described below:
  - a. Set the interior on the enclosure studs. An elevating screw is not required (See Figure 1 on page 8).
  - b. Tighten the keps nuts against the interior side rails until the rails are against the back of the enclosure.
  - c. Remount the interior trim after wiring.
4. If used as service entrance equipment, neutral bonding is required. See the “Neutral Bonding Strap/Cable Installation” instructions on page 9.
5. Apply equipment labels (located in the bag assembly) as directed by the instructions on the back of the equipment label sheet.

### Flush Mounting (Enclosure Recessed in Wall)

1. Mount the enclosure as instructed in the NEMA PB 1.1 standards publication.
2. Remove the interior trim from the trim brackets.
3. Install the interior as described below:
  - a. Thread the (4) 10-32 x .875 in. self-tapping, elevating screws provided with the flush trim into the side rails.
  - b. Set the interior on the enclosure studs (see Figure 1 on page 8). Place the keps nuts onto the enclosure studs, but do not tighten.
  - c. Adjust the screws so that the lip of the interior trim is approximately 0.25 inches (6.35 mm) from wall line.
  - d. Tighten the keps nuts against the side rails.
  - e. Remount the interior trim after wiring.
4. If used as service entrance equipment, neutral bonding is required. See the “Neutral Bonding Strap/Cable Installation” instructions on page 9.
5. Apply equipment labels (located in the bag assembly) as directed by the instructions on the back of the equipment label sheet.

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Figure 1: Interior Mounting of Square D Brand Enclosures



## Neutral Bonding Strap/Cable Installation

The neutral bonding strap/cable should be used only when the panelboard is **installed** as service equipment.

To properly bond the neutral to the panelboard, follow the instructions for either “100 or 250 A Maximum NQ Panelboards” or “400 or 600 A Maximum NQ Panelboards and QONQ Load Centers” below and on page 11, respectively.

### **⚠ DANGER**

#### **HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- Turn OFF all power supplying this equipment before working on or inside the equipment.
- The main bonding strap/cable should be used only when the panelboard is installed as service equipment.
- Do not mix the mounting screws with the interior trim screws.

**Failure to follow these instructions will result in death or serious injury.**

**NOTE:** The bonding strap/cable parts are found in the bag assembly provided with the interior.

### 100 or 250 A Maximum NQ Panelboards

To install a neutral bonding strap on a 100 or 250 A maximum NQ panelboard, refer to Figure 2 and follow the instructions below.

1. Align the bonding strap on the side rail, as pictured.

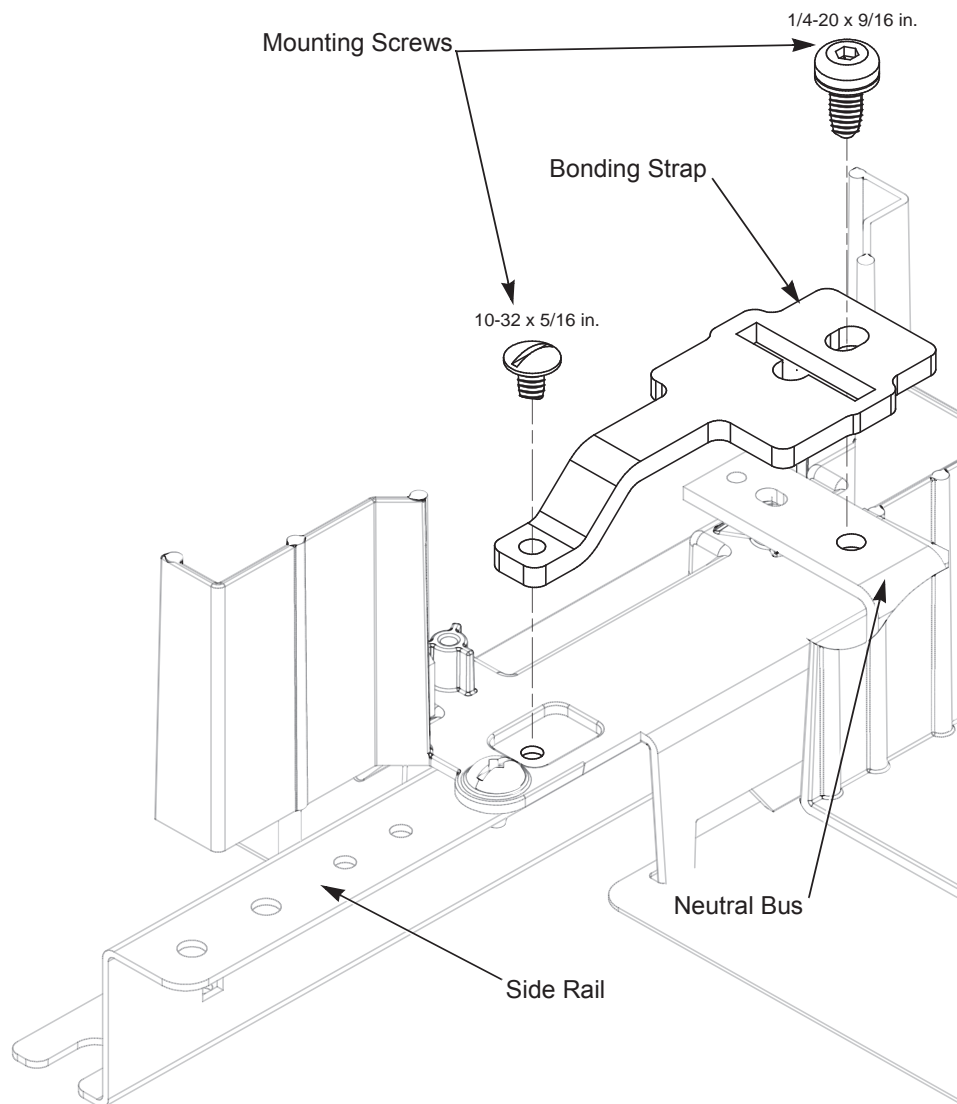
**NOTE:** For some applications, it may be necessary to remove the lug (not pictured) before installing the bonding strap.

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- Insert the two mounting screws, as pictured. Tighten the 10-32 screw to 10–12 lb-in (1.1–1.4 N•m) and the 1/4-20 to 25–30 lb-in (2.8–3.4 N•m).

**NOTE:** If the lug was removed in Step 1 above, reinstall it on top of the bonding strap. Use the 1/4-20 x 11/16 in. mounting screw with feed-through lug, sub-feed lug, sub-feed breaker, or 200% neutral applications. Use the 1/4-20 x 7/8 in. lug mounting screw with 200% neutral on 225 A applications with feed-through lug, sub-feed lug, or sub-feed breaker applications. Lug mounting screws are provided in the bonding strap bag assembly.

**Figure 2: Bonding Strap Installation —  
 100 or 250 A Maximum NQ Panelboards**

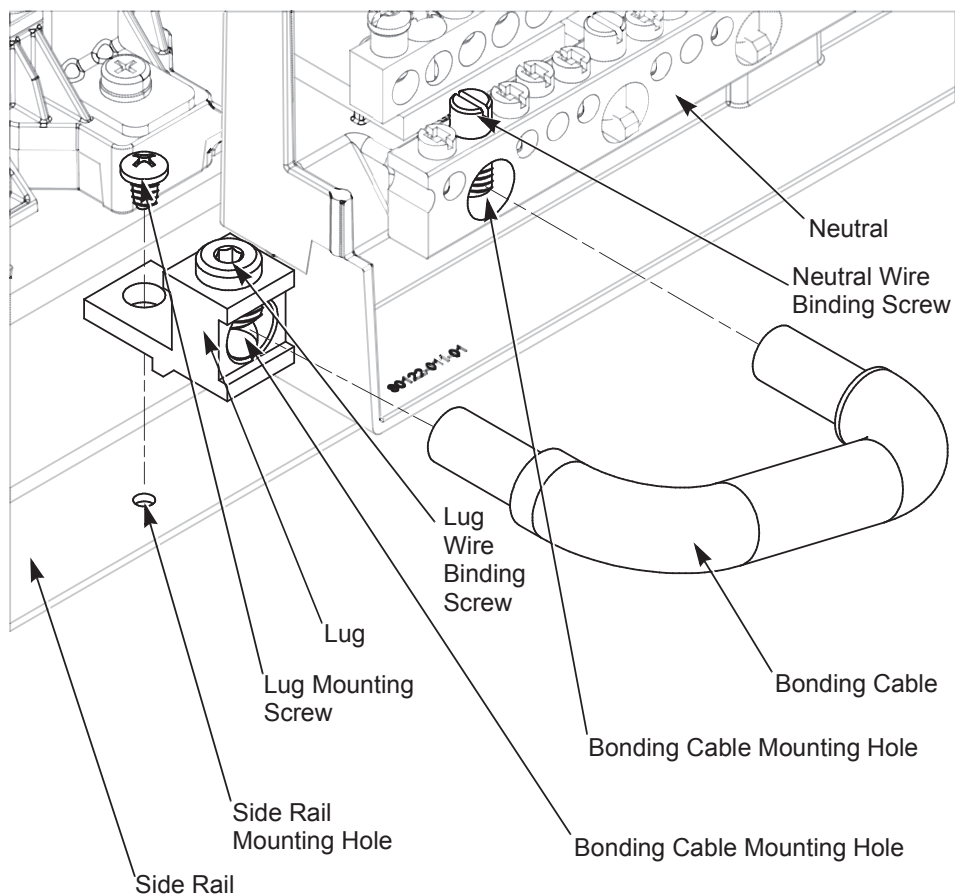


## 400 or 600 A Maximum NQ Panelboards and QONQ Load Centers

To install a neutral bonding cable on a 400 or 600 A maximum NQ panelboard and QONQ load center, refer to Figure 3 and follow the instructions below.

1. Align the lug on the side rail mounting hole, as pictured.
2. Tighten the lug mounting screw against the side rail to 10–12 lb-in (1.1–1.4 N•m).
3. Align the bonding cable, as pictured, and insert it into the lug and neutral mounting holes.
4. Tighten both the lug wire binding screw and the neutral wire binding screw to 45–50 lb-in (5.1–5.6 N•m).

**Figure 3: Bonding Cable Installation — 400 or 600 A Maximum NQ Panelboards and QONQ Load Centers**



## QO and QOB Circuit Breaker Installation and Removal

### **DANGER**

#### **HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Turn OFF all power supplying this equipment before working on or inside equipment.
- Always use a properly-rated voltage sensing device to confirm that all power is OFF.
- All unused spaces must be filled with blank fillers.
- Replace all devices, doors and covers before turning ON power to this equipment.

**Failure to follow these instructions will result in death or serious injury.**



## QO and QOB Breaker Installation

Refer to Figure 4 on page 14 for the following instructions:

1. Turn OFF all power to the panelboard.
2. Turn the breaker OFF.
3. Remove the interior trim.
4. Snap the wire terminal end of the circuit breaker onto the mounting rail.
5. Engage the branch connector.

For QO Circuit Breakers:

- a. Push inward until the plug-on jaws fully engage the branch connector.

For QOB Circuit Breakers:

- a. Push inward until the breaker connector is centered on the branch connector mounting hole. Engage the screw into the branch connector hole and tighten it to the torque values shown on the interior wiring and torque diagram.

6. Install the load wire.
7. Reinstall the interior trim.

## QO and QOB Breaker Removal

Refer to Figure 4 on page 14 for the following instructions:

1. Turn OFF all power to the panelboard.
2. Remove the load wire.
3. Remove the interior trim.
4. Disengage the branch connector.

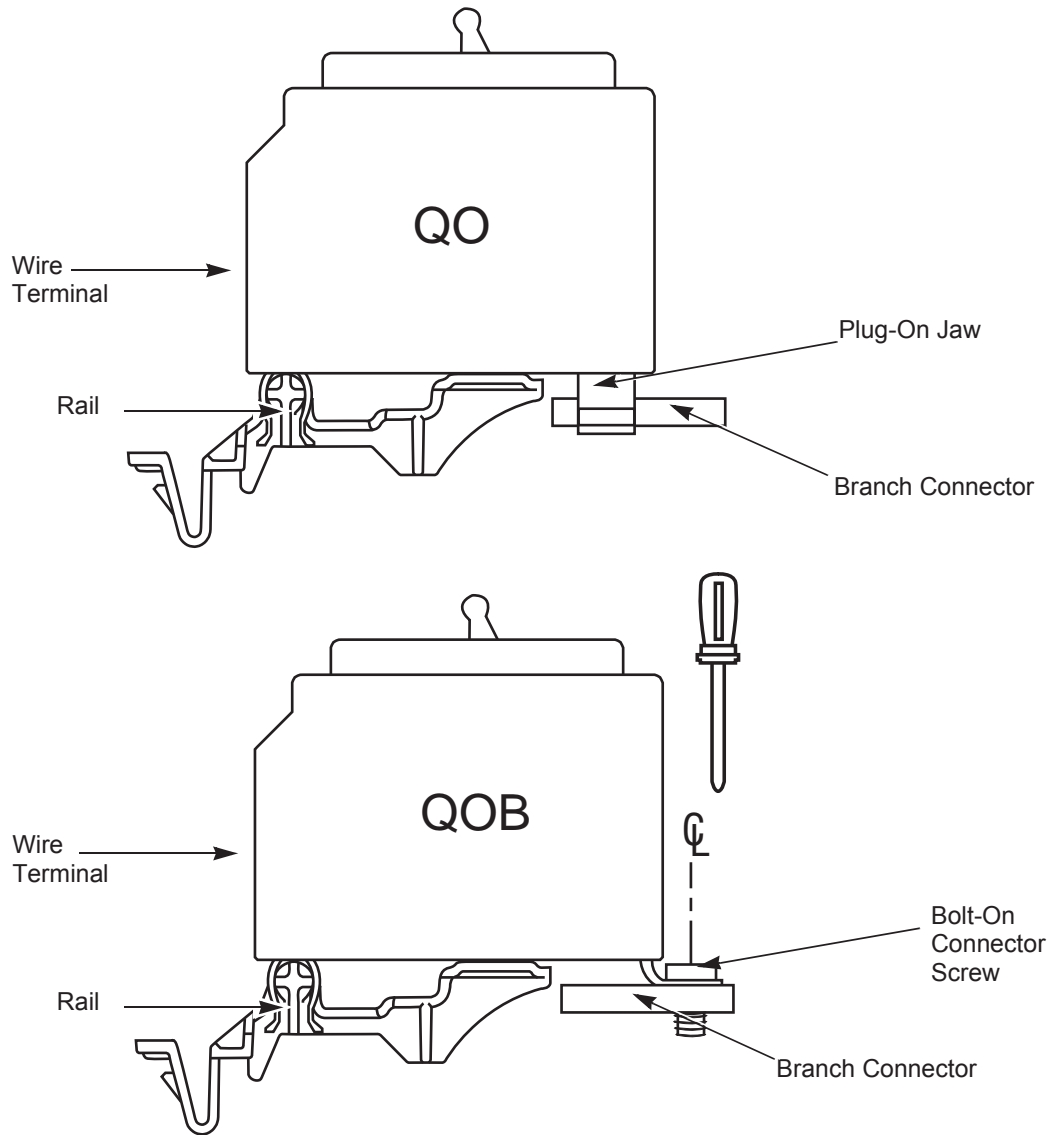
For QO Circuit Breakers:

- a. Pull outward until the plug-on jaws fully disengage the branch connector.

For QOB Circuit Breakers:

- a. Loosen the screw in the breaker connector and pull the breaker off of the branch connector.
5. Snap the wire terminal end of the circuit breaker off of the mounting rail.
6. Reinstall the interior trim.

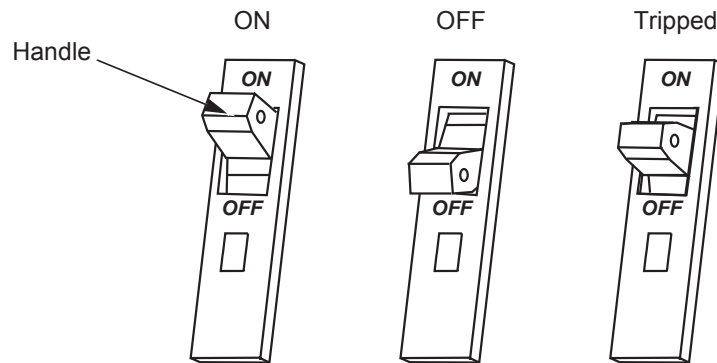
Figure 4: QO and QOB Circuit Breaker Installation and Removal



## Circuit Breaker Reset Instructions

If the circuit breaker is tripped, the handle will be at the mid-position between ON and OFF. To reset the circuit breaker, push the handle to the OFF position, then to the ON position.

**Figure 5: Circuit Breaker Handle Positions**



## Interior Trim Preparation

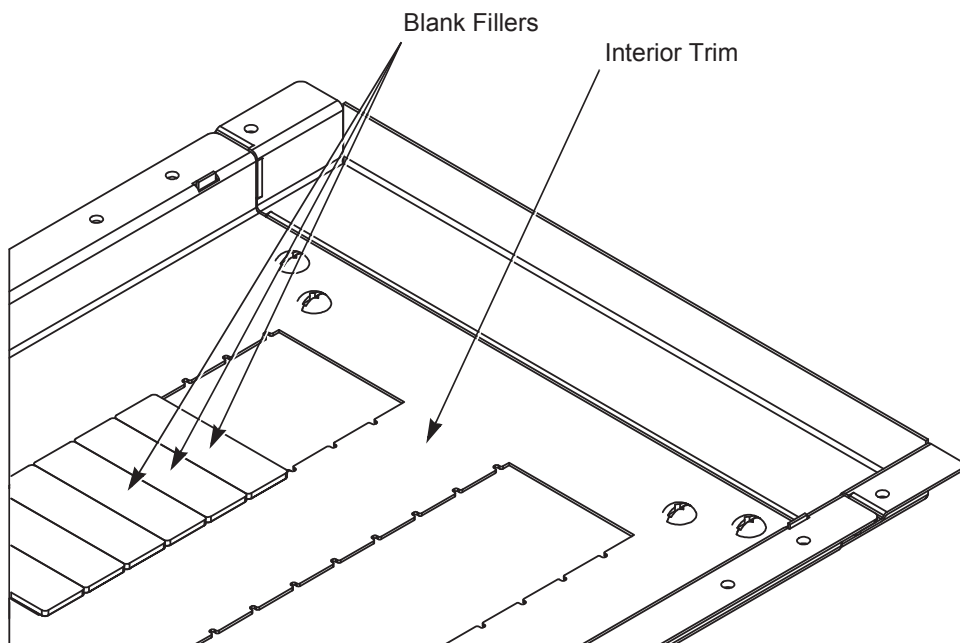
### **⚠ DANGER**

#### **HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- Before energizing the panelboard, all unused spaces must be filled with blank fillers.
- Replace all devices, doors, and covers before energizing this equipment.

**Failure to follow this instruction will result in death or serious injury.**

**Figure 6: Interior Trim Diagram**



**NOTE:** The back of the interior trim lists the catalog number for its corresponding compatible blank fillers.

## Appendix 1: Specifications

### Typical Wiring

**Table 1: Panelboard Typical Wiring<sup>1</sup>**

Voltage AC	1-Phase Panelboards		3-Phase Panelboards	
	Phase	Wires	Phase	Wires
208Y/120	—	—	3	4
120/240	1	3	—	—
240 <sup>2</sup>	1	2	3	3
240 <sup>3</sup>	3	3	—	—
240/120 <sup>4</sup>	—	—	3	4 Delta

<sup>1</sup> Additional information is provided on the panelboard. See the main circuit breaker rating, if used.

<sup>2</sup> For this system, the neutral is not used and only circuit breakers rated 240 V AC minimum should be used. Do not use circuit breakers rated 120 V or 120/240 V AC.

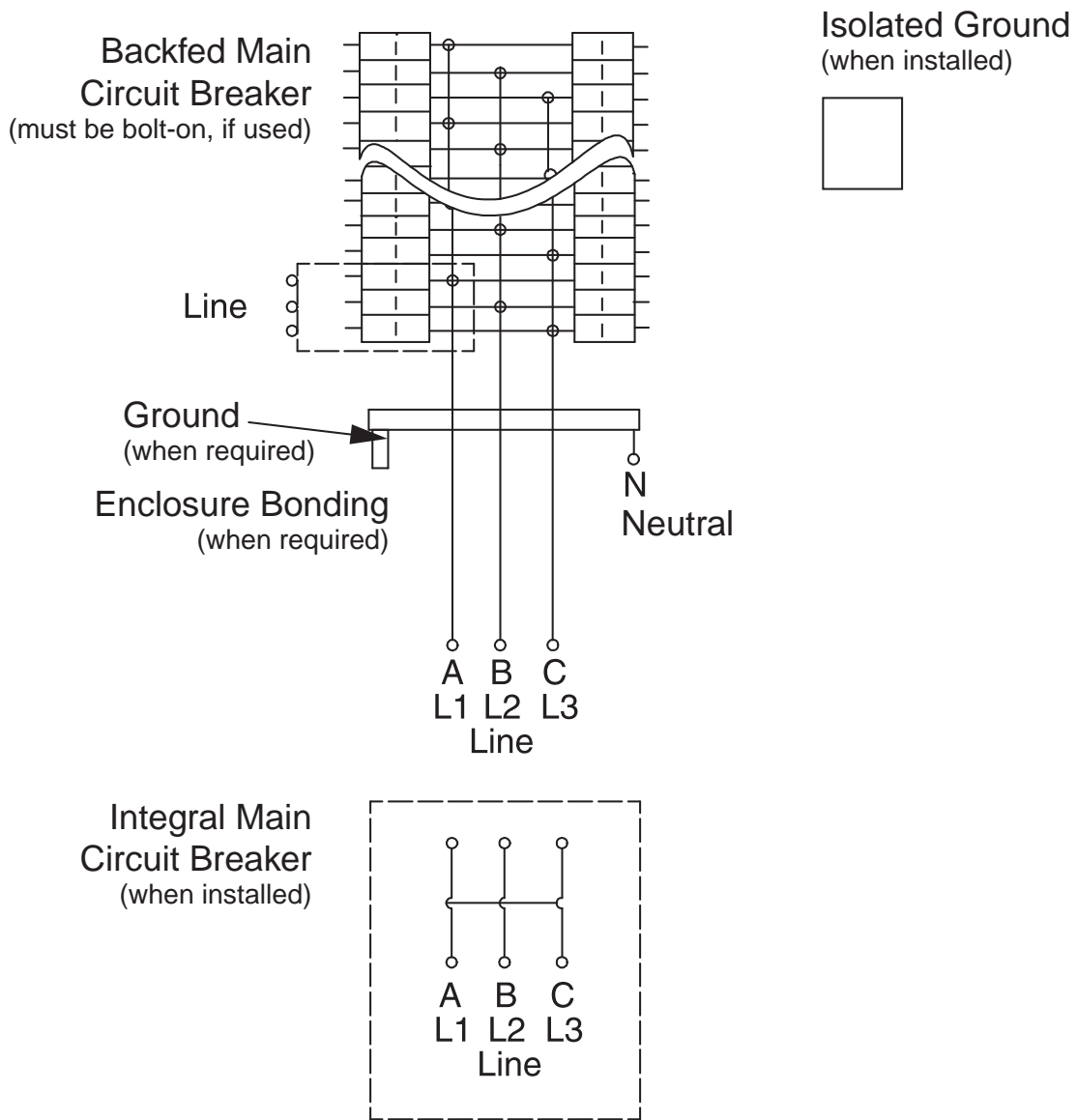
<sup>3</sup> For a grounded “B” phase system, only circuit breakers rated 240 V AC minimum should be used. Do not use circuit breakers rated 120 V or 120/240 V AC.

<sup>4</sup> When wiring for a delta system, phases “A” and “C” must be 120 V to neutral, phase “B” 208 V to neutral. Connect only circuit breakers rated 240 V AC minimum. Do not use circuit breakers rated 120 V or 120/240 V to “B” phase.

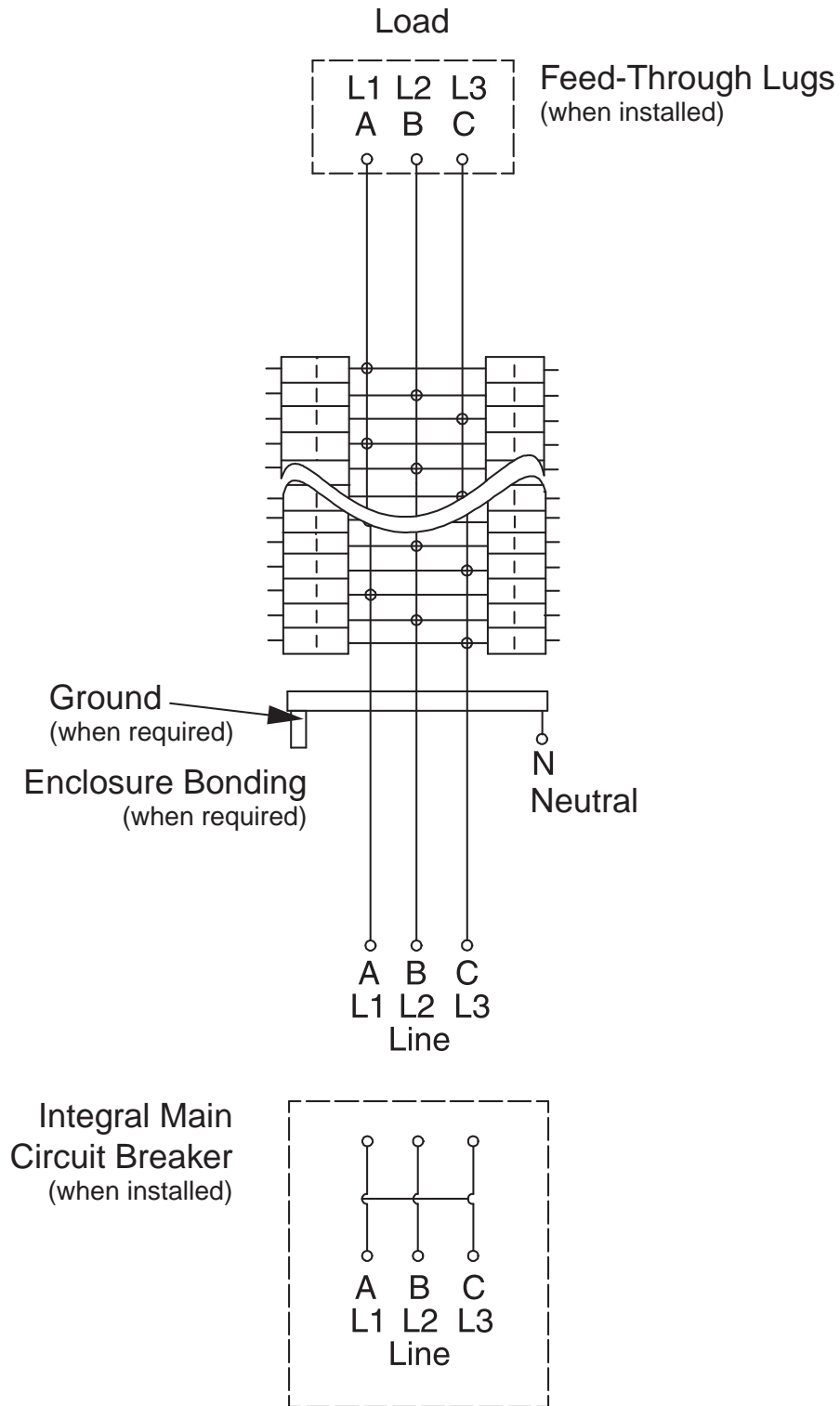
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Integral Main or Sub-Feed:  
 DJ, FI, KI, H, J, LA, LC, LH, QB, QD, QG, QJ, QO(B)VH

**Figure 7: NQ/NQM 100–225 A Main Lugs or 100–250 A Main Breaker Diagram**



**Figure 8: NQ Panelboard or QONQ Load Center 400–600 A Main Lugs or Main Circuit Breaker with or without Feed-Through Lugs Diagram**



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**Figure 9: NQ Panelboard or QONQ Load Center 400–600 A Main Circuit Breaker with Feed-Through Lugs or Sub-Feed Circuit Breakers Diagram**

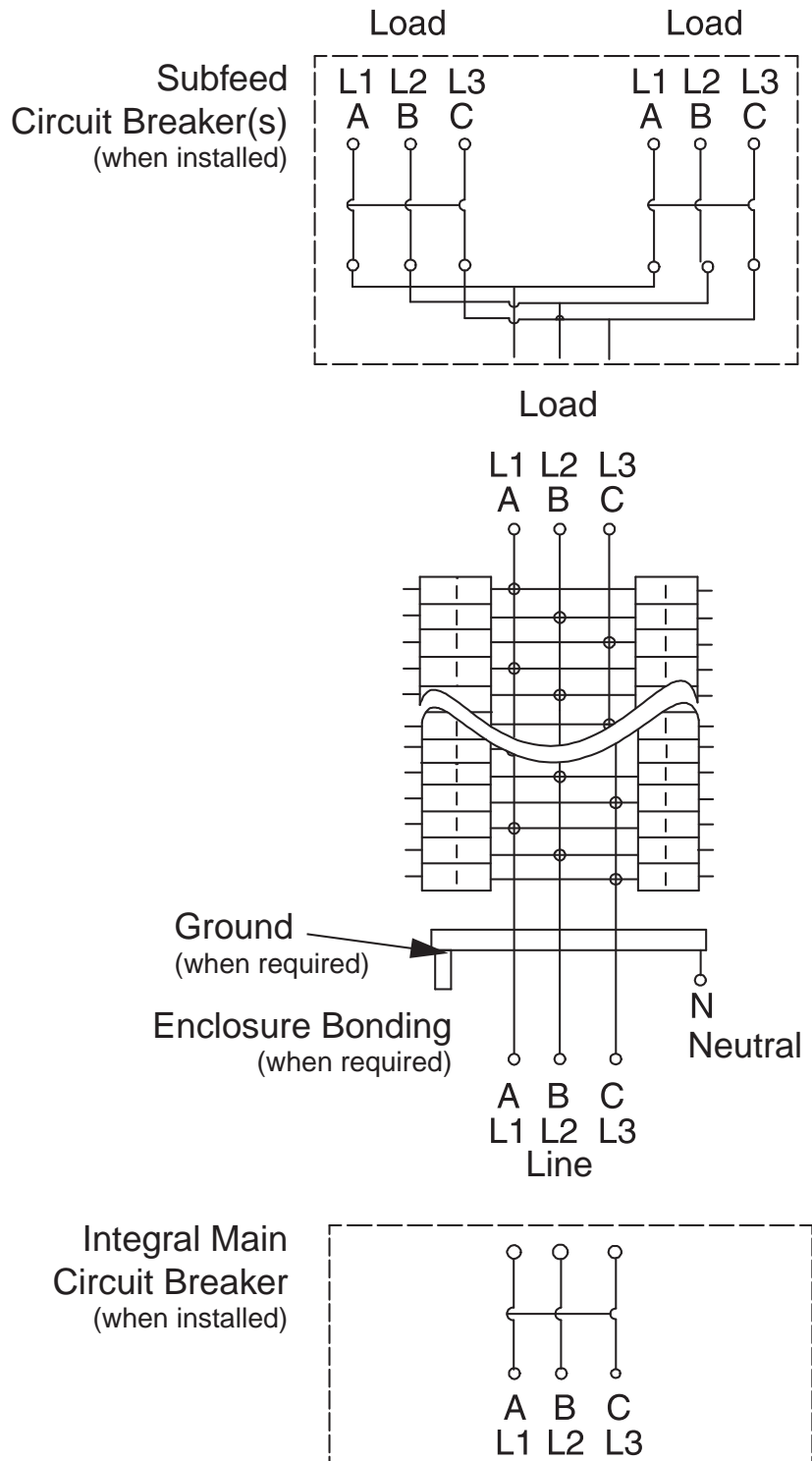
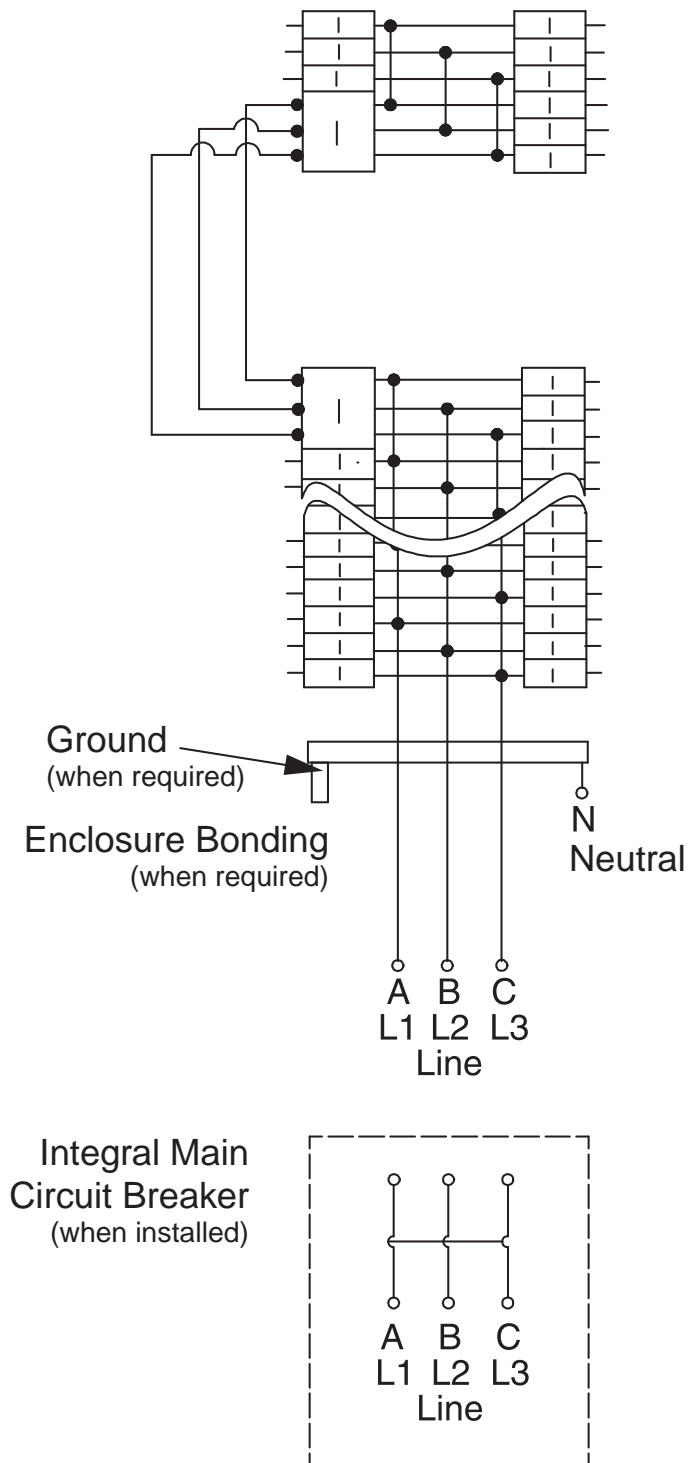




Figure 10: Typical NQ Panelboard with Split Bus Diagram



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## Panelboard Ratings

Refer to NEC section 110-22 and CEC rule 14-014 for more information. The series rated system label is located in the bag assembly.

**Table 2: Series Connected Breaker Ratings (RMS Symmetrical)**

Max. System Voltage AC <sup>1 2</sup>	Max. Short Circuit Current Rating	Square D Brand Integral or Remote Main Circuit Breakers and Remote Main Fuses	Square D Brand Branch Circuit Breaker Catalog Designation and Allowable Ampere Ranges <sup>3 4 5 6</sup>						
			Type	1 Pole	2 Pole	3 Pole			
120/240 1PH	22,000	MG	QO (B)	15-30A	—	—			
	25,000	HD, JD	QO (B) PL		15-60 A	15-30 A			
	65,000	HG, JG	QO (B) PL						
	100,000	HJ, JJ	QO (B) PL						
	125,000	HL, JL	QO (B) PL						
120/240 1PH 208Y/120	100,000	DJ 400A	QO (B)	15-70 A	15-125 A	—			
			QO (B) GFI	15-30 A	40-60 A	—			
			QO (B) AFI	15-20 A	—	—			
			QO (B) AFI, QO (B) CAFI	15-20 A	—	—			
			QO (B) VH	—	150 A	15-150 A			
			QO (B) EPD	15-30 A	15-60 A	15-30 A			
		QJ	QO (B)	15-70 A	15-125 A	15-30 A			
			QO (B) AS	15-30 A	15-30 A	15-30 A			
			QO (B) GFI	15-30 A	15-60 A	15-50 A			
			QO (B) VH	—	150 A	35-150 A			
			QO (B) PL	15-30 A	15-60 A	15-30 A			
			QO (B) AFI	15-20 A	—	—			
			208Y/120	18,000	LA/LH (L) 34200MC	QO (B)	15-30A	15-30 A	15-30 A
					LA/LH (L) 34225MC				
LA/LH (L) 34250MC									
LA/LH (L) 34400MC									
208Y/120	30,000	DJ-W 150 A MC <sup>7</sup>	QO (B)	15-70 A	15-70 A	—			
			QO (B) GFI	15-30 A	15-60 A	—			
			QO (B) AFI, QO (B) CAFI	15-20 A	—	—			
			QO (B) EPD	15-30 A	15-60 A	—			
			QO (B) VH	—	—	15-70 A			

*Continued on next page*

**Table 2: Series Connected Breaker Ratings (RMS Symmetrical) (continued)**

Max. System Voltage AC <sup>1 2</sup>	Max. Short Circuit Current Rating	Square D Brand Integral or Remote Main Circuit Breakers and Remote Main Fuses	Square D Brand Branch Circuit Breaker Catalog Designation and Allowable Ampere Ranges <sup>3 4 5 6</sup>			
			Type	1 Pole	2 Pole	3 Pole
208Y/120	30,000	DJ-W 250 A MC <sup>7</sup>	QO (B)	15–70 A	15–100 A	—
			QO (B) GFI	15–30 A	15–60 A	—
			QO (B) AFI, QO (B) CAFI	15–20 A	—	—
			QO (B) EPD	15–30 A	15–60 A	—
			QO (B) VH	—	—	15–100 A
		DJ-W 400 and 600 A MC <sup>7</sup>	QO (B)	15–70 A	15–100 A	—
			QO (B) GFI	15–30 A	15–60 A	—
			QO (B) AFI, QO (B) CAFI	15–20 A	—	—
			QO (B) EPD	15–30 A	15–60 A	—
			QO (B) VH	—	—	15–100 A
240	22,000	QO (B) VH	QO (B)	15–70 A	15–125 A	15–100 A
			QO (B) AS	15–30 A	15–30 A	15–30 A
			QO (B) GFI	15–30 A	15–60 A	15–50 A
			QO (B) PL	15–30 A	15–30 A	—
			QO (B) AFI	15–20 A	—	—
		Q2-H	QO (B)	15–70 A	15–100 A	15–30 A
			QO (B) GFI	15–30 A	15–30 A	—
			QO (B) AFI	15–20 A	—	—
	25,000	QD	QO (B)	15–70 A	15–125 A	15–30 A
			QO (B) AS	15–30 A	15–30 A	15–30 A
			QO (B) GFI	15–30 A	15–60 A	15–50 A
			QO (B) VH	—	150 A	35–150 A
			QO (B) PL	15–30 A	15–60 A	15–30 A
			QO (B) AFI	15–20 A	—	—
ED, FD		QO (B)	15–70 A	15–125 A	15–100 A	
		QO (B) GFI	15–30 A	15–60 A	15–50 A	
		QO (B) AFI	15–20 A	—	—	
KD		QO (B)	15–70 A	15–125 A	15–100 A	
		QO (B) AS	15–30 A	15–30 A	15–30 A	
		QO (B) GFI	15–30 A	15–60 A	—	
		QO (B) AFI	15–20 A	—	—	
HD, JD		QO (B)	15–70 A	15–125 A	15–100 A	
		QO (B) VH	—	—	35–150 A	
		QO (B) GFI	15–30 A	15–60 A	15–50 A	
	QO (B) AFI	15–20 A	—	—		
	QO (B) H	—	15–100 A	—		
QOB 2150VH	—	150 A	—			

Continued on next page

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**Table 2: Series Connected Breaker Ratings (RMS Symmetrical) (continued)**

Max. System Voltage AC <sup>1 2</sup>	Max. Short Circuit Current Rating	Square D Brand Integral or Remote Main Circuit Breakers and Remote Main Fuses	Square D Brand Branch Circuit Breaker Catalog Designation and Allowable Ampere Ranges <sup>3 4 5 6</sup>			
			Type	1 Pole	2 Pole	3 Pole
240	42,000	LA, MA	Q2L-H	—	100–225 A	100–225 A
			QDL	—	70–225 A	70–225 A
		LC400A	QO (B)	15–70 A	—	—
			QO (B) VH	15–30 A	15–125 A	15–100 A
			QOBVH	—	150 A	—
			QO (B) GFI	15–30 A	15–60 A	—
			QO (B) AFI	15–20 A	—	—
			QO (B) VH	15–30 A	15–125 A	15–100 A
		LC600A	QOBVH	—	150 A	—
			QO (B) GFI	—	15–60 A	—
			QO (B) AFI	15–20 A	—	—
			QO (B) VH	15–30 A	15–30 A	15–30 A
		MG	QO (B) VH	15–30 A	15–30 A	15–30 A
		HD, JD	QO (B) PL	15–30 A	15–60 A	15–30 A
	65,000	LC400A	QO (B)	15–30 A	—	—
			QO (B) VH	15–30 A	15–125 A	15–100 A
			QOBVH	—	150 A	—
			QO (B) GFI	15–30 A	—	15–50 A
			QO (B) AFI	15–20 A	—	—
		LC600A	QO (B) VH	15–30 A	15–125 A	35–100 A (3P208 V max) 15–30 A (3P240 V max)
			QOBVH	—	150 A	—
			QO (B) GFI	—	—	15–50 A
			QO (B) AFI	15–20 A	—	—
		DJ 400A	QO (B)	15–70 A	15–125 A	—
QO (B) VH			—	150 A	15–150 A	
QO (B) H			—	15–100 A	—	
DJ__W		QO (B)	15–70 A	15–150 A	—	
		QO (B)-AFI	15–20 A	—	—	
		QO (B)-GFI	15–30 A	15–60 A	—	
		QO (B)-VH	—	110–125 A	15–150 A	
DJ, DG, DL 150–600 A		QO (B) EPD	—	—	15–30 A	
		QO (B) EPE	—	—	15–30 A	
EG, FG, KG	QO (B)	15–70 A	15–125 A	15–100 A		
	QO (B) GFI	15–30 A	15–60 A	15–50 A		
	QO (B) AFI	15–20 A	—	—		

Continued on next page

**Table 2: Series Connected Breaker Ratings (RMS Symmetrical) (continued)**

Max. System Voltage AC <sup>1 2</sup>	Max. Short Circuit Current Rating	Square D Brand Integral or Remote Main Circuit Breakers and Remote Main Fuses	Square D Brand Branch Circuit Breaker Catalog Designation and Allowable Ampere Ranges <sup>3 4 5 6</sup>				
			Type	1 Pole	2 Pole	3 Pole	
240	65,000	QG	QO (B)	15–70 A	15–125 A	15–30 A	
			QO (B) AS	15–30 A	15–30 A	15–30 A	
			QO (B) VH	—	150 A	35–150 A	
		QG, HG, JG	QO (B) GFI	15–30 A	15–60 A	15–50 A	
			QO (B) PL	15–30 A	15–60 A	15–30 A	
			QO (B) AFI	15–20 A	—	—	
		HG, JG	QO (B)	15–70 A	15–125 A	15–100 A	
			QO (B) VH	—	—	35–150 A	
			QO (B) H	—	15–100 A	—	
		FC_or KC_22_	QO (B)	15–70 A	15–100 A	15–100 A	
			FC_or KC_32_	QO (B) AS	15–30 A	15–30 A	15–30 A
		100,000	FC_or KC_24_	FC_or KC_34_	QO (B) GFI	15–30 A	15–30 A
	QO (B) AFI			15–20 A	—	—	
	DJ 400 A			QO (B) H	—	15–100 A	—
	EJ, FJ		QO (B)	15–70 A	15–125 A	15–100 A	
			QO (B) GFI	15–30 A	15–60 A	15–50 A	
			QO (B) AFI	15–20 A	—	—	
	HJ, JJ		QO (B)	15–70 A	15–125 A	15–100 A	
			QO (B) VH	—	—	35–150 A	
			QO (B) GFI	15–30 A	15–60 A	15–50 A	
	125,000		HL, JL	QO (B) PL	15–30 A	15–60 A	15–30 A
				QO (B) AFI	15–20 A	—	—
				QO (B) H	—	15–100 A	—
		QOB 2150VH		—	150 A	—	
200,000	FI, KI	QO (B)	15–70 A	15–125 A	15–100 A		
		QO (B) AS	15–30 A	15–30 A	15–30 A		
		QO (B) GFI	15–30 A	15–60 A	—		
		QO (B) AFI	15–20 A	—	—		

Continued on next page

**Table 2: Series Connected Breaker Ratings (RMS Symmetrical) (continued)**

Max. System Voltage AC <sup>1 2</sup>	Max. Short Circuit Current Rating	Square D Brand Integral or Remote Main Circuit Breakers and Remote Main Fuses	Square D Brand Branch Circuit Breaker Catalog Designation and Allowable Ampere Ranges <sup>3 4 5 6</sup>			
			Type	1 Pole	2 Pole	3 Pole
240	65,000	400 A Max. Class J or T6 Fuses	QO (B) VH	15–30 A	15–125 A	15–100 A
			QOB-VH	—	150 A	—
			QO (B) AFI	15–20 A	—	—
	100,000	200 A Max. Class T3 Fuses	QO (B) AFI	15–20 A	—	—
			QO (B)	15–70 A	15–125 A	15–100 A
	200,000	200 A Max. Class J or T6 Fuses and 400 A Max. Class T3 Fuses	QO (B) AS	15–30 A	15–30 A	15–30 A
			QO (B) GFI	15–30 A	15–60 A	15–50 A
			QO (B) GFI	15–30 A	15–60 A	15–50 A

- <sup>1</sup> For shown circuit breakers rated less than this maximum voltage, the indicated short circuit current rating also applies, but at the voltage rating of the circuit breaker.
- <sup>2</sup> Short circuit tests are conducted at 100–105% of the maximum rated voltage of the panelboard.
- <sup>3</sup> Suffixes HID, SWD, and SWN may also be applied to the applicable branch circuit breakers shown above. Suffix SWN may **not** be applied in combination with LC main breakers.
- <sup>4</sup> Where QO (B) circuit breakers are shown above, QO (B) H, QO (B) VH, and QH (B) circuit breakers may also be used.
- <sup>5</sup> Where QO (B) GFI circuit breakers are shown above, QO (B) EPD and/or QO (B) EPE circuit breakers may also be used.
- <sup>6</sup> Where QO (B) AFI circuit breakers are shown above, QO (B) CAFI circuit breakers may also be used.
- <sup>7</sup> To achieve selective coordination, the rating of the DJ main circuit breaker must be at least two times greater than the ampere rating of any branch circuit breaker.

**Table 3: Short Circuit Current Rating<sup>1</sup> for Main Lug Interiors with Sub-Feed or Feed-Through Lugs**

Maximum System Voltage AC	Maximum Current Rating	Branch Circuits	Application	Adder <sup>2</sup>	Maximum Short Circuit Current Rating <sup>3</sup>
240	100	18, 30	SFL and FTL	—	10,000
	225	30, 42, 54, 72, 84	SFL	6 inches (152.4 mm)	
		42	FTL	—	
		30, 54, 72, 84		6 inches (152.4 mm)	
	400	30, 42, 54, 72, 84	SFL	—	25,000
		30, 84	FTL	—	
		42, 54, 72		6 inches (152.4 mm)	
		600		30, 42, 54, 72, 84	

<sup>1</sup> This rating applies to main lug interiors, equipped with sub-feed or feed-through lugs, where the device feeding the interior is unknown or not a Square D brand device. Use of a Square D brand main circuit breaker ahead of these lugs will result in a rating equal to the rating of the breaker. Short circuit tests are conducted at 100–105% of the maximum rated voltage of the panelboard.

<sup>2</sup> The adder is the additional length of the enclosure.

<sup>3</sup> RMS symmetrical amperes, for three cycles.

## CE Marking

Interiors with the “CE” mark meet the IEC 60439-1 standard.

ENGLISH

## Appendix 2: Accessory Kits

An assortment of field-installable accessory kits are available for NQ panelboards:

- Equipment Ground Bar Kits
- Oversized Lug Kits for 100–250 A Panelboards
- Sub-Feed Lug Kits for 100–400 A Panelboards
- Main Lug Kits
  - Mechanical Lug Kits — Aluminum
  - Mechanical Lug Kits — Copper
  - Versa-Crimp<sup>®</sup> Compression Lug Kits — Aluminum
  - Versa-Crimp Compression Lug Kits — Copper

### Equipment Ground Bar Kits


Equipment ground bar kits, suitable for copper or aluminum wire, meet the grounding needs of NQ panelboards and QONQ load centers.

**Table 4: Equipment Ground Bar Kits Specifications**

Panelboard		Use Ground Bar Kit Catalog Number	
Branch Circuit	Mains Rating	Aluminum <sup>1</sup>	Copper <sup>2</sup>
1–42	600 A Maximum	(1) PK27GTA	(1) PK27GTACU
54–84		(2) PK27GTA	(2) PK27GTACU

<sup>1</sup> Aluminum bars suitable for 60° C or 75° C Copper or Aluminum conductors.

<sup>2</sup> Copper bars suitable for 60° C or 75° C Copper conductors.

**NOTE:** Ground bar mounting locations are identified by the ground symbol  stamped into the backwall of the enclosure.



## Oversized Lug Kits for 100–250 A Panelboards

Oversized lug kits are available for applications where termination conductors of 3 AWG or larger are required for the neutral.

**Table 5: Oversized Lug Kits for 100–250 A Panelboards Specifications**

Circuit Breaker Rating	Kit Catalog Number	Wire Range
70 A	QO70AN	(1) 10–2 Al (1) 5.76–33.6 mm <sup>2</sup> (1) 14–4 Cu (1) 2.08–21.1 mm <sup>2</sup>
80–125 A	Q1100AN	(1) 4–1/0 Al/Cu (1) 42.4–53.5 mm <sup>2</sup>
125–150 A	Q1150AN	(1) 1–4/0 Al/Cu (1) 42.4–107 mm <sup>2</sup>

## Sub-Feed Lug Kits for 100–400 A Panelboards

Sub-feed main lugs are available for 100, 225, or 400 A applications.

**Table 6: Sub-Feed Lug Kits for 100–400 A Panelboards Specifications**

Main Amps	Kit Catalog Number	Maximum Circuits
100	NQSFL1	18, 30
225	NQSFL2	30 <sup>1</sup> , 42 <sup>1</sup> , 54 <sup>1</sup> , 72 <sup>1</sup> , 84 <sup>1</sup>
400	NQSFL4	30, 42, 54, 72, 84

<sup>1</sup> These panels require an additional 6 inches (152.4 mm) for the box and trim, for proper wire bending space.

ENGLISH

## Main Lug Kits

**Table 7: Mechanical Lug Kits — Aluminum**

Panelboard Amps	Kit Catalog Number	Wire Range
100	Standard	#6–2/0 AWG 13.3–67.43 mm <sup>2</sup>
225	Standard	#6–350 kcmil 13.3–177.3 mm <sup>2</sup>
400	Standard	(1) 1/0–750 kcmil (2) 1/0–350 kcmil (1) 53.48–380 mm <sup>2</sup> (2) 53.48–177.3 mm <sup>2</sup>
600	Standard	(2) 1/0–750 kcmil (2) 53.48–380 mm <sup>2</sup>
	NQALM6A	(3) #6–250 kcmil (3) 13.3–127 mm <sup>2</sup>

**Table 8: Mechanical Lug Kits — Copper**

Panelboard Amps	Kit Catalog Number	Wire Range
100	NQCUM1	#6–2/0 AWG 13.3–67.43 mm <sup>2</sup>
225	NQCUM2	#6–250 kcmil 13.3–127 mm <sup>2</sup>
400	NQCUM4	(1) 1/0–750 kcmil (2) 1/0–350 kcmil
600	NQCUM6	(1) 53.48–380 mm <sup>2</sup> (2) 53.48–177.3 mm <sup>2</sup>

**Table 9: Versa-Crimp® Compression Lug Kits — Aluminum**

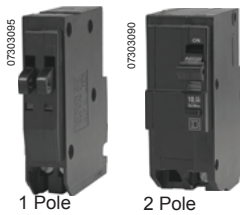
Panelboard Amps	Kit Catalog Number	Wire Range	Crimp Tool
100	NQALV1	#8–1/0 AWG 8.36–53.48 mm <sup>2</sup>	VC6 (All)
225	NQALV2	#4–300 kcmil 21.15–152 mm <sup>2</sup>	
400	NQALV4	(2) 2/0–500 kcmil	VC6-3, VC6-FT
600	NQALV6	(2) 67.43–253.4 mm <sup>2</sup>	

**Table 10: Versa-Crimp® Compression Lug Kits — Copper**

Panelboard Amps	Kit Catalog Number	Wire Range	Crimp Tool
100	NQCUV1	#6–1/0 AWG 13.30–53.48 mm <sup>2</sup>	VC6 (All), VC7 (All)
225	NQCUV2	2/0–300 kcmil 67.43–152 mm <sup>2</sup>	VC6-3, VC7, VC6-FT, VC7-FT
400	NQCUV4	400–750 kcmil 202.7–380 mm <sup>2</sup>	VC6-FT, VC7-FT, VC8
600	NQCUV6	(2) 250–500 kcmil (2) 126.7–253.4 mm <sup>2</sup>	VC6-3, VC7, VC6-FT, VC7-FT

## General Information

### QO<sup>®</sup> and QOB Circuit Breakers



QO<sup>®</sup> (plug-on) and QOB (bolt-on) one-, two- and three-pole thermal-magnetic circuit breakers provide overcurrent protection and switching on ac and dc systems. Plug-on QO circuit breakers are for use in QO load centers, NQ and NQOD panelboards, OEM mounting bases, and Speed-D<sup>®</sup> switchboard distribution panels. Bolt-on QOB circuit breakers are for use in NQO and NQOD panelboards.

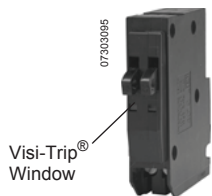
#### Operating mechanism



QO and QOB circuit breakers have an overcenter, trip-free toggle mechanism with quick-make, quick-break action and positive handle indication. The tripping mechanisms in two- and three-pole circuit breakers operate such that an overcurrent on any pole of the circuit breaker will cause all poles of the circuit breaker to open simultaneously. Each pole has an individual thermal-magnetic trip element calibrated for 40°C ambient temperature.

QO Circuit Breakers

#### Trip Indication



QO and QOB circuit breakers have Visi-Trip<sup>®</sup> trip indication, which provides a visual indication that the circuit breaker has tripped and interrupted the circuit. When the circuit breaker has tripped, the handle assumes a center position and the red Visi-Trip indicator appears in a window in the circuit breaker case. The Visi-Trip indicator is only visible when the circuit breaker has tripped. Trip indication immediately distinguishes the circuit from any other circuit which is merely in the on or off position. The circuit breaker can be reset by pushing the handle to OFF and then to ON.

#### Construction Standards

QO and QOB circuit breakers are built to comply with UL Standard 489, CSA 22.2 No. 5, NOM/ANCE and NEMA Standard AB1 and to meet Federal Specification W-C-375B/GEN. QO circuit breakers are UL Listed under UL File E84967 and are CSA Certified under CSA Master Contract 153555.

QO Circuit Breaker	UL Type
QO280–QO210	QOA, QOB
QO2110–QO2125	QOC, QOCB
QO2150–QO2200	QOC (no bolt-on version)

# QO<sup>®</sup> and QOB Miniature Circuit Breakers

## General Information

### Ratings

When designing an electrical distribution system, overcurrent protective devices are generally selected based on performance requirements. Factors influencing this selection include system voltage, continuous current, interrupting rating, and frequency.

#### Voltage Rating

The circuit breaker must have a voltage rating greater than, or equal to, the system voltage. When a circuit breaker clears an overcurrent, it is done in two steps. First, the current sensing system identifies the overcurrent and releases the tripping mechanism. This results in a parting of the contacts. The circuit breaker must then extinguish the voltage arc across the contacts. If the circuit breaker has the correct voltage rating, it can efficiently extinguish this voltage arc. QO and QOB circuit breakers are rated for use in the following voltage systems:

- 120 Vac
- 208/120 Vac
- 120/240 Vac
- 240 Vac
- 48 Vdc (10–70 A for 1 and 2 pole circuit breakers, 10–60 A for 3 pole circuit breakers)

#### Continuous Current Rating

The continuous current rating of a circuit breaker is the maximum current in amperes (dc or rms ac at rated frequency) which a device will carry continuously without exceeding the specified allowable temperature rise. Sometimes referred to as the ampere rating or handle rating of the circuit breaker, the continuous current rating relates to the system current flow under normal conditions.

UL and CSA require that circuit breakers must be able to carry their continuous current rating indefinitely at 40°C in free air in order to achieve a UL Listing/CSA Certification. The National Electrical Code (NEC) and the Canadian Electrical Code (CEC) recognize that devices applied in end-use equipment can be affected by heat build up during normal operating conditions. For this reason, the codes require that circuit breakers be selected based on the characteristics of the load (particularly, the portion of the load which will be on continuously for three hours or more at a time).

#### Frequency Rating

The standard rated frequency for circuit breakers is 60 Hz. Circuit breakers are also rated for dc applications as shown in Table 1. Many Square D circuit breakers can also be applied on 50 Hz systems without derating. GFCI, AFCI and EPD devices are rated for 60 Hz operation only. Frequencies can affect the thermal, magnetic and short-circuit characteristics of circuit breakers. See Data Bulletin 0100DB0101 *Determining Current Carrying Capacity in Special Applications*. Contact the Field Sales office before applying circuit breakers on systems at frequencies other than 50/60 Hz.

### Interrupting Rating

The interrupting rating of a circuit breaker is the highest current at rated voltage that the circuit breaker is intended to interrupt under standard test conditions. A circuit breaker must be chosen so that the interrupting rating is equal to or greater than the maximum available short-circuit current at the point where the circuit breaker is applied in the system.

**Table 1: Interrupting Ratings**

Circuit Breaker Type	Number of Poles	Ampere Rating	UL Listed Interrupting Rating <sup>1</sup>			
			120 Vac	120/240 Vac	240 Vac	48 Vdc <sup>2</sup>
QO	1	10–70 A	10 kA	10 kA	—	5 kA
	2	10–70 A	10 kA	10 kA	10 kA	5 kA
		80–100 A	10 kA	10 kA	10 kA	—
		110–200 A	10 kA	10 kA	—	—
	3	15–60 A	10 kA	10 kA	10 kA	5 kA
		70–100 A	10 kA	10 kA	10 kA	—
QOB	1	10–70 A	10 kA	10 kA	—	5 kA
	2	10–70 A	10 kA	10 kA	10 kA	5 kA
		80–100 A	10 kA	10 kA	10 kA	—
		110–125 A	10 kA	10 kA	—	—
	3	15–60 A	10 kA	10 kA	10 kA	5 kA
		70–100 A	10 kA	10 kA	10 kA	—
QO-H, QOB-H	2	15–100 A	10 kA <sup>3</sup>	10 kA <sup>3</sup>	10 kA <sup>3</sup>	—
QO-VH	1	15–30 A	22 kA	22 kA	—	—
	2	15–200 A	22 kA	22 kA	—	—
	3	15–100 A	22 kA	22 kA	22 kA	—
QOB-VH	1	15–30 A	22 kA	22 kA	—	—
	2	15–125 A	22 kA	22 kA	—	—
	3	15–150 A	22 kA	22 kA	22 kA	—
QOH	1	40–125 A	42 kA	42 kA	—	—
QH, QHB	1	15–30 A	65 kA	65 kA	—	—
	2	15–30 A	65 kA	65 kA	—	—
	3	15–30 A	65 kA	65 kA	65 kA	—
QO-GFI, QOB-GFI	1	15–30 A	10 kA	—	—	—
	2	15–60 A	10 kA	10 kA	—	—
QO-VHGFI, QOB-GFI	1	15–30 A	22 kA	—	—	—
QO-AFI, QOB-AFI	1	15–30 A	10 kA	—	—	—
QO-CAFI, QOB-CAFI	1	15–30 A	10 kA	—	—	—
QO-VHCAFI, QOB-VHCAFI	1	15–30 A	22 kA	—	—	—
QO-EPD, QOB-EPD	1	15–30 A	10 kA	—	—	—
	2	15–60 A	10 kA	10 kA	—	—
QO-PL	1	15–30 A	10 kA	10 kA	10 kA	—
	2	15–30 A	10 kA	10 kA	10 kA	—
	3	15–30 A	10 kA	10 kA	10 kA	—

<sup>1</sup> 10 kA and 5 kA are 1Ø-3Ø.

<sup>2</sup> DC ratings do not apply to circuit breakers rated 10 A.

<sup>3</sup> UL Listed 5,000 AIR on 3Ø grounded B-Phase Delta system.

### DC Voltage Rating

QO and QOB circuit breakers are available with a UL Listed 48 Vdc rating. See Table 1. Refer to Square D Data Bulletin 0601DB0401 for additional information on dc-rated circuit breakers.

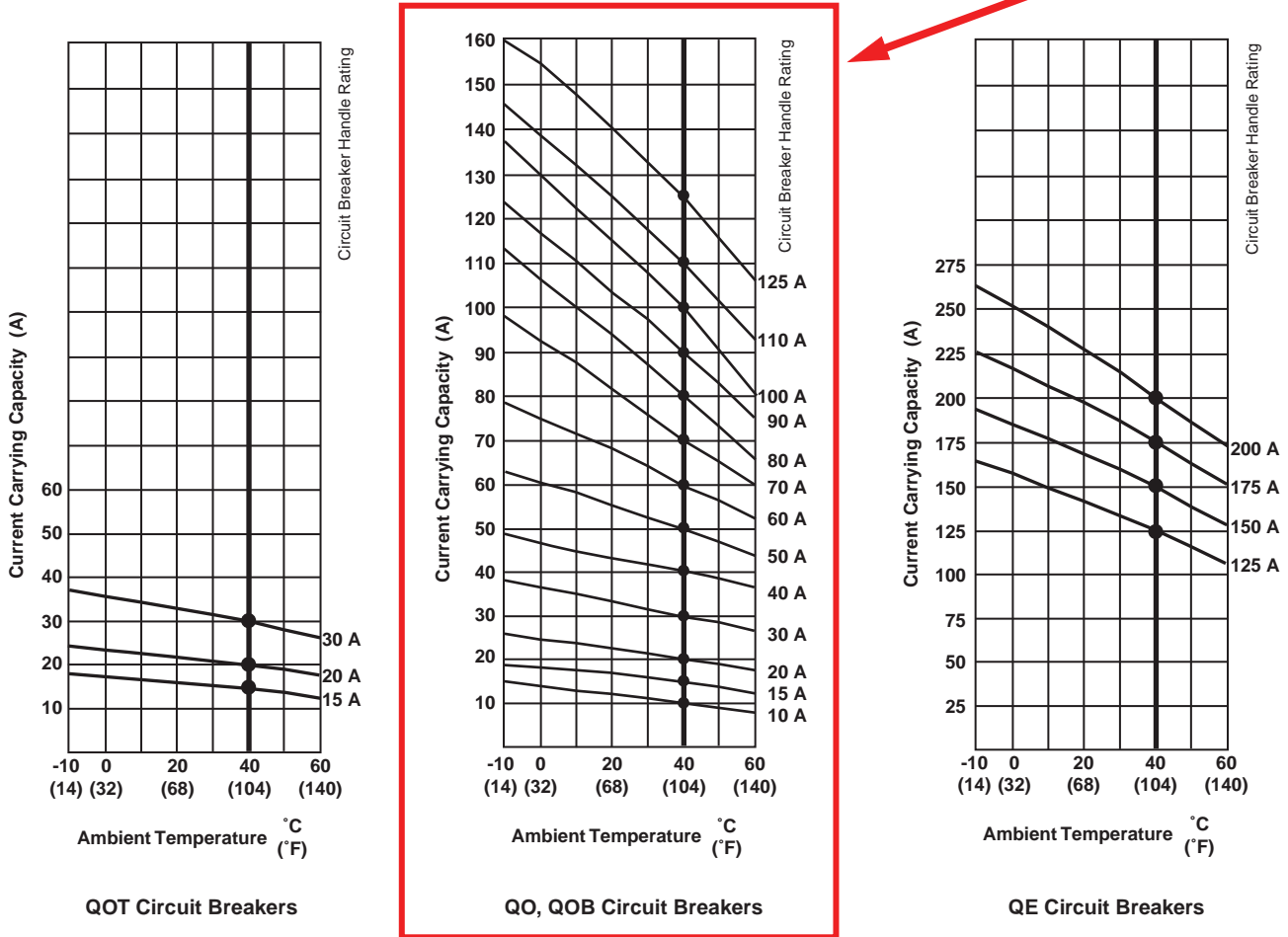
# QO<sup>®</sup> and QOB Miniature Circuit Breakers

## General Information

### Temperature Rating

To meet the requirements of Underwriters Laboratories Standard 489, molded case circuit breakers are designed, built, and calibrated for use on 60 Hz ac systems in 40°C (104°F) ambient temperature. When applied at ambient temperatures other than 40°C, the current-carrying capacity and/or trip characteristics of the circuit breaker may vary.

Figure 1: Ambient Derating Curves



### IEC Rating

IEC rated QO circuit breakers are available. For further information contact the Field Sales office.

### Terminology

#### HACR

HACR is a term used to designate circuit breakers which have been certified to be used on multi-motor and combination loads such as are found in heating, air conditioning and refrigeration equipment. QO circuit breakers meet the UL requirements for HACR circuit breakers and are suitable for group motor applications requiring HACR listing.

This means that QO and QOB circuit breakers meet the code requirements that HACR circuit breaker must be of the inverse time type and be approved for group installation. QO and QOB circuit breakers, except for GFI, AFI and EPD, are Listed with UL as HACR Type and are labeled accordingly.

**Switching Duty (SWD) Circuit Breakers**


QO and QOB circuit breakers are suitable for switching 120 Vac fluorescent lighting loads. The switching duty (SWD) listing applies only to one-pole 15 and 20 A circuit breakers rated at 347 Vac or less. The circuit breakers are subjected to specified temperature rise tests at predetermined periods during the endurance operations.

**Terminations**

The 10–30 A circuit breakers have pressure plate terminals suitable for single or two-wire terminations. Copper or aluminum conductors may be used as outlined in Table 2. QO-GFI 15–30 A and QO-AFI circuit breakers have pressure plate terminals suitable for single-wire terminations. These circuit breakers are suitable for use with 60°C or 75°C conductors.

The QO 35–200 A and all QO-PL and QOT tandem circuit breakers have box-type lugs suitable for single-wire terminations. These circuit breakers are suitable for use with 75°C conductors.

**Table 2: Terminations**



Circuit Breaker Types	Rating	Wire Size
QO, QOB, QO-VH, QOB-VH	10–30 A	(1) 14–8 AWG (1.5–3.3 mm <sup>2</sup> ) Al/Cu (2) 14–10 AWG (1.5–2.6 mm <sup>2</sup> ) Cu
	35–70 A	(1) 8–2 AWG (3.3–6.5 mm <sup>2</sup> ) Al/Cu
	80–125 A	(1) 4–2/0 AWG (5.2–9.3 mm <sup>2</sup> ) Al/Cu
QO, QOB, QO-VH	150–200 A	(1) 4 AWG–300 kcmil (5.2–50 mm <sup>2</sup> ) Al/Cu
QOB-VH	110–175 A	(1) 4 AWG–300 kcmil (5.2–50 mm <sup>2</sup> ) Al/Cu
QOT	15–20 A	(1) 12–8 AWG (2.0–3.3 mm <sup>2</sup> ) Al (1) 14–8 AWG (1.6–3.3 mm <sup>2</sup> ) Cu
QO-CAFI, QO-AFI, QO-GFI, QO-EPD, QOB-CAFI, QOB-AFI, QOB-GFI, QOB-EPD	15–30 A	(1) 12–8 AWG (2.0–3.3 mm <sup>2</sup> ) Al (1) 14–8 AWG (1.6–3.3 mm <sup>2</sup> ) Cu
QO-GFI, QO-EPD, QOB-GFI, QOB-EPD	40–60 A	(1) 12–4 AWG (2.0–4.1 mm <sup>2</sup> ) Al (1) 14–6 AWG (1.6–4.1 mm <sup>2</sup> ) Cu
QO-PL	10–60 A	(1) 12–2 AWG (2.0–6.5 mm <sup>2</sup> ) Al

**Special Application Circuit Breakers**

There are several special application circuit breakers in the QO family:

- QO-HM and QOB-HM High-Magnetic Circuit Breakers
- QO-HID and QOB-HID Circuit Breakers
- QO and QOB Miniature Switches
- QOK and QOBK Key-Operated Circuit Breakers
- QO-GFI and QOB-GFI Qwik-Gard® Circuit Breakers
- QO-EPD and QOB-EPD Equipment Protection Devices
- QO-SWN and QOB-SWN Switch Neutral Circuit Breakers
- QOT Tandem Circuit Breakers
- QO-PL and QOB-PL Powerlink® Circuit Breakers
- QO-AFI and QOB-AFI Branch Feeder Arc-Fault Circuit Interrupters (AFCI)
- QO-CAFI, QOB-CAFI Combination Arc-Fault Circuit Interrupters (AFCI)

The following sections describe the special application circuit breakers and provides application information for their use.

