

M-SERIES DRAW THRU DIRECT GAS-FIRED MAKE-UP AIR HEATERS TECHNICAL MANUAL

⚠WARNING:

Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operating, and maintenance instructions thoroughly before installing or servicing this equipment.

FOR YOUR SAFETY

The use and storage of gasoline or other flammable vapors and liquids in open containers in the vicinity of this appliance is hazardous.

FOR YOUR SAFETY

If you smell gas:

1. Open windows.
2. Don't touch electrical switches.
3. Extinguish any open flame.
4. Immediately call your gas supplier.

Made in the USA



LIMITED WARRANTY

Cambridge Air Solutions Limited Warranty is included within the Terms and Conditions that are sent with every Order Acknowledgement. For questions regarding Limited Warranty, contact Cambridge Air Solutions Customer Service Group at 1-800-473-4569.

M-SERIES TECHNICAL MANUAL

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HAZARD SUMMARY

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

⚠WARNING: Indicates a potentially hazardous situation which could result in death or serious injury.

⚠CAUTION: Indicates a potentially hazardous situation which may result in minor or moderate injury. It may also be used to alert against unsafe practices.

CAUTION: Indicates a situation that may result in accidents with equipment or property damage only.

The following safety precautions apply to the installation, operation, and maintenance of the equipment described by this technical manual.

⚠WARNING:

Any unauthorized modification of this equipment shall void the warranty.

⚠WARNING:

Only qualified personnel should attempt installation, service, and repair of this equipment. Use extreme caution and observe safety regulations at all times. Obey applicable plant and OSHA safety regulations.

⚠WARNING:

Recirculation of room air is not permitted.

Adequate building relief shall be provided so as to not over-pressurize the building when the make-up air heating system is operating at its rated capacity. It should be noted that this can be accomplished by taking into account, through standard engineering methods, the structure's designed infiltration rate, by providing properly sized relief openings, by interlocking a powered exhaust system, or by a combination of these methods.

If the failure or malfunction of this heater creates a hazard to other fuel burning equipment in the building

(e.g. when the heater is providing the make-up air to a boiler room), the heater is to be interlocked to open inlet air dampers or other such devices.

If the heater is installed such that an inlet duct is utilized, the duct system must be purged with at least four air changes prior to an ignition attempt.

IMPORTANT

Installation in Aircraft Hangars

Refer to the Standard for Aircraft Hangars, ANSI/NFPA 409, for specific information on the installation requirements for these heaters in airplane hangars.

IMPORTANT

Installation in Parking Garages

Refer to the Standard for Parking Structures, ANSI/NFPA 88A, or the Standard for Repair Garages, ANSI/NFPA 88B, for specific information on the installation requirements for these heaters in public garages.

If in doubt regarding installation or application, contact Cambridge Air Solutions Customer Service Group at 800-473-4569 during the hours of 8:00 a.m. to 5:00 p.m. Central Time, Monday through Friday.

TYPICAL SYSTEM OVERVIEW

CONTROL SYSTEMS:

MAXITROL SERIES 14

The Maxitrol Series 14 electronic discharge temperature control system maintains a constant discharge temperature. The standard control permits manual adjustment of discharge temperature (55° to 90°F) from inside the heater control enclosure. As an option, a Remote Heat Adjust control with override capability to 130°F can be provided to allow manual adjustment of discharge temperature (55° to 130°F) from either inside the heater control enclosure or in the Remote Control Station.

MAXITROL SERIES 14 WITH SPACE THERMOSTAT

The Maxitrol Series 14 modulation controls function as described above using the optional Remote Heat Adjust control in conjunction with an electronic space thermostat switch contact to increase discharge temperature. The discharge temperature will increase to a preset rise (0°F to 40°F) above the set point on the Remote Heat Adjust control face based on the setting of the override temperature dial, which is visible from the top of the control.

MAXITROL SERIES 44

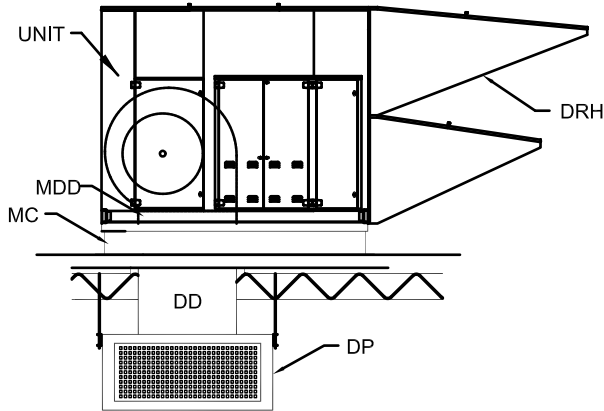
The Maxitrol Series 44 modulation controls maintain a constant space temperature by increasing or decreasing the discharge temperature. The Space Temperature Selector is set to maintain the space temperature of the heated space by controlling the heater output between the MIN and MAX setting on the amplifier. The MIN dial setting determines the minimum discharge temperature the heater will deliver (40°F to 80°F). The MAX dial setting determines the maximum discharge temperature the heater will deliver (80°F to 140°F).

MAXITROL SERIES 44 / TAMPER PROOF

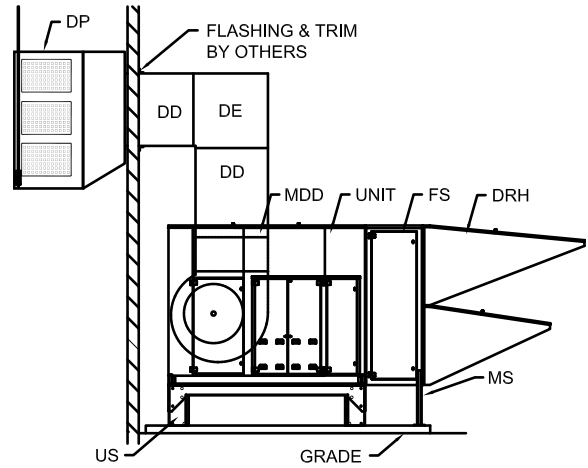
The Maxitrol Series 44 / Tamper Proof temperature control system is similar to the Maxitrol Series 44 controls above except the adjustable Space Temperature Selector control is replaced by two other controls. The adjustable portion of the temperature selector is typically mounted in the Remote Control Station to prevent unwanted tampering of the temperature setting and the non-adjustable space sensor is mounted in the space being heated.

TYPICAL SYSTEM OVERVIEW ACCESSORY IDENTIFICATION

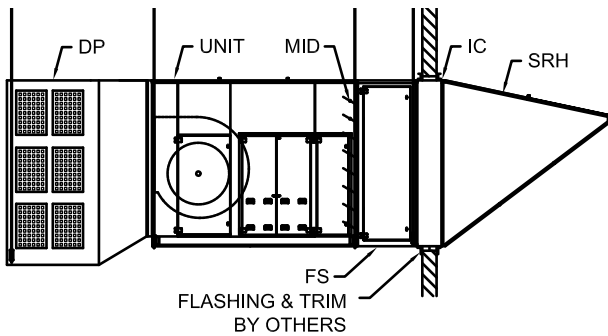
Horizontal Mount Roof Top Configuration



Horizontal Mount Outdoor Pad Mount Configuration



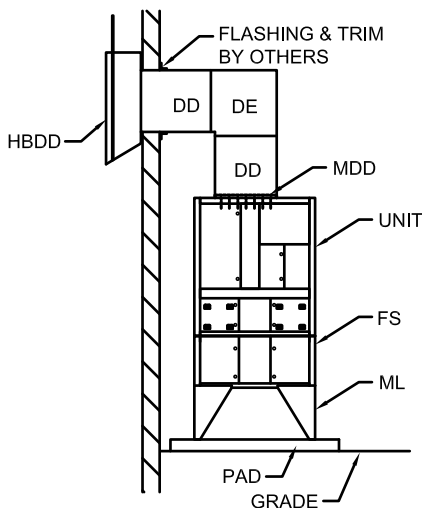
Horizontal Mount Thru Wall Configuration



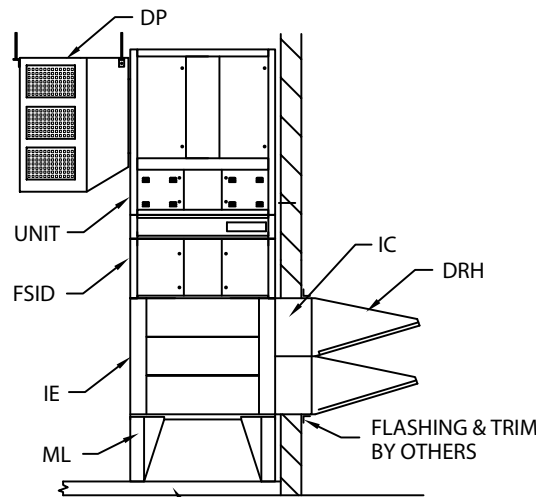
Component Identification

DD	Discharge Duct
DE	Discharge Elbow
DP	Discharge Plenum
DRH	Dual Rainhood w/ Inlet Screen & Filter Rack
FS	Filter Section V-Bank
FSID	V-Bank Filter Section/Inlet Damper Combo
HBDD	Horizontal Blast Discharge Diffuser
IC	Inlet Collar
IE	Inlet Elbow
MC	Mounting Curb
MDD	Motorized Discharge Damper
MID	Motorized Inlet Damper
ML	Mounting Legs
SRH	Single Rainhood w/ Inlet Screen

Vertical Mount Outdoor Configuration



Vertical Mount Indoor Configuration



HEATER / ACCESSORY WEIGHTS

Horizontal Mount (Weights Shown In Pounds)

Model	M110	M112	M115	M118	M120	M125	M130	M136	M140
Base Heater	425	440	550	1125	1395	2045	2475	2845	5345*
Rain Hood - Single	45	45	70	135	175	275	325	375	N/A
Rain Hood - Dual, Upper	N/A	N/A	N/A	95	145	240	270	325	480
Rain Hood - Dual, Lower	N/A	N/A	N/A	75	105	170	205	280	410
Filters for Rain Hood	10	10	15	20	30	45	60	80	90
Inlet Screen	5	5	10	10	15	25	35	40	45
Inlet Collar	40	40	50	85	110	170	200	230	335
Inlet Damper (internal)	25	25	35	55	65	125	155	210	290
V-Bank Filter Section	70	70	100	215	235	285	400	500	**
Discharge Duct - 20"	25	30	35	40	45	50	60	75	80
Discharge Duct - 50"	60	70	80	90	120	140	160	180	200
Discharge Duct - 72"	70	85	95	125	150	180	220	250	280
Discharge Damper (internal)	N/A	N/A	N/A	30	30	35	45	55	75
Discharge Plenum 4-way	100	150	200	250	300	400	470	930	1480
Discharge Plenum 3-way	80	130	175	220	260	360	430	500	795
Discharge Splash Pan	40	40	40	60	60	60	80	80	80
Curb 14"	60	70	80	100	120	180	210	230	270
Curb 24"	100	120	140	170	200	270	310	340	445

*Due to shipping constraints the M140 consists of a of blower module (3625 lbs.) and burner module (1720 lbs.)

**The burner module with integral Filter Section weighs 2380 lbs.

Vertical Mount (Weights Shown In Pounds)

Model	M118	M120	M125	M130	M136
Base Heater	1800	2300	2900	3200	3600
Rain Hood - Single	135	175	275	325	500
Rain Hood - Dual, Upper	95	145	240	270	380
Rain Hood - Dual, Lower	75	105	170	205	275
Filters for Rain Hood	20	30	45	60	80
Inlet Collar	100	110	170	200	230
Inlet Elbow	450	500	780	1040	1325
Inlet Damper	305	345	400	475	490
V-Bank Filter Section	280	380	420	555	715
Filter Section/Inlet Damper Combo	470	600	670	860	920
Discharge Duct - 20"	40	45	50	60	75
Discharge Duct - 50"	90	120	140	160	180
Discharge Duct - 72"	125	150	180	220	250
Discharge Damper (internal)	35	35	40	60	75
Discharge Elbow	95	120	170	230	340
Discharge Plenum 3-way w/enclosure	280	320	420	510	580
Discharge Diffuser	210	230	280	310	350
Mounting Legs 3-foot, set of 4	250	250	250	250	250
Mounting Legs 5-foot, set of 4	400	400	400	400	400

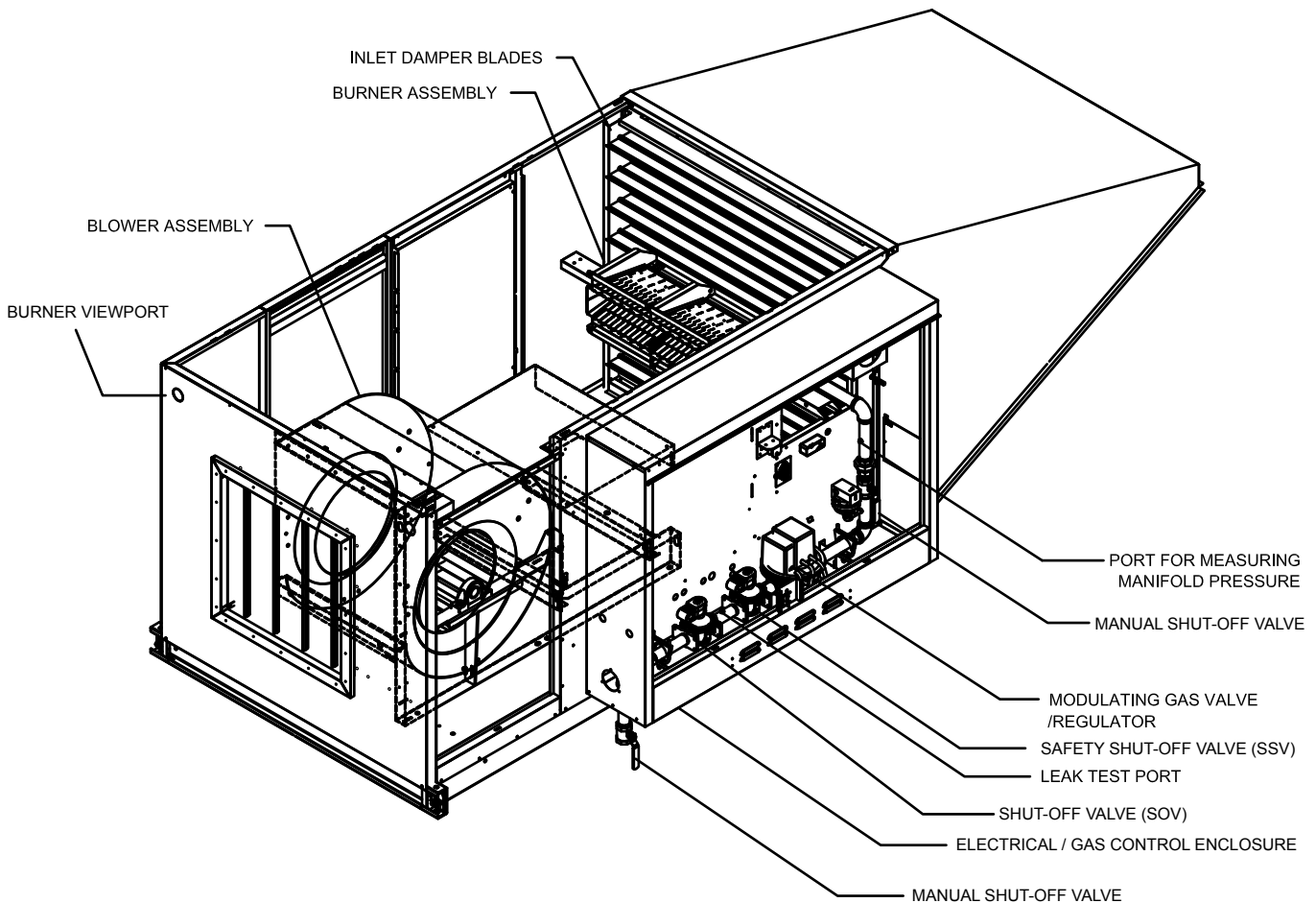
TYPICAL SYSTEM OVERVIEW

HEATER OPERATION

Cambridge M-Series Draw-Thru heaters provide fresh air ventilation to a facility, provide tempered air to replace the air that is mechanically exhausted, or address cold drafts from natural infiltration. Heater operation is typically electrically interlocked with mechanical exhaust fans, manually operated switches,

programmable timers, or other process control systems. The discharge temperature of heaters with fixed discharge temperature controls is typically set 10°F to 20°F above the desired space temperature. The entering air thermostat acts as an economizer by deactivating burner operation during mild weather.

HEATER CONFIGURATION



INSTALLATION INSTRUCTIONS

UNCRATING INSTRUCTIONS

1. Verify the number of items on the Bill of Lading versus the number of items received.
2. Check for shipping damage. **If damage is found, immediately file a claim with carrier before proceeding further. Take photographs of any damage.**
3. Check items received to make sure they agree with ordering information including verification of data on the make-up air heater nameplate.

IMPORTANT

Do not discard any components or accessories.

IMPORTANT

Field constructed intake accessories should be designed to minimize the entry of snow and rain.

IMPORTANT

Minimum clearance from the face of the electrical control enclosure to surrounding grounded surfaces for service activities is 42". Adequate clearance for burner removal is also required, which is based on 42" or the length of the burner + 12", whichever is greater. Access for service functions is also required on the opposite side of the make-up air heater from the control enclosure for a minimum distance of 24".

MOUNTING LOCATION

Verify feasibility of the installation location selected with respect to accessibility to the heater for service and maintenance functions. Ensure the positioning of the heater does not inhibit fork truck operation, storage rack access, or other operations within the facility. Ensure the heater inlet and outlet are not blocked or severely restricted, such that it would affect the rated airflow through the heater or affect the desired air distribution pattern of the heater. If upon review of the proposed installation, a problem is discovered which may be considered detrimental to the performance of the heater, or restricts its serviceability, or deviates from the instructions or drawings which may be provided, it is the responsibility of the installer to communicate that information to the person or persons responsible for providing the installation instructions or drawings prior to proceeding with the installation.

⚠WARNING:

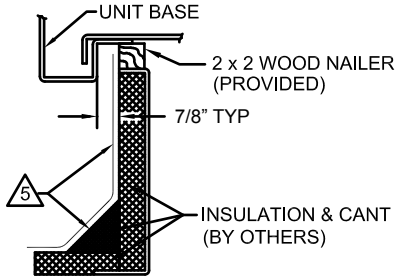
Where the mounting height of the heater is a consideration, work platforms or service lifts should be provided for accessibility to the equipment for service and maintenance activities.

INSTALLATION INSTRUCTIONS

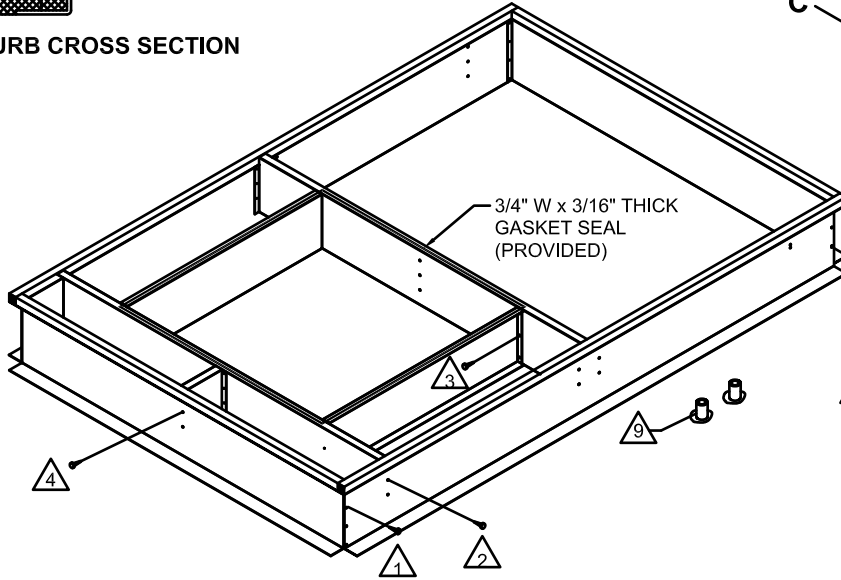
HORIZONTAL ROOF MOUNT - MOUNTING CURB

M110 - M136

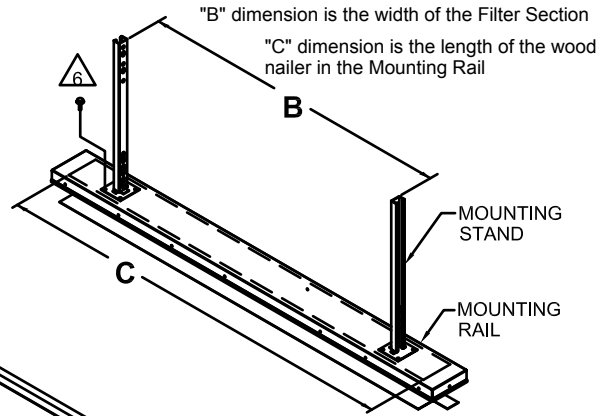
(Shown for Roof Top Configuration - Downblast Application)



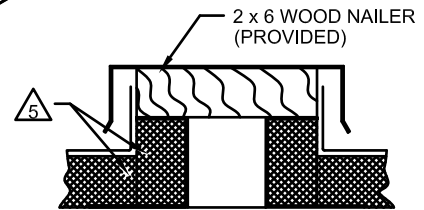
CURB CROSS SECTION



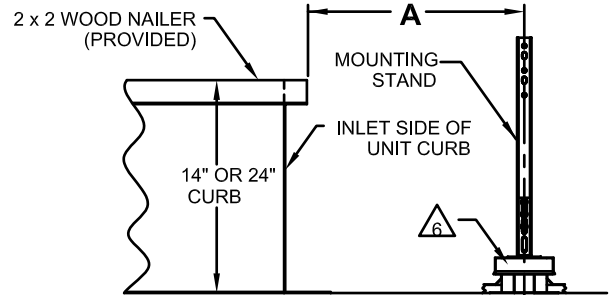
MOUNTING CURB



MOUNTING STAND/RAIL
(FOR OPTIONAL FILTER SECTION)



RAIL CROSS SECTION



RAIL LOCATION DETAIL

INSTRUCTIONS

- 1 PLACE EXTERIOR CURB SIDES TOGETHER AS SHOWN AND ATTACH IN PLACE USING LARGE TEK SCREWS (AS REQ'D)
- 2 INSTALL THE CURB/DUCT CROSS SUPPORTS AS SHOWN AND ATTACH IN PLACE USING LARGE TEK SCREWS. (NOTE DIMENSION LOCATIONS)
- 3 INSTALL THE CENTER SUPPORTS AS SHOWN USING LARGE TEK SCREWS. (NOTE DIMENSION LOCATIONS)
- 4 INSULATION AND CANT (IF REQUIRED) BY OTHERS.
- 5 SECURE MOUNTING STAND TO TIMBER WITH WOOD LAG SCREWS AND ADD WATERPROOF SEALANT.
- 6 MOUNTING STAND CONSTRUCTION: 12 GA GALVANIZED STEEL. REQUIRED FOR INSTALLATION OF FILTER SECTION.
- 7 MOUNTING RAIL CONSTRUCTION: 16 GA GALVANIZED STEEL. REQUIRED FOR INSTALLATION OF FILTER SECTION.
- 8 FOR ROOF MOUNTING, GAS AND ELECTRICAL CONNECTIONS MUST NOT PENETRATE UNIT BASE OR MOUNTING CURB. PITCH POCKETS OR ROOF BOOTS (BY OTHERS) RECOMMENDED.

Model	A	B	C
M110	30 3/4"	26 7/8"	48"
M112	30 3/4"	26 7/8"	48"
M115	30 3/4"	41 1/8"	60"
M118	31 1/2"	48 5/8"	60"
M120	31 1/2"	54 5/8"	72"
M125	31 1/2"	66 5/8"	84"
M130	37 3/8"	88 3/8"	96"
M136	37 1/2"	88 3/8"	96"
M140	N/A	N/A	N/A

Note: The V Bank Filter Section is an integral part of the M140 cabinet, thus it does not require a separate Mounting Stand/Rail.

INSTALLATION INSTRUCTIONS

HORIZONTAL MOUNT - ROOF TOP CONFIGURATION

⚠WARNING:

Due to the size and weight of this equipment, it is recommended that the heater support structure be reviewed and approved by a qualified structural engineer and the roof manufacturer before installing this equipment.

IMPORTANT

Before proceeding with the installation, verify the feasibility of the location selected with respect to accessibility to the equipment for service and maintenance functions.

IMPORTANT

To minimize snow and rain ingestion, position the heater inlet opposite the prevailing wind.

⚠CAUTION:

To prevent contaminated air from being drawn into the heater, install the heater's inlet at least 10 feet from any building exhaust, process exhaust, sewer stacks, or other sources that would allow contaminants to be drawn into the heater. Consult local codes for applicable building code provisions for ventilation air.

IMPORTANT

For model M140 heaters, refer to the "Field Assembly Instructions" worksheets included with this manual and with the components for detailed heater assembly directions.

1. Prepare the roof for installation. (See pages 10-12 for roof opening dimensions for your specific heater.) The gas and electrical connections must not penetrate the unit base or mounting curb. Cambridge Air Solutions recommends using pitch pockets or roof boots to seal the penetrations.

IMPORTANT

Accurate measurements are critical and will affect installation process.

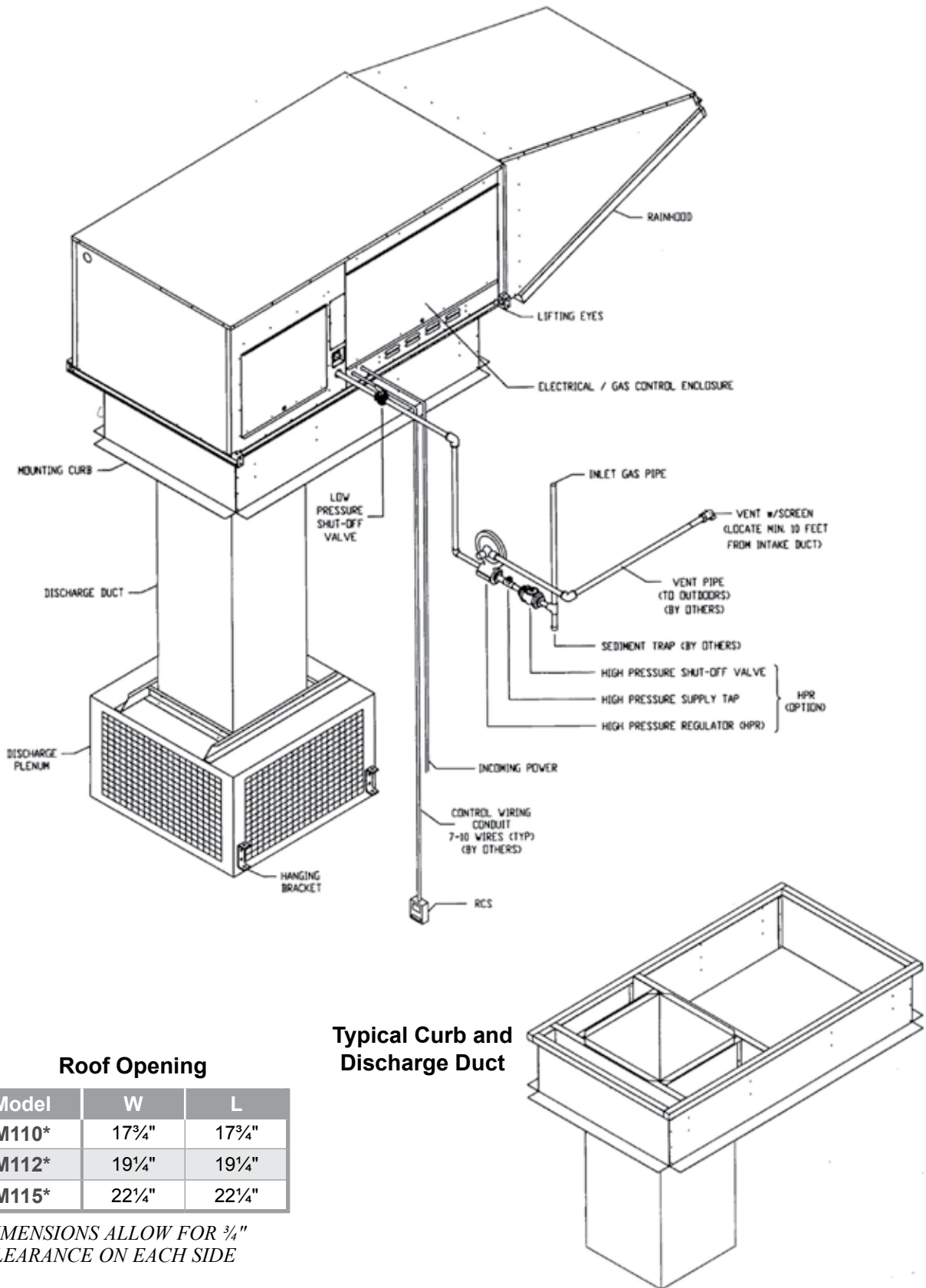
2. Assemble and secure the roof curb to the support structure per the recommendations of the structural engineer and roof manufacturer.