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**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 26 2913 1.6 CONTACTORS

Submittal Number: 1

Item: Contactors

Manufacturer:

Model #:

Installing Contractor: Premier Electric, LLC  
2485 E ZAK Circle, STE D.  
Wasilla, AK 99654  
Phone: (907) 357-4220  
Fax: (907) 357-4225

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

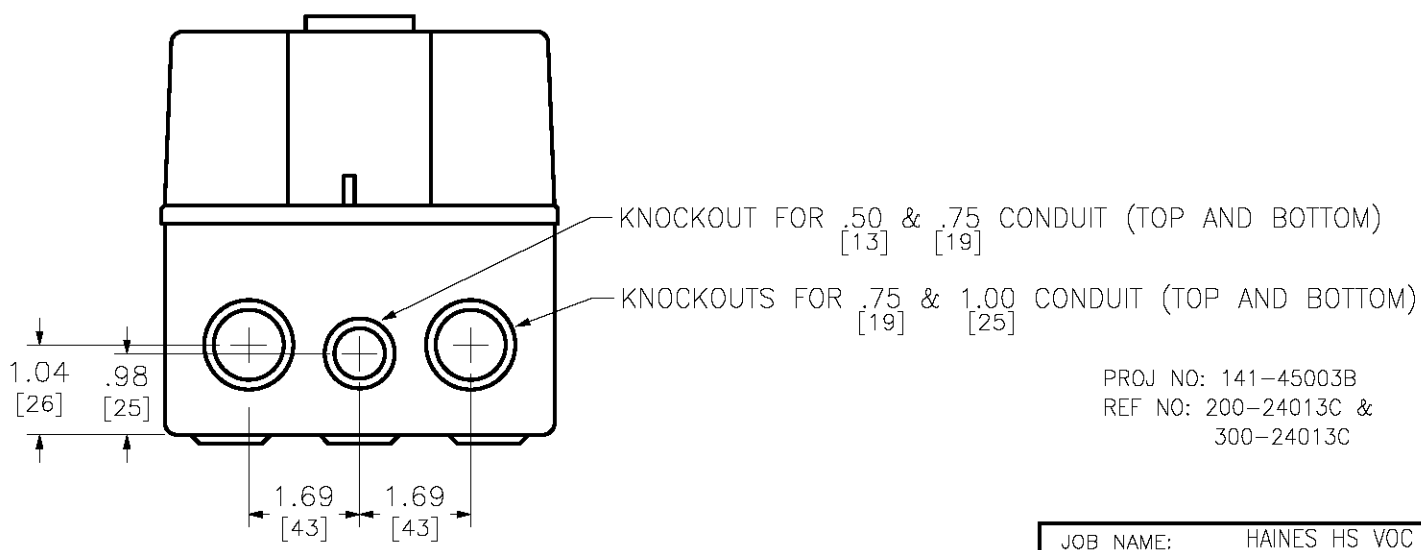
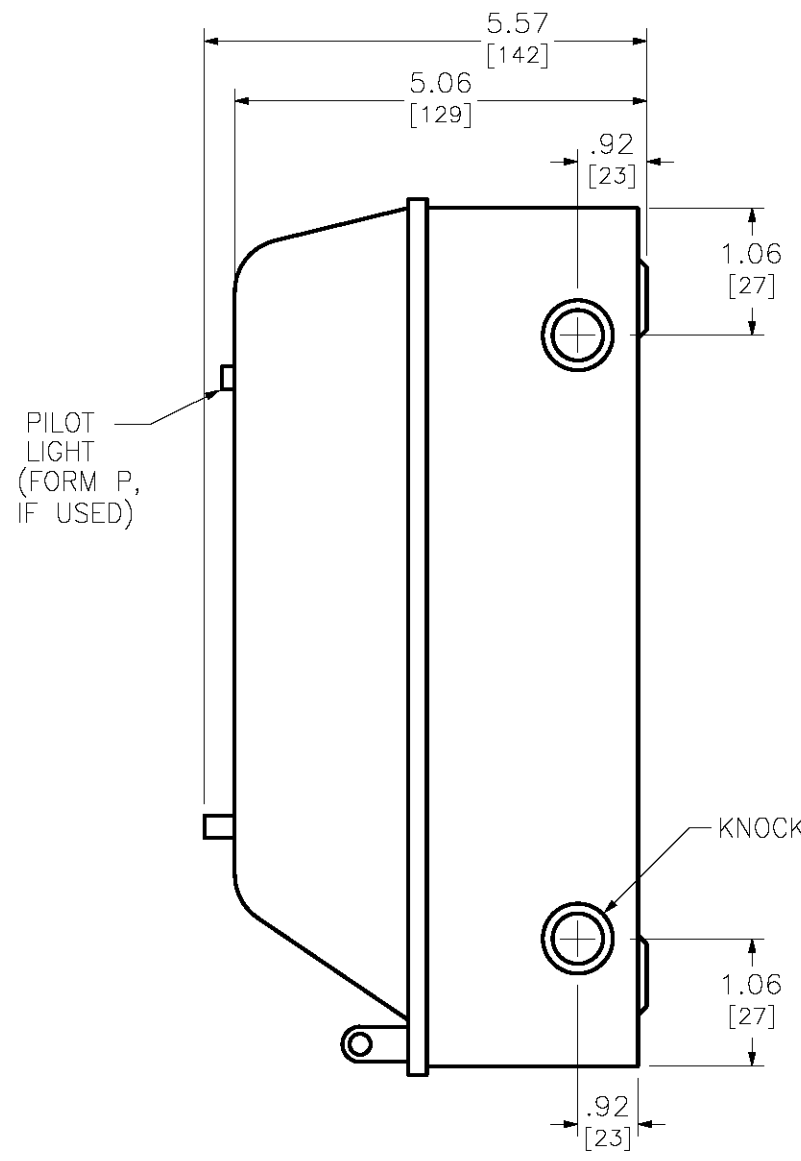
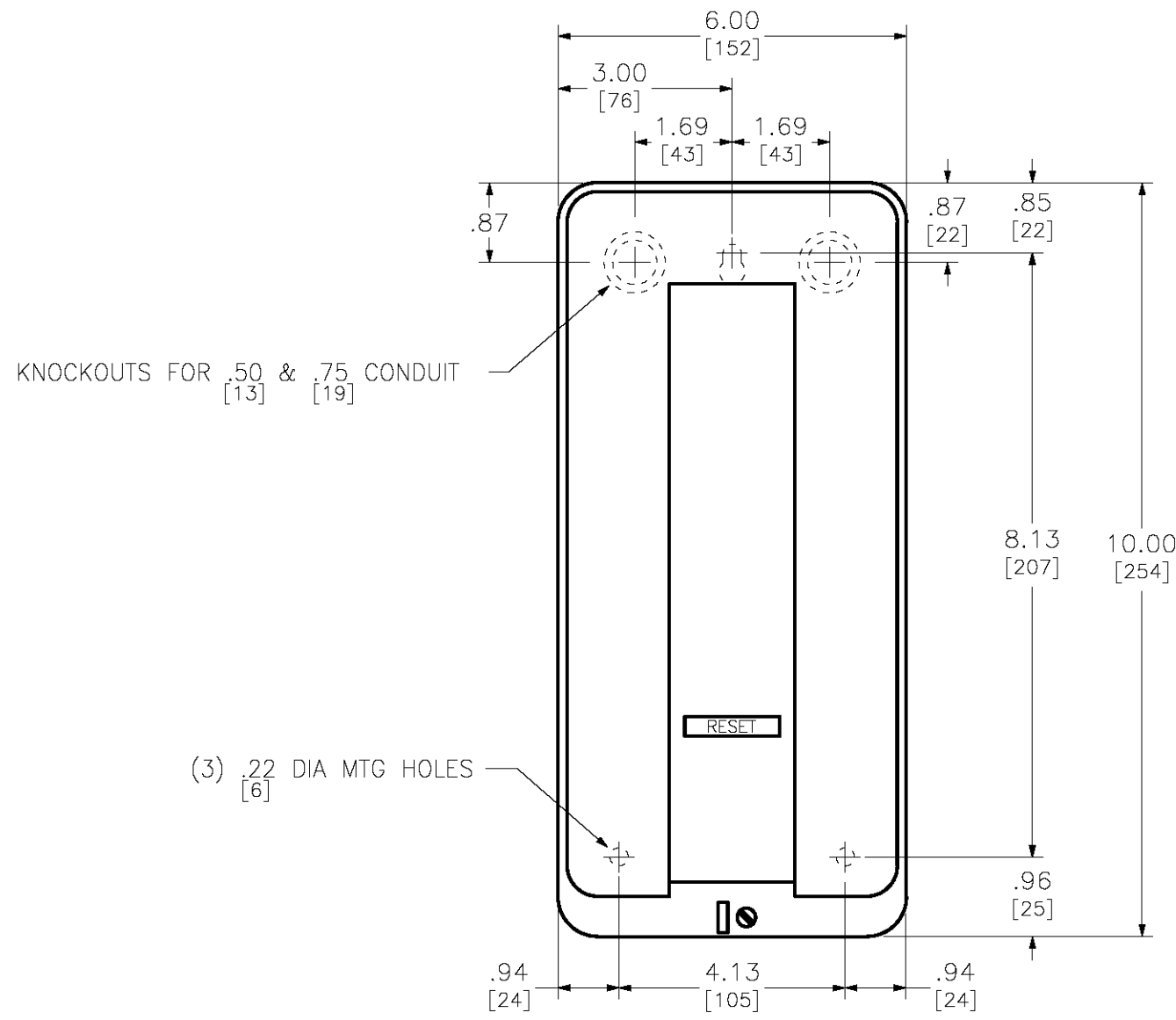
Engineer Review/Comments

Resubmittal Required: Yes  No

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REV	DESCRIPTION	BY	DATE						
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CLASS 8502/8536 MAGNETIC CONTACTORS AND STARTERS  
NEMA TYPE 1 GENERAL PURPOSE ENCLOSURE



**Class 8536 Starter  
Designation: EF-1  
8536SAG11V02S**

DUAL DIMENSIONS: INCHES  
MILLIMETERS

NEMA SIZE	CLASS	TYPE	NO. OF POLES	FORMS
00	8502 & 8536	SAG	2-3	STD,A,C,P,S,X
0 & 1	8502 & 8536	SBG SCG	1-5	STD,A,B,C,P,S,X

PROJ NO: 141-45003B  
REF NO: 200-24013C &  
300-24013C

NOT TO SCALE

JOB NAME:	HAINES HS VOC TECH BLDG	EQUIPMENT DESIGNATION:	EF-1
JOB LOCATION:	HAINES AK	EQUIPMENT TYPE:	
DRAWN BY:	(Q2C)	DRAWING TYPE:	
ENGR:			
DATE:	May 06 2015		
DRAWING STATUS:	QUOTE	DWG#	F36582663-01
		PG	1 OF 1
		REV	-



**NEMA Contactors and Starters**



**Manual Starters and Switches** (p. 16-4)



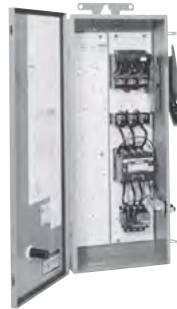
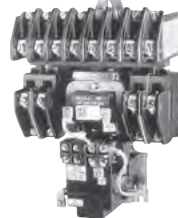
**Definite Purpose Contactors and Starters** (p. 16-70)



**NEMA Style Type S Contactors and Starters** (p. 16-14)



**Lighting Contactors** (p. 16-59)



**Pump Panel** (p. 16-75)



**Combination Starters**  
(p. 16-31)



**NEMA Style TeSys N Contactors and Starters**  
(p. 16-139)



**NEMA AC Magnetic Contactors and Starters  
Catalog Numbering System**

16-13

**Combination Starters—NEMA Style**

Non-Reversing

Non-Fusible Disconnect Class 8538	16-32, 16-34
Fusible Disconnect Class 8538	16-31, 16-33, 16-34
Electronic Motor Circuit Protector (MCP) Class 8539	16-35, 16-36, 16-37
Thermal Magnetic Circuit Breaker Class 8539	16-38, 16-39

Reversing

Non-Fusible Disconnect Class 8738	16-52
Fusible Disconnect Class 8738, 8739	16-51, 16-52
Electronic Motor Circuit Protector (MCP) Class 8739	16-53
Thermal Magnetic Circuit Breaker Class 8739	16-55

**Contactors—NEMA Style**

Non-Reversing Class 8502	16-14
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Vacuum, Low Voltage, Non-Reversing Class 8502	16-28
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See Supplemental Digest

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Full Voltage Class 8940	16-75
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**Reduced Voltage Starters**

Electro-Mechanical Class 8600

See Supplemental Digest

**Starters, Full Voltage—NEMA Style**

Non-Reversing Class 8536	16-18
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Vacuum, Low Voltage, Non-Reversing Class 8536	16-29

**Additional Products**

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Reversing Drum Switches Class 2601	See Supplemental Digest



**TeSys N Contactors and Starters**

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Class	2510, 2511, 2512	8502 & 8702	8536 & 8736	8538 & 8738	8539 & 8739
	Manual Starters and Switches, Non-Reversing, Reversing and Two Speed	NEMA Style Full Voltage Non-Reversing and Full Voltage Reversing Magnetic Contactors	NEMA Style Full Voltage Non-Reversing and Full Voltage Reversing Magnetic Starters	NEMA Style Full Voltage Non-Reversing and Full Voltage Reversing Combination (Disconnect Switch) Magnetic Starters	NEMA Style Full Voltage Non-Reversing and Full Voltage Reversing Combination (PowerPact™ Circuit Breaker) Magnetic Starters
Page	16-4	8502 16-14	8536 16-18	8538 16-31	8539 16-35
		8702 16-44	8736 16-46	8738 16-51	8739 16-53
NEMA Sizes	Type F = N/A	00 to 7	00 to 7	8538 = 0 to 6	8539 = 0 to 7
	Type K = N/A			8738 = 0 to 5	8739 = 0 to 6
	Type M = 0 & 1				
Load Voltage	Type F = 277 V	600 Vac Max.	600 Vac Max.	600 Vac Max.	600 Vac Max.
	Types K & M = 600 Vac				
Current Ratings (Continuous)	Type F = 16 A	9A to 810 A	9 A to 810 A	8538 = 18 A to 540 A	8539 = 18 A to 810 A
	Types K & M = 30 A			8738 = 18 A to 270 A	8739 = 18 A to 540 A
Horsepower Ratings (Maximum)	Type F = 1	1/2 to 600	1/2 to 600	8538 = 1/2 to 400	8539 = 1/2 to 600
	Type K = 20			8738 = 1/2 to 200	8739 = 1/2 to 400
	Type M = 10				
Overload Relay	Type F = Melting Alloy	N/A	Melting Alloy	Melting Alloy	Melting Alloy
	Type K = N/A		Bi-Metallic	Bi-Metallic	Bi-Metallic
	Type M = Melting Alloy		Solid State	Solid State	Solid State
Enclosure Types	1, Flush Mount, 3R, 4, 4X, 7 & 9 and Open	1, 3R, 4, 4X, 12/3R, 7 & 9 and Open	1, 3R, 4, 4X, 12/3R, 7 & 9 and Open	1, 4, 4X, 12/3R	1, 4, 4X, 12/3R
Approvals	UL File E42243 NLRV	UL File E78351 NLDX	UL File E78351 NLDX	UL File E152395 NKJH7	UL File E152395 NKJH7
	UR File E42243 NLRV2	CSA 60905 Class 3211-04	CSA 60905 Class 3211-04	CSA LR584 Class 3211 04	CSA LR584 Class 3211 04
	CSA File LR 25490	CE IEC 947-4-1 Sizes 00-5 Only	CE IEC 947-4-1 Sizes 00-5 Only		

**Class 8536 Starter  
Designation: EF-1  
8536SAG11V02S**

Class 8536		Type S C G - 3 V02		Form S
<b>General Classification</b>				
8502	Contactor Page 16-14			
8536	<b>Starter Page 16-18</b>			
8538	Combination Starter with Disconnect Switch Page 16-31			
8539	Combination Starter with Circuit Breaker Page 16-35			
8702	Reversing Contactor Page 16-44			
8736	Reversing Starter Page 16-46			
8738	Reversing Combination Starter with Disconnect Switch Page 16-54			
8739	Reversing Combination Starter with Circuit Breaker			
8810	Two Speed Starter ▲			
8903	Type S Lighting Contactors Page 16-60 ▲			
8940	Pumping Plant Panel ▲			
8941	Duplex Controller Page 16-78 ▲			
<b>Design</b>				
Type S NEMA Contactors and Starters				
<b>NEMA Size</b>		<b>8903 (only)</b>		
A	Size 00			
B	Size 0	M	30 Amperes	
C	Size 1	P	60 Amperes	
D	Size 2	Q	100 Amperes	
E	Size 3	V	200 Amperes	
F	Size 4	X	300 Amperes	
G	Size 5	Y	400 Amperes	
H	Size 6	Z	600 Amperes	
J	Size 7	J	800 Amperes	
<b>Enclosure</b>				
A	NEMA 12 Industrial Use			
F	NEMA 1 Flush Mounting General Purpose			
G	<b>NEMA 1 General Purpose Surface Mounting</b>			
H	NEMA 3R Rainproof			
O	Open Style Device (no enclosure)			
R	NEMA 7 & 9 Hazardous Environments, Spin Top			
T	NEMA 7 & 9 Hazardous Environments, Bolted			
W	NEMA 4 Watertight, 4X Corrosion Resistant			
<b>Numerals</b>				
Used to designate specific, physical arrangements, such as number of poles, fuse clip size, etc.; but the numbering varies with Class of equipment. Consult Digest listings for specific device numbers.				
<b>Voltage Code</b>				
AC operated devices without control transformer				
Code	Voltage/Frequency			
V01	24/60			
V02	120/60 or 110/50			
V06	480/60 or 440/50			
V07	600/60 or 550/50			
V08	208/60			
V81 - 480V Primary, 120V Secondary for units using a fused transformer control circuit Form (F4T).				
This is only a partial listing consult Digest pages 16-14 and 16-101 for more information.				
<b>Common Forms (factory modifications) Page 16-100</b>				
A	"Start-Stop" pushbuttons in the enclosure cover			
B■	Bimetallic overload relays			
C	<b>"Hand-Off-Auto" selector switch in the enclosure cover</b>			
F4T	Fused transformer control circuit (primary fuses only)			
FF4T	Fused transformer control circuit (primary & secondary fuses)			
H	Solid state overload relay			
P1	Red ON pilot light in the enclosure cover			
P2	Green OFF pilot light in cover			
S	<b>Separate control circuit</b>			
X01	One "normally closed" auxiliary contact N.C.			
X10	One "normally open" auxiliary contact N.O.			
Consult Digest pages 16-100 to 16-104 for additional form letters. When more than one form is applied to a single device, arrange Forms in alphabetical order.				
▲ Combination two speed starters will replace the "S" with a "C", "U" or "D". Pumping plant panels have various leading characters. Not all use Type S contactors. Duplex controllers use "N", "C", "U", and "D".				
■ May also designate Motor Logic Plus overload relay				

**Table 16.33: How to Order**

To Order Specify:	Catalog Number			
• Class Number	Class	Type	Voltage Code	Form(s)
• Type Number				
• Voltage Code				
• Form(s) see pages 16-100-16-104	8539	SCG44	V06	AH20P1X11

Note: Description: NEMA Size 1, (10 Hp) Electronic Motor Circuit Protector (MCP) Combo Starter in a NEMA Type 1 enclosure with a 480V coil, start/stop pushbutton (A), class 20 SSOLR (H20), red pilot light (P1), 1 N.O. and 1 N.C. auxiliary contact (X11)

**IMPORTANT - This information is intended for general interpretation of catalog numbers. Do not use to create catalog numbers for this product line.**

Note: The terms Type and Form do not appear in the catalog number.

Devices are wired from factory according to customer preference as follows:

- Common control
- **Separate control (Form S)**
- Control power transformer (CPT)



Type SCO3  
Size 1, 3-Pole Starter

### General Information

Type S magnetic starters are used for full-voltage starting and stopping of AC squirrel cage motors. Motor overload protection is provided via melting alloy type thermal overload relays. Type S starters are available in NEMA Sizes 00 through 7, and are designed for operation at 600 Vac, 50 to 60 Hz.

### Solid State Overload Relay Protection (Motor Logic™)

These ambient insensitive overload relays are available on Sizes 00 through 6 and standard on size 7. They provide phase loss, phase unbalance protection. To order, add Form **H30** (for selectable trip class 10 or 20 protection). For more information about Motor Logic, see pages 16-83 and 16-102.

### New! Adapted Bimetal (NEMA Sizes 00–1)

The Adapted Bimetal motor starter consists of a specially designed adapter that attaches with bus bars to the NEMA Type S contactor and holds the LRD or LR3D (IEC Style) bimetal overload relay. This starter configuration can be ordered by adding Form E (adapter only) to the standard catalog number. Once the FLA of the motor has been determined, the LRD or LR3D bimetal overload can be purchased separately and installed in the field at a later date. For more information see Table 16.421.

### New! TeSys T Motor Management System (NEMA Sizes 1–6)

TeSys T is a flexible system that integrates seamlessly into your automation system through five major communication protocols. TeSys T can predict what will happen in the process, as it accurately monitors current, voltage, and power over a wide range. For additional information about TeSys T Motor Management System, see pages 16-84 to 16-88 and page 16-103.

### 3-Pole Polyphase—600 Vac Maximum—50–60 Hz

Note that prices shown do not include thermal units. Devices require 3 thermal units (Sizes 00–6). Standard trip thermal units are **\$21.50** each. See page 16-116 for selection information.

Table 16.40:

NEMA Size	Continuous Current Ratings	Motor Voltage	Max. Hp	Open Type		NEMA 1 General Purpose Enclosure		NEMA 4 & 4X Watertight, Dusttight Brushed Stainless Steel Enclosure (Size 0-5)▲		NEMA 4X Watertight, Dusttight, Corrosion-Resistant Glass-Polyester Enclosure	
				Type	\$ Price	Type	\$ Price	Type	\$ Price	Type	\$ Price
00	9	200 230 460 575	1-1/2 1-1/2 2 2	SAO12■	386.00	SAG12■	419.00	Use Size 0		Use Size 0	
0	18	200 230 460 575	3 3 5 5	SBO2■	485.00	SBG2■	518.00	SBW12■	1017.00	SBW22■	1017.00
1	27	200 230 460 575	7-1/2 7-1/2 10 10	SCO3■	557.00	SCG3■	590.00	SCW13■	1103.00	SCW23■	1103.00
2	45	200 230 460 575	10 15 25 25	SDO1■	1013.00	SDG1■	1160.00	SDW11■	2186.00	SDW21■	2186.00
3	90	200 230 460 575	25 30 50 50	SEO1■	1638.00	SEG1■	1929.00	SEW11■	3380.00	SEW21■	4226.00
4	135	200 230 460 575	40 50 100 100	SFO1■	3747.00	SFG1■	4350.00	SFW11■	6827.00	SFW21■	8535.00
5	270	200 230 460 575	75 100 200 200	SGO1■	9152.00	SGG1■	10254.00	SGW11■	15795.00	—	—
6	540	200 230 460 575	150 200 400 400	SHO2■	21756.00	SHG2■	28881.00	SHW2■	36003.00	—	—
7	810	200 230 460 575	— 300 600 600	SJO2■	31256.00	SJG2■	38381.00	SJW2■	45503.00	—	—

▲ Size 6 and 7 are rated NEMA 4 only, painted sheet steel.

■ Coil voltage code must be specified to order this product. Refer to standard coil voltage codes shown below.



Schneider Electric offers express shipping for factory modified NEMA Type 1 and Type 12/3R Enclosed Starters. When you need them fast, our Laser™ Delivery program is the answer to getting your product when you need it most. Ask for Laser™ Delivery, then select the product and the modifications you need when you place your order. It's as easy as that!

**2-Pole Single Phase—600 Vac Maximum—50–60 Hz**

**Table 16.43:**

Note that prices shown do not include thermal units. Devices require 1 thermal unit. Standard trip thermal units are **\$21.50** each. See page 16-116 for selection information.

NEMA Size	Continuous Current Ratings	Motor Voltage	Max. Hp	Open Type		NEMA 1 General Purpose Enclosure		NEMA 4 & 4X Watertight, Dusttight Brushed Stainless Steel Enclosure		NEMA 4X Watertight, Dusttight, Corrosion-Resistant Glass-Polyester Enclosure	
				Type	\$ Price	Type	\$ Price	Type	\$ Price	Type	\$ Price
00	9	115 230	1/3 1	SAO11▲	386.00	SAG11▲	419.00	Use Size 0		Use Size 0	
0	18	115 230	1 2	SBO1▲	435.00	SBG1▲	468.00	SBW11▲	966.00	SBW21▲	966.00
1	27	115 230	2 3	SCO1▲	507.00	SCG1▲	539.00	SCW11▲	1052.00	SCW21▲	1052.00
1P	36	115 230	3 5	SCO2▲	662.00	SCG2▲	696.00	SCW12▲	1209.00	SCW22▲	1209.00
2	45	115 230	3 7-1/2	SDO6▲	918.00	SDG6▲	1067.00	SDW16▲	2091.00	SDW26▲	2091.00

**4-Pole, 2-Phase—600 Vac Maximum—50–60 Hz**

**Table 16.44:**

Note that prices shown do not include thermal units. Devices require 2 thermal units. Standard trip thermal units are **\$21.50** each. See page 16-116 for selection information.

NEMA Size	Continuous Current Ratings	Motor Voltage	Max. Hp	Open Type		NEMA 1 General Purpose Enclosure		NEMA 4 & 4X Watertight, Dusttight Brushed Stainless Steel Enclosure		NEMA 4X Watertight, Dusttight, Corrosion-Resistant Glass-Polyester Enclosure	
				Type	\$ Price	Type	\$ Price	Type	\$ Price	Type	\$ Price
0	18	200 230 460 575	3 3 5 5	SBO3▲	629.00	SBG3▲	675.00	SBW13▲	1229.00	SBW23▲	1229.00
1	27	200 230 460 575	7-1/2 7-1/2 10 10	SCO4▲	714.00	SCG4▲	761.00	SCW14▲	1301.00	SCW24▲	1301.00
2	45	200 230 460 575	10 15 25 25	SDO2▲	1283.00	SDG2▲	1430.00	SDW12▲	2910.00	SDW22▲	2910.00
3	90	200 230 460 575	25 30 50 50	SEO2▲	2096.00	SEG2▲	2357.00	SEW12▲	4206.00	Consult Schneider Electric CCC at (1-888-778-2733)	
4	135	200 230 460 575	40 50 100 100	SFO2▲	5142.00	SFG2▲	5715.00	SFW12▲	9221.00		

▲ Coil voltage code must be specified to order this product. Refer to standard coil voltage codes listed below.

**Table 16.45: Coil Voltage Codes**

Voltage		Code	\$ Price Adder
60 Hz	50 Hz		
24■	—	V01	No Charge
120◆	110	V02	No Charge
208	—	V08	No Charge
240	220	V03	No Charge
277	—	V04	No Charge
480	440	V06	No Charge
600	550	V07	No Charge
Specify	Specify	V99	35.60

■ 24 V coils are not available on Sizes 4–7. On sizes 00–3, where 24 V coils are available, **Form S** (separate control) must be specified (i.e., order as 8536SBO2V01S).

◆ 120 Volt Polyphase starters are wired for separate control. **Form S** (separate control) must be specified (i.e., order as 8536SCO2V02S).

Note: For voltage codes used with control transformers, see 16-101.

Form S (separate control) is used when a separate source of power is available for the control (coil) voltage. Form S is supplied at no charge.

- Dimensions . . . . . page 16-24
- Factory Modifications (Forms) . . . . . page 16-100
- Separate Enclosures (Class 9991) . . . . . page 16-93
- Replacement Parts (Class 9998) . . . . . page 16-105
- Type S Accessories (Class 9999) . . . . . page 16-108

For How to Order Information, see page 16-13.



**Class 8536 Starter  
Designation: EF-1  
8536SAG11V02S**

Class 8502, 8536 / Refer to Catalog 8502CT9701

**Application Data for Selection**

**Table 16.51:**

NEMA Size	Load Voltage	Maximum Hp Rating—Nonplugging and Nonjogging Duty		Maximum Hp Rating—Plugging and Jogging Duty		Continuous Current Rating, (A) 600 Volt Max.	Service—Limit Current Rating, (A)	Tungsten and Infrared Lamp Load, (A) 250 Volts Max.	Resistance Heating Loads, KW—other than Infrared Lamp Loads *		KVA Rating for Switching Transformer Primaries at 50 or 60 Cycles				3Ø Rating for Switching Capacitors KVAR
		Single Phase	Poly-Phase	Single Phase	Poly-Phase				Single Phase	Poly-Phase	Inrush Currents (Worst Case Peak) ? 20 Times Peak of Continuous Current Rating		Inrush Currents (Worst Case Peak) > 20–40 Times Peak of Continuous Current Rating		
											Single Phase	Poly-Phase	Single Phase	Poly-Phase	
00	115	1/2	—	—	—	9	11	5	—	—	—	—	—	—	—
	200	—	1-1/2	—	—	9	11	5	—	—	—	—	—	—	—
	230	1	1-1/2	—	—	9	11	5	—	—	—	—	—	—	—
	380	—	1-1/2	—	—	9	11	—	—	—	—	—	—	—	—
	460	—	2	—	—	9	11	—	—	—	—	—	—	—	—
575	—	2	—	—	9	11	—	—	—	—	—	—	—	—	—
0	115	1	—	1/2	—	18	21	10	—	—	0.6	—	0.3	—	—
	200	—	3	—	1-1/2	18	21	10	—	—	—	1.8	—	0.9	—
	230	2	3	1	1-1/2	18	21	10	—	—	1.2	2.1	0.6	1.0	—
	380	—	5	—	1-1/2	18	21	—	—	—	—	—	—	—	—
	460	—	5	—	2	18	21	—	—	—	2.4	4.2	1.2	2.1	—
575	—	5	—	2	18	21	—	—	—	3.0	5.2	1.5	2.6	—	
1	115	2	—	1	—	27	32	15	3	5	1.2	—	0.6	—	—
	200	—	7-1/2	—	3	27	32	15	—	9.1	—	3.6	—	1.8	—
	230	3	7-1/2	2	3	27	32	15	6	10	2.4	4.3	1.2	2.1	—
	380	—	10	—	5	27	32	—	—	16.5	—	—	—	—	—
	460	—	10	—	5	27	32	—	12	20	4.9	8.5	2.5	4.3	—
575	—	10	—	5	27	32	—	15	25	6.2	11.0	3.1	5.3	—	
1P	115	3	—	1-1/2	—	36	42	24	—	—	—	—	—	—	—
	230	5	—	3	—	36	42	24	—	—	—	—	—	—	—
2	115	3	—	2	—	45	52	30	5	8.5	2.1	—	1.0	—	—
	200	—	10	—	7-1/2	45	52	30	—	15.4	—	6.3	—	3.1	—
	230	7-1/2	15	5	10	45	52	30	10	17	4.1	7.2	2.1	3.6	8
	380	—	25	—	15	45	52	—	—	28	—	—	—	—	—
	460	—	25	—	15	45	52	—	20	34	8.3	14	4.2	7.2	16
575	—	25	—	15	45	52	—	25	43	10.0	18	5.2	8.9	20	
3	115	—	—	—	—	90	104	60	10	17	4.1	—	2.0	—	—
	200	—	25	—	15	90	104	60	—	31	—	12	—	6.1	—
	230	—	30	—	20	90	104	60	20	34	8.1	14	4.1	7.0	27
	380	—	50	—	30	90	104	—	—	56	—	—	—	—	—
	460	—	50	—	30	90	104	—	40	68	16	28	8.1	14	53
575	—	50	—	30	90	104	—	50	86	20	35	10	18	67	
4	200	—	40	—	25	135	156	120	—	45	—	20	—	10	—
	230	—	50	—	30	135	156	120	30	52	14	23	6.8	12	40
	380	—	75	—	50	135	156	—	—	86.7	—	—	—	—	—
	460	—	100	—	60	135	156	—	60	105	27	47	14	23	80
	575	—	100	—	60	135	156	—	75	130	34	59	17	29	100
5	200	—	75	—	60	270	311	240	—	91	—	41	—	20	—
	230	—	100	—	75	270	311	240	60	105	27	47	14	24	80
	380	—	150	—	125	270	311	—	—	173	—	—	—	—	—
	460	—	200	—	150	270	311	—	120	210	54	94	27	47	160
	575	—	200	—	150	270	311	—	150	260	68	117	34	59	200
6Δ	200	—	150	—	125	540	621	480	—	182	—	81	—	41	—
	230	—	200	—	150	540	621	480	120	210	54	94	27	47	160
	380	—	300	—	250	540	621	—	—	342	—	—	—	—	—
	460	—	400	—	300	540	621	—	240	415	108	188	54	94	320
	575	—	400	—	300	540	621	—	300	515	135	234	68	117	400
7Δ	230	—	300	—	—	810	932	—	180	315	—	—	—	—	240
	460	—	600	—	—	810	932	—	360	625	—	—	—	—	480
	575	—	600	—	—	810	932	—	450	775	—	—	—	—	600

Tables and footnotes are taken from NEMA Standards.

The ratings for capacitor switching above assume the following maximum available fault currents:

- ▲ Ratings shown are for applications requiring repeated interruptions of stalled motor current or repeated closing of high transient currents encountered in rapid motor reversal, involving more than five openings or closings per minute and more than ten in a ten-minute period, such as plug-stop, plug-reverse or jogging duty. Ratings apply to single speed and multi-speed controllers.
- Per NEMA Standards paragraph ICS 2-321.20, the service-limit current represents the maximum rms current, in Amperes, which the controller may be expected to carry for protracted periods in normal service. At service-limit current ratings, temperature rises may exceed those obtained by testing the controller at its continuous current rating. The ultimate trip current of over-current (overload) relays or other motor protective devices shall not exceed the service-limit current ratings of the controller.
- ◆ FLUORESCENT LAMP LOADS—300 VOLTS AND LESS—The characteristics of fluorescent lamps are such that it is not necessary to derate Class 8502 contactors below their normal continuous current rating. Class 8903 contactors may also be used with fluorescent lamp loads. For controlling tungsten and infrared lamp loads, and resistance heating loads, Class 8903 AC lighting contactors are recommended. These contactors are specifically designed for such loads and are applied at their full rating as listed in the Class 8903 Section.
- ★ Ratings apply to contactors which are employed to switch the load at the utilization voltage of the heat producing element with a duty which requires continuous operation of not more than five openings per minute. Class 8903 Types L and S lighting contactors are rated for resistance heating loads.
- ▼ When discharged, a capacitor has essentially zero impedance. For repetitive switching by a contactor, sufficient impedance should be connected in series to limit inrush current to not more than 6 times the contactor rated continuous current. In many installations, the impedance of connecting conductors may be sufficient for this purpose. When switching to connect additional banks, the banks already on the line may be charged and can supply additional available short-circuit current which should be considered when selecting the impedance to limit the current.

- NEMA Size 00–3: 5,000 A RMS Sym.
  - NEMA Size 4–5: 10,000 A RMS Sym.
  - NEMA Size 6: 18,000 A RMS Sym.
  - NEMA Size 7: 30,000 A RMS Sym.
- Note: If available fault current is greater than these values, connect sufficient impedance in series as noted in the previous paragraph.

▲ For NEMA Size 6 & 7, the operation rate is as follows: Continuous operation rate is 3 operations per minute maximum; Jogging or Plugging Duty operation rate is 15 operations per minute for a maximum of three minutes.

The motor ratings in Table 16.51 are NEMA standard ratings and apply only when the code letter of the motor is the same as or occurs earlier in the alphabet than is shown in the Table 16.52. Motors having code letters occurring later in the alphabet may require a larger controller. Consult Schneider Electric CCC at (1-888-778-2733).

**Table 16.52:**

Motor Hp Rating	Maximum Allowable Motor Code Letter
1-1/2-2	L K H
3-5	
7-1/2 and above	

Approximate Dimensions

Table 16.53: Dimensions for Class 8502 Open Type

NEMA Size	Type	No. of Poles	Fig. No.	Dimensions—Inches (Refer to Appropriate Figure)										Wt (lb)
				A	B	C	D	E	F	G	H	I		
				IN	IN	IN	IN	IN	IN	IN	IN	IN		
00	SAO	2-3	1	3-7/32	4-11/32	4-7/32	1-5/8	1-5/8	7/32	3-15/16	—	—	4	
0	SBO	1-3	1	3-7/32	4-11/32	4-7/32	1-5/8	1-5/8	7/32	3-15/16	—	—	4	
1	SCO	4-5		4-1/4	4-11/32	4-7/32	1-5/8	2-5/8	7/32	3-15/16	—	—	4-1/2	
2	SDO	2-3	1	4-5/16	5-1/8	4-15/16	2-5/32	2-5/32	7/32	4-19/32	17/32	1-1/16	6-3/4	
		4-5		5-5/8	5-1/8	4-15/16	2-5/32	3-15/32	7/32	4-19/32	17/32	1-1/16	8-1/4	
3	SEO	2-3	1	5-15/32	7-3/32	6-1/2	1-7/8	3-17/32	5/16	6-1/32	3-1/4	4-3/4	14	
		4-5		9-3/4	7-7/8	6-1/2	3-15/16	5-13/16	5/16	7	4-17/32	9-1/16	22	
4	SFO	2-3	1	6	8-3/16	6-1/2	2-1/16	3-15/16	5/16	7	3-19/32	5-5/16	18	
		4-5		9-3/4	8-3/16	6-1/2	3-15/16	5-13/16	5/16	7	4-17/32	9-1/16	22	
5	SGO	2-3	1	8-2/3	12-5/16	8-3/4	3-1/4	5-13/16	5/8	11-1/8	4-3/4	7-1/4	45	
6	SHO	2-3	1	10-35/64	28-1/16	9	3-17/32	7-1/32	5-1/16	18-9/16	4-3/4	7-1/4	80	
7	SJO	2-3	1	10-35/64	37-1/4	10-7/8	3-17/32	7-1/32	7-7/32	22-3/8	4-3/4	7-1/4	135	

Table 16.54: Dimensions for 8536 Open Type

NEMA Size	Type	No. of Poles	Fig. No.	Dimensions—Inches (Refer to Appropriate Figure)										Wt (lb)
				A	B	C	D	E	F	G	H	I		
				IN	IN	IN	IN	IN	IN	IN	IN	IN		
00, 0, 1, 1P	SAO-SCO	2-3	2	3-1/2	6-49/64	4-7/32	1/2	1	1-39/64	13/64	6-1/4	3-31/32	5	
0, 1	SBO-SCO	4	2	4-17/32	6-49/64	4-7/32	1/2	1	2-2/3	13/64	6-1/4	3-31/32	5-1/2	
2	SDO	2-3	2	4-5/16	7-13/16	4-15/16	1/2	1	2-5/32	13/64	7-11/32	4-1/16	7-3/4	
				4	5-5/8	7-13/16	4-15/16	1/2	1	3-15/32	13/64	7-11/32	4-1/16	9-1/4
3	SEO	2-3	2	5-15/32	11-3/32	6-1/2	7/8	1-3/4	3-19/32	5/16	10-3/16	5-3/4	17	
				4	9-3/4	12-1/8	6-1/2	1-13/16	1-3/4	5-13/16	5/16	11-3/16	5-3/4	25
4	SFO	3	2	6	12-7/8	6-1/2	1-13/16	1-3/4	3-15/16	5/16	11-3/16	5-3/4	22	
				4	9-3/4	12-7/8	6-1/2	1-13/16	1-3/4	5-29/32	5/16	11-3/16	5-3/4	25
5	SGO	3	2	8-9/16	17-9/16	8-3/4	4-3/4	7-1/4	5-12/32	5/8	16-3/8	6	62	
6	SHO	3	2	12-11/32	28-1/16	9	4-3/4	7-1/4	5-25/32	5-1/16	18-9/16	8-11/16	85	
7	SJO	3	2	12-11/32	37-1/4	10-7/8	4-3/4	7-1/4	5-25/32	7-7/32	22-3/8	9	140	

Table 16.55: Dimensions for NEMA 1 General Purpose Enclosure

NEMA Size	Type	No. of Poles	Fig. No.	Dimensions—Inches												
				A	B	C		D	E	F	G	H	I	J	K	L
						8502	8536									
00	SAG	All	3	6	10	5-9/32	5-9/16	—	7/8	8-1/8	1	15/16	4-1/8	5	—	—
0	SBG	All	3													
1	SCG	All	3													
2	SDG	All	3	7-13/16	12-11/16	6-1/32	6-5/16	—	1-3/32	10-1/2	1-3/32	1-3/32	5-5/8	5-3/4	1-3/32	5-5/8
3	SEG	All	3	11-7/16	21-13/16	8	8-3/8	—	1-17/32	18-3/4	1-17/32	1-17/32	8-3/8	7-3/4	1-17/32	8-3/8
4	SFG	All	5	11-1/4	25-5/32	9	9	8-19/32	1-1/4	1-1/4	22-5/16	1-7/16	7/16	—	—	—
5	SGG	All	5	17-7/32	44-7/32	12-13/16	12-15/16	13	2-1/8	2-1/8	40	2-1/8	9/16	—	—	—
6	SHG	All	4	65-3/4	20-7/32	13-1/8	13-1/8	—	11	64-1/2	2-5/16	5-1/2	—	—	—	—
7	SJG	All	4	93	34-1/2	23-1/2	23-1/2	Floor Mounting								

Class 8536 Starter  
Designation: EF-1  
8536SAG11V02S

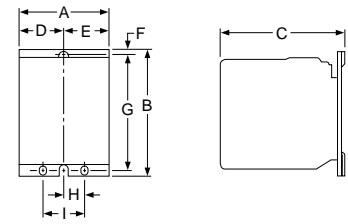


Figure 1  
Class 8502

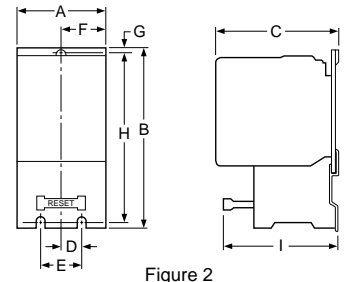


Figure 2  
Class 8536

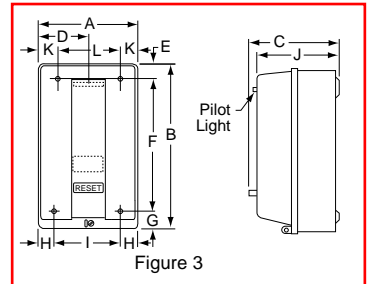


Figure 3

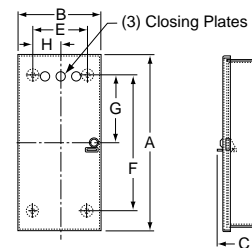


Figure 4

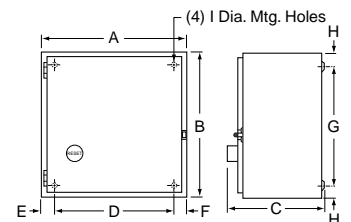


Figure 5

**For Full Voltage Contactors and Starters**

**Table 16.263: Full Voltage Controllers Only**

Classes 8502, 8536, 8538, 8539, 8702, 8736, 8738, 8739, 8810, 8811 and 8812													
Factory Modifications	Enclosure Type	Form	NEMA SIZE										
			00	0	1	2	3	4	5	6	7		
Separate Control Circuit— (specify voltage and frequency)	Any	S▲		No Charge	No Charge	No Charge	No Charge	No Charge	No Charge	No Charge	No Charge	No Charge	
Fused Control Circuit (without control transformer)													
One fuse	1, 3R, 4, 4X, 12	F	314.00	314.00	314.00	314.00	314.00	314.00	314.00	314.00	—	—	
Two fuses	1, 3R, 4, 4X, 7, 9, 12	F4	314.00	314.00	314.00	314.00	314.00	314.00	314.00	314.00	—	—	
<b>Control Circuit Transformers — Standard capacity (50 or 60 Hz) Note: All orders requesting Form FT will be supplied as Form F4T.</b>													
<b>FUSES</b>													
	Primary	Secondary											
CONTROL CIRCUIT Full Voltage and Multi-Speed Controllers Only Classes 8502 8536 8538 8539 8702 8736 8738 8739 8810 8811 8812	2	1	1, 4, 4X, 12	FF4T	698.00	698.00	698.00	855.00	1112.00	1283.00	1412.00 ♦	1412.00	1412.00
	2	1	7 & 9	FF4T	755.00	755.00	755.00	1053.00	1353.00	1640.00	1839.00 ♦	1839.00	1839.00
	2	2	1, 4, 4X, 12	F4F10T	698.00	698.00	698.00	855.00	1112.00	1283.00	1412.00 ♦	—	—
	<b>Additional Capacity (50 or 60 Hz)</b>												
	Two fuses in primary and one fuse in secondary												
	100 VA additional capacity	1, 4, 4X, 12		FF4T11	998.00	998.00	998.00	1197.00	1425.00	1566.00 ♦	1710.00 ♦	1710.00	1710.00
	100 VA additional capacity	7 & 9		FF4T11	1053.00	1053.00	1053.00	1395.00	1668.00	1925.00 ♦	2138.00 ♦	—	—
	200 VA additional capacity	1, 4, 4X, 12		FF4T12	1241.00	1241.00	1241.00	1467.00	1695.00 ♦	1839.00 ♦	1839.00 ♦	1839.00	1839.00
	300 VA additional capacity	1, 4, 4X, 12		FF4T13	1481.00	1481.00 ♦	1481.00 ♦	1737.00 ♦	1967.00 ♦	2109.00 ♦	2109.00 ♦	2109.00	2109.00
	400 VA additional capacity	1, 4, 4X, 12		FF4T14	1967.00	1967.00 ♦	1967.00 ♦	2280.00 ♦	2507.00 ♦	2793.00 ♦	2793.00 ♦	2793.00 ♦	2793.00 ♦
	500 VA additional capacity	1, 4, 4X, 12		FF4T15	2250.00	2250.00 ♦	2250.00 ♦	2564.00 ♦	2793.00 ♦	3077.00 ♦	3077.00 ♦	3077.00 ♦	3077.00 ♦

- ▲ All combination style devices such as 8538, 8539, 8738, 8739, that use Form S should also use Form Y74 (auxiliary contact installed on disconnect switch) per NEC Article 430-74.
- Table 16.266 at right.
- ♦ Single primary voltage must be specified.

**Table 16.264: Marine Control**

Class	Factory Modification	Enclosure Type	Form	\$ Price
8502 8536 8538 8539 8702 8736 8738 8739 8810 8841	Modification of standard device for use as marine control per UL508	12/3R 4/4X (S.S. only)	M10	See Below

**Table 16.265:**

Form	NEMA Size★							
	00▼	0▼	1	2	3	6		
M10	—	—	338.00	450.00	720.00	1260.00	3015.00	4725.00

- ★ Not available for NEMA Size 7.
- ▼ Cannot be used with Marine controls.

**■ Selection of Control Circuit Transformers**

The standard primary/secondary voltages for control circuit transformers are indicated in the following table.

**Table 16.266:**

AC-OPERATED DEVICES With Control Transformers	
Voltage	Code
60 Hz (Primary-Secondary)	
120-12Δ	V88
120-24Δ	V89
208-120	V84
240-24Δ	V82
240-120	V80
277-120	V85
480-24Δ	V83
480-120	V81
480-240	V87
600-120	V86
Specify	V99

- Δ 12 V coils are not available on Sizes 3-7.
- 24 V coils are not available on Sizes 4-7.

To order, select the desired device with the appropriate transformer Form designation. Then convert the previously selected voltage code (V●●) to reflect the desired primary/secondary voltage for the transformer. The secondary voltage should equal the previously selected coil voltage of the device.

**Example:**

You have previously selected a Class 8536SDG1V02S. V02S means that you need a coil voltage of 120-60/110-50 wired for separate control. You would like to add Form FF4T with the transformer voltages being 480 volt primary, 120 volt secondary with Solid State Overload Relay Protection Class 20 Trip Class (H20).

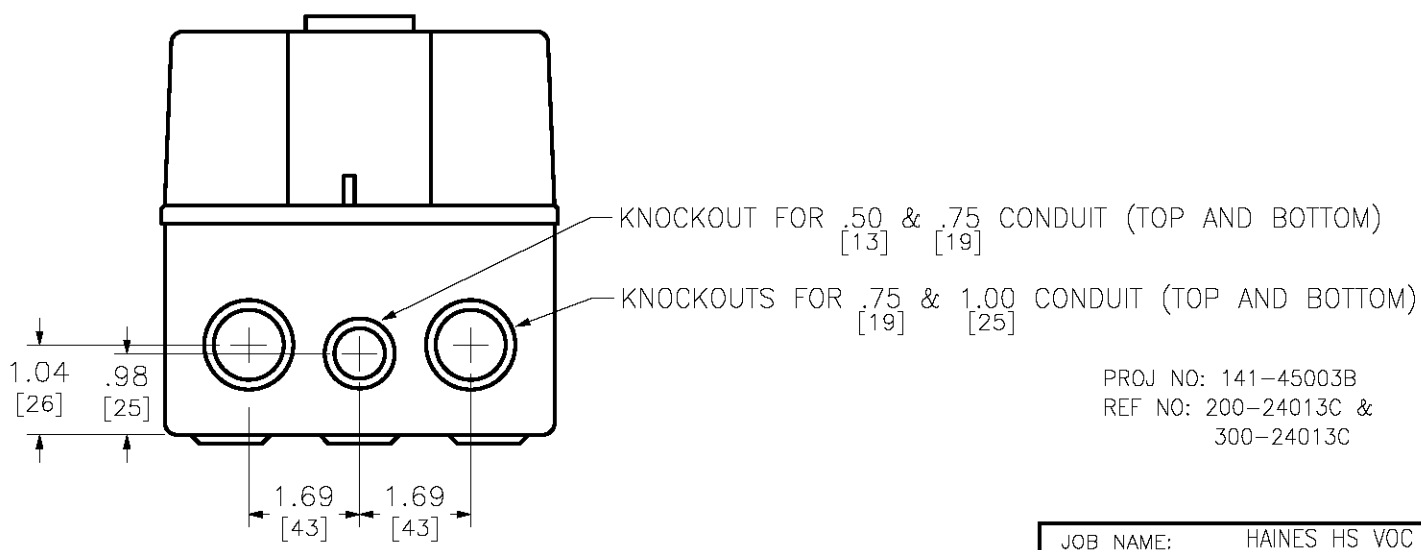
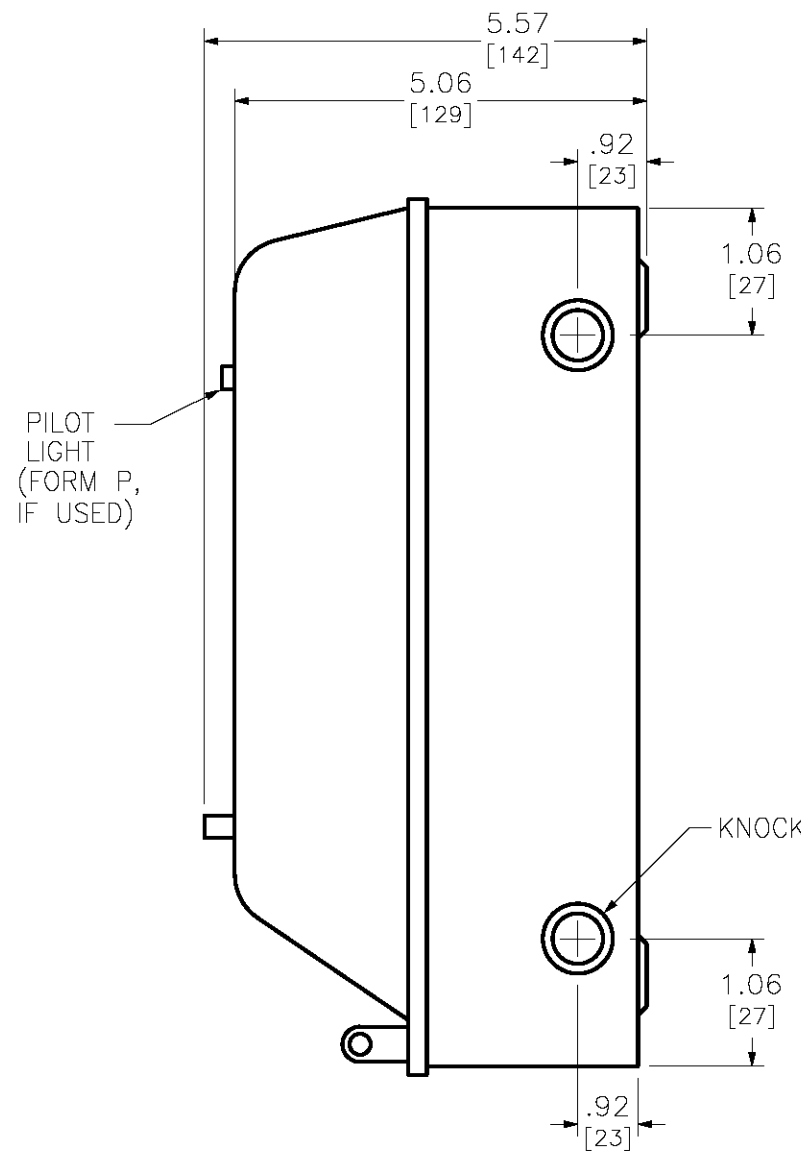
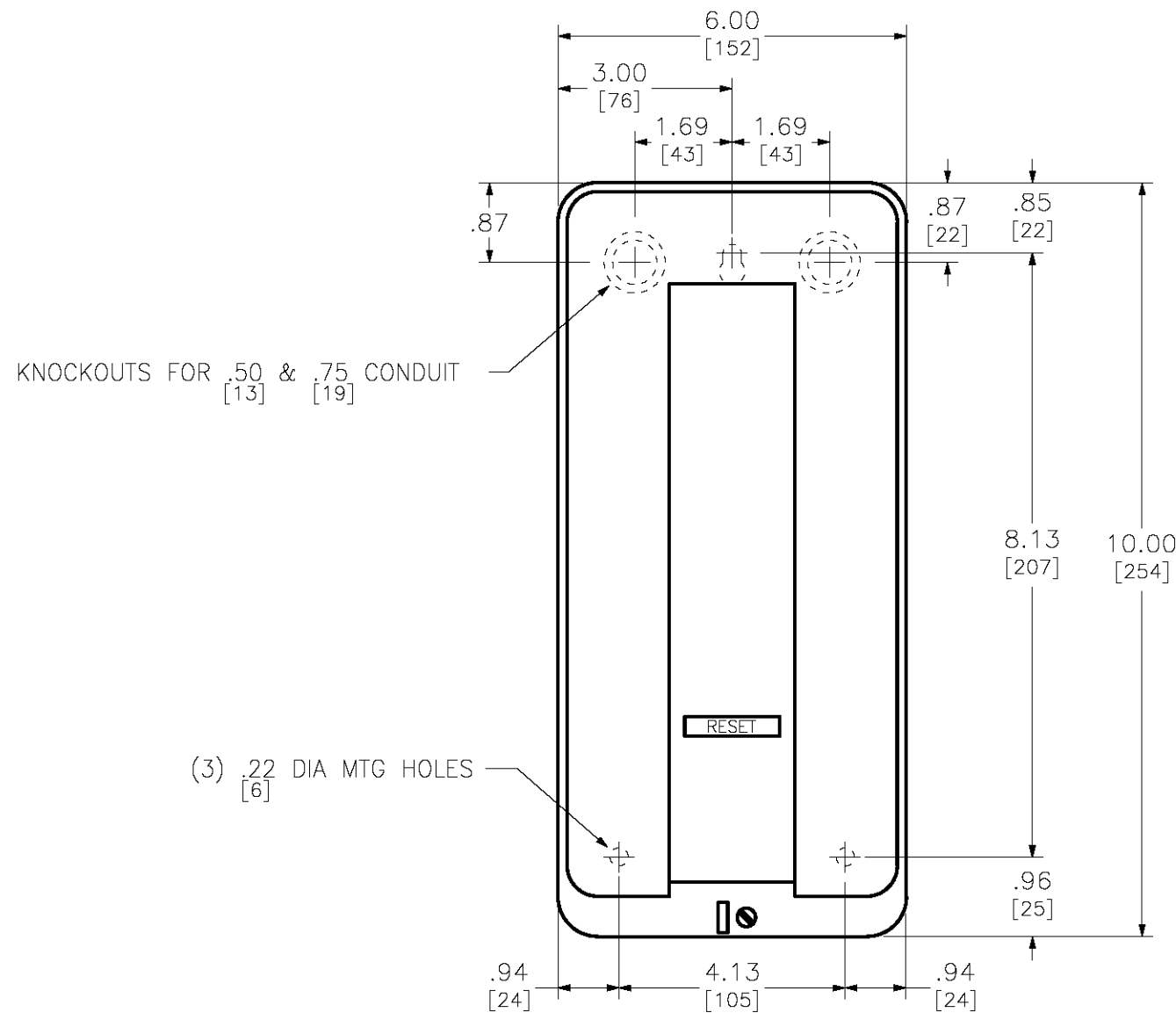
The new and complete class, type, voltage code and form number will be:

Class            Type            Voltage Code            Form □  
8536            SDG1            V81            FF4H20T

- Form numbers should always be shown in alphabetical order. Each letter indicates the beginning of a new form and may be followed by one or more numbers.

REV	DESCRIPTION	BY	DATE						
-	-	-	-	-	-	-	-	-	-

CLASS 8502/8536 MAGNETIC CONTACTORS AND STARTERS  
NEMA TYPE 1 GENERAL PURPOSE ENCLOSURE



**Class 8536 Starter**  
**Designation: EF-2, EF-3**  
**8536SBG2V02H31S**

DUAL DIMENSIONS: INCHES  
MILLIMETERS

NEMA SIZE	CLASS	TYPE	NO. OF POLES	FORMS
00	8502 & 8536	SAG	2-3	STD,A,C,P,S,X
0 & 1	8502 & 8536	SBG SCG	1-5	STD,A,B,C,P,S,X

PROJ NO: 141-45003B  
REF NO: 200-24013C &  
300-24013C

NOT TO SCALE

JOB NAME:	HAINES HS VOC TECH BLDG	EQUIPMENT DESIGNATION:	<b>EF-2, EF-3</b>
JOB LOCATION:	HAINES AK	EQUIPMENT TYPE:	
DRAWN BY:	(Q2C)	DRAWING TYPE:	
ENGR:			
DATE:	May 06 2015		
DRAWING STATUS:	QUOTE	DWG#	<b>F36582663-01</b>
		PG	<b>1</b> OF <b>1</b> REV -

Class 8536 Starter  
Designation: EF-2, EF-3  
8536SBG2V02H31S

NEMA Contactors and Starters



Manual Starters and Switches (p. 16-4)



Definite Purpose Contactors and Starters (p. 16-70)



NEMA Style Type S Contactors and Starters (p. 16-14)



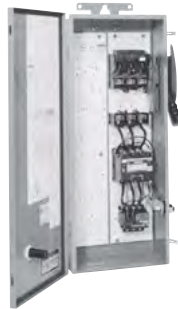
Lighting Contactors (p. 16-59)



Pump Panel (p. 16-75)



Combination Starters (p. 16-31)



NEMA Style TeSys N Contactors and Starters (p. 16-139)



NEMA AC Magnetic Contactors and Starters  
Catalog Numbering System

16-13

Combination Starters—NEMA Style

Non-Reversing	
Non-Fusible Disconnect Class 8538	16-32, 16-34
Fusible Disconnect Class 8538	16-31, 16-33, 16-34
Electronic Motor Circuit Protector (MCP) Class 8539	16-35, 16-36, 16-37
Thermal Magnetic Circuit Breaker Class 8539	16-38, 16-39
Reversing	
Non-Fusible Disconnect Class 8738	16-52
Fusible Disconnect Class 8738, 8739	16-51, 16-52
Electronic Motor Circuit Protector (MCP) Class 8739	16-53
Thermal Magnetic Circuit Breaker Class 8739	16-55

Contactors—NEMA Style

Non-Reversing Class 8502	16-14
Reversing Class 8702	16-44
Vacuum, Low Voltage, Non-Reversing Class 8502	16-28
Vacuum, Low Voltage, Reversing Class 8702	16-50

Definite Purpose Contactors and Starters

Class 8910, 8965 16-70

Duplex Motor Starters Class 8941

16-78

Enclosures Class 9991

16-93

External Reset Mechanisms Class 9065

16-92

Factory Modifications (Forms)

16-100

Lighting Contactors Class 8903

16-59

Panel Board (PB) Lighting Contactors

See Supplemental Digest

Manual Starters and Switches Class 2510, 2511, 2512

16-4

Multispeed Starters Class 8810

See Supplemental Digest

Overload Relays

Bimetallic Class 9065	16-89
Melting Alloy Class 9065	16-82
Motor Logic/Motor Logic Plus Class 9065	16-83
TeSys T Motor Management System	16-84

Pump Panels

Full Voltage Class 8940	16-75
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Reduced Voltage Starters

Electro-Mechanical Class 8600

See Supplemental Digest

Starters, Full Voltage—NEMA Style

Non-Reversing Class 8536	16-18
Reversing Class 8736	16-46
TeSys U Simple Motor Starter	16-12
Vacuum, Low Voltage, Non-Reversing Class 8536	16-29

Additional Products

Accessories Class 9998, 9999	16-108
Renewal Parts Class 9998	16-105
Thermal Units	16-116
Reversing Drum Switches Class 2601	See Supplemental Digest

New! TeSys N Contactors and Starters

16-139



**Class 8536 Starter**  
**Designation: EF-2, EF-3**  
**8536SBG2V02H31S**



Class	2510, 2511, 2512	8502 & 8702	8536 & 8736	8538 & 8738	8539 & 8739
	Manual Starters and Switches, Non-Reversing, Reversing and Two Speed	NEMA Style Full Voltage Non-Reversing and Full Voltage Reversing Magnetic Contactors	NEMA Style Full Voltage Non-Reversing and Full Voltage Reversing Magnetic Starters	NEMA Style Full Voltage Non-Reversing and Full Voltage Reversing Combination (Disconnect Switch) Magnetic Starters	NEMA Style Full Voltage Non-Reversing and Full Voltage Reversing Combination (PowerPact™ Circuit Breaker) Magnetic Starters
Page	16-4	8502 16-14	8536 16-18	8538 16-31	8539 16-35
		8702 16-44	8736 16-46	8738 16-51	8739 16-53
NEMA Sizes	Type F = N/A	00 to 7	00 to 7	8538 = 0 to 6	8539 = 0 to 7
	Type K = N/A			8738 = 0 to 5	8739 = 0 to 6
	Type M = 0 & 1				
Load Voltage	Type F = 277 V	600 Vac Max.	600 Vac Max.	600 Vac Max.	600 Vac Max.
	Types K & M = 600 Vac				
Current Ratings (Continuous)	Type F = 16 A	9A to 810 A	9 A to 810 A	8538 = 18 A to 540 A	8539 = 18 A to 810 A
	Types K & M = 30 A			8738 = 18 A to 270 A	8739 = 18 A to 540 A
Horsepower Ratings (Maximum)	Type F = 1	1/2 to 600	1/2 to 600	8538 = 1/2 to 400	8539 = 1/2 to 600
	Type K = 20			8738 = 1/2 to 200	8739 = 1/2 to 400
	Type M = 10				
Overload Relay	Type F = Melting Alloy	N/A	Melting Alloy	Melting Alloy	Melting Alloy
	Type K = N/A		Bi-Metallic	Bi-Metallic	Bi-Metallic
	Type M = Melting Alloy		Solid State	Solid State	Solid State
Enclosure Types	1, Flush Mount, 3R, 4, 4X, 7 & 9 and Open	1, 3R, 4, 4X, 12/3R, 7 & 9 and Open	1, 3R, 4, 4X, 12/3R, 7 & 9 and Open	1, 4, 4X, 12/3R	1, 4, 4X, 12/3R
Approvals	UL File E42243 NLRV	UL File E78351 NLDX	UL File E78351 NLDX	UL File E152395 NKJH7	UL File E152395 NKJH7
	UR File E42243 NLRV2	CSA 60905 Class 3211-04	CSA 60905 Class 3211-04	CSA LR584 Class 3211 04	CSA LR584 Class 3211 04
	CSA File LR 25490	CE IEC 947-4-1 Sizes 00-5 Only	CE IEC 947-4-1 Sizes 00-5 Only		







Type SCO3  
Size 1, 3-Pole Starter

**General Information**

Type S magnetic starters are used for full-voltage starting and stopping of AC squirrel cage motors. Motor overload protection is provided via melting alloy type thermal overload relays. Type S starters are available in NEMA Sizes 00 through 7, and are designed for operation at 600 Vac, 50 to 60 Hz.

**Solid State Overload Relay Protection (Motor Logic™)**

These ambient insensitive overload relays are available on Sizes 00 through 6 and standard on size 7. They provide phase loss, phase unbalance protection. To order, add Form **H30** (for selectable trip class 10 or 20 protection). For more information about Motor Logic, see pages 16-83 and 16-102.

**Adapted Bimetal (NEMA Sizes 00–1)**

The Adapted Bimetal motor starter consists of a specially designed adapter that attaches with bus bars to the NEMA Type S contactor and holds the LRD or LR3D (IEC Style) bimetal overload relay. This starter configuration can be ordered by adding Form E (adapter only) to the standard catalog number. Once the FLA of the motor has been determined, the LRD or LR3D bimetal overload can be purchased separately and installed in the field at a later date. For more information see Table 16.421.

**TeSys T Motor Management System (NEMA Sizes 1–6)**

TeSys T is a flexible system that integrates seamlessly into your automation system through five major communication protocols. TeSys T can predict what will happen in the process, as it accurately monitors current, voltage, and power over a wide range. For additional information about TeSys T Motor Management System, see pages 16-84 to 16-88 and page 16-103.

**3-Pole Polyphase—600 Vac Maximum—50–60 Hz**

Note that prices shown do not include thermal units. Devices require 3 thermal units (Sizes 00–6). Standard trip thermal units are **\$21.50** each. See page 16-116 for selection information.

**Table 16.40:**

NEMA Size	Continuous Current Ratings	Motor Voltage	Max. Hp	Open Type		NEMA 1 General Purpose Enclosure		NEMA 4 & 4X Watertight, Dusttight Brushed Stainless Steel Enclosure (Size 0-5)▲		NEMA 4X Watertight, Dusttight, Corrosion-Resistant Glass-Polyester Enclosure	
				Type	\$ Price	Type	\$ Price	Type	\$ Price	Type	\$ Price
00	9	200 230 460 575	1-1/2 1-1/2 2 2	SAO12■	386.00	SAG12■	419.00	Use Size 0		Use Size 0	
0	18	200 230 460 575	3 3 5 5	SBO2■	485.00	SBG2■	518.00	SBW12■	1017.00	SBW22■	1017.00
1	27	200 230 460 575	7-1/2 7-1/2 10 10	SCO3■	557.00	SCG3■	590.00	SCW13■	1103.00	SCW23■	1103.00
2	45	200 230 460 575	10 15 25 25	SDO1■	1013.00	SDG1■	1160.00	SDW11■	2186.00	SDW21■	2186.00
3	90	200 230 460 575	25 30 50 50	SEO1■	1638.00	SEG1■	1929.00	SEW11■	3380.00	SEW21■	4226.00
4	135	200 230 460 575	40 50 100 100	SFO1■	3747.00	SFG1■	4350.00	SFW11■	6827.00	SFW21■	8535.00
5	270	200 230 460 575	75 100 200 200	SGO1■	9152.00	SGG1■	10254.00	SGW11■	15795.00	—	—
6	540	200 230 460 575	150 200 400 400	SHO2■	21756.00	SHG2■	28881.00	SHW2■	36003.00	—	—
7	810	200 230 460 575	— 300 600 600	SJO2■	31256.00	SJG2■	38381.00	SJW2■	45503.00	—	—

▲ Size 6 and 7 are rated NEMA 4 only, painted sheet steel.  
■ Coil voltage code must be specified to order this product. Refer to standard coil voltage codes shown below.



Schneider Electric offers express shipping for factory modified NEMA Type 1 and Type 12/3R Enclosed Starters. When you need them fast, our Laser™ Delivery program is the answer to getting your product when you need it most. Ask for Laser™ Delivery, then select the product and the modifications you need when you place your order. It's as easy as that!



**Application Data for Selection**

**Class 8536 Starter**  
**Designation: EF-2, EF-3**  
**8536SBG2V02H31S**

Class 8502, 8536 / Refer to Catalog 8502CT9701

**Table 16.51:**

NEMA Size	Load Voltage	Maximum Hp Rating—Nonplugging and Nonjogging Duty		Maximum Hp Rating—Plugging and Jogging Duty		Continuous Current Rating, (A) 600 Volt Max.	Service—Limit Current Rating, (A)	Tungsten and Infrared Lamp Load, (A) 250 Volts Max.	Resistance Heating Loads, KW—other than Infrared Lamp Loads *		KVA Rating for Switching Transformer Primaries at 50 or 60 Cycles				3Ø Rating for Switching Capacitors KVAR
		Single Phase	Poly-Phase	Single Phase	Poly-Phase				Single Phase	Poly-Phase	Inrush Currents (Worst Case Peak) ? 20 Times Peak of Continuous Current Rating		Inrush Currents (Worst Case Peak) > 20–40 Times Peak of Continuous Current Rating		
											Single Phase	Poly-Phase	Single Phase	Poly-Phase	
00	115	1/2	—	—	—	9	11	5	—	—	—	—	—	—	—
	200	—	1-1/2	—	—	9	11	5	—	—	—	—	—	—	—
	230	1	1-1/2	—	—	9	11	5	—	—	—	—	—	—	—
	380	—	1-1/2	—	—	9	11	—	—	—	—	—	—	—	—
	460	—	2	—	—	9	11	—	—	—	—	—	—	—	—
	575	—	2	—	—	9	11	—	—	—	—	—	—	—	—
0	115	1	—	1/2	—	18	21	10	—	—	0.6	—	0.3	—	—
	200	—	3	—	1-1/2	18	21	10	—	—	—	1.8	—	0.9	—
	230	2	3	1	1-1/2	18	21	10	—	—	1.2	2.1	0.6	1.0	—
	380	—	5	—	1-1/2	18	21	—	—	—	—	—	—	—	—
	460	—	5	—	2	18	21	—	—	—	2.4	4.2	1.2	2.1	—
	575	—	5	—	2	18	21	—	—	—	3.0	5.2	1.5	2.6	—
1	115	2	—	1	—	27	32	15	3	5	1.2	—	0.6	—	—
	200	—	7-1/2	—	3	27	32	15	—	9.1	—	3.6	—	1.8	—
	230	3	7-1/2	2	3	27	32	15	6	10	2.4	4.3	1.2	2.1	—
	380	—	10	—	5	27	32	—	—	16.5	—	—	—	—	—
	460	—	10	—	5	27	32	—	12	20	4.9	8.5	2.5	4.3	—
	575	—	10	—	5	27	32	—	15	25	6.2	11.0	3.1	5.3	—
1P	115	3	—	1-1/2	—	36	42	24	—	—	—	—	—	—	—
	230	5	—	3	—	36	42	24	—	—	—	—	—	—	—
2	115	3	—	2	—	45	52	30	5	8.5	2.1	—	1.0	—	—
	200	—	10	—	7-1/2	45	52	30	—	15.4	—	6.3	—	3.1	—
	230	7-1/2	15	5	10	45	52	30	10	17	4.1	7.2	2.1	3.6	8
	380	—	25	—	15	45	52	—	—	28	—	—	—	—	—
	460	—	25	—	15	45	52	—	20	34	8.3	14	4.2	7.2	16
	575	—	25	—	15	45	52	—	25	43	10.0	18	5.2	8.9	20
3	115	—	—	—	—	90	104	60	10	17	4.1	—	2.0	—	—
	200	—	25	—	15	90	104	60	—	31	—	12	—	6.1	—
	230	—	30	—	20	90	104	60	20	34	8.1	14	4.1	7.0	27
	380	—	50	—	30	90	104	—	—	56	—	—	—	—	—
	460	—	50	—	30	90	104	—	40	68	16	28	8.1	14	53
	575	—	50	—	30	90	104	—	50	86	20	35	10	18	67
4	200	—	40	—	25	135	156	120	—	45	—	20	—	10	—
	230	—	50	—	30	135	156	120	30	52	14	23	6.8	12	40
	380	—	75	—	50	135	156	—	—	86.7	—	—	—	—	—
	460	—	100	—	60	135	156	—	60	105	27	47	14	23	80
	575	—	100	—	60	135	156	—	75	130	34	59	17	29	100
	5	200	—	75	—	60	270	311	240	—	91	—	41	—	20
230		—	100	—	75	270	311	240	60	105	27	47	14	24	80
380		—	150	—	125	270	311	—	—	173	—	—	—	—	—
460		—	200	—	150	270	311	—	120	210	54	94	27	47	160
575		—	200	—	150	270	311	—	150	260	68	117	34	59	200
6Δ		200	—	150	—	125	540	621	480	—	182	—	81	—	41
	230	—	200	—	150	540	621	480	120	210	54	94	27	47	160
	380	—	300	—	250	540	621	—	—	342	—	—	—	—	—
	460	—	400	—	300	540	621	—	240	415	108	188	54	94	320
	575	—	400	—	300	540	621	—	300	515	135	234	68	117	400
	7Δ	230	—	300	—	—	810	932	—	180	315	—	—	—	—
460		—	600	—	—	810	932	—	360	625	—	—	—	—	480
575		—	600	—	—	810	932	—	450	775	—	—	—	—	600

Tables and footnotes are taken from NEMA Standards.

The ratings for capacitor switching above assume the following maximum available fault currents:

- ▲ Ratings shown are for applications requiring repeated interruptions of stalled motor current or repeated closing of high transient currents encountered in rapid motor reversal, involving more than five openings or closings per minute and more than ten in a ten-minute period, such as plug-stop, plug-reverse or jogging duty. Ratings apply to single speed and multi-speed controllers.
- Per NEMA Standards paragraph ICS 2-321.20, the service-limit current represents the maximum rms current, in Amperes, which the controller may be expected to carry for protracted periods in normal service. At service-limit current ratings, temperature rises may exceed those obtained by testing the controller at its continuous current rating. The ultimate trip current of over-current (overload) relays or other motor protective devices shall not exceed the service-limit current ratings of the controller.
- ◆ FLUORESCENT LAMP LOADS—300 VOLTS AND LESS—The characteristics of fluorescent lamps are such that it is not necessary to derate Class 8502 contactors below their normal continuous current rating. Class 8903 contactors may also be used with fluorescent lamp loads. For controlling tungsten and infrared lamp loads, and resistance heating loads, Class 8903 AC lighting contactors are recommended. These contactors are specifically designed for such loads and are applied at their full rating as listed in the Class 8903 Section.
- ★ Ratings apply to contactors which are employed to switch the load at the utilization voltage of the heat producing element with a duty which requires continuous operation of not more than five openings per minute. Class 8903 Types L and S lighting contactors are rated for resistance heating loads.
- ▼ When discharged, a capacitor has essentially zero impedance. For repetitive switching by a contactor, sufficient impedance should be connected in series to limit inrush current to not more than 6 times the contactor rated continuous current. In many installations, the impedance of connecting conductors may be sufficient for this purpose. When switching to connect additional banks, the banks already on the line may be charged and can supply additional available short-circuit current which should be considered when selecting the impedance to limit the current.

- NEMA Size 00–3: 5,000 A RMS Sym.
  - NEMA Size 4–5: 10,000 A RMS Sym.
  - NEMA Size 6: 18,000 A RMS Sym.
  - NEMA Size 7: 30,000 A RMS Sym.
- Note: If available fault current is greater than these values, connect sufficient impedance in series as noted in the previous paragraph.

▲ For NEMA Size 6 & 7, the operation rate is as follows: Continuous operation rate is 3 operations per minute maximum; Jogging or Plugging Duty operation rate is 15 operations per minute for a maximum of three minutes.

The motor ratings in Table 16.51 are NEMA standard ratings and apply only when the code letter of the motor is the same as or occurs earlier in the alphabet than is shown in the Table 16.52. Motors having code letters occurring later in the alphabet may require a larger controller. Consult Schneider Electric CCC at (1-888-778-2733).

**Table 16.52:**

Motor Hp Rating	Maximum Allowable Motor Code Letter
1-1/2-2	L K H
3-5	
7-1/2 and above	

Approximate Dimensions

Table 16.53: Dimensions for Class 8502 Open Type

NEMA Size	Type	No. of Poles	Fig. No.	Dimensions—Inches (Refer to Appropriate Figure)										Wt (lb)
				A	B	C	D	E	F	G	H	I		
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	
00	SAO	2-3	1	3-7/32	4-11/32	4-7/32	1-5/8	1-5/8	7/32	3-15/16	—	—	4	
0	SBO	1-3	1	3-7/32	4-11/32	4-7/32	1-5/8	1-5/8	7/32	3-15/16	—	—	4	
1	SCO	4-5		4-1/4	4-11/32	4-7/32	1-5/8	2-5/8	7/32	3-15/16	—	—	4-1/2	
2	SDO	2-3	1	4-5/16	5-1/8	4-15/16	2-5/32	2-5/32	7/32	4-19/32	17/32	1-1/16	6-3/4	
		4-5		5-5/8	5-1/8	4-15/16	2-5/32	3-15/32	7/32	4-19/32	17/32	1-1/16	8-1/4	
3	SEO	2-3	1	5-15/32	7-3/32	6-1/2	1-7/8	3-17/32	5/16	6-1/32	3-1/4	4-3/4	14	
		4-5		9-3/4	7-7/8	6-1/2	3-15/16	5-13/16	5/16	7	4-17/32	9-1/16	22	
4	SFO	2-3	1	6	8-3/16	6-1/2	2-1/16	3-15/16	5/16	7	3-19/32	5-5/16	18	
		4-5		9-3/4	8-3/16	6-1/2	3-15/16	5-13/16	5/16	7	4-17/32	9-1/16	22	
5	SGO	2-3	1	8-2/3	12-5/16	8-3/4	3-1/4	5-13/16	5/8	11-1/8	4-3/4	7-1/4	45	
6	SHO	2-3	1	10-35/64	28-1/16	9	3-17/32	7-1/32	5-1/16	18-9/16	4-3/4	7-1/4	80	
7	SJO	2-3	1	10-35/64	37-1/4	10-7/8	3-17/32	7-1/32	7-7/32	22-3/8	4-3/4	7-1/4	135	

Table 16.54: Dimensions for 8536 Open Type

NEMA Size	Type	No. of Poles	Fig. No.	Dimensions—Inches (Refer to Appropriate Figure)										Wt (lb)
				A	B	C	D	E	F	G	H	I		
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	
00, 0, 1, 1P	SAO-SCO	2-3	2	3-1/2	6-49/64	4-7/32	1/2	1	1-39/64	13/64	6-1/4	3-31/32	5	
0, 1	SBO-SCO	4	2	4-17/32	6-49/64	4-7/32	1/2	1	2-2/3	13/64	6-1/4	3-31/32	5-1/2	
2	SDO	2-3	2	4-5/16	7-13/16	4-15/16	1/2	1	2-5/32	13/64	7-11/32	4-1/16	7-3/4	
		4		5-5/8	7-13/16	4-15/16	1/2	1	3-15/32	13/64	7-11/32	4-1/16	9-1/4	
3	SEO	2-3	2	5-15/32	11-3/32	6-1/2	7/8	1-3/4	3-19/32	5/16	10-3/16	5-3/4	17	
		4		9-3/4	12-1/8	6-1/2	1-13/16	1-3/4	5-13/16	5/16	11-3/16	5-3/4	25	
4	SFO	3	2	6	12-7/8	6-1/2	1-13/16	1-3/4	3-15/16	5/16	11-3/16	5-3/4	22	
		4		9-3/4	12-7/8	6-1/2	1-13/16	1-3/4	5-29/32	5/16	11-3/16	5-3/4	25	
5	SGO	3	2	8-9/16	17-9/16	8-3/4	4-3/4	7-1/4	5-12/32	5/8	16-3/8	6	62	
6	SHO	3	2	12-11/32	28-1/16	9	4-3/4	7-1/4	5-25/32	5-1/16	18-9/16	8-11/16	85	
7	SJO	3	2	12-11/32	37-1/4	10-7/8	4-3/4	7-1/4	5-25/32	7-7/32	22-3/8	9	140	

Table 16.55: Dimensions for NEMA 1 General Purpose Enclosure

NEMA Size	Type	No. of Poles	Fig. No.	Dimensions—Inches												
				A	B	C		D	E	F	G	H	I	J	K	L
						8502	8536									
00	SAG	All	3	—	—	—	—	—	—	—	—	—	—	—	—	—
0	SBG	All	3	6	10	5-9/32	5-9/16	3	7/8	8-1/8	1	15/16	4-1/8	5	—	—
1	SCG	All	3	—	—	—	—	—	—	—	—	—	—	—	—	—
2	SDG	All	3	7-13/16	12-11/16	6-1/32	6-5/16	—	1-3/32	10-1/2	1-3/32	1-3/32	5-5/8	5-3/4	1-3/32	5-5/8
3	SEG	All	3	11-7/16	21-13/16	8	8-3/8	—	1-17/32	18-3/4	1-17/32	1-17/32	8-3/8	7-3/4	1-17/32	8-3/8
4	SFG	All	5	11-1/4	25-5/32	9	9	8-19/32	1-1/4	1-1/4	22-5/16	1-7/16	7/16	—	—	—
5	SGG	All	5	17-7/32	44-7/32	12-13/16	12-15/16	13	2-1/8	2-1/8	40	2-1/8	9/16	—	—	—
6	SHG	All	4	65-3/4	20-7/32	13-1/8	13-1/8	—	11	64-1/2	2-5/16	5-1/2	—	—	—	—
7	SJG	All	4	93	34-1/2	23-1/2	23-1/2	Floor Mounting								

Class 8536 Starter  
Designation: EF-2, EF-3  
8536SBG2V02H31S

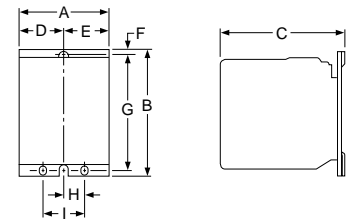


Figure 1  
Class 8502

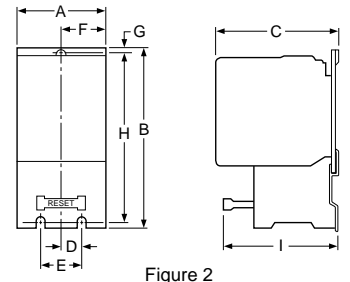


Figure 2  
Class 8536

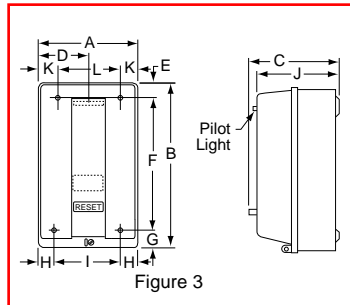


Figure 3

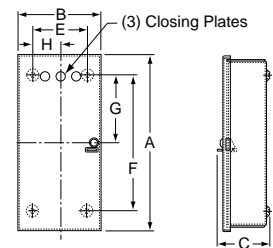


Figure 4

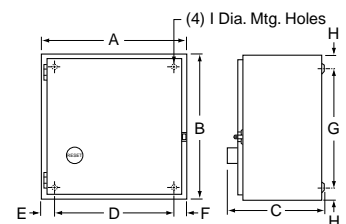


Figure 5

**For Full Voltage Contactors and Starters**

**Table 16.263: Full Voltage Controllers Only**

Classes 8502, 8536, 8538, 8539, 8702, 8736, 8738, 8739, 8810, 8811 and 8812													
Factory Modifications	Enclosure Type	Form	NEMA SIZE										
			00	0	1	2	3	4	5	6	7		
Separate Control Circuit— (specify voltage and frequency)	Any	S▲		No Charge	No Charge	No Charge	No Charge	No Charge	No Charge	No Charge	No Charge	No Charge	
Fused Control Circuit (without control transformer)													
One fuse	1, 3R, 4, 4X, 12	F	314.00	314.00	314.00	314.00	314.00	314.00	314.00	314.00	—	—	
Two fuses	1, 3R, 4, 4X, 7, 9, 12	F4	314.00	314.00	314.00	314.00	314.00	314.00	314.00	314.00	—	—	
<b>Control Circuit Transformers — Standard capacity (50 or 60 Hz) Note: All orders requesting Form FT will be supplied as Form F4T.</b>													
<b>FUSES</b>													
	Primary	Secondary											
CONTROL CIRCUIT Full Voltage and Multi-Speed Controllers Only Classes 8502 8536 8538 8539 8702 8736 8738 8739 8810 8811 8812	2	1	1, 4, 4X, 12	FF4T	698.00	698.00	698.00	855.00	1112.00	1283.00	1412.00 ♦	1412.00	1412.00
	2	1	7 & 9	FF4T	755.00	755.00	755.00	1053.00	1353.00	1640.00	1839.00 ♦	1839.00	1839.00
	2	2	1, 4, 4X, 12	F4F10T	698.00	698.00	698.00	855.00	1112.00	1283.00	1412.00 ♦	—	—
	<b>Additional Capacity (50 or 60 Hz)</b>												
	Two fuses in primary and one fuse in secondary												
	100 VA additional capacity	1, 4, 4X, 12		FF4T11	998.00	998.00	998.00	1197.00	1425.00	1566.00 ♦	1710.00 ♦	1710.00	1710.00
	100 VA additional capacity	7 & 9		FF4T11	1053.00	1053.00	1053.00	1395.00	1668.00	1925.00 ♦	2138.00 ♦	—	—
	200 VA additional capacity	1, 4, 4X, 12		FF4T12	1241.00	1241.00	1241.00	1467.00	1695.00 ♦	1839.00 ♦	1839.00 ♦	1839.00	1839.00
	300 VA additional capacity	1, 4, 4X, 12		FF4T13	1481.00	1481.00 ♦	1481.00 ♦	1737.00 ♦	1967.00 ♦	2109.00 ♦	2109.00 ♦	2109.00	2109.00
	400 VA additional capacity	1, 4, 4X, 12		FF4T14	1967.00	1967.00 ♦	1967.00 ♦	2280.00 ♦	2507.00 ♦	2793.00 ♦	2793.00 ♦	2793.00 ♦	2793.00 ♦
	500 VA additional capacity	1, 4, 4X, 12		FF4T15	2250.00	2250.00 ♦	2250.00 ♦	2564.00 ♦	2793.00 ♦	3077.00 ♦	3077.00 ♦	3077.00 ♦	3077.00 ♦

- ▲ All combination style devices such as 8538, 8539, 8738, 8739, that use **Form S** should also use **Form Y74** (auxiliary contact installed on disconnect switch) per NEC Article 430-74.
- Table 16.266 at right.
- ♦ Single primary voltage must be specified.

**Table 16.264: Marine Control**

Class	Factory Modification	Enclosure Type	Form	\$ Price
8502 8536 8538 8539 8702 8736 8738 8739 8810 8811 8812	Modification of standard device for use as marine control per UL508	12/3R 4/4X (S.S. only)	M10	See Below

**Table 16.265:**

Form	NEMA Size★							
	00▼	0▼	1	2	3	4	5	6
M10	—	—	338.00	450.00	720.00	1260.00	3015.00	4725.00

- ★ Not available for NEMA Size 7.
- ▼ Cannot be used with Marine controls.

**■ Selection of Control Circuit Transformers**

The standard primary/secondary voltages for control circuit transformers are indicated in the following table.

**Table 16.266:**

AC-OPERATED DEVICES With Control Transformers	
Voltage	Code
60 Hz (Primary-Secondary)	
120-12Δ	V88
120-24Δ	V89
208-120	V84
240-24Δ	V82
240-120	V80
277-120	V85
480-24Δ	V83
480-120	V81
480-240	V87
600-120	V86
Specify	V99

- Δ 12 V coils are not available on Sizes 3-7.
- 24 V coils are not available on Sizes 4-7.

To order, select the desired device with the appropriate transformer Form designation. Then convert the previously selected voltage code (V●●) to reflect the desired primary/secondary voltage for the transformer. The secondary voltage should equal the previously selected coil voltage of the device.

**Example:**

You have previously selected a Class 8536SDG1V02S. V02S means that you need a coil voltage of 120-60/110-50 wired for separate control. You would like to add **Form FF4T** with the transformer voltages being 480 volt primary, 120 volt secondary with Solid State Overload Relay Protection Class 20 Trip Class (H20).

The new and complete class, type, voltage code and form number will be:

Class            Type            Voltage Code            Form □  
8536            SDG1            V81            FF4H20T

- Form numbers should always be shown in alphabetical order. Each letter indicates the beginning of a new form and may be followed by one or more numbers.

**Factory Modifications (Forms)  
For Full Voltage Contactors and Starters**

**Class 8536 Starter  
Designation: EF-2, EF-3  
8536SBG2V02C6H31S**

**Full Voltage Controllers Only**

CLASSES 8538, 8539, 8738 and 8739

Factory Modifications		Enclosure Type	Form Letters
OVERLOAD RELAYS	<b>Non-Compensated Bimetallic Overload Relays</b>		
	Single Phase:		
	Types SB-SD (Sizes 0-2)Ⓜ	Any	B1
	Polyphase:		
	Two Element — For 2 Phase Only		
	Types SB-SD (Sizes 0-2)	Any	B1
	Three Element		
	Types SB-SD (Sizes 0-2)	Any	B2
	Types SE-SF (Sizes 3-4)	Any	B5
	Type SG (Size 5)	Any	B2Y500
	Type SH (Size 6)	Any	B2
	<b>Ambient Compensated Bimetallic Overload Relays</b>		
	Three Element		
	Types SB-SD (Sizes 0-2)	1, 4, 7, 9, 12	2B
	Types SE-SF (Sizes 3 & 4)	Any	Y59
Type SG (Size 5)	Any	BY500	
Type SH (Size 6)	Any	B	
<b>Overload Relays - General</b>			
Substitute Class 9065 SSRO100			
For Standard Overload Protection	Any	B11	
Omit overload protection from combination starters. (Classes 8538, 8539, 8738, 8739 only)			
Do not use with MAG-GARD® Circuit Breakers.			
Deduct per starter	Any	Y76	
Modify Size 3 Type SE starters with melting alloy overload relays to accept Type FB quick trip or SB slow trip thermal units and Size 4 Type SF starters to accept Type FB quick trip thermal units. (Rejects Type CC standard trip thermal units.)	Any	Y81	
Substitute 9999 SO4 isolated alarm contact (N.O.) on melting alloy overload relay	Any	Y342	
Substitute 9999 SO5 isolated alarm contact (N.C.) on melting alloy overload relay	Any	Y344	

Ⓜ Size 7 uses a solid state overload relay as standard. See Class 8536 for complete details.  
 Ⓜ Single phase bimetallic overload relays for Type S Sizes 0-2 require two (2) thermal units per starter.  
 Ⓜ For Classes 8736, 8738 and 8739, Type SG, consult Local Square D Field Office.

**Solid State Overload Relay Factory Modifications (Forms)**

The solid state overload relay is available on NEMA Size 00-7.  
 For Class 8536, 8538, 8539, 8736, 8738, 8739 and 8810 devices.

**Form Description**

Type S Starter with Motor Logic  
 Solid State Overload Relay

- 1 - Motor Logic, Base Unit, Trip Class 10
- 2 - Motor Logic, Base Unit, Trip Class 20
- 3 - Motor Logic, Feature Base Unit
- 0 - No additional modifications

1 - N.O. Aux. Contact (Field Convertible to N.C.)

Special Overload/Contactor Size Combinations (Base Unit & Feature Base Units):  
 (Must Be Specified On Size 00 Starter Orders)

- Blank - Overload Matched to Starter Size (i.e. Size 1 contactor & 9-27A overload)
- 0 - A 6 - 18A overload on a starter size as indicated by the Starter Catalog Number
- 1 - A 9 - 27A overload on a starter size as indicated by the Starter Catalog Number
- 2 - A 15 - 45A overload on a starter size as indicated by the Starter Catalog Number
- 3 - A 30 - 90A overload on a starter size as indicated by the Starter Catalog Number
- 4 - A 45 - 135A overload on a starter size as indicated by the Starter Catalog Number
- 8 - A 1.5 - 4.5A overload on a starter size as indicated by the Starter Catalog Number (only offered on Feature Base Units)
- 9 - A 3 - 9A overload on a starter size as indicated by the Starter Catalog Number

SPECIAL NOTE FOR Class 8810 devices:  
 You MUST SPECIFY TWO SEPARATE FORM NUMBERS TO GET MOTOR LOGIC OVERLOADS ON TWO SPEED STARTERS. The first form number is for the low speed winding and the second is for the high speed winding.  
 EXAMPLE: Open Style, Size 4 Two Speed Starter with Motor Logic Overloads Required.  
 Single Winding, 460V, Constant Horsepower  
 High Speed FLA = 96A  
 Low Speed FLA = 27A (use Size 2 Overload)  
 Catalog Number to Order: 8810 SF01V02 form S H20 H202  
 Where: Form H20 is a Size 4 Contactor with a 45-135A Motor Logic Overload for the High Speed and form H202 is a 15-45A Motor Logic Overload on the low speed contactor.

**Classes 8538, 8539, 8738 and 8739**

Factory Modifications	Form
Motor Logic Solid State Overload	Base Unit, Trip Class 10 H10
	Base Unit, Trip Class 20 H20
	Feature Base Unit H30
	Base Unit, Trip Class 10 H11
	Base Unit, Trip Class 20 H21
Motor Logic Solid State Overload with Auxiliary Contact	Feature Base Unit H31

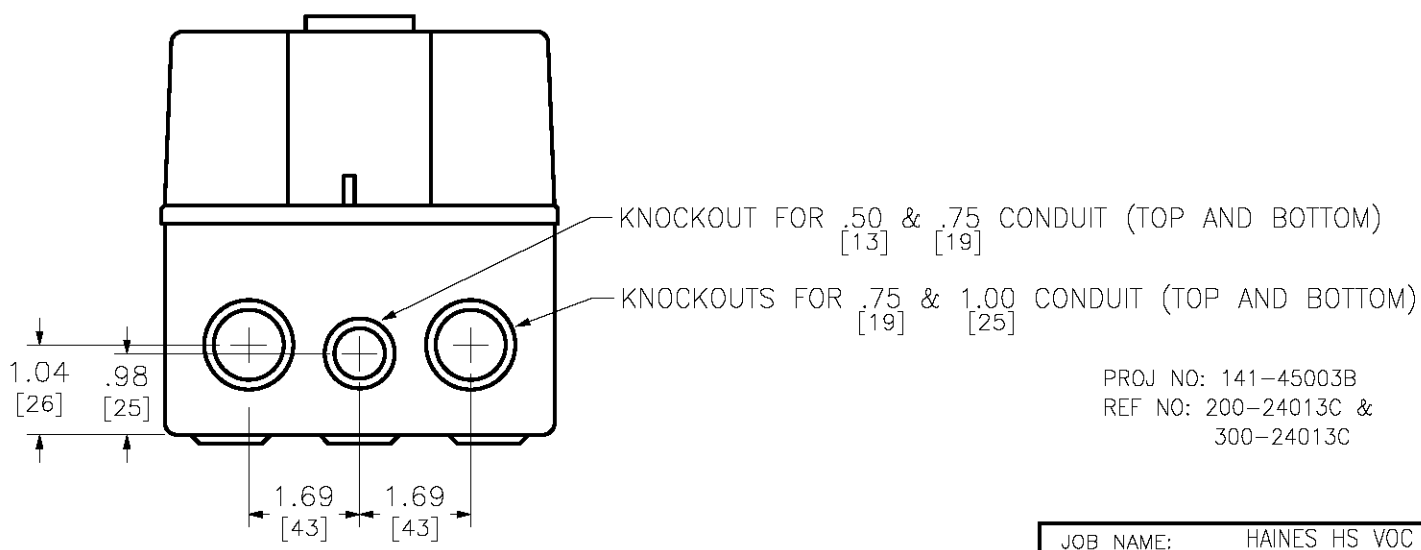
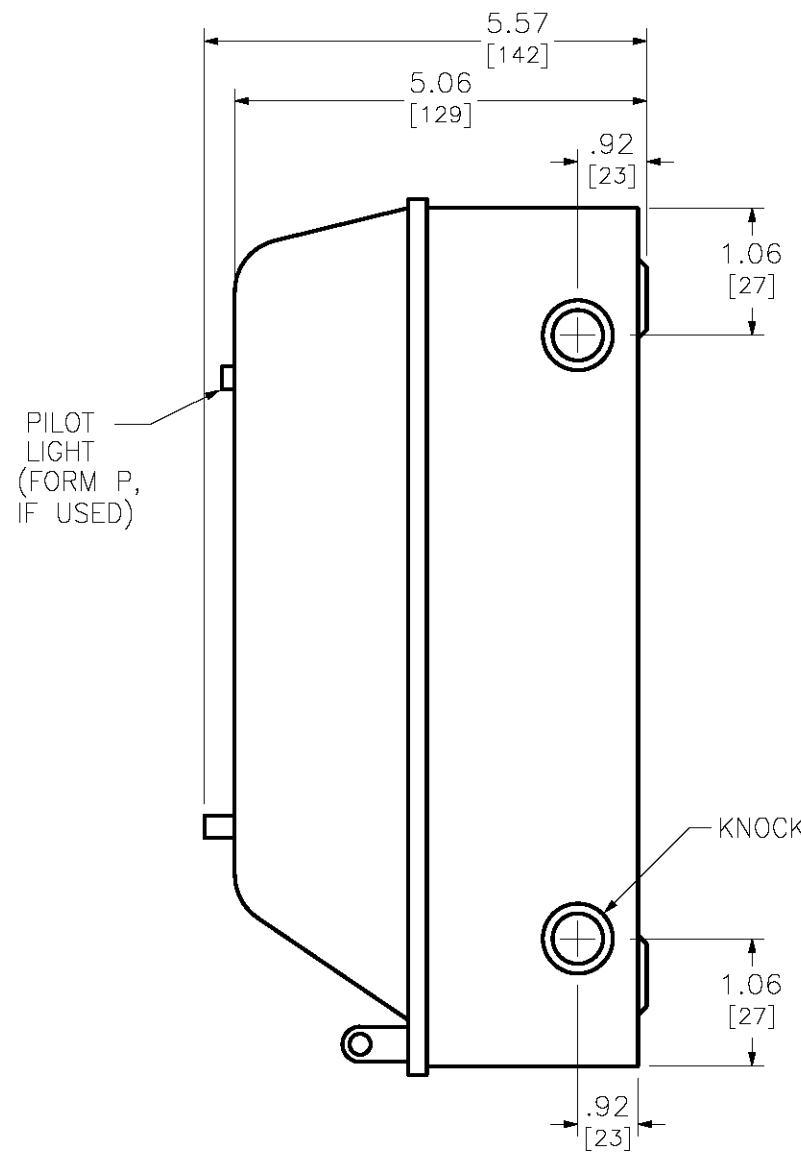
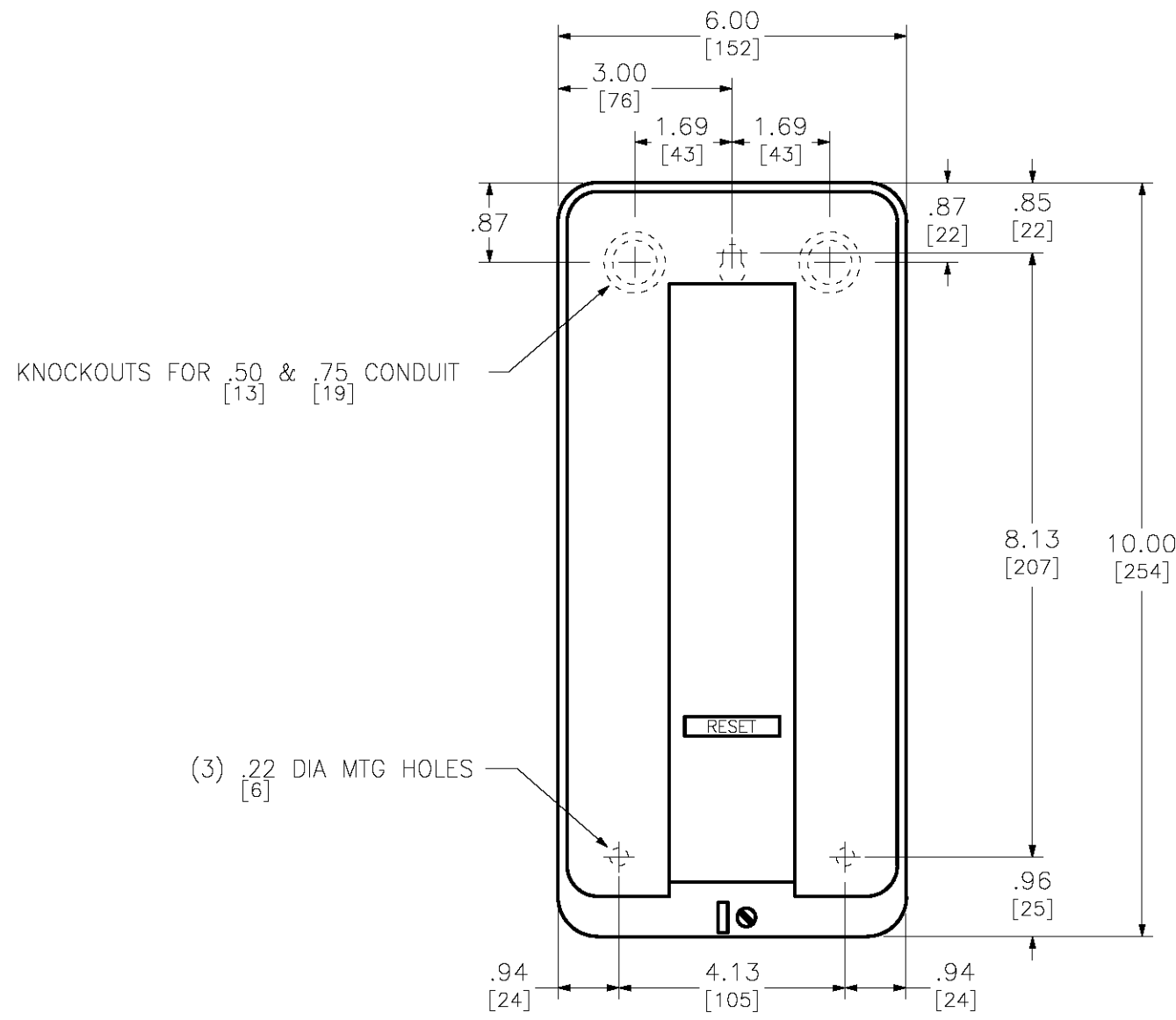
**Special Starter Combinations with Motor Logic™ Overload Relay Protection**

NEMA Contactor Size	Solid State Overload Relay Size							NEMA Contactor Size	Solid State Overload Relay Size						
	00B	00C	0	1	2	3	4		00B	00C	0	1	2	3	4
00	▲	Std.						2	▲	▲	▲	▲	Std.		
0	▲	▲	Std.					3	n/a	n/a	n/a	n/a	n/a	Std.	
1	▲	▲	▲	Std.				4	n/a	n/a	n/a	n/a	n/a	▲	Std.

▲ Possible factory starter combinations available.

REV	DESCRIPTION	BY	DATE						
-	-	-	-	-	-	-	-	-	-

CLASS 8502/8536 MAGNETIC CONTACTORS AND STARTERS  
NEMA TYPE 1 GENERAL PURPOSE ENCLOSURE




**Class 8536 Starter**  
**Designation: EF-4**  
**8536SBG2V02H31S**

DUAL DIMENSIONS: INCHES  
MILLIMETERS

NEMA SIZE	CLASS	TYPE	NO. OF POLES	FORMS
00	8502 & 8536	SAG	2-3	STD,A,C,P,S,X
0 & 1	8502 & 8536	SBG SCG	1-5	STD,A,B,C,P,S,X

PROJ NO: 141-45003B  
REF NO: 200-24013C &  
300-24013C

NOT TO SCALE

JOB NAME:	HAINES HS VOC TECH BLDG	EQUIPMENT DESIGNATION:	<b>EF-4</b>
JOB LOCATION:	HAINES AK	EQUIPMENT TYPE:	
DRAWN BY:	(Q2C)	DRAWING TYPE:	
ENGR:			
DATE:	May 06 2015	by Schneider Electric	
DRAWING STATUS:	QUOTE	DWG#	<b>F36582663-01</b>
		PG	<b>1</b> OF <b>1</b> REV -



Manual Starters and Switches (p. 16-4)



Definite Purpose Contactors and Starters (p. 16-70)



NEMA Style Type S Contactors and Starters (p. 16-14)



Lighting Contactors (p. 16-59)



Pump Panel (p. 16-75)



Combination Starters (p. 16-31)



NEMA Style TeSys N Contactors and Starters (p. 16-139)



**NEMA AC Magnetic Contactors and Starters Catalog Numbering System**

16-13

**Combination Starters—NEMA Style**

Non-Reversing		
Non-Fusible Disconnect Class 8538		16-32, 16-34
Fusible Disconnect Class 8538		16-31, 16-33, 16-34
Electronic Motor Circuit Protector (MCP) Class 8539		16-35, 16-36, 16-37
Thermal Magnetic Circuit Breaker Class 8539		16-38, 16-39
Reversing		
Non-Fusible Disconnect Class 8738		16-52
Fusible Disconnect Class 8738, 8739		16-51, 16-52
Electronic Motor Circuit Protector (MCP) Class 8739		16-53
Thermal Magnetic Circuit Breaker Class 8739		16-55

**Contactors—NEMA Style**

Non-Reversing Class 8502	16-14
Reversing Class 8702	16-44
Vacuum, Low Voltage, Non-Reversing Class 8502	16-28
Vacuum, Low Voltage, Reversing Class 8702	16-50

**Definite Purpose Contactors and Starters**

Class 8910, 8965 16-70

**Duplex Motor Starters** Class 8941

16-78

**Enclosures** Class 9991

16-93

**External Reset Mechanisms** Class 9065

16-92

**Factory Modifications (Forms)**

16-100

**Lighting Contactors** Class 8903

16-59

Panel Board (PB) Lighting Contactors

See Supplemental Digest

**Manual Starters and Switches** Class 2510, 2511, 2512

16-4

**Multispeed Starters** Class 8810

See Supplemental Digest

**Overload Relays**

Bimetallic Class 9065	16-89
Melting Alloy Class 9065	16-82
Motor Logic/Motor Logic Plus Class 9065	16-83
TeSys T Motor Management System	16-84

**Pump Panels**

Full Voltage Class 8940	16-75
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**Reduced Voltage Starters**

Electro-Mechanical Class 8600

See Supplemental Digest

**Starters, Full Voltage—NEMA Style**

Non-Reversing Class 8536	16-18
Reversing Class 8736	16-46
TeSys U Simple Motor Starter	16-12
Vacuum, Low Voltage, Non-Reversing Class 8536	16-29

**Additional Products**

Accessories Class 9998, 9999	16-108
Renewal Parts Class 9998	16-105
Thermal Units	16-116
Reversing Drum Switches Class 2601	See Supplemental Digest

**TeSys N Contactors and Starters**

16-139





**Class 8536 Starter  
Designation: EF-4  
8536SBG2V02H31S**



Class	2510, 2511, 2512	8502 & 8702	8536 & 8736	8538 & 8738	8539 & 8739
	Manual Starters and Switches, Non-Reversing, Reversing and Two Speed	NEMA Style Full Voltage Non-Reversing and Full Voltage Reversing Magnetic Contactors	NEMA Style Full Voltage Non-Reversing and Full Voltage Reversing Magnetic Starters	NEMA Style Full Voltage Non-Reversing and Full Voltage Reversing Combination (Disconnect Switch) Magnetic Starters	NEMA Style Full Voltage Non-Reversing and Full Voltage Reversing Combination (PowerPact™ Circuit Breaker) Magnetic Starters
Page	16-4	8502 16-14	8536 16-18	8538 16-31	8539 16-35
		8702 16-44	8736 16-46	8738 16-51	8739 16-53
NEMA Sizes	Type F = N/A	00 to 7	00 to 7	8538 = 0 to 6	8539 = 0 to 7
	Type K = N/A			8738 = 0 to 5	8739 = 0 to 6
	Type M = 0 & 1				
Load Voltage	Type F = 277 V	600 Vac Max.	600 Vac Max.	600 Vac Max.	600 Vac Max.
	Types K & M = 600 Vac				
Current Ratings (Continuous)	Type F = 16 A	9A to 810 A	9 A to 810 A	8538 = 18 A to 540 A	8539 = 18 A to 810 A
	Types K & M = 30 A			8738 = 18 A to 270 A	8739 = 18 A to 540 A
Horsepower Ratings (Maximum)	Type F = 1	1/2 to 600	1/2 to 600	8538 = 1/2 to 400	8539 = 1/2 to 600
	Type K = 20			8738 = 1/2 to 200	8739 = 1/2 to 400
	Type M = 10				
Overload Relay	Type F = Melting Alloy	N/A	Melting Alloy	Melting Alloy	Melting Alloy
	Type K = N/A		Bi-Metallic	Bi-Metallic	Bi-Metallic
	Type M = Melting Alloy		Solid State	Solid State	Solid State
Enclosure Types	1, Flush Mount, 3R, 4, 4X, 7 & 9 and Open	1, 3R, 4, 4X, 12/3R, 7 & 9 and Open	1, 3R, 4, 4X, 12/3R, 7 & 9 and Open	1, 4, 4X, 12/3R	1, 4, 4X, 12/3R
Approvals	UL File E42243 NLRV	UL File E78351 NLDX	UL File E78351 NLDX	UL File E152395 NKJH7	UL File E152395 NKJH7
	UR File E42243 NLRV2	CSA 60905 Class 3211-04	CSA 60905 Class 3211-04	CSA LR584 Class 3211 04	CSA LR584 Class 3211 04
	CSA File LR 25490	CE IEC 947-4-1 Sizes 00-5 Only	CE IEC 947-4-1 Sizes 00-5 Only		

**Class 8536 Starter  
Designation: EF-4  
8536SBG2V02H31S**

Class 8536		Type S C G - 3 V02		Form S
<b>General Classification</b>				
8502	Contactor Page 16-14			
8536	Starter Page 16-18			
8538	Combination Starter with Disconnect Switch Page 16-31			
8539	Combination Starter with Circuit Breaker Page 16-35			
8702	Reversing Contactor Page 16-44			
8736	Reversing Starter Page 16-46			
8738	Reversing Combination Starter with Disconnect Switch Page 16-54			
8739	Reversing Combination Starter with Circuit Breaker			
8810	Two Speed Starter ▲			
8903	Type S Lighting Contactors Page 16-60 ▲			
8940	Pumping Plant Panel ▲			
8941	Duplex Controller Page 16-78 ▲			
<b>Design</b>				
Type S NEMA Contactors and Starters				
<b>NEMA Size</b>		<b>8903 (only)</b>		
A	Size 00			
B	Size 0	M	30 Amperes	
C	Size 1	P	60 Amperes	
D	Size 2	Q	100 Amperes	
E	Size 3	V	200 Amperes	
F	Size 4	X	300 Amperes	
G	Size 5	Y	400 Amperes	
H	Size 6	Z	600 Amperes	
J	Size 7	J	800 Amperes	
<b>Enclosure</b>				
A	NEMA 12 Industrial Use			
F	NEMA 1 Flush Mounting General Purpose			
G	NEMA 1 General Purpose Surface Mounting			
H	NEMA 3R Rainproof			
O	Open Style Device (no enclosure)			
R	NEMA 7 & 9 Hazardous Environments, Spin Top			
T	NEMA 7 & 9 Hazardous Environments, Bolted			
W	NEMA 4 Watertight, 4X Corrosion Resistant			
<b>Numerals</b>				
Used to designate specific, physical arrangements, such as number of poles, fuse clip size, etc.; but the numbering varies with Class of equipment. Consult Digest listings for specific device numbers.				
2				
<b>Voltage Code</b>				
AC operated devices without control transformer				
Code	Voltage/Frequency			
V01	24/60			
V02	120/60 or 110/50			
V06	480/60 or 440/50			
V07	600/60 or 550/50			
V08	208/60			
V81 - 480V Primary, 120V Secondary for units using a fused transformer control circuit Form (F4T).				
This is only a partial listing consult Digest pages 16-14 and 16-101 for more information.				
<b>Common Forms (factory modifications) Page 16-100</b>				
A	"Start-Stop" pushbuttons in the enclosure cover			
B■	Bimetallic overload relays			
C	"Hand-Off-Auto" selector switch in the enclosure cover			
F4T	Fused transformer control circuit (primary fuses only)			
FF4T	Fused transformer control circuit (primary & secondary fuses)			
H	Solid state overload relay			
P1	Red ON pilot light in the enclosure cover			
P2	Green OFF pilot light in cover			
S	Separate control circuit			
X01	One "normally closed" auxiliary contact N.C.			
X10	One "normally open" auxiliary contact N.O.			
Consult Digest pages 16-100 to 16-104 for additional form letters. When more than one form is applied to a single device, arrange Forms in alphabetical order.				
▲ Combination two speed starters will replace the "S" with a "C", "U" or "D". Pumping plant panels have various leading characters. Not all use Type S contactors. Duplex controllers use "N", "C", "U", and "D".				
■ May also designate Motor Logic Plus overload relay				

**Table 16.33: How to Order**

To Order Specify:	Catalog Number			
<ul style="list-style-type: none"> <li>• Class Number</li> <li>• Type Number</li> <li>• Voltage Code</li> <li>• Form(s) see pages 16-100-16-104</li> </ul>	Class	Type	Voltage Code	Form(s)
	8539	SCG44	V06	AH20P1X11
Note: Description: NEMA Size 1, (10 Hp) Electronic Motor Circuit Protector (MCP) Combo Starter in a NEMA Type 1 enclosure with a 480V coil, start/stop pushbutton (A), class 20 SSOLR (H20), red pilot light (P1), 1 N.O. and 1 N.C. auxiliary contact (X11)				

**IMPORTANT - This information is intended for general interpretation of catalog numbers. Do not use to create catalog numbers for this product line.**

Note: The terms Type and Form do not appear in the catalog number.

Devices are wired from factory according to customer preference as follows:

- Common control
- Separate control (Form S)
- Control power transformer (CPT)





Type SCO3  
Size 1, 3-Pole Starter

**General Information**

Type S magnetic starters are used for full-voltage starting and stopping of AC squirrel cage motors. Motor overload protection is provided via melting alloy type thermal overload relays. Type S starters are available in NEMA Sizes 00 through 7, and are designed for operation at 600 Vac, 50 to 60 Hz.

**Solid State Overload Relay Protection (Motor Logic™)**

These ambient insensitive overload relays are available on Sizes 00 through 6 and standard on size 7. They provide phase loss, phase unbalance protection. To order, add Form **H30** (for selectable trip class 10 or 20 protection). For more information about Motor Logic, see pages 16-83 and 16-102.

**Adapted Bimetal (NEMA Sizes 00–1)**

The Adapted Bimetal motor starter consists of a specially designed adapter that attaches with bus bars to the NEMA Type S contactor and holds the LRD or LR3D (IEC Style) bimetal overload relay. This starter configuration can be ordered by adding Form E (adapter only) to the standard catalog number. Once the FLA of the motor has been determined, the LRD or LR3D bimetal overload can be purchased separately and installed in the field at a later date. For more information see Table 16.421.

**TeSys T Motor Management System (NEMA Sizes 1–6)**

TeSys T is a flexible system that integrates seamlessly into your automation system through five major communication protocols. TeSys T can predict what will happen in the process, as it accurately monitors current, voltage, and power over a wide range. For additional information about TeSys T Motor Management System, see pages 16-84 to 16-88 and page 16-103.

**3-Pole Polyphase—600 Vac Maximum—50–60 Hz**

Note that prices shown do not include thermal units. Devices require 3 thermal units (Sizes 00–6). Standard trip thermal units are \$21.50 each. See page 16-116 for selection information.

Table 16.40:

NEMA Size	Continuous Current Ratings	Motor Voltage	Max. Hp	Open Type		NEMA 1 General Purpose Enclosure		NEMA 4 & 4X Watertight, Dusttight Brushed Stainless Steel Enclosure (Size 0-5)▲		NEMA 4X Watertight, Dusttight, Corrosion-Resistant Glass-Polyester Enclosure	
				Type	\$ Price	Type	\$ Price	Type	\$ Price	Type	\$ Price
00	9	200 230 460 575	1-1/2 1-1/2 2 2	SAO12■	386.00	SAG12■	419.00	Use Size 0		Use Size 0	
0	18	200 230 460 575	3 3 5 5	SBO2■	485.00	SBG2■	518.00	SBW12■	1017.00	SBW22■	1017.00
1	27	200 230 460 575	7-1/2 7-1/2 10 10	SCO3■	557.00	SCG3■	590.00	SCW13■	1103.00	SCW23■	1103.00
2	45	200 230 460 575	10 15 25 25	SDO1■	1013.00	SDG1■	1160.00	SDW11■	2186.00	SDW21■	2186.00
3	90	200 230 460 575	25 30 50 50	SEO1■	1638.00	SEG1■	1929.00	SEW11■	3380.00	SEW21■	4226.00
4	135	200 230 460 575	40 50 100 100	SFO1■	3747.00	SFG1■	4350.00	SFW11■	6827.00	SFW21■	8535.00
5	270	200 230 460 575	75 100 200 200	SGO1■	9152.00	SGG1■	10254.00	SGW11■	15795.00	—	—
6	540	200 230 460 575	150 200 400 400	SHO2■	21756.00	SHG2■	28881.00	SHW2■	36003.00	—	—
7	810	200 230 460 575	— 300 600 600	SJO2■	31256.00	SJG2■	38381.00	SJW2■	45503.00	—	—

▲ Size 6 and 7 are rated NEMA 4 only, painted sheet steel.  
■ Coil voltage code must be specified to order this product. Refer to standard coil voltage codes shown below.



Schneider Electric offers express shipping for factory modified NEMA Type 1 and Type 12/3R Enclosed Starters. When you need them fast, our Laser™ Delivery program is the answer to getting your product when you need it most. Ask for Laser™ Delivery, then select the product and the modifications you need when you place your order. It's as easy as that!

**Class 8536 Starter  
Designation: EF-4  
8536SBG2V02H31S**

**Application Data for Selection**

**Table 16.51:**

NEMA Size	Load Voltage	Maximum Hp Rating—Nonplugging and Nonjogging Duty		Maximum Hp Rating—Plugging and Jogging Duty		Continuous Current Rating, (A) 600 Volt Max.	Service—Limit Current Rating, (A)	Tungsten and Infrared Lamp Load, (A) 250 Volts Max.	Resistance Heating Loads, KW—other than Infrared Lamp Loads *		KVA Rating for Switching Transformer Primaries at 50 or 60 Cycles				3Ø Rating for Switching Capacitors KVAR
		Single Phase	Poly-Phase	Single Phase	Poly-Phase				Single Phase	Poly-Phase	Inrush Currents (Worst Case Peak) ? 20 Times Peak of Continuous Current Rating		Inrush Currents (Worst Case Peak) > 20–40 Times Peak of Continuous Current Rating		
											Single Phase	Poly-Phase	Single Phase	Poly-Phase	
00	115	1/2	—	—	—	9	11	5	—	—	—	—	—	—	—
	200	—	1-1/2	—	—	9	11	5	—	—	—	—	—	—	—
	230	1	1-1/2	—	—	9	11	5	—	—	—	—	—	—	—
	380	—	1-1/2	—	—	9	11	—	—	—	—	—	—	—	—
	460	—	2	—	—	9	11	—	—	—	—	—	—	—	—
	575	—	2	—	—	9	11	—	—	—	—	—	—	—	—
0	115	1	—	1/2	—	18	21	10	—	—	0.6	—	0.3	—	—
	200	—	3	—	1-1/2	18	21	10	—	—	—	1.8	—	0.9	—
	230	2	3	1	1-1/2	18	21	10	—	—	1.2	2.1	0.6	1.0	—
	380	—	5	—	1-1/2	18	21	—	—	—	—	—	—	—	—
	460	—	5	—	2	18	21	—	—	—	2.4	4.2	1.2	2.1	—
	575	—	5	—	2	18	21	—	—	—	3.0	5.2	1.5	2.6	—
1	115	2	—	1	—	27	32	15	3	5	1.2	—	0.6	—	—
	200	—	7-1/2	—	3	27	32	15	—	9.1	—	3.6	—	1.8	—
	230	3	7-1/2	2	3	27	32	15	6	10	2.4	4.3	1.2	2.1	—
	380	—	10	—	5	27	32	—	—	16.5	—	—	—	—	—
	460	—	10	—	5	27	32	—	12	20	4.9	8.5	2.5	4.3	—
	575	—	10	—	5	27	32	—	15	25	6.2	11.0	3.1	5.3	—
1P	115	3	—	1-1/2	—	36	42	24	—	—	—	—	—	—	—
	230	5	—	3	—	36	42	24	—	—	—	—	—	—	—
2	115	3	—	2	—	45	52	30	5	8.5	2.1	—	1.0	—	—
	200	—	10	—	7-1/2	45	52	30	—	15.4	—	6.3	—	3.1	—
	230	7-1/2	15	5	10	45	52	30	10	17	4.1	7.2	2.1	3.6	8
	380	—	25	—	15	45	52	—	—	28	—	—	—	—	—
	460	—	25	—	15	45	52	—	20	34	8.3	14	4.2	7.2	16
	575	—	25	—	15	45	52	—	25	43	10.0	18	5.2	8.9	20
3	115	—	—	—	—	90	104	60	10	17	4.1	—	2.0	—	—
	200	—	25	—	15	90	104	60	—	31	—	12	—	6.1	—
	230	—	30	—	20	90	104	60	20	34	8.1	14	4.1	7.0	27
	380	—	50	—	30	90	104	—	—	56	—	—	—	—	—
	460	—	50	—	30	90	104	—	40	68	16	28	8.1	14	53
	575	—	50	—	30	90	104	—	50	86	20	35	10	18	67
4	200	—	40	—	25	135	156	120	—	45	—	20	—	10	—
	230	—	50	—	30	135	156	120	30	52	14	23	6.8	12	40
	380	—	75	—	50	135	156	—	—	86.7	—	—	—	—	—
	460	—	100	—	60	135	156	—	60	105	27	47	14	23	80
	575	—	100	—	60	135	156	—	75	130	34	59	17	29	100
	5	200	—	75	—	60	270	311	240	—	91	—	41	—	20
230		—	100	—	75	270	311	240	60	105	27	47	14	24	80
380		—	150	—	125	270	311	—	—	173	—	—	—	—	—
460		—	200	—	150	270	311	—	120	210	54	94	27	47	160
575		—	200	—	150	270	311	—	150	260	68	117	34	59	200
6Δ		200	—	150	—	125	540	621	480	—	182	—	81	—	41
	230	—	200	—	150	540	621	480	120	210	54	94	27	47	160
	380	—	300	—	250	540	621	—	—	342	—	—	—	—	—
	460	—	400	—	300	540	621	—	240	415	108	188	54	94	320
	575	—	400	—	300	540	621	—	300	515	135	234	68	117	400
	7Δ	230	—	300	—	—	810	932	—	180	315	—	—	—	—
460		—	600	—	—	810	932	—	360	625	—	—	—	—	480
575		—	600	—	—	810	932	—	450	775	—	—	—	—	600

Tables and footnotes are taken from NEMA Standards.

The ratings for capacitor switching above assume the following maximum available fault currents:

- ▲ Ratings shown are for applications requiring repeated interruptions of stalled motor current or repeated closing of high transient currents encountered in rapid motor reversal, involving more than five openings or closings per minute and more than ten in a ten-minute period, such as plug-stop, plug-reverse or jogging duty. Ratings apply to single speed and multi-speed controllers.
- Per NEMA Standards paragraph ICS 2-321.20, the service-limit current represents the maximum rms current, in Amperes, which the controller may be expected to carry for protracted periods in normal service. At service-limit current ratings, temperature rises may exceed those obtained by testing the controller at its continuous current rating. The ultimate trip current of over-current (overload) relays or other motor protective devices shall not exceed the service-limit current ratings of the controller.
- ◆ FLUORESCENT LAMP LOADS—300 VOLTS AND LESS—The characteristics of fluorescent lamps are such that it is not necessary to derate Class 8502 contactors below their normal continuous current rating. Class 8903 contactors may also be used with fluorescent lamp loads. For controlling tungsten and infrared lamp loads, and resistance heating loads, Class 8903 AC lighting contactors are recommended. These contactors are specifically designed for such loads and are applied at their full rating as listed in the Class 8903 Section.
- ★ Ratings apply to contactors which are employed to switch the load at the utilization voltage of the heat producing element with a duty which requires continuous operation of not more than five openings per minute. Class 8903 Types L and S lighting contactors are rated for resistance heating loads.
- ▼ When discharged, a capacitor has essentially zero impedance. For repetitive switching by a contactor, sufficient impedance should be connected in series to limit inrush current to not more than 6 times the contactor rated continuous current. In many installations, the impedance of connecting conductors may be sufficient for this purpose. When switching to connect additional banks, the banks already on the line may be charged and can supply additional available short-circuit current which should be considered when selecting the impedance to limit the current.

- NEMA Size 00–3: 5,000 A RMS Sym.
  - NEMA Size 4–5: 10,000 A RMS Sym.
  - NEMA Size 6: 18,000 A RMS Sym.
  - NEMA Size 7: 30,000 A RMS Sym.
- Note: If available fault current is greater than these values, connect sufficient impedance in series as noted in the previous paragraph.

▲ For NEMA Size 6 & 7, the operation rate is as follows: Continuous operation rate is 3 operations per minute maximum; Jogging or Plugging Duty operation rate is 15 operations per minute for a maximum of three minutes.

The motor ratings in Table 16.51 are NEMA standard ratings and apply only when the code letter of the motor is the same as or occurs earlier in the alphabet than is shown in the Table 16.52. Motors having code letters occurring later in the alphabet may require a larger controller. Consult Schneider Electric CCC at (1-888-778-2733).

**Table 16.52:**

Motor Hp Rating	Maximum Allowable Motor Code Letter
1-1/2-2 3-5	L K H
7-1/2 and above	

Approximate Dimensions

Table 16.53: Dimensions for Class 8502 Open Type

NEMA Size	Type	No. of Poles	Fig. No.	Dimensions—Inches (Refer to Appropriate Figure)										Wt (lb)
				A	B	C	D	E	F	G	H	I		
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	
00	SAO	2-3	1	3-7/32	4-11/32	4-7/32	1-5/8	1-5/8	7/32	3-15/16	—	—	4	
0	SBO	1-3	1	3-7/32	4-11/32	4-7/32	1-5/8	1-5/8	7/32	3-15/16	—	—	4	
1	SCO	4-5		4-1/4	4-11/32	4-7/32	1-5/8	2-5/8	7/32	3-15/16	—	—	4-1/2	
2	SDO	2-3	1	4-5/16	5-1/8	4-15/16	2-5/32	2-5/32	7/32	4-19/32	17/32	1-1/16	6-3/4	
		4-5		5-5/8	5-1/8	4-15/16	2-5/32	3-15/32	7/32	4-19/32	17/32	1-1/16	8-1/4	
3	SEO	2-3	1	5-15/32	7-3/32	6-1/2	1-7/8	3-17/32	5/16	6-1/32	3-1/4	4-3/4	14	
		4-5		9-3/4	7-7/8	6-1/2	3-15/16	5-13/16	5/16	7	4-17/32	9-1/16	22	
4	SFO	2-3	1	6	8-3/16	6-1/2	2-1/16	3-15/16	5/16	7	3-19/32	5-5/16	18	
		4-5		9-3/4	8-3/16	6-1/2	3-15/16	5-13/16	5/16	7	4-17/32	9-1/16	22	
5	SGO	2-3	1	8-2/3	12-5/16	8-3/4	3-1/4	5-13/16	5/8	11-1/8	4-3/4	7-1/4	45	
6	SHO	2-3	1	10-35/64	28-1/16	9	3-17/32	7-1/32	5-1/16	18-9/16	4-3/4	7-1/4	80	
7	SJO	2-3	1	10-35/64	37-1/4	10-7/8	3-17/32	7-1/32	7-7/32	22-3/8	4-3/4	7-1/4	135	

Table 16.54: Dimensions for 8536 Open Type

NEMA Size	Type	No. of Poles	Fig. No.	Dimensions—Inches (Refer to Appropriate Figure)										Wt (lb)
				A	B	C	D	E	F	G	H	I		
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	
00, 0, 1, 1P	SAO-SCO	2-3	2	3-1/2	6-49/64	4-7/32	1/2	1	1-39/64	13/64	6-1/4	3-31/32	5	
0, 1	SBO-SCO	4	2	4-17/32	6-49/64	4-7/32	1/2	1	2-2/3	13/64	6-1/4	3-31/32	5-1/2	
2	SDO	2-3	2	4-5/16	7-13/16	4-15/16	1/2	1	2-5/32	13/64	7-11/32	4-1/16	7-3/4	
		4		5-5/8	7-13/16	4-15/16	1/2	1	3-15/32	13/64	7-11/32	4-1/16	9-1/4	
3	SEO	2-3	2	5-15/32	11-3/32	6-1/2	7/8	1-3/4	3-19/32	5/16	10-3/16	5-3/4	17	
		4		9-3/4	12-1/8	6-1/2	1-13/16	1-3/4	5-13/16	5/16	11-3/16	5-3/4	25	
4	SFO	3	2	6	12-7/8	6-1/2	1-13/16	1-3/4	3-15/16	5/16	11-3/16	5-3/4	22	
		4		9-3/4	12-7/8	6-1/2	1-13/16	1-3/4	5-29/32	5/16	11-3/16	5-3/4	25	
5	SGO	3	2	8-9/16	17-9/16	8-3/4	4-3/4	7-1/4	5-12/32	5/8	16-3/8	6	62	
6	SHO	3	2	12-11/32	28-1/16	9	4-3/4	7-1/4	5-25/32	5-1/16	18-9/16	8-11/16	85	
7	SJO	3	2	12-11/32	37-1/4	10-7/8	4-3/4	7-1/4	5-25/32	7-7/32	22-3/8	9	140	

Table 16.55: Dimensions for NEMA 1 General Purpose Enclosure

NEMA Size	Type	No. of Poles	Fig. No.	Dimensions—Inches												
				A	B	C		D	E	F	G	H	I	J	K	L
						8502	8536									
00	SAG	All	3	—	—	—	—	—	—	—	—	—	—	—	—	—
0	SBG	All	3	6	10	5-9/32	5-9/16	3	7/8	8-1/8	1	15/16	4-1/8	5	—	—
1	SCG	All	3	—	—	—	—	—	—	—	—	—	—	—	—	—
2	SDG	All	3	7-13/16	12-11/16	6-1/32	6-5/16	—	1-3/32	10-1/2	1-3/32	1-3/32	5-5/8	5-3/4	1-3/32	5-5/8
3	SEG	All	3	11-7/16	21-13/16	8	8-3/8	—	1-17/32	18-3/4	1-17/32	1-17/32	8-3/8	7-3/4	1-17/32	8-3/8
4	SFG	All	5	11-1/4	25-5/32	9	9	8-19/32	1-1/4	1-1/4	22-5/16	1-7/16	7/16	—	—	—
5	SGG	All	5	17-7/32	44-7/32	12-13/16	12-15/16	13	2-1/8	2-1/8	40	2-1/8	9/16	—	—	—
6	SHG	All	4	65-3/4	20-7/32	13-1/8	13-1/8	—	11	64-1/2	2-5/16	5-1/2	—	—	—	—
7	SJG	All	4	93	34-1/2	23-1/2	23-1/2	Floor Mounting								

Class 8536 Starter  
Designation: EF-4  
8536SBG2V02H31S

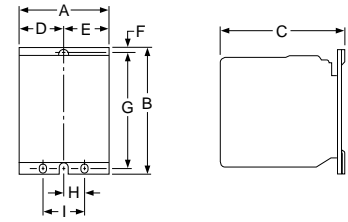


Figure 1  
Class 8502

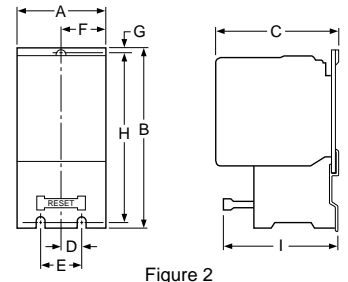


Figure 2  
Class 8536

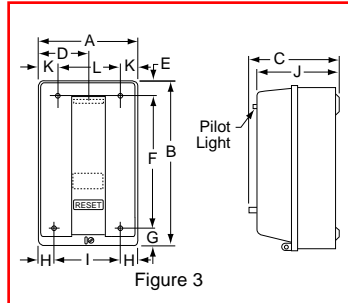


Figure 3

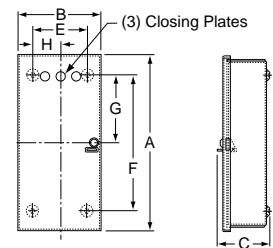


Figure 4

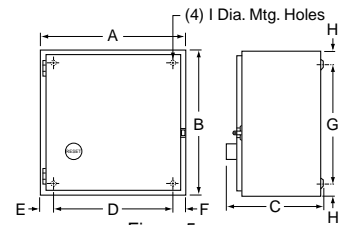


Figure 5

**For Full Voltage Contactors and Starters**

**Table 16.263: Full Voltage Controllers Only**

Classes 8502, 8536, 8538, 8539, 8702, 8736, 8738, 8739, 8810, 8811 and 8812														
Factory Modifications	Enclosure Type	Form	NEMA SIZE											
			00	0	1	2	3	4	5	6	7			
Separate Control Circuit— (specify voltage and frequency)	Any	S▲		No Charge	No Charge	No Charge	No Charge	No Charge	No Charge	No Charge	No Charge	No Charge		
Fused Control Circuit (without control transformer)														
One fuse	1, 3R, 4, 4X, 12	F	314.00	314.00	314.00	314.00	314.00	314.00	314.00	314.00	—	—		
Two fuses	1, 3R, 4, 4X, 7, 9, 12	F4	314.00	314.00	314.00	314.00	314.00	314.00	314.00	314.00	—	—		
<b>Control Circuit Transformers — Standard capacity (50 or 60 Hz) Note: All orders requesting Form FT will be supplied as Form F4T.</b>														
<b>FUSES</b>														
	Primary	Secondary												
CONTROL CIRCUIT Full Voltage and Multi-Speed Controllers Only Classes 8502 8536 8538 8539 8702 8736 8738 8739 8810 8811 8812	2	1	1, 4, 4X, 12	FF4T	698.00	698.00	698.00	855.00	1112.00	1283.00	1412.00 ♦	1412.00	1412.00	
	2	1	7 & 9	FF4T	755.00	755.00	755.00	1053.00	1353.00	1640.00	1839.00 ♦	1839.00	1839.00	
	2	2	1, 4, 4X, 12	F4F10T	698.00	698.00	698.00	855.00	1112.00	1283.00	1412.00 ♦	—	—	
	<b>Additional Capacity (50 or 60 Hz)</b>													
	Two fuses in primary and one fuse in secondary													
	100 VA additional capacity	1, 4, 4X, 12		FF4T11	998.00	998.00	998.00	1197.00	1425.00	1566.00 ♦	1710.00 ♦	1710.00	1710.00	1710.00
	100 VA additional capacity	7 & 9		FF4T11	1053.00	1053.00	1053.00	1395.00	1668.00	1925.00 ♦	2138.00 ♦	—	—	—
	200 VA additional capacity	1, 4, 4X, 12		FF4T12	1241.00	1241.00	1241.00	1467.00	1695.00 ♦	1839.00 ♦	1839.00 ♦	1839.00	1839.00	1839.00
	300 VA additional capacity	1, 4, 4X, 12		FF4T13	1481.00	1481.00 ♦	1481.00 ♦	1737.00 ♦	1967.00 ♦	2109.00 ♦	2109.00 ♦	2109.00	2109.00	2109.00
	400 VA additional capacity	1, 4, 4X, 12		FF4T14	1967.00	1967.00 ♦	1967.00 ♦	2280.00 ♦	2507.00 ♦	2793.00 ♦	2793.00 ♦	2793.00 ♦	2793.00 ♦	2793.00 ♦
500 VA additional capacity	1, 4, 4X, 12		FF4T15	2250.00	2250.00 ♦	2250.00 ♦	2564.00 ♦	2793.00 ♦	3077.00 ♦	3077.00 ♦	3077.00 ♦	3077.00 ♦	3077.00 ♦	

- ▲ All combination style devices such as 8538, 8539, 8738, 8739, that use **Form S** should also use **Form Y74** (auxiliary contact installed on disconnect switch) per NEC Article 430-74.
- Table 16.266 at right.
- ♦ Single primary voltage must be specified.

**Table 16.264: Marine Control**

Class	Factory Modification	Enclosure Type	Form	\$ Price
8502 8536 8538 8539 8702 8736 8738 8739 8810 8841	Modification of standard device for use as marine control per UL508	12/3R 4/4X (S.S. only)	M10	See Below

**Table 16.265:**

Form	NEMA Size★							
	00▼	0▼	1	2	3	4	5	6
M10	—	—	338.00	450.00	720.00	1260.00	3015.00	4725.00

- ★ Not available for NEMA Size 7.
- ▼ Cannot be used with Marine controls.

**■ Selection of Control Circuit Transformers**

The standard primary/secondary voltages for control circuit transformers are indicated in the following table.

**Table 16.266:**

AC-OPERATED DEVICES With Control Transformers	
Voltage	Code
60 Hz (Primary-Secondary)	
120-12Δ	V88
120-24Δ	V89
208-120	V84
240-24Δ	V82
240-120	V80
277-120	V85
480-24Δ	V83
480-120	V81
480-240	V87
600-120	V86
Specify	V99

- Δ 12 V coils are not available on Sizes 3-7.
- 24 V coils are not available on Sizes 4-7.

To order, select the desired device with the appropriate transformer Form designation. Then convert the previously selected voltage code (V●●) to reflect the desired primary/secondary voltage for the transformer. The secondary voltage should equal the previously selected coil voltage of the device.

**Example:**

You have previously selected a Class 8536SDG1V02S. V02S means that you need a coil voltage of 120-60/110-50 wired for separate control. You would like to add **Form FF4T** with the transformer voltages being 480 volt primary, 120 volt secondary with Solid State Overload Relay Protection Class 20 Trip Class (H20).

The new and complete class, type, voltage code and form number will be:

Class            Type            Voltage Code            Form □  
8536            SDG1            V81            FF4H20T

- Form numbers should always be shown in alphabetical order. Each letter indicates the beginning of a new form and may be followed by one or more numbers.

# Factory Modifications (Forms) For Full Voltage Contactors and Starters

Class 8536 Starter  
Designation: EF-4  
8536SBG2V02C6H31S

## Full Voltage Controllers Only

CLASSES 8538, 8539, 8738 and 8739

Factory Modifications		Enclosure Type	Form Letters
OVERLOAD RELAYS	<b>Non-Compensated Bimetallic Overload Relays</b>		
	Single Phase:		
	Types SB-SD (Sizes 0-2)Ⓜ	Any	B1
	Polyphase:		
	Two Element — For 2 Phase Only		
	Types SB-SD (Sizes 0-2)	Any	B1
	Three Element		
	Types SB-SD (Sizes 0-2)	Any	B2
	Types SE-SF (Sizes 3-4)	Any	B5
	Type SG (Size 5)	Any	B2Y500
	Type SH (Size 6)	Any	B2
	<b>Ambient Compensated Bimetallic Overload Relays</b>		
	Three Element		
	Types SB-SD (Sizes 0-2)	1, 4, 7, 9, 12	2B
	Types SE-SF (Sizes 3 & 4)	Any	Y59
Type SG (Size 5)	Any	BY500	
Type SH (Size 6)	Any	B	
<b>Overload Relays - General</b>			
Substitute Class 9065 SSRO100			
For Standard Overload Protection	Any	B11	
Omit overload protection from combination starters. (Classes 8538, 8539, 8738, 8739 only)			
Do not use with MAG-GARD® Circuit Breakers.			
Deduct per starter	Any	Y76	
Modify Size 3 Type SE starters with melting alloy overload relays to accept Type FB quick trip or SB slow trip thermal units and Size 4 Type SF starters to accept Type FB quick trip thermal units. (Rejects Type CC standard trip thermal units.)	Any	Y81	
Substitute 9999 SO4 isolated alarm contact (N.O.) on melting alloy overload relay	Any	Y342	
Substitute 9999 SO5 isolated alarm contact (N.C.) on melting alloy overload relay	Any	Y344	

Ⓜ Size 7 uses a solid state overload relay as standard. See Class 8536 for complete details.  
 Ⓜ Single phase bimetallic overload relays for Type S Sizes 0-2 require two (2) thermal units per starter.  
 Ⓜ For Classes 8736, 8738 and 8739, Type SG, consult Local Square D Field Office.

## Solid State Overload Relay Factory Modifications (Forms)

The solid state overload relay is available on NEMA Size 00-7.  
 For Class 8536, 8538, 8539, 8736, 8738, 8739 and 8810 devices.

### Form Description

Type S Starter with Motor Logic  
 Solid State Overload Relay

- 1 - Motor Logic, Base Unit, Trip Class 10
- 2 - Motor Logic, Base Unit, Trip Class 20
- 3 - Motor Logic, Feature Base Unit
- 0 - No additional modifications

1 - N.O. Aux. Contact (Field Convertible to N.C.)

Special Overload/Contactor Size Combinations (Base Unit & Feature Base Units):  
 (Must Be Specified On Size 00 Starter Orders)

- Blank - Overload Matched to Starter Size (i.e. Size 1 contactor & 9-27A overload)
- 0 - A 6 - 18A overload on a starter size as indicated by the Starter Catalog Number
- 1 - A 9 - 27A overload on a starter size as indicated by the Starter Catalog Number
- 2 - A 15 - 45A overload on a starter size as indicated by the Starter Catalog Number
- 3 - A 30 - 90A overload on a starter size as indicated by the Starter Catalog Number
- 4 - A 45 - 135A overload on a starter size as indicated by the Starter Catalog Number
- 8 - A 1.5 - 4.5A overload on a starter size as indicated by the Starter Catalog Number (only offered on Feature Base Units)
- 9 - A 3 - 9A overload on a starter size as indicated by the Starter Catalog Number

SPECIAL NOTE FOR Class 8810 devices:  
 You MUST SPECIFY TWO SEPARATE FORM NUMBERS TO GET MOTOR LOGIC OVERLOADS ON TWO SPEED STARTERS. The first form number is for the low speed winding and the second is for the high speed winding.  
 EXAMPLE: Open Style, Size 4 Two Speed Starter with Motor Logic Overloads Required.  
 Single Winding, 460V, Constant Horsepower  
 High Speed FLA = 96A  
 Low Speed FLA = 27A (use Size 2 Overload)  
 Catalog Number to Order: 8810 SF01V02 form S H20 H202  
 Where: Form H20 is a Size 4 Contactor with a 45-135A Motor Logic Overload for the High Speed and form H202 is a 15-45A Motor Logic Overload on the low speed contactor.

## Classes 8538, 8539, 8738 and 8739

Factory Modifications	Form
Motor Logic Solid State Overload	Base Unit, Trip Class 10 H10
	Base Unit, Trip Class 20 H20
	Feature Base Unit H30
	Base Unit, Trip Class 10 H11
	Base Unit, Trip Class 20 H21
Motor Logic Solid State Overload with Auxiliary Contact	Feature Base Unit H31

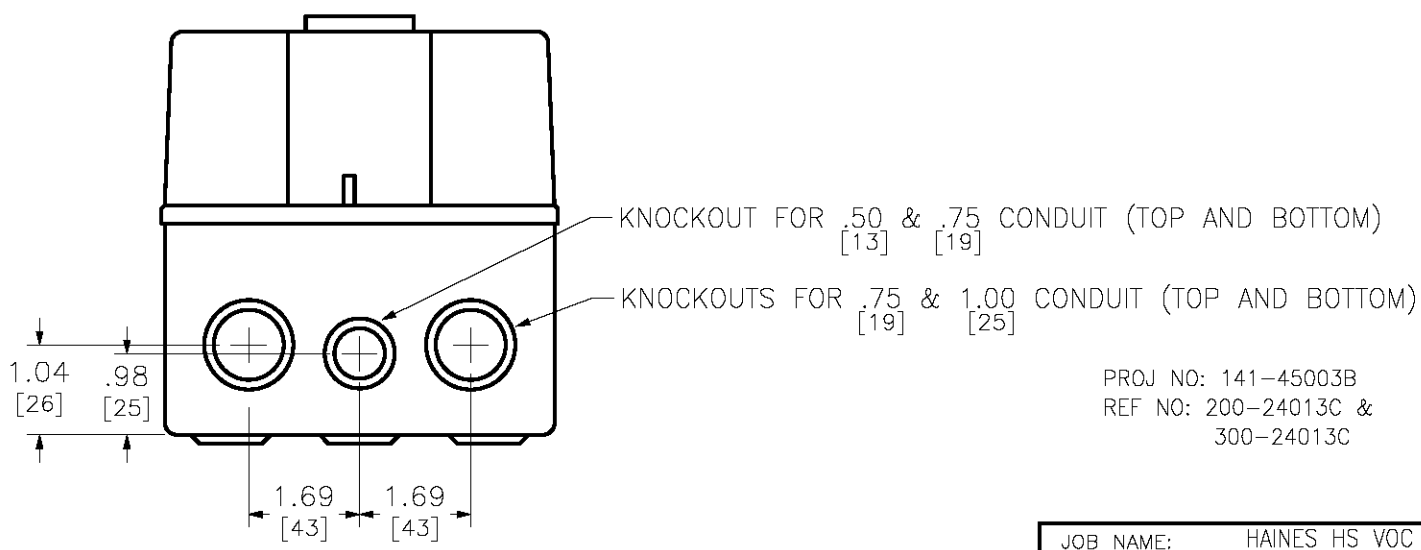
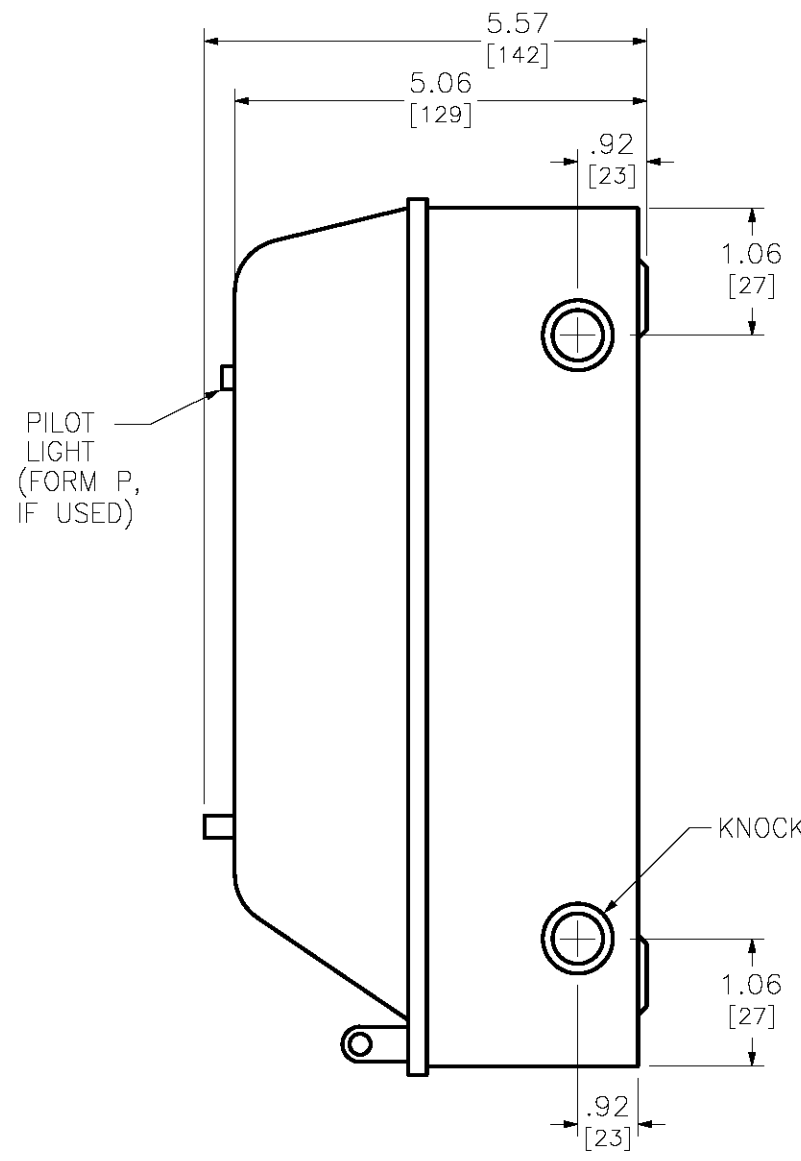
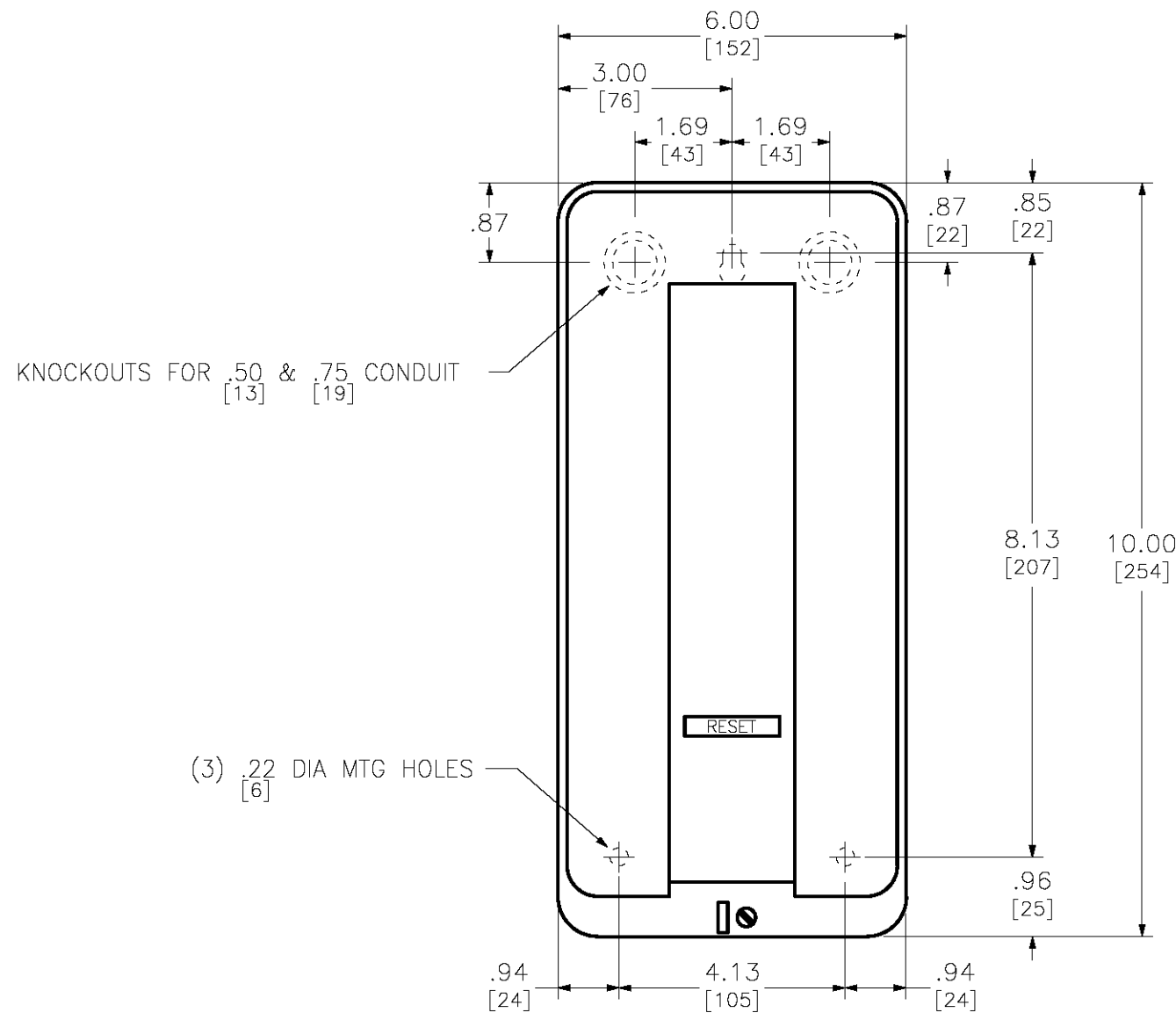
## Special Starter Combinations with Motor Logic™ Overload Relay Protection

NEMA Contactor Size	Solid State Overload Relay Size							NEMA Contactor Size	Solid State Overload Relay Size						
	00B	00C	0	1	2	3	4		00B	00C	0	1	2	3	4
00	▲	Std.						2	▲	▲	▲	▲	Std.		
0	▲	▲	Std.					3	n/a	n/a	n/a	n/a	n/a	Std.	
1	▲	▲	▲	Std.				4	n/a	n/a	n/a	n/a	n/a	▲	Std.

▲ Possible factory starter combinations available.