IMPORTANT

The roof curb or support structure should be installed such that the heater will sit level. Cambridge Air Solutions recommends mounting the heater 24" off the roof surface in areas where snow accumulation could impact heater operation.

3. Install the roof curb gasket seal. See drawing on page 8.
4. Lower the discharge duct through the roof opening.
5. Use a crane or comparable lifting device to raise and position the equipment. Use a spreader bar to prevent damage and connect slings to the lifting eyes.
6. Caulk all joints of the heater's accessories installed in the field. Use a clear or gray silicone caulking to prevent water leaks.
7. Seal all roof penetrations to prevent roof leaks.
8. Install the discharge accessory, where used, by screwing the plenum to the discharge duct. Install 4 hanging rods from the ceiling supports to the accessory's support brackets.
9. Adjust internal vibration isolators, if applicable, per the setup instructions provided with this manual.

TYPICAL INSTALLATION HORIZONTAL MOUNT - ROOF TOP CONFIGURATION M110 - M115



Roof Opening

Model	W	L
M110*	17 ³ / ₄ "	17 ³ / ₄ "
M112*	19 ¹ / ₄ "	19 ¹ / ₄ "
M115*	22 ¹ / ₄ "	22 ¹ / ₄ "

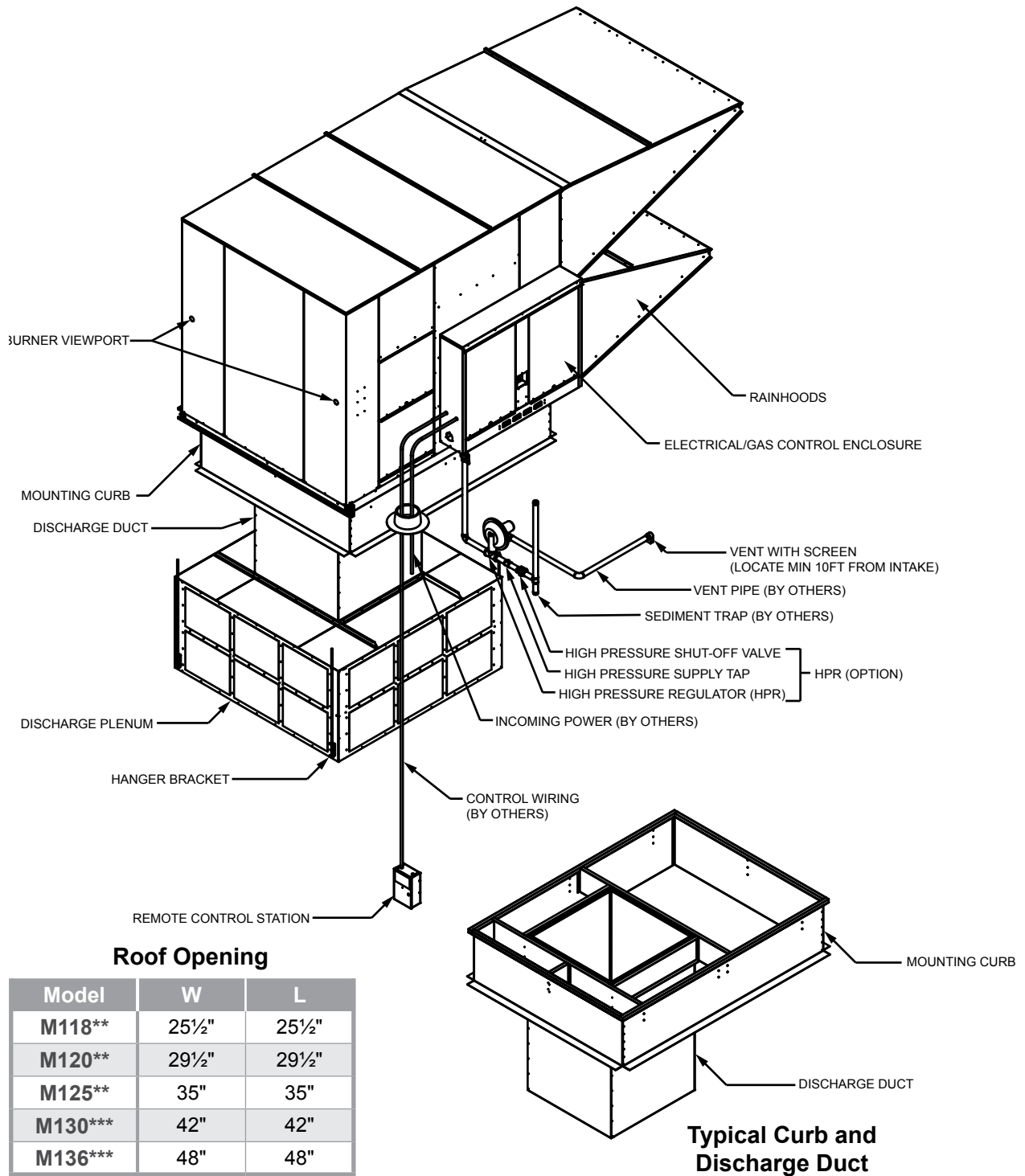
* DIMENSIONS ALLOW FOR 3/4" CLEARANCE ON EACH SIDE

Typical Curb and Discharge Duct

TYPICAL INSTALLATION

HORIZONTAL MOUNT - ROOF TOP CONFIGURATION

M118 - M136



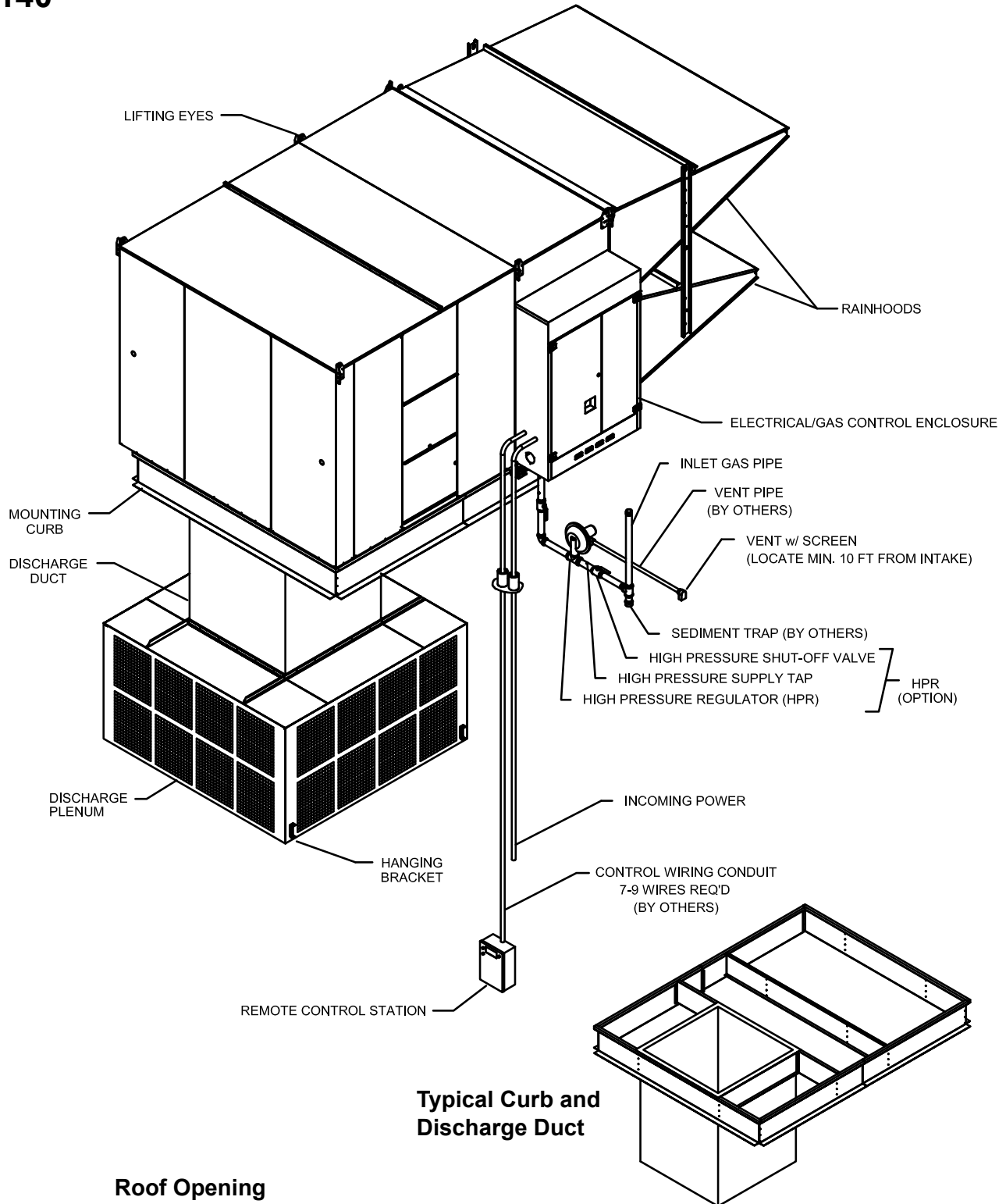
Roof Opening

Model	W	L
M118**	25½"	25½"
M120**	29½"	29½"
M125**	35"	35"
M130***	42"	42"
M136***	48"	48"

** DIMENSIONS ALLOW FOR 1" CLEARANCE ON EACH SIDE

*** DIMENSIONS ALLOW FOR 1½" CLEARANCE ON EACH SIDE

TYPICAL INSTALLATION HORIZONTAL MOUNT - ROOF TOP CONFIGURATION M140



Roof Opening

Model	W	L
M140***	55¼"	55¼"

*** DIMENSIONS ALLOW FOR 1½" CLEARANCE ON EACH SIDE

INSTALLATION INSTRUCTIONS

HORIZONTAL MOUNT - OUTDOOR STAND MOUNT CONFIGURATION

⚠WARNING:

Due to the size and weight of this equipment, it is recommended the heater support structure be reviewed and approved by a qualified structural engineer before installing this equipment.

IMPORTANT

Before proceeding with the installation, verify the feasibility of the location selected for accessibility to the equipment for service and maintenance functions.

IMPORTANT

To minimize snow and rain ingestion, position the heater inlet opposite the prevailing wind.

⚠CAUTION:

To prevent contaminated air from being drawn into the heater, install the heater's inlet at least 10 feet from any building exhaust, process exhaust, sewer stacks, or other sources that would allow contaminants to be drawn into the heater. Consult local codes for applicable building code provisions for ventilation air.

IMPORTANT

For model M140 heaters, refer to the "Field Assembly Instructions" worksheets included with this manual for detailed heater assembly directions.

1. Prepare the wall for installation. (See pages 14-15 for wall opening dimensions for your specific heater.)

IMPORTANT

Accurate measurements are critical and will affect installation process.

2. Assemble and secure the support structure per the structural engineer's recommendations.

IMPORTANT

The support structure should be installed such that the heater will sit level.

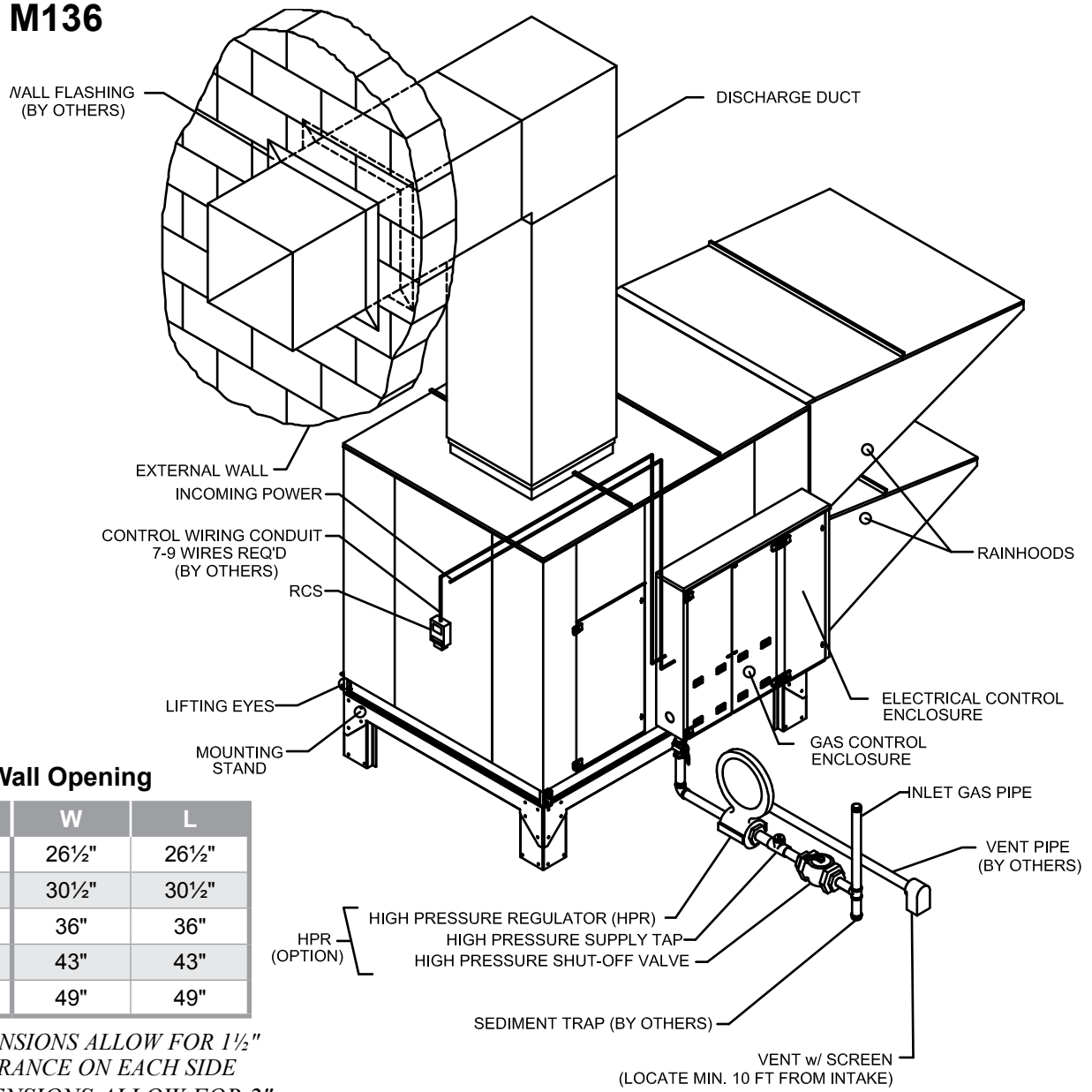
3. Use a crane or comparable lifting device to raise and position the equipment. Use a spreader bar to prevent damage and connect slings to the lifting brackets.

IMPORTANT

Cambridge Air Solutions recommends mounting the heater a minimum of 24" off the mounting surface in areas where snow accumulation could impact heater operation.

4. Caulk all joints of the heater's accessories installed in the field. Use a clear or gray silicone caulking to prevent water leaks.
5. Install the discharge duct through the wall opening.
6. Install fiberglass insulation in the gaps between the wall opening and discharge duct. Apply enough insulation material to accommodate the full thickness of the wall.
7. Install finish trim pieces (by others) to the top, sides and bottom of the discharge duct on both the inside and outside wall surfaces.
8. Apply a bead of silicone caulk that best matches the color of the exterior wall surface of the facility and/or the color of the heater accessories at the joint between the top discharge duct and outside wall surface. Make certain this is a continuous bead and that it runs the entire width of the duct. Caulk all other exposed joints.
9. Install the discharge accessory, where used, by screwing the accessory to the discharge duct. Install hanging rods (3/8") minimum from the ceiling supports to the accessory's support brackets.
10. For M140 installations, see the field assembly drawings provided with components.
11. Adjust internal vibration isolation, if applicable, per the setup instructions provided with this manual.

TYPICAL INSTALLATION HORIZONTAL MOUNT - OUTDOOR STAND MOUNT CONFIGURATION M118 - M136



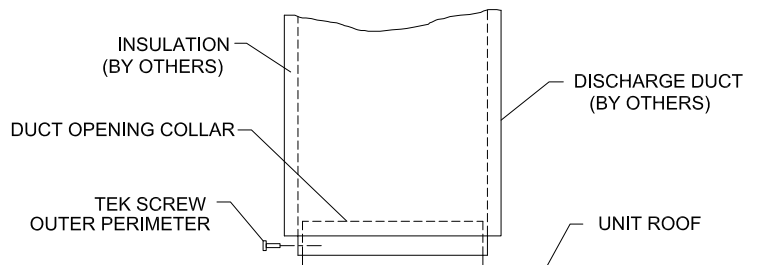
Wall Opening

Model	W	L
M118***	26½"	26½"
M120***	30½"	30½"
M125***	36"	36"
M130****	43"	43"
M136****	49"	49"

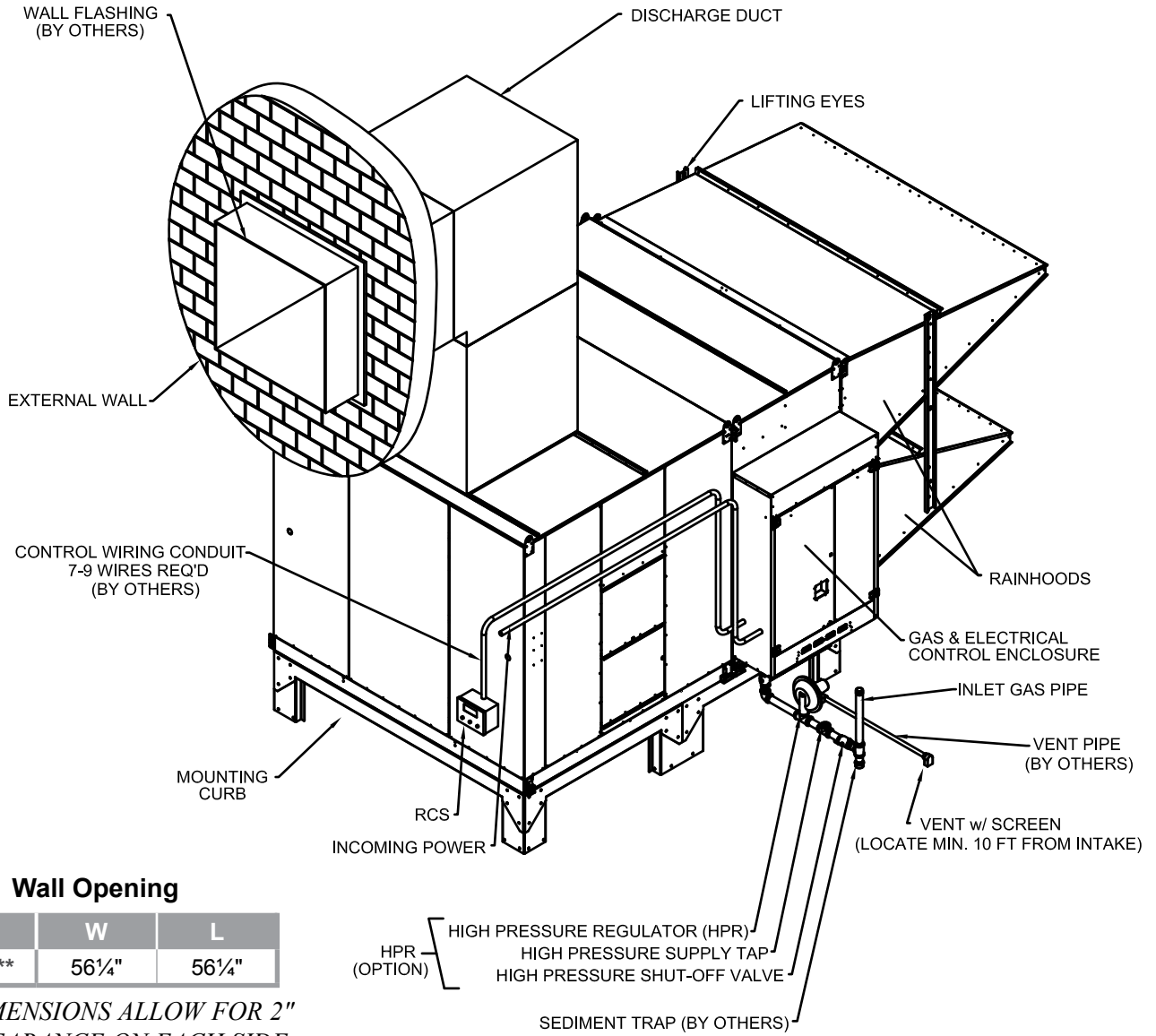
*** DIMENSIONS ALLOW FOR 1½" CLEARANCE ON EACH SIDE

**** DIMENSIONS ALLOW FOR 2" CLEARANCE ON EACH SIDE

Typical Duct Interface



TYPICAL INSTALLATION HORIZONTAL MOUNT - OUTDOOR STAND MOUNT CONFIGURATION M140

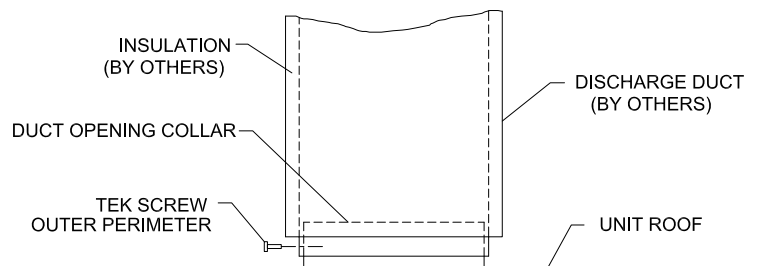


Wall Opening

Model	W	L
M140****	56¼"	56¼"

**** DIMENSIONS ALLOW FOR 2" CLEARANCE ON EACH SIDE

Typical Duct Interface



INSTALLATION INSTRUCTIONS

HORIZONTAL MOUNT - THRU WALL CONFIGURATION

⚠WARNING:

Due to the size and weight of this equipment, it is recommended that the heater support structure be reviewed and approved by a qualified structural engineer before installing this equipment.

IMPORTANT

Before proceeding with the installation, verify the feasibility of the location selected with respect to accessibility to the equipment for service and maintenance functions.

IMPORTANT

To minimize snow and rain ingestion, position the heater inlet opposite the prevailing wind.

⚠CAUTION:

To prevent contaminated air from being drawn into the heater, install the heater's inlet at least 10 feet from any building exhaust, process exhaust, sewer stacks, or other sources that would allow contaminants to be drawn into the heater. Consult local codes for applicable building code provisions for ventilation air.

1. Prepare the wall for installation. (See pages 17-18 for wall opening dimensions for your specific heater.)

IMPORTANT

Accurate measurements are critical and will affect the installation process.

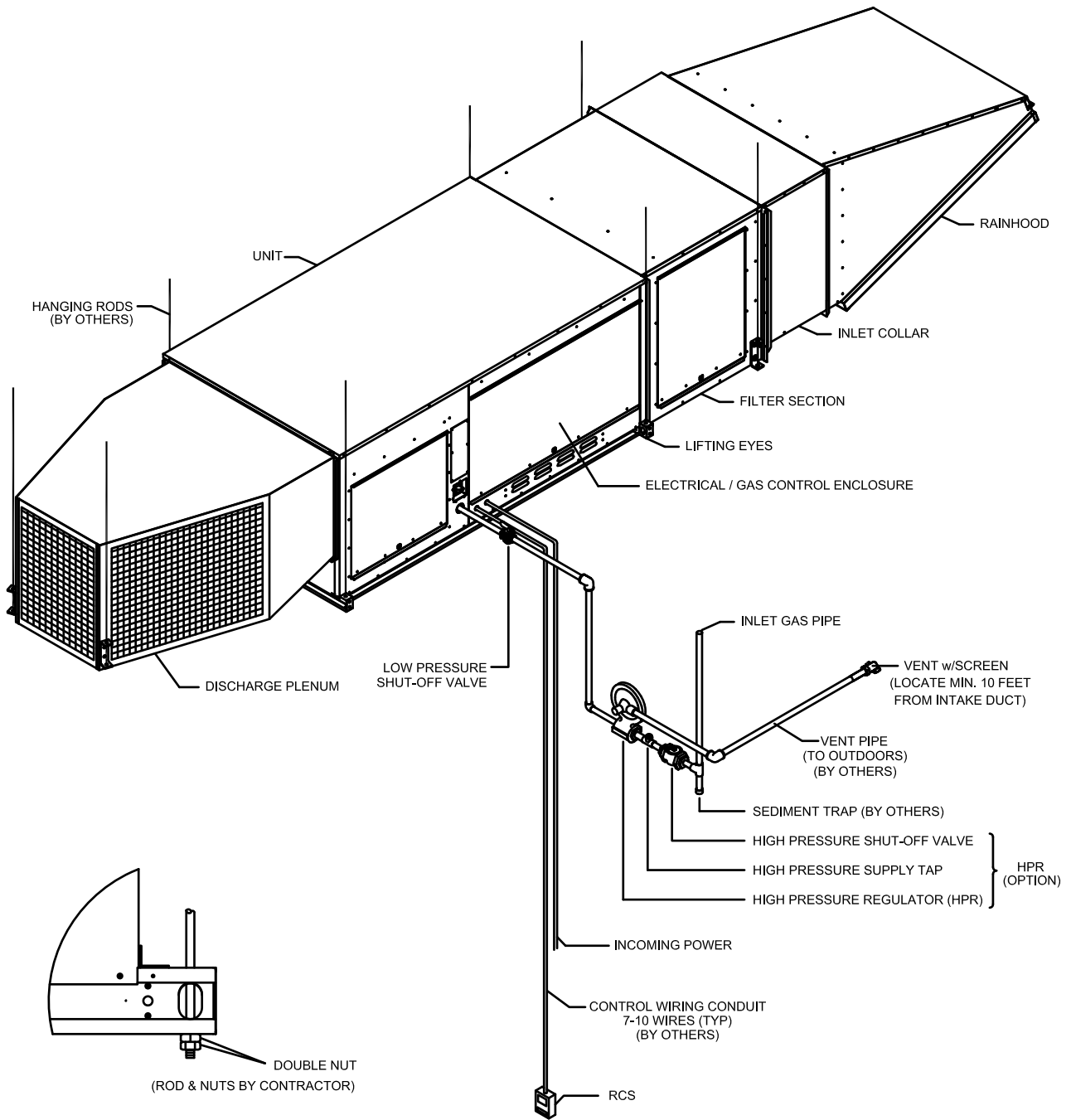
2. Install heater support rods per the structural engineer's recommendations.
3. Use a crane or comparable lifting device to raise and position equipment. Block the heater where necessary. Use a spreader bar to prevent damage and connect slings to the lifting brackets.

IMPORTANT

Cambridge Air Solutions recommends mounting the heater's rainhood a minimum of 24" off the ground or other surfaces.

4. Apply washers and double lock nuts to secure equipment on hanging rods. Note: The discharge end of the heater should be raised slightly (1/8" above level) to allow ingested moisture to drain from the heater.
5. Apply shims at the bottom of the rainhood to take up slack in the opening, leaving a small joint between the top of the heater and the wall.
6. Install fiberglass insulation in the gaps between the wall opening and the inlet collar. Apply enough material to accommodate the full thickness of the wall.
7. Install finish trim pieces (by others) to the top, sides and bottom of the inlet collar on both the inside and the outside wall surfaces.
8. Apply a bead of silicone caulk. Make certain this is a continuous bead and that it runs the entire width of the collar. Caulk all other exposed joints.
9. Install the discharge accessory, where used, by screwing the accessory to the heater or to the discharge duct, as applicable. Install hanging rods (3/8") minimum from the ceiling supports to the accessory's support brackets.
10. For M140 installations, see the field assembly drawings provided with components.
11. Adjust internal vibration isolation, if applicable, per the setup instructions provided with this manual.
12. For drain trough installation, see the field installation detail provided with the component.

TYPICAL INSTALLATION HORIZONTAL MOUNT - THRU WALL CONFIGURATION M110 - M115

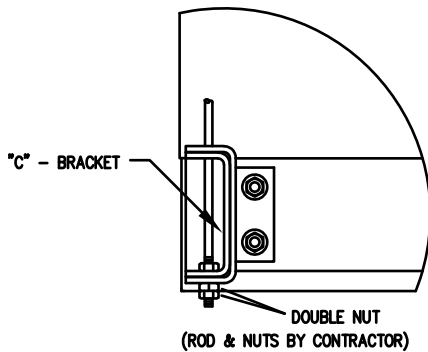
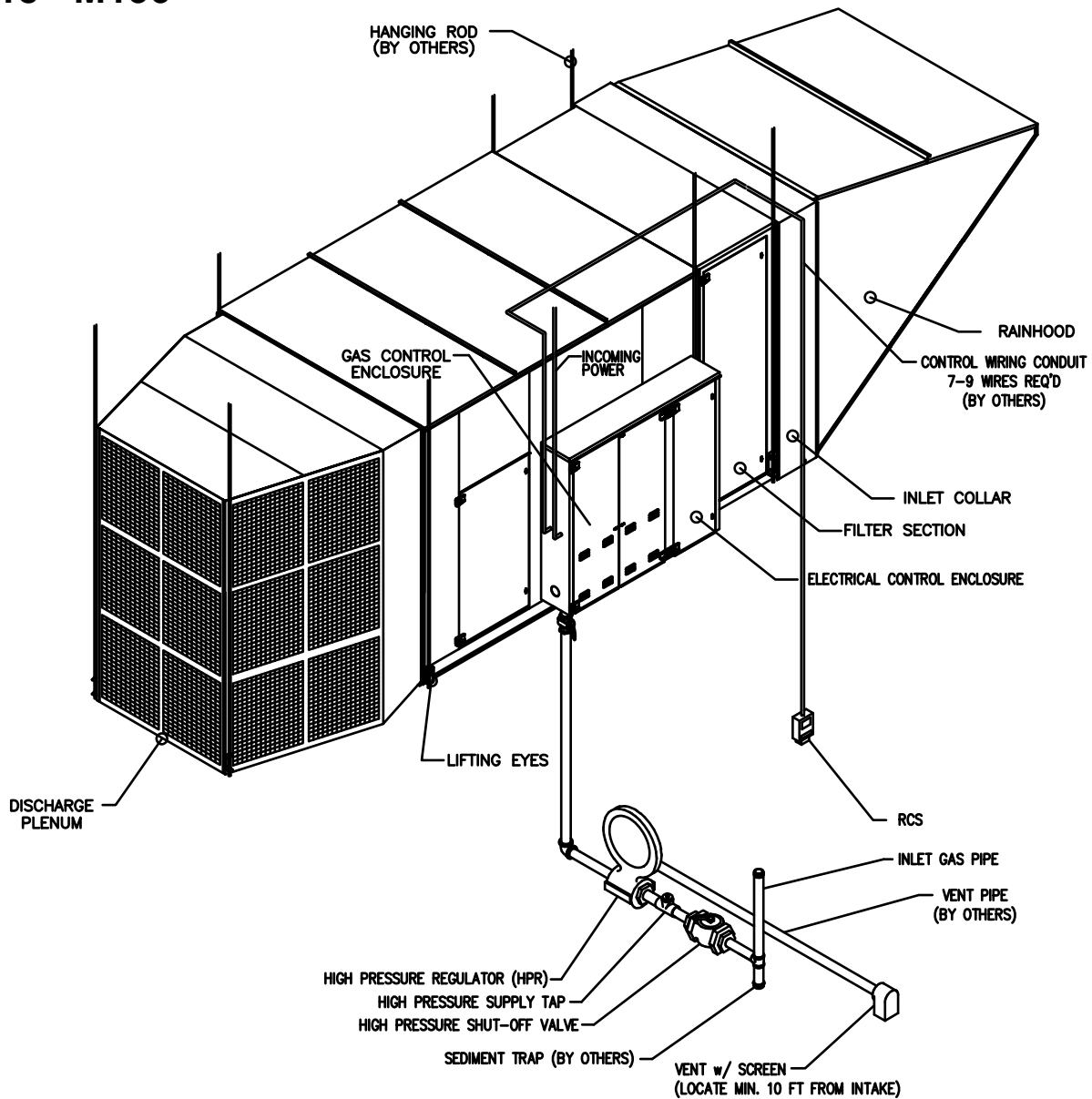


Wall Opening

Model	W	H
M110**	32¼"	35"
M112**	32¼"	35"
M115**	46¼"	35"

** DIMENSIONS ALLOW FOR 1" CLEARANCE ON EACH SIDE

TYPICAL INSTALLATION HORIZONTAL MOUNT - THRU WALL CONFIGURATION M118 - M136



Wall Opening

Model	W	H
M118***	51 $\frac{3}{4}$ "	55 $\frac{1}{4}$ "
M120***	57 $\frac{3}{4}$ "	55 $\frac{1}{2}$ "
M125***	69 $\frac{3}{4}$ "	72 $\frac{1}{4}$ "
M130****	92 $\frac{1}{2}$ "	73 $\frac{1}{4}$ "
M136****	92 $\frac{1}{2}$ "	98 $\frac{1}{4}$ "
M140****	121 $\frac{3}{4}$ "	97 $\frac{3}{4}$ "

*** DIMENSIONS ALLOW FOR 1 $\frac{1}{2}$ " CLEARANCE ON EACH SIDE

**** DIMENSIONS ALLOW FOR 2" CLEARANCE ON EACH SIDE

INSTALLATION INSTRUCTIONS

VERTICAL MOUNT - OUTDOOR CONFIGURATION

⚠WARNING:

Due to the size and weight of the equipment, it is recommended the heater support structure be reviewed and approved by a qualified structural engineer before installing this equipment.

IMPORTANT

Before proceeding with the installation, verify the feasibility of the location selected with respect to accessibility to the equipment for service and maintenance functions.

IMPORTANT

To prevent contaminated air from being drawn into the heater, install the heater's inlet at least 10 feet from any building exhaust, process exhaust, sewer stacks, or other sources that would allow contaminants to be drawn into the heater. Consult local codes for applicable building code provisions for ventilation air.

IMPORTANT

This heater should be mounted on a concrete pad adequate to support the weight of the heater with length and width dimensions that exceed the dimensions of the heater by at least 5 feet (30" on each side). The pad should slope slightly away from the building (approximately 1/4" per foot) to avoid water collecting under the heater.

1. Prepare the wall for installation. (See pages 21-22 for opening dimensions for your specific heater.)

IMPORTANT

Accurate measurements are critical and will affect the installation process.

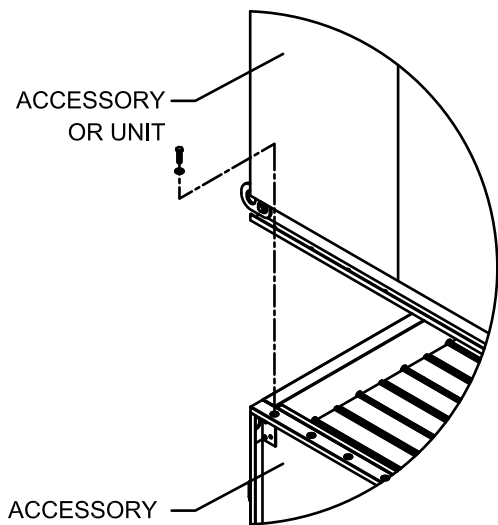
2. Install the discharge duct through the wall opening.
3. Use a crane or comparable lifting device to raise and position the equipment. Use a spreader bar to prevent damage and connect slings to the lifting eyes. The Vertical Mount heaters may be shipped in

sections due to shipping constraints. Review the Accessory Identification drawings (see page 4) to identify the locations of these sections.

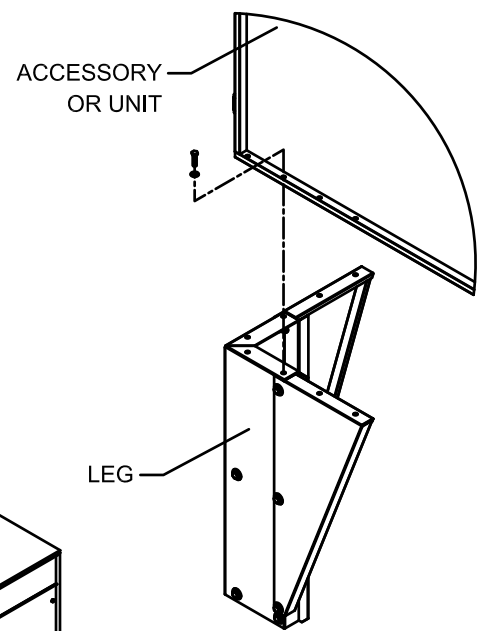
IMPORTANT

Cambridge Air Solutions recommends mounting the heater a minimum of 60" off the mounting surface in areas where snow accumulation could impact the heater operation.

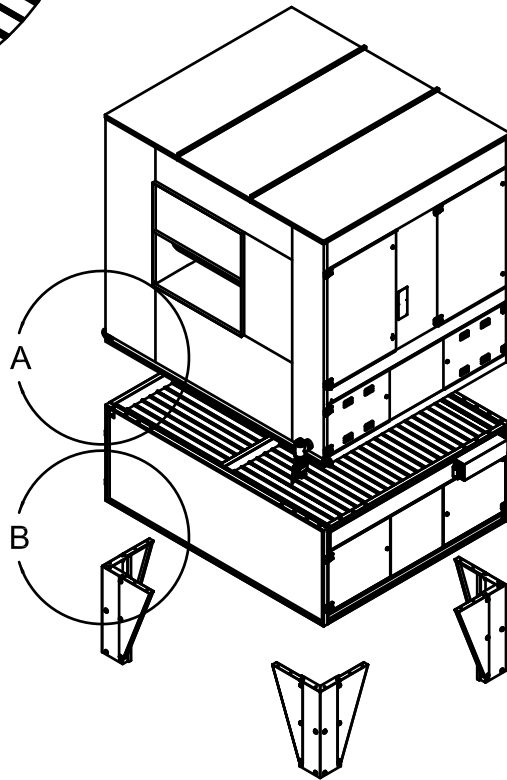
4. Attach each mounting leg to the inlet accessory (filter section, inlet damper, or filter section/inlet damper combo, as specified) using the 1/2"-13 x 1-1/2" bolts. The bolts install downward through a clearance hole in the accessory into a threaded insert in the mounting leg. Install all four legs on the accessory, then set this assembly in its intended position (page 20). If no inlet accessory is specified, install the legs directly to the heater. Level the assembly by placing shims under the appropriate legs.
5. Position the heater on the inlet accessory. Secure the heater using the 1/2"-13 x 1-1/2" bolts. The bolts install downward through a clearance hole in the heater into a threaded insert in the inlet accessory.
6. Attach discharge duct to heater.
7. Caulk all joints of the heater's accessories installed in the field. Use a silicone caulking to prevent water leaks.
8. Install fiberglass insulation in the gaps around the wall opening and discharge duct. Apply enough insulation material to accommodate the full thickness of the wall.
9. Install finish trim pieces (by others) to the top, sides and bottom of the discharge duct on both the inside and outside wall surfaces.



DETAIL A



DETAIL B



Note: If supplied with a damper accessory, ensure damper motor is installed on same side as the electrical control enclosure of the base unit.

10. Apply a bead of silicone caulk. Make certain this is a continuous bead and that it runs the entire width of the duct. Caulk all other exposed joints.

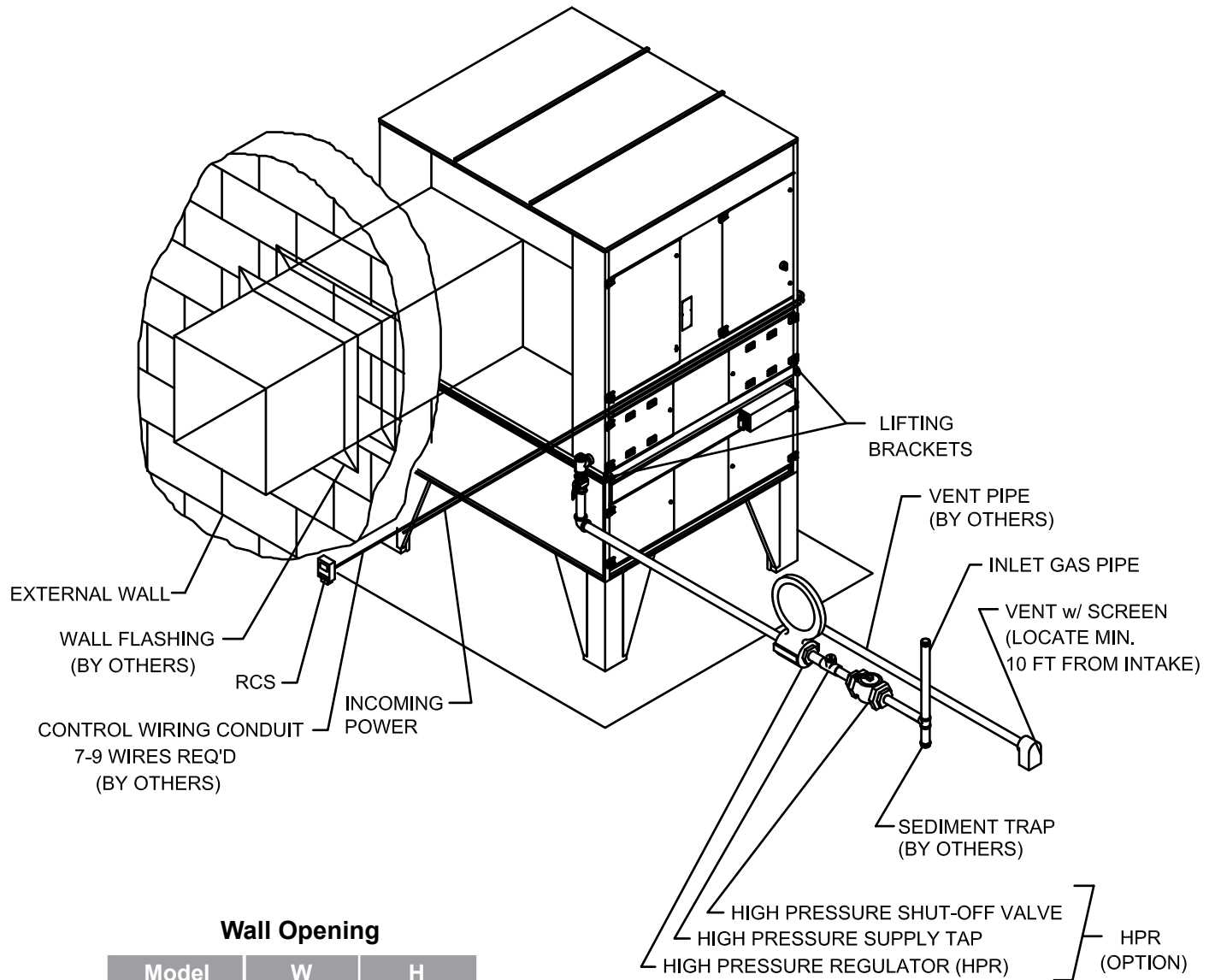
11. Install the discharge plenum by screwing the plenum to the discharge duct. Install hanging rods 3/8" minimum from ceiling supports to the plenum's support brackets.

12. For M136 Inlet Elbow and Rain Hoods assembly, see field assembly instructions provided with components.

13. Mounting Leg and Filter Section/Inlet Damper Combo attachment instructions are provided with components.

14. Adjust internal vibration isolation, if applicable, per the setup instructions provided with this manual.

**TYPICAL INSTALLATION
VERTICAL MOUNT - OUTDOOR CONFIGURATION
HORIZONTAL BLAST
M118 - M136**



Wall Opening

Model	W	H
M118***	26½"	26½"
M120***	30½"	30½"
M125***	36"	36"
M130****	43"	43"
M136****	49"	49"

*** DIMENSIONS ALLOW FOR 1½" CLEARANCE ON EACH SIDE

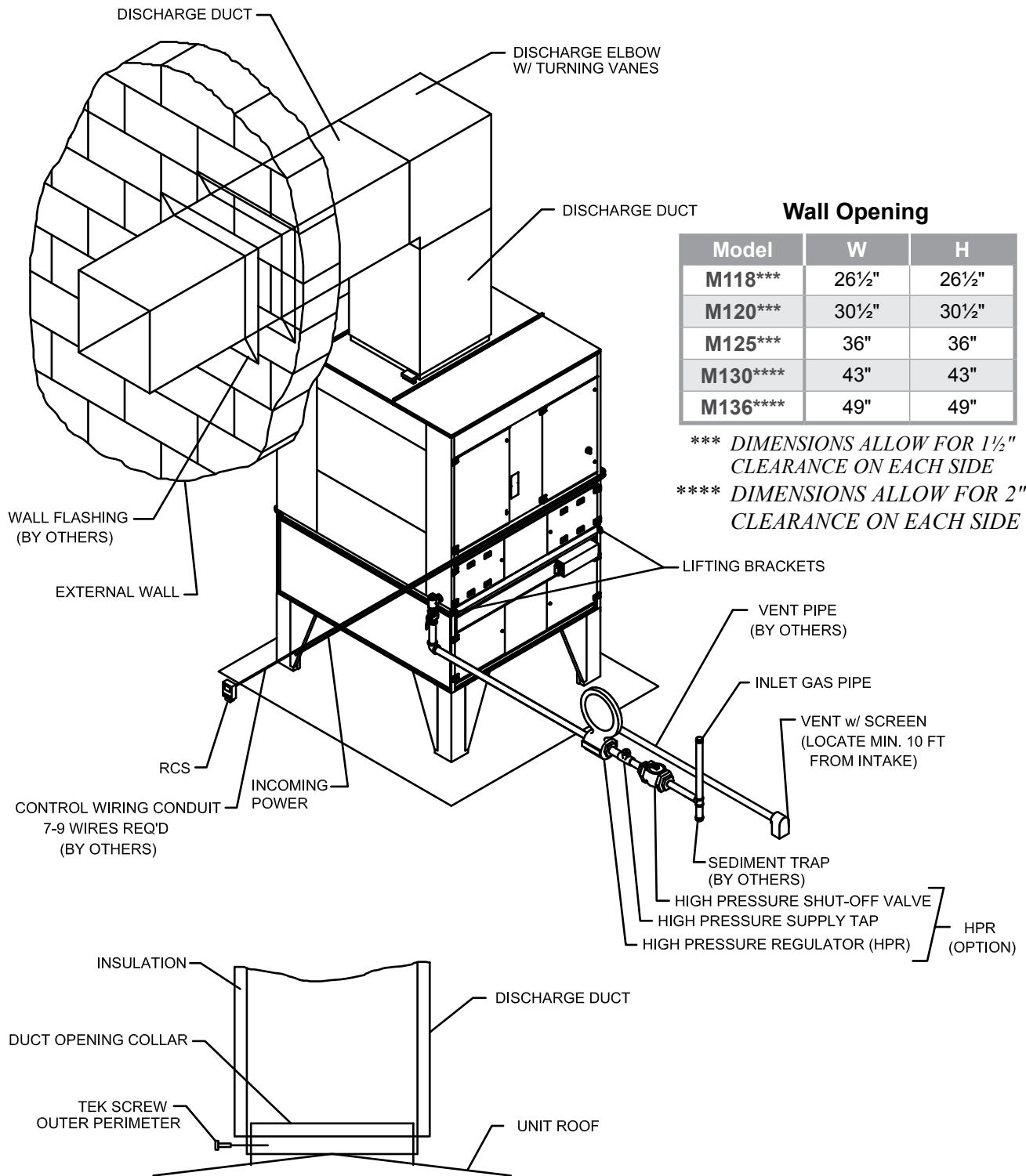
**** DIMENSIONS ALLOW FOR 2" CLEARANCE ON EACH SIDE

TYPICAL INSTALLATION

VERTICAL MOUNT - OUTDOOR CONFIGURATION

UP BLAST

M118 - M136



INSTALLATION INSTRUCTIONS

VERTICAL MOUNT - INDOOR CONFIGURATION

⚠WARNING:

Due to the size and weight of this equipment, it is recommended the heater support be reviewed and approved by a qualified structural engineer before installing the equipment.

IMPORTANT

Before proceeding with installation, verify the feasibility of the location selected with respect to accessibility to the equipment for service and maintenance functions.

IMPORTANT

To prevent contaminated air from being drawn into the heater, install the heater's inlet at least 10 feet from any building exhaust, process exhaust, sewer stacks, or other sources that would allow contaminants to be drawn into the heater. Consult local codes for applicable building code provisions for ventilation air.

1. Prepare the wall for installation. (See page 25 for opening dimensions for your specific heater.)

IMPORTANT

Accurate measurements are critical and will affect the installation process.

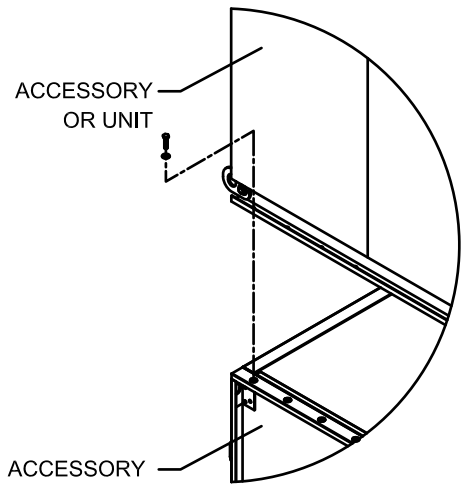
2. Install discharge accessory's support rods per the structural engineer's recommendations.
3. Use a crane or comparable lifting device to raise and position the equipment. Use a spreader bar to prevent damage and connect slings to the lifting eyes.

The Vertical Mount heaters may be shipped in sections due to shipping constraints. Review the Accessory Identification drawings (see page 4) to identify the locations of these sections.

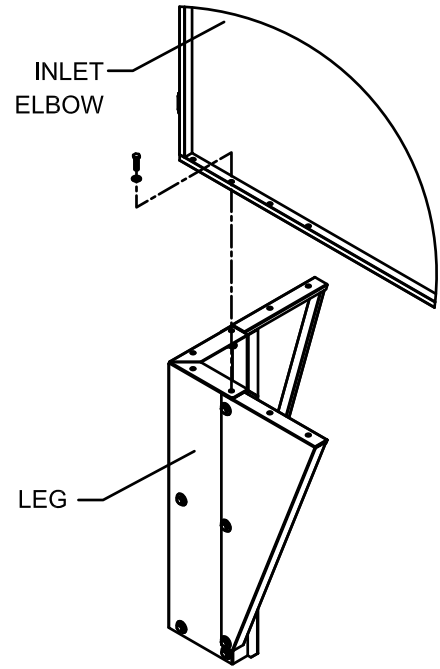
IMPORTANT

Cambridge Air Solutions recommends mounting the heater's rain hood a minimum of 60" off the ground or other surfaces in areas where snow accumulation could impact operation.

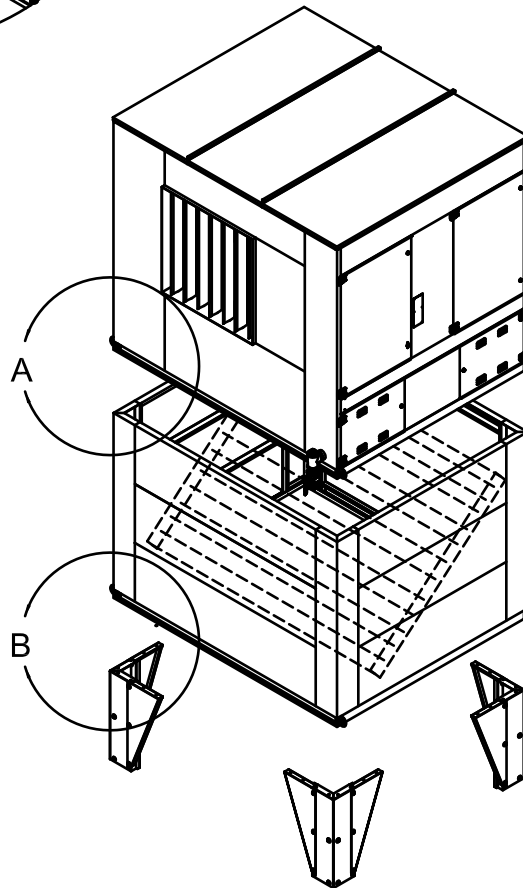
4. Attach each Mounting Leg to the inlet elbow using the 1/2"-13 x 1-1/2" bolts. The bolts install downward through a clearance hole in the accessory into a threaded insert in the Mounting Leg. Install all four legs on the accessory, and then attach the inlet collar to the inlet elbow using the 5/16"-18 x 1/2" bolts. Position this assembly with the inlet collar situated through the wall. Level the assembly by placing shims under the appropriate legs.
5. Position the next inlet accessory, if specified, on the inlet elbow, and then secure them to each other using the 1/2"-13 x 1-1/2" bolts. The bolts install downward through a clearance hole in the upper accessory into a threaded insert in the inlet elbow.
6. Position the heater on the last inlet accessory. Secure the heater using the 1/2"-13 x 1-1/2" bolts. The bolts install downward through a clearance hole in the heater into a threaded insert in the inlet accessory.
7. Attach the rain hoods to the inlet collar using the 5/16"-18 x 1/2" bolts.
8. Install fiberglass insulation in the gaps around the wall opening and inlet collar. Apply enough insulation material to accommodate the full thickness of the wall.
9. Install finish trim pieces (by others) to the top, sides and bottom of the inlet collar on both the inside and outside wall surfaces.



DETAIL A



DETAIL B



10. Apply a bead of silicone caulk that best matches the color of the exterior wall surface of the facility and/or the color of the heater accessories at the joint between the top inlet collar and outside wall surface. Make certain this is a continuous bead and that it runs the entire width of the collar. Caulk all other exposed joints.

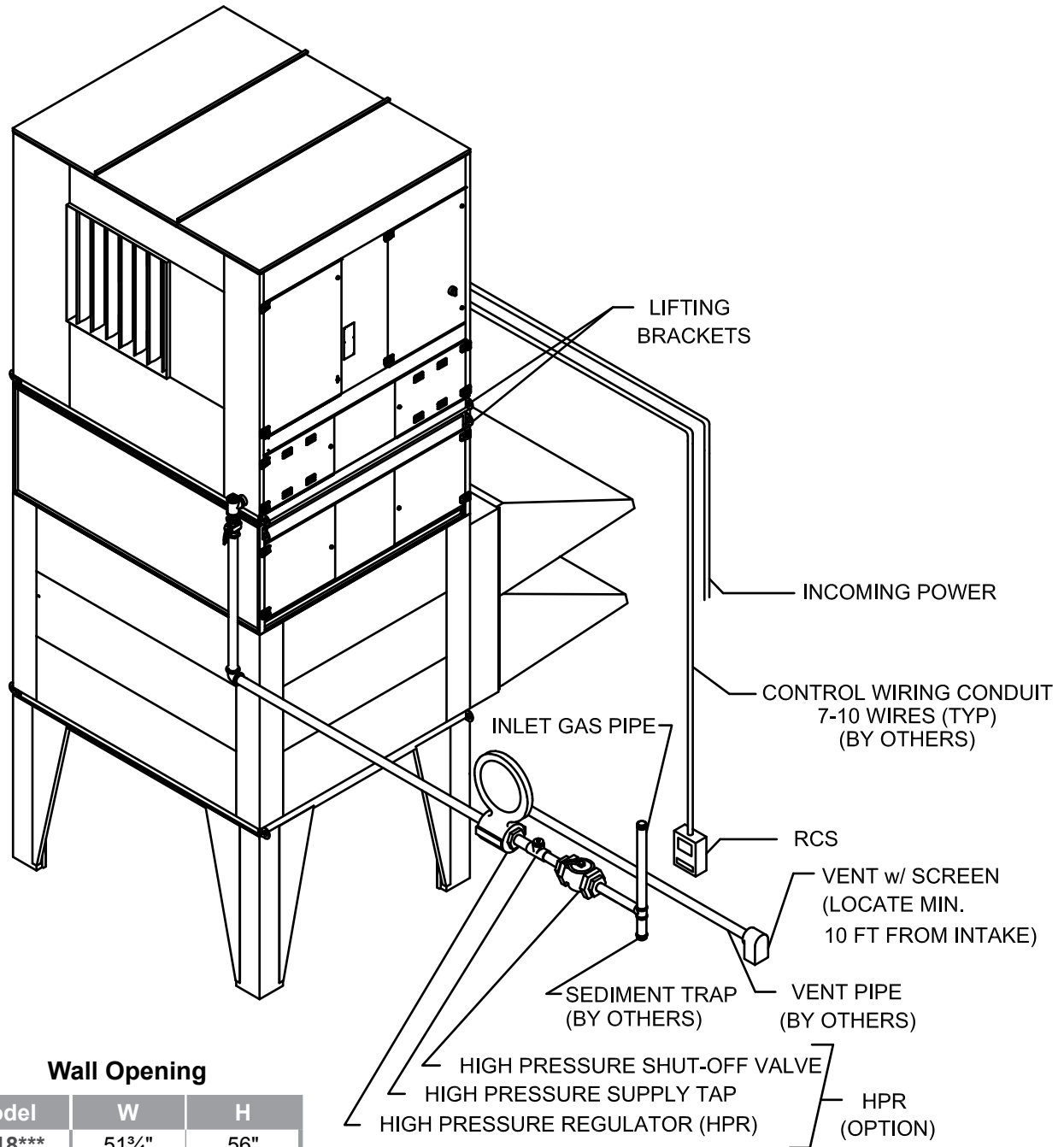
11. Install the discharge accessory by screwing the accessory to the heater. Install hanging rods from the ceiling supports to the accessory's support brackets.