REV	DESCRIPTION	BY	DATE						
-	-	-	-	-	-	-	-	-	-

CLASS 8502/8536 MAGNETIC CONTACTORS AND STARTERS  
NEMA TYPE 1 GENERAL PURPOSE ENCLOSURE



**Class 8536 Starter**  
**Designation: EF-5**  
**8536SBG1V02SY344**

DUAL DIMENSIONS: INCHES  
MILLIMETERS

NEMA SIZE	CLASS	TYPE	NO. OF POLES	FORMS
00	8502 & 8536	SAG	2-3	STD,A,C,P,S,X
0 & 1	8502 & 8536	SBG SCG	1-5	STD,A,B,C,P,S,X

PROJ NO: 141-45003B  
REF NO: 200-24013C &  
300-24013C

NOT TO SCALE

JOB NAME:	HAINES HS VOC TECH BLDG	EQUIPMENT DESIGNATION:	<b>EF-5</b>
JOB LOCATION:	HAINES AK	EQUIPMENT TYPE:	
DRAWN BY:	(Q2C)	DRAWING TYPE:	
ENGR:			
DATE:	May 06 2015		
DRAWING STATUS:	QUOTE	DWG#	<b>F36582663-01</b>
		PG	<b>1</b> OF <b>1</b> REV -



**Class 8536 Starter**  
**Designation: EF-5**  
**8536SBG1V02SY344**

**NEMA Contactors and Starters**



Manual Starters and Switches (p. 16-4)



Definite Purpose Contactors and Starters (p. 16-70)



NEMA Style Type S Contactors and Starters (p. 16-14)



Lighting Contactors (p. 16-59)



Pump Panel (p. 16-75)



Combination Starters (p. 16-31)



NEMA Style TeSys N Contactors and Starters (p. 16-139)



**NEMA AC Magnetic Contactors and Starters Catalog Numbering System**

16-13

**Combination Starters—NEMA Style**

Non-Reversing	
Non-Fusible Disconnect Class 8538	16-32, 16-34
Fusible Disconnect Class 8538	16-31, 16-33, 16-34
Electronic Motor Circuit Protector (MCP) Class 8539	16-35, 16-36, 16-37
Thermal Magnetic Circuit Breaker Class 8539	16-38, 16-39
Reversing	
Non-Fusible Disconnect Class 8738	16-52
Fusible Disconnect Class 8738, 8739	16-51, 16-52
Electronic Motor Circuit Protector (MCP) Class 8739	16-53
Thermal Magnetic Circuit Breaker Class 8739	16-55

**Contactors—NEMA Style**

Non-Reversing Class 8502	16-14
Reversing Class 8702	16-44
Vacuum, Low Voltage, Non-Reversing Class 8502	16-28
Vacuum, Low Voltage, Reversing Class 8702	16-50

**Definite Purpose Contactors and Starters**

Class 8910, 8965 16-70

**Duplex Motor Starters** Class 8941

16-78

**Enclosures** Class 9991

16-93

**External Reset Mechanisms** Class 9065

16-92

**Factory Modifications (Forms)**

16-100

**Lighting Contactors** Class 8903

16-59

Panel Board (PB) Lighting Contactors See Supplemental Digest

**Manual Starters and Switches** Class 2510, 2511, 2512

16-4

**Multispeed Starters** Class 8810

See Supplemental Digest

**Overload Relays**

Bimetallic Class 9065	16-89
Melting Alloy Class 9065	16-82
Motor Logic/Motor Logic Plus Class 9065	16-83
TeSys T Motor Management System	16-84

**Pump Panels**

Full Voltage Class 8940	16-75
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**Reduced Voltage Starters**

Electro-Mechanical Class 8600	See Supplemental Digest
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**Starters, Full Voltage—NEMA Style**

Non-Reversing Class 8536	16-18
Reversing Class 8736	16-46
TeSys U Simple Motor Starter	16-12
Vacuum, Low Voltage, Non-Reversing Class 8536	16-29

**Additional Products**

Accessories Class 9998, 9999	16-108
Renewal Parts Class 9998	16-105
Thermal Units	16-116
Reversing Drum Switches Class 2601	See Supplemental Digest

**TeSys N Contactors and Starters**

16-139



**Class 8536 Starter**  
**Designation: EF-5**  
**8536SBG1V02SY344**



Class	2510, 2511, 2512	8502 & 8702	8536 & 8736	8538 & 8738	8539 & 8739
	Manual Starters and Switches, Non-Reversing, Reversing and Two Speed	NEMA Style Full Voltage Non-Reversing and Full Voltage Reversing Magnetic Contactors	NEMA Style Full Voltage Non-Reversing and Full Voltage Reversing Magnetic Starters	NEMA Style Full Voltage Non-Reversing and Full Voltage Reversing Combination (Disconnect Switch) Magnetic Starters	NEMA Style Full Voltage Non-Reversing and Full Voltage Reversing Combination (PowerPact™ Circuit Breaker) Magnetic Starters
Page	16-4	8502 16-14	8536 16-18	8538 16-31	8539 16-35
		8702 16-44	8736 16-46	8738 16-51	8739 16-53
NEMA Sizes	Type F = N/A	00 to 7	00 to 7	8538 = 0 to 6	8539 = 0 to 7
	Type K = N/A			8738 = 0 to 5	8739 = 0 to 6
	Type M = 0 & 1				
Load Voltage	Type F = 277 V	600 Vac Max.	600 Vac Max.	600 Vac Max.	600 Vac Max.
	Types K & M = 600 Vac				
Current Ratings (Continuous)	Type F = 16 A	9A to 810 A	9 A to 810 A	8538 = 18 A to 540 A	8539 = 18 A to 810 A
	Types K & M = 30 A			8738 = 18 A to 270 A	8739 = 18 A to 540 A
Horsepower Ratings (Maximum)	Type F = 1	1/2 to 600	1/2 to 600	8538 = 1/2 to 400	8539 = 1/2 to 600
	Type K = 20			8738 = 1/2 to 200	8739 = 1/2 to 400
	Type M = 10				
Overload Relay	Type F = Melting Alloy	N/A	Melting Alloy	Melting Alloy	Melting Alloy
	Type K = N/A		Bi-Metallic	Bi-Metallic	Bi-Metallic
	Type M = Melting Alloy		Solid State	Solid State	Solid State
Enclosure Types	1, Flush Mount, 3R, 4, 4X, 7 & 9 and Open	1, 3R, 4, 4X, 12/3R, 7 & 9 and Open	1, 3R, 4, 4X, 12/3R, 7 & 9 and Open	1, 4, 4X, 12/3R	1, 4, 4X, 12/3R
Approvals	UL File E42243 NLRV	UL File E78351 NLDX	UL File E78351 NLDX	UL File E152395 NKJH7	UL File E152395 NKJH7
	UR File E42243 NLRV2	CSA 60905 Class 3211-04	CSA 60905 Class 3211-04	CSA LR584 Class 3211 04	CSA LR584 Class 3211 04
	CSA File LR 25490	CE IEC 947-4-1 Sizes 00-5 Only	CE IEC 947-4-1 Sizes 00-5 Only		



**Class 8536 Starter  
Designation: EF-5  
8536SBG1V02SY344**

Class 8536		Type S C G - 3 V02		Form S
<b>General Classification</b>				
8502	Contactor Page 16-14			
8536	Starter Page 16-18			
8538	Combination Starter with Disconnect Switch Page 16-31			
8539	Combination Starter with Circuit Breaker Page 16-35			
8702	Reversing Contactor Page 16-44			
8736	Reversing Starter Page 16-46			
8738	Reversing Combination Starter with Disconnect Switch Page 16-54			
8739	Reversing Combination Starter with Circuit Breaker			
8810	Two Speed Starter ▲			
8903	Type S Lighting Contactors Page 16-60 ▲			
8940	Pumping Plant Panel ▲			
8941	Duplex Controller Page 16-78 ▲			
<b>Design</b>				
Type S NEMA Contactors and Starters				
<b>NEMA Size</b>		<b>8903 (only)</b>		
A	Size 00			
B	Size 0	M	30 Amperes	
C	Size 1	P	60 Amperes	
D	Size 2	Q	100 Amperes	
E	Size 3	V	200 Amperes	
F	Size 4	X	300 Amperes	
G	Size 5	Y	400 Amperes	
H	Size 6	Z	600 Amperes	
J	Size 7	J	800 Amperes	
<b>Enclosure</b>				
A	NEMA 12 Industrial Use			
F	NEMA 1 Flush Mounting General Purpose			
G	NEMA 1 General Purpose Surface Mounting			
H	NEMA 3R Rainproof			
O	Open Style Device (no enclosure)			
R	NEMA 7 & 9 Hazardous Environments, Spin Top			
T	NEMA 7 & 9 Hazardous Environments, Bolted			
W	NEMA 4 Watertight, 4X Corrosion Resistant			
<b>Numerals</b>				
Used to designate specific, physical arrangements, such as number of poles, fuse clip size, etc.; but the numbering varies with Class of equipment. Consult Digest listings for specific device numbers.				
1				
<b>Voltage Code</b>				
AC operated devices without control transformer				
V02	120/60 or 110/50			
V01	24/60			
V06	480/60 or 440/50			
V07	600/60 or 550/50			
V08	208/60			
V81 - 480V Primary, 120V Secondary for units using a fused transformer control circuit Form (F4T).				
This is only a partial listing consult Digest pages 16-14 and 16-101 for more information.				
<b>Common Forms (factory modifications) Page 16-100</b>				
A	"Start-Stop" pushbuttons in the enclosure cover			
B■	Bimetallic overload relays			
C	"Hand-Off-Auto" selector switch in the enclosure cover			
F4T	Fused transformer control circuit (primary fuses only)			
FF4T	Fused transformer control circuit (primary & secondary fuses)			
H	Solid state overload relay			
P1	Red ON pilot light in the enclosure cover			
P2	Green OFF pilot light in cover			
S	Separate control circuit			
X01	One "normally closed" auxiliary contact N.C.			
X10	One "normally open" auxiliary contact N.O.			
Consult Digest pages 16-100 to 16-104 for additional form letters. When more than one form is applied to a single device, arrange Forms in alphabetical order.				
▲ Combination two speed starters will replace the "S" with a "C", "U" or "D". Pumping plant panels have Various leading characters. Not all use Type S contactors. Duplex controllers use "N", "C", "U", and "D".				
■ May also designate Motor Logic Plus overload relay				

Y344 - Additional NC alarm contact

**Table 16.33: How to Order**

To Order Specify:	Catalog Number			
<ul style="list-style-type: none"> <li>• Class Number</li> <li>• Type Number</li> <li>• Voltage Code</li> <li>• Form(s) see pages 16-100-16-104</li> </ul>	Class	Type	Voltage Code	Form(s)
	8539	SCG44	V06	AH20P1X11

Note: Description: NEMA Size 1, (10 Hp) Electronic Motor Circuit Protector (MCP) Combo Starter in a NEMA Type 1 enclosure with a 480V coil, start/stop pushbutton (A), class 20 SSOLR (H20), red pilot light (P1), 1 N.O. and 1 N.C. auxiliary contact (X11)

**IMPORTANT - This information is intended for general interpretation of catalog numbers. Do not use to create catalog numbers for this product line.**

Note: The terms Type and Form do not appear in the catalog number.

Devices are wired from factory according to customer preference as follows:

- Common control
- Separate control (Form S)
- Control power transformer (CPT)



Type SCO3  
Size 1, 3-Pole Starter

**General Information**

Type S magnetic starters are used for full-voltage starting and stopping of AC squirrel cage motors. Motor overload protection is provided via melting alloy type thermal overload relays. Type S starters are available in NEMA Sizes 00 through 7, and are designed for operation at 600 Vac, 50 to 60 Hz.

**Solid State Overload Relay Protection (Motor Logic™)**

These ambient insensitive overload relays are available on Sizes 00 through 6 and standard on size 7. They provide phase loss, phase unbalance protection. To order, add Form **H30** (for selectable trip class 10 or 20 protection). For more information about Motor Logic, see pages 16-83 and 16-102.

**Adapted Bimetal (NEMA Sizes 00–1)**

The Adapted Bimetal motor starter consists of a specially designed adapter that attaches with bus bars to the NEMA Type S contactor and holds the LRD or LR3D (IEC Style) bimetal overload relay. This starter configuration can be ordered by adding Form E (adapter only) to the standard catalog number. Once the FLA of the motor has been determined, the LRD or LR3D bimetal overload can be purchased separately and installed in the field at a later date. For more information see Table 16.421.

**TeSys T Motor Management System (NEMA Sizes 1–6)**

TeSys T is a flexible system that integrates seamlessly into your automation system through five major communication protocols. TeSys T can predict what will happen in the process, as it accurately monitors current, voltage, and power over a wide range. For additional information about TeSys T Motor Management System, see pages 16-84 to 16-88 and page 16-103.

**3-Pole Polyphase—600 Vac Maximum—50–60 Hz**

Note that prices shown do not include thermal units. Devices require 3 thermal units (Sizes 00–6). Standard trip thermal units are **\$21.50** each. See page 16-116 for selection information.

**Table 16.40:**

NEMA Size	Continuous Current Ratings	Motor Voltage	Max. Hp	Open Type		NEMA 1 General Purpose Enclosure		NEMA 4 & 4X Watertight, Dusttight Brushed Stainless Steel Enclosure (Size 0-5)▲		NEMA 4X Watertight, Dusttight, Corrosion-Resistant Glass-Polyester Enclosure	
				Type	\$ Price	Type	\$ Price	Type	\$ Price	Type	\$ Price
00	9	200 230 460 575	1-1/2 1-1/2 2 2	SAO12■	386.00	SAG12■	419.00	Use Size 0		Use Size 0	
0	18	200 230 460 575	3 3 5 5	SBO2■	485.00	SBG2■	518.00	SBW12■	1017.00	SBW22■	1017.00
1	27	200 230 460 575	7-1/2 7-1/2 10 10	SCO3■	557.00	SCG3■	590.00	SCW13■	1103.00	SCW23■	1103.00
2	45	200 230 460 575	10 15 25 25	SDO1■	1013.00	SDG1■	1160.00	SDW11■	2186.00	SDW21■	2186.00
3	90	200 230 460 575	25 30 50 50	SEO1■	1638.00	SEG1■	1929.00	SEW11■	3380.00	SEW21■	4226.00
4	135	200 230 460 575	40 50 100 100	SFO1■	3747.00	SFG1■	4350.00	SFW11■	6827.00	SFW21■	8535.00
5	270	200 230 460 575	75 100 200 200	SGO1■	9152.00	SGG1■	10254.00	SGW11■	15795.00	—	—
6	540	200 230 460 575	150 200 400 400	SHO2■	21756.00	SHG2■	28881.00	SHW2■	36003.00	—	—
7	810	200 230 460 575	— 300 600 600	SJO2■	31256.00	SJG2■	38381.00	SJW2■	45503.00	—	—

▲ Size 6 and 7 are rated NEMA 4 only, painted sheet steel.  
■ Coil voltage code must be specified to order this product. Refer to standard coil voltage codes shown below.



Schneider Electric offers express shipping for factory modified NEMA Type 1 and Type 12/3R Enclosed Starters. When you need them fast, our Laser™ Delivery program is the answer to getting your product when you need it most. Ask for Laser™ Delivery, then select the product and the modifications you need when you place your order. It's as easy as that!

**2-Pole Single Phase—600 Vac Maximum—50–60 Hz**

**Table 16.43:**

Note that prices shown do not include thermal units. Devices require 1 thermal unit. Standard trip thermal units are **\$21.50** each. See page 16-116 for selection information.

NEMA Size	Continuous Current Ratings	Motor Voltage	Max. Hp	Open Type		NEMA 1 General Purpose Enclosure		NEMA 4 & 4X Watertight, Dusttight Brushed Stainless Steel Enclosure		NEMA 4X Watertight, Dusttight, Corrosion-Resistant Glass-Polyester Enclosure	
				Type	\$ Price	Type	\$ Price	Type	\$ Price	Type	\$ Price
00	9	115 230	1/3 1	SAO11▲	386.00	SAG11▲	419.00	Use Size 0		Use Size 0	
0	18	115 230	1 2	SBO1▲	435.00	SBG1▲	468.00	SBW11▲	966.00	SBW21▲	966.00
1	27	115 230	2 3	SCO1▲	507.00	SCG1▲	539.00	SCW11▲	1052.00	SCW21▲	1052.00
1P	36	115 230	3 5	SCO2▲	662.00	SCG2▲	696.00	SCW12▲	1209.00	SCW22▲	1209.00
2	45	115 230	3 7-1/2	SDO6▲	918.00	SDG6▲	1067.00	SDW16▲	2091.00	SDW26▲	2091.00

**4-Pole, 2-Phase—600 Vac Maximum—50–60 Hz**

**Table 16.44:**

Note that prices shown do not include thermal units. Devices require 2 thermal units. Standard trip thermal units are **\$21.50** each. See page 16-116 for selection information.

NEMA Size	Continuous Current Ratings	Motor Voltage	Max. Hp	Open Type		NEMA 1 General Purpose Enclosure		NEMA 4 & 4X Watertight, Dusttight Brushed Stainless Steel Enclosure		NEMA 4X Watertight, Dusttight, Corrosion-Resistant Glass-Polyester Enclosure	
				Type	\$ Price	Type	\$ Price	Type	\$ Price	Type	\$ Price
0	18	200 230 460 575	3 3 5 5	SBO3▲	629.00	SBG3▲	675.00	SBW13▲	1229.00	SBW23▲	1229.00
1	27	200 230 460 575	7-1/2 7-1/2 10 10	SCO4▲	714.00	SCG4▲	761.00	SCW14▲	1301.00	SCW24▲	1301.00
2	45	200 230 460 575	10 15 25 25	SDO2▲	1283.00	SDG2▲	1430.00	SDW12▲	2910.00	SDW22▲	2910.00
3	90	200 230 460 575	25 30 50 50	SEO2▲	2096.00	SEG2▲	2357.00	SEW12▲	4206.00	Consult Schneider Electric CCC at (1-888-778-2733)	
4	135	200 230 460 575	40 50 100 100	SFO2▲	5142.00	SFG2▲	5715.00	SFW12▲	9221.00		

▲ Coil voltage code must be specified to order this product. Refer to standard coil voltage codes listed below.

**Table 16.45: Coil Voltage Codes**

Voltage		Code	\$ Price Adder
60 Hz	50 Hz		
24■	—	V01	No Charge
120◆	110	V02	No Charge
208	—	V08	No Charge
240	220	V03	No Charge
277	—	V04	No Charge
480	440	V06	No Charge
600	550	V07	No Charge
Specify	Specify	V99	35.60

■ 24 V coils are not available on Sizes 4–7. On sizes 00–3, where 24 V coils are available, **Form S** (separate control) must be specified (i.e., order as 8536SBO2V01S).

◆ 120 Volt Polyphase starters are wired for separate control. **Form S** (separate control) must be specified (i.e., order as 8536SCO2V02S).

Note: For voltage codes used with control transformers, see 16-101.

Form S (separate control) is used when a separate source of power is available for the control (coil) voltage. Form S is supplied at no charge.

Dimensions . . . . . page 16-24  
 Factory Modifications (Forms) . . . . . page 16-100  
 Separate Enclosures (Class 9991) . . . . . page 16-93  
 Replacement Parts (Class 9998) . . . . . page 16-105  
 Type S Accessories (Class 9999) . . . . . page 16-108

For How to Order Information, see page 16-13.

**Application Data for Selection**

**Class 8536 Starter**  
**Designation: EF-5**  
**8536SBG1V02SY344**

**Table 16.51:**

NEMA Size	Load Voltage	Maximum Hp Rating—Nonplugging and Nonjogging Duty		Maximum Hp Rating—Plugging and Jogging Duty		Continuous Current Rating, (A) 600 Volt Max.	Service—Limit Current Rating, (A)	Tungsten and Infrared Lamp Load, (A) 250 Volts Max.	Resistance Heating Loads, KW—other than Infrared Lamp Loads *		KVA Rating for Switching Transformer Primaries at 50 or 60 Cycles				3Ø Rating for Switching Capacitors KVAR
		Single Phase	Poly-Phase	Single Phase	Poly-Phase				Single Phase	Poly-Phase	Inrush Currents (Worst Case Peak) ? 20 Times Peak of Continuous Current Rating		Inrush Currents (Worst Case Peak) > 20–40 Times Peak of Continuous Current Rating		
											Single Phase	Poly-Phase	Single Phase	Poly-Phase	
00	115	1/2	—	—	—	9	11	5	—	—	—	—	—	—	—
	200	—	1-1/2	—	—	9	11	5	—	—	—	—	—	—	—
	230	1	1-1/2	—	—	9	11	5	—	—	—	—	—	—	—
	380	—	1-1/2	—	—	9	11	—	—	—	—	—	—	—	—
	460	—	2	—	—	9	11	—	—	—	—	—	—	—	—
	575	—	2	—	—	9	11	—	—	—	—	—	—	—	—
0	115	1	—	1/2	—	18	21	10	—	—	0.6	—	0.3	—	—
	200	—	3	—	1-1/2	18	21	10	—	—	—	1.8	—	0.9	—
	230	2	3	—	1-1/2	18	21	10	—	—	1.2	2.1	0.6	1.0	—
	380	—	5	—	1-1/2	18	21	—	—	—	—	—	—	—	—
	460	—	5	—	2	18	21	—	—	—	2.4	4.2	1.2	2.1	—
	575	—	5	—	2	18	21	—	—	—	3.0	5.2	1.5	2.6	—
1	115	2	—	1	—	27	32	15	3	5	1.2	—	0.6	—	—
	200	—	7-1/2	—	3	27	32	15	—	9.1	—	3.6	—	1.8	—
	230	3	7-1/2	—	3	27	32	15	6	10	2.4	4.3	1.2	2.1	—
	380	—	10	—	5	27	32	—	—	16.5	—	—	—	—	—
	460	—	10	—	5	27	32	—	12	20	4.9	8.5	2.5	4.3	—
	575	—	10	—	5	27	32	—	15	25	6.2	11.0	3.1	5.3	—
1P	115	3	—	1-1/2	—	36	42	24	—	—	—	—	—	—	—
	230	5	—	3	—	36	42	24	—	—	—	—	—	—	—
2	115	3	—	2	—	45	52	30	5	8.5	2.1	—	1.0	—	—
	200	—	10	—	7-1/2	45	52	30	—	15.4	—	6.3	—	3.1	—
	230	7-1/2	15	—	10	45	52	30	10	17	4.1	7.2	2.1	3.6	8
	380	—	25	—	15	45	52	—	—	28	—	—	—	—	—
	460	—	25	—	15	45	52	—	20	34	8.3	14	4.2	7.2	16
	575	—	25	—	15	45	52	—	25	43	10.0	18	5.2	8.9	20
3	115	—	—	—	—	90	104	60	10	17	4.1	—	2.0	—	—
	200	—	25	—	15	90	104	60	—	31	—	12	—	6.1	—
	230	—	30	—	20	90	104	60	20	34	8.1	14	4.1	7.0	27
	380	—	50	—	30	90	104	—	—	56	—	—	—	—	—
	460	—	50	—	30	90	104	—	40	68	16	28	8.1	14	53
	575	—	50	—	30	90	104	—	50	86	20	35	10	18	67
4	200	—	40	—	25	135	156	120	—	45	—	20	—	10	—
	230	—	50	—	30	135	156	120	30	52	14	23	6.8	12	40
	380	—	75	—	50	135	156	—	—	86.7	—	—	—	—	—
	460	—	100	—	60	135	156	—	60	105	27	47	14	23	80
	575	—	100	—	60	135	156	—	75	130	34	59	17	29	100
	5	200	—	75	—	60	270	311	240	—	91	—	41	—	20
230		—	100	—	75	270	311	240	60	105	27	47	14	24	80
380		—	150	—	125	270	311	—	—	173	—	—	—	—	—
460		—	200	—	150	270	311	—	120	210	54	94	27	47	160
575		—	200	—	150	270	311	—	150	260	68	117	34	59	200
6Δ		200	—	150	—	125	540	621	480	—	182	—	81	—	41
	230	—	200	—	150	540	621	480	120	210	54	94	27	47	160
	380	—	300	—	250	540	621	—	—	342	—	—	—	—	—
	460	—	400	—	300	540	621	—	240	415	108	188	54	94	320
	575	—	400	—	300	540	621	—	300	515	135	234	68	117	400
	7Δ	230	—	300	—	—	810	932	—	180	315	—	—	—	—
460		—	600	—	—	810	932	—	360	625	—	—	—	—	480
575		—	600	—	—	810	932	—	450	775	—	—	—	—	600

Tables and footnotes are taken from NEMA Standards.

The ratings for capacitor switching above assume the following maximum available fault currents:

- ▲ Ratings shown are for applications requiring repeated interruptions of stalled motor current or repeated closing of high transient currents encountered in rapid motor reversal, involving more than five openings or closings per minute and more than ten in a ten-minute period, such as plug-stop, plug-reverse or jogging duty. Ratings apply to single speed and multi-speed controllers.
- Per NEMA Standards paragraph ICS 2-321.20, the service-limit current represents the maximum rms current, in Amperes, which the controller may be expected to carry for protracted periods in normal service. At service-limit current ratings, temperature rises may exceed those obtained by testing the controller at its continuous current rating. The ultimate trip current of over-current (overload) relays or other motor protective devices shall not exceed the service-limit current ratings of the controller.
- ◆ FLUORESCENT LAMP LOADS—300 VOLTS AND LESS—The characteristics of fluorescent lamps are such that it is not necessary to derate Class 8502 contactors below their normal continuous current rating. Class 8903 contactors may also be used with fluorescent lamp loads. For controlling tungsten and infrared lamp loads, and resistance heating loads, Class 8903 AC lighting contactors are recommended. These contactors are specifically designed for such loads and are applied at their full rating as listed in the Class 8903 Section.
- ★ Ratings apply to contactors which are employed to switch the load at the utilization voltage of the heat producing element with a duty which requires continuous operation of not more than five openings per minute. Class 8903 Types L and S lighting contactors are rated for resistance heating loads.
- ▼ When discharged, a capacitor has essentially zero impedance. For repetitive switching by a contactor, sufficient impedance should be connected in series to limit inrush current to not more than 6 times the contactor rated continuous current. In many installations, the impedance of connecting conductors may be sufficient for this purpose. When switching to connect additional banks, the banks already on the line may be charged and can supply additional available short-circuit current which should be considered when selecting the impedance to limit the current.

- NEMA Size 00–3: 5,000 A RMS Sym.
  - NEMA Size 4–5: 10,000 A RMS Sym.
  - NEMA Size 6: 18,000 A RMS Sym.
  - NEMA Size 7: 30,000 A RMS Sym.
- Note: If available fault current is greater than these values, connect sufficient impedance in series as noted in the previous paragraph.

▲ For NEMA Size 6 & 7, the operation rate is as follows: Continuous operation rate is 3 operations per minute maximum; Jogging or Plugging Duty operation rate is 15 operations per minute for a maximum of three minutes.

The motor ratings in Table 16.51 are NEMA standard ratings and apply only when the code letter of the motor is the same as or occurs earlier in the alphabet than is shown in the Table 16.52. Motors having code letters occurring later in the alphabet may require a larger controller. Consult Schneider Electric CCC at (1-888-778-2733).

**Table 16.52:**

Motor Hp Rating	Maximum Allowable Motor Code Letter
1-1/2-2	L K H
3-5	
7-1/2 and above	

Approximate Dimensions

Table 16.53: Dimensions for Class 8502 Open Type

NEMA Size	Type	No. of Poles	Fig. No.	Dimensions—Inches (Refer to Appropriate Figure)										Wt (lb)
				A	B	C	D	E	F	G	H	I		
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	
00	SAO	2-3	1	3-7/32	4-11/32	4-7/32	1-5/8	1-5/8	7/32	3-15/16	—	—	4	
0	SBO	1-3	1	3-7/32	4-11/32	4-7/32	1-5/8	1-5/8	7/32	3-15/16	—	—	4	
1	SCO	4-5		4-1/4	4-11/32	4-7/32	1-5/8	2-5/8	7/32	3-15/16	—	—	4-1/2	
2	SDO	2-3	1	4-5/16	5-1/8	4-15/16	2-5/32	2-5/32	7/32	4-19/32	17/32	1-1/16	6-3/4	
		4-5		5-5/8	5-1/8	4-15/16	2-5/32	3-15/32	7/32	4-19/32	17/32	1-1/16	8-1/4	
3	SEO	2-3	1	5-15/32	7-3/32	6-1/2	1-7/8	3-17/32	5/16	6-1/32	3-1/4	4-3/4	14	
		4-5		9-3/4	7-7/8	6-1/2	3-15/16	5-13/16	5/16	7	4-17/32	9-1/16	22	
4	SFO	2-3	1	6	8-3/16	6-1/2	2-1/16	3-15/16	5/16	7	3-19/32	5-5/16	18	
		4-5		9-3/4	8-3/16	6-1/2	3-15/16	5-13/16	5/16	7	4-17/32	9-1/16	22	
5	SGO	2-3	1	8-2/3	12-5/16	8-3/4	3-1/4	5-13/16	5/8	11-1/8	4-3/4	7-1/4	45	
6	SHO	2-3	1	10-35/64	28-1/16	9	3-17/32	7-1/32	5-1/16	18-9/16	4-3/4	7-1/4	80	
7	SJO	2-3	1	10-35/64	37-1/4	10-7/8	3-17/32	7-1/32	7-7/32	22-3/8	4-3/4	7-1/4	135	

Table 16.54: Dimensions for 8536 Open Type

NEMA Size	Type	No. of Poles	Fig. No.	Dimensions—Inches (Refer to Appropriate Figure)										Wt (lb)
				A	B	C	D	E	F	G	H	I		
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	
00, 0, 1, 1P	SAO-SCO	2-3	2	3-1/2	6-49/64	4-7/32	1/2	1	1-39/64	13/64	6-1/4	3-31/32	5	
0, 1	SBO-SCO	4	2	4-17/32	6-49/64	4-7/32	1/2	1	2-2/3	13/64	6-1/4	3-31/32	5-1/2	
2	SDO	2-3	2	4-5/16	7-13/16	4-15/16	1/2	1	2-5/32	13/64	7-11/32	4-1/16	7-3/4	
		4		5-5/8	7-13/16	4-15/16	1/2	1	3-15/32	13/64	7-11/32	4-1/16	9-1/4	
3	SEO	2-3	2	5-15/32	11-3/32	6-1/2	7/8	1-3/4	3-19/32	5/16	10-3/16	5-3/4	17	
		4		9-3/4	12-1/8	6-1/2	1-13/16	1-3/4	5-13/16	5/16	11-3/16	5-3/4	25	
4	SFO	3	2	6	12-7/8	6-1/2	1-13/16	1-3/4	3-15/16	5/16	11-3/16	5-3/4	22	
		4		9-3/4	12-7/8	6-1/2	1-13/16	1-3/4	5-29/32	5/16	11-3/16	5-3/4	25	
5	SGO	3	2	8-9/16	17-9/16	8-3/4	4-3/4	7-1/4	5-12/32	5/8	16-3/8	6	62	
6	SHO	3	2	12-11/32	28-1/16	9	4-3/4	7-1/4	5-25/32	5-1/16	18-9/16	8-11/16	85	
7	SJO	3	2	12-11/32	37-1/4	10-7/8	4-3/4	7-1/4	5-25/32	7-7/32	22-3/8	9	140	

Table 16.55: Dimensions for NEMA 1 General Purpose Enclosure

NEMA Size	Type	No. of Poles	Fig. No.	Dimensions—Inches												
				A	B	C		D	E	F	G	H	I	J	K	L
						8502	8536									
00	SAG	All	3	—	—	—	—	—	—	—	—	—	—	—	—	—
0	SBG	All	3	6	10	5-9/32	5-9/16	3	7/8	8-1/8	1	15/16	4-1/8	5	—	—
1	SCG	All	3	—	—	—	—	—	—	—	—	—	—	—	—	—
2	SDG	All	3	7-13/16	12-11/16	6-1/32	6-5/16	—	1-3/32	10-1/2	1-3/32	1-3/32	5-5/8	5-3/4	1-3/32	5-5/8
3	SEG	All	3	11-7/16	21-13/16	8	8-3/8	—	1-17/32	18-3/4	1-17/32	1-17/32	8-3/8	7-3/4	1-17/32	8-3/8
4	SFG	All	5	11-1/4	25-5/32	9	9	8-19/32	1-1/4	1-1/4	22-5/16	1-7/16	7/16	—	—	—
5	SGG	All	5	17-7/32	44-7/32	12-13/16	12-15/16	13	2-1/8	2-1/8	40	2-1/8	9/16	—	—	—
6	SHG	All	4	65-3/4	20-7/32	13-1/8	13-1/8	—	11	64-1/2	2-5/16	5-1/2	—	—	—	—
7	SJG	All	4	93	34-1/2	23-1/2	23-1/2	Floor Mounting								

Class 8536 Starter  
Designation: EF-5  
8536SBG1V02SY344

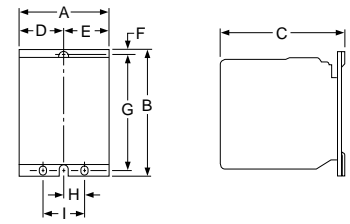


Figure 1  
Class 8502

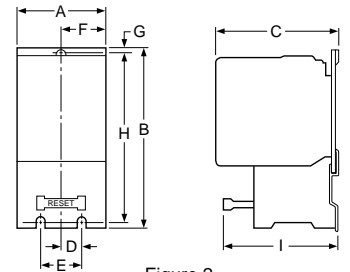


Figure 2  
Class 8536

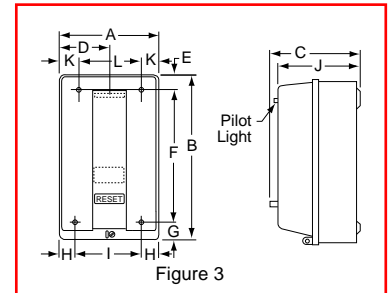


Figure 3

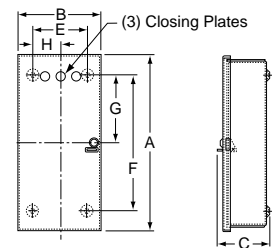


Figure 4

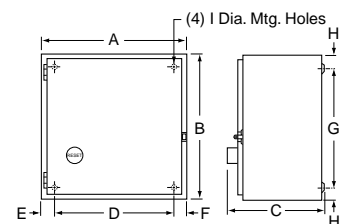


Figure 5

**For Full Voltage Contactors and Starters**

**Table 16.263: Full Voltage Controllers Only**

Classes 8502, 8536, 8538, 8539, 8702, 8736, 8738, 8739, 8810, 8811 and 8812														
Factory Modifications	Enclosure Type	Form	NEMA SIZE											
			00	0	1	2	3	4	5	6	7			
Separate Control Circuit— (specify voltage and frequency)	Any	S▲		No Charge	No Charge	No Charge	No Charge	No Charge	No Charge	No Charge	No Charge	No Charge		
Fused Control Circuit (without control transformer)														
One fuse	1, 3R, 4, 4X, 12	F	314.00	314.00	314.00	314.00	314.00	314.00	314.00	314.00	—	—		
Two fuses	1, 3R, 4, 4X, 7, 9, 12	F4	314.00	314.00	314.00	314.00	314.00	314.00	314.00	314.00	—	—		
<b>Control Circuit Transformers — Standard capacity (50 or 60 Hz) Note: All orders requesting Form FT will be supplied as Form F4T.</b>														
<b>FUSES</b>														
	Primary	Secondary												
CONTROL CIRCUIT Full Voltage and Multi-Speed Controllers Only Classes 8502 8536 8538 8539 8702 8736 8738 8739 8810 8811 8812	2	1	1, 4, 4X, 12	FF4T	698.00	698.00	698.00	855.00	1112.00	1283.00	1412.00 ♦	1412.00	1412.00	
	2	1	7 & 9	FF4T	755.00	755.00	755.00	1053.00	1353.00	1640.00	1839.00 ♦	1839.00	1839.00	
	2	2	1, 4, 4X, 12	F4F10T	698.00	698.00	698.00	855.00	1112.00	1283.00	1412.00 ♦	—	—	
	<b>Additional Capacity (50 or 60 Hz)</b>													
	Two fuses in primary and one fuse in secondary													
	100 VA additional capacity	1, 4, 4X, 12		FF4T11	998.00	998.00	998.00	1197.00	1425.00	1566.00 ♦	1710.00 ♦	1710.00	1710.00	1710.00
	100 VA additional capacity	7 & 9		FF4T11	1053.00	1053.00	1053.00	1395.00	1668.00	1925.00 ♦	2138.00 ♦	—	—	—
	200 VA additional capacity	1, 4, 4X, 12		FF4T12	1241.00	1241.00	1241.00	1467.00	1695.00 ♦	1839.00 ♦	1839.00 ♦	1839.00	1839.00	1839.00
	300 VA additional capacity	1, 4, 4X, 12		FF4T13	1481.00	1481.00 ♦	1481.00 ♦	1737.00 ♦	1967.00 ♦	2109.00 ♦	2109.00 ♦	2109.00	2109.00	2109.00
	400 VA additional capacity	1, 4, 4X, 12		FF4T14	1967.00	1967.00 ♦	1967.00 ♦	2280.00 ♦	2507.00 ♦	2793.00 ♦	2793.00 ♦	2793.00 ♦	2793.00 ♦	2793.00 ♦
500 VA additional capacity	1, 4, 4X, 12		FF4T15	2250.00	2250.00 ♦	2250.00 ♦	2564.00 ♦	2793.00 ♦	3077.00 ♦	3077.00 ♦	3077.00 ♦	3077.00 ♦	3077.00 ♦	

- ▲ All combination style devices such as 8538, 8539, 8738, 8739, that use **Form S** should also use **Form Y74** (auxiliary contact installed on disconnect switch) per NEC Article 430-74.
- Table 16.266 at right.
- ♦ Single primary voltage must be specified.

**Table 16.264: Marine Control**

Class	Factory Modification	Enclosure Type	Form	\$ Price
8502 8536 8538 8539 8702 8736 8738 8739 8810 8811 8812	Modification of standard device for use as marine control per UL508	12/3R 4/4X (S.S. only)	M10	See Below

**Table 16.265:**

Form	NEMA Size★							
	00▼	0▼	1	2	3	4	5	6
M10	—	—	338.00	450.00	720.00	1260.00	3015.00	4725.00

- ★ Not available for NEMA Size 7.
- ▼ Cannot be used with Marine controls.

**■ Selection of Control Circuit Transformers**

The standard primary/secondary voltages for control circuit transformers are indicated in the following table.

**Table 16.266:**

AC-OPERATED DEVICES With Control Transformers	
Voltage	Code
60 Hz (Primary-Secondary)	
120-12Δ	V88
120-24Δ	V89
208-120	V84
240-24Δ	V82
240-120	V80
277-120	V85
480-24Δ	V83
480-120	V81
480-240	V87
600-120	V86
Specify	V99

- Δ 12 V coils are not available on Sizes 3-7.
- 24 V coils are not available on Sizes 4-7.

To order, select the desired device with the appropriate transformer Form designation. Then convert the previously selected voltage code (V●●) to reflect the desired primary/secondary voltage for the transformer. The secondary voltage should equal the previously selected coil voltage of the device.

**Example:**

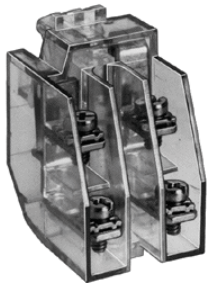
You have previously selected a Class 8536SDG1V02S. V02S means that you need a coil voltage of 120-60/110-50 wired for separate control. You would like to add **Form FF4T** with the transformer voltages being 480 volt primary, 120 volt secondary with Solid State Overload Relay Protection Class 20 Trip Class (H20).

The new and complete class, type, voltage code and form number will be:

Class            Type            Voltage Code            Form □  
8536            SDG1            V81            FF4H20T

- Form numbers should always be shown in alphabetical order. Each letter indicates the beginning of a new form and may be followed by one or more numbers.





Type SO4

**Y344 Additional  
NC alarm contact**

### Isolated Alarm Contacts For Melting Alloy Overload Relays

Isolated overload relay alarm contacts are available factory installed or in kit form for field installation in Type S, NEMA Size 00–6▲ starters and Class 9065 Types M and S melting alloy overload relays. Type S, NEMA Size 7, utilizes a solid state overload relay which has isolated alarm contacts as a standard feature. The alarm contacts allow the starter to be used in applications which require isolated contacts, such as inputs to a computer.

Class 9999 Types SO4 and SO5 modules are interchangeable with the standard module (Class 9998 Type SO1) and may be installed on starters already in service. The case is made of clear plastic (polycarbonate) to allow for visual inspection of contacts.

**Table 16.308: Contact Unit For Melting Alloy Overload Relays**

Magnetic Starter		Parts Kit Description	Class 9999 Type	\$ Price
NEMA Size	Type			
00-6▲	SA-SH	N.O. Isolated Alarm Contact Plus Standard N.C. Overload Contact	SO4	116.00
		N.C. Isolated Alarm Contact Plus Standard N.C. Overload Contact	SO5	

▲ Isolated alarm contacts **cannot** be added in the field to the Type S Size 5 starter. Current transformers and a Size 1 overload block must be used. For factory installation specify **Form Y342**.

### Solid Neutral

The Class 9999 Type SN kit can be used on Class 8903 Type S lighting contactors and other controllers where field addition of a solid neutral is required. Each kit has lugs suitable for both copper and aluminum wire, and mounts with two screws.

**Table 16.309:**

Number of Lugs	Wire Capacity Per Lug (Cu/Al)	Class 9999	
		Type	\$ Price
4	14–2/0	SN1	134.00
3	(1) 4–600 MCM or (2) 1/0–250 MCM	SN2	392.00
3 (Dual)	(2) 2–600 MCM	SN3	624.00
2 (Dual)	(2) 6–350 MCM	SN4	392.00

### Tie Point Terminal Block

The tie point terminal block provides easy wiring of a Hand-Off-Auto selector switch or Start-Stop push buttons with separate control. The T7 terminal block requires no panel space. It simply snaps on Type S Sizes 00–4 contactors and starters by two tabs and is secured to the left hand coil terminal.



Tie Point Terminal Block

**Table 16.310:**

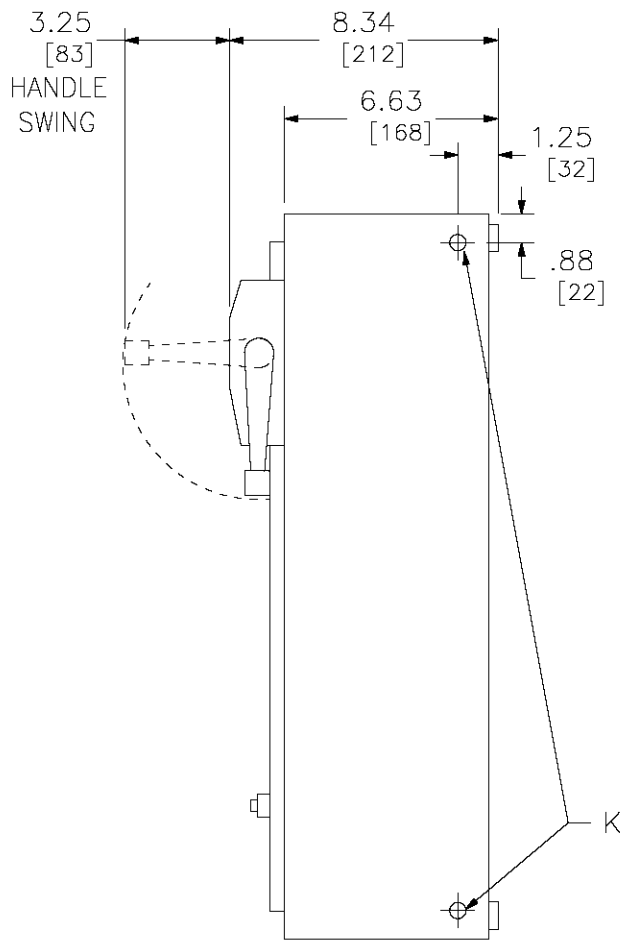
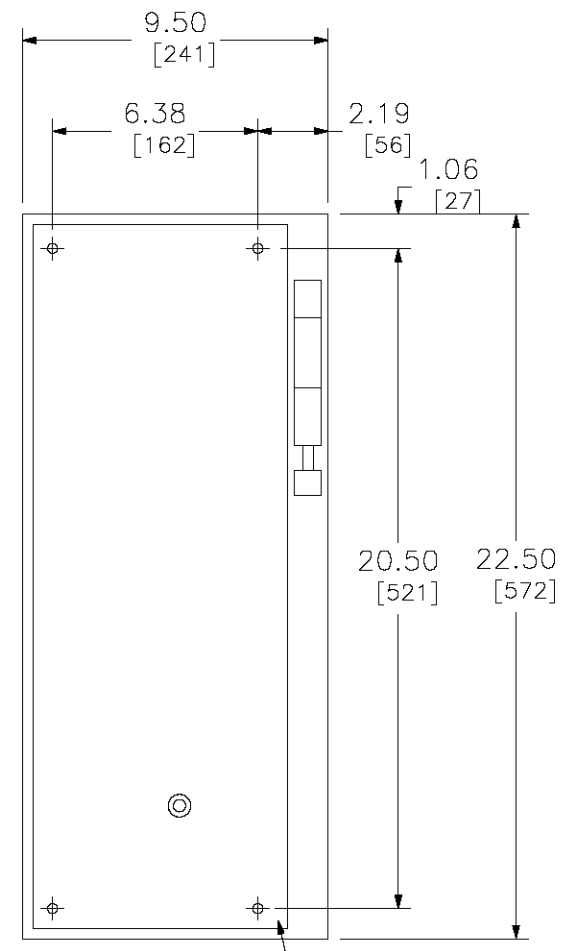
Magnetic Contactor or Starter		Class 9999 Type	\$ Price
NEMA Size	Type		
00–4	SA-SF	T7	33.30

**Table 16.311: How to Order**

To Order Specify:	Catalog Number	
• Class Number	Class	Type
• Type Number	9999	SO4

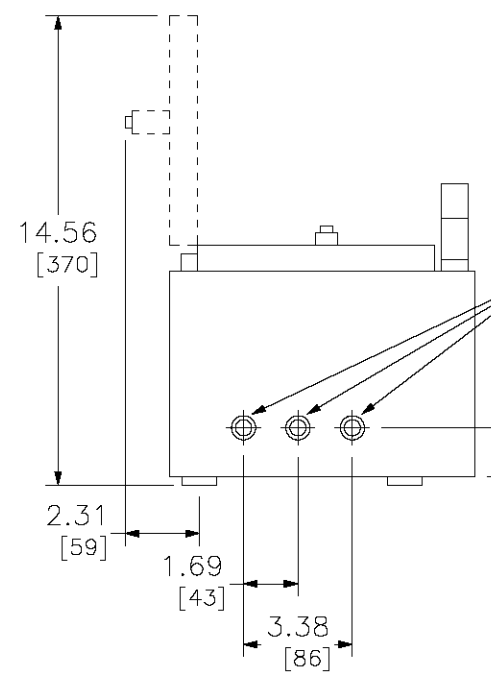
REV	DESCRIPTION	BY	DATE						
-	-	-	-	-	-	-	-	-	-

CLASS 8538/8539 COMBINATION STARTER  
NEMA TYPE 1 GENERAL PURPOSE ENCLOSURE



KNOCKOUT FOR .50 CONDUIT [13]

(4) .31 DIA MTG HOLES [8]



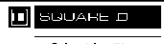
KNOCKOUTS FOR .50 OR .75 CONDUIT (TOP AND BOTTOM) [13] [19]

DUAL DIMENSIONS: INCHES  
MILLIMETERS

NEMA SIZE	CLASS	TYPE
0 & 1	8538 & 8539	SBG SCG

**CLASS 8538 FUSED COMBINATION STARTER  
DESIGNATION: P-1  
8538SBG32V84CFF4H318T**

PROJ NO: G371-35003  
REF NO: 710-16403D

JOB NAME: HAINES HS VOC TECH BLDG	EQUIPMENT DESIGNATION: <b>P-1</b>
JOB LOCATION: HAINES AK	EQUIPMENT TYPE:
DRAWN BY: (Q2C)	DRAWING TYPE:
ENGR:	
DATE: May 06 2015	by Schneider Electric
DRAWING STATUS: QUOTE	DWG# <b>F36582663-01</b> PG 1 OF 1 REV -

NOTE: THE DIMENSIONS INCLUDE SPACE FOR A CONTROL TRANSFORMER (FORM F4T).



# Combination Starters

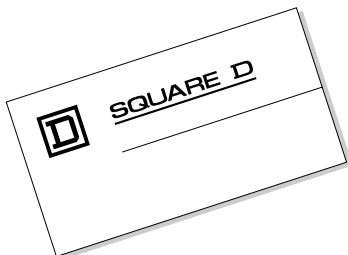
CLASS 8538 FUSED COMBINATION STARTER  
DESIGNATION: P-1  
8538SBG32V84CFF4H318T

Class 8538/8539, 8738/8739



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## General Information

CLASS 8538 FUSED COMBINATION STARTER  
DESIGNATION: P-1  
8538SBG32V84CFF4H318T

Class 8538 and 8539 Type S combination starters combine the requirements of motor overload and short circuit protection into one package. These starters are manufactured in accordance with NEMA standards and are UL Listed (although some FORM numbers may not be listed – contact your local Square D representative for information). Class 8538 and 8539 combination starters are designed to operate at 600 Vac maximum, 50 to 60 Hz – and are supplied with melting alloy overload relays as standard.

### Type 2 Coordination

Square D is one of the leaders in North America and Europe in providing starters that are verified by UL to comply with IEC 947-4-1 and Type 2 coordination. This means that the components of a motor branch circuit protective device (fuses and circuit breaker), contactor, and overload relay will be suitable for further use following a short circuit fault (even though contact welding is recognized but can be easily broken) allowing for replacement of components during normal scheduled maintenance.

Square D starters and specified fuses have been tested by UL and CSA (at 100,000 Amps fault current) for operation at 600 volts AC. Class 8538 Type S Combination Starters, NEMA size 0 through 5, with fusible disconnect switches have tested to Type 2 performance criteria.

### Class 8538 Disconnect Switch Type



Class 8538 combination starters can be supplied with either a fusible or non-fusible disconnect switch. Class 8538 combination starters are available in NEMA Sizes 0-6.

The fusible disconnect switch type combination starter design utilizes a flange operated visible blade switch. Interchangeable fuse clips, straight through wiring, space for a fused control transformer with additional capacity, and provisions for adding a disconnect switch electrical interlock are key features of the combination starters.

The fusible disconnect switch type can be supplied with Class R fuse clips increasing the short-circuit rating to 100,000A.

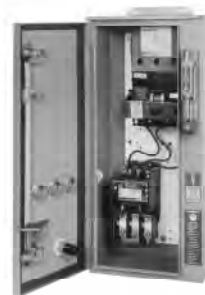
Size 0-2 non-fusible combination starters can be converted to a fusible type. See Catalog 999CT9701 for fuse block kits and fuse clips.

### Class 8539 MAG-GARD® Motor Circuit Protector or Thermal Magnetic Circuit Breaker

Class 8539 combination starters can be supplied with either a MAG-GARD® motor circuit protector (MCP) or a thermal magnetic circuit breaker. Class 8539 combination starters are available in NEMA Sizes 0-7.

The circuit breakers in Class 8539 combination starters can be supplied with a factory installed auxiliary switch for remote indication of an open and/or tripped or closed breaker. For one auxiliary switch, specify **Form Y74**. For two auxiliary switches, specify **Form Y75**. The switches are supplied with normally open and normally closed circuits with a common connection. Contacts must be used on the same polarity and are rated 15 Amps at 240 Volts AC.

An alarm switch can be factory supplied only, specify **Form Y742**. The alarm switch only operates when the breaker is tripped. It is used to actuate bell alarms and warning lights. The alarm switch consists of a normally open single pole single throw switch. The contacts are rated 4 Amps at 240 Volts AC.



**Enclosures** – Class 8538 and 8539 combination starters are available in the following enclosures:

#### NEMA Type 1 General Purpose

NEMA Type 4 & 4X Watertight and Dusttight Stainless Steel  
NEMA Type 4X Watertight, Dusttight, and Corrosion Resistant Glass-Polyester  
NEMA Type 7 & 9 Bolted and Spin-Top® for Hazardous Locations (Class 8539 only).  
NEMA Type 12 Dusttight and Driptight for Industrial Use

The NEMA Type 4 & 4X stainless steel enclosure (Sizes 0 - 5) has a brushed finish. Sizes 6 & 7 are painted sheet steel enclosures and are rated NEMA Type 4 only. For an electropolished finish, specify **Form G16** and add 15% to the price of the standard device. Hubs are supplied as standard on NEMA Type 4 & 4X enclosures.

Hubs are supplied as standard on NEMA Type 4X enclosures.

NEMA Type 12 enclosures may be field modified for outdoor applications. Specify **Form G26** for NEMA Type 3R (no additional charge). See Catalog 9999CT9701 for additional information. Also, NEMA Type 12 devices are available UL Listed for use in Class II, Division 2, Group G and Class III, Divisions 1 and 2 locations. Request **Form G21** (no additional charge).

**Oversized Enclosures** – Class 8538 disconnect switch type and Class 8539 MAG-GARD® MCP (Sizes 0-2) are available in NEMA Type 1, 4 & 4X and 12 enclosures. The oversized enclosures provide additional panel

space for customer installation of control transformers, fuse blocks, terminal blocks, relays, and other auxiliary equipment. These enclosures have three Class 9001 Type “K” holes as standard for installation of push buttons, pilot lights, and other cover mounted control units.

**Coil Voltages** – AC coils are available for application on 50-60 Hz. NEMA Sizes 00 - 5 are supplied with coils that are designed to operate satisfactorily on line voltages of 85% - 110% of rated voltage. NEMA Size 6 and 7 contactors are supplied with a DC coil operated by a solid state rectifier circuit that is powered by an AC source and is designed to operate satisfactorily on line voltages of 90-110% of rated voltage.

Please note that Voltage Codes have been added to the Type designations in order to improve customer service. It is necessary to include the Voltage Code when ordering combination starters. Also, 120 Volt polyphase combination starters will be wired for separate control.

**Auxiliary Contacts** – Additional auxiliary contacts may be added to Type S starters. Refer to Page 14 for maximum number of auxiliary units and Form designations for factory installed auxiliary contacts. See Catalog 9999CT9701 for auxiliary contact kits for field installation.

**Type S Accessories** – Additional accessories such as fuse blocks, fuse clip kits, disconnect switch and circuit breaker interlocks, and cover mounted control stations are available for field modifications, see Catalog 9999CT9701. For factory modifications (Forms), see Pages 30-34.



**Class 8538 – Fusible Disconnect Switch Type with Class R Fuse Clips**

**3-POLE POLYPHASE – 600 VOLTS AC MAXIMUM – 50-60 HZ**

Devices require 3 thermal units. See Catalog 9065CT9701 for selection information.

**Fusible (with Class R Fuse Clips) Full Voltage Type, Non-Reversing,  
with Melting Alloy Overload Relays — (100,000 AIC Rated)**

RATINGS					NEMA Type 1 General Purpose Enclosure	NEMA Type 4 & 4X Watertight and Dusttight Enclosure Stainless Steel (304) (Sizes 0-5)†	NEMA Type 4X Watertight, Dusttight and Corrosion Resistant Polyester Enclosure	NEMA Type 12/3R▲ Dusttight and Driptight Industrial Enclosure	
Motor Voltage (Starter Voltage)	Max. HP Poly- phase	Coil Voltage *	NEMA Size	Fuse Clip Size Amps	Type	Type	Type	With External Reset	Without External Reset
								Type	Type
200 (208)	3	208-60	0	30	SBG32V08	SBW32V08	SBW42V08	SBA42V08	SBA32V08
	5		1	30	SCG32V08	SCW32V08	SCW42V08	SCA42V08	SCA32V08
	7½		1	60	SCG33V08	SCW33V08	SCW43V08	SCA43V08	SCA33V08
	10		2	60	SDG32V08	SDW32V08	SDW42V08	SDA42V08	SDA32V08
	20		3	100	SEG35V08	SEW35V08	SEW45V08	SEA45V08	SEA35V08
	25		3	200	SEG32V08	SEW32V08	.....	SEA42V08	SEA32V08
230 (240)	40	240-60 220-50	4	200	SFG35V08	SFW35V08	.....	SFA45V08	SFA35V08
	75		5	400	SGG35V08	SGW35V08	.....	SGA45V08	SGA35V08
	150		6	600	SHG33V08	SHW33V08	.....	SHA43V08	SHA33V08
	3		0	30	SBG32V03	SBW32V03	SBW42V03	SBA42V03	SBA32V03
	5		1	30	SCG32V03	SCW32V03	SCW42V03	SCA42V03	SCA32V03
	7½		1	60	SCG33V03	SCW33V03	SCW43V03	SCA43V03	SCA33V03
460 (480)	15	480-60 440-50	2	60	SDG32V03	SDW32V03	SDW42V03	SDA42V03	SDA32V03
	25		3	100	SEG35V03	SEW35V03	SEW45V03	SEA45V03	SEA35V03
	30		3	200	SEG32V03	SEW32V03	.....	SEA42V03	SEA32V03
	100		4	200	SFG35V03	SFW35V03	.....	SFA45V03	SFA35V03
	200		5	400	SGG35V03	SGW35V03	.....	SGA45V03	SGA35V03
	400		6	600	SHG33V03	SHW33V03	.....	SHA43V03	SHA33V03
575 (600)	5	600-60 550-50	0	30	SBG33V06	SBW33V06	SBW43V06	SBA43V06	SBA33V06
	10		1	30	SCG34V06	SCW34V06	SCW44V06	SCA44V06	SCA34V06
	15		2	30	SDG36V06	SDW36V06	SDW46V06	SDA46V06	SDA36V06
	25		2	60	SDG34V06	SDW34V06	SDW44V06	SDA44V06	SDA34V06
	50		3	100	SEG33V06	SEW33V06	SEW43V06	SEA43V06	SEA33V06
	100		4	200	SFG33V06	SFW33V06	.....	SFA43V06	SFA33V06
575 (600)	200	600-60 550-50	5	400	SGG33V06	SGW33V06	.....	SGA43V06	SGA33V06
	400		6	600	SHG32V06	SHW32V06	.....	SHA42V06	SHA32V06
	5		0	30	SBG33V07	SBW33V07	SBW43V07	SBA43V07	SBA33V07
	10		1	30	SCG34V07	SCW34V07	SCW44V07	SCA44V07	SCA34V07
	15		2	30	SDG36V07	SDW36V07	SDW46V07	SDA46V07	SDA36V07
	25		2	60	SDG34V07	SDW34V07	SDW44V07	SDA44V07	SDA34V07
575 (600)	50	600-60 550-50	3	100	SEG33V07	SEW33V07	SEW43V07	SEA43V07	SEA33V07
	100		4	200	SFG33V07	SFW33V07	.....	SFA43V07	SFA33V07
	200		5	400	SGG33V07	SGW33V07	.....	SGA43V07	SGA33V07
	400		6	600	SHG32V07	SHW32V07	.....	SHA42V07	SHA32V07

▲ NEMA Type 12 enclosures may be field modified for outdoor non-corrosive and non-service-entrance-rated applications; see Page 17 for more information.

\* Coil voltage code must be specified to order this product. Refer to standard coil voltage codes listed in selection table above or additional standard voltage codes shown below.

† NEMA Size 6 starters are NEMA Type 4 painted sheet steel enclosures.

*NOTE: Some control transformers may require the use of oversized enclosures. Refer to the control transformer selection table on Page 35.*

**Coil Voltage Codes**

Voltage	Code
60 Hz	50 Hz
24†▲	...
120†	110
208	...
240	220
480	440
600	550
Specify	Specify
	V01
	V02
	V08
	V03
	V06
	V07
	V99

▲ 24V coils are not available on Sizes 4-7. On Sizes 00-3, where 24V coils are available, **Form S** (separate control) must be specified.

† These voltage codes must include **Form S** (supplied at No Charge). When specifying **Form S**, please supply motor voltage when ordering.



# Full Voltage Contactors and Starters – NEMA Rated

## Application Data for Selection

**CLASS 8538 FUSED COMBINATION STARTER**  
**DESIGNATION: P-1**  
**8538SBG32V84CFF4H318T**

NEMA Size	Load Volts		Maximum HP Rating—Nonplugging and Nonjogging Duty		Maximum HP Rating—Plugging and Jogging Duty †		Continuous Current Rating, Amperes—600 Volt Max.	Service-Limit Current Rating, Amperes *	Tungsten and Infrared Lamp Load, Amperes—250 Volts Max. ‡	Resistance Heating Loads, KW – other than Infrared Lamp Loads ‡		KVA Rating for Switching Transformer Primaries At 50 or 60 Cycles				3 PH Rating for Switching Capacitors •			
			Single Phase	Poly-Phase	Single Phase	Poly-Phase				Single Phase	Poly-Phase	Single Phase	Poly-Phase	Single Phase	Poly-Phase		Single Phase	Poly-Phase	KVAR
00	115	1/2	...	...	...	...	9	11	5	...	...	...	...	...	...	...	...		
	200	...	1/2	...	...	...	9	11	5	...	...	...	...	...	...	...	...		
	230	1	1 1/2	...	...	...	9	11	5	...	...	...	...	...	...	...	...		
	380	...	1 1/2	...	...	...	9	11	...	...	...	...	...	...	...	...	...		
	460	...	2	...	...	...	9	11	...	...	...	...	...	...	...	...	...		
575	...	2	...	...	...	9	11	...	...	...	...	...	...	...	...	...	...		
0	115	1	...	1/2	...	...	18	21	10	...	...	0.6	...	0.3	...	...	...		
	200	...	3	...	1 1/2	...	18	21	10	...	...	1.8	...	...	0.9	...	...		
	230	2	3	1	1 1/2	...	18	21	10	...	...	1.2	2.1	0.6	1.0	...	...		
	380	...	5	...	1 1/2	...	18	21	...	...	...	...	...	...	...	...	...		
	460	...	5	...	2	...	18	21	...	...	2.4	4.2	1.2	2.1	2.1	2.6	...		
575	...	5	...	2	...	18	21	...	...	3.0	5.2	1.5	2.6	...	...	...			
1	115	2	...	1	...	...	27	32	15	3	5	1.2	...	0.6	...	...	...		
	200	...	7 1/2	...	3	...	27	32	15	...	9.1	...	3.6	...	1.8	...	...		
	230	3	7 1/2	2	3	...	27	32	15	6	10	2.4	4.3	1.2	2.1	...	...		
	380	...	10	...	5	...	27	32	...	...	16.5	...	...	...	...	...	...		
	460	...	10	...	5	...	27	32	...	12	20	4.9	8.5	2.5	4.3	...	...		
575	...	10	...	5	...	27	32	...	15	25	6.2	11.0	3.1	5.3	...	...			
1P	115	3	...	1 1/2	...	...	36	42	24	...	...	...	...	...	...	...	...		
	230	5	...	3	...	...	36	42	24	...	...	...	...	...	...	...	...		
2	115	3	...	2	...	...	45	52	30	5	8.5	2.1	...	1.0	...	...	...		
	200	...	10	...	7 1/2	...	45	52	30	...	15.4	...	6.3	...	3.1	...	...		
	230	...	7 1/2	...	10	...	45	52	30	10	17	4.1	7.2	2.1	3.6	8	...		
	380	...	25	...	15	...	45	52	...	...	28	...	...	...	...	...	...		
	460	...	25	...	15	...	45	52	...	20	34	8.3	14	4.2	7.2	16	...		
575	...	25	...	15	...	45	52	...	25	43	10.0	18	5.2	8.9	20	...			
3	115	...	...	...	...	...	90	104	60	10	17	4.1	...	2.0	...	...	...		
	200	...	25	...	15	...	90	104	60	...	31	...	12	...	6.1	...	...		
	230	...	30	...	20	...	90	104	60	20	34	8.1	14	4.1	7.0	27	...		
	380	...	50	...	30	...	90	104	...	...	56	...	...	...	...	...	...		
	460	...	50	...	30	...	90	104	...	40	68	16	28	8.1	14	53	...		
575	...	50	...	30	...	90	104	...	50	86	20	35	10	18	67	...			
4	200	...	40	...	25	...	135	156	120	...	45	...	20	...	10	...	...		
	230	...	50	...	30	...	135	156	120	30	52	14	23	6.8	12	40	...		
	380	...	75	...	50	...	135	156	...	...	86.7	...	...	...	...	...	...		
	460	...	100	...	60	...	135	156	...	60	105	27	47	14	23	80	...		
	575	...	100	...	60	...	135	156	...	75	130	34	59	17	29	100	...		
5	200	...	75	...	60	...	270	311	240	...	91	...	41	...	20	...	...		
	230	...	100	...	75	...	270	311	240	60	105	27	47	14	24	80	...		
	380	...	150	...	125	...	270	311	...	...	173	...	...	...	...	...	...		
	460	...	200	...	150	...	270	311	...	120	210	54	94	27	47	160	...		
	575	...	200	...	150	...	270	311	...	150	260	68	117	34	59	200	...		
6▲	200	...	150	...	125	...	540	621	480	...	182	...	81	...	41	...	...		
	230	...	200	...	150	...	540	621	480	120	210	54	94	27	47	160	...		
	380	...	300	...	250	...	540	621	...	...	342	...	...	...	...	...	...		
	460	...	400	...	300	...	540	621	...	240	415	108	188	54	94	320	...		
	575	...	400	...	300	...	540	621	...	300	515	135	234	68	117	400	...		
7▲	230	...	300	...	...	...	810	932	...	180	315	...	...	...	240	...	...		
	460	...	600	...	...	...	810	932	...	360	625	...	...	...	480	...	...		
	575	...	600	...	...	...	810	932	...	450	775	...	...	...	600	...	...		

Tables and footnotes are taken from NEMA Standards.

- † Ratings shown are for applications requiring repeated interruptions of stalled motor current or repeated closing of high transient currents encountered in rapid motor reversal, involving more than five openings or closings per minute and more than ten in a ten-minute period, such as plug-stop, plug-reverse or jogging duty. Ratings apply to single speed and multi-speed controllers.
- \* Per NEMA Standards ICS 2-1993 clause 4, the service-limit current represents the maximum rms current, in Amperes, which the controller may be expected to carry for protracted periods in normal service. At service-limit current ratings, temperature rises may exceed those obtained by testing the controller at its continuous current rating. The ultimate trip current of over-current (overload) relays or other motor protective devices shall not exceed the service-limit current ratings of the controller.
- ★ FLUORESCENT LAMP LOADS – 300 VOLTS AND LESS – The characteristics of fluorescent lamps are such that it is not necessary to derate Class 8502 contactors below their normal continuous current rating. Class 8903 contactors may also be used with fluorescent lamp loads. For controlling tungsten and infrared lamp loads, and resistance heating loads, Class 8903 ac lighting contactors are recommended. These contactors are specifically designed for such loads and are applied at their full rating as listed in the Class 8903 Section.
- ‡ Ratings apply to contactors which are employed to switch the load at the utilization voltage of the heat producing element with a duty which requires continuous operation of not more than five openings per minute. Class 8903 Types L and S lighting contactors are rated for resistance heating loads.

- When discharged, a capacitor has essentially zero impedance. For repetitive switching by a contactor, sufficient impedance should be connected in series to limit inrush current to not more than 6 times the contactor rated continuous current. In many installations, the impedance of connecting conductors may be sufficient for this purpose. When switching to connect additional banks, the banks already on the line may be charged and can supply additional available short-circuit current which should be considered when selecting the impedance to limit the current.  
 The ratings for capacitor switching above assume the following maximum available fault currents:  
 NEMA Size 2-3: 5,000 A RMS Sym.  
 NEMA Size 4-5: 10,000 A RMS Sym.  
 NEMA Size 6: 18,000 A RMS Sym.  
 NEMA Size 7: 30,000 A RMS Sym.  
 If available fault current is greater than these values, connect sufficient impedance in series as noted in the previous paragraph.
  - ▲ For NEMA Size 6 and 7, the operation rate is as follows: Continuous operation rate is 3 operations per minute maximum; Jogging or Plugging Duty operation rate is 15 operations per minute for a maximum of three minutes.
- The motor ratings in the above table are NEMA standard ratings and apply only when the code letter of the motor is the same as or occurs earlier in the alphabet than is shown in the table below.**  
**Motors having code letters occurring later in the alphabet may require a larger controller. Consult local Square D field office.**

Motor HP Rating	Maximum Allowable Motor Code Letter
1 1/2-2	L
3-5	K
7 1/2 and above	H

# Full Voltage Contactors and Starters – NEMA Rated Application Data

**Power Contact Ratings:** All contactors and starters are rated in accordance with NEMA standards. The ratings shown in the selection tables are for normal service. For complete data on power contact ratings, refer to Page 12.

**Short Circuit Protection:** According to the National Electrical Code branch circuit overcurrent protection must be provided for each contactor or starter. For starters refer to instructions furnished with the thermal unit selection table. For contactors (Class 8502 or 8702) provide branch circuit overcurrent protection in accordance with the National Electrical Code, except do not exceed the maximum protective device ratings in table below.

NEMA Size	Maximum Voltage	Class K5, RK5 or RK1 Fuse (Ampere)	Class J or T Fuse (Ampere)	Inverse-Time Circuit Breaker (Ampere)
00	600	10	15	15
	250	12	15	15
0	600	20	30	20
	250	25	30	35
1	600	30	60	40
	250	40	60	60
2	600	60	100	80
	250	60	100	90
3	600	100	200	125
	250	125	200	150
4	600	200	400	225
5	600	400	600	400
6	600	600	1200*	800
7	600	600	1600*	1200

\* Class L Fuse only

**Capacitor Switching:** The kilovar ratings of enclosed, three phase contactors used as switches for capacitor loads, when only one load appears on the secondary of a distribution system are shown in the table on Page 12.

### Coil Burden

NEMA Size	No. of Poles	Inrush VA		Sealed VA		Sealed Watts	
		50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
00	2-3	....	165	....	33	....	6
0 & 1	1-5	232	245	26	27	7.7	7.8
2	2 & 3	296	311	36	37	12	14
	4 & 5	429	438	37	38	12	14
3	2-3	676	700	47	46	15	14
	4-5	1260	1185	89	85	23.4	22
4	2-5	2970	2970	250	212	42	39
6‡	2-3	1495	1780	56	48	27	32
7‡	2-3	....	1960	....	59	....	36

▲ Mean values.

‡ Size 6 and 7 have a DC coil. The values shown are for the AC input to the DC power supply that provides power to the coil.  
Ambient temperature (operating temperature): 0°C - 40°C (32°F - 104°F)

**CLASS 8538 FUSED COMBINATION STARTER  
DESIGNATION: P-1  
8538SBG32V84CFF4H318T**

**Maintenance of Equipment:** Class 9998 Repair Parts Kits are available for all Class 8502 contactors and Class 8536 starters. Service bulletins with a complete list of replaceable parts are supplied with all enclosed devices. Separate bulletins can be ordered and are listed along with the appropriate contact parts kit.

Device				Instruction Bulletin	Service Bulletin	Replacement Contacts Class 9998 Type
NEMA Type	Type	Series	No. of Poles			
00	SA	A	2-3	30072-013-08	362AS	SL2
		B	2-3		556AS	SJ1
0	SB	A&B	1-3	30072-013-09	277AS	SL2
			4		277AS & 250AS	(1)SL12 & (1)SL22
			5		277AS & 250AS	or (1)SL2 & (2)SL22
1	SC	A&B	1-3	30072-013-10	278AS	SL3
			4		278AS & 250AS	(1)SL13 & (1)SL22
			5		278AS & 250AS	or (1)SL3 & (2)SL22
1P	SC	A	2	30072-013-10	278AS	SL3
2	SD	A	2-3	30072-013-11	279AS	SL4
			4		279AS & 293AS	(1)SL14 & (1)SL24
			5		279AS & 293AS	or (1)SL4 & (2)SL24
3	SE	A	2	30072-013-01	305AS	SL6
			3		305AS	SL7
			4		326AS	(2)SL6
			5		326AS	(1)SL6 & (1)SL7
4	SF	A	2	30072-013-02	306AS	SL8
			3		306AS	SL9
			4		326AS	(2)SL8
			5		326AS	(1)SL8 & (1)SL9
5	SG	A	2	30072-013-18	328AS	SL10
			3		328AS	SL11
6	SH	A	2	30072-013-12	342AS	SL25
			3		342AS	SL26
7	SJ	A	2	30072-013-13	370AS	SL25
			3		370AS	SL26
7	SJ	A	2	30072-013-13	397AS	SL30
			3		397AS	SL31

### Terminals

NEMA Size	Type	Power Terminals		Control Terminals	
		Type of Lug	Wire Sizes* Min.-Max.	Type of Lug	Wire Sizes* Min.-Max.
00, 0 & 1	SA, SB & SC	Pressure Wire	#14-#8	Pressure Wire	#16-#12
2	SD	Box Lug	#14-#4	Pressure Wire	#16-#12
3	SE	Box Lug	#14-1/0	Pressure Wire	#16-#12
4	SF	Box Lug	#8-250 kcmil	Pressure Wire	#16-#12
5	SG	Box Lug	#4-500 kcmil	Pressure Wire	#16-#12
6	SH	Parallel Groove	One or two 250-500 kcmil per phase	Pressure Wire	#16-#12
7	SJ	Parallel Groove	One to four 250-500 kcmil per phase	Pressure Wire	#16-#12

\* Solid or stranded copper wire. One wire per connector.  
Coil temperature: Not more than 85°C rise in 40°C ambient (125°C max.).



# Full Voltage Contactors & Starters – NEMA Rated Application Data

**CLASS 8538 FUSED COMBINATION STARTER  
DESIGNATOR: P-1  
8538SBG32V84CFF4H318T**

## Auxiliary Units

Auxiliary contacts, power poles, and timer attachments can be added by the factory or in the field on all Type S starters and contactors. The table below shows the maximum number of auxiliary units (**in addition to the holding circuit contact**) that can be added to a given size starter or contactor. In addition, it is possible to add a second internal contact on NEMA Size 0, 1, and 2 contactors and starters.

NEMA Size	Type	No. of Poles of Basic Contactor	Maximum Number of External Auxiliary Units (In addition to holding circuit contact)
00	SA	2-3	4 single circuit auxiliary contacts (N.O. or N.C.) if second internal auxiliary contact is not used.
0, 1 and 2	SB SC SD	1, 2 or 3	4 single circuit auxiliary contacts (N.O. or N.C.)
			3 single circuit auxiliary contacts (N.O. or N.C.) plus 1 attached timer (ON or OFF delay).
			2 single circuit auxiliary contacts (N.O. or N.C.) plus 1 power pole adder (1 or 2 poles, N.O. or N.C.).
		4 or 5	1 attached timer (ON or OFF delay) plus 1 power pole adder (1 or 2 poles, N.O. or N.C.) plus 1 auxiliary contact.
			2 single circuit auxiliary contacts (N.O. or N.C.) plus 1 timer attachment plus 1 auxiliary contact.
3, 4 & 5	SE SF SG	2-5 (Size 3 & 4)	4 single circuit auxiliary contacts (N.O. or N.C.)
			2 single circuit (Sizes 3 & 4) or 3 single circuit (Size 5) auxiliary contacts plus 1 attached timer (ON or OFF delay).
		2-3 (Size 5)	2 single circuit auxiliary contacts (N.O. or N.C.) plus 1 NEMA Size 0-1 or Size 2 power pole adder (1 or 2 poles, N.O. or N.C.)
			4 single circuit auxiliary contacts (N.O. or N.C.)
6 and 7	SH SJ	2-3	3 single circuit auxiliary contacts (N.O. or N.C.) plus 1 attached timer (ON or OFF delay).
			2 single circuit auxiliary contacts (N.O. or N.C.) plus 1 NEMA Size 0-1 or Size 2 power pole adder (1 or 2 poles, N.O. or N.C.)
			2 single circuit auxiliary contacts (N.O. or N.C.) plus 1 NEMA Size 0-1 or Size 2 power pole adder (1 or 2 poles, N.O. or N.C.)

## Factory Installed Auxiliary Contacts

The table below lists the Form designations for factory installed electrical contacts. See Factory Modifications (Forms) section for pricing.

See Class 9999 for field modification kits.

## Form Number Of Additional Auxiliary Contacts

When ordering factory installed auxiliary contacts, the Form designations listed should be used.

Number of N.O. Contacts	Number of N.C. Contacts	Form Number
0	1	X01
0	2	X02
0	3	X03
0	4	X04
1	0	X10
1	1	X11
1	2	X12
1	3	X13
2	0	X20
2	1	X21
2	2	X22
3	0	X30
3	1	X31
4	0	X40

## Control Circuit Transformers

Class 9070 Type T control transformers are normally used when it is necessary to provide a lower voltage to the control circuit. This transformer with fused protection may be ordered from the factory by specifying Form F4T. The addition of a transformer often requires the use of a larger enclosure (refer to dimensions on Page 17–19). The table below shows the transformer selection for given sized starters and contactors with or without auxiliary units.

NEMA Size	Type	No. of Poles	Auxiliary Units	Transformer Class 9070 Type
0 & 1	SB SC	1-3	With max. of 2 auxiliary contacts	T50
			With timer and maximum of 1 auxiliary contact	
			With 3 or 4 auxiliary contacts With timer and 2 or 3 auxiliary contacts	T100
0 & 1	SB SC	4 & 5	With or without auxiliary contacts or timer	T100
0 & 1 Mechanically Interlocked Devices	SB SC	1-5	With or without attachments	T100
2	SD	2-5	With or without attachments	T100
3	SE	2-3	With or without attachments	T150
3	SE	4 & 5	With or without attachments	T300
4	SF	2-5	With or without attachments	T300
5	SG	2-3	Any	T500
6, 7	SH, SJ	2-3	Any	‡

‡ A Class 9070 transformer is an integral part of the Size 6 and Size 7 control circuit providing 120 volt control circuit voltage as standard.