12. For drain trough installation, see the field installation detail provided with the component.

13. For M140 installations, see the field assembly drawings provided with the components.

14. Adjust internal vibration isolation, if applicable, per the setup instructions provided with this manual.

**TYPICAL INSTALLATION
VERTICAL MOUNT - INDOOR CONFIGURATION
HORIZONTAL BLAST
M118 - M136**



Wall Opening

Model	W	H
M118***	51 ³ / ₄ "	56"
M120***	57 ³ / ₄ "	56"
M125***	69 ³ / ₄ "	72 ¹ / ₂ "
M130****	92 ¹ / ₂ "	73 ¹ / ₂ "
M136****	104"	83 ¹ / ₂ "

*** DIMENSIONS ALLOW FOR 1¹/₂" CLEARANCE ON EACH SIDE

**** DIMENSIONS ALLOW FOR 2" CLEARANCE ON EACH SIDE

INSTALLATION INSTRUCTIONS

GAS PIPING

IMPORTANT

Refer to the heater rating plate for determining the minimum gas supply pressure for obtaining the maximum gas capacity for which this heater is specified. Any field installed components, including, but not limited to meters, regulators, pipe elbows, pipe nipples and strainers must be installed such that the minimum operating supply pressure for obtaining the maximum gas capacity is provided.

1. Check with the local utility or gas supplier for the facility gas supply pressure.

⚠CAUTION:

If the gas supply pressure is in excess of the maximum standing pressure indicated on the heater nameplate, a separate positive shut-off high pressure regulator must be added upstream of the heater's individual manual shut-off valve. This regulator must be vented to the outside of the building at least 10 feet from any intake opening. The vent pipe should be designed to prevent the entry of water, snow, insects or other foreign material that could cause blockage. There must be no reduction in the size of the vent piping. Depending on the length and the configuration of the vent piping the pipe size may need to be increased. Refer to the applicable codes for proper sizing.

⚠WARNING:

For roof mounting, the gas and electrical connections must not penetrate the unit base or mounting curb. Cambridge Air Solutions recommends using pitch pockets or roof boots to seal the penetrations.

2. Properly size the gas supply piping for the rated capacity, per local codes, and/or the National Fuel Gas Code, NFPA 54, ANSI Standard Z223.1 or the CAN/CGA B149 Installation Codes.
3. Make sure the supply piping is free of foreign matter and purged.
4. Verify that the gas piping, when installed, will not restrict or block the access door from fully opening.

5. Install gas piping to the make-up air heater in accordance with local codes or, in their absence, in accordance with the National Fuel Gas Code, NFPA 54, ANSI Standard Z223.1, or the CAN/CGA B149 Installation Codes.

IMPORTANT

A 1/8" NPT tap is supplied with the heater for measuring the gas supply pressure. The tap is shipped with the low gas pressure shut-off valve. The valve assembly is shipped loose and tie wrapped to the gas train, to be field installed. If the gas supply pressure exceeds that indicated on the nameplate, the installer must install a 1/8" NPT tap and high pressure manual shut-off valve upstream of the high gas pressure regulator.

IMPORTANT

An adequate sediment trap must be installed prior to all gas controls for the heater and as close to the gas inlet connection of the heater as practical.

Many gas train components are equipped with listed Vent Limiters as atmospheric bleeds, however, local codes may require that these vents and bleeds be vented to the outdoors. If so, the vent piping should be designed to prevent the entry of water, snow, insects or other foreign materials that could cause blockage.

6. Check for leaks in the supply piping system. Use liquid gas leak detector. Do NOT use flame.

⚠CAUTION:

If the test pressure is in excess of 1/2 PSIG (3.5 KPA), the heater and its manual shut-off valve must be disconnected from the gas supply system during pressure testing. Failure to comply will void the warranty.

If the test pressure is less than or equal to 1/2 PSIG (3.5 KPA), the heater must be isolated from the gas supply piping by closing its manual shut-off valve during pressure testing.

⚠CAUTION:

Do not attempt to start the make-up air heater at this time. Premature start-up can result in damage to the equipment and components.

INSTALLATION INSTRUCTIONS

ELECTRICAL

IMPORTANT

Before attempting electrical installation, review the following instructions and wiring and connection diagrams to make sure you have a thorough understanding of what is required.

⚠WARNING:

High voltage electrical input to this equipment is required. EXTREME caution should be exercised. This equipment must be electrically grounded in accordance with local codes or in accordance with National Electrical Code ANSI/NFPA No. 70.

1. Check the heater nameplate to determine the voltage and amperage requirements.

⚠CAUTION:

If the supply voltage does not agree with the nameplate voltage, notify your local agent or Cambridge Air Solutions' Customer Service Group at 800-473-4569.

⚠WARNING:

For roof mounting, the gas and electrical connections must not penetrate the unit base or mounting curb. Cambridge Air Solutions recommends using pitch pockets or roof boots to seal the penetrations.

2. Wire the supply wiring and adequate Branch Circuit Protection in accordance with the National Electric Code ANSI/NFPA 70.
3. Mount the Remote Control Station in a location inside of the building and convenient to the operator without being susceptible to damage.
4. Space temperature sensors are normally located along a perimeter wall and out of the direct path of the discharge air or air infiltration. Consult the design drawing or your local Cambridge Air Solutions Representative for placement assistance. Do not locate the remote mounted temperature sensors immediately adjacent to overhead doors because the infiltration air can affect the sensor when the door is closed and may not adequately sense the temperature when the door is open. In dock areas,

the sensor should be located on the first column in from the outside wall.

IMPORTANT

Observe the special notes and instructions on the wiring diagrams including the following:
The wiring for the space temperature sensors must be shielded, twisted-pair wiring and must be run separately from the other line voltage AC wiring. This also applies to other remotely mounted controls utilized in the Maxitrol Series 14 and 44 control systems. Shielded wire which is routed to the electrical control enclosure on the heater should extend beyond the high voltage section of the enclosure before the shielding is removed and the wiring is distributed to its ultimate destination. Shielding must be grounded on one end only.

IMPORTANT

Conduit connections for power and control wiring must be caulked to ensure a tight seal and prevent moisture accumulation.

5. Wire the Remote Control Station and other temperature control options using Class 2 wiring per Cambridge Air Solutions wiring diagram and National Electrical Code Article 725 or local codes.
6. Run conduit and primary wiring to the disconnect switch inside of the control enclosure on the heater per N.E.C., Article 430, ANSI/NFPA 70.
7. If applicable on vertical mount, feed the damper wiring cable from the gas train enclosure to the damper actuator J-box. Follow the instructions provided that are attached to the cable. Connect wiring to the damper motor junction box per the wiring diagram.
8. Return the wiring diagram to the manual holder. Replace and fasten all access covers.

⚠CAUTION:

Do not attempt to start the make-up air heater at this time.
Premature start-up can result in damage to the equipment and components.

START-UP INSTRUCTIONS FOR NON-VARIABLE FREQUENCY DRIVE (VFD) HEATERS

1. Visual Inspection Of Equipment
(page 30)
2. Electrical Supply Voltage Verification
(page 30)
3. Gas Supply Pressure Verification
(page 31)
4. Blower Rotation Check
(page 31)
5. Burner Profile Damper Pressure Drop Check
(page 31)
6. Motor Amp Draw Check
(page 32)
7. Calculating and Adjusting
Burner Manifold Pressure
(page 32)
8. Gas Valve Leak Check
(page 33)
9. Gas Train Leak Check
(page 34)
10. Minimum Fire Setting
(page 34)
11. Low Fire Start Adjustment
(page 35)
12. Final Heater Preparation
(page 36)
13. Preliminary Remote Control Station
Operational Check
(page 36)

After start-up, please complete and fax the M-Series Start-Up Checklist to the Cambridge Customer Service Group. Receipt of a completed checklist will extend the start date for your warranty period to the date of the start-up but not to exceed six months from date of shipment.

If applicable, compare all variable frequency drive (VFD) parameters with specifications provided in the manual holder of the Electrical/Gas Enclosure in the heater.

IMPORTANT

Read the following instructions carefully. Any unauthorized modifications to, or deviations from these instructions may void the warranty.

1. VISUAL INSPECTION OF EQUIPMENT

- a. Check for any physical damage from shipping or installation that could render the heater inoperable.
- b. Verify all heater accessories and filters (if applicable) have been properly installed.
- c. Check for loose components (belts, plugs, terminal screws, etc.).
- d. Verify the access doors and controls enclosure are free from obstructions, such that they can be fully opened.
- e. Verify the field wiring, both primary and control, has been installed according to the Cambridge Air Solutions wiring diagram and the National Electrical Code.
- f. Verify that a sediment trap has been provided upstream of other gas train components.
- g. Verify the high pressure regulator and/or vent limiter, if applicable, have been vented to the outside of the building at least 10 feet from any intake opening.
- h. Verify the factory supplied manual gas shut-off cock is installed external to the heater and downstream of the high pressure regulator, if applicable.
- i. Verify that the gas piping unions are tight.
- j. Verify that the burner union is tight.

2. ELECTRICAL SUPPLY VOLTAGE VERIFICATION

For model M110 - M115 heaters, remove electrical enclosure access door and check the electrical supply voltage at the terminal block provided off of the disconnect switch. For model M118 - M140 heaters, remove electrical control enclosure access door and check the electrical supply voltage at the disconnect switch. For electrical control enclosure drawings, see page 78 for M110 - M115, page 79 for M118 - M136 and page 80 for M140 .

⚠CAUTION:

Do not proceed with start-up unless the supply voltage agrees with the nameplate voltage. If the supply voltage does not agree with the nameplate voltage, check with your local Cambridge Air Solutions representative or Cambridge Air Solutions’ Customer Service Group at 800-473-4569 to determine what changes are required.

3. GAS SUPPLY PRESSURE VERIFICATION

Verify that the gas supply pressure complies with the heater nameplate.

⚠CAUTION:

Do not proceed with start-up unless the gas supply pressure agrees with the nameplate pressure requirements. If the gas supply pressure is in excess of the maximum pressure indicated, a separate positive shut-off high pressure regulator must be added upstream of the heater’s low pressure manual shut-off valve. If a high pressure regulator is needed and has not been installed, check with your local Cambridge Air Solutions representative or Cambridge Air Solutions’ Customer Service Group at 800-473-4569 to determine the size and capacity requirements that are required.

4. BLOWER ROTATION CHECK

- a. Open the access door on the electrical control enclosure side and turn the disconnect switch on.

⚠WARNING:

When the disconnect switch is activated with the enclosure open, live power is present. Only experienced technicians with knowledge and respect for live power should proceed beyond this point.

- b. Turn the blower service switch to the “LOCAL” position. The blower motor will start after the motorized damper opens. Then turn the blower service switch to the “OFF” position and verify the blower is rotating in the proper direction. (See the directional arrow on the blower housing.)

IMPORTANT

On a three phase system, the rotation direction of the blower may be reversed by switching any two wires located on the downstream side of the service disconnect. The electrical supply to the heater must be turned off prior to switching the wiring.

IMPORTANT

Indications of loose belts include barking or squealing when the blower starts. If these symptoms occur, please refer to the BELT TENSIONING section of the MAINTENANCE INSTRUCTIONS (page 60). Periodic belt adjustments may be required.

5. BURNER PROFILE DAMPER PRESSURE DROP CHECK

IMPORTANT

The blower access doors must be in place when adjusting the profile plate.

IMPORTANT

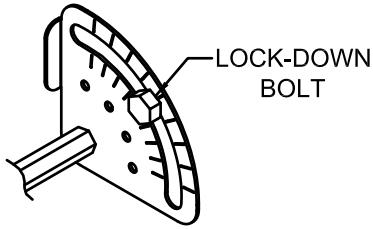
Verify that the inclined manometer, if applicable, is level and zeroed for proper readings to be obtained.

- a. Turn the blower service switch to the “LOCAL” position. (Note: The burner service switch must remain in the “OFF” position)
- b. Check the pressure drop across the burner profile plate to ensure that it complies with the table below:

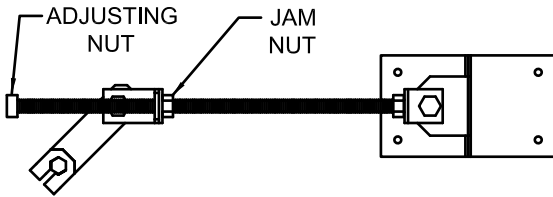
Profile Plate Pressure Drop - Blower Only (inches WC)

Gas Type	Models	Filters	Manual Adjust	Automatic Adjust	
				Min.	Max.
Natural	M110-M140	No	0.68	0.62	0.72
	M110-M136	Yes	0.72		
	M140	Yes	0.75		
LP	M110-M140	No	0.90	0.84	0.94
	M110-M136	Yes	0.94		
	M140	Yes	0.97		

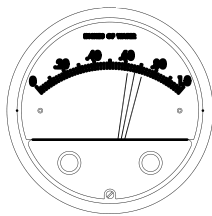
- c.1. To change the profile plate pressure drop on model M110 - M115 heaters with a Manual Profile Adjust mechanism, locate the adjusting mechanism in the electrical control enclosure, loosen the lock-down bolt, and rotate the adjuster to increase or decrease the pressure as required. Retighten the lock-down bolt to secure the mechanism.



c.2. To change the profile plate pressure drop on model M118 - M140 heaters with a Manual Profile Adjust mechanism, locate the adjusting mechanism in the gas train enclosure, loosen the jam nut, and rotate the adjusting nut to increase or decrease the pressure drops, as required. Hold the adjusting nut and retighten the jam nut to secure the mechanism.



c.3. For make-up air heaters with an Automatic Profile Adjust system, check the Differential Pressure Switch/Gauge and verify that the left orange needle is set to the Minimum setting and the right orange needle is set to the Maximum setting as defined in the the column labeled "Automatic Adjust" in the table on page 31.



IMPORTANT

Call the Cambridge Air Solutions Customer Service Group at 800-473-4569 if unable to obtain the required pressure drop across the burner profile plate.

6. MOTOR AMP DRAW CHECK

IMPORTANT

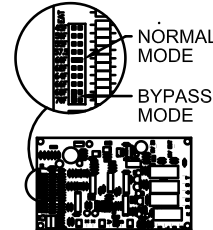
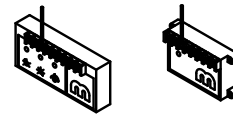
The heater access doors must be closed for this test.

- a. Check the motor current at the overload relay on all three legs.
- b. Turn the blower service switch to the "OFF" position.

IMPORTANT

The average amps must not exceed the motor nameplate FLA. High amperage may indicate excessive blower RPM. Call the Cambridge Air Solutions Customer Service Group at 800-473-4569 if unable to obtain acceptable amperage readings.

7. CALCULATING AND ADJUSTING BURNER MANIFOLD PRESSURE



- a. Turn the disconnect switch off.
 - b.1. For units with an A1014 or an A1044 amplifier: Disconnect #3 wire from the amplifier to drive the modulating valve to full open and keep the heater in continuous high fire.
 - b.2. For units with a signal conditioner (SC25S):
 - Check control signal (4-20 mA, 0-10 VDC).
 - Disconnect push ons at Sensor terminals T1 & T2 of the SC25S. This will take the discharge temperature sensor TS194(Q) out of the circuit.
 - Place an 1100 Ohm resistor across T1 & T2. This will mimic the sensing of ambient air. Since the TS194(Q) can no longer sense temperature, it cannot override the control signal, reduce the DC voltage and maintain discharge limits between the set limits.
 - Note polarity of the terminals: #5 is negative, #6 is positive.

- Disconnect push ons at Input Signal terminals #5 & #6.
- Connect test leads with alligator clips from a current/voltage signal generator to terminals #5 & #6.
- This will drive the modulating valve to full open and keep the heater in continuous high fire.

- c. If the ambient temperature is at or above the Entering Air Thermostat (EAT) setpoint on the multi-functional PC board, then note the setpoint position and set the EAT to its highest setting (see page 94). If the ambient temperature exceeds its highest setting, remove the set point jumper and rotate 90° for the bypass mode.
- d. Remove the 1/8" NPT plug from the manual shut-off valve located just prior to the burner and connect a manometer for the purpose of measuring the manifold pressure.
- e. Refer to the heater nameplate for the Manifold Differential Pressure (MDP) (inch WC) for which the heater was specified.

Record the Nameplate Manifold Differential Pressure

- f. Turn the disconnect switch on.
- g. Turn the blower service switch to the "LOCAL" position. The blower motor will start. Monitor the pressure reading on the manometer. Record the Manifold Static Pressure (Blower Only).
- h. Using the formula below, calculate the required manifold pressure:

$$\begin{array}{l}
 \text{Nameplate Manifold Differential Pressure} \\
 \underline{\hspace{2cm}} \text{ inch WC} \\
 + \text{ Manifold Static Pressure (Blower Only)} \\
 \underline{\hspace{2cm}} \text{ inch WC} \\
 = \text{ Calculated Manifold Pressure} \\
 \underline{\hspace{2cm}} \text{ inch WC}
 \end{array}$$

IMPORTANT

The high limit may trip on warm days. If this occurs allow the high limit to cool by leaving the blower only on for 3-5 minutes. Turn the blower and burner switches to the "OFF" position. Access the high limit and manually reset. Replace access panels. Turn the blower and burner switches to the "LOCAL" position.

- i. Turn the burner service switch to the "LOCAL" position. After a delay for pre-

purge and igniter warm-up, the burner will light.

- j. Observe the manometer reading and compare to the Calculated Manifold Pressure above. If the manifold pressure reading does not equal this value, adjust the manifold pressure regulator until the proper manifold pressure is obtained. See page 76 for gas train drawings.

IMPORTANT

The pressure drop across the burner profile damper that was adjusted in Step 5 (page 31) must not fall below 0.51 inches WC for natural gas heaters without filters or 0.55 inches WC for natural gas heaters with a filter section or filters in the rainhood. The pressure drop must not fall below 0.75 inches WC for LP gas heaters without filters or 0.79 inches WC for LP gas heaters with a filter section or filters in the rainhood. If the pressure drop is below these values the low airflow switch will shutoff power to the burner. This is an indication of low airflow or burner overfiring. To correct this condition, either adjust the manifold pressure regulator to reduce the manifold pressure or increase the blower speed, provided the motor full load amps are not exceeded.

- k. Turn the blower and burner service switches to the "OFF" position, remove the manometer from the manual shut-off valve, re-install the 1/8" NPT plug.

8. GAS VALVE LEAK CHECK

All heaters should be evaluated for the gas tightness of the gas valve seat. Heaters with separate redundant valves are equipped with a leak test facility to assist in checking this seal. A momentary switch and a gas port for measuring pressure between valves are provided as the leak test hardware (page 76). Refer to the Individual Component Description Section (page 91) for more information regarding the leak test switch. The procedures for the gas valve leak check are as follows:

- a. Connect a 0 to 10 inches water column (inch WC) manometer to the 1/8" NPT tapped fitting on the manual shut-off valve located just prior to the burner for the purpose of monitoring an increase in pressure. Verify that the manometer is properly zeroed.
 - b.1. On single redundant valve applications (heaters rated less than 400,000 Btu/

hr), close the manual burner shut-off valve and wait 30 seconds to read the manometer. If the reading is greater than 0 inch WC, replace the gas valve and retest. If the reading is 0 inch WC, remove the manometer and reinstall the pipe plug.

- b.2. On heaters with separate redundant valves, close the manual burner shut-off valve, hold the momentary leak test switch in the closed position, and wait 30 seconds to read the manometer. If the reading is greater than 0 inch WC, refer to the Maintenance Instruction Section for information on Gas Valve Cleaning (page 62) for cleaning the safety shut-off valve (SSV) which is closest to the burner and retest. If the reading is 0 inch WC, remove the manometer and reinstall the pipe plug.
- c. To check the gas tightness of the shut-off valve (SOV) in the gas train which is farthest from the burner on heaters with separate redundant valves, connect the manometer to the leak test port between the valves and verify that the manometer is properly zeroed. Wait 30 seconds to read the manometer. If the reading is greater than 0 inch WC, refer to the Maintenance Instruction Section (page 62) for information on Gas Valve Cleaning for the shut-off valve (SOV) gas valve and retest. If the reading is 0 inch WC, remove the manometer and reinstall the pipe plug.

9. GAS TRAIN LEAK CHECK

- a. Turn the blower and burner service switches to the “LOCAL” position.
- b. With the burner operating, spray the complete gas train with leak detector solution, checking all pipe connections and plugs.
- c. Turn the blower and burner service switches to the “OFF” position.

⚠WARNING:

Do not use flame to leak check piping.

⚠WARNING:

Any gas leak detected must be repaired before the make-up air heater is placed into service.

10. MINIMUM FIRE SETTING

IMPORTANT

All access doors must be closed during this procedure.

- a.1. For units with an A1014 or an A1044 amplifier: Reinstall #3 wire on the amplifier that was removed in Step 7.b.1 (See page 32).
- a.2. For units with a signal conditioner (SC25S): Remove the 1100 Ohm resistor and re-install the push ons for T1 & T2 and terminals #5 & #6 that were removed in Step 7.b.2. (See page 32).
- b. Connect a meter set to read DC microamps (μA) in order to verify the minimum fire flame signal during the adjustment process. Connect the meter by removing the red wire from terminal FP of the flame safeguard relay (FSR) and attaching the positive lead of the meter to terminal FP and the negative lead to the red wire.
- c. Turn the blower and burner switches to the “LOCAL” position.
- d.1. For units with an A1014 or an A1044 amplifier: After the burner has ignited, remove the #8 wire from the amplifier to drive the modulating valve to minimum fire.
- d.2. For units with a signal conditioner (SC25S): After the burner has ignited, remove the push on for terminal #3 to drive the modulating valve to minimum fire.
- e. Look through the burner viewport in the front of the heater to verify that the burner flame is a very small ribbon (approximately 1-1/2" to 2" long) that is evenly spread across the burner (without gaps).

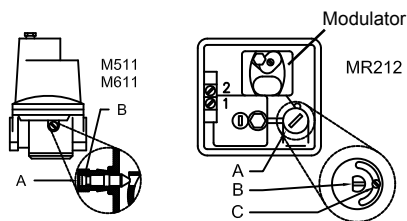
- f. Verify that the minimum fire flame signal is steady and above 2.0 microamps (μA).

IMPORTANT

If any of the conditions in steps 10.e and 10.f are not met, an adjustment is required.

g. Minimum Fire Adjustment

- i. On M511 or M611 modulating valves, to adjust the minimum fire, remove cap (A) exposing the minimum fire adjusting screw. On the MR212 modulating/regulating valve, remove the housing cover, then cap (A), and then loosen lock screw (C). Turn the adjusting screw (B) to obtain the desired minimum fire setting. A clockwise rotation decreases the flame size and reduces minimum flow rate. Repeat steps 10.e and 10.f.



- ii. Replace the cap (A). Tighten the lock screw (C) on the MR212 valve prior to reinstalling the cap and housing cover.
- iii. Turn the blower and burner service switches to the “OFF” position.
- iv.1. For units with an A1014 or an A1044 amplifier: Reinstall the #8 wire on the amplifier that was removed in Step 10.d.1 (See page 34).
- iv.2. For units with an SC25S signal conditioner: Reinstall the push on for terminal #3 on the signal conditioner that was removed in Step 10.d.2 (See page 34).
- v. Remove the meter and reattach the red wire to terminal FP on the FSR board.

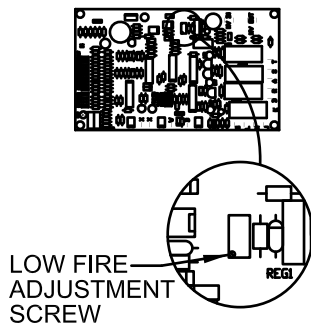
11. LOW FIRE START ADJUSTMENT

The Low Fire Start control setting is preset at the factory to provide a fixed, repetitive, initial firing rate that equates to the following for most burner applications:

- 20°F to 30°F temperature rise
- 0.10 to 0.30 inches WC manifold differential pressure (above blower pressure)
- Voltage to the modulating valve of 9 to 11 Volts DC for the Maxitrol M511 or M611 valve and 10 to 13 Volts DC for the Maxitrol MR212 valve.
- Flame length of 3" to 5"

The Low Fire Start function lasts for 15 seconds before returning to the control of the temperature control system. It is important that the flame travels across the burner length fast enough (within 2 seconds) to establish the flame signal during the trial for ignition period. If adjustment is required, proceed as follows:

- Connect a meter in the flame sense circuit as in step 10.b (page 34).
- Connect a manometer to the burner static pressure port. Turn the blower service switch to the “LOCAL” position and the burner service switch to the “OFF” position and measure the burner static pressure.
- Connect a DC voltmeter to terminals “MV OUT” on the multi-functional PC board.
- Turn the burner service switch to the “LOCAL” position and monitor the modulating valve voltage, flame length, manifold differential pressure, and the time required to establish flame signal after the gas valves are energized. (This may need to be repeated several times to note all of the above information)
- If adjustment is required, the Low Fire Start adjustment screw is located on the multi-functional PC board as shown in the drawing. Only minor adjustments are normally required to obtain the proper setting.



12. FINAL HEATER PREPARATION

- a. Turn the disconnect switch off.
- b. Set the Entering Air Thermostat (EAT) to the specified temperature setting. Refer to the Individual Component Description Section for additional information (page 94).
- c.1. For units with an A1044 amplifier: Set the “MIN” and “MAX” setting of the amplifier to the application specifications.
- c.2. For units with an SC25S signal conditioner: Set the Min DA (Discharge Air) and Max DA settings to the application specifications.
- d. For adjustment of the Clogged Filter Switch, refer to the procedure that is provided with this manual.
- e. Verify the blower and burner service switches are in the “REMOTE” position.
- f. Return the Technical Manual and Wiring Diagram to the manual holder.
- g. Perform a visual inspection of all wiring and gas valve plugs to ensure they have been properly replaced.
- h. Replace and fasten all covers and panels. Turn the disconnect switch on.

13. REMOTE CONTROL STATION OPERATIONAL CHECK

- a. Identify the type of Remote Control Station, if applicable, that is utilized on this application. Refer to Individual Component Description Section for additional information (page 89).

- b. Turn the blower and burner service switches to the “REMOTE” position and, if applicable, turn the Remote Control Station mode selector switch to the “HEATING” position.
- c.1. If the Remote Control Station utilizes a thermostat, refer to the Operating Instructions for the Electronic Thermostat (page 45) or the TSS Controller (page 47) to set the thermostat at its highest setting.
- c.2. If another device in the Remote Control Station controls the operation of the heater, activate this device.
- c.3. If the make-up air heater is not equipped with a Remote Control Station, activate that part of the control system which will initiate the blower and burner operation.
- d. After a short delay for damper operation, the blower should operate, followed by burner ignition after a delay for prepurge and igniter warm-up.
- e. Adjust the applicable temperature control and verify the heater output changes. See page 88.
- f. Reset the thermostat, if applicable, and the temperature control to the desired temperature.
- g. Turn the mode selector switch to the “SUMMER VENTILATION” position. Verify the blower operates.

SHUT-DOWN INSTRUCTIONS

1. Turn the mode selector switch of the Remote Control Station to the “OFF” position.
2. Turn the service disconnect switch off.
3. Turn the blower and burner service switches to the “OFF” position.
4. Close the supply gas cock.
5. Turn off the electric supply to the heater.

IMPORTANT

If you need technical assistance, call the Cambridge Air Solutions Customer Service Group at 800-473-4569 during the hours of 8:00 a.m. to 5:00 p.m. Central Time, Monday through Friday.