## Power Poles

Single or double circuit power pole adders may be factory or field installed on 2 and 3 pole Type S contactors and starters. The table below lists the Form designation for factory installed power pole adders. Only one power pole adder may be installed per contactor. See Factory Modifications (Forms) section for pricing.

See Class 9999 for field modification kits.

Type	NEMA Size	Class 9999 Type	Form Designation
1 N.O.	0, 1	SB6	Y428
	2	SB11	Y436
1 N.C.	0, 1	SB7	Y429
	2	SB12	Y437
1 N.O., 1 N.C.	0, 1	SB8	Y435
	2	SB13	Y440
2 N.O.	0, 1	SB9	Y430
	2	SB14	Y438
2 N.C.	0, 1	SB10	Y434
	2	SB15	Y439

 File E78360  
CCN NITW2

## Transformers

 File E61239  
CCN XPTQ

 File LR37055  
Class 5411 06



# Combination Starters – NEMA Rated

## Application Data – Class 8538, 8539

**CLASS 8538 FUSED COMBINATION STARTER**  
**DESIGNATION: P-1**  
**8538SBG32V84CFF4H318T**

### Class 8539 – UL Listed Short Circuit Ratings

MAG-GARD® Motor Circuit Protector Type			
NEMA Size	Voltage	Enclosure	Available Amperes RMS Symmetrical
0 & 1, 2 Size 3 Type SE*41 & SE*51 Only (GJL)	0-480	Standard† and Oversize	100,000
0 & 1 (FAL)	0-480	Standard† and Oversize	22,000
0 & 1 (FAL)	481-600	Standard† and Oversize	10,000
0 & 1, 2 Size 3 Type SE*41 & SE*51 Only (GJL)	481-600	Standard† and Oversize	10,000
0-2 with Current Limiting Module	600	Oversize	100,000
0-3 with Current Limiting Module	600	Standard†	100,000
0-3	600	NEMA 7 & 9	5,000*
2	600	Oversize	22,000
2-6	600	Standard†	22,000
4 & 5	600	NEMA 7 & 9	10,000
7	0-480	Standard†	30,000
7	481-600	Standard†	22,000

† Standard enclosure includes non-oversize NEMA Types 1, 4 & 4X Stainless, and 12.  
 \* Consult factory for higher withstand ratings.

### Class 8539 – UL Listed Short Circuit Ratings

Thermal Magnetic Circuit Breaker Type			
NEMA Size	Voltage	Enclosure	Available Amperes RMS Symmetrical
0-3	600	Standard†	5,000
4 & 5	600	Standard†	10,000
6	600	Standard†	18,000
7	0-480	Standard†	30,000
7	481-600	Standard†	22,000

† Standard enclosure includes non-oversize NEMA Types 1, 4 & 4X Stainless, and 12.

### Class 8538 – UL Listed Short Circuit Ratings

NEMA Size	NEMA Fuse Class	Enclosure	Available Amperes RMS Symmetrical
0-3	Class H or K	Standard†	5,000
0-3	Class R	Standard†	100,000
0-2	Class H or K	Oversize	5,000
0-2	Class R	Standard	100,000
4-5	Class H or K	Standard†	10,000
4-5	Class R	Standard†	100,000
6	Class H or K	Standard†	18,000
6	Class R	Standard†	100,000

† Standard enclosure includes non-oversize NEMA Types 1, 4 & 4X Stainless, and 12.

**Table 1: MAG-GARD Trip Range**

Suffix No.	Range Amps	Suffix No.	Range Amps	Suffix No.	Range Amps	Suffix No.	Range Amps
M01	9-33	11M	8-28	25M	625-1250	33M	1500-3000
M02	21-77	12M	18-70	26M	750-1500	35M	1750-3500
M03	45-165	13M	50-180	29M	875-1750	36M	2000-4000
M04	90-330	15M	100-350	30M	1000-2000	40M	2500-5000
M05	150-550	16M	150-580	31M	1125-2250	42M	3000-6000
M06	225-825	18M	300-1100	32M	1250-2500	44M	3500-7000

The MAG-GARD adjustable trip range is determined by the suffix of the circuit breaker catalog number. Table 1 indicates the trip range which corresponds to a given suffix number. The MAG-GARD Motor Circuit Protector should be adjusted to a level just above Locked-Rotor Current of the motor. This setting will provide optimum overcurrent protection for the motor. For more information on MAG-GARD instantaneous trip circuit breakers, refer to the MAG-GARD circuit breaker section of this Catalog.

**Table 2: Motor Code Letter Table**

Horsepower	Motor Code Letters
½ or less	A-L
¾ — 1½	A-K
2 — 3	A-J
5 — 25	A-H
30 — 125	A-G
150 or more	A-F

The combination starter selection tables on Pages 7 — 9 are suitable for motors with Locked-Rotor Current letters per NEC Table 430-7(b) as listed in Table 2. For other motors a special thermal magnetic circuit breaker with adjustable magnetic trip settings for the specific motor is required. When ordering for these special applications, specify the motor horsepower, voltage, frequency, full load current and code letter (or locked rotor current) to assure proper protection.

### Terminals

NEMA Size	Type	Line Terminals on Disconnect		Power Terminals On Magnetic Starter			Control Terminals On Magnetic Starter			
		Type of Lug	Wire Size Min.-Max.		Type of Lug	Wire Size Min.-Max.	Wires Per Terminal	Type of Lug	Wire Size Min.-Max.	Wires Per Terminal
			Switch	Circuit Breaker						
0 & 1	SB & SC	Box Lug	#14-1/0 Cu/Al	#14-#4 Cu▼ #12-#4 Al or #14-#1/0 Cu #12-#1/0 Al #14-#1 Cu/#8-#1/0 Al (GJL Breaker)	Pressure Wire	#14-#8 Cu	1 or 2	Pressure Wire	#16-#12 Cu	2
2	SD	Box Lug	#14-1/0 Cu/Al	#14-#1/0 Cu or #12-#1/0 Al #14-#1 Cu/#8-#1/0 Al (GJL Breaker)	Box Lug	#14-#4 Cu	1	Pressure Wire	#16-#12 Cu	2
3	SE	Box Lug	#14-1/0 Cu/Al	#14-#2 Cu #10-#2 Al (FA Breaker) #4-300 MCM Cu/Al (KA Brkr) #14-#1 Cu/#8-#1/0 Al (GJL Breaker)	Box Lug	#14-#0 Cu	1	Pressure Wire	#16-#12 Cu	2
4	SF	Box Lug	#6-300 MCM Cu/Al	#14-#1/0 Cu #12-#1/0 Al (FA Breaker) #4-300 MCM Cu/Al (KA Brkr)	Box Lug	#8-250 MCM Cu	1	Pressure Wire	#16-#12 Cu	2
5	SG	Box Lug	One #4-500 MCM Cu	#4-300 MCM Cu/AL (KA Breaker) (1)#1-600 MCM or (2)#1-250 MCM Cu/Al (LA Brkr)	Box Lug	#4-500 MCM Cu	1	Pressure Wire	#16-#12 Cu	2
6	SH	Box Lug	....	(1)#1-600 MCM or (2)#1-250 MCM Cu/Al (LA Breaker) (3)#3/0-500 MCM Cu/Al (MA Brkr)	Parallel Groove	250-500 MCM Cu●	1 or 2	Pressure Wire	#16-#12 Cu▲	2
7	SJ	Box Lug	....	(3)#3/0-500 MCM Cu/Al	Parallel Groove	250-500 MCM Cu	1-4	Pressure Wire	#16-#12 Cu	2

● Order Class 9999 Type SAL-16 parts kit to convert power terminals to accept sizes 1/0-300 MCM wire.  
 ▲ Terminal block range limited to #16-#14.  
 ▼ Use on FAL circuit breakers rated 25 Amps or less.

**NEMA Type 1 Enclosure – Figure 1**

NEMA Size	Class	Type	Dimensions in Inches*														Top & Bottom			Sides	Wt. (Lbs.)	
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	W			X
0-1	8538 & 8539	SBG SCG	9 1/2	22 1/2	8 1/2	6 3/8	20 1/2	142 1/2	1 1/8	1 1/16	3	2 5/16	1 1/16	3/4	2 3/16	1 1/4	7/8	...	1/2-3/4	1/2-3/4	1/2	38
2	8538 & 8539	SDG	10 1/2	26	9 1/8	7 3/8	24	162 3/8	2 1/8	2	4	2 5/16	1 1/16	3/4	2 3/16	1 1/4	7/8	...	1-1 1/4	1/2-3/4	1/2	54

\* Above dimensions include space for control circuit transformers.

**NEMA Type 1 Enclosure – Figure 2**

NEMA Size	Class	Type	Dimensions in Inches*														Top & Bottom			Sides	Wt. (Lbs.)	
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	W			X
3	8538 & 8539	SEG	15 1/4	42	10 19/32	9 1/4	3	222 3/2	41	1/2	...	2 53/64	3 17/32	5	2 11/16	5 3/8	1 9/32	2 9/32	1-1 1/4	1/2-3/4	1/2	102
4	8538	SFG	16	52 1/2	10 17/32	10	3	232 1/2	51 1/2	1/2	...	2 53/64	3 17/32	5	2 11/16	5 3/8	1 9/32	2 9/32	2 1/2	1/2-3/4	1/2	163
	8539	SFG	16	52 1/2	10 17/32	10	3	232 1/2	51 1/2	1/2	...	2 53/64	3 17/32	5	2 11/16	5 3/8	1 9/32	2 9/32	2 1/2	1/2-3/4	1/2	163
5	8538	SGG	20	78	15 1/2	12	4	291 3/2	77	1/2	...	3 33/64	4 39/64	9 1/4	3 3/16	...	...	...	1/2-3/4†	3	...	450
	8539	SGG	20	66	13 23/32	12	4	291 3/2	65	1/2	...	3 33/64	4 39/64	5	3 3/16	...	...	...	1/2-3/4†	3	...	420
6	8538 & 8539	SHG	36	90	21 1/2	...	...	41 3/8	...	...	...	...	...	5	...	...	...	...	...	...	...	...

† Left side only

▲ Size 6 enclosures are floor mounting.

\* Above dimensions include space for control circuit transformers.

■ Class 8538 Size 3 devices with 200 Amp fuse clips use dimensions for Class 8538 Size 4.

**NEMA Type 12 Enclosure – Figure 3**

NEMA Size	Class	Type	Dimensions in Inches*										Wt. (Lbs.)
			A	B	C	D	E	F	G	H	I	J	
0-1	8538 & 8539	SBA SCA	9 1/2	8 1/2	24	3 1/4	2 1/2	4 1/2	23 1/2	1 9/32	4 7/16	14 9/16	40
2	8538 & 8539	SDA	10 1/2	9 1/8	27 3/4	3 1/4	2 1/2	5 1/2	27	3/8	4 1/8	16 9/16	55
3	8538 & 8539	SEA	15 1/4	10 19/32	42	5	3	9 1/4	41	1/2	5 1/16	22 5/16	111
	8538	SFA	16	10 17/32	52 1/2	5	3	10	51 1/2	1/2	4 3/16	22 31/32	170
4	8538	SFA	16	10 17/32	52 1/2	5	3	10	51 1/2	1/2	5 3/16	22 31/32	170
	8539	SFA	16	10 17/32	52 1/2	5	3	10	51 1/2	1/2	5 3/16	22 31/32	170
5	8538	SGA	20	13 23/32	78	9 1/4	4	12	77	1/2	7 23/32	29 13/32	...
	8539	SGA	20	13 23/32	66	5	4	12	65	1/2	7 23/32	27 13/32	440
6	8538 & 8539	SHA	36	17	90	5	...	...	...	...	...	47 3/8	...

▲ Size 6 enclosures are floor mounting.

\* Above dimensions include space for control circuit transformers.

■ Class 8538 Size 3 devices with 200 Amp fuse clips use dimensions for Class 8538 Size 4.

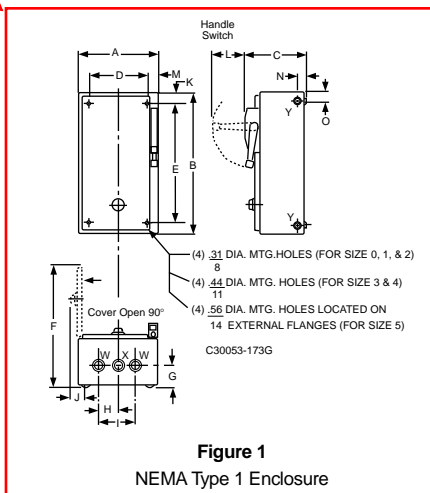
NOTE: Illustrations may not represent the actual enclosure, they are intended for dimensional information only.

**NEMA Type 12 Enclosures Modified for Outdoor Applications**  
**(not to be used in salt air or corrosive environments)**

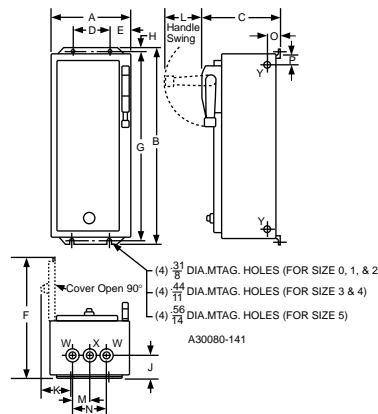
**Field Modifications for NEMA Type 3** dusttight, raintight and sleet resistant outdoor applications are as follows: Watertight conduit hubs or equivalent provision for watertight connection at the conduit entrance shall be used.

**Field Modifications for NEMA Type 3R** rainproof and sleet resistant outdoor applications are as follows:

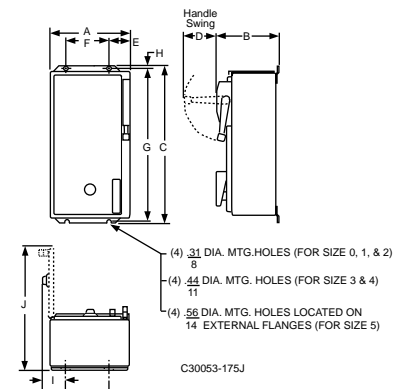
1. Watertight conduit hubs or equivalent provision for watertight connection at the conduit entrance, when the conduit enters at a level higher than the lowest live part, shall be used.
2. Drain holes of 1/8 inch diameter shall be added to the bottom of the enclosure.



**Figure 1**  
NEMA Type 1 Enclosure



**Figure 2**  
NEMA Type 1 Enclosure



**Figure 3**  
NEMA Type 12 Enclosure





# Combination Starters — NEMA Rated Panel Layout Drawings – Class 8538, 8539

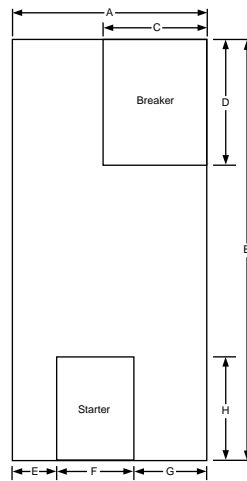
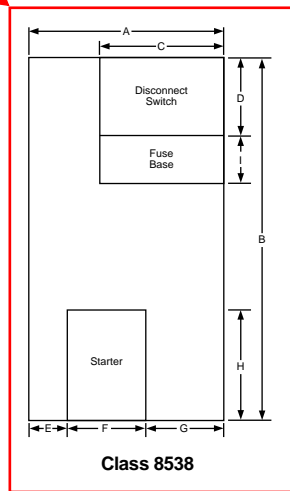
**CLASS 8538 FUSED COMBINATION STARTER  
DESIGNATION: P-1  
8538SBG32V84CFF4H318T**

## Standard NEMA Type 1, 4 & 4X Stainless, 12

The following table is provided to identify open panel space on standard NEMA Type 1, 4 & 4X stainless steel and 12 combination starters. Space and mounting holes are provided in all combination starters (except NEMA Type 7 & 9 SPIN TOP®) for the field addition of a control transformer – see Page 35 for control transformer selection.

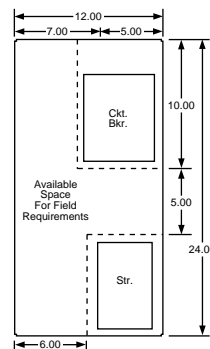
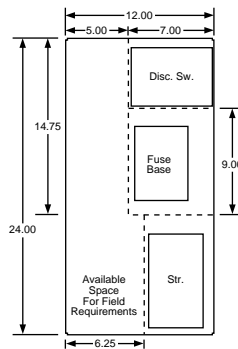
Class	NEMA Size	Dimensions in Inches								
		A	B	C	D	E	F	G	H	I
8538	0, 1	6.9	18.5	6.9	6.5	0	3.5	3.4	6.9	4.0
8539	0, 1	6.9	18.5	6.5	7.9	0	3.5	3.4	6.9	—
8538	2	7.9	22.0	7.5	7.0	3.1	4.8	0	7.7	6.0
8539	2	7.9	22.0	6.5	8.4	3.1	4.8	0	7.7	—
8538	3	12.0	29.5	9.0	7.7	0	5.6	6.4	12.9	5.3
8539	3	12.0	29.5	FAL: 6.5 KAL: 6.8	FAL: 8.5 KAL: 10.5	0	5.6	6.4	12.9	—
8538	4	13.0	39.0	11.0	11.5	0	7.0	6.0	13.0	9.0
8539	4	13.0	39.0	6.8	12.5	0	7.0	6.0	13.0	—
8538	5*	17.3	59.0	13.5	25.0	0	10.8	6.5	20.5	—
8539	5*	17.3	59.0	KAL: 6.8 LAL: 9.0	KAL: 23.0 LAL: 24.5	0	10.8	6.5	20.5	—
8538	6	32.0	82.0	32.0	40.0	0	13.0	19.0	35.0	—
8539	6	32.0	82.0	LAL: 9.0 MAL: 12.5	LAL: 25.5 MAL: 40.5	0	13.0	19.0	35.0	—

\* Size 5 combination starter does not contain a full size panel. No usable panel space is available.



## Oversize Enclosures, NEMA Type 1, 4 & 4X Stainless, 12

Combination starters in oversized enclosures provide additional panel space for field addition of control relays, timing relays, terminal blocks or other auxiliary equipment. Disconnect type devices offer over 130 square inches of available panel space. Circuit breaker type devices offer over 180 square inches of available panel space.



# Factory Modifications (Forms) For Full Voltage Contactors and Starters

**CLASS 8538 FUSED COMBINATION STARTER  
DESIGNATION: P-1  
8538SBG32V84CFF4H318T**

Factory installed modifications are available for the classes of control equipment listed in the respective tables. Prices shown are **additions** to standard equipment prices and are **not** to be used as separate selling prices. Kits are also available for many field modifications and normal parts replacement on most control items. Refer to Classes 9998 and 9999 for complete listings.

Standard equipment dimensions and enclosure construction may not apply when certain special features are added. Such cases should be referred to the factory with complete description when accurate dimensions are required. **Note:** If UL label is required, consult local Square D Field Sales Office. Some forms are **not** UL Listed.

## Full Voltage Starters

	Factory Modifications	Enclosure Type	Form Letters
<b>PILOT DEVICES IN COVER Full Voltage Non-Reversing Controllers Only Classes 8538 8539</b>	<b>Push Buttons ★</b>		
	"Start-Stop"	1 3R, 4, 4X, 12 7 & 9	A A A
	"Start-Stop" (maintained contact)Ⓞ	1, 3R, 4, 4X■, 12	A16
	"Start-Stop" push button and "Hand-Off-Auto" selector switch	1, 3R, 4, 4X■, 12	AC
	"On-Off"	1 3R, 4, 4X■, 12	A3 A3
	Single Oiltight Pushbutton (specify marking)	1, 3R, 4, 4X■, 12	A11
	<b>Selector Switches</b>		
	"Hand-Off-Auto"	1 3R, 4, 4X, 12 7 & 9	C C C
	"On-Off"	1 3R, 4, 4X■, 12 7 & 9	C6 C6 C6
	Key Operated Selector Switch (specify marking and Key withdrawal position/code)	1, 3R, 4, 12	C33
	<b>NON-STANDARD markings for Pilot Devices</b>	1, 3R, 4, 12	G12▼
	<b>Addition of padlock attachment to Class 9001 operators</b>	1, 3R, 4, 12	G122
<b>PILOT DEVICES IN COVER Full Voltage Reversing and Multi-Speed Controllers Only Classes 8738 8739</b>	<b>Pilot Lights (specify color/type) ▲</b>		
	Without Operating Interlock: Per light Per light Push-to-test (each)	1, 3R, 4, 4X, 12 7 & 9♦ 1, 3R, 4, 4X■, 12	P▲ P▲ P▲
	With Operating Interlock: Add price of each interlock per light	1, 3R, 4, 4X■, 12	X*
	<b>Push Buttons ★</b>		
	"Forward-Reverse-Stop"	1, 4, 4X■, 12	A1
	"High-Low-Stop"	1, 4, 12	A2
	"Fast-Off-Slow"	1, 4, 12	A9
	"High-Low" push button and "Hand-Off-Auto" selector	1, 4, 12	A10C
	Single Oiltight Pushbutton (specify marking)	1, 4, 4X■, 12	A11
	<b>Selector Switches</b>		
	"Hand-Off-Auto"	1, 4, 4X■, 12 7 & 9	C C
	"On-Off"	1, 4, 4X■ 7 & 9	C6 C6
"High-Off-Low"	1, 4, 12	C7	
"Forward-Off-Reverse"	1, 4, 4X■, 7, 9, 12	C14	
"High-Low" and "Hand-Off-Auto"	1, 4, 12	CC17	
"Slow-Fast"	1, 4, 4X■, 12	C19	
"Forward-Reverse"	1, 4, 4X■, 12	C20	
"High-Low-Off-Auto"	1, 4, 12	C25	
<b>NON-STANDARD markings for Pilot Devices</b>	Any	G12▼	
<b>Pilot Lights (specify color/type)▲</b>			
One Pilot Light: one light with two electrical interlocks. Two Pilot Lights: each light is wired in parallel, no interlocks used			
Without Operating Interlock: Per light Per light Push-to-test (each)	1, 4, 4X■, 12 7 & 9♦ 1, 4, 4X■, 12	P▲ P▲ P▲	
With Operating Interlock: Add price of each interlock per light	1, 4, 4X■, 12	X*	

- ★ All push buttons are momentary contact unless specified otherwise.
- This adder, used with a NEMA Type 4X enclosure, applies to Classes 8538, 8539, 8738, 8739.
- ▲ Indicate pilot light color as Form P1 (red) or Form P2 (green), etc. as shown in the table below. Unless otherwise requested, standard practice is to wire red pilot light to indicate device is energized. No additional auxiliary contact is required. Also, standard practice is to wire green pilot light to indicate device is de-energized. An additional normally-closed auxiliary contact is required. A wiring diagram must be supplied for other pilot light colors and/or arrangements.
- ♦ Pilot lights available at 120 to 600 volt only.
- ◆ Specify marking and/or Class 9001 Type KN or Type SKN legend plate required.
- † Specify appropriate Class 9001 Type K or SK operator required.
- \* To determine the maximum number of auxiliary contacts which can be added to each Type S device and for the appropriate "X Form", refer to the tables in the Class 8736 section on Page 12-81 (for reversing or two-speed devices).

Standard Pilot Light Form	Push -to-Test Pilot Light Form	LED Pilot Light	Color
P1	P21	P51	Red
P2	P22	P52	Green
P3	P23	—	Amber
P4	P24	—	Clear
—	P25	P55	Yellow

**Full Voltage Controllers Only**

**Classes 8538, 8539, 8738 and 8739**

Factory Modifications		Enclosure Type	Form Letters	
Separate Control Circuit — (specify voltage and frequency)		Any	S*	
Fused Control Circuit (without control transformer)				
One fuse .....		1, 3R, 4, 4X, 12	F	
Two fuses .....		1, 3R, 4, 4X, 7, 9, 12	F4	
Control Circuit Transformers■				
Standard capacity (50 or 60 Hz)				
NOTE: All orders requesting Form FT will be supplied as Form F4T.				
FUSES				
CONTROL CIRCUIT  FULL VOLTAGE AND MULTI- SPEED CON- TROLLERS ONLY CLASSES 8538 8539 8738 8739	Primary	Secondary		
	2	0 .....	1, 4, 4X, 12	
	2	0 .....	7 & 9	
	1	1† .....	1, 4, 4X, 12	
	2	1 .....	1, 4, 4X, 12	
	2	1 .....	7 & 9	
	1	2‡ .....	1, 4, 4X, 12	
	2	2 .....	1, 4, 4X, 12	
	Additional Capacity (50 or 60 Hz)			
	Two fuses in primary			
100 VA additional capacity .....		1, 4, 4X, 12	F4T11○	
100 VA additional capacity .....		7 & 9	F4T11○	
200 VA additional capacity .....		1, 4, 4X, 12	F4T12○	
Two fuses in primary and one fuse in secondary				
100 VA additional capacity .....		1, 4, 4X, 12	FF4T11	
100 VA additional capacity .....		7 & 9	FF4T11	
200 VA additional capacity .....		1, 4, 4X, 12	FF4T12	
300 VA additional capacity .....		1, 4, 4X, 12	FF4T13	
400 VA additional capacity .....		1, 4, 4X, 12	FF4T14	
500 VA additional capacity .....		1, 4, 4X, 12	FF4T15	
Substitute non-standard single primary, and/or single secondary voltage rating on control transformer■		Any	T1▼	
Substitute dual-voltage magnet coil.		Any	Y5†	

\* All combination style devices such as 8538, 8539, 8738, 8739, that use Form S should also use Form Y74 (auxiliary contact installed on disconnect switch) per NEC Article 430-74.  
 ■ Table at right.  
 ▲ Single primary voltage must be specified.  
 ▼ Must be used with another form of F4T. (Ex. Standard capacity transformer required, 208-24V. Order as Form F4TT1, 208-24V.)  
 † Not available on Size 2 or Size 3 devices with 4 or 5 poles.  
 ‡ Not available on this Size. Select appropriate transformer with secondary fuse protection.  
 ○ Not available with 24V secondary on Size 3. Select appropriate transformer with secondary fuse protection. See Table at right for 24V secondary restrictions.  
 ◊ Not available with 24V secondary. Select appropriate transformer with secondary fuse protection. See Table at right for 24V secondary restrictions.  
 ‡ Single phase with one leg grounded or grounded B phase applications ONLY.

**■ Selection of Control Circuit Transformers**

The standard primary/secondary voltages for control circuit transformers are indicated in the following table.

AC-OPERATED DEVICES With Control Transformers	
Voltage	Code
60Hz (Primary-Secondary)	
120-12▲	V88
120-24▲	V89
208-120	V84
240-24▲	V82
240-120	V80
277-120	V85
480-24▲	V83
480-120	V81
480-240	V87
600-120	V86
Specify	V99

▲ 12V coils are not available on Sizes 3-7. 24V coils are not available on Sizes 4-7.

To order, select the desired device with the appropriate transformer form designation. Then convert the previously selected voltage code (V\_) to reflect the desired primary/secondary voltage for the transformer. The secondary voltage should equal the previously selected coil voltage of the device.

**Example:**

You have previously selected a Class 8536SDG1V02S. V02S means that you need a coil voltage of 120-60/110-50 wired for separate control. You would like to add form FF4T with the transformer voltages being 48 volt primary, 120 volt secondary with Solid State Overload Relay Protection Class 20 Trip Class (H20).

The new and complete class, type, voltage code and form number will be:

Class	Type	Voltage Code	Form*
8536	SDG1	V81	FF4TH20

\* Form numbers should always be shown in alphabetical order.

**Marine Control**

Class	Factory Modification	Enclosure Type	Form
8538	Modification of standard device for use as marine control per UL508	12/3R	M10
8539		4/4X (S.S. only)	
8738	Modification of standard device for use as marine control like Form 10 standards in addition to IEEE45.	12/3R	M11
8739		4/4X (S.S. only)	



# Factory Modifications (Forms) For Full Voltage Contactors and Starters

CLASS 8538 FUSED COMBINATION STARTER  
DESIGNATION: P-1  
8538SBG32V84CFF4H318T

## Full Voltage Controllers Only

CLASSES 8538, 8539, 8738 and 8739

Factory Modifications		Enclosure Type	Form Letters
OVERLOAD RELAYS	<b>Non-Compensated Bimetallic Overload Relays</b>		
	Single Phase:		
	Types SB-SD (Sizes 0-2)Ⓜ	Any	B1
	Polyphase:		
	Two Element — For 2 Phase Only		
	Types SB-SD (Sizes 0-2)	Any	B1
	Three Element		
	Types SB-SD (Sizes 0-2)	Any	B2
	Types SE-SF (Sizes 3-4)	Any	B5
	Type SG (Size 5)	Any	B2Y500
	Type SH (Size 6)	Any	B2
	<b>Ambient Compensated Bimetallic Overload Relays</b>		
	Three Element		
	Types SB-SD (Sizes 0-2)	1, 4, 7, 9, 12	2B
	Types SE-SF (Sizes 3 & 4)	Any	Y59
Type SG (Size 5)	Any	BY500	
Type SH (Size 6)	Any	B	
<b>Overload Relays - General</b>			
Substitute Class 9065 SSRO100			
For Standard Overload Protection	Any	B11	
Omit overload protection from combination starters. (Classes 8538, 8539, 8738, 8739 only)			
Do not use with MAG-GARD® Circuit Breakers.			
Deduct per starter	Any	Y76	
Modify Size 3 Type SE starters with melting alloy overload relays to accept Type FB quick trip or SB slow trip thermal units and Size 4 Type SF starters to accept Type FB quick trip thermal units. (Rejects Type CC standard trip thermal units.)	Any	Y81	
Substitute 9999 SO4 isolated alarm contact (N.O.) on melting alloy overload relay	Any	Y342	
Substitute 9999 SO5 isolated alarm contact (N.C.) on melting alloy overload relay	Any	Y344	

Ⓜ Size 7 uses a solid state overload relay as standard. See Class 8536 for complete details.  
 Ⓜ Single phase bimetallic overload relays for Type S Sizes 0-2 require two (2) thermal units per starter.  
 Ⓜ For Classes 8736, 8738 and 8739, Type SG, consult Local Square D Field Office.

## Solid State Overload Relay Factory Modifications (Forms)

The solid state overload relay is available on NEMA Size 00-7.  
 For Class 8536, 8538, 8539, 8736, 8738, 8739 and 8810 devices.

### Form Description

Type S Starter with Motor Logic  
 Solid State Overload Relay

- 1 - Motor Logic, Base Unit, Trip Class 10
- 2 - Motor Logic, Base Unit, Trip Class 20
- 3 - Motor Logic, Feature Base Unit
- 0 - No additional modifications

1 - N.O. Aux. Contact (Field Convertible to N.C.)

Special Overload/Contactor Size Combinations (Base Unit & Feature Base Units):  
 (Must Be Specified On Size 00 Starter Orders)

- Blank - Overload Matched to Starter Size (i.e. Size 1 contactor & 9-27A overload)
- 0 - A 6 - 18A overload on a starter size as indicated by the Starter Catalog Number
- 1 - A 9 - 27A overload on a starter size as indicated by the Starter Catalog Number
- 2 - A 15 - 45A overload on a starter size as indicated by the Starter Catalog Number
- 3 - A 30 - 90A overload on a starter size as indicated by the Starter Catalog Number
- 4 - A 45 - 135A overload on a starter size as indicated by the Starter Catalog Number
- 8 - A 1.5 - 4.5A overload on a starter size as indicated by the Starter Catalog Number (only offered on Feature Base Units)
- 9 - A 3 - 9A overload on a starter size as indicated by the Starter Catalog Number

SPECIAL NOTE FOR Class 8810 devices:  
 You MUST SPECIFY TWO SEPARATE FORM NUMBERS TO GET MOTOR LOGIC OVERLOADS ON TWO SPEED STARTERS. The first form number is for the low speed winding and the second is for the high speed winding.  
 EXAMPLE: Open Style, Size 4 Two Speed Starter with Motor Logic Overloads Required.  
 Single Winding, 460V, Constant Horsepower  
 High Speed FLA = 96A  
 Low Speed FLA = 27A (use Size 2 Overload)  
 Catalog Number to Order: 8810 SF01V02 form S H20 H202  
 Where: Form H20 is a Size 4 Contactor with a 45-135A Motor Logic Overload for the High Speed and form H202 is a 15-45A Motor Logic Overload on the low speed contactor.

## Classes 8538, 8539, 8738 and 8739

Factory Modifications	Form
Motor Logic Solid State Overload	Base Unit, Trip Class 10 H10
	Base Unit, Trip Class 20 H20
	Feature Base Unit H30
	Base Unit, Trip Class 10 H11
	Base Unit, Trip Class 20 H21
Motor Logic Solid State Overload with Auxiliary Contact	Feature Base Unit H31

## Special Starter Combinations with Motor Logic™ Overload Relay Protection

NEMA Contactor Size	Solid State Overload Relay Size							NEMA Contactor Size	Solid State Overload Relay Size						
	00B	00C	0	1	2	3	4		00B	00C	0	1	2	3	4
00	▲	Std.						2	▲	▲	▲	Std.			
0	▲	▲	Std.					3	n/a	n/a	n/a	n/a	n/a	Std.	
1	▲	▲	▲	Std.				4	n/a	n/a	n/a	n/a	n/a	▲	Std.

▲ Possible factory starter combinations available.

# Product data sheet

## Characteristics

# 2510FG1P

## MANUAL STARTER 277VAC

Product availability: Stock - Normally stocked in distribution facility

Price\*: 129.00 USD



### Main

Commercial Status	Commercialised
Product or component type	Single Unit Manual Starter
Range of product	F
[In] rated current	16 A
Product certifications	CE CSA UL listed
Cable entry	0.5" and 0.75" knock-outs (top and bottom)
NEMA degree of protection	NEMA 1 plastic standard size
Motor power hp	1 hp 277 V AC 1 hp 230 V AC 1 hp 115 V AC
[Ue] rated operational voltage	277 V AC
Poles description	1P
Control type	Toggle switch
Network number of phases	1 phase
Local signalling	Red indicator
Reset	Manual
Motor starter type	Non reversing
Electrical connection	Screw clamp terminals
Thermal overload type	Melting alloy

### Ordering and shipping details

Category	21101 - 2510,2511,2512 F
Discount Schedule	CP1
GTIN	00785901553946
Nbr. of units in pkg.	1
Package weight(Lbs)	0.79
Product availability	Stock - Normally stocked in distribution facility
Returnability	Y
Country of origin	MX

### Offer Sustainability

Sustainable offer status	Not Green Premium product
RoHS	Will not be Compliant
REACH	Reference not containing SVHC above the threshold

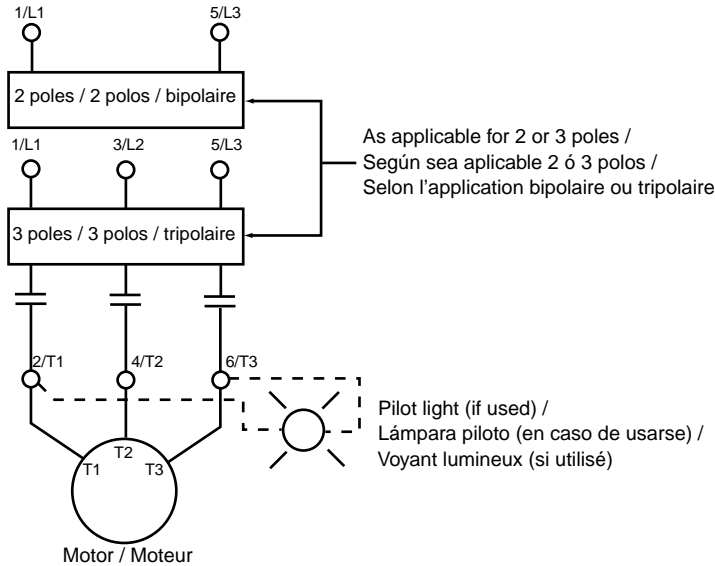
### Contractual warranty

Period	18 months
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**Class 2510 Type K Manual Motor Starting Switch**  
**Interruptor manual de arranque de motor clase 2510 tipo K**  
**Interrupteur manuel de démarrage de moteur de classe 2510 de type K**

⚠ DANGER	⚠ PELIGRO	⚠ DANGER
<p><b>HAZARDOUS VOLTAGE</b>            Disconnect all power before working on equipment.  <b>Failure to follow this instruction will result in death or serious injury.</b></p>	<p><b>TENSION PELIGROSA</b>            Desenergice el equipo antes de realizar cualquier trabajo en él.  <b>El incumplimiento de esta precaución podrá causar la muerte o lesiones serias.</b></p>	<p><b>TENSION DANGEREUSE</b>            Coupez l'alimentation de cet appareil avant d'y travailler.  <b>Si cette précaution n'est pas respectée, cela entraînera la mort ou des blessures graves.</b></p>



**Table / Tabla / Tableau 1**

V ~	HP (kW) max.			
	Type / Tipo / Type K <sub>1</sub>		Type / Tipo / Type K <sub>5</sub> , K <sub>6</sub>	
	(2 Poles / 2 Polos / Bipolaire) 1 Ø	(3 Poles / 3 Polos / Tripolaire) 3 Ø	(2 Poles / 2 Polos / Bipolaire) 1 Ø	(3 Poles / 3 Polos / Tripolaire) 3 Ø
115	2 (1,5)	2 (1,5)	2 (1,5)	2 (1,5)
200 / 230	2 (1,5)	7.5 (5,6)	3 (2,2)	7.5 (5,6)
460 / 575	3 (2,2)	10 (7,5)		
460			7.5 (5,6)	15 (11,2)
575			10 (7,5)	20 (14,9)

Resistance Rating / Capacidad resistiva / Résistance nominale : 30 A, 600 V~



**SHORT CIRCUIT PROTECTION**

Suitable for use on a circuit capable of delivering not more than 5000 RMS Symmetrical Amperes, 600 Volts maximum.

Short-circuit protective device rating must comply with applicable electrical codes. Do not exceed rating in Table 2 for the applicable protective device.

**Control and Auxiliary Circuits** – Electrical codes may require additional overcurrent protection.

**PROTECCION CONTRA CORTOCIRCUITO**

Adecuado para utilizarse con un circuito capaz de suministrar no más de 5 000 A simétricos rcm, 600 V como máximo.

La capacidad del dispositivo protector debe cumplir con los códigos eléctricos correspondientes. No exceda la capacidad indicada en la tabla 2 para el dispositivo protector aplicable.

**Circuitos de control y auxiliares** – Los códigos eléctricos pueden requerir protección adicional contra sobrecorriente.

**PROTECTION CONTRE LES COURTS-CIRCUITS**

Convient à un circuit pouvant fournir au maximum 5 000 A efficaces symétriques, à 600 V maximum.

La valeur nominale du dispositif de protection doit se conformer aux codes électriques en vigueur. Ne pas dépasser l'intensité nominale figurant au tableau 2 pour le dispositif de protection applicable.

**Circuits de commande et auxiliares** – Les codes électriques peuvent exiger une protection de surintensité supplémentaire.

**Table / Tabla / Tableau 2**

Class / Clase / Classe	Generic Type / Tipo genérico / Type générique	Class RK5 Nontime-delay Fuse / Fusible sin retardo de tiempo clase RK5 / Fusible non temporisé de classe RK5	
		240 V	600 V
2510	K*1, 2	90 A	45 A
2510	K&3, 4	90 A	45 A
2510	K*5, 6	35 A	35 A
2511	K#11, 22	90 A	45 A
2512	K#11, 22	90 A	45 A

\* F, G, GJ, O, S, SJ, W  
& F, G, GJ, O, S, SJ  
# F, G, O

Electrical equipment should be serviced only by qualified electrical maintenance personnel. No responsibility is assumed by Square D for any consequences arising out of the use of this material.

Square D  
8001 Hwy 64 East  
Knightdale, NC 27545 USA  
(919) 266-3671

Solamente el personal de mantenimiento eléctrico especializado deberá prestar servicios de mantenimiento al equipo eléctrico. La Compañía no asume responsabilidad alguna por las consecuencias emergentes de la utilización de este material.

Importado en México por:  
Schneider Electric México, S.A. de C.V.  
Calz. J. Rojo Gómez 1121  
Col. Gpe. del Moral 09300 México, D.F.  
Tel. 686-30-00

L'entretien du matériel électrique ne doit être effectué que par du personnel qualifié. La Société n'assume aucune responsabilité des conséquences éventuelles découlant de l'utilisation de ce matériel.

Schneider Canada Inc.  
19 Waterman Avenue, M4B 1Y2  
Toronto, Ontario  
(416) 752-8020





## NEMA Size M-0 Class 2510, Manual Starter

With Melting Alloy Overload Relay  
Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical A, 600 V maximum.

Grounding Kit                      Class 9999, Type GBK24

NOTE: Overload relay thermal units must be installed and reset before starter can be operated. After inspection of contacts, device must be reset.

### ⚠ WARNING/ADVERTENCIA/AVERTISSEMENT

#### OVERLOAD PROTECTION HAZARD

If burnout of an overload relay thermal unit occurs, the thermal unit must be replaced to provide continued protection against fire and shock hazard. **Failure to observe this precaution can result in death, serious injury or equipment damage.**

#### PELIGRO DE FALLA DE PROTECCION CONTRA SOBRECARGA

Si se quema un elemento térmico del relevador de sobrecarga, es necesario reemplazarlo para proporcionar una protección permanente contra incendio y descarga eléctrica.

**El incumplimiento de esta precaución puede causar la muerte, lesiones serias o daño al equipo.**

#### RISQUE DE MANQUE DE PROTECTION CONTRE LES SURCHARGES

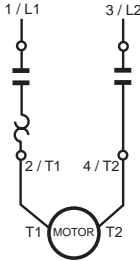
Si une unité thermique du relais de surcharge brûle, elle doit être remplacée pour assurer une protection continue contre l'incendie et l'électrocution. **Si cette précaution n'est pas respectée, cela peut entraîner la mort, des blessures graves ou des dommages matériels.**



NOTE: Side knockouts must not be used when electrical interlocks are installed, because of insufficient electrical spacing between interlock terminals and conduit bushing.

Power lugs suitable for copper conductors only. Sized for 60°C wire ampacity, rated 60°C minimum or sized for 75°C wire ampacity, rated 75°C minimum. Lug torque requirements: Line and load: 20 lb-in

### SINGLE-PHASE, 2-WIRE SYSTEM



30072-004-19N

### OVERLOAD RELAY THERMAL UNITS

For continuous-rated motors having service factors of 1.15 to 1.25, select thermal units directly from table using 100% of full-load current (FLC) shown on motor nameplate. For continuous-rated motors having a service factor of 1.0, select the thermal units from table using 90% of FLC shown on motor nameplate.

Motor FLC (A)	Thermal Unit No.	Single Motor Installation (N.E.C. 430-52)	Group Motor Installation (N.E.C. 430-53)		Thermal Unit No.	Motor FLC (A)	Single Motor Installation (N.E.C. 430-52)	Group Motor Installation (N.E.C. 430-53)
			Class K9 or Unclassified Fuse	Class K5 Fuse				
0.33-0.36	B 0.44	0.6	15	30	B 4.15	3.00-3.37	0.6	15
0.37-0.40	B 0.51	0.8	15	30	B 4.85	3.38-3.94	0.8	15
0.41-0.45	B 0.57	0.8	15	30	B 5.50	3.95-4.24	0.8	15
0.46-0.52	B 0.63	1	15	30	B 6.25	4.25-4.54	1	15
0.53-0.59	B 0.71	1.125	15	30	B 6.90	4.55-5.29	1.125	15
0.60-0.66	B 0.81	1.25	15	30	B 7.70	5.30-5.73	1.25	15
0.67-0.73	B 0.92	1.4	15	30	B 8.20	5.74-6.35	1.4	15
0.74-0.81	B 1.03	1.6	15	30	B 9.10	6.36-7.08	1.6	15
0.82-0.91	B 1.16	1.8	20	30	B 10.2	7.09-7.83	1.8	20
0.92-1.02	B 1.30	2	20	30	B 11.5	7.84-8.47	2	20
1.03-1.14	B 1.45	2.25	20	30	B 12.8	8.48-9.83	2.25	20
1.15-1.29	B 1.67	2.5	20	30	B 14.0	9.84-10.5	2.5	20
1.30-1.42	B 1.88	2.8	20	30	B 15.5	10.6-11.4	2.8	20
1.43-1.64	B 2.10	3.2	25	30	B 17.5	11.5-12.8	3.2	25
1.65-1.80	B 2.40	3.5	25	30	B 19.5	12.9-13.9	3.5	25
1.81-2.10	B 2.65	4	25	30	B 22.0	14.0-16.1	4	25
2.11-2.30	B 3.00	4.5	25	30	B 25.0	16.2-18.0	4.5	25
2.31-2.61	B 3.30	5	30	30			5	30
2.62-2.99	B 3.70	5.6	30	30			5.6	30
			GROUP FUSING RESTRICTIONS					
			Maximum thermal unit size B 12.8					
			Maximum branch circuit available current 5000 A symmetrical.					

Branch circuit fuse rating must comply with applicable electrical codes and must not exceed the maximum fuse rating shown opposite the thermal unit selected. Fuses for single motor installation may need to be of the time delay type to permit motor starting. Trip current rating in a 40°C (104°F) ambient temperature is 1.25 times the minimum FLC shown for the thermal unit selected. Instructions given above assume that the motor and the controller are located in approximately the same ambient temperature. For other conditions, consult Square D Company.





## Arrancador manual NEMA tamaño M-0, clase 2510

con relevador de sobrecarga de aleación fusible  
Adecuado para utilizarse con un circuito capaz de suministrar no más de 5000 A simétricos rcm, 600 V como máximo.

Accesorio de conexión a tierra clase 9999, tipo GBK24

NOTA: Se deberán instalar y restablecer los elementos térmicos del relevador de sobrecarga antes de hacer funcionar el arrancador. Después de haber realizado una inspección visual de los contactos, se deberá restablecer el dispositivo.

### ⚠ WARNING/ADVERTENCIA/AVERTISSEMENT

#### OVERLOAD PROTECTION HAZARD

If burnout of an overload relay thermal unit occurs, the thermal unit must be replaced to provide continued protection against fire and shock hazard. Failure to observe this precaution can result in death, serious injury or equipment damage.

#### PELIGRO DE FALLA DE PROTECCION CONTRA SOBRECARGA

Si se quema un elemento térmico del relevador de sobrecarga, es necesario reemplazarlo para proporcionar una protección permanente contra incendio y descarga eléctrica.

**El incumplimiento de esta precaución puede causar la muerte, lesiones serias o daño al equipo.**

#### RISQUE DE MANQUE DE PROTECTION CONTRE LES SURCHARGES

Si une unité thermique du relais de surcharge brûle, elle doit être remplacée pour assurer une protection continue contre l'incendie et l'électrocution.

**Si cette précaution n'est pas respectée, cela peut entraîner la mort, des blessures graves ou des dommages matériels.**

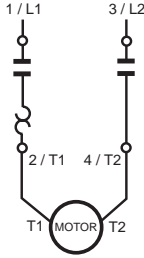


NOTA: No utilice discos removibles laterales cuando se encuentran instalados entrelaces eléctricos, ya que no hay espacio suficiente para las instalaciones eléctricas entre las terminales de bloqueo y el pasamuros del tubo conduit.

Las zapatas de alimentación son adecuadas solamente para conductores de cobre con una ampacidad a 60°C y clasificados para 60°C como mínimo o con una ampacidad a 75°C y clasificados para 75°C como mínimo.

Requisitos de par de apriete de las zapatas:  
Línea y carga: 2,26 N•m (20 lbs-pulg)

### SISTEMA MONOFASICO DE 2 HILOS



30072-004-19N

### ELEMENTOS TERMICOS DEL RELEVADOR DE SOBRECARGA

Para los motores de potencia continua con un factor de servicio de 1,15 a 1,25, seleccione los elementos térmicos directamente de la tabla utilizando el 100% de la corriente plena carga del motor (CPCM) que se muestra en la placa de identificación del motor. Para los motores de potencia continua con un factor de servicio de 1,0, seleccione los elementos térmicos de la tabla utilizando el 90% de la CPCM que se muestra en la placa de identificación del motor.

CPCM (A)	No. de elemento térmico	Instalación de un motor (N.E.C. 430-52)	Instalación de un grupo de motores (N.E.C. 430-53)		CPCM (A)	No. de elemento térmico	Instalación de un motor (N.E.C. 430-52)	Instalación de un grupo de motores (N.E.C. 430-53)	
			Fusible clase K5	Fusible clase K5				Fusible clase K9 o sin clasificación	Fusible clase K5
0,33-0,36	B 0,44	0,6	15	30	3,00-3,37	B 4,15	6,25	30	30
0,37-0,40	B 0,51	0,8	15	30	3,38-3,94	B 4,85	7	30	30
0,41-0,45	B 0,57	0,8	15	30	3,95-4,24	B 5,50	8	30	30
0,46-0,52	B 0,63	1	15	30	4,25-4,54	B 6,25	9	30	30
0,53-0,59	B 0,71	1,125	15	30	4,55-5,29	B 6,90	10	30	30
0,60-0,66	B 0,81	1,25	15	30	5,30-5,73	B 7,70	10	30	30
0,67-0,73	B 0,92	1,4	15	30	5,74-6,35	B 8,20	12	30	30
0,74-0,81	B 1,03	1,6	15	30	6,36-7,08	B 9,10	12	30	30
0,82-0,91	B 1,16	1,8	20	30	7,09-7,83	B 10,2	15	30	30
0,92-1,02	B 1,30	2	20	30	7,84-8,47	B 11,5	17,5	30	30
1,03-1,14	B 1,45	2,25	20	30	8,48-9,83	B 12,8	17,5	30	30
1,15-1,29	B 1,67	2,5	20	30	9,84-10,5	B 14,0	20	30	30
1,30-1,42	B 1,88	2,8	20	30	10,6-11,4	B 15,5	20	30	30
1,43-1,64	B 2,10	3,2	25	30	11,5-12,8	B 17,5	25	30	30
1,65-1,80	B 2,40	3,5	25	30	12,9-13,9	B 19,5	25	30	30
1,81-2,10	B 2,65	4	25	30	14,0-16,1	B 22,0	25	30	30
2,11-2,30	B 3,00	4,5	25	30	16,2-18,0	B 25,0	25	30	30
2,31-2,61	B 3,30	5	30	30					
2,62-2,99	B 3,70	5,6	30	30					

RESTRICCIONES DE FUSIBLES EN GRUPO  
Tamaño máximo del elemento térmico: B 12,8  
Corriente máxima del circuito derivado de spómbles: 5000 A simétricos.

El valor nominal de fusibles de los circuitos derivados debe cumplir con los códigos eléctricos correspondientes y no debe superar el valor nominal máximo de fusibles que se indica al opuesto del elemento térmico seleccionado. Puede ser necesario que los fusibles para la instalación de un solo motor sean de tipo de retardo para permitir el arranque del motor.

El valor nominal de corriente de disparo a una temperatura ambiente de 40°C (104°F) es 1,25 veces la CPCM mínima que se indica para el elemento térmico seleccionado. Las instrucciones proporcionadas anteriormente suponen que el motor y el controlador están ubicados en aproximadamente la misma temperatura ambiente. Para otras condiciones, consulte a Square D Company.

# SQUARE D

## Démarrateur manuel NEMA taille M-0, classe 2510

avec relais de surcharge à fusion d'alliage  
Convient à un circuit pouvant fournir au maximum  
5000 A efficaces symétriques, à 600 V maximum.

Kit de mise à la terre : classe 9999, type GBK24

REMARQUE : Les unités thermiques de relais de surcharge doivent être installées et réinitialisées pour que le démarreur puisse fonctionner. Après l'inspection des contacts, le dispositif doit être réinitialisé.

### ⚠ WARNING/ADVERTENCIA/AVERTISSEMENT

#### OVERLOAD PROTECTION HAZARD

If burnout of an overload relay thermal unit occurs, the thermal unit must be replaced to provide continued protection against fire and shock hazard.  
**Failure to observe this precaution can result in death, serious injury or equipment damage.**

#### PELIGRO DE FALLA DE PROTECCION CONTRA SOBRECARGA

Si se quema un elemento térmico del relevador de sobrecarga, es necesario reemplazarlo para proporcionar una protección permanente contra incendio y descarga eléctrica.  
**El incumplimiento de esta precaución puede causar la muerte, lesiones serias o daño al equipo.**

#### RISQUE DE MANQUE DE PROTECTION CONTRE LES SURCHARGES

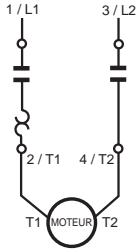
Si une unité thermique du relais de surcharge brûle, elle doit être remplacée pour assurer une protection continue contre l'incendie et l'électrocution.  
**Si cette précaution n'est pas respectée, cela peut entraîner la mort, des blessures graves ou des dommages matériels.**

REMARQUE : Les débouchures latérales ne doivent pas être utilisées lorsque des interverrouillages électriques sont installés, par suite de la distance insuffisante d'isolement électrique entre les bornes des interverrouillages et le manchon du conduit.

Les cosses d'alimentation ne conviennent que pour des conducteurs en cuivre, pour des intensités de courant admissibles à 60 °C d'une valeur nominale minimale de 60 °C ou pour des intensités de courant admissibles à 75 °C d'une valeur nominale minimale de 75 °C.

Couples requis des cosses :  
Secteur et charge :  
2,26 N•m (20 lb-po)

### SYSTÈME MONOPHASÉ À 2 FILS



30072-004-19N

### UNITÉS THERMIQUES DU RELAIS DE SURCHARGE

Pour des moteurs en régime continu ayant des facteurs de service de 1,15 à 1,25, sélectionner les unités thermiques directement dans le tableau en utilisant 100 % du courant nominal à pleine charge du moteur (CPCM) indiqué sur la plaque signalétique du moteur. Pour des moteurs en régime continu ayant un facteur de service de 1,0, sélectionner les unités thermiques directement dans le tableau en utilisant 90 % du CPCM indiqué sur la plaque signalétique.

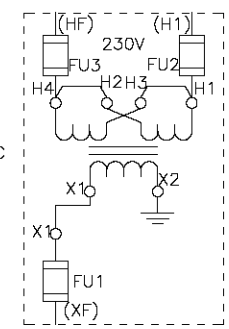
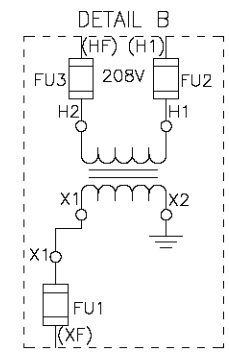
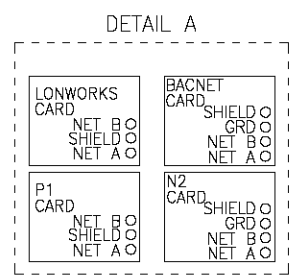
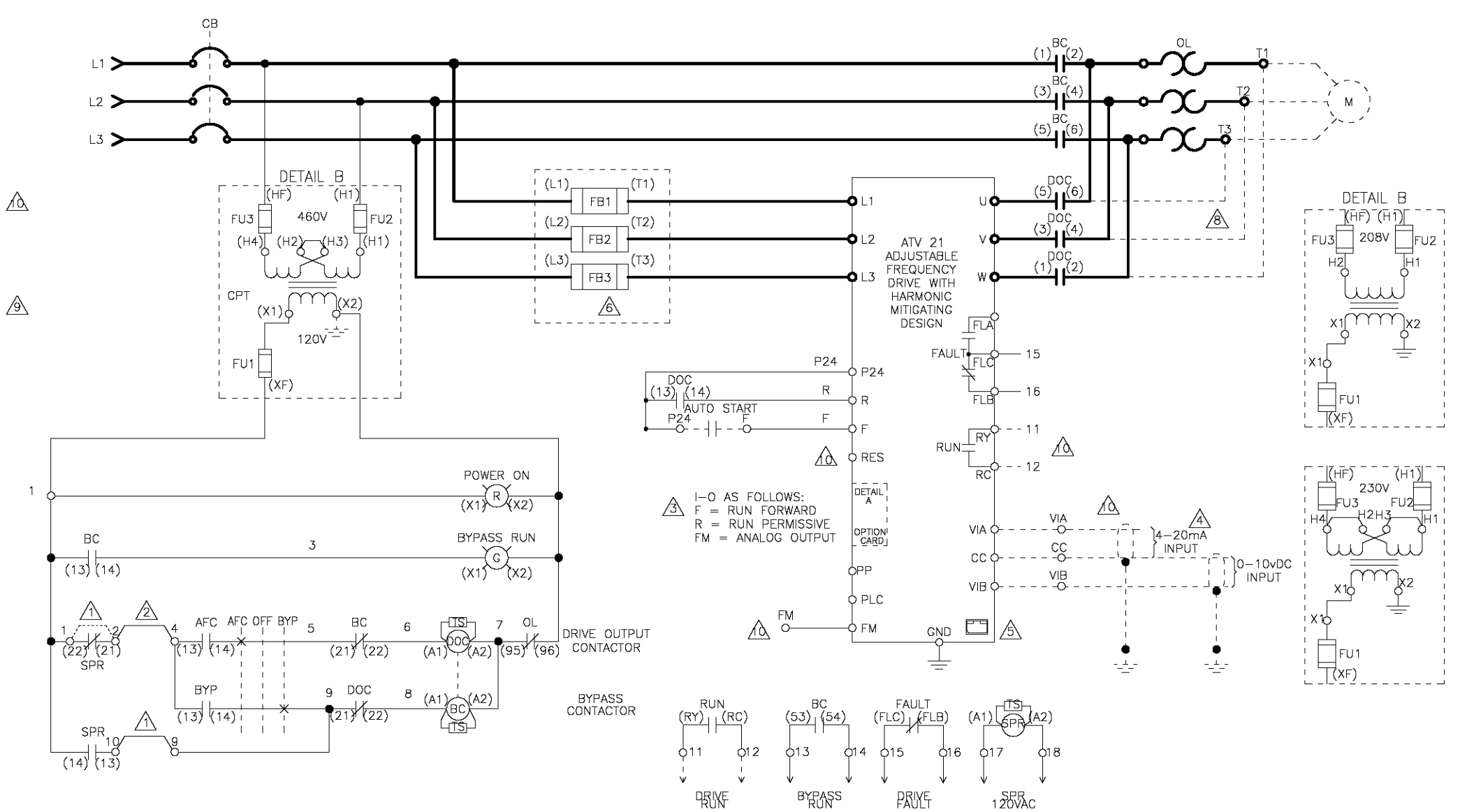
CPCM (A)	N° de l'unité thermique	Installation d'un seul moteur (N.E.C. 430-52)	Installation d'un groupe de moteurs (N.E.C. 430-53)		CPCM (A)	N° de l'unité thermique	Installation d'un seul moteur (N.E.C. 430-52)	Installation d'un groupe de moteurs (N.E.C. 430-53)	
			Fusible de classe K9 ou non classé	Fusible de classe K5				Fusible de classe K9 ou non classé	Fusible de classe K5
0,33-0,36	B 0,44	0,6	15	30	3,38-3,94	B 4,85	7	30	30
0,37-0,40	B 0,51	0,8	15	30	3,95-4,24	B 5,50	8	30	30
0,41-0,45	B 0,57	0,8	15	30	4,25-4,54	B 6,25	9	30	30
0,46-0,52	B 0,63	1	15	30	4,55-5,29	B 6,90	10	30	30
0,53-0,59	B 0,71	1,125	15	30	5,30-5,73	B 7,70	10	30	30
0,60-0,66	B 0,81	1,25	15	30	5,74-6,35	B 8,20	12	30	30
0,67-0,73	B 0,92	1,4	15	30	6,36-7,08	B 9,10	12	30	30
0,74-0,81	B 1,03	1,6	15	30	7,09-7,83	B 10,2	15	30	30
0,82-0,91	B 1,16	1,8	20	30	7,84-8,47	B 11,5	17,5	30	30
0,92-1,02	B 1,30	2	20	30	8,48-9,83	B 12,8	17,5	30	30
1,03-1,14	B 1,45	2,25	20	30	9,84-10,5	B 14,0	20	30	30
1,15-1,29	B 1,67	2,5	20	30	10,6-11,4	B 15,5	20	30	30
1,30-1,42	B 1,88	2,8	20	30	11,5-12,8	B 17,5	25	30	30
1,43-1,64	B 2,10	3,2	25	30	12,9-13,9	B 19,5	25	30	30
1,65-1,80	B 2,40	3,5	25	30	14,0-16,1	B 22,0	25	30	30
1,81-2,10	B 2,65	4	25	30	16,2-18,0	B 25,0	25	30	30
2,11-2,30	B 3,00	4,5	25	30					
2,31-2,61	B 3,30	5	30	30					
2,62-2,99	B 3,70	5,6	30	30					
3,00-3,37	B 4,15	6,25	30	30					

RESTRICTIONS DE FUSIBLES EN GROUPE  
Taille maximale des unités thermiques :  
B 12,8  
Courant maximum disponible du circuit d'arrière : 5000 A symétriques

La valeur nominale des fusibles des circuits d'arrière doit être conforme aux codes électriques en vigueur et ne doit pas dépasser la valeur nominale maximale indiquée à l'opposé de l'unité thermique sélectionnée. Les fusibles pour l'installation d'un seul moteur peuvent devoir être de type temporisé pour permettre le démarrage du moteur. La valeur nominale du courant de déclenchement à une température ambiante de 40 °C (104 °F) est de 1,25 fois le CPCM minimum indiqué pour l'unité thermique sélectionnée. Les directives ci-dessus supposent que le moteur et le contrôleur se trouvent à une température ambiante qui est pratiquement la même. Pour des conditions différentes, consulter la Société Square D.

REV	DESCRIPTION	BY	DATE						
---	---	---	---	---	---	---	---	---	---

VT FACTORY CONFIGURATION				
MENU	SUB-MENU	CODE	ADJ.	DESCRIPTION
PRG	---	typ	2	60 Hz DEFAULT SETTINGS
PRG	---	ACC	60	ACCELERATION TIME, IN SECONDS
PRG	---	dEC	60	DECELERATION TIME, IN SECONDS
PRG	---	LL	15	LOW SPEED: 15 HZ
PRG	---	UL	60	HIGH SPEED: 60 HZ
PRG	---	Pt	1	VARIABLE TORQUE MODE
MACRO	MACRO	AU4	1	MACRO FUNCTION: COAST STOP
PRG	---	ULU	208/460	APPLICATION VOLTAGE DEPENDANT
PRG	F---	f130	14	RY-RC RELAY FUNCTION: DRIVE RUN
PRG	F---	F132	11	FL RELAY FUNCTION: DRIVE FAULT
PRG	F---	F201	20	VIA INPUT POINT 1 SETTING
PRG	F---	F605	0	OUTPUT PHASE FAILURE DETECTION DISABLED
PRG	F---	F692	20	BIAS OF ANALOG OUTPUT
PRG	---	AU1	0	DISABLE ADAPTIVE ACC/DEC
PRG	---	CNOD	2	SERIAL COMMUNICATION
PRG	---	FNOD	4	SERIAL COMMUNICATION
PRG	F---	F829	△	SELECTION OF COMM. PROTOCOL



- NOTES:
- △1 REMOVE JUMPER 9-10 AND ADD 1-2 TO DISABLE SMOKE PURGE
  - △2 FIRE/FREEZESTAT INTERLOCKS, REMOVE JUMPER
  - △3 SEE PROGRAMMING AND OPERATION GUIDE, 30072-451-63
  - △4 TO CHANGE VIA TO A VOLTAGE ANALOG INPUT, MOVE CONFIGURABLE SWITCH TO THE "V" POSITION.
  - △5 MODBUS VIA RJ45 CONNECTION NATIVE TO ALL DRIVES
  - △6 FUSES REQUIRED ON 460V MODELS ONLY, CONVERTER ENDING IN \_N4
  - △7 VARIABLE BASED ON THE FOLLOWING:
    - 1. MODBUS RTU
    - 2. METASYS N2
    - 3. APOGEE FLN
    - 4. BAC-NET
  - △8 WIRING CHANGE FOR 40HP, 208V AND 100HP, 460V DRIVE
  - △9 FOR WHEN MOD A06, B06, C06, D06, OR NATIVE MODBUS IS REQUIRED FOR CONTROL. IF COMMUNICATION CARDS ARE USED FOR MONITORING ONLY, REFER TO INSTRUCTION BULLETIN 30072-451-83
  - △10 NOT AVAILABLE WHEN OPTIONS A06, B06, C06, OR D06 SELECTED.

NON-FUSIBLE DISCONNECT  
DESIGNATION: P-2 (HU361)

80462-031-00

JOB NAME:	HAINES HS VOC TECH BLDG	EQUIPMENT DESIGNATION:	<b>P-2</b>
JOB LOCATION:	HAINES AK	EQUIPMENT TYPE:	
DRAWN BY:	(Q2C)	DRAWING TYPE:	
ENGR:		 by Schneider Electric	
DATE:	May 06 2015	DWG#	<b>F36582663-01</b>
DRAWING STATUS:	QUOTE	PG	1 OF 2 REV -

# Heavy Duty Safety Switches

NON-FUSIBLE DISCONNECT  
DESIGNATION: P-2 (HU361)

## Class 3110



CONTENTS		
Description	Class	Page
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Technical Data .....	3110 .....	7
Dimensions .....	3110 .....	8-16



**SQUARE D**  
GROUPE SCHNEIDER

# Application Data

**NON-FUSIBLE DISCONNECT  
DESIGNATION: P-2 (HU361)**

## Description

Heavy Duty Safety Switches may be used as a means for disconnecting a load from its supply, or for opening and closing a circuit. When equipped with fuses, overload and short circuit protection are also provided.

## Application

Heavy Duty Safety Switches are designed for the following applications:

- Commercial and industrial installations.
- Up to 600 Vac or 600 Vdc maximum.
- Up to 200,000 rms symmetrical amperes short circuit current.
- 30 through 1200 amperes.
- Horsepower ratings.
- Two or three fusible switched poles with or without insulated, groundable neutral.
- Four fusible switched poles, neutral not available.
- Two or three not fusible, switched poles with or without insulated, groundable neutral.
- Four not fusible switched poles, neutral not available.
- Six not fusible switched poles, neutral not available.

## Standards

Heavy Duty Safety Switches are manufactured in accordance with these standards.

- UL98, Standard for Safety, Enclosed and Dead Front Switches. UL Listed under File E2875, or E154828.
- NEMA Standards Publication KS1, Enclosed Switches.
- Federal Specifications WS-865c for Type HD.
- CSA Certified – C22.2 No.4.
- NOM Certified.

## Construction

- Visible blades for positive blade position.
- Optional viewing window – allows visual verification of blade position without opening door. Not available on all devices, contact Square D Sales Offices.



Visible Blades

- Red and black handle indication for switch position.



E Series



F Series

- F Series handle/lockplate is field replaceable.
- F Series RB devices have side opening covers.
- Highly visible ON-OFF marking.
- Quick-make, quick-break spring driven operating mechanism.
- F Series operating mechanism is a field replaceable, enclosed modular design.



E Series  
Operating  
Mechanism



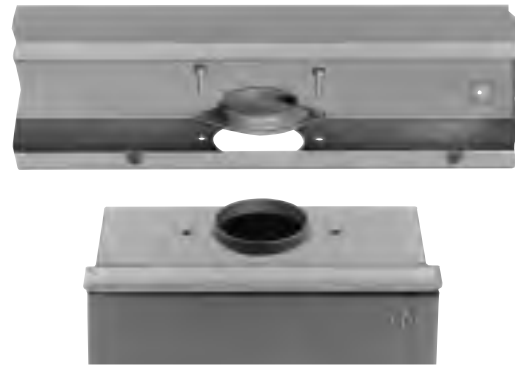
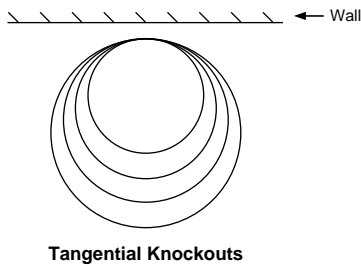
F Series  
Operating  
Mechanism



# Application Data

**NON-FUSIBLE DISCONNECT  
DESIGNATION: P-2 (HU361)**

- Tangential combination knockouts alleviate the need for conduit offset bends.



**Box Coupling Device**

## NEMA Types:

- **NEMA Type 1 — indoor, general purpose**
- NEMA Type 3R — outdoor, rainproof
- NEMA Type 4, 4X, 5 — indoor or outdoor, watertight, dust-tight and corrosion-resistant (stainless steel)
- NEMA Type 4X — indoor or outdoor, watertight, dust-tight and corrosion-resistant (fiberglass reinforced polyester enclosures)
- NEMA Type 7 — hazardous locations, Class I, Groups C and/or D
- NEMA Type 9 — hazardous locations, Class II, Groups E, F and/or G or Class III, Division 1 or 2
- NEMA Type 12, 12K — indoor, dust-tight and dripproof  
NEMA Type 12 has no knockouts (suitable for outdoor use)  
NEMA Type 12K provided with knockouts.

- ½" through 4" zinc or chrome plated watertight hubs for field installation on NEMA Type 3R, 12 or 4, 4X, 5 stainless steel switches.



**Watertight Hubs**

## Accessories

Bolt-on hubs for rainproof applications. Switches with RB suffix accept ¾" through 2½" bolt-on hubs. Switches with R suffix have blank top endwalls. RB devices may be coupled to raintight trough with a box coupling. F Series RB devices are compatible with 4" raintight trough only.



**Bolt-On Hubs**



**Class R Fuse Kits**



NON-FUSIBLE DISCONNECT  
DESIGNATION: P-2 (HU361)

## Technical Data:

Horsepower Ratings  
Typical Horsepower Ratings: Check Catalog Number For Specific Ratings of Heavy Duty Safety Switches

Ampere Rating	Fusible												Not Fusible									
	240 Vac				480 Vac				600 Vac				Vdc		240 Vac		480 Vac		600 Vac		Vdc	
	Std.		Max.		Std.		Max.		Std.		Max.				Max.		Max.		Max.			
	1PH	3PH	1PH	3PH	1PH	3PH	1PH	3PH	1PH	3PH	1PH	3PH	250V	600V	1PH	3PH	1PH	3PH	1PH	3PH	250V	600V
30	1½	3	3	7½	3	5	7½	15	3	7.5	10	20	5	15	5	10	7½	20	10	30	5	15
60	3	7½	10	15	5	15	20	30	10	15	25	50	10	30	10	20	25	50	30	60	10	30
100	7½	15	15	30	10	25	30	60	15	30	40	75	20	50	20	40	40	75	40	75	20	50
200	15	25	...	60	25	50	50	125	30	60	50	150	40	50	...	60	...	125	...	150	40	50
400	...	50	...	125	...	100	...	250	...	125	...	350	50	...	...	125	...	250	...	350	50	...
600	...	75	...	200	...	150	...	400	...	200	...	500	...	...	...	200	...	400	...	500	...	...
800	50	100	50	250	50	200	50	500	50	250	50	500	50	50	50	250	50	500	50	500	50	50
1200	50	100	50	250	50	200	50	500	50	250	50	500	50	50	50	250	50	500	50	500	50	50

### Short Circuit Withstand Ratings

Heavy Duty Safety Switch	UL Listed Fuse Class	UL Listed Short Circuit Withstand Rating †† (RMS Symmetrical Amperes)
Fusible or Not Fusible ◊	H K	10,000
	R J L	200,000

◊ UL Listed, short-circuit withstand ratings as shown apply to not fusible switches when protected by the corresponding class fuse.  
 †† Short circuit withstand ratings apply to AC only.  
**Note:** I<sup>2</sup>t and I<sub>p</sub> values for Square D heavy duty safety switches are the same as published UL maximum acceptable I<sup>2</sup>t and I<sub>p</sub> values for corresponding class fuse.

### Electrical Interlock Ratings

Electrical interlocks for Heavy Duty Safety Switches are available factory installed or in kit form for field installation. A pivot arm operates from the switch mechanism, breaking the control circuit before the main switch blades break. Electrical interlock kits are UL Listed. Refer to current Square D Digest for appropriate electrical interlock catalog number.

### Electrical Interlock Contact Ratings ◊

Interlock Type	AC – 50 or 60 Hz				DC		
	Volts	Make	Break	Cont.	Volts	Make & Break	Cont.
1 NO/1 NC Contact (-1 Suffix)	120	40A	15A	15A	115	.50A	15A
	240	20A	10A	15A	230	.25A	15A
	480	10A	6A	15A	600	.05A	15A
	600	8A	5A	15A			
2 NO/2 NC Contacts (-2 Suffix)	120	30A	3.0A	10A	115	1.0A	10A
	240	15A	1.5A	10A	230	.30A	10A
	480	7.5A	.75A	10A	600	.10A	10A
	600	6.0A	.60A	10A			

◊ Single pole single throw interlock kits are rated 1/2 HP @ 110 and 220 Vac.  
 -1 Suffix utilizes a 9007A01 limit switch.  
 -2 Suffix utilizes a 9007C03 limit switch.

### Terminal Lug Data For NEMA Type 1, 3R, and 4X Switches

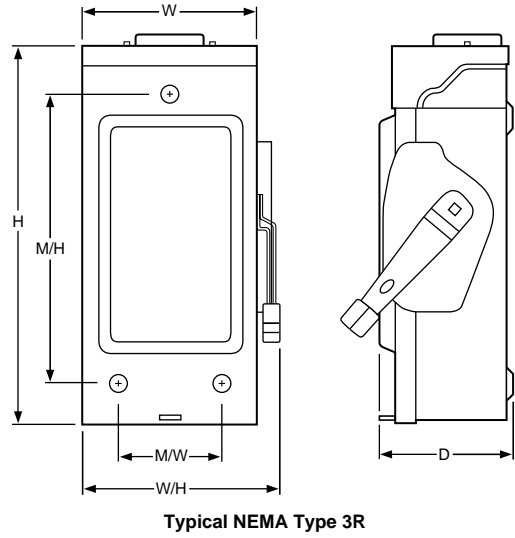
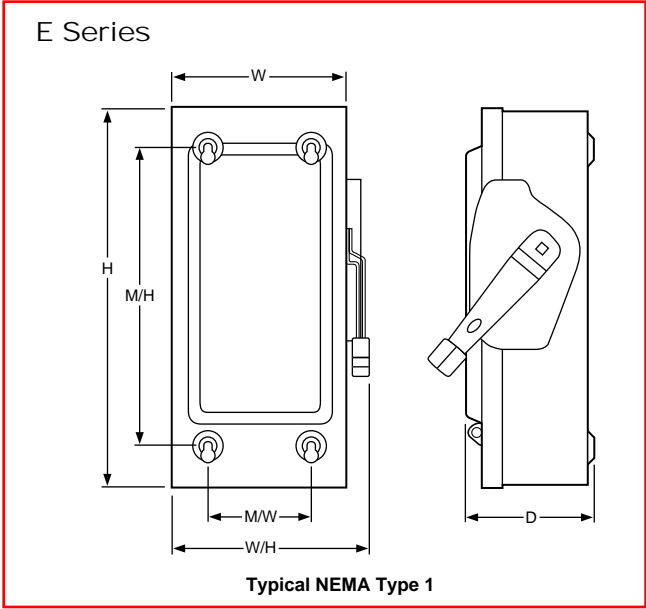
Ampere Rating	NEMA Type Enclosure	Conductors Per Phase	Wire Range Wire Bending Space Per NEC Table 373-6	Lug Wire Range ▲	Optional VERSA-CRIMP® Compression Lug Field Installable
30	1, 3R, 4X■	1	#12-6 AWG (Al) or #14-6 AWG (Cu)	#12-2 AWG (Al) or #14-2 AWG (Cu)	...
60	1, 3R, 4X■	1	#12-3 AWG (Al) or #14-3 AWG (Cu)	#12-2 AWG (Al) or #14-2 AWG (Cu)	...
100	1, 3R, 4X■	1	#12-1/0 AWG (Al) or #14-1/0 AWG (Cu)	#12-1/0 AWG (Al) or #14-1/0 AWG (Cu)	VCEL-021-14S1
200	1, 3R	1	#6 AWG – 250 kcmil (Al/Cu)	#6 AWG – 300 kcmil (Al/Cu)	VCEL-030-516H
400	1, 3R	1 or 2	#1/0 AWG – 750 kcmil (Al/Cu) or #1/0 AWG – 300 kcmil (Al/Cu)	#1/0 AWG – 750 kcmil (Al/Cu) and #1/0 AWG – 300 kcmil (Al/Cu)	VCEL-075-12H1 or VCEL-030-516H1 and VCEL-050-12H1
600	1, 3R	2	#3/0 AWG – 500 kcmil (Al/Cu)	#3/0 AWG – 500 kcmil (Al/Cu)	VCEL-050-12H1
800	1, 3R/5	3	#3/0 AWG – 750 kcmil (Al/Cu)	#3/0 AWG – 750 kcmil (Al/Cu)	H8LKE2
1200	1, 3R/5	4	#3/0 AWG – 750 kcmil (Al/Cu)	#3/0 AWG – 750 kcmil (Al/Cu)	H12LKE2

▲ 30-100 ampere switches suitable for 60°C or 75°C conductors. 200-1200 ampere switches suitable for 75°C conductors.  
 ■ 4X Fiberglass Reinforced Polyester and KRYDON® Switches.