VARIABLE FREQUENCY DRIVE (VFD) START UP PROCEDURE

⚠CAUTION:

Read the following instructions carefully. Any unauthorized modifications to, or deviations from these instructions may void the warranty.

1. VISUAL INSPECTION OF EQUIPMENT

- a. Check for any physical damage from shipping or installation.
- b. Verify all heater accessories and filters (if applicable) have been properly installed. Filters may be shipped loose inside heater cabinet.
- c. Check for loose components (belts, plugs, terminal screws, etc.).
- d. Verify the access doors and electrical enclosure doors are free from obstructions, such as they can be fully opened / removed.
- e. Verify the field wiring, both primary and control, have been installed according to the Cambridge Air Solutions wiring diagram and the National Electrical Code. Some control circuits may need to be run using shielded twisted pair wire; they will be noted on the heater schematic on “NOTE 1”.
- f. Verify a sediment trap has been provided upstream of all gas train components, including external high pressure gas regulators (if applicable).
- g. Verify the high pressure regulator and/or vent limiter, if applicable, have been vented to the outside of the building at least 10’ from any intake opening. Vent piping cannot be reduced and cannot exceed 20’ of linear piping. 90-degree elbows will add 5’ to the total length of linear pipe. The vent size will need to be increased to the next nominal pipe size for every 10’ over 20’.
- h. Verify the factory supplied manual gas shutoff cock is installed external to the heater and downstream of the high pressure regulator, if applicable.
- i. Verify that the gas piping unions are tight.
- j. Verify that the burner union is tight.

2. ELECTRICAL SUPPLY VOLTAGE VERIFICATION

For model M110 - M115 heaters, remove electrical control enclosure access door and check the electrical supply voltage at the terminal block which is adjacent to the disconnect switch. For model M118 - M140 heaters, check the electrical supply voltage at the disconnect switch. If the supply voltage matches the heater nameplate, turn the disconnect switch to the “ON” position.

⚠CAUTION:

Do not proceed with start-up unless the supply voltage agrees with the nameplate voltage. If the supply voltage does not agree with the nameplate voltage, check with your local Cambridge Air Solutions representative or Cambridge Air Solutions’s Customer Service Group at 800- 473-4569 to determine what changes are required.

3. GAS SUPPLY PRESSURE VERIFICATION

Verify that the gas supply pressure complies with the heater nameplate.

⚠CAUTION:

Do not proceed with start-up unless the gas supply pressure agrees with the nameplate pressure requirements. If the gas supply pressure is in excess of the maximum pressure indicated, a separate positive shut-off high pressure regulator must be added upstream of the heater’s individual low pressure manual shut-off valve. If a high pressure regulator is needed and has not been installed, check with your local Cambridge Air Solutions representative or Cambridge Air Solutions’s Customer Service Group at 800-473-4569 to determine the size and capacity requirements that are required.

4. BLOWER ROTATION CHECK

- a. Open / remove the blower access door(s) on the electrical control enclosure side of the heater and verify the disconnect switch is in the “ON” position.

⚠WARNING:

When the disconnect switch is activated with the electrical control enclosure door open, live power is present. Only experienced technicians with knowledge and respect for live power should proceed beyond this point.

- b. Place the blower service switch in the “LOCAL” position. Once the damper (inlet / discharge) opens and makes the end switch (if applicable), press the “HAND” button on the VFD keypad. The VFD will energize the blower motor. Allow the blower to run for a few seconds then turn the blower service switch to the “OFF” position. Verify the blower is rotating in the proper direction. (See the directional arrow on the blower housing.) Once the blower rotation is verified, re-install the blower access door(s) and latch.

- b. Once the Hz on the VFD display stop climbing, verify the VFD is showing 60 Hz on the display. If the Hz are not at 60, press the “UP” arrow on the VFD keypad until the Hz reach 60. Verify the pressure reading on the photohelic gauge (black needle) is between the two orange needles. Verify the photohelic settings (orange needles) comply with the settings below:

Profile Plate Pressure Drop -
Blower Only (inches WC)

Natural Gas

The left orange needle on the photohelic should be set to .62” and the right orange needle should be set to .72”. Be sure right needle does not exceed .72”.

LP Gas

The left orange needle should be set to .84” and the right orange needle should be set to .94”. Be sure the right needle does not exceed .94”.

NOTE: The unit is equipped with a low temperature cutout (LTC) relay; it is a 3 1/2 minute time delay relay that is part of the freeze protection circuit. The LTC monitors the incoming air temperature and cycles the unit off in 3 1/2 minutes if the incoming air temperature is 45°F or below and the burner is not energized. If the outdoor temperature is 45°F or below and the blower shuts down, place the blower service switch in the “OFF” position for 2-seconds. Then place the blower service switch back to the local position. This may have to be done several times.

If the pressure measured on the photohelic gauge does not settle between the two orange needles, please contact Cambridge Air Solutions’s Customer Service Group at 800-473-4569.

5. BURNER PROFILE DAMPER PRESSURE DROP CHECK

IMPORTANT

The blower access doors must be in place when verifying the profile static on the photohelic gauge. Verify the photohelic gauge is zeroed with the blower in the “OFF” position.

- a. Place the blower service switch in the “LOCAL” position and verify the VFD display is still in the “HAND” mode. (Note: The burner service switch must remain in the “OFF” position)

6. MOTOR AMP DRAW CHECK – HIGH SPEED

IMPORTANT

The blower access doors must be closed for the duration of the start-up procedure.

-Note: The burner service switch must remain in the “OFF” position.

-Note: The VFD should still be in “HAND” mode and the Hz at 60.

- a. Document the nominal motor current from parameter 9906 of the VFD. This is the blower motor full load amps (FLA). To access the VFD parameters, press the “MENU” button on the VFD keypad and use the arrows to scroll to “PARAMETERS” and press “ENTER”. Then scroll to group “99” and press “ENTER”. Then use the arrows to scroll to parameter 9906 to view.
- b. Locate the “VFD SPEC’S” sticker located on the subpanel to the right of the VFD and document the “AMPS @ DESIGN”.
- c. Document the actual “AMPS” from the VFD display. The amps on the VFD display should be within 10% of the “AMPS @ DESIGN”.
- d. If amps on VFD display are greater / less than 10% of “AMPS @ DESIGN”, please contact the Cambridge Customer Service Group at 1-800-473-4569. In order for the unit to operate at the specified CFM, the High Speed amps need to be at the “AMPS @ DESIGN”.

IMPORTANT

The average amps must not exceed the motor nameplate FLA. High amperage may indicate excessive blower RPM. Call the Cambridge Air Solutions Customer Service Group at 800-473-4569 if unable to obtain acceptable Amperage readings.

7. BURNER PROFILE DAMPER PRESSURE CHECK – LOW SPEED

IMPORTANT

-Note: The burner service switch must remain in the “OFF” position.

-Note: The VFD should still be in “HAND” mode.

- a. Press the down arrow on the VFD keypad and hold till the Hz reach the low speed programmed in the VFD; the hertz will stop at the programmed low speed hertz. Document the low speed Hz read on the VFD display.
- b. Document the pressure read on the photohelic gauge.

IMPORTANT

If the pressure on the photohelic gauge is less than .62” (NG) or .84” (LP), please contact the Cambridge Customer Service Group at 1-800-473-4569. If the low speed pressure measured on the photohelic is too low, the low speed airflow is inadequate and may cause equipment resets or burner short cycling.

8. LOW FIRE START ADJUSTMENT

The Low Fire Start control setting is preset at the factory to provide a fixed, repetitive, initial firing rate that equates to the following for most burner applications:

- 20°F to 30°F temperature rise
- 0.10 to 0.30 inches WC manifold differential pressure (above blower pressure)
- Voltage to the modulating valve of 11 to 14 VDC
- Flame length of 3" to 5"
- Flame signal of 3-5uA

The Low Fire Start function lasts for 15 seconds before returning control to the temperature control system. It is important that the flame travels across the burner length fast enough (within 1 second) to establish the flame signal during the trial for ignition period. If adjustment is required, proceed as follows:

- a. Connect a meter set to read DC micro amps (□A) in order to verify the minimum fire flame signal during the adjustment process. Connect the meter by removing the red wire from terminal FP of the flame safeguard relay (FSR) and attaching the positive lead of the meter to terminal FP and the negative lead to the red wire.
- b. Verify the blower service switch is in the “LOCAL” position and the burner service switch is in the “OFF” position.
- c. Connect a DC voltmeter to terminals “MV OUT” on the multi-functional PC board.
- d. Press and hold the “UP” arrow on the VFD keypad and increase the Hz to 60 Hz (or the max programmed Hz. The max Hz may have been changed in step 6.d in order to reach the “AMPS @ DESIGN”).
- e. Place the burner service switch in the “LOCAL” position. Once the burner fires, monitor the voltage measured on the “MV OUT” terminals of the multi-functional PC board and the time required to establish flame signal after the gas valves are energized.

NOTE: This may need to be repeated several times to record the above information. The LFS light on the main PCB must remain off while setting the Low Fire Start Voltage. If the LFS light energizes, turn the burner service switch to the “OFF” position for 2 seconds then back to the “LOCAL” position. Once the burner fires, continue making your adjustments if necessary.

- f. If adjustment is required, the Low Fire Start adjustment screw (POT 1) is located on the multi-functional PC board as shown in the drawing below. Only minor adjustments are normally required to obtain the proper setting. To increase the Low Fire Start voltage, turn POT1 clockwise. To decrease the Low Fire Start voltage, turn POT1 counter clockwise.

9. CALCULATING AND ADJUSTING BURNER MANIFOLD PRESSURE FOR HIGH SPEED

NOTE: The VFD should still be in “HAND” mode and at 60Hz.

- a. Turn the burner service switch to the “OFF” position.
- b. Disconnect wire #3 from the Maxitrol amplifier to drive the modulating valve to full open when the burner fires and the low fire start sequence has ended.
- c. Remove the 1/8" NPT plug from near the manual shut-off valve located just prior to the burner and connect a manometer for the purpose of measuring the manifold pressure. The manometer will need to be able to read a negative pressure of up to -2” WC.
- d. Refer to the heater nameplate and document the Manifold Differential Pressure (MDP) (inch WC) for which the heater was specified.
- e. Verify the blower service switch is in the “LOCAL” position.
- f. Record the Manifold Static Pressure measured on your manometer (Blower Only).
- g. Using the formula below, calculate the required manifold pressure:

$$\begin{aligned} & \text{Nameplate Manifold Differential Pressure} \\ & \underline{\hspace{2cm}} \text{” WC} \\ & + \text{Manifold Static Pressure (Blower Only)} \\ & \underline{\hspace{2cm}} \text{” WC (Should Be A Negative Pressure)} \\ & = \text{Calculated Manifold Pressure} \\ & \underline{\hspace{2cm}} \text{” WC} \end{aligned}$$

NOTE: A negative manifold static pressure (blower only) will cause the calculated manifold pressure reading to be lower than the nameplate manifold differential pressure.

IMPORTANT

The high limit may trip on warm or mild temperature days. A jumper across the high limit may be necessary to complete the manifold pressure adjustment.

- h. Turn the burner service switch to the “LOCAL” position. After a delay for pre-purge and igniter warm-up, the burner will light.
- i. The burner will fire in low fire start. After several seconds, the “LFS” light will energize on the multifunctional PC board; the burner will go into high fire.
- j. Observe your manometer reading and compare to the Calculated Manifold Pressure above. If the manifold pressure reading does not equal this value, adjust the unit regulator until the proper manifold pressure is obtained. The manifold pressure is changed by adjusting the unit regulator; White Rogers combination valve (brass or silver cap), Maxitrol RV53, Maxitrol RV61, Maxitrol RV81 or Maxitrol MR212 valve (under dime size cap).

IMPORTANT

The pressure drop across the burner profile damper that was adjusted in Step 5 must not fall below 0.51 inches WC for natural gas heaters without filters or 0.55 inches WC for natural gas heaters with a filter section or filters in the rain hood. The pressure drop must not fall below 0.75 inches WC for LP gas heaters without filters or 0.79 inches WC for LP gas heaters with a filter section or filters in the rain hood. If the pressure drop is below these values, it is an indication of low airflow or burner over firing. To correct this condition, either adjust the manifold pressure regulator to reduce the manifold pressure or increase the blower speed, provided the motor full load amps are not exceeded.

- k. Turn the burner service switch to the “OFF” position.

10. CALCULATING AND ADJUSTING BURNER MANIFOLD PRESSURE FOR LOW SPEED

Note: The VFD should still be in “HAND” mode.

- a. Press the down arrow on the VFD keypad and hold till the Hz reach the low speed programmed in the VFD; the hertz will stop at the programmed low speed hertz.
- b. Refer to the “VFD SPEC’S” sticker located on the subpanel to the right of the VFD and document the “MANIFOLD @ GEO SPEED”. This is the high fire pressure for low speed.
- c. Using the formula below, calculate the required manifold pressure for low speed:

$$\begin{array}{r} \text{Manifold @ Geo Speed} \\ \text{_____} \text{” WC} \\ + \text{ Manifold Static Pressure (Blower Only)} \\ \text{_____} \text{” WC (Should be A Negative Pressure)} \\ \hline = \text{ Calculated Low Speed Manifold Pressure} \\ \text{_____} \text{” WC} \end{array}$$

NOTE: A negative manifold static pressure (blower only) will cause the calculated low speed manifold pressure reading to be lower than the “MANIFOLD @ GEO SPEED” pressure noted on the “VFD SPEC’S” sticker.

IMPORTANT

The high limit may trip on warm or mild temperature days. A jumper across the high limit may be necessary to complete the manifold pressure adjustment.

- d. Turn the burner service switch to the “LOCAL” position. After a delay for pre-purge and igniter warm-up, the burner will light.
- e. The burner will fire in low fire start. After several seconds, the LFS light will energize on the multifunctional PC board; the burner will go into high fire.
- f. Observe your manometer reading and compare to the Calculated Manifold Pressure above. If the manifold pressure reading does not equal this value, adjust the low speed kit (LSK) until the proper manifold pressure is obtained. The LSK is a resistor that limits the voltage from

the amplifier to the modulating valve. If adjustment is required, the LSK adjustment screw is located on the LSK under the brass cylindrical cap as shown in the drawing below. Remove the cap, make the necessary adjustment and replace the cap. Only minor adjustments are normally required to obtain the proper setting.

- g. Place the burner service switch in the “OFF” position.

11. MINIMUM FIRE ADJUSTMENT (LOW FIRE BYPASS SETTING ON MODULATING VALVE)

IMPORTANT

- a. Reinstall the #3 wire previously removed from the amplifier.
- b. Connect a meter set to read DC micro-amps ($\square A$) in order to verify the minimum fire flame signal during the adjustment process. Connect the meter by removing the red wire from terminal FP of the flame safeguard relay (FSR) and attaching the positive lead of the meter to terminal FP and the negative lead to the red wire. This may have already been done in step 8a.
- c. Press the “UP” arrow on the VFD keypad until the Hz on the display reach 60Hz (or the max programmed Hz. The max Hz may have been changed in step 6.d in order to reach the “AMPS @ DESIGN”).
- d. Turn burner switch to the “LOCAL” position.
- e. After the burner has ignited and the low fire start sequence has ended (the LFS light will energize on the multifunctional PC board) remove #8 wire from the amplifier to drive the modulating valve to minimum fire (low fire bypass).
- f. Look through the burner porthole on the front of the heater to verify that the burner flame is a very small ribbon (approximately 1-1/2" to 2" long) that is evenly spread across the burner (without gaps).
- g. Verify that the minimum fire flame signal is steady and above 2.0 micro-amps ($\square A$) and document.

IMPORTANT

If any of the conditions in steps 10.f and 10.g are not met, an adjustment is required. Please refer to drawing below.

- h. Minimum Fire Adjustment
- i. To adjust the minimum fire on a maxitrol M411, M511 or M611, remove cap (A) exposing the minimum fire adjusting screw.

On the MR212 modulating / regulating valve, remove the housing cover, then cap (A), and then loosen lock screw (C). Turn the adjusting screw (B) to obtain the desired minimum fire setting. Repeat steps 11.e and 11.f until a consistent flame signal of 2-5uA or above is observed.

- ii. Replace the cap (A). Tighten the lock screw (C) on the MR212 valve prior to reinstalling the cap and housing cover.
- iii. Turn the blower and burner service switches to the "OFF" position.
- iv. Reconnect wire #8 to the amplifier.
- v. Remove the meter and reattach the red wire to terminal FP on the FSR board.

12. GAS VALVE LEAK CHECK

All heaters should be evaluated for the gas tightness of the gas valve seat. Heaters with separate redundant valves are equipped with a leak test facility to assist in checking this seal. A momentary switch and a gas port for measuring pressure between valves are provided as the leak test hardware. Refer to the Individual Component Description Section in the Technical Manual for more information regarding the leak test switch. The procedures for the gas valve leak check are as follows:

- a. Connect a 0 to 10 inches water column (inch WC) manometer to the 1/8" NPT tapped fitting on the manual shut-off valve located just prior to the burner for the purpose of monitoring an increase in pressure. Verify that the manometer is properly zeroed.
- b.1. On single redundant valve applications (heaters rated less than 400,000 Btu/hr), close the manual burner shut-off valve and wait 30 seconds to read the manometer. If the reading is greater than 0 inch WC, replace the gas valve and retest. If the reading is 0 inch WC, remove the manometer and reinstall the pipe plug.
- b.2. On heaters with separate redundant valves,

close the manual burner shutoff valve, hold the momentary leak test switch in the closed position, and wait 30 seconds to read the manometer. If the reading is greater than 0 inch WC, refer to the Maintenance Instruction Section for information on Gas Valve Cleaning for cleaning the second gas valve and retest. If the reading is 0 inch WC, remove the manometer and reinstall the pipe plug.

- c. To check the gas tightness of the first valve in the gas train on heaters with separate redundant valves, connect the manometer to the leak test port between the valves and verify that the manometer is properly zeroed. Wait 30 seconds to read the manometer. If the reading is greater than 0 inch WC, refer to the Maintenance Instruction Section in the Technical Manual for information on Gas Valve Cleaning for the first gas valve and retest. If the reading is 0 inch WC, remove the manometer and reinstall the pipe plug.

13. GAS TRAIN LEAK CHECK

- a. Turn the blower and burner service switches to the "LOCAL" position.
- b. With the burner operating, spray the complete gas train with leak detector solution, checking all pipe connections and plugs.
- c. Turn the blower and burner service switches to the "REMOTE" position.

14. PRELIMINARY REMOTE CONTROL STATION OPERATIONAL CHECK

- a. Turn the blower and burner service switches to the "REMOTE" position and, if applicable, turn the Remote Control Station mode selector switch to the "HEATING" position.
- b. Identify the type of Remote Control Station, if applicable, that is utilized on this application.

Refer to Individual Component Description Section for additional information.

- c.1. If the Remote Control Station utilizes a thermostat, refer to the Operating Instructions for the Electronic Thermostat or the TSS Controller in the Technical Manual to set the thermostat at its highest setting.
- c.2. If another device in the Remote Control Station controls the operation of the heater, activate this device.
- c.3. If the make-up air heater is not equipped with a Remote Control Station, activate that part of the control system which will initiate the blower and burner operation.
- d. After a short delay for damper operation, the blower will energize, followed by burner ignition after a delay for pre-purge and igniter warm-up.
- e. Adjust the applicable temperature control and verify the heater output changes.
- f. Reset the thermostat, if applicable, and the temperature control to the desired temperature.
- g. Turn the mode selector switch to the “Summer Ventilation” position. Verify the blower operates.
- f. Return the Technical Manual, The wiring diagram and all VFD paperwork including the VFD parameters in the watertight bag to the manual holder. Be sure to seal bag to prevent moisture from damaging paperwork.
- g. Perform a visual inspection of all wiring and gas valve plugs to ensure they have been properly replaced.
- h. Replace and fasten all covers and panels. Turn the disconnect switch “ON”.

15. FINAL HEATER PREPARATION

- a. Turn the disconnect switch off.

NOTE: Be sure to wait 3 minutes before re-energizing a VFD once the disconnect is turned to the “OFF” position. Re-energizing a VFD before an off time of three minutes could result in a VFD failure.

- b. Set the Entering Air Thermostat (EAT) to the specified temperature setting. Refer to the Individual Component Description Section in the Technical Manual for additional information.
- c. Remove the jumper wire from the high limit, if one was used. Reset the high limit.
- d. For the Maxitrol Series 44 control system, set the “MIN” and “MAX” setting of the amplifier to the application specifications.
- e. Verify the blower and burner service switches are in the “REMOTE” position.

OPERATING INSTRUCTIONS

OPERATING SEQUENCE

POWER ON

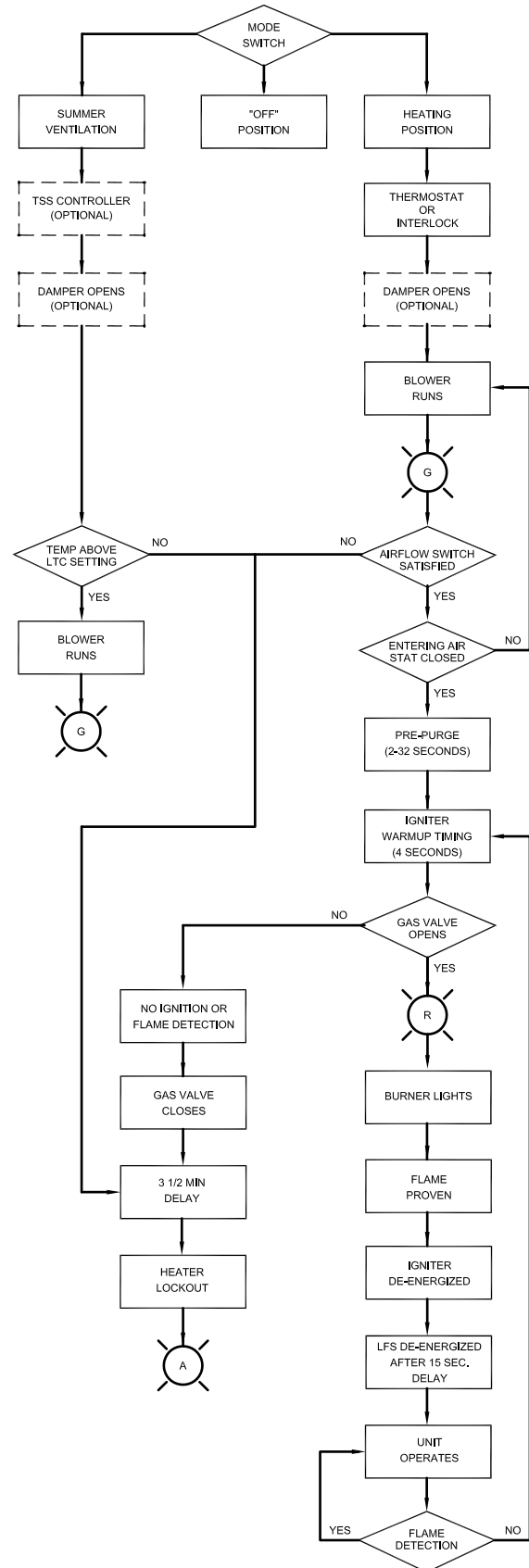
1. Control transformer energized.
2. Operator must select “SUMMER VENTILATION” or “HEATING” mode.

SUMMER VENTILATION MODE

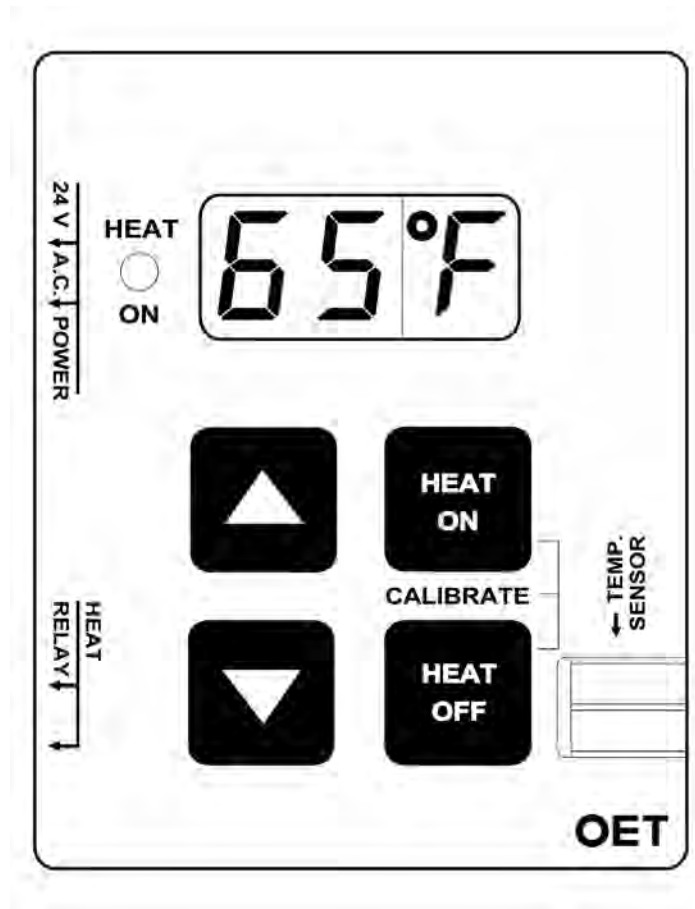
1. Mode switch in “SUMMER VENTILATION” position.
2. Optional TSS Controller schedule calls for ventilation.
3. Optional motorized inlet or discharge damper opens.
4. Blower motor starts.
5. Unit continues to run until turned off.

HEATING MODE

1. Mode switch in “HEATING” position.
2. Thermostat or interlock calls for heat.
3. Optional motorized inlet or discharge damper opens.
4. Blower motor starts.
5. Low airflow switch closes.
6. Entering air thermostat closes when inlet temperature is below setpoint after the prepurge delay.
7. Igniter warm up timing.
8. Gas valve opens.
9. Burner lights.
10. Igniter is de-energized.
11. Low Fire Start is de-energized after 15 seconds.
12. Unit runs and modulates until operating thermostat and/or interlock opens (heater shuts off).
13. Steps (2) through (12) repeat themselves automatically as necessary.



OPERATING INSTRUCTIONS ELECTRONIC THERMOSTAT



The Cambridge Air Solutions Operating Electronic Thermostat (OET) controls the heater's ON/OFF operation in a space heating mode. It includes the following features:

- Digital LED display of current temperature and temperature settings.
- LED indication of status of output relay.
- Separate settings for HEAT ON and HEAT OFF settings.
- Temperature Calibration for accurate temperature control.
- EEPROM storage maintains temperature settings indefinitely in case of power loss.

The thermistor enclosure (SH-1) is packed inside the Remote Control Station for shipment. It can be mounted on the exterior sides or bottom of the Remote Control Station or a remote location within 500 feet of the Remote Control Station using 18 gauge stranded, twisted-pair, shielded cable. The thermistor is hard wired to the temperature sensor terminal block.

SETTING TEMPERATURES

The Operating Electronic Thermostat requires two temperature settings. When the temperature drops below the HEAT ON setting, the heater will turn on. When the heater raises the space temperature above the HEAT OFF setting, the heater will turn off. This difference provides an adjustable range of operation for the heater which minimizes temperature swings.

The minimum run time and off time for the heater regardless of temperature are both set at 2 minutes. The allowable temperature range is 40°F to 99°F. The HEAT OFF temperature can not be set lower than the HEAT ON temperature.

1. Press and hold the **HEAT ON** button while pressing the **UP** or the **DOWN** button until the desired temperature for the heater to turn ON is displayed.



TEMPERATURE CALIBRATION

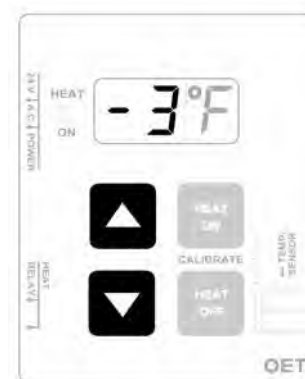
To compensate for lead wire resistance, it may be necessary to make an adjustment to the displayed temperature to correct it to the temperature measured at the thermistor sensor. The calibration feature allows the displayed temperature to be offset either above or below the actual sensed temperature. Be sure to use an accurate temperature meter for making this correction.

1. Press and hold the **HEAT ON** and **HEAT OFF** buttons while pressing the **UP** or the **DOWN** button until the correct temperature is displayed. (A period [.] after the temperature will indicate the Calibration Mode).