# Dimensions NEMA Type 1 and 3R

NON-FUSIBLE DISCONNECT  
DESIGNATION: P-2 (HU361)



Catalog Numbers	Overall Dimensions IN/mm ± 1/16											Knockouts				
	H		M/H		W		W/H		M/W		D	Top & Bottom ■		Sides	Back	
	IN	mm	IN	mm	IN	mm	IN	mm	IN	mm	IN	mm				
<b>30 Ampere</b>																
H221N	14.25	362	11.13	283	6.50	165	7.25	184	3.75	95	4.63	118	2-1/2, 3/4, 1	1-1/2, 3/4, 1, 1 1/4	2-1/2, 3/4, 1	1-1/2, 3/4, 1
H221NRB	15.25	387	11.00	279	6.50	165	7.50	191	3.75	95	4.75	121	2-1/2, 3/4, 1	1-1/2, 3/4, 1, 1 1/4	1-1/2, 3/4, 1	1-1/2, 3/4, 1
H321N	14.25	362	11.13	283	6.50	165	7.25	184	3.75	95	4.63	118	2-1/2, 3/4, 1	1-1/2, 3/4, 1, 1 1/4	2-1/2, 3/4, 1	1-1/2, 3/4, 1
H321NRB	15.25	387	11.00	279	6.50	165	7.50	191	3.75	95	4.75	121	2-1/2, 3/4, 1	1-1/2, 3/4, 1, 1 1/4	1-1/2, 3/4, 1	1-1/2, 3/4, 1
H361	14.25	362	11.13	283	6.50	165	7.25	184	3.75	95	4.63	118	2-1/2, 3/4, 1	1-1/2, 3/4, 1, 1 1/4	2-1/2, 3/4, 1	1-1/2, 3/4, 1
H361N	14.25	362	11.13	283	6.50	165	7.25	184	3.75	95	4.63	118	2-1/2, 3/4, 1	1-1/2, 3/4, 1, 1 1/4	2-1/2, 3/4, 1	1-1/2, 3/4, 1
H361NRB	15.25	387	11.00	279	6.50	165	7.50	191	3.75	95	4.75	121	2-1/2, 3/4, 1	1-1/2, 3/4, 1, 1 1/4	1-1/2, 3/4, 1	1-1/2, 3/4, 1
H361RB	15.25	387	11.00	279	6.50	165	7.50	191	3.75	95	4.75	121	2-1/2, 3/4, 1	1-1/2, 3/4, 1, 1 1/4	1-1/2, 3/4, 1	1-1/2, 3/4, 1
H461▲	20.50	521	21.25	540	14.75	375	16.13	410	12.00	305	6.85	174	...	...	...	...
HU361	14.25	362	11.13	283	6.50	165	7.25	184	3.75	95	4.63	118	2-1/2, 3/4, 1	1-1/2, 3/4, 1, 1 1/4	2-1/2, 3/4, 1	1-1/2, 3/4, 1
HU361-EI	14.25	362	11.13	283	6.50	165	7.25	184	3.75	95	4.63	118	2-1/2, 3/4, 1	1-1/2, 3/4, 1, 1 1/4	2-1/2, 3/4, 1	1-1/2, 3/4, 1
HU361RB	15.25	387	11.00	279	6.50	165	7.50	191	3.75	95	4.75	121	2-1/2, 3/4, 1	1-1/2, 3/4, 1, 1 1/4	1-1/2, 3/4, 1	1-1/2, 3/4, 1
HU361RB-EI	15.25	387	11.00	279	6.50	165	7.50	191	3.75	95	4.75	121	2-1/2, 3/4, 1	1-1/2, 3/4, 1, 1 1/4	1-1/2, 3/4, 1	1-1/2, 3/4, 1
HU461▲	20.50	521	21.25	540	14.75	375	16.13	410	12.00	305	6.85	174	...	...	...	...

■ Top of NEMA Type 3R switches have a provision for maximum 2 1/2" bolt-on hub.  
▲ F Series Switch





**Table 19.316: Empty Enclosures (for Customer Assembly)** NOTE: When ordering, add prefix 9001 to the catalog number.

No of Holes	Sheet Steel		Die Cast Zinc		Stainless Steel (304)		Polymeric (Plastic)	
	Type	\$ Price	Type	\$ Price	Type	\$ Price	Type	\$ Price
1	KYAF1	143.00	KY1	143.00	KYSS1	257.00	SKY1	171.00
2	KYAF2	158.00	KY2 ▲	158.00	KYSS2	270.00	SKY2	201.00
3	KYAF3	185.00	KY3 ▲	185.00	KYSS3	372.00	SKY3	228.00
4	KYAF4	228.00	KY4 ▲	228.00	KYSS4	485.00	SKY4	269.00
6	KYAF6	287.00	KY6	287.00	KYSS6	714.00	SKY6	287.00

▲ Only KN200 series legend plates will fit upright on these enclosures with their long axis vertical.

NOTE: See Table 19.319 on Page 19-106 for Assembled Control Stations



KYG1Y  
(mushroom head not included)

**Table 19.317: Guarded Enclosures**

No of Holes	UL Types 1, 3, 4 and 13/ NEMA 1, 3, 4 and 13			\$ Price
	Cover Color	Box Color	Type	
1	Gray	Gray	KYG1 ■	150.00
1	Yellow	Gray	KYG1Y ■	

■ Includes 1" NPT threaded conduit opening.

NOTE: See Table 19.319 on Page 19-106 for Assembled Control Stations



K26

**Table 19.318: Stainless Steel (302) NEMA 1 Flush Plates ♦**

No of Holes	Description	Type	\$ Price
1	1 Hole flush plate, cover screws, insulating liners	K25	28.70
2	2 Hole flush plate, cover screws, insulating liners	K26	42.80
3	3 Hole flush plate, cover screws, insulating liners	K27	57.00
4	4 Hole flush plate, cover screws, insulating liners	K28	86.00

♦ To be used with a standard 2 x 3 in. general purpose switch box. A 2.5 in. deep switch box should be used if two Type KA contact blocks are mounted side by side. If two Type KA contact blocks are mounted in tandem, a 3.5 in. deep box should be used.

# Point-of-Purchase packaging provides convenient solutions for control, signaling, and relay products.

**Need to grab and go?** Get out and go grab the right products conveniently packaged together with all the selection and accessories you need. Point-of-Purchase packaging does all the thinking for you so that you can just grab what you need – and go!

**9001AS1 -  
Push Button +Options**

## 30 mm products

### Features and benefits

- Heavy-duty pushbuttons, selector switches, and pilot lights for industrial applications
- Oiltight, watertight, and dustproof (rated for NEMA<sup>®</sup> Types 4 and 13 environments without boots)
- Includes multiple color inserts or legend plates (where applicable) — use what you need, discard what you don't
- Fingersafe<sup>®</sup> terminals for improved safety
- UL<sup>\*</sup> listed, CSA<sup>\*</sup> approved, CE per IEC<sup>\*</sup>

### 30 mm pushbuttons

Description	POP Catalog Number	Package Includes
30 mm pushbutton with contact block and multi colors	9001AB1	9001KR1U + KA1 + KN201 + KN202
30 mm push/pull mushroom	9001AB2	9001KR9R + 9001KA1
30 mm mushroom with legend	9001AB3	9001KR5R + KA1 + KN205
30 mm two-position selector switch with contact and legend	9001AS1	9001KS11B + 9001KA1 + 9001KN244
30 mm three-position selector switch with contact and legend	9001AS2	9001KS43B + 9001KA1 + 9001KN260



30 mm pushbuttons



30 mm pilot light



30 mm control station

### Pilot light

Description	POP Catalog Number	Package Includes
Pilot light (KP)	9001AL1	9001KP1 + 9001R9 + 9001G9

### 30 mm control station

Description	POP Catalog Number	Package Includes
30 mm control station	9001AE3	9001BG201

## BW pendant station

### Features and benefits

- Easy to hold in one hand with contoured grip
- Single- or two-speed buttons
- Momentary or maintained contact
- Available with or without mechanical interlocks
- Yellow, black, or red enclosure options
- High-impact thermoplastic enclosure with self-extinguishing flammability rating (UL 94V)
- Oiltight, watertight, dustproof, and corrosion-resistant (rated for NEMA 1, 3, 3R, 4, 4X, and 13)
- UL listed, CSA certified, CE per IEC

Description	POP Catalog Number	Package Includes
BW pendant	9001BWP1	9001BW92Y



BW pendant

Make the most of your energy<sup>SM</sup>

**Schneider**  
Electric<sup>™</sup>

Table 19.197: 2-Position Selector Switches

NOTE: When ordering, add prefix 9001 to the catalog number.

Contact Block Required				1 — Contact Closed 0 — Contact Open						
Contact Block Position	Quantity and Type KA1 or KA2 or KA3		Mount on Side KA1 or KA2 or KA3		Left	Right	Left	Right		
	<p>Top View</p>	KA1	or	KA3	KA1 #2	or	KA3 #2	1	0	0
0								1	1	0
KA1		or	KA3	KA1 #1	or	KA3 #1	1	0	0	1
							0	1	1	0
19-73					E	D				

Non-Illuminated Operators	Cat. No.	Cat. No.	\$ Price
<b>Manual Return ▲, Operator Only (without contact blocks)</b>			
Without Knob	KS11	KS12	42.80
With Knob (select style and color from Table 19.198 below)	KS11*	KS12*	42.80
Key Operated with E10 Key (Code 1,2,3)	KS11K**	KS12K**	138.00
<b>Operator with Contact Blocks and Standard black knob</b>			
With 1 KA1 on Side #2	KS11BH13	—	106.00
With 1 KA1 on Side #1	KS11BH1	—	106.00
With 1 KA1 on Side #1 and 1 KA1 on side #2	KS11BH2	—	152.00
<b>Spring Return from Left ▲, Operator Only (without contact blocks)</b>			
Without Knob	KS25	—	71.00
With Knob (select style and color from Table 19.198)	KS25*	—	71.00
Key Operated with E10 Key (Code 2 only)*	KS25K2	—	167.00
<b>Spring Return from Right ▲, Operator Only (without contact blocks)</b>			
Without Knob	—	KS34	71.00
With Knob (select style and color from Table 19.198 below)	—	KS34*	71.00
Key Operated with E10 Key (Code 1 only)	—	KS34K1	167.00
<b>Illuminated Operators</b>			
<b>Manual Return ▲, Operator Only (without contact blocks)</b>			
Without Knob, 110-120V 50-60 Hz Transformer	K11J1	K12J1	158.00
With Standard Red Knob, 110-120V 50-60 Hz Transformer	K11J1R	K12J1R	167.00
With Other Color Knob and other voltage Light Module ■ ◆	K11J■◆	K12J■◆	167.00
<b>Spring Return from Left ▲, Operator Only (without contact blocks)</b>			
Without Knob, 110-120V 50-60 Hz Transformer	K25J1	—	185.00
With Standard Red Knob, 110-120V 50-60 Hz Transformer	K25J1R	—	197.00
With Other Color Knob and other voltage Light Module ■ ◆	K25J■◆	—	197.00
<b>Spring Return from Right ▲, Operator Only (without contact blocks)</b>			
Without Knob, 110-120V 50-60 Hz Transformer	—	K34J1	185.00
With Standard Red Knob, 110-120V 50-60 Hz Transformer	—	K34J1R	197.00
With Other Color Knob and other voltage Light Module ■ ◆	—	K34J■◆	197.00

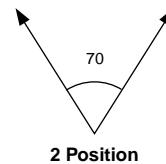
- ▲ These operators can be ordered complete with contact blocks. Add the "H code" from page 19-88 as needed for your application.
- Add the voltage assembly code as chosen from page 19-86. Example: K25J■ with 208 Vac = K25J3.
- ◆ Add the knob color code from Table 19.198. For LED, knob color must match LED.
- ★ Add the key withdrawal code from Table 19.199.

Table 19.198: Selector Switch Assembly Code and Knob Cat. No.

Color	Standard Knob		Gloved Hand Knob		\$ Price
	◆ Knob Code	Cat. No.	◆ Knob Code	Cat. No.	
Black	B	B11	FB	B25	9.90
Red	R	R8	FR	R24	
Green	G	G8	FG	G24	
Yellow	Y	Y8	FY	Y24	
Blue	L	L8	FL	L24	
White	W	W8	FW	W24	
Amber	A	A8	FA	A24	
Clear	C	C8	FC	C24	

Table 19.199: ★ Key Withdrawal Codes

Code	Position
1	Left Only
2	Right Only
3	Left and Right



NOTE: To select and order Contact Blocks, Light Modules, Knobs, and Accessories, see pages 19-85 through 19-92.

**Table 16.167: Mechanically Held**

Description	Form No.	TYPE LX				TYPE S									
		30 A		30 A		60 A		100 A		200 A		300 A		400, 600, 800 A	
		Kit	\$ Price	Kit	\$ Price	Kit	\$ Price	Kit	\$ Price	Kit	\$ Price	Kit	\$ Price	Kit	\$ Price
PUSH BUTTON (ON-OFF) NEMA 1 Enclosure	A3	9999BLX	35.60	▲	—	9001KA2	21.50	9001KA2	21.50	9001KA2	21.50	9001KA2	21.50	9001KA2	21.50
		9999LXPB	116.00			9999SA3	215.00	9999SA3	215.00	9999SA3	215.00	9999SA3	215.00	9999SA3	215.00
NEMA 3R, 4 or 12 Enclosure		9001KA2	21.50	9001KA2	215.00	9001KA2	21.50	9001KA2	215.00	9001KA2	21.50	9001KA2	215.00	9001KA2	215.00
SELECTOR SWITCH (2 POSITION) NEMA 1 Enclosure	C6	9999BLX	35.60	9001KN244	4.40	9001KN244	4.40	9001KN244	4.40	9001KN244	4.40	9001KN244	4.40	9001KN244	4.40
		9999LXS	116.00	9001KS11BH1	96.00	9001KS11BH1	96.00	9001KS11BH1	96.00	9001KS11BH1	96.00	9001KS11BH1	96.00	9001KS11BH1	96.00
NEMA 3R, 4 or 12 Enclosure		9001KN244	4.40	9001KN244	4.40	9001KN244	4.40	9001KN244	4.40	9001KN244	4.40	9001KN244	4.40	9001KN244	4.40
		9001KS11BH1	96.00	9001KS11BH1	96.00	9001KS11BH1	96.00	9001KS11BH1	96.00	9001KS11BH1	96.00	9001KS11BH1	96.00	9001KS11BH1	96.00
SELECTOR SWITCH (3 POSITION) NEMA 1 Enclosure (MUST INCLUDE TWO WIRE CONTROL RELAY, Form R6)	C	9999BLX	35.60	9001KN260	4.40	9001KN260	4.40	9001KN260	4.40	9001KN260	4.40	9001KN260	4.40	9001KN260	4.40
		9999SC2	116.00	9001KS46BH2	138.00	9001KS46BH2	138.00	9001KS46BH2	138.00	9001KS46BH2	138.00	9001KS46BH2	138.00	9001KS46BH2	138.00
NEMA 3R, 4 or 12 Enclosure		9001KN260	4.40	9001KS46BH2	138.00										
TWO WIRE CONTROL RELAY (Form R6)Δ	R6	9999RLX	35.60	8501XO11	201.00	8501XO11	201.00	8501XO11	201.00	8501XO11	201.00	8501XO11	201.00	8501XO11	201.00
		CA2SK11□	95.00												

**Table 16.168: Electrically Held**

Description	Form No.	TYPE L				TYPE S									
		30 A		30 A		60 A		100 A		200 A		300 A		400, 600, 800 A	
		Kit	\$ Price	Kit	\$ Price	Kit	\$ Price	Kit	\$ Price	Kit	\$ Price	Kit	\$ Price	Kit	\$ Price
PILOT LIGHTS (RED and GREEN) NEMA 1 Enclosure NEMA 3R, 4 or 12 Enclosure	P1	9999SP28R	215.00	9999SP2R	215.00	9999SP3R	215.00	9999SP14R	215.00	9999SP28R	215.00	9999SP28R	215.00	9999SP28R	215.00
				9999SP28R	215.00	9999SP28R	215.00	9999SP28R	215.00	9999SP28R	215.00	9999SP28R	215.00	9999SP28R	215.00
PUSH BUTTONS▼ NEMA 1 Enclosure	A12	9999BLX	35.60	9999SA10	116.00	9999SA10	116.00	9999SA3	215.00	9999SA3	215.00	9999SA3	215.00	9999SA3	215.00
		9999SA10	116.00												
NEMA 3R, 4 or 12 Enclosure		9999SA3	215.00	9999SA3	215.00	9999SA3	215.00	9999SA3	215.00	9999SA3	215.00	9999SA3	215.00	9999SA3	215.00
SELECTOR SWITCH (2 POSITION) NEMA 1 Enclosure	C6	9999BLX	35.60	9999SC22	116.00	9999SC22	116.00	9999SC22	116.00	9001KN244	4.40	9001KN244	4.40	9001KN244	4.40
		9999SC22	116.00							9001KS11BH1	96.00	9001KS11BH1	96.00	9001KS11BH1	96.00
NEMA 3R, 4 or 12 Enclosure		9001KN244	4.40	9001KN244	4.40	9001KN244	4.40	9001KN244	4.40	9001KN244	4.40	9001KN244	4.40	9001KN244	4.40
		9001KS11BH1	96.00	9001KS11BH1	96.00	9001KS11BH1	96.00	9001KS11BH1	96.00	9001KS11BH1	96.00	9001KS11BH1	96.00	9001KS11BH1	96.00
SELECTOR SWITCH (3 POSITION) NEMA 1 Enclosure	C	9999BLX	35.60	9999SC2	116.00	9999SC2	116.00	9999SC2	116.00	9999SC8	215.00	9999SC8	215.00	9999SC8	215.00
		9999SC2	116.00												
NEMA 3R, 4 or 12 Enclosure		9999SC8	215.00	9999SC8	215.00	9999SC8	215.00	9999SC8	215.00	9999SC8	215.00	9999SC8	215.00	9999SC8	215.00

- ▲ No field installed kit available.
- Mechanically held contactors need two distinct signals to operate. An N.O. contact block must be added to the Class 9999 Type SA3 push button kit.
- ◆ Selection for 2- or 3-Pole only; for 4- or 5-Pole use Class 9999SP15R \$215.
- ★ The coil voltage must be the same as the pilot lighting rating. Kit contains one (1) Class 9001, Type KP1R6 120 V/60 Hz red pilot light control unit. For other voltages, refer to the Class 9001, Type KP Control Section.
- ▼ Requires holding circuit interlock for Type S or additional power pole on Type L devices.
- Δ Form R6 available for 24 V, 120 V, 240 V and 277 V only.
- Insert CA2SK11( ) voltage code from page 23-21.

**PREMIER ELECTRIC  
OPERATION & MAINTENANCE COVER SHEET  
JOB NAME: HAINES BOROUGH VOCATIONAL EDUCATION BUILDING UPGRADE  
LOCATION: HAINES, ALASKA**

Specification section: 26 5119 1.6 LED INTERIOR LIGHTING

Submittal Number: 1

Item: Led Interior Lighting

Manufacturer: Lithonia Lighting

Model #:

Installing Contractor: Premier Electric, LLC  
2485 E ZAK Circle, STE D.  
Wasilla, AK 99654  
Phone: (907) 357-4220  
Fax: (907) 357-4225

Supplier/Parts Source:

Specified Equipment  Yes  No

Named Equipment  Yes  No

Proposed Substitute  Yes  No

Engineer Review/Comments

Resubmittal Required: Yes  No

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# **Haines Borough Vocational Education**

## **Lighting Operations and Maintenance Manual**



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**Acuity Brands Terms and Conditions of Sale**  
For Shipments Within the United States  
Effective August 1, 2012

**PAYMENT TERMS:**

Purchaser agrees to pay the prices quoted by Acuity Brands Lighting, Inc. or Acuity Brands Technology Services, Inc. (collectively, "Acuity Brands"), and is responsible for applicable shipping and handling charges, taxes and duties as provided below. Payment terms for sales by Acuity Brands of Acuity Brands products, services and service offerings are available at [http://www.acuitybrands.com/CustomerResources/Terms\\_and\\_conditions.aspx](http://www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx).

If purchaser does not pay any invoice, in whole or in part, when due, Acuity Brands shall assess a finance charge on any past due balance at the maximum legal rate permitted on open accounts. If any amount due Acuity Brands is collected by or through an attorney, Acuity Brands shall be entitled to recover all costs of collection, including attorney's fees equal to 15% of the total principal and interest owed.

**PRICES:**

All prices are those in effect at the time of quotation and are subject to change without notice. Unless prices are quoted as "firm," Acuity Brands reserves the right to invoice at the prices in effect on the date of shipment. Acuity Brands reserves the right to require minimum order amounts. Prices exclude all taxes. Prices do not include lamps unless specified.

**FREIGHT ALLOWANCE:**

Any orders that qualify for a freight allowance will be shipped F.O.B. Origin, freight prepaid and allowed or as otherwise agreed to in writing by Acuity Brands. Any orders that do not qualify for a freight allowance will be shipped F.O.B. Origin, freight prepaid and add. For all orders that qualify for freight allowance, Acuity Brands reserves the right to select the carrier and method of shipment and to route shipments at Acuity Brands' discretion. Acuity Brands will ship in the manner selected by purchaser provided purchaser assumes any additional transportation costs. See [http://www.acuitybrands.com/CustomerResources/Terms\\_and\\_conditions.aspx](http://www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx) for specific freight requirements.

**TAXES:**

Purchaser has responsibility for paying and reporting all applicable taxes levied or based on account of the purchase price or the acquisition, ownership, license or use of the products or services.

**TRANSPORTATION CLAIMS:**

Title and risk of loss passes to purchaser upon delivery of products by Acuity Brands to the carrier. Therefore, claims for damages or shortages in transit are the responsibility of purchaser. Bills of Lading marked with "Shippers Load and Count" do not constitute a transfer of liability for the freight or damages from purchaser to Acuity Brands.

**PACKAGING:**

Acuity Brands reserves the right to optimize packaging at its discretion. Some products may only be available in bulk package multiples or case quantities.

**SERVICE AREA LIMITATION:**

Acuity Brands reserves the right to refuse to make quotations, accept orders or make shipments to points of destination outside of the regular or assigned selling and service area of the applicable Acuity Brands distributor.

**RETURN OF STOCK MERCHANDISE:**

No merchandise may be returned without prior written authorization from Acuity Brands. Requests to return merchandise must be made within four (4) months from date of shipment by Acuity Brands. All returns must be shipped prepaid to the location designated on the return authorization. Credit will be issued based on the original invoice price, or price in effect at time of return, whichever is lower, less a minimum disposition charge of 35% (to defray the cost of handling). All returned product must be in salable condition in order to qualify for credit. Return authorization will not be granted when the value of all items to be returned is less than \$300.

**NON-RETURNABLE MERCHANDISE:**

The following products are not returnable: all non-stock, special, custom made or modified products; all stock products containing time-sensitive components that have reached the end of their warranty or shelf life; outdated or phase-out stock products; and all Lithonia Lighting C&I stock and non-stock poles.

**CANCELLATIONS:**

Stock products may be cancelled prior to shipment without charge. Cancellation of any order for non-stock products will incur charges for work already performed and for special material purchased by Acuity Brands. Cancellation of any product order after shipment will be subject to the return provisions of these Terms and Conditions of Sale. Orders for services are non-cancellable, and except as provided in the applicable Acuity Brands services warranty, fees for services are non-refundable. If services are not provided prior to invoice, the purchaser is entitled to the performance of ordered services only within the 18-month period after the services invoice date.

**LIMITED WARRANTY:**

Statements of the limited warranties provided by Acuity Brands for Acuity Brands products, services and service offerings are available at [http://www.acuitybrands.com/CustomerResources/Terms\\_and\\_conditions.aspx](http://www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx).

**LIMITATION OF LIABILITY:**

The total liability of Acuity Brands on any and all claims of any kind, whether in contract, warranty, tort (including negligence), strict liability or otherwise, arising out of or in connection with, or resulting from, Acuity Brands' sale, delivery, resale, repair, or replacement of any products, service offerings, or the performance of any services, shall in no event exceed the purchase price allocable to the specific product or service which gives rise to the claim, and any and all such liability shall terminate upon the expiration of the applicable warranty period.

Acuity Brands shall not be liable for damages that result from the delivery of products or the performance of services that do not occur within purchaser's specified time frame or for any delay or default in delivering products or performing services where occasioned by any cause beyond the control of Acuity Brands, including without limitation embargoes; shortages of labor, raw materials, or fuel; fires; floods; accidents; acts of war; or other similar causes.

IN NO EVENT SHALL ACUITY BRANDS BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL, EXEMPLARY OR PUNITIVE DAMAGES ARISING OUT OF THE SALE OR PERFORMANCE OF ANY PRODUCTS, SERVICES OR SERVICE OFFERINGS, OR ANY BREACH OF WARRANTY OR OBLIGATIONS UNDER WARRANTY, EVEN IF INFORMED OF THE POSSIBILITY OF SUCH DAMAGES, WHETHER AS THE RESULT OF BREACH OF CONTRACT, WARRANTY, TORT (INCLUDING NEGLIGENCE), STRICT LIABILITY, OR ANY OTHER THEORY, INCLUDING WITHOUT LIMITATION LABOR OR EQUIPMENT REQUIRED TO REMOVE AND/OR REINSTALL ORIGINAL OR REPLACEMENT PARTS, LOSS OF TIME, PROFITS OR REVENUES, LACK OR LOSS OF PRODUCTIVITY, INTEREST CHARGES OR COST OF CAPITAL, COST OF SUBSTITUTE EQUIPMENT, SYSTEMS OR SERVICES, DOWNTIME COSTS, LOSS OR CORRUPTION OF DATA, LOSS OF USE OF PROPERTY OR EQUIPMENT, OR ANY INCONVENIENCE.

**INTELLECTUAL PROPERTY:**

Nothing herein shall be construed to grant to purchaser or any end user of an Acuity Brands product any right, title, or interest in or to any intellectual property rights (including, without limitation, any patent, trademark or copyright) embodied in or associated with the products, services, service offerings or related software that may be already installed in or included with the products, services or service offerings (the "Software"). The Software is not sold, and is protected by international intellectual property laws and treaties. Such Software may be used solely in connection with the product, service or service offering with which it is included, subject to any additional terms and conditions that

may become applicable when the end user installs or accepts the Software or part of a written agreement between Acuity Brands and the end user. The products may not be loaned, rented or disclosed, nor may access be provided to the Software, for a fee or otherwise, to any third party. The Software may be permanently transferred, but only as part of a sale or transfer of the products, provided that no copies are retained, all Software is transferred, and such sale is subject to the applicable terms of these Terms and Conditions of Sale. No product or Software shall be duplicated, reverse engineered, or decompiled by anyone other than Acuity Brands except and only to the extent this restriction is prohibited by law.

**CHOICE OF LAW; CONSENT TO JURISDICTION:**

These Terms and Conditions of Sale shall be construed and enforced in accordance with the substantive laws of the State of Georgia, USA, without regard to such state's laws related to choice of law. Any State or Federal Court in Fulton County, Georgia shall have jurisdiction for the purpose of any suit or other proceeding arising out of the transactions under these Terms and Conditions of Sale.

**GENERAL:**

Unless otherwise specifically agreed in writing by an authorized representative of Acuity Brands, any different or additional terms and conditions proposed by any purchaser in a purchase order, response to a quotation or other proposal, are hereby rejected by Acuity Brands and shall not be incorporated into any order or other agreement for the sale of Acuity Brands products, services or service offerings. Purchaser's assent to these Terms and Conditions of Sale shall be conclusively presumed from purchaser's acceptance of all or part of any products, services or service offerings ordered. If an authorized representative of Acuity Brands has acknowledged purchaser's order or proposal, and such acknowledgement is found to constitute an acceptance of an offer, such acceptance is expressly made conditional on purchaser's assent solely to these Terms and Conditions of Sale which shall form part of the acknowledgement, and acceptance or authorized resale by purchaser of any products or services shall be deemed to constitute such assent. If any quotation or other document of Acuity Brands is deemed to constitute an offer to purchaser, purchaser's acceptance of such offer is limited to these Terms and Conditions of Sale. These Terms and Conditions of Sale, together with any warranty statement by Acuity Brands, constitute the entire sales agreement between Acuity Brands and purchaser, unless they are made part of a written agreement between Acuity Brands and purchaser. No custom, practice, or course of prior dealings between the parties and no usage of trade shall modify or otherwise affect these Terms and Conditions of Sale. Acuity Brands objects to and rejects any terms between purchaser and any other party, and no such terms, including but not limited to any government regulations or "flowdown" terms, shall be a part of or incorporated into any order from purchaser to Acuity Brands, unless agreed to in writing by an authorized representative of Acuity Brands. These Terms and Conditions of Sale supersede all those published or issued previously by Acuity Brands. All orders are subject to final acceptance by Acuity Brands and credit approval. Acuity Brands will not accept orders that require customer-furnished components, unless agreed to in writing by an authorized representative of Acuity Brands. Acuity Brands price sheets are not offers to sell and possession of a price sheet does not entitle one to purchase. Acuity Brands shall not be bound to sell any products or provide any services unless it shall (in its sole discretion) accept submitted purchase orders.

**Acuity Brands reserves the right to change these Terms and Conditions of Sale at any time without notice.**

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ONE LITHONIA WAY, CONYERS, GEORGIA 30012  
PHONE 770-922-9000 [www.acuitybrands.com](http://www.acuitybrands.com)

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Terms and Conditions of Sale-Acuity US, Rev. 8/1/12



**STATEMENT OF LIMITED WARRANTY  
FOR ACUITY BRANDS LIGHTING, INC.  
LED COMMERCIAL INDOOR PRODUCTS  
FOR SHIPMENTS WITHIN THE UNITED STATES AND CANADA**  
10/01/12

Subject to the exclusions set forth below, Acuity Brands Lighting, Inc. ("Acuity") warrants its commercial indoor light emitting diode (LED) fixtures, including the LED arrays and the LED drivers and integral control devices ("Product(s)") to be free from defect in material and workmanship (the "General Warranty") for a period of five (5) years from the date of shipment from Acuity's facilities. The LED arrays in the Product(s) will be considered defective in material or workmanship only if a total of 15% or more of the individual light emitting diodes in the Product(s) fail to illuminate.

Ballasts, lamps, emergency batteries and poles are excluded from the General Warranty. Holophane® and Accupro® brand ballasts, Acculamp® brand lamps, emergency batteries, and poles are warranted separately; and the terms of such warranties are located at [www.acuitybrands.com/CustomerResources/Terms\\_and\\_conditions.aspx](http://www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx). Manufacturers of ballasts, lamps, emergency batteries and poles incorporated into the Product(s) are solely responsible for any costs or expenses related to any claims, repairs, or replacements associated with any such component(s). Assistance with warranty claims for any such component(s), and/or copies of each applicable manufacturer's warranty, may be obtained from an authorized Acuity post-sales or customer service representative.

This Statement of Limited Warranty ("Warranty") applies only when the Product(s) are installed in applications in which ambient temperatures are within the range of specified operating temperatures and are operated within the electrical values shown on the LED driver Label. Acuity will not be responsible under this Warranty for any failure of the Product(s) that results from external causes such as: acts of nature; physical damage; exposure to adverse or hazardous chemical or other substances; use of reactive cleaning agents and/or harsh chemicals to clean the Product(s); environmental conditions; vandalism; fire; power failure, improper power supply, power surges or dips, and/or excessive switching; induced vibration; animal or insect activity; fault or negligence of purchaser, any end user of the Product(s) and/or any third party not engaged by Acuity; improper or unauthorized use, installation, handling, storage, alteration, maintenance or service, including failure to abide by any product classifications or certifications, or failure to comply with any applicable standards, codes, recommendations, product specification sheets, or instructions of Acuity; use of the Product(s) with products, processes or materials supplied by any end user or third party; or any other occurrences beyond Acuity's reasonable control. Acuity also will not be responsible under this Warranty for any substantial deterioration in the Product finish that is caused by failure to clean, inspect or maintain the finish of the Product(s). If the Product(s) are used on existing foundations, anchorages or structures, the end user is solely responsible for the structural integrity of such existing foundations, anchorages or structures and all consequences arising from their use. Adequate records of operating history, maintenance, and/or testing must be kept by the end user and provided to Acuity upon request to substantiate that the Product(s) have failed to comply with the terms of this Warranty. Neither polycarbonate nor acrylic material used in the Products is warranted against yellowing, as yellowing may naturally occur over time due to normal aging. The Product(s) are not warranted against costs that may be incurred in connection with changes or modifications to the Product(s) required to accommodate site conditions and/or faulty building construction or design. In addition, the Product(s) are not warranted against cost resulting from installation of a third party components, failures of third party supplied components, or failures of Acuity supplied Product(s) caused by a third party supplied component. This Warranty only applies to the Product(s) when sold for commercial purposes and does not apply to any consumer product(s), all of which are governed by separate limited warranty terms. For the avoidance of doubt, Acuity emergency fixtures are not covered by this Warranty.

If the Product(s) fail to comply with the terms of this Warranty, Acuity, at its option, will repair or replace the Product(s) with the same or a functionally equivalent Product(s) or component part(s). This Warranty excludes labor and equipment required to remove and/or reinstall original or replacement parts. This Warranty extends only to the Product(s) as delivered to, and is for the sole and exclusive benefit of, the original end user of the Product(s) at the original location. This Warranty may not be transferred or assigned by the original end user. The repair or replacement of any Product(s) or component part within the Product(s) is the sole and exclusive remedy for failure of the Product(s) to comply with the terms of this Warranty and does not extend the Warranty period. Warranty claims regarding the Product(s) must be submitted in writing within (30) days of discovery of the defect or failure to an authorized Acuity post-sales or customer service representative. Product(s) or component part(s) may be required to be returned for inspection and verification of non-conformance by Acuity, but no Product(s) or component part(s) will be accepted for inspection, verification or return unless accompanied by a "return authorization number" which can be obtained only from an authorized Acuity post-sales or customer service representative. Acuity is not responsible for any costs and expenses incurred in connection with shipment of Product(s) to Acuity, but Acuity shall bear all cost and expense incurred in connection with shipment of replacement Product(s) to the customer.

THE FOREGOING WARRANTY TERMS ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, AND ACUITY EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, RELATING DIRECTLY OR INDIRECTLY TO THE PRODUCT(S), WHETHER ORAL, WRITTEN, OR ARISING BY COURSE OF DEALING OR USAGE OF TRADE, INCLUDING, WITHOUT LIMITATION, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. NO AGENT, DISTRIBUTOR OR OTHER SUPPLIER OF ACUITY PRODUCTS HAS THE AUTHORITY TO MODIFY OR AMEND THIS WARRANTY WITHOUT EXPRESS WRITTEN AUTHORIZATION FROM ACUITY.

The total liability of Acuity on any and all claims of any kind, whether in contract, warranty, tort (including negligence), strict liability or otherwise, arising out of or in connection with, or resulting from, Acuity's performance or breach of this Warranty, or from Acuity's sale, delivery, resale, repair, or replacement of any Product(s) or the furnishing of any services, shall in no event exceed the purchase price allocable to the Product(s) that give rise to the claim, and any and all such liability shall terminate upon the expiration of the warranty period specified above.



**STATEMENT OF LIMITED WARRANTY  
FOR ACUITY BRANDS LIGHTING, INC.  
LED COMMERCIAL INDOOR PRODUCTS  
FOR SHIPMENTS WITHIN THE UNITED STATES AND CANADA  
10/01/12**

IN NO EVENT SHALL ACUITY BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL, EXEMPLARY OR PUNITIVE DAMAGES, EVEN IF INFORMED OF THE POSSIBILITY OF SUCH DAMAGES, WHETHER AS THE RESULT OF BREACH OF CONTRACT, WARRANTY, TORT (INCLUDING NEGLIGENCE), STRICT LIABILITY, OR ANY OTHER THEORY, INCLUDING WITHOUT LIMITATION LABOR OR EQUIPMENT REQUIRED TO REMOVE AND/OR REINSTALL ORIGINAL OR REPLACEMENT PARTS, LOSS OF TIME, PROFITS OR REVENUES, LACK OR LOSS OF PRODUCTIVITY, INTEREST CHARGES OR COST OF CAPITAL, COST OF SUBSTITUTE EQUIPMENT, SYSTEMS, SERVICES OR DOWNTIME COSTS, DAMAGE TO OR LOSS OF USE OF PROPERTY OR EQUIPMENT OR ANY INCONVENIENCE ARISING OUT OF ANY BREACH OF THE FOREGOING WARRANTY OR OBLIGATIONS UNDER SUCH WARRANTY.

Acuity reserves the right to modify or discontinue this Warranty without notice provided that any such modification or discontinuance will only be effective with respect to any Product(s) purchased after such modification or discontinuance.

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Catalog Number	VAP 4000LM FST MD MVOLT GZ10 35K 80CRI
Notes	HAINES BOROUGH VOC ED BLDG
Type	A1

## FEATURES & SPECIFICATIONS

**INTENDED USE** — Ideal for use in applications where smart, energy-efficient fixtures are desired. Typical applications include parking garages, canopies, transportation, schools, hospitals, cold storage and exterior retail environments where moisture or dust is a concern. Polycarbonate enclosure protects fixture while remaining easy to service and clean.

**CONSTRUCTION** — UV-stabilized, injection-molded, impact-resistant, frosted polycarbonate housing with continuous poured-in-place, closed-cell gasket. 20-gauge steel channel and channel cover. Aluminum sheet metal board plate for thermal conduction and support. Captive, tamper-resistant, polycarbonate latches standard (8 Torx T-20 tamper-resistant screws included). Stainless steel latches also available. Fixture design allows for approximately 4% up-light.

**OPTICS** — UV-stabilized, injection-molded, impact-resistant, clear transparent and frosted, polycarbonate lens with aesthetic rib detail (.080" thick). Miro 5 aluminum reflector used to achieve wide distribution.

**ELECTRICAL** — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Electronic LED driver rated for 44 input watts and is standard 0-10V dimming. Integral 6kV/3kA surge protection, tested in accordance to IEEE/ANSI standards. L85 at 60,000 hours.

**INSTALLATION** — Stainless steel surface spring-mounting brackets standard (2 included) allows for ceiling or suspended mount. A variety of stainless steel mounting options also available: J-box mounting and mounting brackets for suspension with aircraft cable (cable not included). Optional stainless steel V-hooks available for chain hanging (chain not included). Surface conduit entry on each end and on top. For horizontal and vertical mounting on a wall, application must be under a covered ceiling and QMB option recommended. 1/2" - 3/4" KO. When wall mounted the product will be rated for damp location only.

**LISTINGS** — CSA Certified to UL and C-UL standards. For use in ambient temperatures ranging from -20°F (-29°C) to 104°F(40°C). VAP LED is wet location listed for covered ceiling applications. IP65 and IP66 rated. When wall mounted the product will be rated for damp location only. DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at [www.designlights.org](http://www.designlights.org) to confirm which versions are qualified.

**WARRANTY** — 5-year limited warranty. Complete warranty terms located at [www.acuitybrands.com/CustomerResources/Terms\\_and\\_conditions.aspx](http://www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx)

For installed Rough Service Product(s), Acuity warrants that, for the lifetime of the product(s), the polycarbonate lens and/or polycarbonate housing will withstand breakage resulting from occasional physical abuse and rough handling (the "Rough Service Warranty"), notwithstanding the vandalism exclusion set forth at [www.acuitybrands.com/CustomerResources/Terms\\_and\\_conditions.aspx](http://www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx)

**Note:** Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25 °C.

Specifications subject to change without notice.



Rough Service Fixture

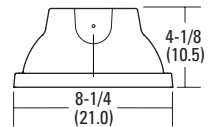
# VAP LED

CEILING/  
SUSPEND MOUNT



*Specifications*

Length: 54-3/4 (139.1)  
Width: 8-1/4 (21.0)  
Depth: 4-1/8 (10.5)  
Weight: 13.5 lbs. (5.9 kg)



All dimensions are shown in inches (centimeters) unless otherwise noted.

### ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

**Example:** VAP 4000LM FST MD MVOLT GZ10 40K 80CRI

VAP	4000LM	FST	MD	MVOLT	GZ10	35K	80CRI
Series	Nominal lumens	Diffuser	Distribution	Voltage	Driver	Color temperature	CRI
VAP	4000LM 4,000 lumens 6000LM 6,000 lumens 12000LM 12,000 lumens <sup>1</sup>	FST Frosted polycarbonate lens PCL Clear polycarbonate lens	MD Medium WD Wide	MVOLT MVOLT 120 120V 277 277V 347 347V <sup>2</sup> 480 480V <sup>2</sup>	GZ10 0-10V dimming	30K 3000K 35K 3500K 40K 4000K 50K 5000K	80CRI 80 CRI 90CRI 90 CRI

### Options<sup>3</sup>

SF	Single fuse <sup>4</sup>	STSL	Stainless steel tamper resistant latches	MSI10XAWL10M DSCXAWL	Xpoint wireless integral motion sensor, On/Off operation for motion sensing, override Off due to daylight <sup>4</sup>
BSL722	Bodine® emergency LED battery pack for 0°C and up <sup>4,5</sup>	QMB	Quick-mount ceiling bracket	MSI10NWL	Low mount 360 integral motion sensor, wet location, On/Off operation <sup>4</sup>
BSL722C	Bodine® emergency LED battery pack for -20°C and up <sup>4,5</sup>	CMB	Chain-mount suspension bracket	MSI102L3VWL	Low mount 360 integral motion sensor, wet location, High/Low operation (bi-level) <sup>4</sup>
WLF	Wet location fitting (two outboard, top) <sup>6</sup>	JSB	Junction box snap-bracket	MSI10NWL DSCNWL	Low mount 360 integral motion sensor, wet location, On/Off operation for motion sensing, override Off due to daylight <sup>4</sup>
WLFIN	Wet location fitting (two inboard, top) <sup>6</sup>	LSC	Lens safety clip	XAD	XPoint™ wireless controller ,0-10V dimming <sup>9</sup>
WLFEND	Wet location fitting (one end) <sup>6</sup>	DL	Damp location <sup>8</sup>		
WLFEND2	Wet location fitting (both ends) <sup>6,7</sup>	L/SP	Less surge protection device		
CS89	6' white cord, 16/3, no plug, wet location				
CS88	6' Brad Harrison 16/3 cord and straight blade plug set <sup>4</sup>				
CS88L12	12' Brad Harrison 16/3 cord and straight blade plug set <sup>4</sup>				

### Accessories: Order as separate catalog number. (Ships separately)

VAP5MB	Surface spring-mount bracket	RK1 T20BIT	Hex base driver bit, Torx T20. Tamper resistant screws with center reject pin
VAPQMB	Quick-mount ceiling bracket	RK1 T20DRV	Torx T20 screwdriver for use with tamper resistant screws with center reject pin
VAPCMB	Chain-mount bracket		
VAPJSB	Junction box snap bracket		
HC36	Wire hook and 36" chain set <sup>10,11</sup>		

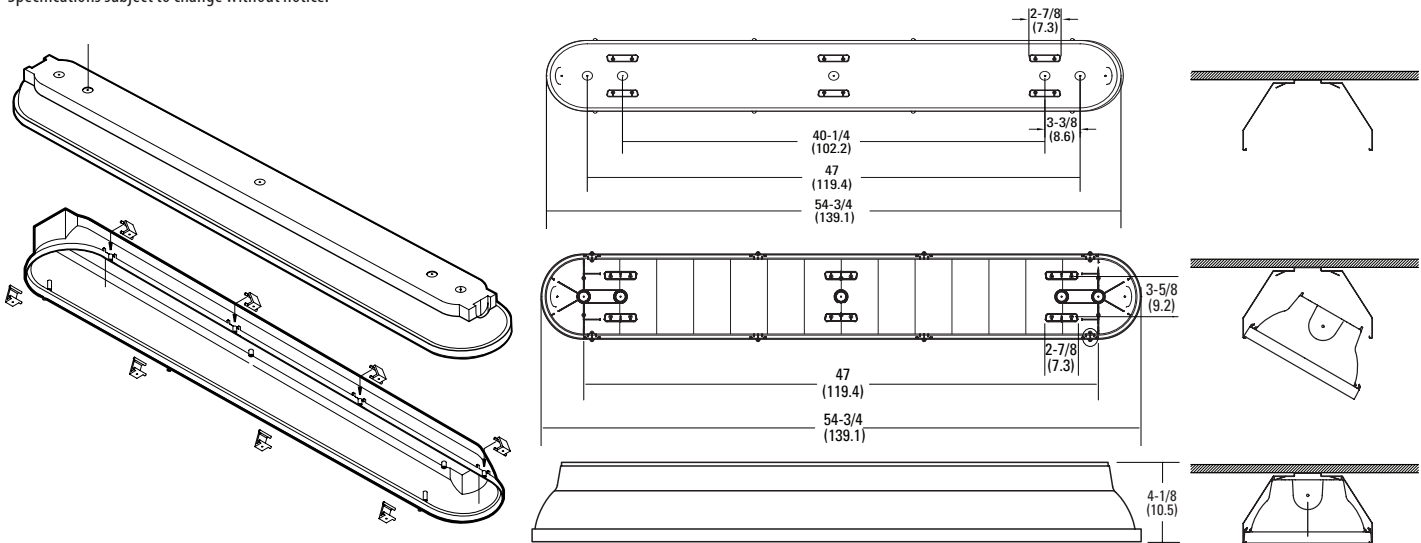
### Notes

- Not available with BSL722 or BSL722C options.
- 347V and 480V utilize a step-down transformer. Available 60HZ only.
- For additional options, consult factory.
- Must specify voltage.
- Not available with 12000LM lumen package. Maximum ambient temperature 30 C.
- 5/8" long NPT threaded hub.
- Not available with cord, sensor, or photocell options.
- Required when using battery packs or cord sets that are not rated for wet locations.
- Not available with BSL722 and BSL722C option.
- Requires CMB (chain mount bracket) option.
- For stainless steel, specify STS (example: HC36 STS).

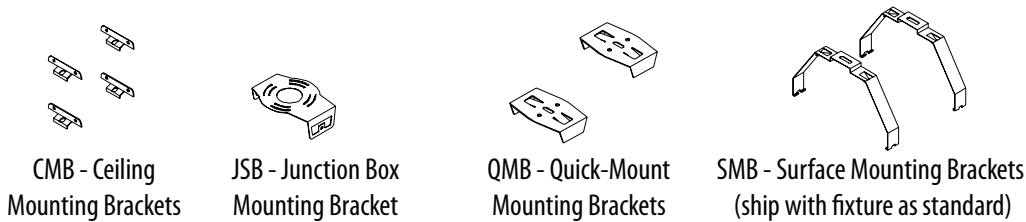
# VAP Linear Rough Service, LED

## DIMENSIONS

All dimensions are shown in inches (centimeters) unless otherwise noted.  
Specifications subject to change without notice.



## MOUNTING ACCESSORIES



ARCHWAY™ PASSAGE™ LED Specification Matrix								
Nominal lumens	Initial delivered lumens @ 80CRI with clear polycarbonate lens			Initial delivered lumens @ 80CRI with frosted polycarbonate lens			Wattage @ 120V	Comparable source
	3500K	4000K	5000K	3500K	4000K	5000K		
4000LM	5,200	5,208	5,672	4,420	4,428	4,822	44	2-lamp 32W T8, 1-lamp 54W T5HO, 70W HID
6000LM	6,630	6,643	7,234	5,637	5,648	6,150	64	3-lamp 32W T8, 2-lamp 54W T5HO, 100W HID
12000LM	11,034	11,056	12,040	9,380	9,400	10,236	109	4-lamp 32W T8, 2-lamp 54W T5HO, 150W HID

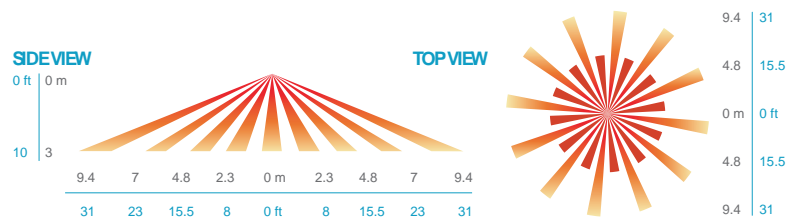
Operating hours	0	10,000	20,000	25,000	35,000	50,000	60,000	75,000	100,000
Lumen Maintenance Factor	1	.95	.92	.91	.89	.86	.84	.81	.77



## COVERAGE PATTERNS

### PARKING GARAGE / LOW MOUNT APPLICATIONS

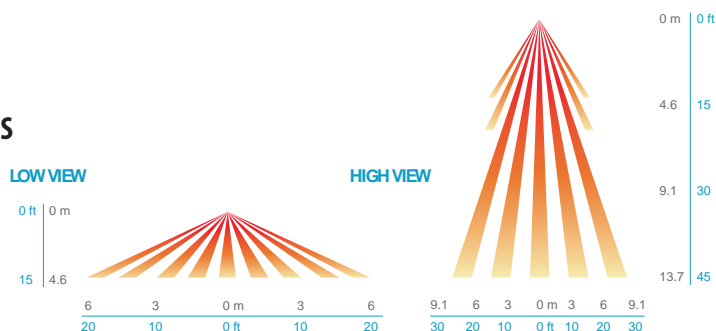
In general, the SBOR 10 is recommended for 8-15 ft (2.44-4.57 m) mounting and provides a coverage area radius for walking motion of greater than 2x the mounting height. The SBOR 10 ODP is ideal for parking garage and low pole mount applications. When mounted 10 ft high, for example, on a luminaire in a parking garage, the sensor's coverage for walking motion extends out 30 ft in a 360° pattern. This closely matches the lighting distribution of a typical parking garage luminaire. When mounted to a light pole, for example, in a parking lot or along a path, the sensor provides 270° of coverage (90° is blocked by the pole). Note, walking askew to sensor typically results in earlier detection than walking directly at sensor.



Coverage Pattern of Low Mount Lens Option (SBOR 10)

### SITE & AREA LIGHTING / HIGH MOUNT APPLICATIONS

The SBOR 6 is intended for higher pole mount applications, between 15-30 ft (4.57-9.14 m), and provides a coverage area radius for walking motion of 15-20 ft (4.57-6.10 m). When mounted to a pole the sensor provides 270° of coverage (90° is blocked by the pole).



Coverage Pattern of High Mount Lens Option (SBOR 6)

Catalog Number	VAP 4000LM FST MD 120 GZ10 35K 80CRI BSL722
Notes	HAINES BOROUGH VOC ED BLDG
Type	A1E

## FEATURES & SPECIFICATIONS

**INTENDED USE** — Ideal for use in applications where smart, energy-efficient fixtures are desired. Typical applications include parking garages, canopies, transportation, schools, hospitals, cold storage and exterior retail environments where moisture or dust is a concern. Polycarbonate enclosure protects fixture while remaining easy to service and clean.

**CONSTRUCTION** — UV-stabilized, injection-molded, impact-resistant, frosted polycarbonate housing with continuous poured-in-place, closed-cell gasket. 20-gauge steel channel and channel cover. Aluminum sheet metal board plate for thermal conduction and support. Captive, tamper-resistant, polycarbonate latches standard (8 Torx T-20 tamper-resistant screws included). Stainless steel latches also available. Fixture design allows for approximately 4% up-light.

**OPTICS** — UV-stabilized, injection-molded, impact-resistant, clear transparent and frosted, polycarbonate lens with aesthetic rib detail (.080" thick). Miro 5 aluminum reflector used to achieve wide distribution.

**ELECTRICAL** — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Electronic LED driver rated for 44 input watts and is standard 0-10V dimming. Integral 6kV/3kA surge protection, tested in accordance to IEEE/ANSI standards. L85 at 60,000 hours.

**INSTALLATION** — Stainless steel surface spring-mounting brackets standard (2 included) allows for ceiling or suspended mount. A variety of stainless steel mounting options also available: J-box mounting and mounting brackets for suspension with aircraft cable (cable not included). Optional stainless steel V-hooks available for chain hanging (chain not included). Surface conduit entry on each end and on top. For horizontal and vertical mounting on a wall, application must be under a covered ceiling and QMB option recommended. 1/2" - 3/4" KO. When wall mounted the product will be rated for damp location only.

**LISTINGS** — CSA Certified to UL and C-UL standards. For use in ambient temperatures ranging from -20°F (-29°C) to 104°F(40°C). VAP LED is wet location listed for covered ceiling applications. IP65 and IP66 rated. When wall mounted the product will be rated for damp location only. DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at [www.designlights.org](http://www.designlights.org) to confirm which versions are qualified.

**WARRANTY** — 5-year limited warranty. Complete warranty terms located at [www.acuitybrands.com/CustomerResources/Terms\\_and\\_conditions.aspx](http://www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx)

For installed Rough Service Product(s), Acuity warrants that, for the lifetime of the product(s), the polycarbonate lens and/or polycarbonate housing will withstand breakage resulting from occasional physical abuse and rough handling (the "Rough Service Warranty"), notwithstanding the vandalism exclusion set forth at [www.acuitybrands.com/CustomerResources/Terms\\_and\\_conditions.aspx](http://www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx)

**Note:** Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25 °C.

Specifications subject to change without notice.



Rough Service Fixture

# VAP LED

CEILING/  
SUSPEND MOUNT



### Specifications

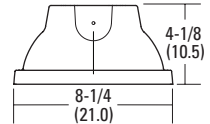
Length: 54-3/4 (139.1)

Width: 8-1/4 (21.0)

Depth: 4-1/8 (10.5)

Weight: 13.5 lbs. (5.9 kg)

All dimensions are shown in inches (centimeters) unless otherwise noted.



## ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

**Example:** VAP 4000LM FST MD MVOLT GZ10 40K 80CRI

VAP	4000LM	FST	MD	120	GZ10	35K	80CRI
Series	Nominal lumens	Diffuser	Distribution	Voltage	Driver	Color temperature	CRI
VAP	4000LM 4,000 lumens 6000LM 6,000 lumens 12000LM 12,000 lumens <sup>1</sup>	FST Frosted polycarbonate lens PCL Clear polycarbonate lens	MD Medium WD Wide	MVOLT MVOLT 120 120V 277 277V 347 347V <sup>2</sup> 480 480V <sup>2</sup>	GZ10 0-10V dimming	30K 3000K 35K 3500K 40K 4000K 50K 5000K	80CRI 80 CRI 90CRI 90 CRI

## BSL722

### Options<sup>3</sup>

SF Single fuse <sup>4</sup>	STSL Stainless steel tamper resistant latches	MSI10XAWL10M DSCXAWL Xpoint wireless integral motion sensor, On/Off operation for motion sensing, override Off due to daylight <sup>4</sup>
BSL722 Bodine® emergency LED battery pack for 0°C and up <sup>4,5</sup>	QMB Quick-mount ceiling bracket	MSI10NWL Low mount 360 integral motion sensor, wet location, On/Off operation <sup>4</sup>
BSL722C Bodine® emergency LED battery pack for -20°C and up <sup>4,5</sup>	CMB Chain-mount suspension bracket	MSI102L3VWL Low mount 360 integral motion sensor, wet location, High/Low operation (bi-level) <sup>4</sup>
WLF Wet location fitting (two outboard, top) <sup>6</sup>	JSB Junction box snap-bracket	MSI10NWL DSCNWL Low mount 360 integral motion sensor, wet location, On/Off operation for motion sensing, override Off due to daylight <sup>4</sup>
WLFIN Wet location fitting (two inboard, top) <sup>6</sup>	LSC Lens safety clip	XAD XPoint™ wireless controller ,0-10V dimming <sup>9</sup>
WLFEND Wet location fitting (one end) <sup>6</sup>	DL Damp location <sup>8</sup>	
WLFEND2 Wet location fitting (both ends) <sup>6,7</sup>	L/SP Less surge protection device	
CS89 6' white cord, 16/3, no plug, wet location		
CS88 6' Brad Harrison 16/3 cord and straight blade plug set <sup>4</sup>		
CS88L12 12' Brad Harrison 16/3 cord and straight blade plug set <sup>4</sup>		

### Accessories: Order as separate catalog number. (Ships separately)

VAP5MB Surface spring-mount bracket	RK1 T20BIT Hex base driver bit, Torx T20. Tamper resistant screws with center reject pin
VAPQMB Quick-mount ceiling bracket	RK1 T20DRV Torx T20 screwdriver for use with tamper resistant screws with center reject pin
VAPCMB Chain-mount bracket	
VAPJSB Junction box snap bracket	
HC36 Wire hook and 36" chain set <sup>10,11</sup>	

### Notes

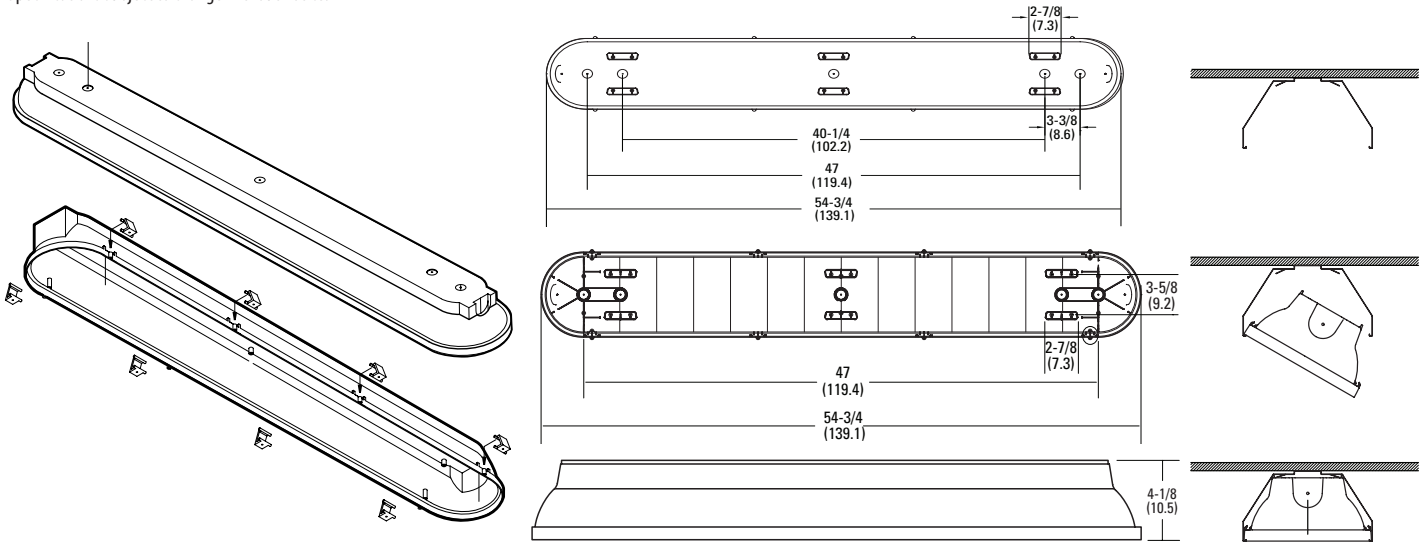
- Not available with BSL722 or BSL722C options.
- 347V and 480V utilize a step-down transformer. Available 60HZ only.
- For additional options, consult factory.
- Must specify voltage.
- Not available with 12000LM lumen package. Maximum ambient temperature 30 C.
- 5/8" long NPT threaded hub.
- Not available with cord, sensor, or photocell options.
- Required when using battery packs or cord sets that are not rated for wet locations.
- Not available with BSL722 and BSL722C option.
- Requires CMB (chain mount bracket) option.
- For stainless steel, specify STS (example: HC36 STS).

# VAP Linear Rough Service, LED

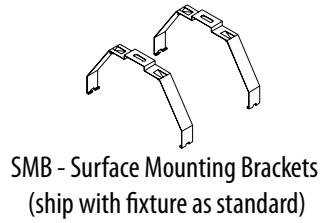
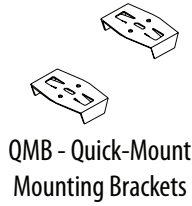
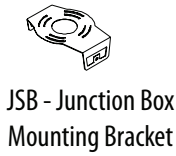
## DIMENSIONS

All dimensions are shown in inches (centimeters) unless otherwise noted.

Specifications subject to change without notice.



## MOUNTING ACCESSORIES



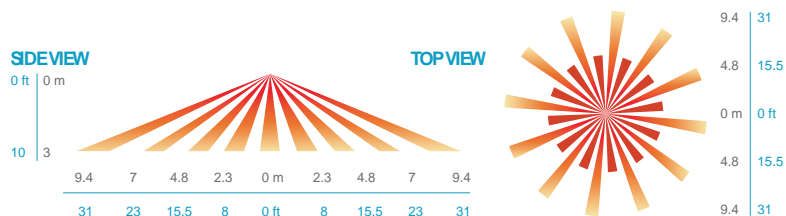
ARCHWAY™ PASSAGE™ LED Specification Matrix								
Nominal lumens	Initial delivered lumens @ 80CRI with clear polycarbonate lens			Initial delivered lumens @ 80CRI with frosted polycarbonate lens			Wattage @ 120V	Comparable source
	3500K	4000K	5000K	3500K	4000K	5000K		
4000LM	5,200	5,208	5,672	4,420	4,428	4,822	44	2-lamp 32W T8, 1-lamp 54W T5HO, 70W HID
6000LM	6,630	6,643	7,234	5,637	5,648	6,150	64	3-lamp 32W T8, 2-lamp 54W T5HO, 100W HID
12000LM	11,034	11,056	12,040	9,380	9,400	10,236	109	4-lamp 32W T8, 2-lamp 54W T5HO, 150W HID

Operating hours	0	10,000	20,000	25,000	35,000	50,000	60,000	75,000	100,000
Lumen Maintenance Factor	1	.95	.92	.91	.89	.86	.84	.81	.77

## COVERAGE PATTERNS

### PARKING GARAGE / LOW MOUNT APPLICATIONS

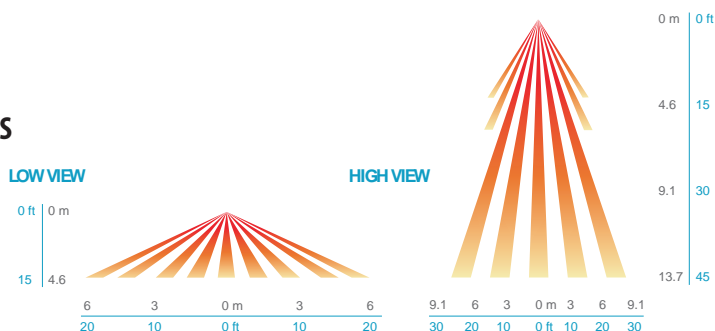
In general, the SBOR 10 is recommended for 8-15 ft (2.44-4.57 m) mounting and provides a coverage area radius for walking motion of greater than 2x the mounting height. The SBOR 10 ODP is ideal for parking garage and low pole mount applications. When mounted 10 ft high, for example, on a luminaire in a parking garage, the sensor's coverage for walking motion extends out 30 ft in a 360° pattern. This closely matches the lighting distribution of a typical parking garage luminaire. When mounted to a light pole, for example, in a parking lot or along a path, the sensor provides 270° of coverage (90° is blocked by the pole). Note, walking askew to sensor typically results in earlier detection than walking directly at sensor.



Coverage Pattern of Low Mount Lens Option (SBOR 10)

### SITE & AREA LIGHTING / HIGH MOUNT APPLICATIONS

The SBOR 6 is intended for higher pole mount applications, between 15-30 ft (4.57-9.14 m), and provides a coverage area radius for walking motion of 15-20 ft (4.57-6.10 m). When mounted to a pole the sensor provides 270° of coverage (90° is blocked by the pole).



Coverage Pattern of High Mount Lens Option (SBOR 6)

Catalog Number	VAP 6000LM FST MD MVOLT GZ10 35K 80CRI
Notes	HAINES BOROUGH VOC ED BLDG
Type	A2

## FEATURES & SPECIFICATIONS

**INTENDED USE** — Ideal for use in applications where smart, energy-efficient fixtures are desired. Typical applications include parking garages, canopies, transportation, schools, hospitals, cold storage and exterior retail environments where moisture or dust is a concern. Polycarbonate enclosure protects fixture while remaining easy to service and clean.

**CONSTRUCTION** — UV-stabilized, injection-molded, impact-resistant, frosted polycarbonate housing with continuous poured-in-place, closed-cell gasket. 20-gauge steel channel and channel cover. Aluminum sheet metal board plate for thermal conduction and support. Captive, tamper-resistant, polycarbonate latches standard (8 Torx T-20 tamper-resistant screws included). Stainless steel latches also available. Fixture design allows for approximately 4% up-light.

**OPTICS** — UV-stabilized, injection-molded, impact-resistant, clear transparent and frosted, polycarbonate lens with aesthetic rib detail (.080" thick). Miro 5 aluminum reflector used to achieve wide distribution.

**ELECTRICAL** — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Electronic LED driver rated for 44 input watts and is standard 0-10V dimming. Integral 6kV/3kA surge protection, tested in accordance to IEEE/ANSI standards. L85 at 60,000 hours.

**INSTALLATION** — Stainless steel surface spring-mounting brackets standard (2 included) allows for ceiling or suspended mount. A variety of stainless steel mounting options also available: J-box mounting and mounting brackets for suspension with aircraft cable (cable not included). Optional stainless steel V-hooks available for chain hanging (chain not included). Surface conduit entry on each end and on top. For horizontal and vertical mounting on a wall, application must be under a covered ceiling and QMB option recommended. 1/2" - 3/4" KO. When wall mounted the product will be rated for damp location only.

**LISTINGS** — CSA Certified to UL and C-UL standards. For use in ambient temperatures ranging from -20°F (-29°C) to 104°F(40°C). VAP LED is wet location listed for covered ceiling applications. IP65 and IP66 rated. When wall mounted the product will be rated for damp location only. DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at [www.designlights.org](http://www.designlights.org) to confirm which versions are qualified.

**WARRANTY** — 5-year limited warranty. Complete warranty terms located at [www.acuitybrands.com/CustomerResources/Terms\\_and\\_conditions.aspx](http://www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx)

For installed Rough Service Product(s), Acuity warrants that, for the lifetime of the product(s), the polycarbonate lens and/or polycarbonate housing will withstand breakage resulting from occasional physical abuse and rough handling (the "Rough Service Warranty"), notwithstanding the vandalism exclusion set forth at [www.acuitybrands.com/CustomerResources/Terms\\_and\\_conditions.aspx](http://www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx)

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Specifications subject to change without notice.



Rough Service Fixture

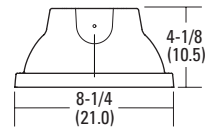
# VAP LED

CEILING/  
SUSPEND MOUNT



*Specifications*

- Length: 54-3/4 (139.1)
- Width: 8-1/4 (21.0)
- Depth: 4-1/8 (10.5)
- Weight: 13.5 lbs. (5.9 kg)



All dimensions are shown in inches (centimeters) unless otherwise noted.

### ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

**Example:** VAP 4000LM FST MD MVOLT GZ10 40K 80CRI

VAP	6000LM	FST	MD	MVOLT	GZ10	35K	80CRI
Series	Nominal lumens	Diffuser	Distribution	Voltage	Driver	Color temperature	CRI
VAP	4000LM 4,000 lumens 6000LM 6,000 lumens 12000LM 12,000 lumens <sup>1</sup>	FST Frosted polycarbonate lens PCL Clear polycarbonate lens	MD Medium WD Wide	MVOLT MVOLT 120 120V 277 277V 347 347V <sup>2</sup> 480 480V <sup>2</sup>	GZ10 0-10V dimming	30K 3000K 35K 3500K 40K 4000K 50K 5000K	80CRI 80 CRI 90CRI 90 CRI

### Options<sup>3</sup>

SF	Single fuse <sup>4</sup>	STSL	Stainless steel tamper resistant latches	MSI10XAWL10M DSCXAWL	Xpoint wireless integral motion sensor, On/Off operation for motion sensing, override Off due to daylight <sup>4</sup>
BSL722	Bodine® emergency LED battery pack for 0°C and up <sup>4,5</sup>	QMB	Quick-mount ceiling bracket	MSI10NWL	Low mount 360 integral motion sensor, wet location, On/Off operation <sup>4</sup>
BSL722C	Bodine® emergency LED battery pack for -20°C and up <sup>4,5</sup>	CMB	Chain-mount suspension bracket	MSI102L3VWL	Low mount 360 integral motion sensor, wet location, High/Low operation (bi-level) <sup>4</sup>
WLF	Wet location fitting (two outboard, top) <sup>6</sup>	JSB	Junction box snap-bracket	MSI10NWL DSCNWL	Low mount 360 integral motion sensor, wet location, On/Off operation for motion sensing, override Off due to daylight <sup>4</sup>
WLFIN	Wet location fitting (two inboard, top) <sup>6</sup>	LSC	Lens safety clip	XAD	XPoint™ wireless controller ,0-10V dimming <sup>9</sup>
WLFEND	Wet location fitting (one end) <sup>6</sup>	DL	Damp location <sup>8</sup>		
WLFEND2	Wet location fitting (both ends) <sup>6,7</sup>	L/SP	Less surge protection device		
CS89	6' white cord, 16/3, no plug, wet location				
CS88	6' Brad Harrison 16/3 cord and straight blade plug set <sup>4</sup>				
CS88L12	12' Brad Harrison 16/3 cord and straight blade plug set <sup>4</sup>				

### Accessories: Order as separate catalog number. (Ships separately)

VAP5MB	Surface spring-mount bracket	RK1 T20BIT	Hex base driver bit, Torx T20. Tamper resistant screws with center reject pin
VAPQMB	Quick-mount ceiling bracket		
VAPCMB	Chain-mount bracket	RK1 T20DRV	Torx T20 screwdriver for use with tamper resistant screws with center reject pin
VAPJSB	Junction box snap bracket		
HC36	Wire hook and 36" chain set <sup>10,11</sup>		

### Notes

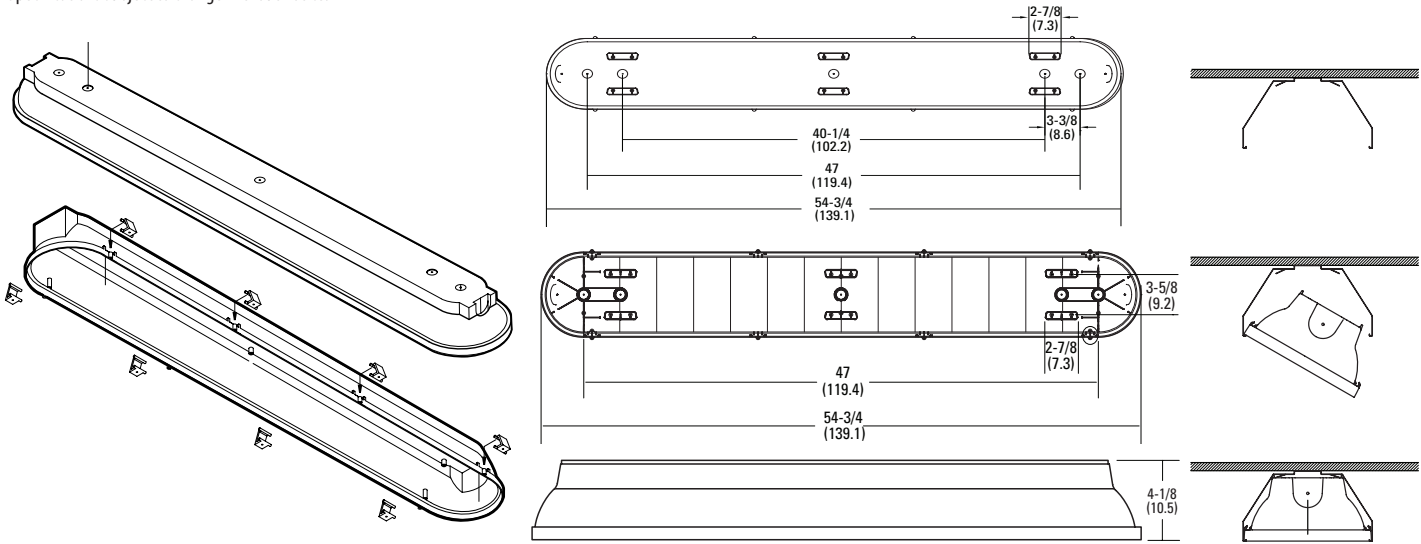
- Not available with BSL722 or BSL722C options.
- 347V and 480V utilize a step-down transformer. Available 60HZ only.
- For additional options, consult factory.
- Must specify voltage.
- Not available with 12000LM lumen package. Maximum ambient temperature 30 C.
- 5/8" long NPT threaded hub.
- Not available with cord, sensor, or photocell options.
- Required when using battery packs or cord sets that are not rated for wet locations.
- Not available with BSL722 and BSL722C option.
- Requires CMB (chain mount bracket) option.
- For stainless steel, specify STS (example: HC36 STS).

# VAP Linear Rough Service, LED

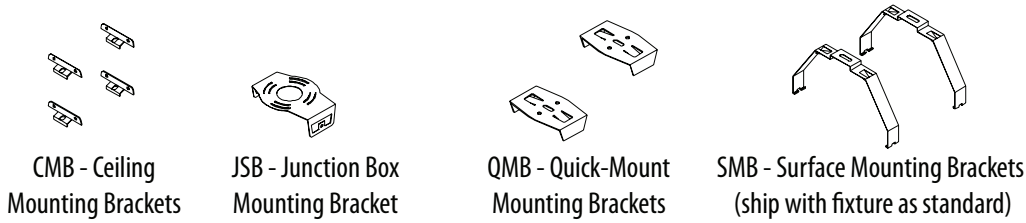
## DIMENSIONS

All dimensions are shown in inches (centimeters) unless otherwise noted.

Specifications subject to change without notice.



## MOUNTING ACCESSORIES



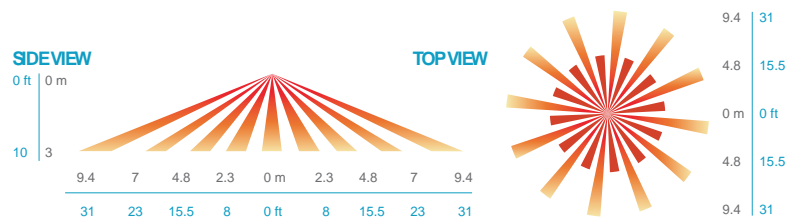
ARCHWAY™ PASSAGE™ LED Specification Matrix								
Nominal lumens	Initial delivered lumens @ 80CRI with clear polycarbonate lens			Initial delivered lumens @ 80CRI with frosted polycarbonate lens			Wattage @ 120V	Comparable source
	3500K	4000K	5000K	3500K	4000K	5000K		
4000LM	5,200	5,208	5,672	4,420	4,428	4,822	44	2-lamp 32W T8, 1-lamp 54W T5HO, 70W HID
6000LM	6,630	6,643	7,234	5,637	5,648	6,150	64	3-lamp 32W T8, 2-lamp 54W T5HO, 100W HID
12000LM	11,034	11,056	12,040	9,380	9,400	10,236	109	4-lamp 32W T8, 2-lamp 54W T5HO, 150W HID

Operating hours	0	10,000	20,000	25,000	35,000	50,000	60,000	75,000	100,000
Lumen Maintenance Factor	1	.95	.92	.91	.89	.86	.84	.81	.77

## COVERAGE PATTERNS

### PARKING GARAGE / LOW MOUNT APPLICATIONS

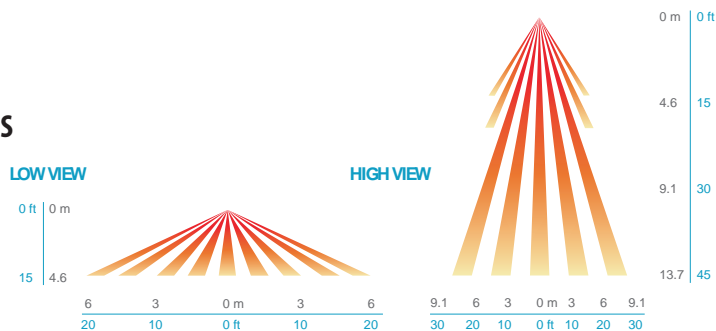
In general, the SBOR 10 is recommended for 8-15 ft (2.44-4.57 m) mounting and provides a coverage area radius for walking motion of greater than 2x the mounting height. The SBOR 10 ODP is ideal for parking garage and low pole mount applications. When mounted 10 ft high, for example, on a luminaire in a parking garage, the sensor's coverage for walking motion extends out 30 ft in a 360° pattern. This closely matches the lighting distribution of a typical parking garage luminaire. When mounted to a light pole, for example, in a parking lot or along a path, the sensor provides 270° of coverage (90° is blocked by the pole). Note, walking askew to sensor typically results in earlier detection than walking directly at sensor.



Coverage Pattern of Low Mount Lens Option (SBOR 10)

### SITE & AREA LIGHTING / HIGH MOUNT APPLICATIONS

The SBOR 6 is intended for higher pole mount applications, between 15-30 ft (4.57-9.14 m), and provides a coverage area radius for walking motion of 15-20 ft (4.57-6.10 m). When mounted to a pole the sensor provides 270° of coverage (90° is blocked by the pole).



Coverage Pattern of High Mount Lens Option (SBOR 6)



Catalog Number	VAP 6000LM FST MD 120 GZ10 35K 80CRI BSL722
Notes	HAINES BOROUGH VOC ED BLDG
Type	A2E

## FEATURES & SPECIFICATIONS

**INTENDED USE** — Ideal for use in applications where smart, energy-efficient fixtures are desired. Typical applications include parking garages, canopies, transportation, schools, hospitals, cold storage and exterior retail environments where moisture or dust is a concern. Polycarbonate enclosure protects fixture while remaining easy to service and clean.

**CONSTRUCTION** — UV-stabilized, injection-molded, impact-resistant, frosted polycarbonate housing with continuous poured-in-place, closed-cell gasket. 20-gauge steel channel and channel cover. Aluminum sheet metal board plate for thermal conduction and support. Captive, tamper-resistant, polycarbonate latches standard (8 Torx T-20 tamper-resistant screws included). Stainless steel latches also available. Fixture design allows for approximately 4% up-light.

**OPTICS** — UV-stabilized, injection-molded, impact-resistant, clear transparent and frosted, polycarbonate lens with aesthetic rib detail (.080" thick). Miro 5 aluminum reflector used to achieve wide distribution.

**ELECTRICAL** — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Electronic LED driver rated for 44 input watts and is standard 0-10V dimming. Integral 6kV/3kA surge protection, tested in accordance to IEEE/ANSI standards. L85 at 60,000 hours.

**INSTALLATION** — Stainless steel surface spring-mounting brackets standard (2 included) allows for ceiling or suspended mount. A variety of stainless steel mounting options also available: J-box mounting and mounting brackets for suspension with aircraft cable (cable not included). Optional stainless steel V-hooks available for chain hanging (chain not included). Surface conduit entry on each end and on top. For horizontal and vertical mounting on a wall, application must be under a covered ceiling and QMB option recommended. 1/2" - 3/4" KO. When wall mounted the product will be rated for damp location only.

**LISTINGS** — CSA Certified to UL and C-UL standards. For use in ambient temperatures ranging from -20°F (-29°C) to 104°F(40°C). VAP LED is wet location listed for covered ceiling applications. IP65 and IP66 rated. When wall mounted the product will be rated for damp location only. DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at [www.designlights.org](http://www.designlights.org) to confirm which versions are qualified.

**WARRANTY** — 5-year limited warranty. Complete warranty terms located at [www.acuitybrands.com/CustomerResources/Terms\\_and\\_conditions.aspx](http://www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx)

For installed Rough Service Product(s), Acuity warrants that, for the lifetime of the product(s), the polycarbonate lens and/or polycarbonate housing will withstand breakage resulting from occasional physical abuse and rough handling (the "Rough Service Warranty"), notwithstanding the vandalism exclusion set forth at [www.acuitybrands.com/CustomerResources/Terms\\_and\\_conditions.aspx](http://www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx)

**Note:** Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25 °C.

Specifications subject to change without notice.



Rough Service Fixture

# VAP LED

CEILING/  
SUSPEND MOUNT



### Specifications

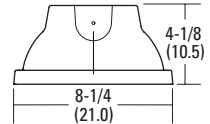
Length: 54-3/4 (139.1)

Width: 8-1/4 (21.0)

Depth: 4-1/8 (10.5)

Weight: 13.5 lbs. (5.9 kg)

All dimensions are shown in inches (centimeters) unless otherwise noted.



### ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

**Example:** VAP 4000LM FST MD MVOLT GZ10 40K 80CRI

VAP	6000LM	FST	MD	120	GZ10	35K	80CRI
Series	Nominal lumens	Diffuser	Distribution	Voltage	Driver	Color temperature	CRI
VAP	4000LM 4,000 lumens 6000LM 6,000 lumens 12000LM 12,000 lumens <sup>1</sup>	FST Frosted polycarbonate lens PCL Clear polycarbonate lens	MD Medium WD Wide	MVOLT MVOLT 120 120V 277 277V 347 347V <sup>2</sup> 480 480V <sup>2</sup>	GZ10 0-10V dimming	30K 3000K 35K 3500K 40K 4000K 50K 5000K	80CRI 80 CRI 90CRI 90 CRI

### BSL722

#### Options<sup>3</sup>

SF Single fuse <sup>4</sup>	STSL Stainless steel tamper resistant latches	MSI10XAWL10M DSCXAWL Xpoint wireless integral motion sensor, On/Off operation for motion sensing, override Off due to daylight <sup>4</sup>
BSL722 Bodine® emergency LED battery pack for 0°C and up <sup>4,5</sup>	QMB Quick-mount ceiling bracket	MSI10NWL Low mount 360 integral motion sensor, wet location, On/Off operation <sup>4</sup>
BSL722C Bodine® emergency LED battery pack for -20°C and up <sup>4,5</sup>	CMB Chain-mount suspension bracket	MSI102L3VWL Low mount 360 integral motion sensor, wet location, High/Low operation (bi-level) <sup>4</sup>
WLF Wet location fitting (two outboard, top) <sup>6</sup>	JSB Junction box snap-bracket	MSI10NWL DSCNWL Low mount 360 integral motion sensor, wet location, On/Off operation for motion sensing, override Off due to daylight <sup>4</sup>
WLFIN Wet location fitting (two inboard, top) <sup>6</sup>	LSC Lens safety clip	XAD XPoint™ wireless controller ,0-10V dimming <sup>9</sup>
WLFEND Wet location fitting (one end) <sup>6</sup>	DL Damp location <sup>8</sup>	
WLFEND2 Wet location fitting (both ends) <sup>6,7</sup>	L/SP Less surge protection device	
CS89 6' white cord, 16/3, no plug, wet location		
CS88 6' Brad Harrison 16/3 cord and straight blade plug set <sup>4</sup>		
CS88L12 12' Brad Harrison 16/3 cord and straight blade plug set <sup>4</sup>		

#### Accessories: Order as separate catalog number. (Ships separately)

VAP5MB Surface spring-mount bracket	RK1 T20BIT Hex base driver bit, Torx T20. Tamper resistant screws with center reject pin
VAPQMB Quick-mount ceiling bracket	RK1 T20DRV Torx T20 screwdriver for use with tamper resistant screws with center reject pin
VAPCMB Chain-mount bracket	
VAPJSB Junction box snap bracket	
HC36 Wire hook and 36" chain set <sup>10,11</sup>	

#### Notes

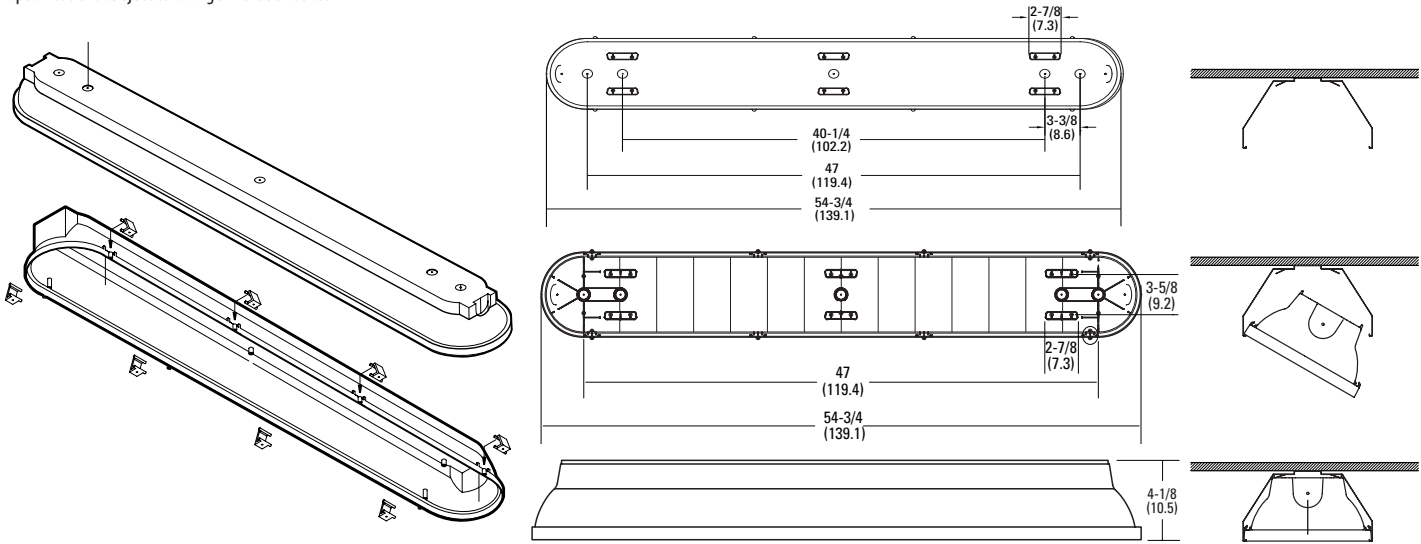
- Not available with BSL722 or BSL722C options.
- 347V and 480V utilize a step-down transformer. Available 60HZ only.
- For additional options, consult factory.
- Must specify voltage.
- Not available with 12000LM lumen package. Maximum ambient temperature 30 C.
- 5/8" long NPT threaded hub.
- Not available with cord, sensor, or photocell options.
- Required when using battery packs or cord sets that are not rated for wet locations.
- Not available with BSL722 and BSL722C option.
- Requires CMB (chain mount bracket) option.
- For stainless steel, specify STS (example: HC36 STS).



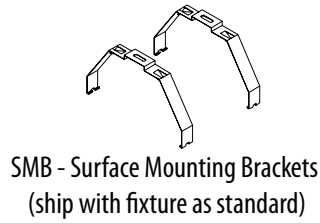
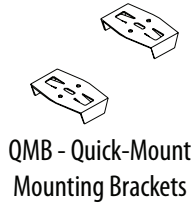
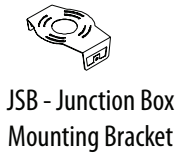
# VAP Linear Rough Service, LED

## DIMENSIONS

All dimensions are shown in inches (centimeters) unless otherwise noted.  
Specifications subject to change without notice.



## MOUNTING ACCESSORIES



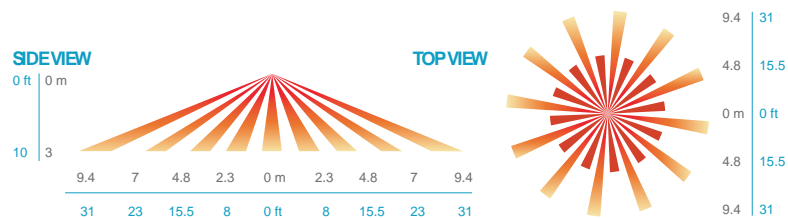
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4000LM	5,200	5,208	5,672	4,420	4,428	4,822	44	2-lamp 32W T8, 1-lamp 54W T5HO, 70W HID
6000LM	6,630	6,643	7,234	5,637	5,648	6,150	64	3-lamp 32W T8, 2-lamp 54W T5HO, 100W HID
12000LM	11,034	11,056	12,040	9,380	9,400	10,236	109	4-lamp 32W T8, 2-lamp 54W T5HO, 150W HID

Operating hours	0	10,000	20,000	25,000	35,000	50,000	60,000	75,000	100,000
Lumen Maintenance Factor	1	.95	.92	.91	.89	.86	.84	.81	.77

## COVERAGE PATTERNS

### PARKING GARAGE / LOW MOUNT APPLICATIONS

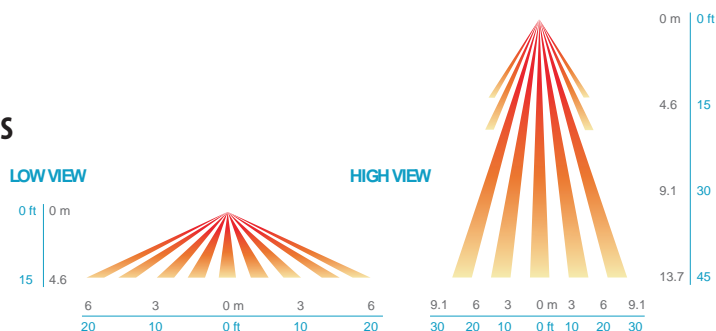
In general, the SBOR 10 is recommended for 8-15 ft (2.44-4.57 m) mounting and provides a coverage area radius for walking motion of greater than 2x the mounting height. The SBOR 10 ODP is ideal for parking garage and low pole mount applications. When mounted 10 ft high, for example, on a luminaire in a parking garage, the sensor's coverage for walking motion extends out 30 ft in a 360° pattern. This closely matches the lighting distribution of a typical parking garage luminaire. When mounted to a light pole, for example, in a parking lot or along a path, the sensor provides 270° of coverage (90° is blocked by the pole). Note, walking askew to sensor typically results in earlier detection than walking directly at sensor.



Coverage Pattern of Low Mount Lens Option (SBOR 10)

### SITE & AREA LIGHTING / HIGH MOUNT APPLICATIONS

The SBOR 6 is intended for higher pole mount applications, between 15-30 ft (4.57-9.14 m), and provides a coverage area radius for walking motion of 15-20 ft (4.57-6.10 m). When mounted to a pole the sensor provides 270° of coverage (90° is blocked by the pole).



Coverage Pattern of High Mount Lens Option (SBOR 6)

## FEATURES & SPECIFICATIONS

**INTENDED USE** — The STL combines digital LED lighting and controls technologies with high-performance optical design to offer the most advanced surface-mount luminaire for general ambient lighting applications. High-efficacy light engine delivers long life and excellent color, ensuring a superior quality lighting installation that is highly efficient and sustainable.

**CONSTRUCTION** — Housing is roll formed from code-gauge steel.

Impact modified linear-faceted refractor with light diffusing film. Refractor attaches to die cast ends by simple hook and pin design with controlled tension provided by sonically welded end plate, providing secure installation and easy maintenance.

Decorative die-cast end caps provide added durability.

Finish: All metal parts are post-painted in white polyester powder coat for smooth, finished edges and uniform light distribution. Natural aluminum finish available on end caps (see Options).

Injection-molded plastic light traps prevent light leaks between shielding and end plates and centers diffuser on channel.

**OPTICS** — Volumetric illumination is achieved by creating an optimal mix of light to vertical and horizontal work surfaces, rendering interior space, objects and occupants in a more balanced luminous environment. Light distribution is carefully controlled at high angles, providing just enough luminous flux to create the volumetric effect.

Angled mounting surface combined with crescent-shape linear faceted refractor system obscures and integrates individual LED images and uniformly washes fixture surface with light.

**ELECTRICAL** — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. STL is rated to deliver L90 performance at 60,000 hours. The LEDs have a CRI of 82.

eldoLED driver options deliver choice of dimming range and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.

Optional nLight® embedded controls continuously monitor system performance, allow for constant lumen management / compensation function, facilitate simple “plug-and-play” network and controls upgrading via Cat-5 cable. Ballast disconnect provided where required to comply with US and Canadian codes.

**LISTINGS** — CSA certified to meet U.S. and Canadian standards.

DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at [www.designlights.org/QPL](http://www.designlights.org/QPL) to confirm which versions are qualified.

Patents pending. Damp listed.

**WARRANTY** — 5-year limited warranty. Complete warranty terms located at [www.acuitybrands.com/CustomerResources/Terms\\_and\\_conditions.aspx](http://www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx)

Catalog Number	STL2 22L EZ1 LP835
Notes	HAINES BOROUGH VOC ED BLDG
Type	B



Surface Volumetric

# STL2



2'  
LED



### INDUSTRY RECOGNITION/AWARDS



**Note:** Actual performance may differ as a result of end-user environment and application. All values are design or typical values, measured under laboratory conditions at 25 °C. Specifications subject to change without notice.

### ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

**Example:** STL2 20L EZ1 LP840

STL2	22L	-	EZ1	LP835			-	
Series	Lumens <sup>1</sup>	Voltage	Driver	Color temperature	Control	Options	Finish <sup>6</sup>	
STL2 2' surface volumetric LED	20L	(blank) MVOLT (120-277)	EZ1 eldoLED dims to 1%, 0-10V	LP830 3000K	N80 nLight with 80% (L80) lumen management	SC1 Surface conduit end cap provisions for one endcap	(blank) White	
	40L	347 347V <sup>2</sup>	EZB eldoLED dims to dark, 0-10V	LP835 3500K	N80EMG nLight with 80% (L80) lumen management for use with generator supply EM power		SC2 Surface conduit end cap provisions for both end caps	DNA Natural aluminum
	22L		SLD Step-level dimming <sup>3</sup>	LP840 4000K	N100 nLight without lumen management			
				EXA1 Dims to 1%, XPoint wireless enabled <sup>3,4</sup>	LP850 5000K	N100EMG nLight without lumen management for use with generator supply EM power		
				EXAB Dims to dark, XPoint wireless enabled <sup>3,4</sup>		LSXRHL Sensor Switch® fixture mount sensor with High/Low occupancy operation <sup>5</sup>		
						LSXR10 Sensor Switch® fixture mount sensor with On/Off occupancy operation		

Accessories: Order as separate catalog number.	
STCR	Continuous row connector (see mounting data)
STACG__	ST adjustable aircraft cable gripper suspension kit (specify length as 36 or 72 inches) (specify ceiling type F1 or F2 - see mounting data)
STACGF__	ST adjustable aircraft cable gripper with power feed (specify length as 36 or 72 inches) (specify ceiling type F1 or F2 - see mounting data)
STACGE__	ST adjustable aircraft cable gripper with emergency power feed (specify length as 36 or 72 inches) (specify ceiling type F1 or F2 - see mounting data)

### Notes

- 1 Approximate lumen output.
- 2 Not available with SLD driver.
- 3 Not available with controls options
- 4 Gateway not included. Requires on-site commissioning. Visit [www.lightingcontrols.com/XPointWireless](http://www.lightingcontrols.com/XPointWireless) for more information.
- 5 Requires SC1 option. Dims to approximately 10% light output when unoccupied. See sensor details on next page.
- 6 For additional paint finishes refer to: [Architectural Colors](#).

# STL2 LED Surface Volumetric

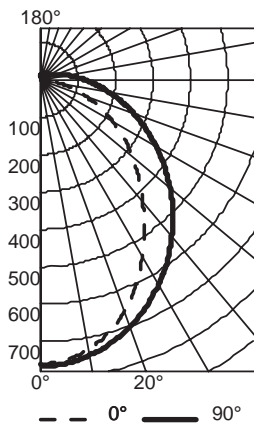
Performance Data			
Lumen Package	Input Watts <sup>1</sup>	Lumens	LPW
20L LP830	20	1960	98.0
20L LP835	20	2058	102.9
20L LP840	20	2156	107.8
20L LP850	20	2211	110.6
40L LP830	39	3443	88.3
40L LP835	39	3616	92.7
40L LP840	39	3796	97.3
40L LP850	39	3890	99.7



Sensor Switch LSXR Sensor	
<b>Lens type:</b>	<b>10</b> - Low Mount 360°
<b>Dimming:</b>	<b>HL</b> - High/Low Occupancy operation
<b>Min Dim Level:</b>	<b>3V</b> - approximately 10% light output when unoccupied
<b>Time Delay:</b>	<b>5M</b> - 5 minutes

## PHOTOMETRICS

STL2 20L EZ1 LP840, 2156 delivered lumens, test no. LTL25686, tested in accordance to IESNA LM-79.



### CP Summary

	0°	90°
0°	762	762
5°	750	761
15°	700	728
25°	604	669
35°	483	591
45°	371	499
55°	272	404
65°	174	310
75°	85	223
85°	21	150
90°	1	119

### Coefficients of Utilization

pf	20%									pw
	80%			70%			50%			
	70%	50%	30%	50%	30%	10%	50%	30%	10%	
0	117	117	117	114	114	114	107	107	107	
1	106	101	96	98	94	90	93	89	86	
2	96	88	81	85	79	73	81	75	71	
3	88	77	69	75	67	61	71	65	59	
4	81	69	60	67	59	52	63	56	51	
5	74	61	52	60	51	45	57	50	44	
6	69	55	46	54	46	40	52	44	39	
7	64	50	41	49	41	35	47	40	34	
8	59	46	37	45	37	31	43	36	31	
9	55	42	34	41	34	28	40	33	28	
10	52	39	31	38	31	26	37	30	25	

### Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	566	26.2	26.2
0° - 40°	901	41.8	41.8
0° - 60°	1529	70.9	70.9
0° - 90°	2013	93.4	93.4
90° - 120°	94	4.4	4.4
90° - 130°	110	5.1	5.1
90° - 150°	132	6.1	6.1
90° - 180°	143	6.6	6.6
0° - 180°	2156	100.0	100.0

## MOUNTING DATA

Suspension Kit Ceiling Types: F1 for use with most T-bar and screw slot grid ceiling applications. Designed for on-grid and off-grid installations.

F2 for use with recessed or surface-mount horizontal J-box applications.

For unit or row installation; surface or suspend mounting.

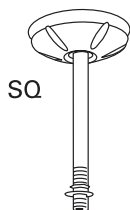
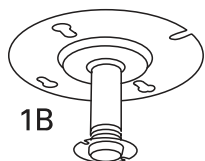
Individual installation — One double-stem or two single-stem hangers required.

For aircraft cable, one STACG\_, STACGF\_ or STACGE\_ required for each suspension point.

Row installation — Order one (1) STCR accessory per fixture for continuous row applications. Not required for last fixture in row. One hanger per fixture plus one per row required.

Note: 2' configurations with emergency option cannot be stem mounted.

See ACCESSORIES below for hanging devices.



## DIMENSIONS

All dimensions are inches (centimeters) unless otherwise noted.

### Specifications

Length: 22-7/8 (58.1)

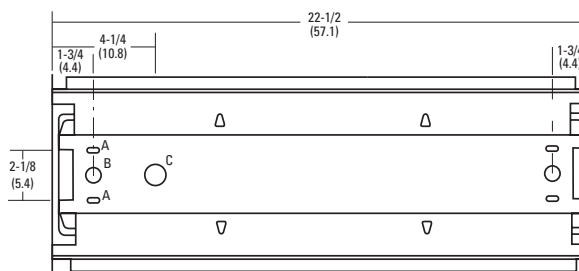
Width: 10-1/8 (25.7)

Depth: 3-7/8 (9.8)

A = 1/4 x 1/2 (.635 x 1.27) Oval Hole

B = 1/4 x 1/2 (.635 x 1.27) K.O.

C = 7/8 (2.22) Dia.K.O.



## FEATURES & SPECIFICATIONS

**INTENDED USE** — For wall or ceiling mounting, vertical or horizontal. The WL combines digital LED lighting and controls technologies with high-performance optical design to offer the most advanced wall-mount luminaire for general ambient lighting applications. High-efficacy light engine delivers long life and excellent color, ensuring a superior quality lighting installation that is highly efficient and sustainable.

**CONSTRUCTION** — Housing is roll formed from code-gauge steel.

Reflector is retained in die cast ends providing secure installation and easy maintenance.

Decorative die-cast end caps provide added durability.

Finish: All metal parts are post-painted in white polyester powder coat for smooth, finished edges and uniform light distribution.

**OPTICS** — Impact modified linear faceted refractor. Optically engineered for superior light distribution and maximum efficacy.

Crescent-shape linear faceted refractor system obscures and integrates individual LED images and uniformly washes fixture surface with light.

**ELECTRICAL** — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 90% LED lumen maintenance at 60,000 hours (L90/60,000). The LEDs have a CRI of 82.

eldoLED driver options deliver choice of dimming range and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.

Driver disconnect provided where required to comply with US and Canadian codes.

**CONTROLS** — Optional nLight™ embedded controls continuously monitor system performance and allow for constant lumen management / compensation function.

Lumen Management: Unique lumen management system (option N80) provides onboard intelligence that actively manages the LED light source so that constant lumen output is maintained over the system life, preventing energy waste created by the traditional practice of over-lighting.

Integral occupancy control: Integrated occupancy sensors allow luminaire to power off or dim to 10% or 50% output when space is unoccupied. Fixture designed to fail on.

The nES 7 is ideal for small rooms without obstructions or areas with primarily walking motion (e.g. corridors, stairwells). Additionally, the NES7ADCX includes an integrated photocell, which enables daylight harvesting.

For rooms like restrooms and private offices or any space with obstructions, the nES PDT 7 dual technology sensor is recommended. The nES PDT 7 utilizes both PIR (passive infrared) and Microphonics™ technologies to detect occupancy.

Wireless networking: XPoint™ Wireless technology creates a mesh network to ensure communication between fixtures, sensors and wall stations facility-wide. This option provides superior lighting management capabilities including granular control, configuration and custom grouping. This option enables sensors that detect motion to wirelessly communicate to neighboring fixtures — whether

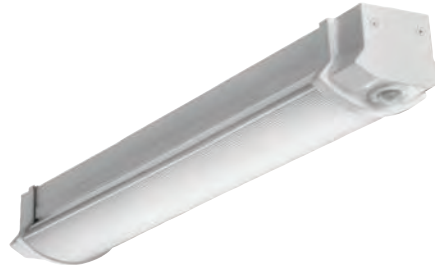
Catalog Number	WL2 18L EZ1 LP835
Notes	HAINES BOROUGH VOC ED BLDG
Type	C

# W SERIES

Wall bracket & Surface Mount LED

# WL2

2'  
LED



eldoLED

on different floors in a stairwell, to a corridor or hallway — illuminating the desired path.

**LISTINGS** — CSA certified to meet U.S. and Canadian standards. Suitable for damp location.

Patents pending. DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at [www.designlights.org/QPL](http://www.designlights.org/QPL) to confirm which versions are qualified.

**WARRANTY** — 5-year limited warranty. Complete warranty terms located at [www.acuitybrands.com/CustomerResources/Terms\\_and\\_conditions.aspx](http://www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx)

NOTE: Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25°C.

Specifications subject to change without notice.

### ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: WL2 18L EZ1 LP840

WL2	18L		EZ1	LP835	
Series	Lumens <sup>1</sup>	Voltage	Driver	Color temperature	Lumen management
WL2 2' wall-mount LED	08L 800 lumens 12L 1200 lumens 18L 1800 lumens 22L 2200 lumens	(blank) MVOLT (120 - 277V)	EZ1 eldoLED dims to 1%, 0-10V EZB eldoLED dims to dark, 0-10V SLD Step-level dimming <sup>2</sup>	LP830 3000 K LP835 3500 K LP840 4000 K LP850 5000 K	(blank) No nLight N80 nLight with 80% lumen management N100 nLight without lumen management N80EMG nLight with 80% lumen management for use with generator supply emergency power N100EMG nLight without lumen management for use with generator supply emergency power

Occupancy control <sup>3</sup>	Standby mode <sup>8</sup>	Options	Finish <sup>9</sup>
NES7 Sensor Switch® nES 7 PIR integral occupancy sensor <sup>4</sup>	(blank) Fixture turns off when unoccupied	SC Surface conduit end cap provisions	(blank) White
NESPD7 Sensor Switch® nES PDT 7 dual technology integral occupancy control <sup>4</sup>	DIM10 Fixture dims to approximately 10% light output when unoccupied		
NES7ADCX Sensor Switch® nES 7 ADCX PIR integral occupancy sensor with automatic dimming control photocell <sup>4</sup>	DIM50 Fixture dims to approximately 50% light output when unoccupied <sup>7</sup>		
XADS7 XPoint™ Wireless controller and micro 360° PIR occupancy and photocell sensor <sup>5,6</sup>			
XADNS7 XPoint™ Wireless controller and micro 360° PIR occupancy and photocell sensor (egress lighting) <sup>5,6</sup>			
MSD7 Sensor Switch® MSD 7 PIR integral occupancy sensor <sup>7</sup>			

#### Notes

1 Approximate lumen output.

2 Not available with XPoint™ Wireless or nLight options.

3 See integral occupancy control section in header.

4 Requires N80 or N100.

5 Select (blank) under "Lumen management" for this option.

6 Gateway not included. Requires on-site commissioning. Visit [www.lightingcontrols.com/XPointWireless](http://www.lightingcontrols.com/XPointWireless) for more information.

7 Not available with EZB or SLD.

8 Requires occupancy control. For XPoint™ Wireless select (blank). Standby mode is programmed at time of commissioning.

9 For additional paint finishes refer to Architectural Colors.

# WL2 Wall Bracket & Surface Mount LED

Performance Data			
Lumen package	Input watts <sup>1</sup>	Lumens	LPW
08L LP830	7.5	771	102.80
08L LP835	7.5	809	107.87
08L LP840	7.5	848	113.07
08L LP850	7.5	877	116.93
12L LP830	12.2	1190	97.54
12L LP835	12.2	1249	102.38
12L LP840	12.2	1311	107.46
12L LP850	12.2	1364	111.80
18L LP830	17.5	1711	97.77
18L LP835	17.5	1796	102.63
18L LP840	17.5	1889	107.94
18L LP850	17.5	1966	112.34
22L LP830	21.0	2086	99.33
22L LP835	21.0	2120.5	100.98
22L LP840	21.0	2189.4	104.26
22L LP850	21.0	2258.4	107.54

## Notes

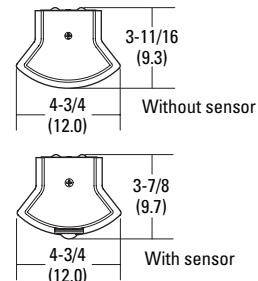
<sup>1</sup> Actual wattage may differ by +/- 5% when operating between 120-277V +/- 10%.

## DIMENSIONS

All dimensions are inches (centimeters) unless otherwise noted.

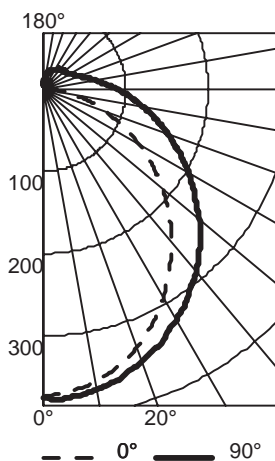
### Specifications

Length: with sensor - 25-7/8 (65.7)  
 without sensor - 23-3/8 (59.4)  
 Height: with sensor - 3-11/16 (9.3)  
 without sensor - 3-7/8 (9.7)  
 Width: 4-3/4 (12.1)



## PHOTOMETRICS

WL2 12L EZ1 LP840, 1310.5 delivered lumens, test no. LTL25476P5, tested in accordance to IESNA LM-79



### CP Summary

	0°	90°
0°	374	374
5°	367	376
15°	350	364
25°	315	340
35°	267	306
45°	216	269
55°	162	224
65°	109	182
75°	58	141
85°	17	105
90°	2	88

### Coefficients of Utilization

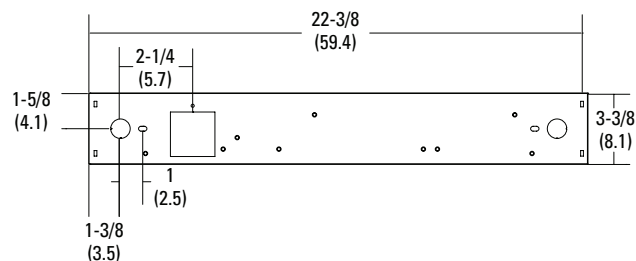
pc	pw	Coefficients of Utilization									
		80%		70%		50%		50%		10%	
0	116	116	116	112	112	112	104	104	104		
1	104	99	94	95	91	87	88	85	82		
2	94	85	78	82	75	70	77	71	66		
3	86	74	66	72	64	58	67	60	55		
4	78	66	57	64	55	49	59	52	47		
5	72	59	49	57	48	42	53	46	40		
6	66	53	44	51	43	36	48	41	35		
7	61	48	39	46	38	32	44	36	31		
8	57	43	35	42	34	29	40	33	28		
9	53	40	32	39	31	26	37	30	25		
10	50	37	29	36	28	23	34	27	22		

### Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	286	21.9	21.9
0° - 40°	466	35.6	35.6
0° - 60°	824	62.9	62.9
0° - 90°	1143	87.2	87.2
90° - 120°	101	7.7	7.7
90° - 130°	122	9.3	9.3
90° - 150°	154	11.7	11.7
90° - 180°	168	12.8	12.8
0° - 180°	1310	100.0	100.0

## MOUNTING DATA

For unit installation; surface ceiling or wall mounting.





## Terms and Conditions of Sale

These standard terms and conditions of sale ("Terms and Conditions") apply to any and all orders placed by purchaser ("Purchaser") for purchases of products or services (together, "Products") from and after June 3, 2015 from Philips Lighting North America Corporation and its Affiliates ("Manufacturer"), whether or not such purchase is subject to a signed purchase order, distribution or other agreement between Manufacturer and Purchaser. Ordering Products from Manufacturer constitutes acceptance of the terms set forth herein, as such terms may have been updated through the date of such order. Any different, or additional terms in any purchase order, blanket instructions or other writing from Purchaser shall be deemed a material alteration hereof and are hereby expressly objected to and rejected and shall be of no force or effect. Commencement of performance or shipment shall not be construed as acceptance of any of Purchaser's terms and conditions which are different from or in addition to those contained in the Agreement. Course of performance or usage of trade shall not be applied to modify these Terms and Conditions.

### ORDERS; CHANGES AND CANCELLATIONS

All orders must be placed in writing and delivered directly to Manufacturer from the entity that will be liable for the payment of the order. Verbal orders or orders through a third party will not be accepted.

No order is final as to Manufacturer until accepted by Manufacturer by written acknowledgement. All orders that are accepted by Manufacturer are subject to these Terms and Conditions. After acceptance, requests to cancel or change orders must be submitted in writing to Manufacturer. All requests are reviewed for approval before processing and are subject to any and all cost or expense incurred by Manufacturer from such cancellation or change including, without limitation, costs for work performed and/or materials purchased by Manufacturer for Products. Hold orders may be accepted for informational purposes only. Procurement and production process will not be initiated and delivery commitments will not be provided without firm release dates.

### PRICES

All prices represent those in effect at the time of quotation and are subject to change without notice. All prices are as stated in Manufacturer's quote and specifically override any prices referenced in Purchaser's purchase order. Unless prices are quoted as "firm" by an officer of Manufacturer, Manufacturer reserves the right to invoice prices in effect at the date of shipment, regardless of any prior quote and regardless of whether notice was received by Purchaser. All prices and other terms are subject to correction for typographical or clerical errors.

### SALES MATERIALS; SPECIFICATIONS

Any catalog, specification or price sheet or other similar documentation prepared by Manufacturer is strictly for the convenience of the user and shall not be deemed as an offer to sell. Manufacturer believes such documentation is complete and accurate at time of printing, but does not warrant that such documentation is error free. Manufacturer will not accept responsibility for any damages including labor charge backs in connection with errors of measurements, descriptions, application recommendations, etc.

Products will be shipped in accordance with the standard styles and sizes as described in Manufacturer's catalogs or, for special or made-to-order Products, in accordance with Manufacturer's drawings and specifications sheets. In the event of a conflict between a customer's written order and a Manufacturer drawing or specification sheet marked "approved" or the like, the Manufacturer drawing or specification sheet shall prevail. Manufacturer reserves the right to change details of design, materials and finish at any time without written notice.



## **TERMS OF PAYMENT**

Unless otherwise stated in Manufacturer's invoice or agreed to in writing by Manufacturer, terms of payment for orders shipped to destinations in the United States shall be as follows (i) for drop ship orders, payment is due by the 10th day of the month following invoicing to earn the 1% discount, the net is due on the 25th of the month following invoicing and (ii) for orders into stock, payment is due by the 10th day of the 2nd month following invoicing to earn the 1% discount, the net is due on the 25th of the 2nd month following invoicing. The terms of payment are subject to review of Purchaser's credit by Manufacturer. Manufacturer shall have the right, at any time and from time to time, to require cash payments in advance or a letter of credit or other assurance of payment satisfactory to Manufacturer as a condition to acceptance of any order or shipment of any Product. Unless otherwise agreed to by Manufacturer, payment shall be by check to be drawn on Purchaser's corporate account, by wire transfer to Manufacturer's account at a commercial bank designated by Manufacturer, or by Manufacturer's draw upon a letter of credit satisfactory in form and substance to Manufacturer.

The requirement of a letter of credit is standard for shipments outside the United States for special products, and for F.O.B. factory orders. All payments by Purchaser shall be made in United States Dollars and shall be paid in full, without set-off, deduction or counterclaim.

## **TAXES AND GOVERNMENTAL CHARGES**

Prices do not include any taxes or other governmental fees, charges or assessments, including, without limitation, value-added, sales, use or privileges taxes, required governmental withholdings or excise or similar taxes levied by any government, now or hereafter enacted. In Manufacturer's discretion, any such taxes, charges or withholdings may be added to the price for any Products or may be billed separately. Purchaser will pay all such taxes and charges, on or before their due dates. In the event Manufacturer is required at any time to pay any such tax or charge, Purchaser will reimburse Manufacturer promptly on demand.

## **LATE CHARGES; COSTS**

If Purchaser fails to pay in full without any set off or deduction any amount due to Manufacturer promptly when due, Manufacturer may recover, in addition to the payment due, interest thereon at a rate equal to the lesser of 1-1/2% per month and the maximum rate of interest allowable under applicable law and Purchaser shall be liable for all costs and expenses, including reasonable attorneys' fees, incurred by Manufacturer in collecting or attempting to collect any and all overdue accounts. If Purchaser fails to pay any amount when due, in addition to any other rights or remedies available to Manufacturer at law or in equity, Manufacturer may discontinue the performance of services, discontinue the delivery of the product, or deduct the unpaid amount from any amounts otherwise owed to Purchaser by Manufacturer under any agreement with Purchaser.

## **SECURITY INTEREST**

Purchaser hereby grants to Manufacturer a purchase money security interest in the products until all payments have been made. Purchaser shall sign any financing statements or other documents necessary to perfect Manufacturer's security interests in the products. Where permitted by applicable law, Purchaser's signature on the quotation or on a purchase order issued as a result of the quotation gives Manufacturer the right to sign on Purchaser's behalf and file any financing statement or other documents to perfect Manufacturer's security interest in the product.



## **PACKAGING AND HANDLING**

Manufacturer shall determine the method of packaging for all Products. If Purchaser requires special packaging or handling, such request must be made in writing and charges for special packaging, handling, and delivery shall be added to the price of the Products. Unless specifically agreed to in writing, Manufacturer **will not be responsible for the payment of any penalties or special handling charges relating to Manufacturer's failure to comply with a customer's special requirement for order processing, handling, packaging, shipping or invoicing.**

## **SHIPMENT, DELIVERY AND TITLE**

Products will be tendered and shipped FOB (Incoterms 2010) **Manufacturer's plant or warehouse** and title to and risk of loss of the Product shall pass to Purchaser at such point. Purchaser shall obtain and pay for insurance covering such risks at such destination. Manufacturer will select the carrier and routing and ship Products freight prepaid and added to the price of the Products. Manufacturer may, in its discretion, choose to make partial shipments and shall bill each shipment as it is made, but on terms applicable to the complete order. Upon request, Manufacturer will drop-ship individual orders of \$1,000 or more to any one destination within the continental United States. Manufacturer may refuse to make direct shipments outside of **Purchaser's regular service area. Orders that are for less than \$1,000 in total are subject to a \$100 shipping and handling fee.** Manufacturer may, at its discretion, offer freight allowances for orders in excess of certain set prices and/or for orders shipped outside the continental United States. Purchaser shall contact Manufacturer for the applicable terms and conditions of any freight allowances offered by Manufacturer. Where Manufacturer provides such an allowance to Purchaser, Manufacturer will use its own discretion in routing the shipment. If a more expensive means of transportation or other special delivery requirements are requested by Purchaser, Purchaser assumes and shall pay all additional costs.

Delivery dates of all shipments are estimated and are not guaranteed. The shipment date mentioned on **Manufacturer's quote or order acknowledgement, if any, is Manufacturer's approximation of a shipment date,** and is not a fixed or guaranteed shipment date. Manufacturer assumes no liability in connection with any delay in delivery. Postponement of deliveries at Purchaser's request, if for a period of more than ten (10) days, will not be permitted unless prior approval is given by an authorized officer of Manufacturer. Any claims for shortages, losses, or damages sustained in transit shall be made by Purchaser with the carrier and must be documented on delivery receipt. Upon request, Manufacturer will provide evidence of delivery of Products to the carrier, but reserves the right to charge a reasonable fee for all proof of delivery requests.

## **STORAGE**

Purchaser shall pay any detention, storage, handling or auxiliary charges assessed by carriers or warehousemen **resulting from Purchaser's requirements for special service or Purchaser's failure to accept delivery in a timely manner.**

## **PRODUCT ACCEPTANCE**

All Products delivered hereunder shall be deemed accepted by Purchaser as conforming to this Agreement, and Purchaser shall have no right to revoke any acceptance, unless written notice of the claimed nonconformity is received by Manufacturer within sixty (60) days of delivery thereof. Notwithstanding the foregoing, any use of a product by Purchaser, its agents, employees, contractors or licensees, for any purpose, after delivery thereof, shall constitute acceptance of that product by Purchaser.

## **FORCE MAJEURE**

Manufacturer shall have no liability or obligation in connection with any failure to manufacture or deliver due **to causes beyond Manufacturer's reasonable control including but not limited to strikes, lockouts, fires, riots, wars, acts of God, inability to obtain materials, components or supplies, failure or breakdown of machinery, production scheduling delays, government regulations or other conditions.**

## PRODUCT RETURNS

In the event it is necessary to return Products to Manufacturer, Purchaser must follow the procedure outlined in these Terms and Conditions. For Purchaser's who received their Products from an authorized distributor of Manufacturer, the procedure outlined below should be directed to, and the term "Manufacturer" shall mean, such distributor. To obtain approval to return Products to Manufacturer, Purchasers must contact Manufacturer's Customer Service staff at (800) 215-1068 (Fall River); (800) 234-1890 (Tupelo); (800) 334-2212 (Somerset) during normal business hours. If a return is approved, a packet will be prepared and mailed to the Purchaser within two standard business days containing (i) a Return Authorization ("RA") number; and (ii) two copies of the authorized RA form (one for the Purchaser's records and one to be included with the return shipment).

NO PRODUCT RETURNS WILL BE ACCEPTED BY MANUFACTURER IF NOT ACCOMPANIED BY A VALID RA NUMBER. Product returned without a RA number will either be refused or returned to Purchaser at Purchaser's expense. Manufacturer is not liable for loss or damage to unauthorized product returns. Once issued, RA numbers are valid for 30 days. Any returns received after 30 days of the issuance of an RA will be refused. Purchaser is responsible for all return freight charges, including taxes, customs and duties if applicable. All product returned for credit must be new, undamaged, and in factory sealed packaging. Product may not be returned if it is non-standard, made-to-order, or manufactured to Purchaser's specific design or specification (including units with non-standard components or accessories), or is outdated or phase-out stock product. Any product returned with marked box, damaged box, missing components, (e.g. cables, manuals, etc.), or other damage not caused by Manufacturer will be assessed a higher restocking fee to cover the cost of replacements.

All Products returned are subject to inspection. Un-saleable and damaged merchandise may be credited at salvage value or less costs of repairs. Credit can be issued only on Products re-saleable as new. Manufacturer may at its option issue credit at prices prevailing at time of shipment, or time of return, whichever is lower, less the any applicable restocking or other charges.

Returns authorized by Manufacturer, other than return of Defective Products which are subject to the terms of Manufacturer's applicable Limited Warranty, will be subject to a restocking fee and Purchaser will pay all transportation costs associated with the return, including taxes, customs and duties, if applicable. Product returned in original condition will be assessed up to a 20% restocking fee. Requests to return non-defective stocking merchandise can be made once per calendar year without a re-stocking fee.

## LIMITED WARRANTY

Manufacturer's limited warranty for the Products is posted on Manufacturer's website at [www.philips.com/warranties](http://www.philips.com/warranties) (as applicable, the "Product Warranty"). The terms of the Product Warranty are hereby herein incorporated by reference. THE WARRANTIES SET FORTH HEREIN AND IN THE PRODUCT WARRANTY ARE THE ONLY WARRANTIES MADE BY MANUFACTURER IN CONNECTION WITH THE PRODUCT AND ARE EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, WHETHER WRITTEN, ORAL, STATUTORY, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

## EXPORT CONTROL

Purchaser understands that certain transactions of Manufacturer are subject to export control laws and regulations, such as but not limited to the UN, EU and the USA export control laws and regulations ("Export Regulations"), which prohibit export or diversion of certain products and technology to certain countries. Any and all obligations of Manufacturer to export, re-export or transfer Products as well as any technical assistance, training, investments, financial assistance, financing and brokering will be subject in all respects to such Export Regulations and will from time to time govern the license and delivery of Products and technology abroad by persons subject to the jurisdiction of the relevant authorities responsible for such

Export Regulations. If the delivery of products, services and/or documentation is subject to the granting of an export or import license by certain governmental authorities or otherwise restricted or prohibited due to export/import control regulations, Manufacturer may suspend its obligations and the Purchaser's/end-user's rights until such license is granted or for the duration of such restrictions or prohibitions. Furthermore, Manufacturer may at its option terminate the relevant order in all cases without incurring any liability towards the Purchaser or end-user.

Purchaser warrants that it will comply in all respects with the export, re-export and transfer restrictions set forth in such Export Regulations or in export licenses (if any) for every Product supplied to Purchaser. Purchaser accepts the responsibility to impose all export control restrictions to any third party if the items are transferred or re-exported to third parties. Purchaser shall take all actions that may be reasonably necessary to ensure that no customer/purchaser or end-user contravenes such Export Regulations. Purchaser shall indemnify Manufacturer against any and all direct, indirect and punitive damages, loss, costs (including **attorney's fees and costs**) and other liability arising from claims resulting from Purchaser's or its customers' breach or non-compliance with this section.

### **ANTI – BRIBERY**

Purchaser and its owners, officers, directors, employees, or agents have not and will not engage in any activities that violate the United States Foreign Corrupt Practices Act, the UK Bribery Act, or any other anti-corruption laws or laws prohibiting the payment of commercial or private bribes. In particular, and not in limitation of the foregoing, Purchaser and its owners, officers, directors, employees, or agents will not pay, offer, or promise to pay, or authorize the payment directly or indirectly, of any money, gift, or anything of value to any Government Official, as defined below, for the purpose of influencing any act or decision of such official or of the government to obtain or retain business, or direct business to any person. As used in this Section, "Government Official" means any minister, officer, director or employee of a government or any department, agency, or instrumentality thereof, or of a public international organization (such as the World Bank, International Monetary Fund or United Nations), or any person acting in an official capacity for or on behalf of any such government or department, agency, or instrumentality, or for or on behalf of any such public international organization.

### **INDEMNIFICATION**

Purchaser shall indemnify, defend and hold harmless Manufacturer and its officers, directors, agents, employees, affiliates, successors, and assigns from and against all losses, liabilities, costs and expenses arising out of or in connection with any claim by third parties for any loss, damage or injury or death caused or alleged to be caused by: (a) the negligent use, application, or installation of Product by Purchaser or its employees, partners to whom Purchaser sold Product, contractors, agents or affiliates, (collectively, "Purchaser Parties"); or (b) the modification of Product or integration of Product into other products by any of the Purchaser Parties unless authorized in writing by Manufacturer. Purchaser shall not join, settle or otherwise attempt to affect or dispose of any such claim without Manufacturer's written consent.

### **PROPRIETARY RIGHTS**

Manufacturer shall defend any suit or legal proceeding brought against Purchaser by a third party based on a claim that the manufacture and sale of a Product, or any part thereof, constitutes infringement of any patent of the United States, if notified promptly in writing and given authority, information and assistance (at **Manufacturer's expense**) for defense of same, and Manufacturer shall pay damages or costs finally awarded against Purchaser therein to the extent that such damages and costs are directly and solely attributable to such infringement. The use of such Products by Purchaser is beyond the control of Manufacturer and Manufacturer has no obligation or liability whatsoever in connection with any suit claiming infringement by reason of the use of the Products.

Notwithstanding the foregoing, with respect to all Products manufactured by Manufacturer, either in whole or in part, to Purchaser's designs, specifications or instructions, Purchaser shall defend and hold harmless Manufacturer from all liability, loss, cost and expense (including attorney's fees) resulting from claims of alleged infringement of patents, designs, copyrights, trademarks, and other proprietary rights.

If any Product is, or in Manufacturer's opinion is likely to become, the subject of a claim of infringement under this Section or if Manufacturer receives from a claim of infringement from a third party in relation to any of the Products, Manufacturer shall have the right, without obligation or liability and at its sole option, to: (i) procure for Purchaser the right to continue to use or sell the Product; (ii) replacement the Product with anon-infringing product, or (iii) modify the Product in such a way as to make the modified Product non-infringing; or (iv) repurchase such Product from the Purchaser for the initial price paid by Purchaser less reasonable depreciation; or (v) suspend or discontinue supplies to Purchaser of the Products or parts to which such notice relates or (vi) terminate any agreement to the extent related to such Product.

### **CONFIDENTIALITY**

Purchaser shall maintain as confidential any information furnished or disclosed to it by the Manufacturer, whether disclosed in writing or disclosed orally, relating to the business of the Manufacturer, its customers, employees, and/or its patients, and the quotation and its terms, including the pricing terms under which Purchaser has agreed to purchase the products. Purchaser shall use the same degree of care to protect the confidentiality of the disclosed information as it uses to protect the confidentiality of its own information, but in no event less than a reasonable amount of care. Purchaser may disclose such confidential information to its employees on a need to know basis necessary to perform the transactions contemplated herein. The obligation to maintain the confidentiality of such information shall not extend to information that (a) is or becomes generally available to the public without violation of these Terms and Conditions or any other obligation of confidentiality or (b) is lawfully obtained by the Purchaser from a third party without any breach of confidentiality or violation of law.

### **SOFTWARE LICENSE**

Any software included with a Product, is licensed and not sold. The license is nonexclusive and is limited to use with the Product. No other use is permitted and Manufacturer retains for itself (or, if applicable, its suppliers) all title and ownership to any software delivered hereunder, all of which contains confidential and proprietary information and which ownership includes, without limitation, all rights in patents, copyrights, trademarks and trade secrets. Purchaser shall not sell, transfer, sublicense, reverse engineer or disassemble or redistribute the software. Purchaser shall not copy, disclose, or display any such software or otherwise make it available to others.

### **ENTIRE AGREEMENT**

This Agreement constitutes the entire agreement of the parties and supersedes all prior negotiations, proposals, agreements and understandings, whether oral or written, relating to the products to be purchased hereunder or otherwise relating to the subject matter of this Agreement. Any representation, warranty, course of dealing or trade usage not expressly contained or referenced herein shall not be binding on Manufacturer. If the products purchased from Manufacturer are to be used in the performance of a government contract or subcontract, no government requirements or regulations shall be binding upon Manufacturer unless specifically agreed to by Manufacturer in writing.

### **APPLICABLE LAW; LIABILITY**

The law applicable to sales in the United States under these Terms and Conditions shall be Article 2 of the Uniform Commercial Code as applicable to the state of destination. The United Nations Convention on Contracts for the International Sales of Goods is hereby excluded and shall not apply.

UNDER NO CIRCUMSTANCES SHALL MANUFACTURER'S AGGREGATE LIABILITY ARISING OUT OF OR IN CONNECTION WITH THE SALE OF PRODUCTS, IN CONTRACT, TORT OR OTHERWISE, EXCEED THE PURCHASE PRICE OF THE PRODUCT TO WHICH SUCH LIABILITY RELATES. IN NO EVENT SHALL MANUFACTURER BE LIABLE FOR SPECIAL, INCIDENTAL, CONSEQUENTIAL, INDIRECT OR COMPENSATORY DAMAGES, INCLUDING, WITHOUT LIMITATION, DAMAGES RESULTING FROM LOSS OF USE, LOST REVENUES OR PROFITS, BUSINESS OR GOODWILL EVEN IF MANUFACTURER HAS BEEN ADVISED OR IS AWARE OF THE POSSIBILITY OF SUCH DAMAGES.

## **PRODUCT SAFETY**

Purchaser shall comply fully with all applicable laws, industry safety standards applicable to the manufacture, distribution or sale of items incorporating the products supplied by Manufacturer, including but not limited to American National Standards Institute (ANSI)/Illuminating Engineering Society of North America (IESNA) RP-27 (or equivalent eye safety labeling standards) and International Standard IEC 62471-2006, published by the International Electrotechnical Commission, including all marking, labeling, and supplemental user and service information (if any) required by the standards, where applicable. Purchaser shall comply fully with all applicable safety-related laws, rules and regulations of any governmental body having jurisdiction to regulate the manufacture, distribution or sale of items incorporating the products supplied by Manufacturer. Purchaser shall obligate all persons and entities buying such products from Purchaser (other than end users) to comply with such industry standards, laws, rules or regulations applicable to such person or entity. Purchaser shall defend and hold Manufacturer harmless against any expense, loss, costs or damages relating to any claimed failure by Purchaser to comply with such industry standards, laws, rules or regulations or from any bodily injury, illness or property damage resulting from products manufactured by Purchaser which incorporate the products supplied by Manufacturer.

## **GENERAL TERMS**

Bankruptcy. If Purchaser becomes insolvent, is unable to pay its debts when due, files for bankruptcy, is the subject of involuntary bankruptcy, has a receiver appointed, or has its assets assigned, Manufacturer may cancel any unfulfilled obligations, or suspend performance; however, Purchaser's financial obligations to Manufacturer shall remain in effect.

Assignment. Purchaser may not assign any rights or obligations in connection with the transactions contemplated herein without the prior written consent of Manufacturer, which consent shall not be unreasonably withheld, and any attempted assignment without such consent shall be of no force or effect.

Governing Law. All transactions contemplated by these Terms and Conditions shall be governed by the laws of the Commonwealth of Massachusetts, without regard to that state's choice of law principles. EACH PARTY, KNOWINGLY AND AFTER CONSULTATION WITH COUNSEL, FOR ITSELF, ITS SUCCESSORS' AND ASSIGNS, WAIVES ALL RIGHT TO TRIAL BY JURY OF ANY CLAIM ARISING WITH RESPECT TO THIS AGREEMENT OR ANY MATTER RELATED IN ANY WAY THERETO.

Headings. The headings contained herein are intended for convenience only and shall not be used to interpret the terms hereof.

Severability. If any provision of these Terms and Conditions are deemed to be illegal, unenforceable, or invalid, in whole or in part, the validity and enforceability of the remaining provisions shall not be affected or impaired, and shall continue in full force and effect.

Performance. The failure of Purchaser or of Manufacturer at any time to require the performance of any obligation will not affect the right to require such performance at any time thereafter. Course of dealing, course of performance, course of conduct, prior dealings, usage of trade, community standards, industry standards, and customary standards and customary practice or interpretation in matters involving the sale, delivery, installation, use, or service of similar or dissimilar products or services shall not serve as references in interpreting these Terms and Conditions.

Obligations. **Purchaser's obligations are independent of any other obligations the Purchaser may have under any other agreement, contract, or account with Manufacturer.** Purchaser will not exercise any right of offset in connection with the terms and conditions in the quotation or in connection with any other agreement, contract, or account with Manufacturer.



## Limited Warranty: Outdoor Professional Luminaires

Philips Lighting North America Corporation (“**Philips**”) warrants to the original purchaser (“**Purchaser**”) that the Philips branded outdoor professional luminaires identified on Schedule 1 (“**Products**”) will be free from defects in material and workmanship which cause the Product to fail to operate in accordance with the performance specifications set forth in documentation published for or provided with the Product (“**Specifications**”) for the applicable period and subject to the additional terms and conditions set forth on Schedule 1 from the date of purchase (as set forth in the applicable invoice) (“**Warranty Period**”). Unless otherwise noted on Schedule 1, Philips warrants that any standard finish on a Product will be free of cracking, peeling, excessive fading, and corrosion defects during the applicable Warranty Period. To the extent that an authorized Philips distributor is the Purchaser of the Products, such distributor may transfer this limited warranty to subsequent purchasers of the Products, provided that such Products are resold in new condition and in their original packaging. For LED Products, the Product shall be considered defective only if 10% or more of the LED components fail for such Product.

Photocells (standard issue NEMA and button type), occupancy sensors, low voltage indicators, fuses, surge suppressors and other third party accessories that are not manufactured by Philips are excluded from this warranty, but may be covered by a third party manufacturer. Such third party manufacturer shall be solely responsible for the costs related to any claims associated with any such accessories. Extended life photocells carry a 10-year limited warranty from the third party manufacturer. Emergency battery packs and polycarbonate lenses (used on vandal resistant products or as vandal resistant covers or options) have a Warranty Period of 1 year.

If any Product covered by this limited warranty is returned by Purchaser in accordance with Philip’s Terms and Conditions of Sale (available at [www.philips.com/termsandconditionsprofessional](http://www.philips.com/termsandconditionsprofessional)) within the Warranty Period, and Philips determines to its satisfaction that such Product failed to satisfy this warranty, Philips will, at its option, repair or replace the Product or the defective part thereof, or reimburse Purchaser for the purchase price, subject to the terms and conditions set forth herein. For purposes of clarity, "repair or replace the Product or the defective part thereof" does not include any removal or reinstallation costs or expenses, including, without limitation, any labor costs or expenses, shipping costs to return non-conforming Products or any damages that may occur during the return of Product to Philips. If Philips chooses to replace the Product and is not able to do so because it has been discontinued or is not available, Philips may replace it with a comparable product. Philips reserves the right to use new, reconditioned, refurbished, repaired or remanufactured products or parts in the repair or replacement of any Product covered by this limited warranty.

This limited warranty is subject to the following additional conditions:

- The Products have been properly handled, stored, wired, transported, installed, operated and maintained in accordance with the applicable Specifications.
- A Philips representative will have access to the failed Products and the fixtures used to operate them. If the fixture or other parts become suspect, the representative shall have the right to invite other manufacturers’ representatives to evaluate the lighting system components.
- The Product has been purchased directly from an authorized Philips distributor/dealer for use in regions that are within the jurisdiction of the United States or Canada.
- Purchase receipt for the Product is available for inspection by Philips.

This limited warranty does not apply to damage or failure to perform arising as a result of any acts of God or from any abuse, misuse, abnormal use, improper power supply, powers surges or fluctuations, corrosive environments, neglect, exposure or any use or installation in violation of the instructions or restrictions prescribed by Philips or any applicable standard or code, including those contained in the latest National Electrical Code, Standards for Safety of Underwriters Laboratory, Inc. (UL), the American National Standards Institute (ANSI), or, in Canada, the Canadian Standards Association (CSA). No agent, distributor or dealer is authorized to change, modify or extend the terms of this limited warranty on behalf of Philips. **THIS LIMITED WARRANTY IS VOID IF THE PRODUCT IS NOT USED FOR THE PURPOSE FOR WHICH IT IS DESIGNED OR IF ANY REPAIRS OR ALTERATIONS ARE MADE BY ANY PERSON NOT AUTHORIZED BY PHILIPS IN WRITING.**

**THIS LIMITED WARRANTY IS THE ONLY WARRANTY GIVEN BY PHILIPS WITH RESPECT TO THE PRODUCTS AND THE SOLE REMEDY FOR ANY AND ALL CLAIMS, IN CONTRACT, IN TORT OR OTHERWISE ARISING FROM THE FAILURE OF PRODUCT AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH WARRANTIES ARE HEREBY EXPRESSLY DISCLAIMED. PURCHASER'S EXCLUSIVE REMEDY FOR ANY NONCONFORMITY OR DEFECT IN ANY PRODUCT SHALL BE ONLY AS EXPLICITLY SET FORTH HEREIN. UNDER NO CIRCUMSTANCES SHALL PHILIPS' AGGREGATE LIABILITY ARISING OUT OF OR IN CONNECTION WITH A DEFECTIVE PRODUCT, IN CONTRACT, TORT OR OTHERWISE, EXCEED THE PURCHASE PRICE OF THE PRODUCT TO WHICH SUCH LIABILITY RELATES. IN NO EVENT SHALL PHILIPS BE LIABLE FOR SPECIAL, INCIDENTAL, CONSEQUENTIAL, INDIRECT OR COMPENSATORY DAMAGES, INCLUDING, WITHOUT LIMITATION, DAMAGES**



RESULTING FROM LOSS OF USE, PROFITS, BUSINESS OR GOODWILL EVEN IF PHILIPS WAS ADVISED OF OR WAS OTHERWISE AWARE OF THE POSSIBILITY OF SUCH DAMAGES.

Special conditions related to all solar Products:

- The Warranty Period for batteries, pole/finish and solar panel racking is 1 year.
- Batteries are fully charged when shipped to the Purchaser or installation site. The batteries must be installed and operational no later than 2 months from the day of shipment. If stored beyond such time period, the Purchaser is responsible for recharging the batteries according to battery manufacturer's instructions at 2 months and every two month thereafter. This limited warranty does not cover batteries if: (i) program has been altered without Philips' authorization, (ii) systems that have not been designed or sized according to Philips standard design practices, or (iii) systems where Philips has conveyed as per specific sales orders, that battery life and other components will be less than the Warranty Period.
- Improper installation includes but is not limited to improper placement, orientation, tilt and/or shading conditions not considered in the energy profile and design conditions.










This limited warranty is effective for the purchases of the Product on or after the effective date set forth herein and is in consideration of and is expressly subject to and conditioned by the terms set forth herein. Philips reserves the right to modify this warranty from time to time and any modifications shall be effective for all orders placed on or after the effective date of such revised warranty.



# PHILIPS

## Limited Warranty: Outdoor Professional Luminaires

### Schedule 1

OUTDOOR PROFESSIONAL LUMINAIRES (EXCLUDING POLES AND BRACKETS)			
All Philips outdoor professional luminaires not otherwise described below shall have a warranty period of 1 year			
Philips Brand	LED	Non-LED	Special Conditions
	5 years	1 year	<p><u>Standard finishes:</u> 5 year warranty on finish for LED products and 1 year warranty on all other products.</p> <p><u>Custom finishes:</u> 1 year warranty on the finish on all products.</p> <p>Optical color filters made from glass or polymeric materials such as acrylic, polyester or polycarbonate have a Warranty Period of 1 year from the date of original shipment. Color fading of the lens material of any kind is not covered under this limited warranty.</p>
	5 years	5 years	<p><u>Standard finishes:</u> 5 year warranty on finish.</p> <p><u>Custom finishes:</u> 1 year warranty on finish.</p> <p>Optical color filters made from glass or polymeric materials such as acrylic, polyester or polycarbonate have a Warranty Period of 1 year from the date of original shipment. Color fading of the lens material of any kind is not covered under this limited warranty.</p>
Urban  	5 years	3 years	<p><u>Standard finishes:</u> 5 year warranty on finish.</p> <p><u>Custom finishes:</u> 1 year warranty on finish.</p>
Landscape and Residential 	5 years	3 years	<p><u>Landscape Products:</u> Warranty Period for all grade mounted composite luminaires, copper luminaires and transformers is 10 years. Lifetime warranty for all cast bronze and stainless steel housing.</p> <p><u>Residential Products:</u> Lifetime warranty offered to all original Purchasers on residential lighting fixtures and posts.</p>
Roadway 	10 years	3 years	<p><u>Standard finishes:</u> 10 year warranty on the finish for LED products and 5 year warranty on the finish for all other products.</p> <p><u>Custom finishes:</u> 1 year warranty on finish.</p>
POLES AND BRACKETS			
Philips Brand	Aluminum	Steel	Special Conditions
  	3 years	1 year	<p><u>Standard finishes on aluminum:</u> 5 year warranty on finish.</p> <p><u>Custom finishes on aluminum:</u> 1 year warranty on finish.</p> <p><u>Standard finishes on steel:</u> 1 year warranty on finish.</p> <p><u>Custom finishes on steel:</u> 1 year warranty on finish.</p> <p>High Mast poles and raising/lowering devices have a 1 year Warranty Period.</p>

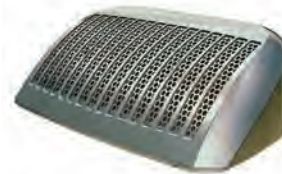
Job: HAINES BOROUGH VOC ED BLDG  
 Type: D  
 Notes: 121-MR-MT-18LA-NW-UNIV-BLP

# 120 LINE LED

Page 1 of 4

## 121 LED Performance Sconce - Generation 2

The Philips Gardco 121 LED Performance Sconce provides an energy efficient, architecturally pleasing solution for wall mount applications. The sloped surface ribs of the die cast aluminum housing create a distinctly unique aesthetic element, and perform important functions in the Philips Gardco thermal management system. 121 Generation 2 luminaires feature high performance Class 1 LED systems. The high performance LED optical systems produce full cutoff performance, minimizing glare and light trespass. Philips Gardco's LED technology provides maximized light output and maximum energy savings.



PREFIX	OPTICAL SYSTEM	LED WATTAGE	LED SELECTION	VOLTAGE	FINISH	OPTIONS
121-MR	MT	18LA	NW	UNIV	BLP	

Enter the order code into the appropriate box above. Note: Philips Gardco reserves the right to refuse a configuration. Not all combinations and configurations are valid. Refer to notes below for exclusions and limitations. For questions or concerns, please consult the factory.

### PREFIX

- 121 121 LED Performance Sconce - Constant Wattage / Full Light Output
- 121-MR** 121 LED Performance Sconce - Motion Response
- 121-DIM 121 LED Performance Sconce - 0 - 10V Dimming
- 121-APD 121 LED Performance Sconce - Automatic Profile Dimming

### OPTICAL SYSTEM

- 2 Type 2
  - 3 Type 3
  - 4 Type 4
  - MT** Medium Throw
- All optical systems are supplied with a clear glass lens standard. A Diffuse Lens (DL) option is available. See **OPTIONS** on Page 2.

121-DCC 121 LED Performance Sconce - Dual Circuit Control

### LED WATTAGE AND LUMEN VALUES

Single LED Array Wattages, Available in 121, 121-MR, 121-DIM and 121-APD Only									
Ordering Code	Average System Watts <sup>1</sup>	LED Current (mA)	LED Quantity - Single LED Array	LED Selection	Luminaire Initial Absolute Lumens <sup>2</sup>				
					TYPE 2	TYPE 3	TYPE 4	MT	
<b>18LA</b>	18	350	16	NW	1,673	1,707	1,609	2,022	
<b>26LA</b>	26	530	16	NW	2,442	2,485	2,345	2,927	
<b>35LA-700</b>	36	700	16	NW	3,102	3,139	2,972	3,650	
<b>35LA-350</b>	35	350	32	NW	3,664	3,736	3,523	4,425	
<b>50LA</b>	52	530	32	NW	5,587	5,685	5,365	6,697	
<b>75LA</b>	72	700	32	NW	6,199	6,538	6,296	7,289	

Dual LED Array Wattages, Available in 121-DCC Only									
Ordering Code	Average System Watts <sup>1</sup>	LED Current (mA)	LED Quantity - Dual LED Arrays		LED Selection	Luminaire Initial Absolute Lumens <sup>2</sup>			
			Per LED Array	Total LEDs		TYPE 2	TYPE 3	TYPE 4	MT
<b>35LA-2</b>	35	350	16	32	NW	3664	3,736	3,523	4,425
<b>50LA-2</b>	52	530	16	32	NW	5587	5,685	5,365	6,697
<b>75LA-2</b>	72	700	16	32	NW	6199	6,538	6,296	7,289

1. Wattage may vary by +/- 8% due to LED manufacturer forward volt specification and ambient temperature. Wattage shown is average for 120V through 277V input. Actual wattage may vary by an additional +/- 10% due to actual input voltage.  
 2. Values shown are for luminaires without the DL option. Tests are in process for configurations not shown. "(s)" following the value indicates that values are scaled from tests on similar, but not identical luminaire configurations. Contact Gardco.applications@philips.com if any approximate estimates are required for design purposes. Lumen values based on tests performed in compliance with IESNA LM-79.



PHILIPS



### LED SELECTION

<b>CW</b>	Cool White - 5700°K - 75 CRI Nominal
<b>NW</b>	Neutral White - 4000°K - 70 CRI Nominal
<b>WW</b>	Warm White - 3000°K - 80 CRI Nominal

### VOLTAGE

<b>120</b>	
<b>208</b>	
<b>240</b>	
<b>277</b>	
<b>UNIV</b>	Accepts 120V through 277V input, 50hz to 60hz.
<b>347</b>	347V - Requires Extended Back Box, which is provided standard. Requires and includes auxilliary transformer mounted in Extended Back Box.

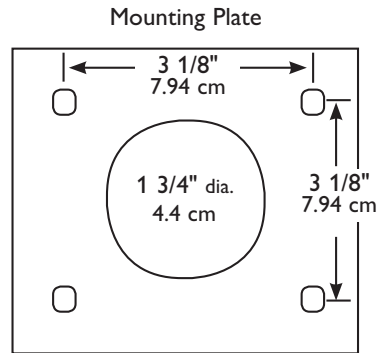
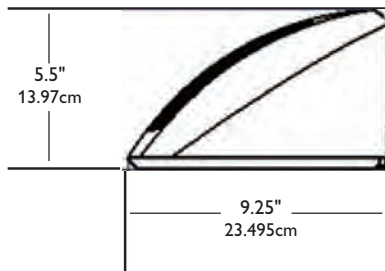
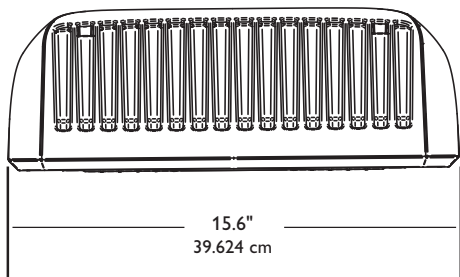
### FINISH

<b>BRP</b>	Bronze Paint
<b>BLP</b>	Black Paint
<b>WP</b>	White Paint
<b>NP</b>	Natural Aluminum Paint
<b>BGP</b>	Beige Paint
<b>OC</b>	Optional Color Paint Specify Optional Color or RAL ex: OC-LGP or OC-RAL7024.
<b>SC</b>	Special Paint Specify. Must supply color chip.

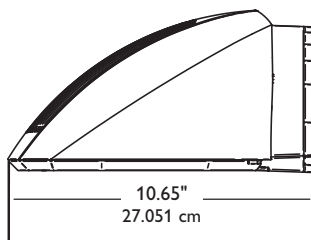
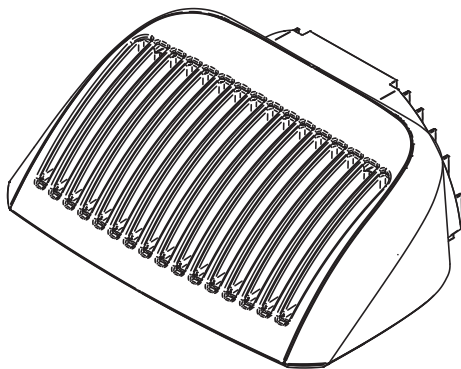
### OPTIONS

<b>F</b>	Fusing (Provide specific input voltage)
<b>DL</b>	Solite Diffusing Glass Lens (Reduces performance significantly.)
<b>PCB</b>	Button Type Photocontrol (Provide specific input voltage)
<b>WS</b>	Wall Mounted Box for Surface Conduit (Rear entry permitted.)
<b>EBB</b>	Extended Back Box (Provided standard with 347V luminaires.)