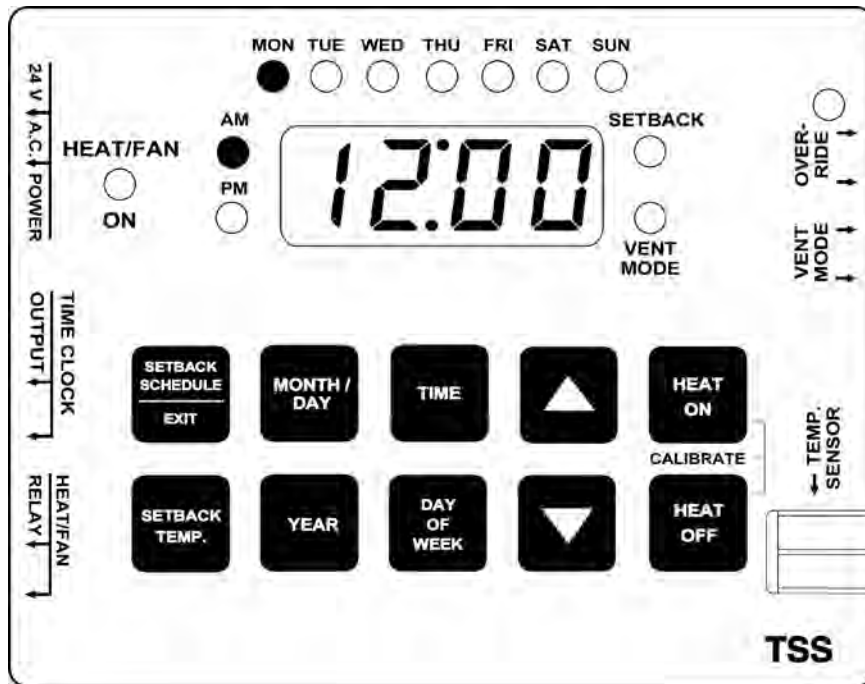
2. Pressing the **UP** or the **DOWN** button will display the current calibration difference above or below (-) the measured temperature.

2. Press and hold the **HEAT OFF** button while pressing the **UP** or the **DOWN** button until the desired temperature for the heater to turn OFF is displayed.



OPERATING INSTRUCTIONS

TSS CONTROLLER



The Cambridge Air Solutions TSS Controller provides several features to tailor the operation of the Cambridge heating system to particular applications.

- Seven day programmable clock
- Separate temperature settings for Heating and Setback operation
- Separate schedules for Summer Ventilation and Heating modes
- Setback Override for temporary heating operation
- Real-Time Clock with automatic adjustment for Daylight Saving Time
- Nine Holiday Setback Periods for temporary setback operation
- Temperature Calibration for accurate temperature control
- Capacitor backup maintains current time and day of week for power loss of up to 96 hours
- EEPROM storage maintains schedules and temperature settings indefinitely

The thermistor enclosure (SH-1) is packed inside the Remote Control Station for shipment. It can be mounted on the exterior sides or bottom of the Remote Control Station or a remote location within 500 feet of the Remote Control Station using 18 gauge stranded, twisted-pair, shielded cable. The thermistor is hard wired to the temperature sensor terminal block.

SETTING CURRENT DAY OF WEEK, TIME, MONTH/DAY, AND YEAR

For proper operation of the scheduler, the TSS Controller clock must be set to the correct day of week, time, month/day and year. In the event of power loss of more than 96 hours, these settings must be updated.

During normal operation, the TSS Controller display will alternate between the current space temperature and the current time and day of the week.

1. Press and hold the **DAY OF WEEK** button while pressing the **UP** or the **DOWN** button until the light for the current day is illuminated.



2. Press and hold the **TIME** button while pressing the **UP** or the **DOWN** button until the current time is displayed.



3. Press and hold the **MONTH/DAY** button while pressing the **UP** or the **DOWN** button until the current date is displayed.



4. Press and hold the **YEAR** button while pressing the **UP** or the **DOWN** button until the current year is displayed.

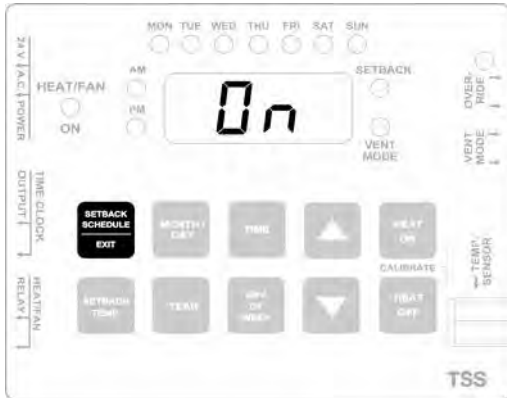


SETTING AUTOMATIC ADJUSTMENT FOR DAYLIGHT SAVING TIME

The TSS Controller has the ability to automatically detect and adjust for daylight saving time. The default setting on the controller is to recognize daylight saving time.

SETTING TEMPERATURES

1. Press the **SETBACK SCHEDULE/EXIT** button to enter the scheduling program at the first ON cycle.



2. Press the **UP** button once to enter the daylight saving time setting ("d-SA" is displayed).



3. Press and hold the **YEAR** button while pressing the **UP** or the **DOWN** button to scroll to "YES" if daylight saving time should be recognized or "NO" if daylight saving time is not recognized.



4. Press the **SETBACK SCHEDULE/EXIT** button to exit the scheduling program.

The TSS Controller has two temperature control modes with the keyswitch on the front of the enclosure in the HEATING position. The HEATING mode controls the heater when the ON time schedule is in effect. The SETBACK mode controls the heater when the OFF time schedule is in effect. (See SETTING SCHEDULES for instructions on setting the ON and OFF schedules). With the keyswitch in the SUMMER VENTILATION position the heater fan will run based on the time schedule with no temperature control.

HEATING MODE (ON Time Schedule)

The HEATING mode requires two temperature settings. When the temperature drops below the HEAT ON setting the heater will turn on. When the heater raises the space temperature above the HEAT OFF setting, the heater will turn off. This difference provides an adjustable range of operation for the heater, which minimizes temperature swings. The minimum on time and off time for the heater regardless of temperature is 2 minutes. The allowable temperature range is 41°F to 99°F.

The HEAT OFF temperature cannot be set lower than the HEAT ON temperature.

1. Press and hold the **HEAT ON** button while pressing the **UP** or the **DOWN** button until the desired temperature for the heater to turn ON is displayed.



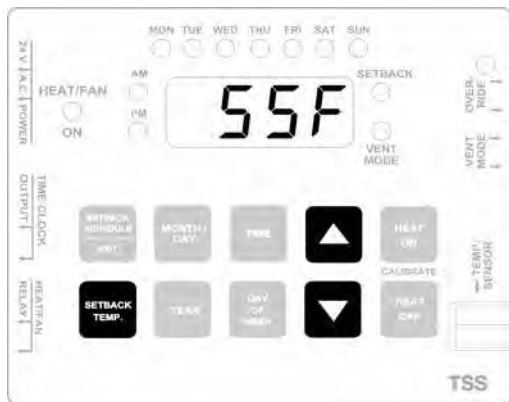
2. Press and hold the **HEAT OFF** button while pressing the **UP** or the **DOWN** button until the desired temperature for the heater to turn OFF is displayed.



SETBACK MODE (OFF Time Schedule)

The SETBACK mode requires setting only the ON temperature. The OFF temperature will be automatically set based on the temperature difference between HEAT ON and HEAT OFF programmed above for the HEAT mode.

1. Press and hold the **SETBACK TEMP.** button while pressing the **UP** or the **DOWN** button until the desired temperature for the heater to turn ON is displayed.



SETBACK OVERRIDE

In instances where temporary heat is desired when the scheduler is in the SETBACK mode, the OVERRIDE timer can be used. Setting this timer, located on the front of the TSS panel, will override the SETBACK temperature setting and increase the space temperature to the HEAT ON and HEAT OFF temperature settings for the amount of time set on the OVERRIDE timer.

SETTING SCHEDULES

The TSS Controller has separate programmable daily schedules for the HEATING and the SUMMER VENTILATION modes. The schedule currently in effect is determined by the position of the keyswitch in the door of the enclosure. With the keyswitch in the HEATING or OFF position, the schedule for the Heating Mode is accessible. With the keyswitch in the SUMMER VENTILATION position, the schedule for the Ventilation Mode is accessible. (This will be indicated by the VENT MODE light on the TSS Controller being illuminated). Before attempting to program the schedule, determine the planned time periods for HEAT (ON) and SETBACK (OFF) for the HEATING mode and the planned ON and OFF time periods for the Ventilation mode. The time that it takes to recover from the SETBACK temperature to the HEAT temperature must also be taken into consideration for the ON time in the HEATING mode. The following charts can be filled in for a reference during the programming of the schedule. There are fifteen available ON and OFF program cycles for both HEATING and SUMMER VENTILATION. The first ON and OFF cycles are fixed for Monday through Friday and should only be used when the schedules for those days are identical. The fourteen additional numbered cycles can be programmed for any one day or successive days.

NOTE: Do not program the TSS controller with overlapping schedules, as operational errors will occur. Whenever the heater is operating during a scheduled ON cycle and a subsequent overlapping program is encountered, that program will be ignored.

A Holiday Setback Schedule is available for temporary operation in the Setback Mode of up to nine different holiday periods without affecting the current schedules. (See HOLIDAY SETBACK SCHEDULE section for instructions on using this feature).

All unused program cycles should not contain any settings. Check all cycles after programming to assure that the display for unused cycles shows "--:--". If undesired settings have been entered, scroll the time display until "--:--" is displayed (between 11.59PM and 12.00AM for time settings; between 12.31 and 1.01 for date settings).

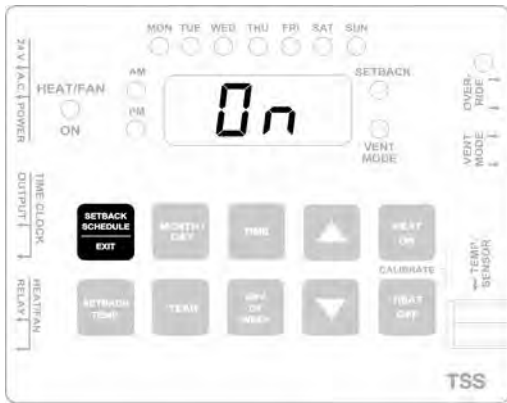
HEATING SCHEDULE

Cycle	Time	AM/PM	Day
On			M-F
Off			M-F
On 1			
Off 1			
On 2			
Off 2			
On 3			
Off 3			
On 4			
Off 4			
On 5			
Off 5			
On 6			
Off 6			
On 7			
Off 7			
On 8			
Off 8			
On 9			
Off 9			
On 10			
Off 10			
On 11			
Off 11			
On 12			
Off 12			
On 13			
Off 13			
On 14			
Off 14			

SUMMER VENTILATION SCHEDULE

Cycle	Time	AM/PM	Day
On			M-F
Off			M-F
On 1			
Off 1			
On 2			
Off 2			
On 3			
Off 3			
On 4			
Off 4			
On 5			
Off 5			
On 6			
Off 6			
On 7			
Off 7			
On 8			
Off 8			
On 9			
Off 9			
On 10			
Off 10			
On 11			
Off 11			
On 12			
Off 12			
On 13			
Off 13			
On 14			
Off 14			

1. Switch the keyswitch on the front of the enclosure to the desired operating mode. Allow ten seconds before proceeding.
2. Press the **SETBACK SCHEDULE/EXIT** button to enter the scheduling program at the first ON cycle.



3. Press and bold the **TIME** button while pressing the **UP** or the **DOWN** button to scroll to the desired ON time for Monday through Friday.



4. Press the **UP** button once to step to the first OFF cycle.



5. Press and bold the **TIME** button while pressing the **UP** or the **DOWN** button to scroll to the desired OFF time for Monday through Friday.



6. If **Monday through Friday** is the only schedule required, proceed to **Step 14**. If any additional programming is required, proceed with the following steps. Remember that subsequent program cycles must not overlap with the ON and OFF times set above.

7. Press the **UP** button once to step to the next ON cycle.



8. Press and bold the **TIME** button while pressing the **UP** or the **DOWN** button to scroll to the desired ON time.

9. Press and bold the **DAY OF WEEK** button while pressing the **UP** or the **DOWN** button until the light for the desired day is illuminated.

- Press the **UP** button once to step to the next OFF cycle.



- Press and hold the **TIME** button while pressing the **UP** or the **DOWN** button to scroll to the desired OFF time.
- Press and hold the **DAY OF WEEK** button while pressing the **UP** or the **DOWN** button until the light for the desired day is illuminated.
- Repeat steps 7-12 until all required program cycles have been entered.
- Press the **SETBACK SCHEDULE/EXIT** button to exit the scheduling program.
- Verify that the correct current time and light for day of the week are still displayed.

HOLIDAY SETBACK SCHEDULE

The Holiday Setback Schedule overrides the normal schedule and holds the space at the SETBACK temperature. The TSS Controller allows up to nine holiday periods (Holiday Start Date [HSD] and Holiday End Date [HED]) to be scheduled.

HOLIDAY SETBACK SCHEDULE

Cycle	Date
HSD 1	
HED 1	
HSD 2	
HED 2	
HSD 3	
HED 3	
HED 4	
HED 4	
HSD 5	
HED 5	
HSD 6	
HED 6	
HSD 7	
HED 7	
HSD 8	
HED 8	
HSD 9	
HED 9	

1. Press the **SETBACK SCHEDULE/EXIT** button to enter the scheduling program at the first ON cycle.



4. Press the **UP** button once to step to the first holiday end date cycle (HEd1).



2. Press the **UP** button repeatedly to step to the first holiday start date (HSd1).



5. Press and hold the **MONTH/DAY** button while pressing the **UP** or the **DOWN** button to scroll to the desired holiday end date. (NOTE: Holiday end date must be at least one day after holiday start date).



3. Press and hold the **MONTH/DAY** button while pressing the **UP** or the **DOWN** button to scroll to the desired holiday start date.



6. Repeat steps 2-5 until all required holiday cycles have been entered.

7. Press the **SETBACK SCHEDULE/EXIT** button to exit the scheduling program.

TEMPERATURE CALIBRATION

To compensate for lead wire resistance, it may be necessary to make an adjustment to the displayed temperature to correct it to the temperature measured at the thermistor sensor. The calibration feature allows the displayed temperature to be offset either above or below the actual sensed temperature. Be sure to use an accurate temperature meter for making this correction.

1. Press and hold the **HEAT ON** and **HEAT OFF** buttons while pressing the **UP** or the **DOWN** button until the correct temperature is displayed. (A period [.] after the F will indicate the Calibration Mode).



2. Pressing the **UP** or the **DOWN** button will display the current calibration difference above or below (-) the measured temperature.

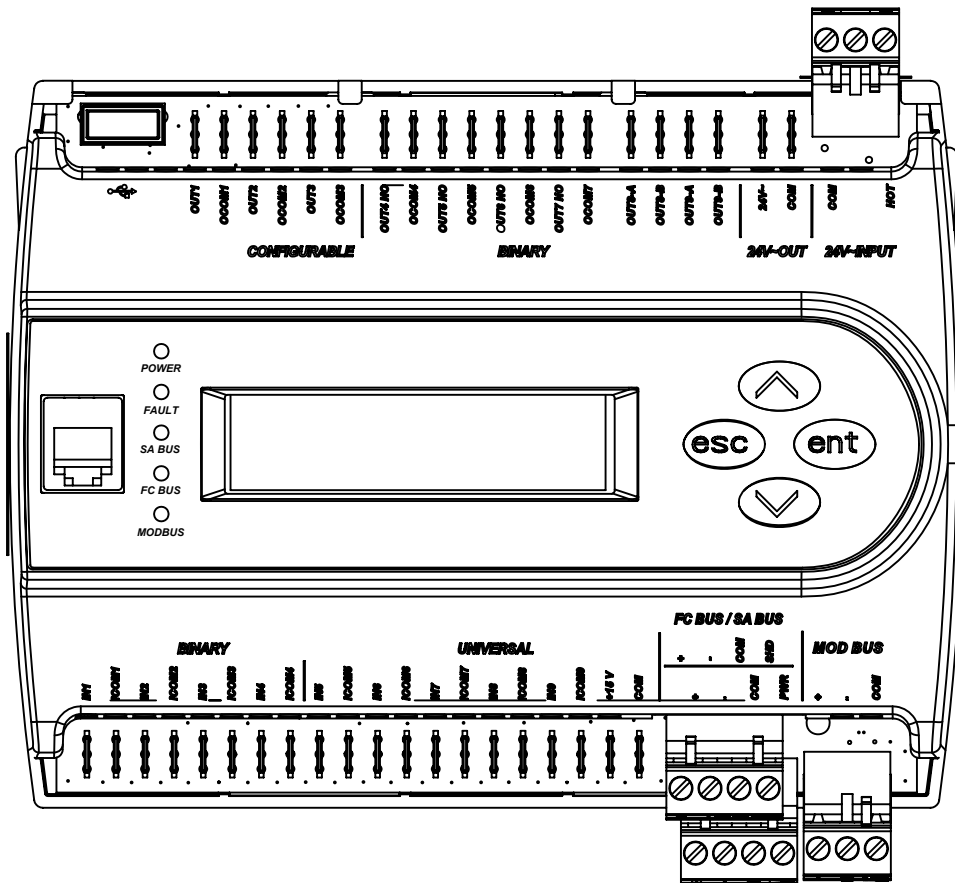


OPERATING INSTRUCTIONS

BACNET CONTROLLER

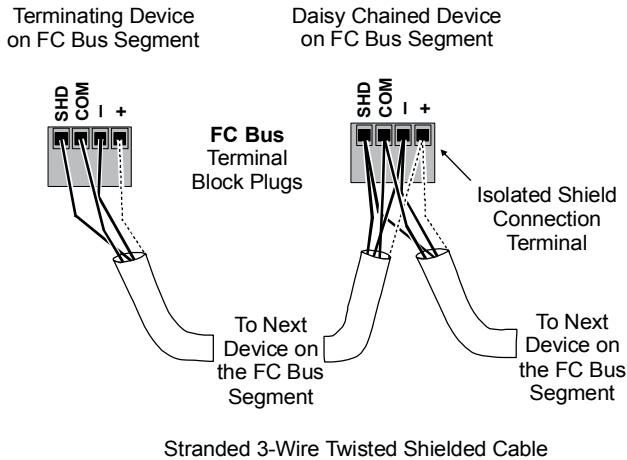
The BACnet Controller is a native BACnet®, fully programmable, direct digital controller. It provides a communication link between a BAS (Building Automation System) and the Cambridge heater. The controller provides precise monitoring and control of connected points.

- BACnet® MS/TP compliant operating at up to 76.8 kilobaud
- BTL-certified controller
- Standard input points for fan status, burner status, discharge temperature, zone temperature, outdoor temperature and unit lockout status
- Standard output points for fan control, burner control and discharge temperature control
- Selectable operating modes (unit heater / makeup air / summer ventilation)
- Removable screw terminal blocks
- Onboard USB port for firmware upgrades
- Local user interface display for commissioning and monitoring



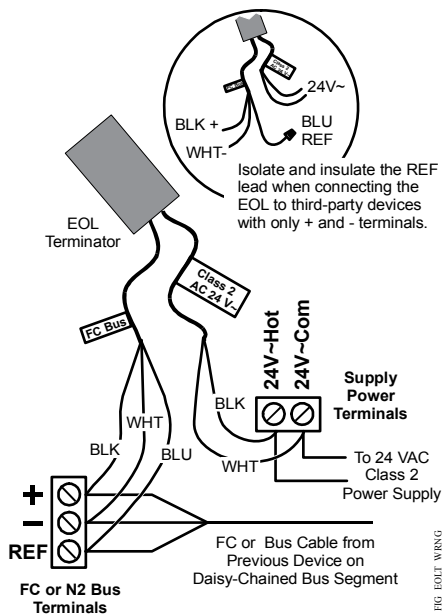
NETWORK CONNECTION

- Use stranded 3-wire twisted pair, shielded cable to connect to FC BUS (blue) terminals.
- Run all low-voltage wiring and cables separate from high-voltage wiring.
- Connect the – terminals in parallel with all other – terminals and the + terminals in parallel with all other + terminals.
- The FC bus Shield (SHD) terminal is isolated and can be used to as a shield drain connection.



END-OF-LINE TERMINATION

If a controller is on either end of a BACnet MS/TP network an EOL terminator (JCI # MS-BACEOL-0) must be installed for proper network operation.



NETWORK PARAMETERS

Before operating controllers on a bus, you must set a valid and unique device address for each controller on the bus through the local display or MAP gateway. Device addresses 4 through 127 are the valid addresses for these controllers. The MAC address is set for a default of 4.

The baud rate is set for a default of Auto. The controller will listen for the bus supervisor to communicate first; then automatically set its baud rate to the bus supervisor's baud rate. If you anticipate critical peer-to-peer communication and therefore do not want the controllers to wait for the bus supervisor to establish the baud rate, you can specify the baud rate for each device immediately at startup.

To change any of the network settings (Device Name, Description, Address, Device Object ID) go to Controller > Network from the local display or MAP gateway.

NOTE: When changing any network parameters it is recommended that the controller be disconnected from the network while the changes are being made and that the power be cycled to the controller after all changes have been made before reconnecting the controller to the network.

OPERATING SEQUENCES

UNIT HEATER / OCCUPIED MODE

1. If Zone Temperature is below Zone Set Point then Supply Fan and Burner start.
2. Discharge Temperature modulates to Discharge Set Point.
3. If Zone Temperature is above Zone Set Point plus Differential then Supply Fan and Burner stop.
4. Unit will not operate if Outdoor Temperature is above Heating Lockout Set Point.

MAKEUP AIR / OCCUPIED MODE

1. Supply Fan and Burner run continuously.
2. Discharge Temperature modulates to Discharge Set Point.
3. Burner will not operate if Outdoor Temperature is above Heating Lockout Set Point.

MAKEUP AIR w/PID / OCCUPIED MODE

1. Supply Fan and Burner run continuously.
2. Discharge Temperature modulates to Discharge Set Point based on PID loop.
3. Burner will not operate if Outdoor Temperature is above Heating Lockout Set Point.

MAKEUP AIR w/PID PLUS ON-OFF / OCCUPIED MODE

1. If Zone Temperature is below Zone Set Point plus Differential then Supply Fan and Burner start.
2. Discharge Temperature modulates to Discharge Set Point based on PID loop.
3. If Zone Temperature is above Zone Set Point plus Differential then Supply Fan and Burner stop.
4. Burner will not operate if Outdoor Temperature is above Heating Lockout Set Point.

SUMMER VENTILATION MODE

1. If Zone Temperature (AI8) is above Zone Set Point (AV4) then Supply Fan (BO1) starts.
2. If Zone Temperature (AI8) is below Zone Set Point (AV4) minus Differential (AV28) then Supply Fan (BO1) stops.
3. Supply Fan (BO1) will not operate if Outdoor Temperature (AV20) is above Zone Temperature (AI8).

UNOCCUPIED MODE

1. If Zone Temperature is below Zone Set Point then start Supply Fan and Burner.
2. Discharge Temperature modulates to Discharge Set Point.
3. If Zone Temperature is above Zone Set Point plus Differential then stop Supply Fan and Burner.
4. Unit will not operate if Outdoor Temperature is above Heating Lockout Set Point.

DEFAULT SETTINGS

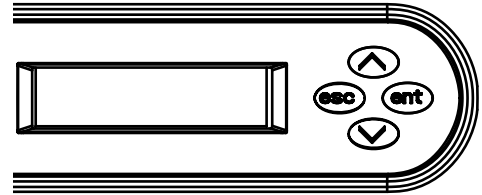
The controller will function to control the unit without the network being connected, provided that a Zone Temperature Sensor is connected.





The default settings are:

- Normal Mode = Unit Heater
- Discharge Set Point = 160°F
- Zone Set Point = 65°F
- Set Point Differential = 3°F

LOCAL DISPLAY

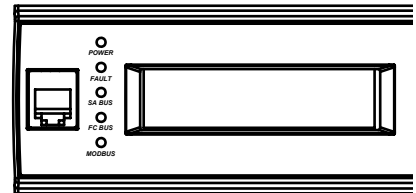
The controller includes an onboard illuminated LCD display and 4 buttons for monitoring and adjustment.



Label	Name	Description
	Escape	Exit the current menu level and go up one level
	Enter	Access the menu Accept the current selection
	Up	Scroll through menu selections Adjust current parameter selection
	Down	

TROUBLESHOOTING

The status LEDs indicate power connection and network communication.



Label	Color	Normal State	Description
Power	Green	On Steady	On Steady = Power Connected Off Steady = No Supply Power. Check Output wiring for short circuits and cycle power to the controller.
Fault	Red	Off Steady	Off Steady = No Faults On Steady = Device Fault: no application loaded; Main Code download required if controller is in Boot mode, or a firmware mismatch exists between the PEAK controllers and the ZRF1811 Wireless Field Bus Router. Blink - 2 Hz = Download or Startup in progress, not ready for normal operation
SA Bus	Green	Blink - 2 Hz	Blink - 2 Hz = Data Transmission (normal communication) Off Steady = No Data Transmission (Auto baud in progress) On Steady = Communication lost, waiting to join.
FC Bus	Green	Blink - 2 Hz	Blink - 2 Hz = Data Transmission (normal communication) Off Steady = No Data Transmission (Auto baud in progress) On Steady = Communication lost, waiting to join.
Mod Bus	Green	Blink - 2 Hz	Blink - 2 Hz = Data Transmission (normal communication) Off Steady = No Data Transmission (Auto baud in progress) On Steady = Communication lost, waiting to join.

MAINTENANCE INSTRUCTIONS

⚠WARNING:

Turn the disconnect switch off when performing service or maintenance functions.

BLOWER BEARING LUBRICATION

Heaters with 3 HP or smaller motors have permanently lubricated, double shielded, and double sealed ball bearings which do not require additional lubrication. Heaters with 5 HP or larger motors require lubrication on intervals of 3 to 6 months. Use Duralube AW-2G, Goldplex (Lithplex HC 150 SMG), Shell Gadus S2V100 2 or Mobilgrease XHP 222 grease. Grease should be bearing quality and compatible to lithium bases thickener.

MOTOR BEARING LUBRICATION

Motors are pre-greased normally with Exxon Polyrex EM. Equivalent greases are Exxon Unirex N 2 and Mobilith SHC 100. Equivalent greases are Exxon Mobil lithium complex greases and electric motor polyurea greases per ASTM D6185.

Annual Motor Operation	Recommended Lubrication Interval	
	NEMA 215T Frame or smaller	NEMA 254 Frame or larger
Intermittent Operation - >5000 hours	5 years	3 years
Continuous Operation - Standard Service	2 years	1 year
Seasonal Service (Motor is idle for 6 months or more)	1 year	1 year
Continuous Operation - Severe Service (High ambient, dirty or moist location, high vibration)	6 months	6 months

BELT TENSIONING

Using a Browning Belt Tension Checker and a straight edge, verify proper belt tension exists according to the following table. Periodic belt adjustments may be required. Indications of loose belts include barking or squealing when blower starts.

Model	Motor HP	Belt(s)		Center Span Deflection	Force (lbs)	
		Qty	Type		New Belts	Used Belts
M110/ M112	1	1	A	1/4"	2 - 3	1 - 2
M110/ M115	2	1	A	1/4"	2½ - 4	1½ - 3
M112/ M118	3	1	BX	1/4"	4½ - 6	4 - 5½
M115	5	2	BX	1/4"	3 - 5	2½ - 4
M118/ M120	5	2	BX	7/16"	5 - 7	4½ - 6½
M118/ M120	7½	2	BX	7/16"	6 - 8	5½ - 7
M120	10	2	BX	7/16"	6½ - 8½	6 - 7½
M120	15	2	BX	7/16"	7 - 9	6 - 8
M125	7½	2	BX	9/16"	6 - 8	5½ - 7
M125/ M130	10	2	BX	9/16"	6½ - 8½	6 - 7½
M125/ M130	15	2	BX	9/16"	7 - 9	6 - 8
M125/ M130	20	3	BX	9/16"	6½ - 8½	6 - 7½
M130/ M136	25	3	BX	9/16"	7 - 9	6 - 8
M130/ M136	25	4	BX	9/16"	6½ - 8½	6 - 7½
M130/ M136	30	4	BX	9/16"	6½ - 8½	6 - 7½
M130/ M136	30	3	5VX	9/16"	7 - 9	6 - 8
M136/ M140	40	5	BX	9/16"	6½ - 8½	6 - 7½
M136/ M140	40	3-4	5VX	9/16"	8 - 10	7 - 9½
M140	50-60	6	BX	9/16"	7-9	6-8
M140	50-60	4 or 5	5VX	9/16"	9-11	8-10
M140	75	5	5VX	9/16"	10-12	9-11
M140	75	6	5VX	9/16"	8½ - 10½	8-10

BLOWER CLEANING

The blower wheel should be examined for accumulation of dust on the blades. These surfaces must be kept clean. Dirt accumulation will result in significant air flow reduction and/or possible imbalance of the blower wheel. Prolonged imbalance CAN result in catastrophic failure of the blower wheel and other related components.

BURNER CLEANING

The Cambridge Air Solutions burner is for the most part self-cleaning. However, if the application is extremely dirty or dusty, it may become necessary to periodically clean the burner. Remove and clean the burner in accordance with the following recommended procedures.

1. Turn the heater disconnect switch off. Close the manual gas supply shut-off valve.
2. Loosen the union in the gas train.

⚠CAUTION:

The igniter is made of silicon carbide material and should be handled with care to avoid breakage.

3. Disconnect the ignition cable from the burner and then remove the flame rod and the igniter.
4. Examine the flame rod ceramic for cracks and replace if necessary. Clean the flame rod element with emery cloth to remove oxidation.
5. Remove the fasteners that secure the burner to the housing. The burner will then be free to slide out.

⚠CAUTION:

Be sure to take necessary safety precautions (such as wearing eye protection, etc.) before attempting this step.

6. Clean the burner by back-flushing using high pressure air (40-80 PSI). Continue back-flushing until dust particles are completely expelled from the burner.
7. Re-install the burner using the above steps in reverse order.

GAS VALVE CLEANING

All solenoid valves should be cleaned periodically. The time between cleanings will vary depending on the medium and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive noise, or leakage will indicate that cleaning is required. Refer to step 8, Gas Valve Leak Check, of the Start-up Procedures (see page 33).

⚠WARNING:

In the extreme case, faulty valve operation will occur and the valve may fail to open or fully close.

IMPORTANT

It is not necessary to remove the valve from the gas train for cleaning.

⚠WARNING:

To prevent the possibility of severe personal injury or property damage, turn off electrical power, close the upstream manual gas valve, depressurize the valve, extinguish all open flames and avoid any type of sparking or ignition. Vent hazardous or combustible fumes to a safe area before servicing the valve.

ASCO GAS VALVES: SERIES 8214

Disassemble the valve (See page 63) and clean all parts as follows:

IMPORTANT

If parts are worn or damaged, install a complete ASCO Rebuild Kit.

1. Remove the solenoid enclosure.
2. Remove the bonnet screws, valve bonnet, bonnet gasket, core/diaphragm sub-assembly and body gasket.
3. All parts are now accessible to clean or replace.
4. Lubricate the bonnet gasket and body gasket with a light coat of Dow Corning® 200 Fluid lubricant or an equivalent high-grade silicone fluid.
5. Apply a light coat of RemGrit TFL 50® Dry Lubricant to: the valve seat; the valve body surface where diaphragm assembly contacts the valve body and body gasket; and internal surface of the valve bonnet where the diaphragm assembly contacts the bonnet when the valve is in the energized (open) position.

IMPORTANT:

If the valve has been disassembled for inspection and cleaning only and a Rebuild Kit is not being installed, lubricate the following with RemGrit TFL 50® Dry Lubricant:

- Diaphragm assembly on both sides
- Main disc at base of core/diaphragm sub-assembly
- Pilot disc at base of core assembly

⚠CAUTION:

Do not distort the hanger spring between the core assembly and the diaphragm assembly when lubricating the pilot disc.

6. Replace the body gasket and the core/diaphragm sub-assembly with the closing spring attached. Locate the bleed hole in the core/diaphragm sub-assembly approximately 30° CCW from the valve inlet.
7. Replace the valve bonnet and the bonnet screws (6). Torque the screws in a crisscross manner to 100 ± 10 in-lbs. Replace the solenoid and make the electrical hookup.

⚠WARNING:

To prevent the possibility of severe personal injury or property damage, check the valve for proper operation before returning to service. Also perform a gas valve leak check and gas train leak check in accordance with steps 8 and 9 of the Start-up Procedures (See pages 33 & 34).

ORDERING INFORMATION FOR ASCO REBUILD KITS

Parts marked with an asterisk (*) in the exploded views are supplied in Rebuild Kits.

When ordering Rebuild Kits for ASCO valves, order the Rebuild Kit number stamped on the valve nameplate. If the number of the kit is not visible, order by indicating the number of kits required, and the Catalog Number and Serial Number of the valve(s) for which they are intended.

GAS TRAIN LEAK CHECK

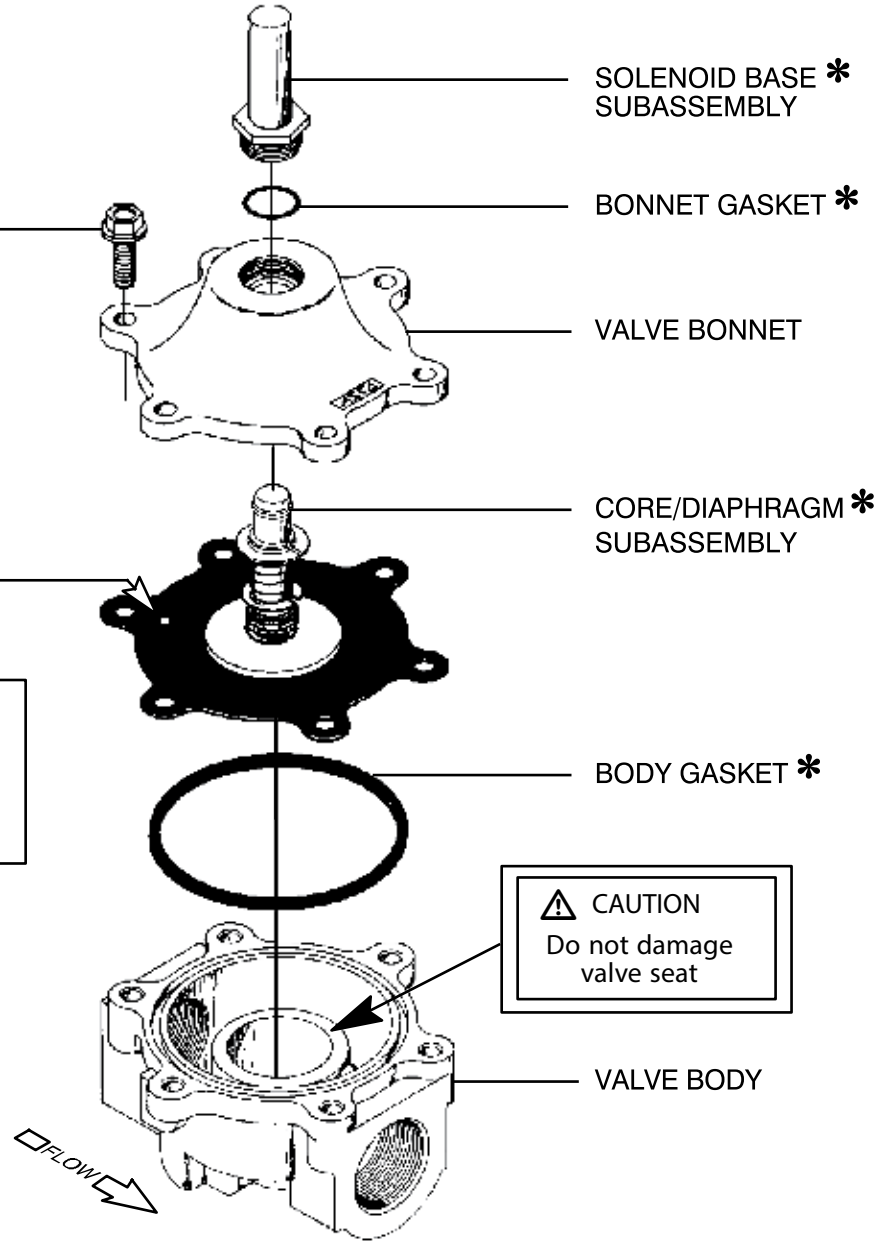
Periodically check the gas control assembly, internal and external piping for leaks. Refer to step 9, Gas Train Leak Check, of the Start-up Procedures (see page 34). All relief vents on the gas controls should be checked for blockage (gas pressure regulators and pressure switches).

* Indicates parts supplied in ASCO Rebuild Kit.

BONNET SCREW

Locate bleed hole in core/diaphragm sub-assembly approximately 30° from valve inlet

BLEED HOLE



SOLENOID BASE *
SUBASSEMBLY

BONNET GASKET *

VALVE BONNET

CORE/DIAPHRAGM *
SUBASSEMBLY

BODY GASKET *

⚠ CAUTION
Do not damage
valve seat

VALVE BODY

Disassembled View of ASCO Valve

FILTERS

Filters may be installed in the V-bank filter section or in the intake of the rainhoods. These may be of the disposable or permanent type. Filters are removed and replaced from the V-bank filter section by opening the filter access door. Filters are removed from the rainhood by removing the retainer from the end of the rainhood. To remove the retainer, remove the shipping screws from the ends of the retainer, then pull the retainer back and downward from the rainhood.

Permanent Filters are 2" thick washable, metal mesh filters that may be installed in the rainhoods or in the V-bank filter section.

Disposable Filters may be one of two types:

1. Pleated panel filters are 2" thick filters which slide into tracks provided in the V-Bank filter section only. (Do not use this type of filter in the rainhoods because of moisture exposure.)
2. Continuous filters are constructed of a two-stage media. The white side faces into the airstream and the orange side faces the exiting air. Internal frames ensure rigidity, while the continuous media eliminates gaps between filters and effectively seals against the filter tracks. These filters are unaffected by moisture and may be installed in the rainhoods or in the V-bank filter section.

CLEANING AND REPLACEMENT

Shut down the heater and turn off the blower before servicing the filters. Remove the filters from the rainhood or filter section. Handle carefully to prevent debris from being dislodged from the filter into the heater.

Permanent filters can be cleaned using a stream of water or soap and water. Back flush the filters until the water comes out clean. If soap is used, ensure that all soap is rinsed out of the filter. Visually inspect the filter to ensure that it is clean. Allow to dry before returning to service.

Disposable pleated panel filters are replaced when they become dirty. Replace the filter with the same size of filter which is removed from the filter section. Note the airflow markings on the filter.

Disposable continuous filters are replaced when they become dirty. Continuous filters are manufactured one panel wide by 24 panels long. (eg., 16" x 600" filters consists of 24-16" x 25" panels and 25" x 384" filters consist of 24-25" x 16" panels.) Cut these filters between panels to select the continuous length required for the filter track. If four 16" x 25" panels are required for a filter track, simply cut a four-panel length. Install the filters with the white side toward the air inlet.

Filters for Horizontal Mount

Filter Type		Permanent or Disposable Panel				Continuous*							
Size (inches)		16x20	16x25	20x20	20x25	16x480	16x600	20x384	20x480	20x600	25x384	25x480	
Rainhood	M110	Single		3							3 (1x3)		
	M112	Single		3							3 (1x3)		
	M115	Single	4		2			4 (2x2)	2 (1x2)				
	M118	Upper			2	2				2 (1x2)			2 (1x2)
		Lower	2	2					2 (1x2)			2 (1x2)	
	M120	Upper	6		3		6 (2x3)			3 (1x3)			
		Lower	4		2		4 (2x2)			2 (1x2)			
	M125	Upper		12				12 (4x3)					
		Lower		8				8 (4x2)					
	M130	Upper			12	4				12 (3x4)			4 (1x4)
Lower				9	3				9 (3x3)			3 (1x3)	
M136	Upper			15	5				15 (3x5)			5 (1x5)	
	Lower			12	4				12 (3x4)			4 (1x4)	
M140	Upper	5		25		5 (1x5)			25 (5x5)				
	Lower	4		20		4 (1x4)			20 (5x4)				
Filter Section	M110				3					3 (3x1)			
	M112				3					3 (3x1)			
	M115			6					6 (3x2)				
	M118			8					8 (4x2)				
	M120				10					10 (5x2)			
	M125		20								20 (5x4)		
	M130				24							24 (6x4)	
	M136				28							28 (7x4)	
	M140		56									56 (8x7)	

Filters for Vertical Mount

Filter Type		Permanent or Disposable Panel				Continuous*						
Size (inches)		16x20	16x25	20x20	20x25	16x480	16x600	20x384	20x480	20x600	25x384	25x480
Rainhood	M118	Upper			2	2				2 (1x2)		2 (1x2)
		Lower	2	2					2 (1x2)		2 (1x2)	
	M120	Upper	6		3		6 (2x3)			3 (1x3)		
		Lower	4		2		4(2x2)			2 (1x2)		
	M125	Upper		12				12 (4x3)				
		Lower		8				8 (4x2)				
M130	Upper			12	4				12 (3x4)			4 (1x4)
	Lower			9	3				9 (3x3)			3 (1x3)
M136	Upper				15					15 (5x3)		
	Lower				15					15 (5x3)		
Filter Section	M118			9					9 (3x3)			
	M120	16						16 (4x4)				
	M125				15					15 (5x3)		
	M130		36								36 (6x6)	
	M136				30							30 (6x5)

* Continuous filters are manufactured in lengths of 24 panels. Cut filter panels like chain links. For example, 6 (2x3) means cut 2 rows x 3 panels long for total of 6 panels of this type. Cut only between filter panels.

DIRECT EVAPORATIVE COOLING (DEC)

GENERAL INFORMATION:

When added as an accessory to an M-Series Make-up Air Heater, the Direct Evaporative Cooling (DEC) section is designed to adiabatically cool make-up air for commercial and industrial applications.

The DEC is custom fabricated to meet specific usage and dimensional requirements with M-Series Units.

The DEC controls will be integrated with the heater controls so there will be no conflict between a call for heat and a call for cooling.

SAFETY CONSIDERATIONS:

Throughout this manual are Warnings, Cautions and Notes to alert the installing contractors, service and maintenance personnel of potential hazards that could result in personal injury, death or serious damage to property or equipment.

Your personal safety and the proper operation of this machinery depend on the careful observance of all Warnings, Cautions and Notes:

⚠WARNING:

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠CAUTION:

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury, or to alert against unsafe practices.

NOTE: Indicates a situation that could result in equipment or property damage, or provides important information on installation considerations.

⚠WARNING:

Proper Field Wiring and Grounding Required!
All field wiring MUST be performed by qualified personnel. Ensure all field wiring and grounding is accomplished in full accordance with National Electrical Code (NEC) and local/state electrical codes. Failure to do so may pose FIRE or ELECTROCUTION hazards resulting in death or serious injury.

⚠WARNING:

Personal Protective Equipment (PPE) Required!
Installing/servicing this unit could result in exposure to electrical, mechanical and chemical hazards.

- Before installing/servicing this unit, technicians MUST wear all recommended Personal Protective Equipment (PPE) for the specific work being undertaken.

ALWAYS refer to appropriate SDS sheets and OSHA guidelines for proper PPE.

- When working with or around hazardous chemicals, ALWAYS review appropriate SDS sheets and OSHA guidelines to ensure compliance with safety standards for personal exposure levels, proper respiratory protection and handling recommendations.
- If there is a risk of arc or flash, technicians MUST put on all Personal Protective Equipment (PPE) in accordance with the NEC or other country-specific requirements for arc flash protection, PRIOR to servicing the unit.
- Failure to follow recommendations could result in death or serious injury.

RECEIVING:

Upon receipt, examine units carefully for in-transit damage or missing components as detailed in packing list. If damaged, report damage(s) to trucking company, take pictures, and contact Cambridge Air Solutions. After uncrating unit, verify proper size and that all loose parts are included.

NOTE: Inspect the exterior and interior of the equipment carefully for any damage that may have occurred during shipment. Verify shipped loose parts are complete and undamaged. Ensure there is no damage to protruding exterior components such as door handles, disconnect switch handle, etc. or to internal components such as pumps, media, filters, louvers and drains.

INSTALLATION:

⚠WARNING:

Do not remove unit from shipping skid until it is at the installation location. Moving these units when not properly secured to the skid can result in personal injury or death and can seriously damage the unit.

⚠WARNING:

To prevent injury or death, and damage to unit, ensure the lifting capacity of the moving equipment exceeds the weight of the unit by an adequate safety margin.

NOTE: Ensure all local building and electrical codes are fully complied with in installing the unit. Take the following factors into consideration before selecting the location of installation:

- Ensure sufficient clearance per submittal drawings to allow easy access for maintenance and system operation.
- Unit must be installed on a level foundation that allows for proper flow of condensation into internal drains, sufficient to support continuous to full perimeter of base and cross members, and minimize deflection of unit base frame to no more than 1/16th “ (1.6mm) over the length and width of unit.

⚠WARNING:

To prevent injury or death, disconnect electrical power source before completing connection to the unit. All wiring must comply with National Electrical Code (NEC) and state and local requirements. Outside the United States, the national and or local electrical requirements of other countries shall apply.

The installing contractor must connect appropriate power wiring to the terminal block or non-fused, unit-mounted disconnect in the power section of the unit control panel.

⚠WARNING:

During installation, testing, servicing, and troubleshooting of this product, it may be necessary to work with live electrical components. To prevent injury or death due to electrocution, take extreme care when performing service procedures with electrical power energized. 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 safety precautions when exposed to live electrical components could result in death or serious injury.

1. All installation should be performed in accordance to local and state codes and with proper permits.
2. Measure DEC for correct sizes. Immediately contact Cambridge Air Solutions if unit's openings do not match.
3. Check for proper air flow direction.

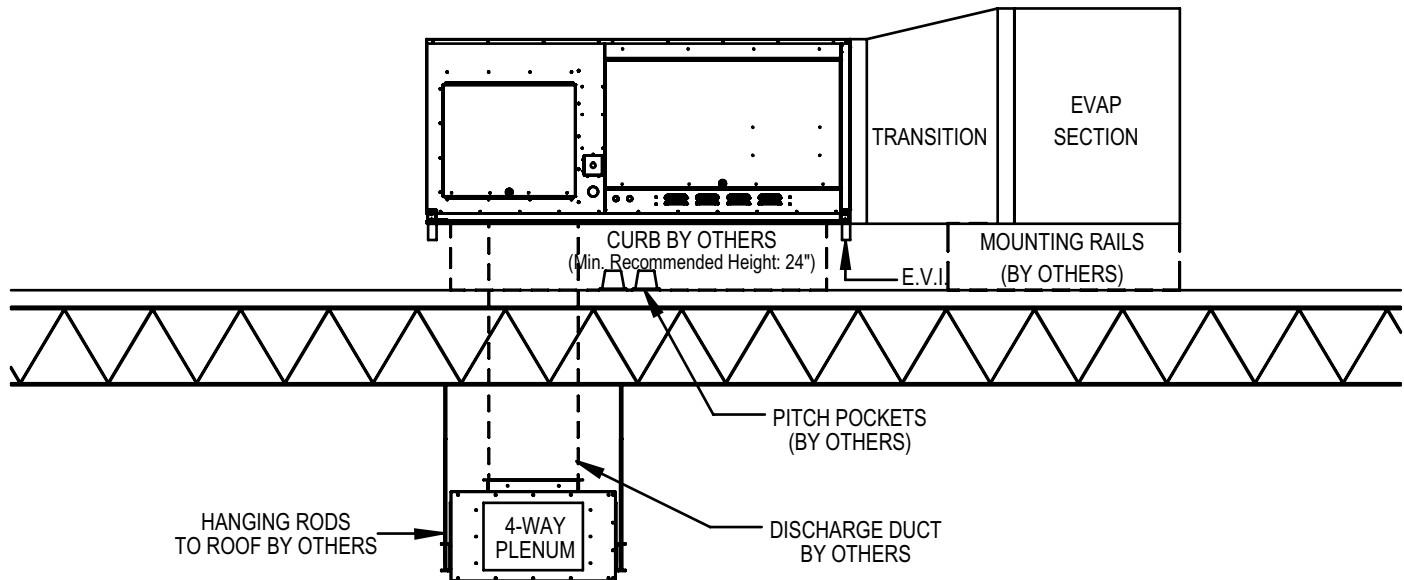
NOTE: DO NOT install DEC unit backwards to ensure full performance capabilities. An airflow directional sticker has been placed on the DEC at the factory.

4. Lift or set DEC in place. Make sure the DEC module covers the entire air inlet opening.
5. Fasten DEC in place with the self-drilling screws provided with unit. Use pre-punched mounting holes around the top and side flanges of DEC module.

NOTE: Take care not to drill or screw into sump tank.

6. Check for air leakage. Air leakage will lower the efficiency.
7. Check that DEC is level for proper water transfer through system.
8. Check that the sump pump has a good seal to floor.

Roof Top Configuration – M-Series w/Evap Unit



PLUMBING / FILL AND DRAIN VALVES:

1. All installation should be performed in accordance to local and state codes and with proper permits.
2. Make-up water connection is ½" FPT.
3. Install 3-way fill valve (if supplied by Cambridge) in a conditioned space to keep the pipe from freezing (see attached schematic).
4. The 2-way drain valve (if supplied by Cambridge) can be installed outdoors or indoors under the roof line in a frost-free environment. See schematic below. If the 2-way drain valve is installed outdoors (above the roof level), valve cover(s) are required.

Auto Drain with Freeze Protection (Optional)

Install two-way drain valve (supplied by Cambridge Air Solutions, as an option, and installed by Contractor) on the sump's drain connection. Install three-way fill valve (supplied by Cambridge Air Solutions, as an option, and installed by Contractor) under the roof-line with port "AB" piped to the make-up water connection from the sump. Port "A" is piped to city water supply and port "B" is piped to an approved roof drain. (See attached drawing.)

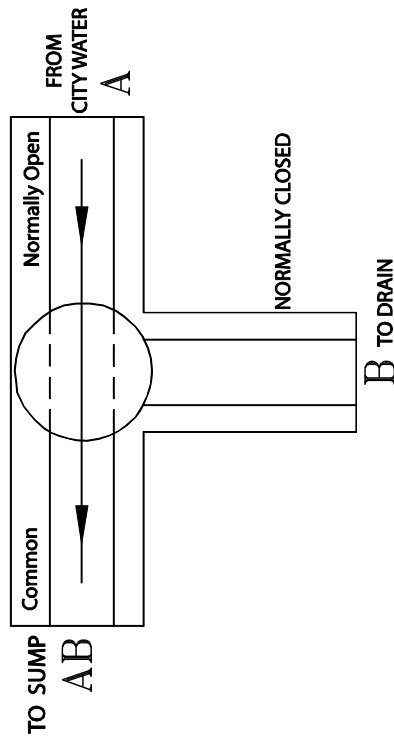
During normal operation of the unit the drain valve will be shut and the fill valve is open from port "A" to port "AB" letting city water enter the sump. Water level is adjusted and controlled by a float assembly to a level ½" inch below the overflow. On a freeze signal or a signal from 24-hour time clock, the drain valve will open allowing for the sump to drain. Simultaneously, the fill valve will shut off the city water, closing port "A" to port "AB" but will open port "AB" to port "B," thus allowing the remaining water in the exposed pipe from the valve to the sump to drain to keep pipe from freezing. A low-water cut off switch will protect the pump(s) from running dry.

Relocate the freeze stat bulb (located inside the electric control panel) to the outside of the enclosure to ensure correct temperature readings.

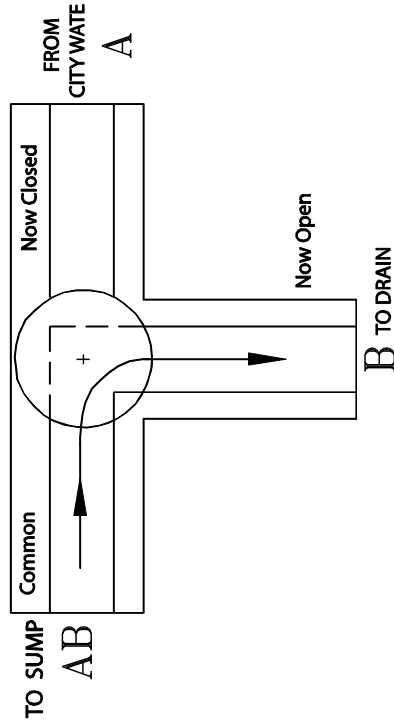
FILL VALVE SCHEMATIC:

NOTE: ALL PLUMBING, PIPING, AND FIXTURES EXTERNAL TO UNIT ARE TO BE FURNISHED AND INSTALLED BY OTHERS UNLESS OTHERWISE INDICATED.

3-WAY VALVE FILLING SUMP

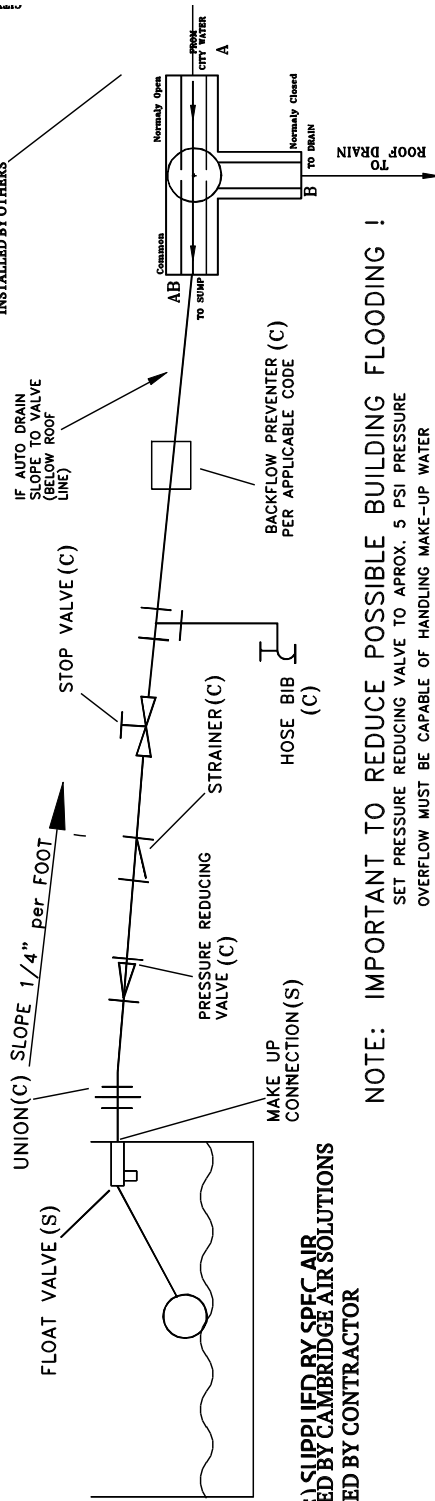


3-WAY VALVE SHUTTING OFF CITY WATER & DRAINING EXPOSED PIPE



SUGGESTED MAKE UP WATER PIPING

PROVIDED BY INSTALLER (FLOAT VALVE BY CAMBRIDGE AIR SOLUTIONS):



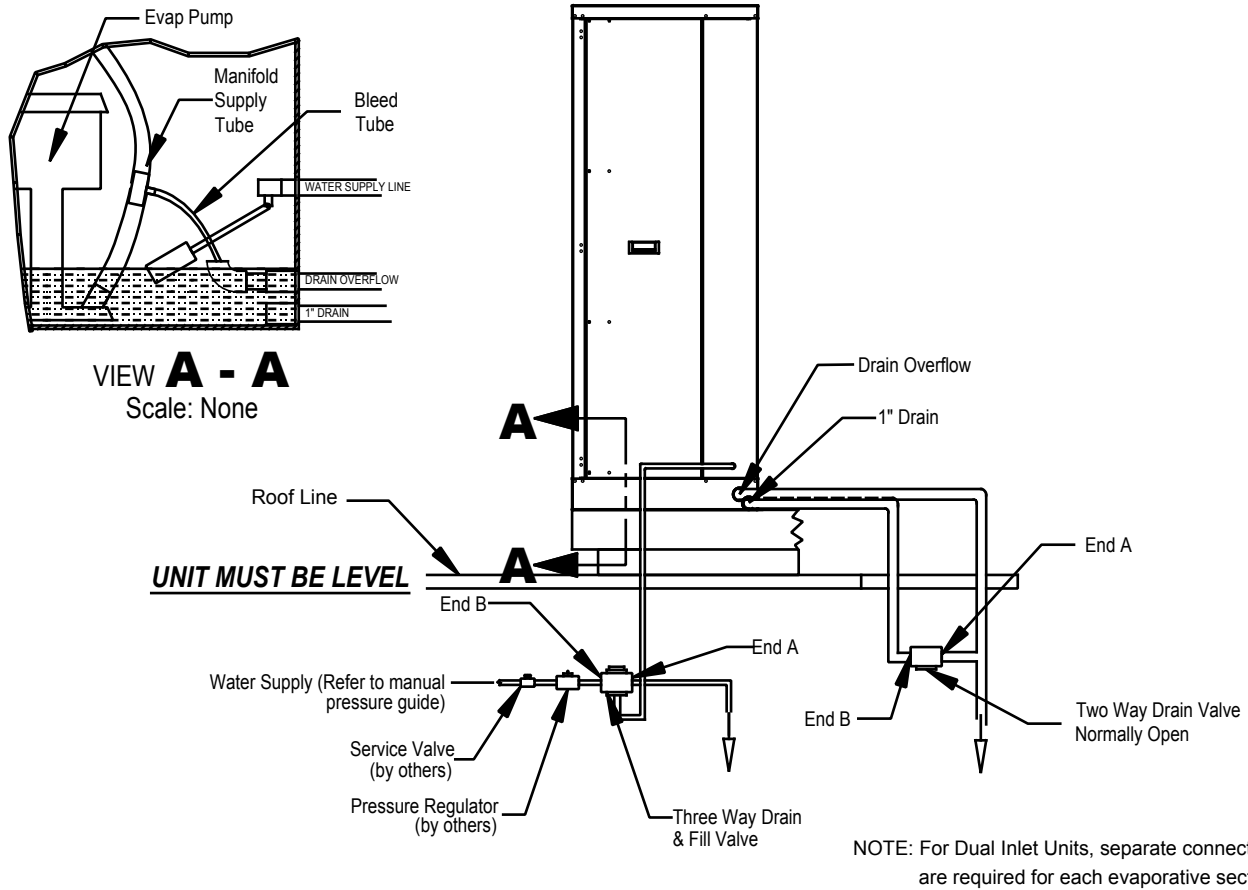
(S) SUPPLIED BY SPEC AIR
(S) SUPPLIED BY CAMBRIDGE AIR SOLUTIONS
(C) SUPPLIED BY CONTRACTOR

NOTE: IMPORTANT TO REDUCE POSSIBLE BUILDING FLOODING !