### DIMENSIONS

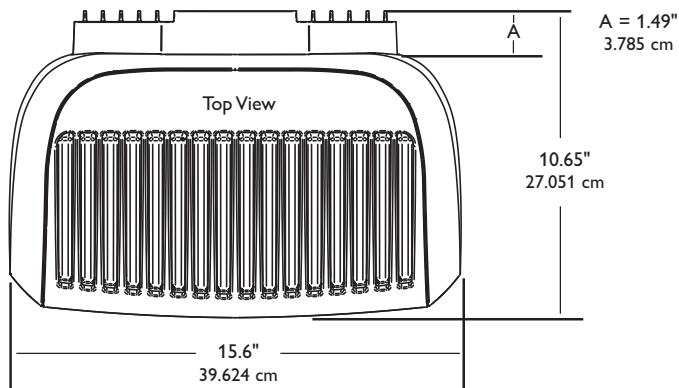


### With Extended Back Box (EBB) Option



Mounting Bolt Pattern

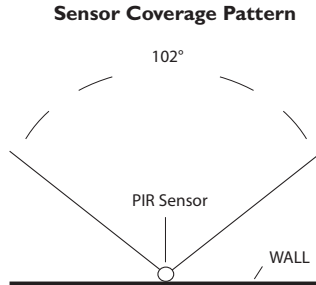
Note: Mounting plate center is located in the center of the luminaire width and 2.38" (6.03cm) above the luminaire bottom (lens down position). Splices must be made in the J-box (by others). Mounting plate must be secured by max. 5/16" (.79cm) diameter bolts (by others) structurally to the wall.



### LUMINAIRE CONFIGURATION INFORMATION

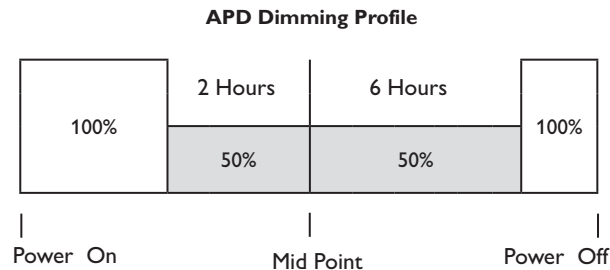
**121-CWL:** 121 LED sconce providing constant wattage and constant light output when power to the luminaire is energized.

**121-MR:** 121 LED sconce including a passive infrared (PIR) motion sensor capable of detecting motion within 30 feet of the 121 LED Sconce. The PIR sensor is mounted in the center of the luminaire, near the wall edge of the door frame, approximately 1.5" forward from the wall, and is less than .75" in diameter. When no motion is detected for 5 minutes, the Motion Response system reduces the wattage by 75%, to 25% of the normal constant wattage, reducing the light level accordingly. When motion is detected by the PIR, the luminaire returns to full wattage and full light output. The PIR sensor is capable of motion detection across a total angle of 102° from the center of the sensor (51° to either side of center.) The sensor may be adjusted directionally to maximize detection of motion to one side of the luminaire if desired based on site traffic patterns. PIR sensor provided is the Panasonic EKMB1203112. If the PIR sensor fails, the luminaire will operate in default-high mode. Motion sensors utilized consume 0.0 watts in the off state.



**121-DIM:** 121 LED sconce provided with 0 -10V dimming for connection to a control system provided by others.

**121-APD:** Philips Gardco performance LED sconces with Automatic Profile Dimming are provided with the Philips DynaDimmer included. The DynaDimmer is factory programmed to go to 50% power, 50% light output two (2) hours prior to night time mid-point and remain at 50% for six (6) hours after night time mid-point. Mid-point is continuously calculated by the DynaDimmer based on the average mid-point of the last two full night cycles. Short duration cycles, and power interruptions are ignored and do not affect the determination of mid-point.



**121-DCC:** 121 LED sconce provided with dual circuiting, and dual arrays, permitting separate switching of each led array. Available in LED wattages shown on Page 1 only.

### SPECIFICATIONS

**GENERAL:** Each Philips Gardco 121 luminaire is a wall mounted full cutoff luminaire with integrated lensed LEDs mounted in a fixed array. Internal components are totally enclosed in a rain-tight, dust-tight and corrosion resistant housing. The housing, back plate and door frame are die cast aluminum. A choice of four (4) optical systems is available. Luminaires are suitable for wet locations, mounted in the normal downlight position.

**HOUSING:** The single-piece stylized housing is die cast aluminum. A memory retentive gasket seals the housing with the door frame to exclude moisture, dust, insects and pollutants from the luminaire. A black, die cast ribbed backplate is included.

**IP RATING:** Luminaires are rated IP66.

**DOOR FRAME:** A single-piece die cast aluminum door frame integrates to the housing form. The door frame is hinged closed and secured to the housing with two (2) captive stainless steel fasteners.

**OPTICAL SYSTEMS:** Philips Gardco 121 Generation 2 LED luminaires utilize lensed LED arrays set to achieve IES Type II, Type III, and Type IV distributions, as well as a Medium Throw distribution. Individual LED arrays are replaceable. Luminaires feature high performance Class 1 LED systems. Luminaires are supplied standard with a clear glass lens.

**ELECTRICAL:** Luminaires are equipped with an LED driver that accepts 120V through 277V, 50hz to 60hz, input. Driver output is either 350 mA, 530 mA or 700 mA, based on the LED wattage selected. Component-to-component wiring within the luminaire will carry no more than 80% of rated current and is listed by UL for use at 600 VAC at 302°F/150°C or higher. Plug disconnects are listed by UL for use at 600 VAC, 15A or higher. Power factor is not less than 90%. Luminaires consume 0.0 watts in the off state. Surge protector standard. 10KA per AN SI/IEEE C62.41.2.

**LED THERMAL MANAGEMENT:** The 121 design provides deep integral thermal radiation fins cast into the upper housing to assist in the thermal management so critical to long LED system life. Metallic screens are placed over the fins and integrated to the housing to prevent the buildup of dust, dirt and contaminants, while permitting required air flow for cooling

### LED PERFORMANCE:

PREDICTED LUMEN DEPRECIATION DATA <sup>4</sup>		
Ambient Temperature °C	Driver mA	L <sub>70</sub> Hours <sup>5</sup>
25 °C	350 mA	180,000
	530 mA	150,000
	700 mA	120,000
40 °C	350 mA	170,000
	530 mA	130,000
	700 mA	100,000

4. Predicted performance derived from LED manufacturer's data and engineering design estimates, based on IESNA LM-80 methodology. Actual experience may vary due to field application conditions.

5. L<sub>70</sub> is the predicted time when LED performance depreciates to 70% of initial lumen output.

**FINISH:** Each standard color luminaire receives a fade and abrasion resistant, electrostatically applied, thermally cured, triglycidal isocyanurate (TGIC) textured polyester powdercoat finish. Standard colors include bronze (BRP), black (BLP), white (WVP), natural aluminum (NP) and beige (BGP). Consult factory for specifications on custom colors.

**LABELS:** All luminaires bear either UL or CUL (where applicable) Wet Location labels.

**WARRANTY:** Philips Gardco luminaires feature a 5 year limited warranty. Philips Gardco LED luminaires with LED arrays feature a 5 year limited warranty covering the LED arrays and LED drivers. See Warranty Information on [www.sitelighting.com](http://www.sitelighting.com) for complete details and exclusions.

**FULL CUTOFF PERFORMANCE:** Full cutoff performance means a luminaire distribution where zero candela intensity occurs at an angle at or above 90° above nadir. Additionally, the candela per 1000 lamp lumens does not numerically exceed 100 (10 percent) at a vertical angle of 80° above nadir. This applies to all lateral angles around the luminaire.



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Philips Lighting  
North America Corporation  
200 Franklin Square Drive  
Somerset, NJ 08873  
Tel. 855-486-2216

Imported by: Philips Lighting,  
A division of Philips Electronics Ltd.  
281 Hillmount Rd,  
Markham, ON, Canada L6C 2S3  
Tel. 800-668-9008

## Standard Terms And Conditions Of Sale - Limited Warranty

**1. Offer, Governing Provisions, and Termination.** This writing is an offer by Phoenix Products Company Inc. ("Company") to sell the goods and/or services described herein to the customer to which this offer is addressed ("Customer"), subject to the terms and conditions set forth herein and on the face and reverse sides hereof and in any Schedules identified herein. This writing is not an acceptance of any offer made by Customer; and Company hereby objects to and rejects any additional or different terms, which may be contained in any of Customer's purchase order, acknowledgement or other forms, or in any other communication heretofore or hereafter received from Customer. Notwithstanding the foregoing, should this writing be deemed an acceptance of a prior offer, quotation, or proposal by Customer, such acceptance is limited to the express terms and conditions set forth herein. This offer expires thirty (30) days from its date unless otherwise extended by Company. **THIS OFFER, WHEN ACCEPTED BY CUSTOMER, BY ACCEPTANCE OF GOODS OR SERVICES OR OTHERWISE, SHALL FORM A BINDING CONTRACT AND CONSTITUTE THE ENTIRE AGREEMENT BETWEEN COMPANY AND CUSTOMER.** No agreement formed pursuant to this offer may be cancelled or altered by Customer except upon terms and conditions acceptable to Company, as evidenced by Company's written consent. Customer has no right to terminate for convenience. Customer may only terminate for Company's material breach if Company, after written notice, fails to cure within 30 days of receipt of such notice. Any termination by Customer must be in writing. In the event of a termination by Customer or Company for any reason other than a material breach by Company that Company fails to cure, Customer shall pay Company termination charges consisting of the amount, if any, specified on the Company's quotation or order acknowledgement or, if no such amount is so specified, an amount equal to all of Company's costs and expenses incurred in connection with Company's performance (including without limitation labor, material, and overhead), all costs and expenses incurred as a result of the termination, any of Company's other incidental damages, and Company's expectation damages. Regarding any breach by Customer hereunder, Company reserves all rights and remedies available hereunder, in equity or at law. Company may, in its sole discretion, elect to reduce or waive such cancellation charges. No such waiver or reduction in any case shall affect Customer's right to impose such charges in any subsequent case.

**2. Prices and Shipment.** Prices and product design are subject to change at any time without notice. Federal and State taxes, if applicable, are not included. Invoices are payable in U.S. funds only. Prices that are acknowledged on orders are current prices. "Hold for Release" orders will be billed at prices in effect at time of shipment. All products shipped FCA (Company's Factory, Milwaukee, WI), unless otherwise agreed to by Company. A call-ahead fee will be applied to all orders requiring advanced notice of shipment delivery. The prices set forth herein reflect Company's normal charges where its Customer accepts all of the terms and conditions contained herein, including but not limited to Company's limited warranty and disclaimer of consequential damage liability. Company offers to submit to Customer a different quotation providing Customer additional warranty coverage and/or for Company's assumption of the disclaimed liabilities, and containing higher prices to reflect the resulting additional risk that Company would assume. Customer acknowledges that it is foregoing the possibility of making claims against Company for matters limited or disclaimed herein, in exchange for paying a lower purchase price.

**3. Payment Terms.** Subject to approval of Customer's credit, net payments shall be due thirty (30) days from invoice date unless otherwise agreed to in writing. If Company (at its sole discretion) determines that Customer should not be extended credit, Company may demand payment in full prior to any work or delivery. Past-due invoices are subject to a service charge, calculated on the outstanding balance, at the lesser of (i) the rate of one and one-half percent (1-1/2%) per month or (ii) the highest rate authorized by applicable law. Upon notice to Company pursuant to Section 7, disputed items shall not be subject to a service charge, provided that Customer does not withhold payment of any undisputed items. The service charge is not intended as an alternative to payment when due, and upon delinquency further sales may be declined and Customer's account may be referred for collection.

**4. Taxes and Other Charges.** Any manufacturer's tax, use tax, sales tax, excise tax, value-added tax, duty, custom, inspection or testing fee, or any other tax, fee or charge of any nature whatsoever imposed by any governmental authority on or measured by the transaction between Company and Customer shall be paid by Customer in addition to the prices quoted or invoiced. In the event the Company is required to pay any such tax, fee or charge, Customer shall reimburse Company therefor.

**5. Limited Express Warranty.** Except as provided below, Company warrants its products against defects in material and workmanship for one (1) year from the date of invoice. Without charge to Customer, the Company will, at its option, either repair or replace, any properly installed product that is the subject of a valid warranty claim, provided that the Company receives written notice of such warranty claim prior to the expiration of the one (1) year limited warranty period set forth above (see LED Warranty Addendum for exceptions). The foregoing remedies constitute Customer's sole and exclusive remedies for any valid warranty claim hereunder. In partial fulfillment of Customer's purchase order the Company may supply products that have been produced by unrelated third parties and not by the Company, and the Company's products may include components and/or ancillary products that are manufactured by unrelated third parties and not by the Company ("Third Party Products and Components"). Some of these Third Party Products and Components may not be expressly identified as such. The foregoing limited warranty covers only those products and components that are manufactured by the Company and does not extend to Third Party Products and Components (regardless of whether they are expressly identified as such), nor does it extend to transportation, installation, or replacement services or charges incurred by Customer. **THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ANY OTHER EXPRESS OR IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE.** The Company's finishes are warranted as above, but the Company provides no warranties of any kind with respect to custom finishes, and Customer accepts such custom finishes "as is". Company's limited warranty ceases to apply and will be void if: (i) the product has been altered or modified in any way; (ii) the defect or failure is attributable to abnormal site or operating conditions, including without limitation, excessive ambient temperatures and/or voltages spikes, or Third Party Products and Components; (iii) the product is damaged by abuse, fire, explosion, lightning, flooding, or other acts of God; or (iv) the uninstalled product has been stored in a wet or damp location. In addition, Company makes no warranties with respect to, and Customer assumes full responsibility for, all handling of the goods after delivery, all quality control and testing of the goods, and all determination of suitability of the goods for their intended application or use. Upon Company's acceptance of a valid warranty claim, Customer shall return the defective product to Company, transportation prepaid.

**6. Risk of Loss.** Title and risk of loss of goods shall pass to the Customer FCA (Company's Factory, Milwaukee, WI), upon the earlier of Company's delivery to carrier or delivery into storage, regardless of whether the transport medium or storage facilities are owned and/or operated by Company, and regardless of whether Company charges Customer for storage.

**7. Claims.** All claims for defective or damaged product or deficient orders must be made by Customer in writing fully setting forth the nature of the alleged claim within thirty (30) days after receipt thereof by Customer. Photographic evidence is required for all claims. Customer's failure to so notify Company shall constitute irrevocable acceptance of the product and a waiver of any defect, damage, or shortage. Claims for damage or loss in transit must be made by Customer directly against the carrier.

**8. Returns.** Products may be returned to Company only when Company's written permission, signed by duly authorized personnel of Company, is obtained by Customer in advance. Goods may not be returned unless they are in marketable condition. Returned products must be securely packaged and be delivered to Company prepaid and without damage. Any cost incurred by Company to put products in marketable condition will be charged to Customer. Returns are subject to a minimum 35% restocking charge. Additional charges may apply. No returned product will be accepted without all cartons marked with authorized Return Material Authorization ("RMA") number. One carton must include a copy of the RMA form in order to ensure prompt credit on return. All RMAs expire 60 days from date of issuance. Unmarked shipments will be refused by Company's receiving department.

**9. Limitation of Liability; Indemnification.** The Company's liability with respect to breaches of warranty shall be limited as provided in Section 5 hereof. With respect to other breaches of this contract, the Company's liability shall in no event exceed the contract price. **IN NO EVENT SHALL COMPANY BE LIABLE FOR ANY SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, WHETHER FOR BREACH OF CONTRACT OR WARRANTY, NEGLIGENCE OR OTHER TORT, ON ANY TYPE OF STRICT LIABILITY THEORY OR ANY OTHER THEORY OF LIABILITY. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, COMPANY SPECIFICALLY DISCLAIMS ANY LIABILITY FOR PENALTIES (INCLUDING ADMINISTRATIVE PENALTIES), SPECIAL OR PUNITIVE DAMAGES, DAMAGES FOR LOST PROFITS OR REVENUES, LOSS OF USE OF PRODUCTS OR ANY ASSOCIATED EQUIPMENT, COST OF CAPITAL, FACILITIES, SERVICES, LABOR OR SALARIES, DOWNTIME, SHUT-DOWN OR SLOWDOWN COSTS, SPOILAGE OF MATERIALS, OR FOR ANY OTHER TYPE OF ECONOMIC LOSS.** All the limitations and disclaimers contained in this paragraph and in the rest of this contract shall apply to claims of Customer's clients or any third party asserted by Customer against Company for indemnity or contribution, as well as direct claims of Customer against Company. Customer shall indemnify Company against any and all losses, liabilities, damages, and expenses (including, without limitation, attorneys fees and other costs of defending any action) which Company may incur as a result of any claim by Customer or others (including damage to property or injury or death to persons) arising out of or in connection with the products and/or services sold hereunder and based on product or service defects or failures not proved to have been caused solely by Company's negligence or, in the event of resale, by virtue of Customer's failure to properly disclaim all implied warranties and consequential damages.

**10. Right to Assurance.** Whenever Company in good faith has reason to question Customer's ability or intent to perform, Company may demand in writing adequate assurance from Customer of Customer's ability or intent to perform, and may suspend performance hereunder pending such assurance. In the event that such a demand is made and such assurance is not given within a reasonable time, Company may treat that failure as anticipatory repudiation hereof and exercise any appropriate remedy therefor.

**11. Bankruptcy.** If Customer makes an assignment for the benefit of creditors, or admits in writing its failure or inability to pay its debts as they become the subject of an "order for relief" within the meaning of that phrase in the U.S. Bankruptcy Code, or applies for or consents to the appointment of receiver for any of its property, Company may terminate any agreement arising out of this offer at any time, effective immediately upon notice. Such termination shall not relieve either party from any obligations accrued hereunder up to the date of notice of termination.

**12. Waivers.** No waiver by either party of any default by the other in the performance of or compliance with any provision, condition, or requirement herein shall be deemed to be a waiver of, or in any manner release such other party from compliance with any such provision, condition, or requirement in the future; nor shall any delay or omission of either party to exercise any right hereunder or otherwise in law in any manner impair the exercise of any such right thereafter.

**13. Delay in Performance.** Company shall not be liable for any damages or penalties as result of any delay in Company's performance when such delay is due to force majeure, weather events, acts of God, delay in transit, delay in delivery by any vendor of Company, or any other cause beyond the reasonable control of Company. Company may allocate its available supply of product among its customers, itself, and its affiliates on such basis as Company deems fair and reasonable if Company is unable, for any reason, to supply the quantities of product contemplated hereby.

**14. Assignment.** Customer shall not assign any of its rights hereunder without the prior written consent of the Company. The terms hereof shall inure to the benefit of and shall bind the successors and permitted assigns of the parties hereto.

**15. Compliance With Laws.** Company certifies that these goods were produced in compliance with all applicable requirements of sections 6, 7, and 12 of the Fair Labor Standards Act, as amended, and of regulations and orders of the United States Department of Labor issued under section 14, thereof.

**16. Severability.** If any provision of this contract shall be deemed illegal or unenforceable, such illegality or unenforceability shall not affect the validity and enforceability of any legal and enforceable provision hereof, which shall be construed as if such illegal and unenforceable provision(s) had not been inserted herein.

**17. Governing Law and Choice of Forum.** This contract shall be governed by and construed under the laws of the State of Wisconsin, without reference to principles of conflicts of laws. The rights and obligations of the parties shall not be governed by the provisions of the 1980 U.N. Convention on Contracts for International Sale of Goods. The state and federal courts having jurisdiction over the county in which the Company's main offices are located shall have exclusive jurisdiction of any dispute arising hereunder, and Customer irrevocably submits to the jurisdiction thereof and waives any defense against such jurisdiction. To the extent permitted by law, Customer agrees to reimburse Company for all reasonable attorneys' fees incurred in connection with enforcing any of Company's rights under this agreement, including, without limitation, any reasonable attorneys' fees incurred by Company in any bankruptcy proceeding involving Customer.

Please visit our website for the most up-to-date Standard Terms and Conditions of Sale.  
[www.phoenixlighting.com/Legal-Policies.htm](http://www.phoenixlighting.com/Legal-Policies.htm)





# METALLIC LED VP SERIES

## Vaporproof Fixtures

### Ceiling Mount



### Wall Mount



**5 Year Limited Warranty**

**D642,327 and Other Patents Pending**

**DESCRIPTION:** The Metallic LED Vaporproof Series fixtures are constructed of marine-grade aluminum or thick-walled brass, which are optimal for outdoor marine (saltwater) and other industrial environments. Developed for applications including marine vessels, offshore platforms, US Navy ships, tankers, exploratory drill ships, high vibration mining equipment, and wastewater treatment plants. Engineered for ultimate durability, these fixtures are UL1598A, UL844 Class I, Division 2; Class II, Division 2 listed and certified to IP66 standards. Patented models are available in 880 lumen output (12W) or 1320 lumen output (16W) with ceiling or wall mounting options.

## SPECIFICATIONS

**Housing:** Marine-grade aluminum VA Series. Thick-walled brass VB Series. Long life silicone gaskets.

**Hardware:** External hardware is 316 stainless steel for ultimate corrosion resistance.

**Grounding:** Junction boxes include hardware to ground the fixture.

**Light Source:** Sealed in optically clear silicone, Bridgelux LED array rated for 50,000 hours. Draws approximately 12W (880 lumen unit) or approximately 16W (1320 lumen unit).

**Globes:** Standard with clear frosted heat-treated glass globe. Available with prismatic glass and prismatic polycarbonate globes. Colored heat-treated glass globe options available in red, blue, green, amber, and opal. Colored polycarbonate globe options available in red, blue, green, and amber.

**Guard:** Marine-grade aluminum or cast brass guard option available.

**Mounting:** Ceiling and wall mount (bulkhead) units have two heavy-duty, thick mounting tabs. Fixtures can be mounted in any orientation.

**Driver:** Fully potted driver system for vibration and tamper-resistance. 100-277V AC, 47-63Hz, over-voltage, over-current, short circuit protection with auto recovery, and Class 2 rated driver standard on all units. See ordering information for additional options.

**Outlets:** Junction box provided with one half-inch NPT outlet for power connection.

**Ambient Storage Temperature Range:** -40°C to 40°C

**Ambient Operating Temperature Range:** -30°C to 40°C

## COMPLIANCES

**UL Listed 1598A - Marine Outside Type (Saltwater)**

**UL Listed 844 - Class I, Division 2  
Class I, Zone 2**

**T3C, 160°C Maximum Surface Temperature**

**-Class II, Division 2/ Groups F & G**

**T4A, 120°C Maximum Surface Temperature**

**cUL**

**ABS**

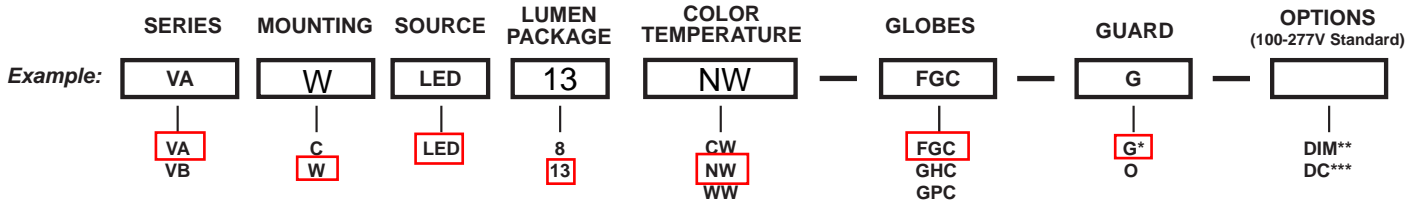
**IP66**



This Product meets the requirements for the Buy American Act, or BAA (US Code, Title 41, Section 10a-10d) and may also meet other country of origin requirements.

For additional information, please visit our website, [www.phoenixproducts.com](http://www.phoenixproducts.com).

# ORDERING INFORMATION



### SERIES

VA = Aluminum  
VB = Brass

### MOUNTING

C = Ceiling Mount  
W = Wall Mount

### LUMEN PACKAGE

8 = 880 Lumen Output  
13 = 1320 Lumen Output

### COLOR TEMPERATURE

CW = Cool White, 5600K  
NW = Neutral White, 4100K  
WW = Warm White, 3000K

### GLOBES

FGC = Frosted Heat-treated Glass  
GHC = Clear Heat-treated Glass  
GPC = Clear Prismatic Glass  
GHR = Frosted Red Heat-treated Glass  
GHB = Frosted Blue Heat-treated Glass  
GHG = Frosted Green Heat-treated Glass  
GHA = Frosted Amber Heat-treated Glass  
GHO = Opal Heat-treated Glass  
PPR = Red Polycarbonate Prismatic  
PPB = Blue Polycarbonate Prismatic  
PPG = Green Polycarbonate Prismatic  
PPA = Amber Polycarbonate Prismatic  
PPC = Clear Polycarbonate Prismatic

### GUARD

G = Guard\*  
O = No Guard

### OPTIONS

DIM = Dimmable Driver\*\*  
DC = 10-30V DC Driver\*\*\*

### LED ARRAY FLUX CHARACTERISTICS

Color Temperature	LED Array	Typical Color Temp	Typical Luminous Flux, 60° C (Case)	Typical Luminous Flux, 25° C (Junction)
Cool White	800 Series	5600K	800	880
	1300 Series		1200	1320
Neutral White	800 Series	4100K	920	1020
	1300 Series		1380	1530
Warm White	800 Series	3000K	850	930
	1300 Series		1230	1370

Source: Bridgelux Product Data Sheet

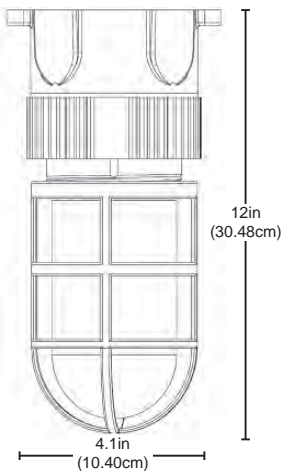
\* Not available with polycarbonate globes.

\*\* Not available for 1320 lumen units in Neutral or Warm White.

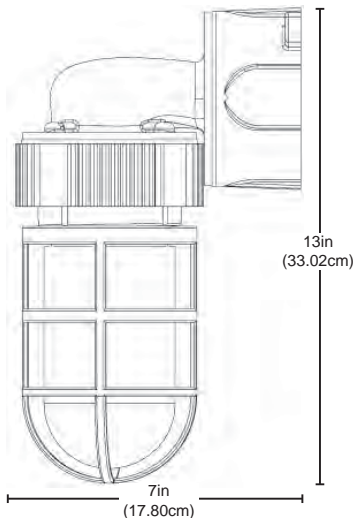
\*\*\* Not UL listed.

# DIMENSIONS

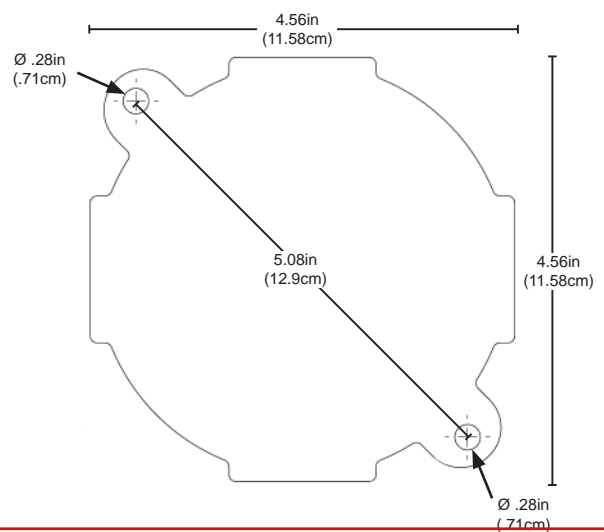
### Ceiling Mount



### Wall Mount



### Mounting Dimensions



### Estimated Fixture Weight:

VAC: 5 lbs

VAW: 6 lbs

VBC: 10 lbs

VBW: 13 lbs

NOTE: Add approximately 1 lb to each for shipping weight

Phoenix Products has taken reasonable steps to ensure that the information contained herein is accurate. While we believe the information is accurate, no warranty is made or implied. Product design and specifications are subject to change without notice. The most current version of this specification sheet can be found on our website, [www.phoenixproducts.com](http://www.phoenixproducts.com).





Subject to the exclusions set forth below, Acuity Brands Lighting, Inc. d/b/a Lithonia Lighting (“Acuity”) warrants its emergency fixtures and/or emergency batteries (“Product(s)”) to be free from defect in material and workmanship for the respective time periods set forth in the applicable table below, from the date of shipment from Acuity’s facilities (the “General Warranty”). An emergency battery (“Battery”), whether sold separately, as part of an emergency fixture (“Emergency Fixture”) or as part of another Acuity product, will be considered defective only if it fails to perform for a full 90 minutes during required annual testing. The Emergency Warranty applies only when (1) Emergency Fixtures or other Acuity products containing Batteries have been continuously connected to an AC input power source, or (2) Batteries sold separately have been placed in fixtures continuously connected to an AC input power source, in each case within 90 days of the date of purchase. Incandescent lamps and fuses are not warranted. For Products that incorporate the FIDO™ wireless retrieval system (the “FIDO System”), only the radio and router components (“Gateway”) of the FIDO System are covered by this General Warranty. The General Warranty, as it applies specifically to Gateways, is limited to a period of five (5) years from the date of shipment.

**EMERGENCY FIXTURE TABLE**

Emergency Fixture	Warranty Term
Exit Signs not specifically shown below	5 years
Hazardous Location Exit Signs	3 years
Self-Luminous Exit Signs	Vandal-Resistant frame: 3 years Tritium components: 10 or 20 years, depending upon option selected
Emergency Lighting Unit not specifically shown below	3 years
Quantum LED Emergency Unit	5 years
Remote Head, Accessories	1 year
Quantum LED Remote Head	5 years
Emergency Combination Exit/Unit not specifically shown below	3 years
Quantum LED Combination Exit/Unit	5 years
AC System/Multiple Circuits	1 year 2 years, if factory start up
AC System/ Single Circuit	3 years

If an Emergency Fixture is determined to be defective during the applicable warranty period described in the table above, the sole and exclusive remedy shall be repair or replacement, as described in the remedy paragraph below.

**BATTERY TABLE**

Battery Type	Warranty Term
Lead Acid	3 years pro-rated
Nickel-Cadmium	5 years pro-rated
AC System Multi Circuit Battery	10 or 20 years pro-rated

Notwithstanding any other potential remedy described herein, if a Battery is determined to be defective during the applicable warranty period, set forth in the table above, the sole and exclusive remedy shall be a discount toward the purchase of a replacement emergency battery as set forth in the applicable chart below. Consult an authorized Acuity post-sales or customer service representative for pro-rated Battery discount schedule for AC System Multi Circuit Batteries.



<b>Lead Acid Pro-Rated Battery Warranty Replacement Discount Schedule</b>	
<b>Time After Shipment</b>	<b>Replacement Cost Discount</b>
Less than 1 year	N/A (repair or replacement only)
Greater than 1 year but less than 2 years	67% off replacement cost at time of replacement
Greater than 2 years but less than 3 years	33% off replacement cost at time of replacement
3 years and longer	No discount

<b>Nickel-Cadmium Pro-Rated Battery Warranty Replacement Discount Schedule</b>	
<b>Time After Shipment</b>	<b>Replacement Cost Discount</b>
Less than 3 years	N/A (repair or replacement only)
Greater than 3 years but less than 4 years	40% off replacement cost at time of replacement
Greater than 4 years but less than 5 years	20% off replacement cost at time of replacement
5 years and longer	No Discount

Proof of Operation/Testing: Adequate records as referenced below include, but are not limited to, National Fire Protection Association (NFPA) 101–required periodic testing documentation.

Ballasts, lamps, poles, and software associated with the FIDO System are excluded from the General Warranty. Holophane® and Accupro® brand ballasts, Acculamp® brand lamps, and poles are warranted separately; and the terms of such warranties are located at [www.acuitybrands.com/CustomerResources/Terms\\_and\\_conditions.aspx](http://www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx). Access to the software associated with the FIDO System is subject to the terms of an End-User License Agreement (“EULA”) and warranty terms applicable to such software are set forth in the EULA. Manufacturers of ballasts, lamps, and poles incorporated into the Product(s) are solely responsible for any costs or expenses related to any claims, repairs, or replacements associated with any such component(s). Assistance with warranty claims for any such component(s), and/or copies of each applicable manufacturer’s warranty, may be obtained from an authorized Acuity post-sales or customer service representative

This Statement of Limited Warranty (“Warranty”) applies only when the Product(s) are installed in applications in which ambient temperatures are within the range of specified operating temperatures. Acuity will not be responsible under this Warranty for any failure of the Product(s) that results from external causes such as: acts of nature; physical damage; exposure to adverse or hazardous chemical or other substances; use of reactive cleaning agents and/or harsh chemicals to clean the Product(s); environmental conditions; vandalism; fire; power failure, improper power supply, power surges or dips, and/or excessive switching; induced vibration; animal or insect activity; fault or negligence of purchaser, any end user of the Product(s) and/or any third party not engaged by Acuity; improper or unauthorized use, installation, handling, storage, alteration, maintenance or service, including failure to abide by any product classifications or certifications, or failure to comply with any applicable standards, codes, recommendations, product specification sheets, or instructions of Acuity; use of the Product(s) with products, processes or materials supplied by any end user or third party; or any other occurrences beyond Acuity’s reasonable control. Acuity also will not be responsible under this Warranty for any substantial deterioration in the Product finish that is caused by failure to clean, inspect or maintain the finish of the Product(s). If the Product(s) are used on existing foundations, anchorages or structures, the end user is solely responsible for the structural integrity of such existing foundations, anchorages or structures and all consequences arising from their use. Adequate records of operating history, maintenance, and/or testing must be kept by the end user and provided to Acuity upon request to substantiate that the Product(s) have failed to comply with the terms of this Warranty. Neither polycarbonate nor acrylic material used in the Products is warranted against yellowing, as yellowing may naturally occur over time due to normal aging. The Product(s) are not warranted against costs that may be incurred in connection with changes or modifications to the Product(s) required to accommodate site conditions and/or faulty building construction or design. This Warranty only applies to the Product(s) when sold for commercial purposes and does not apply to any consumer product(s), all of which are governed by separate limited warranty terms.

**STATEMENT OF LIMITED WARRANTY  
FOR ACUITY BRANDS LIGHTING, INC.  
d/b/a LITHONIA LIGHTING  
EMERGENCY PRODUCTS  
FOR SHIPMENTS WITHIN THE UNITED STATES AND CANADA  
10/01/12**



If the Product(s) fail to comply with the terms of this Warranty, Acuity, at its option, will repair or replace the Emergency Fixture(s) with the same or a functionally equivalent Emergency Fixture(s) or component part(s) or provide the applicable Battery discount specified above. This Warranty excludes labor and equipment required to remove and/or reinstall original or replacement parts. This Warranty extends only to the Product(s) as delivered to, and is for the sole and exclusive benefit of, the original end user of the Product(s) at the original location. This Warranty may not be transferred or assigned by the original end user. The specified repair or replacement or discount are the sole and exclusive remedies for failure of the Product(s) to comply with the terms of this Warranty and does not extend the Warranty period. Warranty claims regarding the Product(s) must be submitted in writing within (30) days of discovery of the defect or failure to an authorized Acuity post-sales or customer service representative. Product(s) or component part(s) may be required to be returned for inspection and verification of non-conformance by Acuity, but no Product(s) or component part(s) will be accepted for inspection, verification or return unless accompanied by a "return authorization number" which can be obtained only from an authorized Acuity post-sales or customer service representative. Acuity is not responsible for any costs and expenses incurred in connection with shipment of Product(s) to Acuity, but Acuity shall bear all cost and expense incurred in connection with shipment of replacement Product(s) to the customer.

THE FOREGOING WARRANTY TERMS ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, AND ACUITY EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, RELATING DIRECTLY OR INDIRECTLY TO THE PRODUCT(S), WHETHER ORAL, WRITTEN, OR ARISING BY COURSE OF DEALING OR USAGE OF TRADE, INCLUDING WITHOUT LIMITATION, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. NO AGENT, DISTRIBUTOR OR OTHER SUPPLIER OF ACUITY PRODUCTS HAS THE AUTHORITY TO MODIFY OR AMEND THIS WARRANTY WITHOUT EXPRESS WRITTEN AUTHORIZATION FROM ACUITY.

The total liability of Acuity on any and all claims of any kind, whether in contract, warranty, tort (including negligence), strict liability or otherwise, arising out of or in connection with, or resulting from, Acuity's performance or breach of this Warranty, or from Acuity's sale, delivery, resale, repair, or replacement of any Product(s) or the furnishing of any services, shall in no event exceed the purchase price allocable to the Product(s) that give rise to the claim, and any and all such liability shall terminate upon the expiration of the warranty period specified above.

IN NO EVENT SHALL ACUITY BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL, EXEMPLARY OR PUNITIVE DAMAGES, EVEN IF INFORMED OF THE POSSIBILITY OF SUCH DAMAGES, WHETHER AS THE RESULT OF BREACH OF CONTRACT, WARRANTY, TORT (INCLUDING NEGLIGENCE), STRICT LIABILITY, OR ANY OTHER THEORY, INCLUDING WITHOUT LIMITATION LABOR OR EQUIPMENT REQUIRED TO REMOVE AND/OR REINSTALL ORIGINAL OR REPLACEMENT PARTS, LOSS OF TIME, PROFITS OR REVENUES, LACK OR LOSS OF PRODUCTIVITY, INTEREST CHARGES OR COST OF CAPITAL, COST OF SUBSTITUTE EQUIPMENT, SYSTEMS, SERVICES OR DOWNTIME COSTS, DAMAGE TO OR LOSS OF USE OF PROPERTY OR EQUIPMENT OR ANY INCONVENIENCE ARISING OUT OF ANY BREACH OF THE FOREGOING WARRANTY OR OBLIGATIONS UNDER SUCH WARRANTY.

Acuity reserves the right to modify or discontinue this Warranty without notice provided that any such modification or discontinuance will only be effective with respect to any Product(s) purchased after such modification or discontinuance.

## FEATURES & SPECIFICATIONS

**INTENDED USE** — Ideal for applications requiring attractive, quick-installation exit signs and low energy consumption.

**CONSTRUCTION** — Engineering-grade thermoplastic housing is impact-resistant, scratch-resistant, and corrosion-proof. UL94V-0 flame rating. UV-stable resin resists discoloration from natural and man-made light sources.

Rugged unibody housing snaps together with no additional mechanical fasteners. Faceplate and back cover are interchangeable on housing. Positive snap-fit tabs hold faceplate securely, yet easily removable for lamp compartment access.

Universal directional Chevron inserts are easily removed and reinserted. Uniform illumination without shadows or hot spots. Reinforced, impact-resistant color panels. Letters 6" high with 3/4" stroke, with 100 ft. viewing distance rating, based upon UL924 standards.

**U.S. Patent No. 5,526,251; 5,611,163; 5,739,639; 5,954,423; 5,988,825; 6,152,581; D383,501; D495,751 and 6,502,044. Other patents pending.**

**OPTICS** — LEDs mounted on printed circuit boards. Low energy consumption – less than one watt. LED lamp operates in normal (AC input) and emergency (DC input) modes.

The typical life of the exit LED lamp is 10 years.

**ELECTRICAL** — Low-voltage disconnect prevents excessively deep discharge that can permanently damage battery. Conveniently located test switch and LED provide visual and manual means of monitoring system.

Constant-current series charger minimizes energy consumption and provides low operating costs. Printed circuit boards are 100% quality tested during manufacturing. Current-limiting charger circuitry protects printed circuit boards from shorts.

AC/LV reset (line latch) allows battery connection before AC power is applied and aids in preventing battery damage from deep discharge.

Crystal oscillator timing system with watchdog protection for precision accuracy.

Brownout protection is automatically switched to emergency mode when supply voltage drops below 80% of nominal.

Battery: Sealed, maintenance-free nickel-cadmium battery delivers 90-minutes capacity to emergency lamps. Two-state constant-current charge maximizes battery life and automatically recharges after battery discharge.

Diagnostics: Single-point microcomputer control for all electronic features.

Single multi-chromatic LED indicator to display two-state charging, test activation and three-state diagnostic status.

Test switch provides manual activation of 30-second diagnostic testing for on-demand visual inspection. Self-diagnostic testing for five minutes every 30 days and 30 minutes every six months and 90 mins annually with WRS.

Diagnostic evaluation of LED light source, AC to DC transfer, charging and battery condition. Continuously monitors AC functionality.

**INSTALLATION** — Universal (top-, end-, or back-) mounting. Easily removed mounting knockouts. J-box pattern on back panel. Housing snaps to canopy with four positive-locking tabs. Cam-locking pin tightly secures housing to canopy.

Ships standard with additional face plate.

**LISTINGS** — UL damp location listed 50°-104°F (10°-40°C) standard. NOM Certified (see options). Meets UL924, NFPA 101 (current Life Safety Code), NEC and OSHA illumination standards. NEMA Premium certified.

Meets all applicable FCC requirements.

Catalog Number	LQM S W 3 G 120/277 EL N M6
Notes	HAINES BOROUGH VOC ED BLDG
Type	EXIT



Thermoplastic Exits

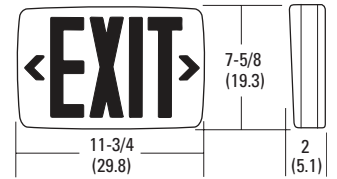
LQM

LED LAMPS



*Specifications*

Length:	11-3/4 (29.8)
Depth:	2 (5.1)
Height:	7-5/8 (19.3)
Weight:	2.6 lbs (1.2 kgs)



All dimensions are inches (centimeters) unless otherwise specified.

**WARRANTY** — 5-year limited warranty. Complete warranty terms located at [www.acuitybrands.com/CustomResources/Terms\\_and\\_conditions.aspx](http://www.acuitybrands.com/CustomResources/Terms_and_conditions.aspx)  
Actual performance may differ as a result of end-user environment and application.  
Note: Specifications subject to change without notice.

### ORDERING INFORMATION

For shortest lead times, configure product using **bolded options**.

**Example:** LQM S W 3 R 120/277 EL N

LQM	S	W	3	G	120/277	EL N	
Family	Face type	Housing color	Number of faces	Letter color	Input voltage <sup>2</sup>	Operation	Options
<b>LQM</b>	<b>S</b> Stencil P Panel <sup>1</sup>	<b>(blank)</b> Black W White	<b>3</b> Single face with extra faceplate and color panel	<b>R</b> Red <b>G</b> Green	<b>120/277</b> Dual voltage	<b>(blank)</b> AC only <b>X2</b> Primary and secondary AC inputs provided <sup>3</sup> <b>EL N</b> Nickel cadmium battery	<b>(blank)</b> None NOM NOM certified for Mexico <sup>4</sup> SD Self-diagnostics <sup>5</sup> SDFIFA Self-diagnostics, fire alarm flashing interface and flashing emergency operation and intermittent audible alarm (one flash/one second) <sup>5</sup> <b>WRS</b> Dual voltage 120/277, Ni-Cad battery back up and self-diagnostic with FIDO wireless reporting system capability <sup>6</sup>

#### Notes

- 1 Only available in custom signage. See spec sheet, [Custom-Signage](#).
- 2 Some special voltages available. Consult factory.
- 3 Must specify input voltage 120 or 277. Not available with other options.
- 4 Available with stencil or panel faces in white housing. Not available with WRS option.
- 5 Only available with EL N operation.
- 6 See [LHQM LED](#) spec sheet (LHQM LED R0 WRS).
- 7 See spec sheet [ELA-WG](#).
- 8 See spec sheet [ELA-Stemkits](#).

Accessories: Order as separate item.			
ELA WG1	Back-mount wireguard <sup>7</sup>	ELA WGEXE	End-mount wireguard <sup>7</sup>
ELA WGEXT	Top-mount wireguard <sup>7</sup>	ELA LQMUS12	12" stem kit <sup>8</sup>

**SPECIFICATIONS**

ELECTRICAL				
Primary Circuit				
Type <sup>1</sup>	Typical LED life <sup>2</sup>	Supply voltage	Input watts	Max. amps
Red LED AC Only	10 years	120	.62	.05
		277	.69	.06
Green LED AC Only	10 years	120	.62	.05
		277	.74	.06
Red LED Emergency	10 years	120	.71	.05
		277	.92	.06
Green LED Emergency	10 years	120	.66	.05
		277	.70	.06

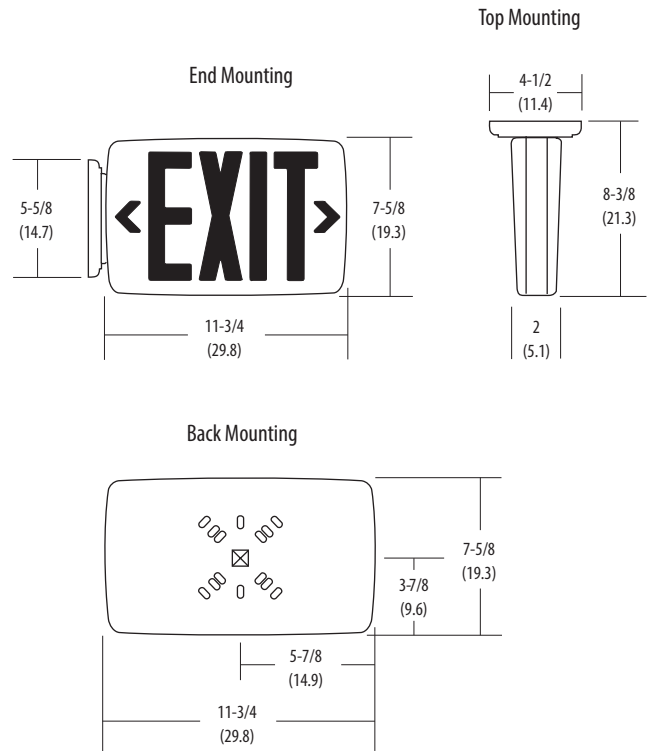
BATTERY				
Nickel Cadmium				
Voltage	Shelf life <sup>3</sup>	Typical life <sup>3</sup>	Maintenance <sup>4</sup>	Optimum temperature <sup>5</sup>
1.2	3 years	7-9 years	none	50°F - 104°F (10°C - 40°C)

**Notes**

- LED lamps operate in normal (AC input) and emergency (DC input) modes.
- Based on continuous operation. The typical life of the exit LED lamp is 10 years.
- At 77°F (25°C).
- All life safety equipment, including emergency lighting for path of egress must be maintained, serviced and tested in accordance with all National Fire Protection Association (NFPA) and local codes. Failure to perform the required maintenance, service, or testing could jeopardize the safety of occupants and will void all warranties.
- Optimum ambient temperature range where unit will provide capacity for 90 minutes. Higher and lower temperatures affect life and capacity. Consult factory for detailed information.

**MOUNTING**

All dimensions are inches (centimeters) unless otherwise specified.  
Shipping weight: 2.6 lbs. (1.2 kgs.)



# LED Lighting Facts

## Recommended Product Performance Scale (Commercial)



### Indoor Fixtures\*

Indoor Fixtures*		Light Output (lumens)	Lumens per Watt (Efficacy)	Typical CRI	Typical CCT Range
Fluorescent Under-cabinet Task Lighting (typical)		≥ 125 per ft	29	80	2700K--6500K
Portable Desk Task Lights with CFLs (typical)		≥ 200	29		
Fluorescent Cove Lighting (typical with T5 lamps)		≥ 445 per ft	56		
Track Lights		≥ 200 per head	35		
Downlights with CFLs (by diameter)	< 4.5"	≥ 345	35		
	> 4.5"	≥ 575			
Surface-mounted or recessed troffers:					
Two-foot-by-four-foot (lensed, with two T12 lamps)		4400	51		
Two-foot-by-four-foot (parabolic, with two T8 lamps)		3700	63		
Refrigerator display case lighting (center-mounted)		100 per ft	35		
Refrigerator display case lighting (end-mounted)		50 per ft			

### Outdoor Fixtures\*\*

Outdoor Fixtures**	Lamp Wattage	Estimated Luminaire Light Output (lumens)	Estimated Luminaire Efficacy (lumens per watt)	Typical CRI	Typical CCT Range
Outdoor Area/Roadway, Parking Garage, Canopy Lights, High-bay and Low-bay					
High Pressure Sodium (HPS)	150	8,000--13,000	46--75	20	2000K--3000K
	250	12,000--18,000	42--63		
	400	25,000--40,000	54--87		
Metal Halide (MH)	150	6,000--10,000	35--58	65	3000K--6000K
	250	11,000--18,000	38--63		
	400	20,000--32,000	43--70		
Outdoor wall-mounted					
High Pressure Sodium (HPS)	100	5,000--7,000	43--61	20	2000K--3000K
	150	8,000--13,000	46--75		
Metal Halide (MH)	100	5,000--7,000	35--61	65	3000K--6000K
	150	6,000--10,000	35--58		
Bollards					
High Pressure Sodium (HPS)	50	1,000--2,000	17--35	20	2000K--3000K
	100	2,000--4,000	17--35		
Metal Halide (MH)	70	1,000--3,000	12--37	65	3000K--6000K
	100	2,000--4,000	17--35		

\*Performance data for indoor fixtures is based on benchmark testing of conventional light sources by Pacific Northwest National Laboratory (PNNL) on behalf of the DOE Solid-State Lighting Program. Refrigerator display case lighting performance is shown only as a suggested reference.

\*\*Light output and efficacy values for outdoor fixtures (luminaires) are based on rated lamp light output and input power from manufacturer published photometric (.ies) files, in addition to estimated luminaire power losses of 15% and luminaire light losses of 20%-50% (50%-80% for bollards).

The outdoor fixture performance table above is only intended to be used as a rough guide. A thorough review of outdoor LED luminaires should include, at a minimum, additional metrics such as light uniformity and light distribution. See more detailed DOE guidance on outdoor lighting here: <http://www.eere.energy.gov/buildings/ssl/resources.html>.



## Using LEDs to their Best Advantage

Light-emitting diodes (LEDs) are often touted for their energy efficiency and long life. Although these are important considerations, selecting a light source should involve many other factors. This fact sheet explores some of the unique attributes of LEDs, which may make them the best choice for a given application.

### Introduction

Financial considerations—namely, purchase price and operating costs—always figure in the selection of lighting products, but many other aspects also come into play, varying in importance depending on the application. LEDs have several unique attributes, and it is critical to understand how they can be used advantageously. Some considerations are dependent on product design, but others amount to using LEDs in appropriate situations. Some of the potentially favorable characteristics of LED sources compared to traditional lamps include:

- Directional light emission
- Size and form factor
- Resistance to mechanical failure (i.e., breaking)
- Instant on at full output
- Rapid on-off cycling capability without detrimental effects
- Improved performance at cold temperatures
- Dimming and control capability
- Opportunity for color tuning
- Minimal nonvisible radiation [e.g., ultraviolet (UV), infrared (IR)]
- Extended lifetime

LEDs are semiconductor devices that emit light through electroluminescence.<sup>1</sup> This basic fact is the foundation for many of the

<sup>1</sup> LEDs rely on injection luminescence, a specific type of electroluminescence. In this case, light is generated directly when electrons recombine with holes, in the process emitting photons. For more on the physics of LED light generation, see the *IES Lighting Handbook* or other reference sources.

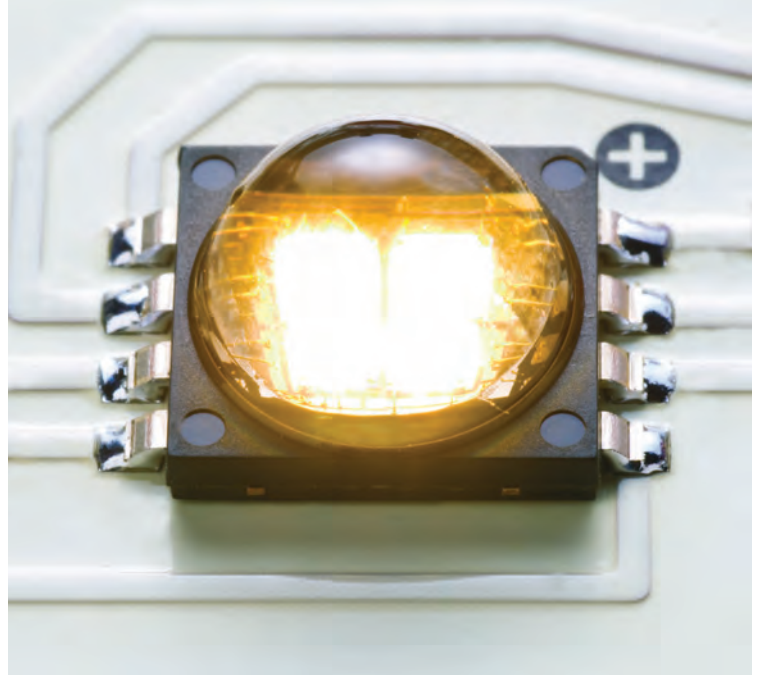


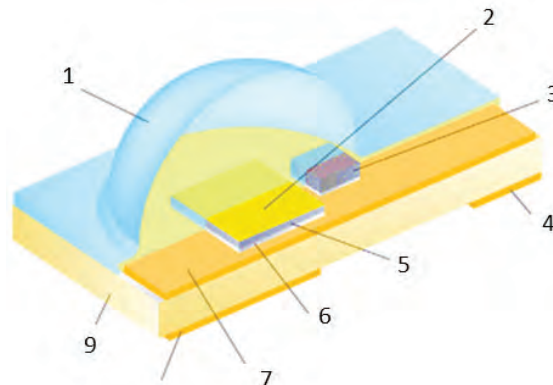
Image Credit: Cree

advantages of LEDs, since it is different from traditional light sources. For example, incandescent lamps rely on a heated filament to emit light, fluorescent lamps create light using a gas discharge to excite phosphors, and high-intensity discharge (HID) lamps utilize an electric arc discharge. All of these traditional technologies require a glass bulb to contain essential gases and/or coatings.

In contrast to the large form factors of traditional lamps, LED lighting starts with a tiny chip (also called a die; most commonly about 1 mm<sup>2</sup>) comprised of layers of semiconducting material—the exact material determines the wavelength (color) of radiation that is emitted. At the next level are LED packages, which may contain one or more chips mounted on heat-conducting material and usually enclosed in a lens or encapsulant. The resulting device, typically less than 1 cm<sup>2</sup>, can then be used individually or in an array. Finally, LEDs are mounted on a circuit board and incorporated into a lighting fixture, attached to an architectural structure, or made to fit the form factor of a traditional lamp (or as it is colloquially known, a light bulb).

### LED Package Design

Although not all LED packages are built the same way, the basic components are often similar. Besides the chip that is responsible for emitting light, the various components are needed for thermal regulation, producing the desired spectrum, regulating electrical characteristics, or creating the appropriate distribution of light. All these components must work in harmony to produce a high-performance product. Many of the advantages of LEDs are derived from their unique physical attributes.



1. Silicone Lens
2. Phosphor Plate
3. Transient Voltage Suppressor
4. Cathode
5. LED Chip
6. Bond Layer
7. Metal Interconnect Layer
8. Thermal Bed
9. Ceramic Substrate

## Directional Light Emission

Traditional light sources emit radiant energy in all directions. As such, an optical system—a lamp housing or a luminaire, with elements such as a reflector or lens—is typically necessary to direct output in the desired direction. Because no optical system is perfectly efficient, losses in efficacy result. Further, if the optical system is not well designed (or is not present), light can be wasted, going in undesired directions.

Due to their physical characteristics and because they are mounted on a flat surface, LEDs emit light hemispherically, rather than spherically. For task lighting and other applications requiring directional lighting, this may increase the application efficacy<sup>2</sup> of the source. In contrast, with LEDs it is more difficult to obtain an omnidirectional distribution when it is desired, although innovative system designs now provide this capability.

## Size and Form Factor

The small size, scalability of arrays, and directional light emission of LEDs offer the potential for innovative, low profile, or compact lighting products. This advantage can be aesthetic, but may also be functional. For example, reducing the depth of a luminaire may allow more room for ducts, conduit, or other building systems in a ceiling cavity. It is even possible that the size of the ceiling plenum could be reduced. In contrast, the unique form factor of LEDs can be a disadvantage when competing with high-wattage HID sources. To match the lumen output, a very large array of LEDs is necessary.

<sup>2</sup> Application efficacy is defined as the lumens delivered to the target plane divided by the input watts to the lamp (or the ballast or driver, if applicable).

### Source Type:

LED

### Dimensions:

6.1" deep  
17.5" square

### Input Watts:

133

### Lumen Output:

10,575



### Source Type:

Metal Halide

### Dimensions:

11.5" deep  
15" round

### Input Watts:

175

### Lumen Output:

10,400



The physical characteristics of LEDs allow for the design of luminaires that are different shapes and sizes compared to those made for conventional lamps. In this example, the depth of the LED parking garage luminaire is significantly less than a more traditional luminaire with a metal halide lamp.

Achieving small form factors requires careful design, specifically with regard to thermal management. Although LEDs used for general lighting do not emit infrared radiation (i.e., heat), they do generate thermal energy that must be moved away from the chip by a mass of material, which is called a heat sink. In order to produce more light output, LEDs are often grouped into arrays, which dictate the use of additional heat-sinking material. Thus, although LED packages are small, matching the performance of small traditional lamps, such as MR16s, can be challenging.

## Breakage Resistance

LEDs are largely impervious to vibration because they do not have filaments or glass enclosures. The life of standard incandescent and discharge lamps may be reduced by vibration when operated in vehicular or industrial applications, although specialized vibration-resistant lamps can help alleviate this problem. The inherent vibration resistance of LEDs may be beneficial in applications such as transportation lighting (planes, trains, or automobiles), lighting on and near industrial equipment, or exterior area and roadway lighting.

In addition to benefits during operation, LEDs offer increased resistance to breaking during transport, storage, handling, and installation. LED devices mounted on a circuit board are connected with soldered leads that may be vulnerable to direct impact, but no more so than cell phones and other electronic devices. Because they do not contain any glass, LED fixtures may be especially appropriate in applications with a high likelihood of lamp breakage, such as sports facilities or vandalism-prone areas, although they are not indestructible. LED durability may also be beneficial in applications where broken lamps present a hazard to occupants, such as children's rooms, assisted living facilities, or food preparation areas.

## Instant On

Most fluorescent lamps do not provide full brightness immediately after being turned on. This is particularly relevant to amalgam compact fluorescent lamps (CFLs), which can take three minutes or more to reach full light output. HID lamps have even longer warm up times, ranging from several minutes for metal halide to ten minutes or more for high-pressure sodium (HPS). HID lamps also have a restrike time delay; if turned off, they must be allowed to cool before turning on again, usually for 2 to 20 minutes, depending on the ballast. In contrast to traditional technologies, LEDs turn on at full brightness almost instantly, with no restrike delay. This advantage can be simply aesthetic or a user preference, but can also be beneficial for emergency egress or high-security situations. It is also especially important for vehicle brake lights—LED versions illuminate 170 to 200 milliseconds faster than standard incandescent lamps, providing an estimated 19 feet of additional stopping distance at highway speeds (65 mph).<sup>3</sup>

## Rapid Cycling

LEDs are impervious to the deleterious effects of on-off cycling. In fact, one method for dimming LEDs is to switch them on and

<sup>3</sup> See *Energy Savings Estimates of Light Emitting Diodes in Niche Lighting Applications* at [http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/niche\\_final\\_report.pdf](http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/niche_final_report.pdf).



off at a frequency that is undetectable by the human eye. For fluorescent lamps, the high starting voltage erodes the emitter material coating the electrodes. Thus, lifetime is reduced when the rate of on-off cycles is increased. Due to the long warm up and restrike times, rapid cycling is not an option for HID lamps. Because of their operating characteristics, LEDs have an advantage when used in conjunction with occupancy sensors or day-light sensors that rely on on-off operation. Whereas the lifetime of fluorescent sources would diminish, there is no negative effect on LED lifetime.

### Cold Temperature Operation

Cold temperatures present a challenge for fluorescent lamps.<sup>4</sup> In contrast, LED light output (and efficacy) increases as operating temperatures drop. This makes LEDs a natural fit for refrigerated and freezer cases, cold storage facilities, and many outdoor applications. In fact, CALiPER testing of an LED refrigerated case light measured 5% higher efficacy at -5 °C compared to operation at 25 °C.<sup>5</sup> Conversely, operation of LEDs in hot environments or use of products with poor thermal management characteristics can lead to undesirable performance attributes ranging from reduced lumen output to premature failure.

### Dimming Performance

Dimming is often a desirable operating characteristic, but most energy-efficient technologies have challenges that must be overcome or mitigated. Many (but not all) LED products can be dimmed, although great care must be taken to ensure compatibility between the different hardware devices (e.g., the driver and dimmer). Incompatible lamp and dimmer combinations may result in flicker, color shift, audible noise, premature lamp failure, very limited or no range of dimming, or failure to light. These problems may manifest themselves at full output and/or when dimmed. Furthermore, they are typically dependent on the number of lamps connected to the dimmer. The best performing LEDs, when matched with a compatible dimmer, have better dimming performance than CFLs (limited range) or HID lighting (limited, if any, dimmability). However, there is a substantial performance differential among LED products and for various LED-dimmer combinations.

### Tunability

One of the most significant advantages of LEDs is the ability to mix chips of multiple types in a single product. For example, red, green, and blue (RGB) chips can be combined to make white light (and any color within their gamut), or two shades of white LEDs can be combined and adjusted independently to create light with varying color temperatures (i.e., warmer or cooler in appearance). Combining multiple fluorescent lamps also provides this capability, but in practice, it is seldom utilized. Although the idea of

<sup>4</sup> At low temperatures, a higher voltage is required to start fluorescent lamps and luminous flux is decreased. A non-amalgam CFL, for example, will drop to 50% of full light output at 0°C. The use of amalgam (an alloy of mercury and other metals that is used to stabilize and control mercury pressure in the lamp) largely addresses this problem, allowing CFLs to maintain light output over a wide temperature range (-17 °C to 65 °C). The trade-off is that amalgam lamps take a noticeably longer time to reach full brightness.

<sup>5</sup> The summary report for CALiPER Round 2 can be found at [http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/cptp\\_round\\_2\\_summary\\_final\\_draft\\_8-15-2007.pdf](http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/cptp_round_2_summary_final_draft_8-15-2007.pdf).



Image Credit: GE Lighting Solutions

tunable light sources is not prevalent today, it is a tool that can be used to increase occupant satisfaction in a variety of settings, such as offices, hotels, restaurants, and homes. Thus, as LEDs become more widely used, the concept may see increased recognition and application.

In addition to color customization, the output of LEDs can also be altered over the course of their lifetime. In this manner, it is possible to prevent color shift and/or greatly reduce lumen depreciation. Eliminating lumen depreciation is particularly advantageous because it would allow for the removal of lamp lumen depreciation from design calculations, reducing initial over-lighting. This technology is not currently in widespread use, but as the equipment becomes less expensive, the potential advantage may be realized.

### No Infrared or Ultraviolet Emissions

Ultraviolet and infrared radiation bookend the spectrum of visible light, but do not contribute to humans' ability to see. Ultraviolet radiation can damage artwork, artifacts, and fabrics, as well as causing skin and eye burns. Similarly, excessive infrared radiation from lighting presents a burn hazard to people and materials. With traditional sources, ultraviolet and infrared emissions are either necessary to generate visible light (e.g., fluorescent lamps) or simply an unavoidable component. The consequences of these undesirable emissions include reduced efficacy and/or the necessity of providing additional safeguards. For example, the infrared radiation generated by incandescent lamps accounts for more than 90% of the power they draw. Metal halide lamps require an ultraviolet-blocking outer bulb (or to be operated in an enclosed

**APPLICATION:  
MUSEUM LIGHTING**

Museums often display artwork that is highly sensitive to both ultraviolet and visible radiation. The ability to carefully tune the spectrum of LED products (and essentially eliminate ultraviolet radiation) give them a unique advantage in this application.

LEDs are used to illuminate the Rose Gallery at the Smithsonian American Art Museum. Lighting and photography by Scott Rosenfeld.



fixture) due to the significant level of ultraviolet radiation emitted from the inner arc tube.

Based on how they generate radiant energy, LEDs chosen for general lighting applications do not emit much (if any) ultraviolet or infrared radiation. This helps boost efficacy and reduces the potential for undesirable consequences.

**Extended Lifetime**

The rated lifetime of LED products is at least comparable to other high-efficacy lighting products, if not better, and for many specific product types, LEDs have the highest rated lifetime. This attribute can be especially important where access is difficult or where maintenance costs are high. In fact, several U.S. Department of Energy GATEWAY demonstrations have revealed that maintenance savings, as opposed to energy savings, are the primary factor in determining the payback period for an LED product.

**Conclusion**

The LED product market continues to grow rapidly. In many applications, today’s high-quality LEDs can outperform traditional technologies when evaluated with conventional metrics including efficacy, color quality, and operating cost. However, LED products have significant variation in performance from one product to the next. Thus, generalized comparisons are often misrepresentative. When purchasing or specifying LED products, it

is essential to evaluate appropriate data and, if necessary, conduct a physical evaluation of a mock-up.

The attributes discussed in this fact sheet are predominantly a result of the physical characteristics of LEDs, and may not show up in a catalog or on a specification sheet. It is critical to understand the specific needs of a given application in order to select the most appropriate technology. Considered holistically, the best option may not always be the most efficacious. No matter how much energy can be saved, a product that does not meet the performance requirements is not a good choice.

# Lower Maintenance with LED lights

*LED Lights Last Longer*



**The Reasons for the shift to LEDs.....2**

**Maintenance Cost Estimation .....4**

**Maintenance Savings with LED Lights .....5**

**Why Do LEDs Last For Decades? .....6**

**Sourcing of LEDs - Global versus Local? .....7**

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# Executive Summary

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*Maintenance cost savings are a significant part of the benefits accruing for the adoption of LED technology. Companies and municipalities are adopting LED lights as these will allow them to improve service levels and reduce costs. Lower maintenance costs come from the exceptionally long life of LED powered luminaries. Payback period for LED luminaries ranges from 1- 3 years depending on labor costs and the nature of applications. The most significant energy and maintenance savings are realized from lights used in stairwells, emergency lights, etc that remain switched on 24 X 7. For outdoor lights that need cherry pickers and U haul trucks to replace, the maintenance savings are substantial and breakeven is achieved quickly. For safety and security applications - like slippery floors in poultry processing companies, perimeter lighting etc. the failure of a light can have unacceptable consequences. In these areas, the long lifespan of LED technology makes it the best choice. In this white paper we shall walk through the maintenance cost savings that are possible with LED technology.*

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## The Reasons for the shift to LEDs



LED parking area lights (8040 Lumens) appear to be brighter than HPS light (19,000 Lumens) due to scotopic advantage, better Color Rendering Index and more uniform light spread.

(Public domain image from— The Office of Energy Efficiency and Renewable Energy  
[http://apps1.eere.energy.gov/buildings/publications/pdfs/alliances/outdoor\\_area\\_lighting.pdf](http://apps1.eere.energy.gov/buildings/publications/pdfs/alliances/outdoor_area_lighting.pdf))

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Companies and government offices are installing LED by the droves. There are several reasons behind this shift

- ✓ Energy efficiency - often talked about as a major reason, in reality, it is merely the tip of the mountain of cash an organization can save by adopting LED technology.
- ✓ Gains in productivity and Maintenance savings - are not talked about as often as energy savings but are equally or more important when it comes to determining financial value of your decision to invest in LED lighting.

The ROI and payback period calculations take on an entirely different appearance when all the gains are factored in.

### **The Basics of Good Lighting**

Color rendering, light uniformity, and color temperature are the first boxes that a light must tick before a company can consider it for its energy savings. LEDs exceed all criteria. Whether it is a hotel looking for mood lighting, a jewelry store looking for highlighters, or a garment store in need for a good wall washer – LEDs fit the bill. The color rendition is good enough for LEDs to be used in museums for illuminating paintings. As far as light color temperature is concerned, the range of color temperatures available from warm lighting for hotel lobbies to cool daylight for hospitals.

### **Energy Savings**

We shall look into the energy saving potential and productivity gains from LEDs in separate white papers. Here we shall limit ourselves to stating that LEDs are the most energy efficient technology around. They consume 10 times less energy than incandescent bulbs and 3 times less energy than fluorescent tubes for producing comparable results.

### **Maintenance Cost Components**

Maintenance savings stem from the following

- 1) Cost of time to report light outage
- 2) Cost of material for repairing non functional lights
- 3) Labor costs for the replacement of bulbs/ ballast/ striker etc.

## LED advantage

Light Emitting Diodes last 50,000 to 100,000 hours and they employ neither ballasts nor strikers. The result is dramatically lower maintenance needs. When considering the maintenance costs arising from a particular lighting option one must factor in the maintenance requirements arising from system characteristics. These include vibrations, general environmental conditions, ballast life, bulb life and incidence of striker failure. The life span of different lighting options and maintenance needs are summarized in the table below.

	<b>Estimated Life Span (Years)</b>	<b>Maintenance cycles</b>	<b>Ballast Maintenance</b>	<b>Striker failure</b>	<b>Total maintenance cycles</b>
<b>LED</b>	34	Nil	Nil	Nil	Nil
<b>HPS</b>	2	17	3	3	23
<b>Fluorescent tubes</b>	1	34	4	4	42
<b>CFL</b>	1	34	NIL	NIL	34
<b>Incandescent Bulbs</b>	6 months	68	NIL	NIL	68

## The incandescent bulb is history

The high maintenance costs and legislation against energy inefficient lighting has practically sealed the fate of the incandescent bulb as a practical lighting option. While some users still prefer it for its light quality the rapid strides in LED light quality will soon make this two century old technology irrelevant.

## Maintenance Cost Estimation

Maintaining outdoor lighting is usually more expensive primarily because each visit needs a team of workers equipped with tall ladders or cherry pickers and U haul trucks. In the case of streetlights the team must contend with traffic and choose an off peak time for repairs.

The city of Ann Arbor estimated the cost labor and equipment for each maintenance visit to be \$211. They estimated this cost for ten foot high lights. The cost for higher streetlights and car parking lights and highbays can be reasonably be expected to be similar. For typical office lights the cost would be close to \$ 50.

Once the bill of materials and the relevant labor charges are in place a simple spread sheet reveals the potential maintenance savings with LED technology.

## Maintenance Savings with LED Lights

The table below demonstrates the annual and life time maintenance savings potential of LED lights.

	LED Lights	Sodium light	Fluorescent Tubes		CFL	Incan. bulb
			Easy Access	High Bay		
Life span (Yeas)	34	2	1	1	1	0.5
Cost of each scheduled maintenance (\$)	0	211	50	150	50	50
Cost of bulb or ballast replacement (\$)		50	6	6	6	2
Frequency of bulb/ballast replacements per light per year	0	0.5	1	1	1	2
<i>Maintenance Dollars Spent Annually (\$/Year)</i>	\$0	\$131	\$56	\$156	\$56	\$104
<i>LED advantage -Annual Maintenance Savings (\$/Year)</i>		\$131	\$56	\$156	\$56	\$104
<b>Total Savings over 34 years</b>		<b>\$4,437</b>	<b>\$1,904</b>	<b>\$5,304</b>	<b>\$1,904</b>	<b>\$3,536</b>

The table above shows the potential savings of a single LED bulb as opposed to other lighting options. There are two things about the table above that must be kept in mind

- 1) The table looks at only the maintenance savings of Led lights and it does not include savings from energy efficiency, reduced air-conditioning bills or disposal costs for mercury containing lighting products.
- 2) Unlike Fluorescent tubes LEDs are scalable. Thus a single LED device can replace a 4-6 tube high bay fixture. In such cases the maintenance costs of a single high bay fixture will be 3-6 times that of a single fluorescent tube and the gains from using LED technology will be even more significant.

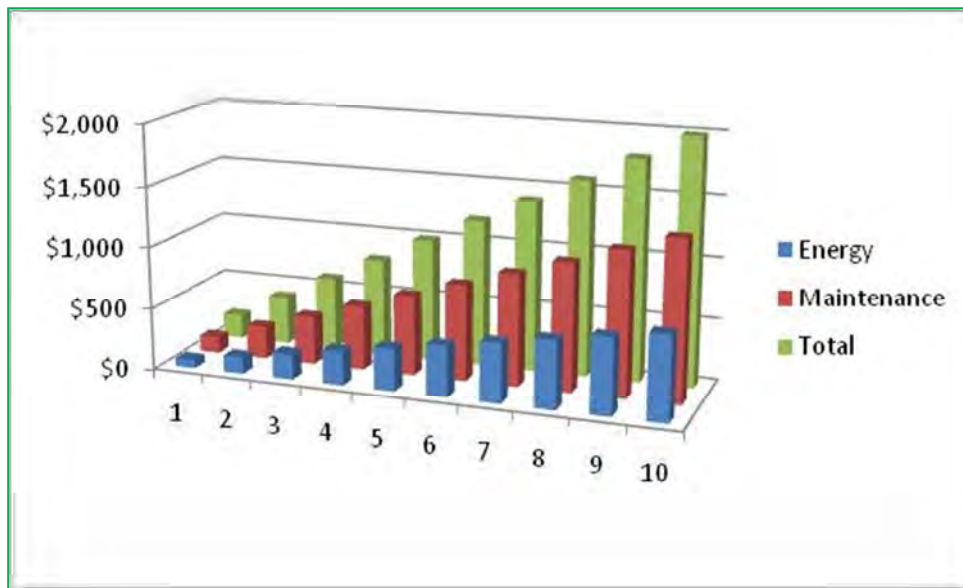
### **Energy Savings**

Sodium lamps are the most energy efficient and require the least maintenance among all the older technologies. This is why they were used widely for street lighting. Sodium lamps were not preferred for applications that required good light quality and thus offices used incandescent bulbs and fluorescent lights while workshops and factories used metal halide highbay lamps. Space restrictions will not permit us to analyze all the lighting options. We are restricting further

analyses to sodium lamps only. The results with other lighting options like fluorescent lights are better than those with sodium lamps.

	LED Luminaire	Sodium Luminaire
Energy consumed by Luminaire (Watts)	75	180
Energy rate (\$/kWh)	0.15	0.15
On-time of light per day (hours)	12	12
Energy Consumed Annually(kWh)	329	788
Annual Energy Savings(kWh/ year)	460	Nil
Annual Energy Costs (\$/year)	\$49	\$118
Annual Energy Savings (\$/year)	<b>\$69</b>	
Annual Maintenance Savings (\$/year)	<b>\$131</b>	
Total Annual Savings	<b>\$200</b>	

The 10 year cumulative savings projections of a single solid state light are shown below.



## Why Do LEDs Last For Decades?

LED lights have a light emitting diode, driver electronics, cooling system and optics. None of the components is fragile like bulb filaments nor are they sealed under high pressure as in the traditional high wattage bulbs. The LED is only as good as the life of its components. Of the different components of an LED, the following can fail



- a) The light emitting diode - The diode is a solid state device, without the burden of fragile coils or high temperature operations the diode has a very long life.
- b) The electronic driver – The driver is usually the limiting factor when it comes to life of LED bulbs and tubes. Low quality soldering of components, poor quality of components, excess heat generation and build up are the usual causes of failure of electronic components. Metal core printed circuit boards that conduct heat away, advanced driver design to minimize heat generation, driver placement to minimize exposure to heat, specialized metal fins to conduct heat away and the use of active cooling systems ensure the longevity of LEDs. Owing to space restrictions it is not possible to review these in this white paper.

## **Sourcing of LEDs - Global versus Local?**

After the economic meltdown the US government has put in place several measures to attract manufacturing jobs to United States. LED light industry is one of the green technology industries that are instrumental in creating jobs in US. Buying US made products ensures that you are eligible for government grants that can dramatically alter the financial return calculations of your project. Moreover products made in US are generally manufactured to more stringent standards than in several developing countries. The full advantage of reduced maintenance cost can be harnessed by using US made LED luminaries. As far as LEDs are concerned buying local makes for emotional, national, environmental and financial sense.



**Block 100, E. Davie Street, Raleigh, N.C., with LED Lighting**

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