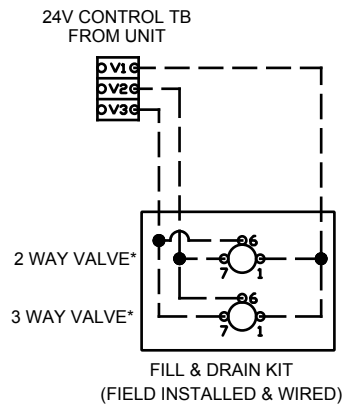
SET PRESSURE REDUCING VALVE TO APPROX. 5 PSI PRESSURE
OVERFLOW MUST BE CAPABLE OF HANDLING MAKE-UP WATER FLOW RATE.
TO SET: BLOCK FLOAT VALVE OPEN AND LOWER PRESSURE UNTIL OVERFLOW WILL HANDLE FULL MAKE-UP WATER FLOW RATE.

FILL AND DRAIN VALVE SCHEMATIC

Drain, Overflow and Make-Up Water Piping for Autodrain with Freeze Protection



FILL & DRAIN KIT WIRING SCHEMATIC



NOTE: *Wiring may change if pumps provided by others.
**All wiring must comply with local and national electrical codes.

ELECTRIC PANEL / WIRING:

Pump and low level switch are wired to a J-Box in the DEC module.

Wiring to the control panel is pre-wired and coiled up in the Electrical Control Enclosure for termination in the field.

Factory-supplied power and control wiring are to be field-connected to the terminal strip located in the J box mounted on the DEC.

NOTE: Power supplied and installed by others.

- All installations should be performed in accordance to local and state codes and with proper permits.
- Wire unit according to approved submittals and wiring diagram.

MEDIA COOLING PADS OPERATING INSTALLATION:



Munters

Engineering Bulletin EB-OI-0906
MEDIA ORIENTATION
INSTRUCTIONS

IMPORTANT

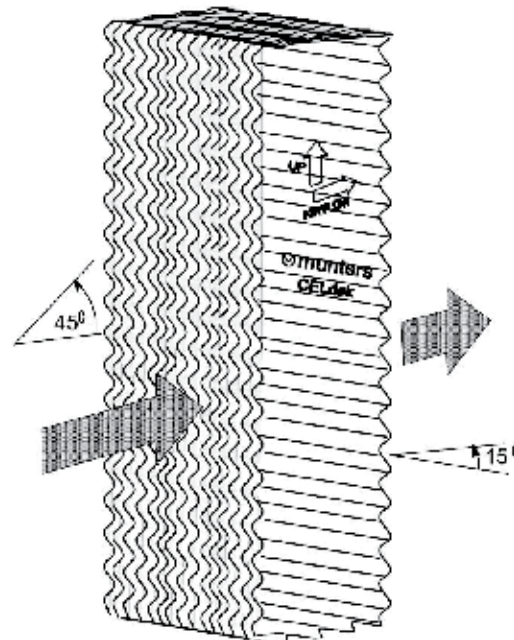
Installation

In order to get the best performance from your Munters cooling pads, they must be installed properly. If you have purchased a pad with two equal angles, they can be installed in either direction. Depending on the application, pads are manufactured with special angle combinations. Those having combinations of 15° x 45° or 30° x 45° are made to direct more water toward the air entering side of the pads. If installed backwards, the pads may not work properly.

Munters pads must always be installed with the steeper flute angle sloping down toward the air entering side. The reasoning is simple, the steeper angle puts more water on the entering side of the pad where the air is hot, dry, and dusty and extra water it is needed most. The unequal angles also counteract the tendency of the air to push the water toward the air leaving side of the pad.

CELdek "New Pad" Odor

CELdek is made from materials similar to those used in paints, carpets, paneling and wallpaper. CELdek pads must be flushed with water to remove the new construction odors. If you find the smell of the new paper to be objectionable, you should run water over the pad for 2-5 hours without the fan running. Change the water often, using bleed off or dump cycles. If the odor continues after one or two days, call Munters customer service. Please have full details of when and from whom the pad was purchased.



Caution

Do not expose CELdek® evaporative cooling pads to sparks, open flame, welding spatter, temperatures in excess of 350° F, or other sources which may ignite the paper. GLASdek® will not readily ignite, unless exposed to a direct flame or extremely high temperatures for an extended period of time.

Test Results for ASTM-E84 Standard Method of Test for Surface Burning Characteristics of Building Materials

PRODUCT	Flame Spread Index	Smoke Density
CELdek	450	420
GLASdek	0	20
Mi-T-Dark®, DRIFdek®, & COOLdek®	15	745

NOTE: SEE ADDITIONAL INFORMATION ON CARE OF MUNTERS MEDIA IN SUPPLEMENTAL INFORMATION.

INITIAL START-UP:

Procedure:

1. Turn unit Disconnect Switch to the "OFF" position and test to verify there is no electricity to the unit and ensure proper grounding. **INSPECT AND TIGHTEN ALL ELECTRICAL AND WIRE TERMINALS.**
2. Check all wire and plumbing connections for proper installation.
3. Fill sump tank with water and adjust float to ½ inch below overflow drain.
4. Check for leaks in sump, water distribution piping, and float operation.
5. The factory-installed freeze thermostat sensing tube (located inside electric panel) senses the outdoor ambient air. The 45 degree factory setting is adjustable.

⚠WARNING:

Whenever power is interrupted, the 24-hour clock must be reset to local time.

6. Check that the fill and drain valve are installed and wired to the 24-hour timer and freeze stat. Set the 24-hour fill and drain timer to local time. The drain and refill feature is factory set to turn off the sump for 1 hour between 4 am to 5 a.m., and is manually adjustable to User's requirements.
7. Turn power to unit on leaving unit disconnect "OFF". Check for any shorts.
8. Check that line and sump pump voltages and amperages are per the nameplate. Record supply voltage and amperage. .
9. Turn the unit disconnect "ON".
10. Confirm the Time Delay has been set to 1 minute on the sump pump(s).
11. Verify the Low Water Level float switch located in sump is working properly and will turn the pump(s) on.
12. Start-up the fan per manufacturer's instructions. After both the fan and sump are running and operating properly, check that water is not being carried over into the airstream from the media pads or sump. Check fan rotation. Cycle damper actuators to ensure they open and close freely.

If there is water carryover from the media pads perform the following procedure:

13. Check for proper positioning of media pads (the sides of pads are arrows marking the direction of air flow. If media pads are correctly positioned then check for air bypassing between the media pads and their frames. If air is bypassing, then place a strip of foam gasketing between the media pads and side channel to compress the media pads and fill the gap.
14. After twenty (20) minutes observe media for complete wetting and check that there are no dry streaks. Open balancing valve more to increase water flow and close valve as necessary to reduce water flow to media pads (Initial factory set position of valve is ½ open).
15. After running Cambridge Air Solutions DEC for (1) week adjust factory pre-set bleed valve(s). This process allows the pump to discharge the concentration of solids in the water. Bleed valve is located on the discharge portion of the pump and is connected to a 3/8" drain tube. Drain tube should always be positioned inside the overflow drain. Use the following procedure to set bleed valve:
 - a. Completely turn the bleed valve(s) open. This allows the pump to discharge the concentration of solids in the water.
 - b. Close the bleed valve(s) and count the number of turns required.
 - c. Set bleed valve(s) to ½ open position.
 - d. Check that bleed lines(s) are connected to overflow drain.
 - e. Increase water flow rate if there are scale deposits on the media pads. Check for water carryover afterwards and adjust if necessary.
 - f. If there are dry streaks in the media then remove distribution header and any debris blocking the distribution holes.

NORMAL OPERATIONS:

Sequence of Operation:

1. Upon external signal the sump pump will energize and water will flow to the distribution header and over the media pads.

NOTE: For longer media pad life do not cycle the water flow over the media pads. The pump should run continuously (Variable air volume or cycling the fan are acceptable methods of temperature control).

If the pump has to be cycled, a wash down cycle component can be purchased to prevent the plating of solids on the media.

2. At the factory pre-set or customer set time, the fill valve will close and the drain valve will open for 1 hour emptying the sump.

NOTE: This procedure is necessary to prevent algae and scale formation on the media pads.

MAINTENANCE:

Procedure:

Spring Start-Up

1. Clean sump tank and sump pump.
2. Remove distribution header and clean out distribution holes that supply water flow to media pads.
3. Inspect all wire connections for discolored and/or burned wires. Replace where necessary.
4. Inspect media pads and replace per manufacturer's recommendations.
5. Follow 'Initial Start Up' procedures.

Monthly and Quarterly Maintenance

1. Inspect sump pump and water level. Adjust float valve if necessary.
2. Check media pads for scaling and adjust bleed valve as required.
3. Inspect for water carryover and leaks.
4. Inspect air flow making sure no outside air is bypassing media pads.

Annual Shutdown for Winterizing

1. Disconnect power supply.
2. Shut off manual water make-up valve to unit.
3. Drain sump. Pump removal is not necessary.
4. Clean any scale or debris in sump and sump pump area.

REFERENCE HEATER ROOF AND WALL OPENINGS

Horizontal Mount

Model	Wall Opening				Roof Opening	
	Discharge		Inlet		W	L
	W	H	W	H		
M110	18 ¹ / ₄ "***	18 ¹ / ₄ "***	32 ¹ / ₄ "***	35"***	17 ³ / ₄ "**	17 ³ / ₄ "*
M112	19 ³ / ₄ "***	19 ³ / ₄ "***	32 ¹ / ₄ "***	35"***	19 ¹ / ₄ "**	19 ¹ / ₄ "*
M115	22 ³ / ₄ "***	22 ³ / ₄ "***	46 ¹ / ₄ "***	35"***	22 ¹ / ₄ "**	22 ¹ / ₄ "*
M118	26 ¹ / ₂ "****	26 ¹ / ₂ "****	51 ³ / ₄ "****	55 ¹ / ₄ "****	25 ¹ / ₂ "***	25 ¹ / ₂ "***
M120	30 ¹ / ₂ "****	30 ¹ / ₂ "****	57 ³ / ₄ "****	55 ¹ / ₂ "****	29 ¹ / ₂ "***	29 ¹ / ₂ "***
M125	36"****	36"****	69 ³ / ₄ "****	72 ¹ / ₄ "****	35"***	35"***
M130	43"****	43"****	92 ¹ / ₂ "	73 ¹ / ₄ "	42"****	42"****
M136	49"****	49"****	92 ¹ / ₂ "	98 ¹ / ₄ "	48"****	48"****
M140	56 ¹ / ₄ "****	56 ¹ / ₄ "****	121 ³ / ₄ "	97 ³ / ₄ "	55 ¹ / ₄ "****	55 ¹ / ₄ "****

* DIMENSIONS ALLOW FOR 3/4" CLEARANCE ON EACH SIDE

** DIMENSIONS ALLOW FOR 1" CLEARANCE ON EACH SIDE

*** DIMENSIONS ALLOW FOR 1 1/2" CLEARANCE ON EACH SIDE

**** DIMENSIONS ALLOW FOR 2" CLEARANCE ON EACH SIDE

Vertical Mount

Model	Wall Opening			
	Discharge		Inlet	
	W	H	W	H
M118	26 ¹ / ₂ "****	26 ¹ / ₂ "****	51 ³ / ₄ "****	56"****
M120	30 ¹ / ₂ "****	30 ¹ / ₂ "****	57 ³ / ₄ "****	56"****
M125	36"****	36"****	69 ³ / ₄ "****	72 ¹ / ₂ "****
M130	43"****	43"****	92 ¹ / ₂ "****	73 ¹ / ₂ "****
M136	49"****	49"****	104"****	83 ¹ / ₂ "****

* DIMENSIONS ALLOW FOR 3/4" CLEARANCE ON EACH SIDE

** DIMENSIONS ALLOW FOR 1" CLEARANCE ON EACH SIDE

*** DIMENSIONS ALLOW FOR 1 1/2" CLEARANCE ON EACH SIDE

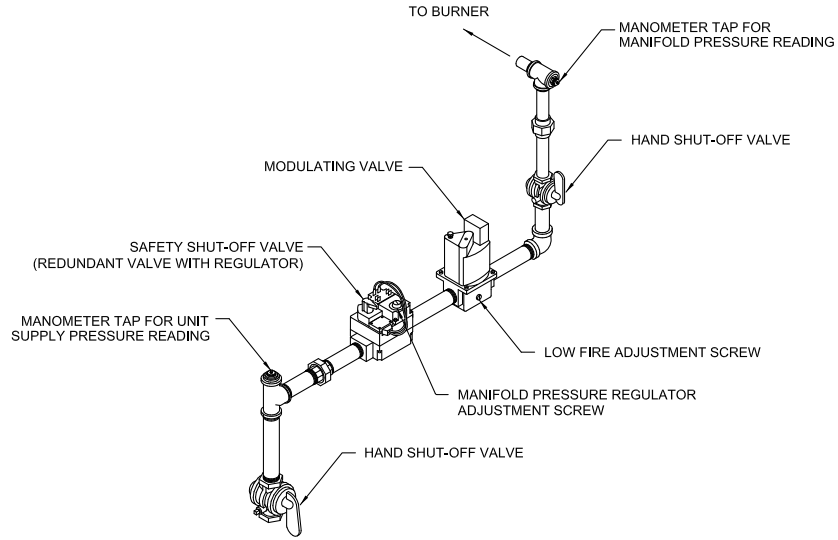
**** DIMENSIONS ALLOW FOR 2" CLEARANCE ON EACH SIDE

HEATER DISCHARGE DIMENSIONS

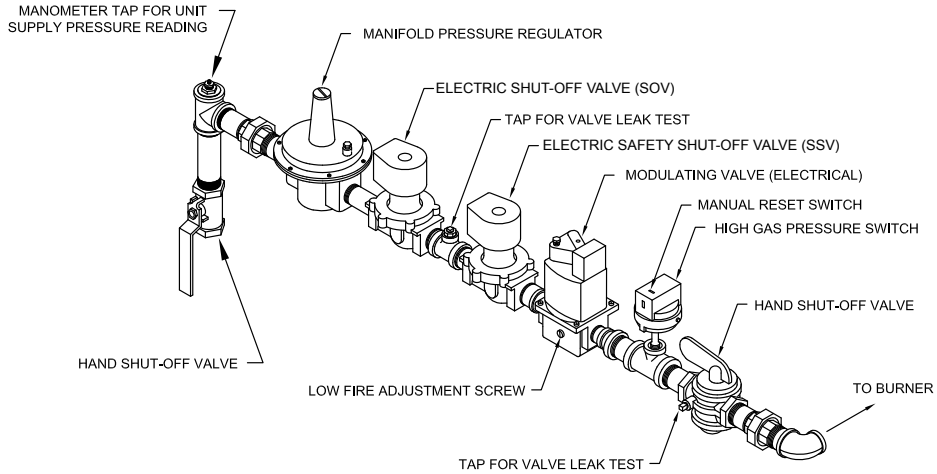
Model	Discharge Opening		Discharge Duct Size	
	W	L	W	L
M110	12 ³ / ₄ "	13 5/8"	16 ¹ / ₄ "	16 ¹ / ₄ "
M112	12 7/8"	15 7/8"	17 ³ / ₄ "	17 ³ / ₄ "
M115	18 5/8"	15 7/8"	20 ³ / ₄ "	20 ³ / ₄ "
M118*	21 7/8"	18 ³ / ₄ "	23 ¹ / ₂ "	23 ¹ / ₂ "
M120*	24 ¹ / ₂ "	24 ³ / ₄ "	27 ¹ / ₂ "	27 ¹ / ₂ "
M125*	31 ¹ / ₄ "	31 ¹ / ₄ "	33"	33"
M130*	36 5/8"	36 5/8"	39"	39"
M136*	42 ¹ / ₂ "	42 ³ / ₄ "	45"	45"
M140	50"	50"	52 ¹ / ₄ "	52 ¹ / ₄ "

REFERENCE GAS TRAIN DRAWINGS

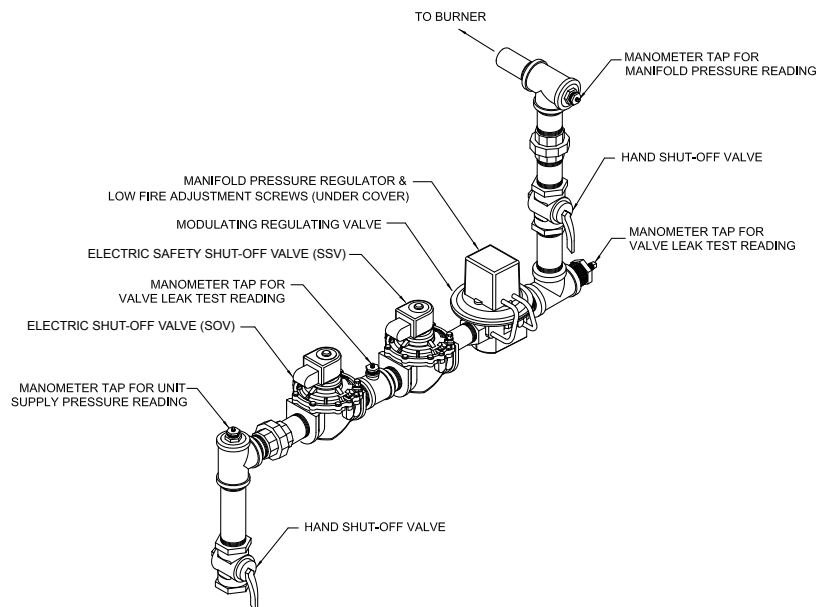
**Horizontal Mount
< 400 MBH
CSA Certified**



**Vertical Mount
> 400 MBH
Low Pressure
CSA Certified**

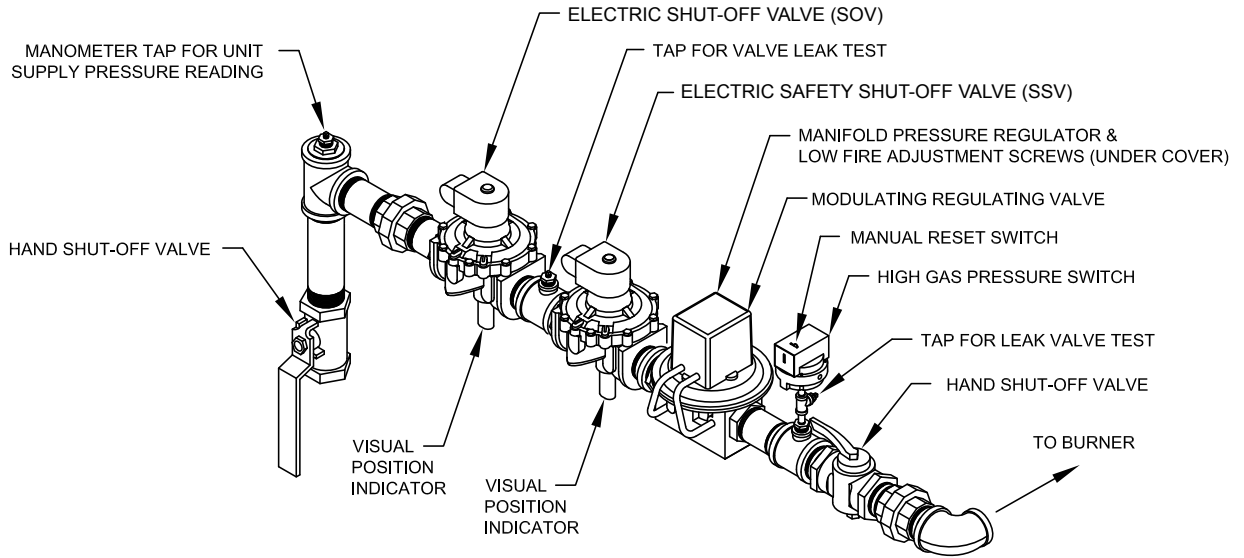


**Horizontal Mount
> 400 MBH
High Pressure
CSA Certified**

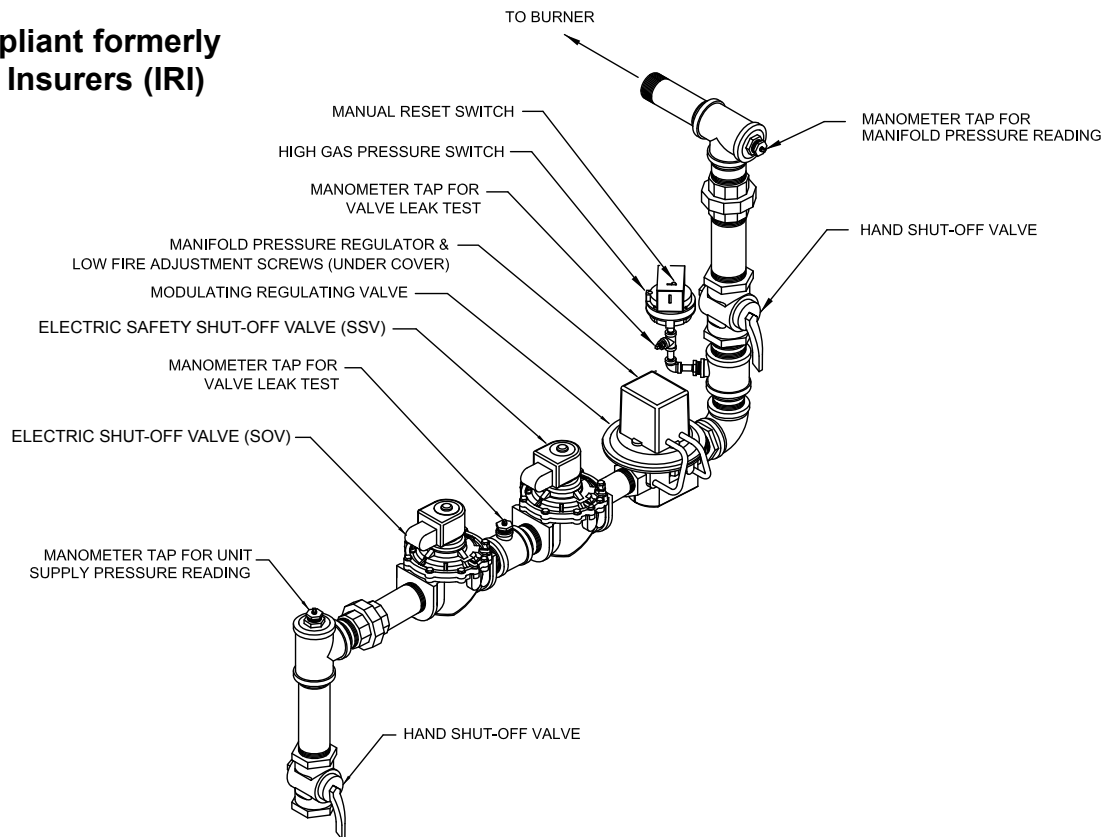


GAS TRAIN DRAWINGS (FM & XL GAPS)

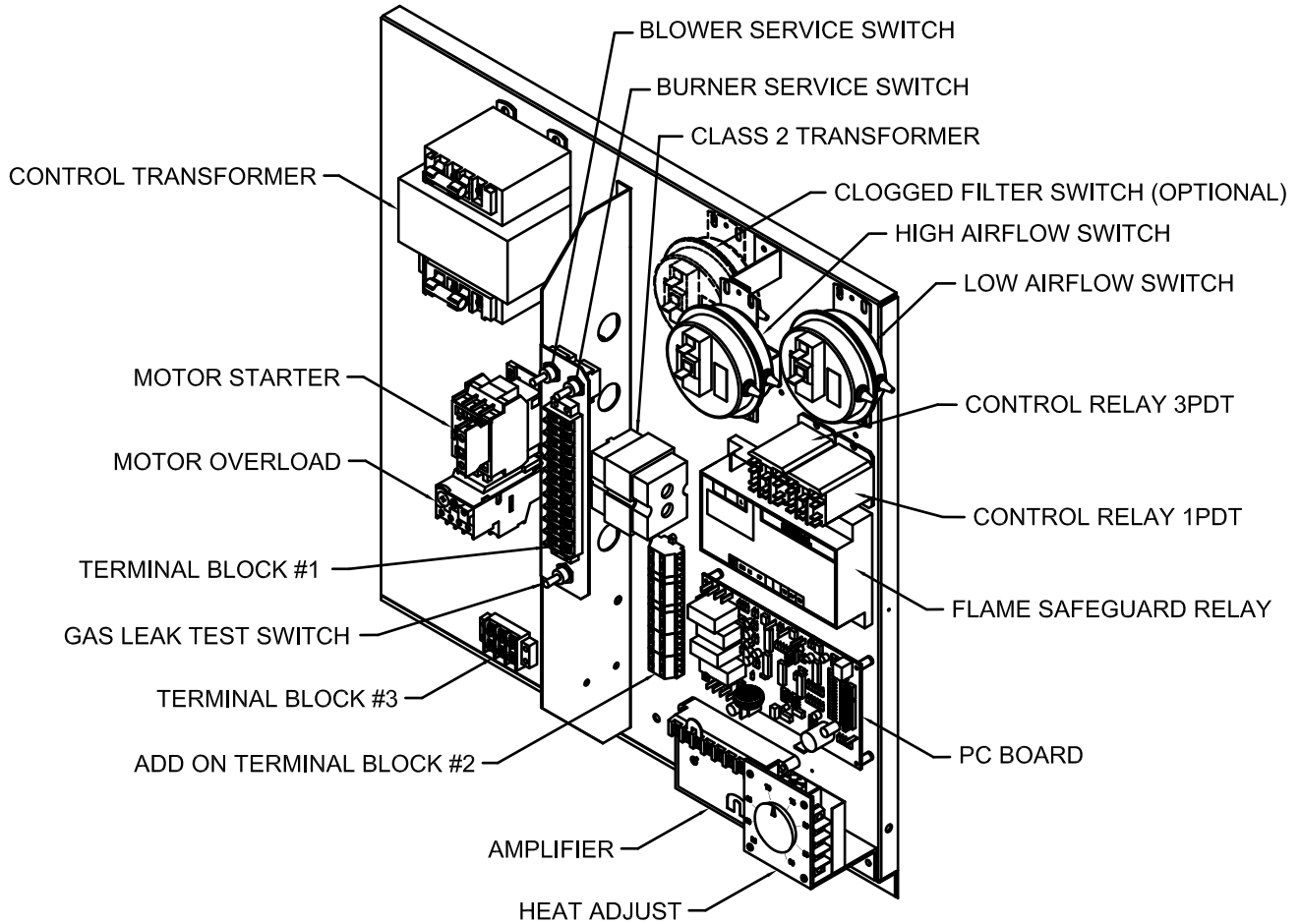
Vertical Mount
> 2500 MBH
Factory Mutual (FM) Compliant
CSA Certified



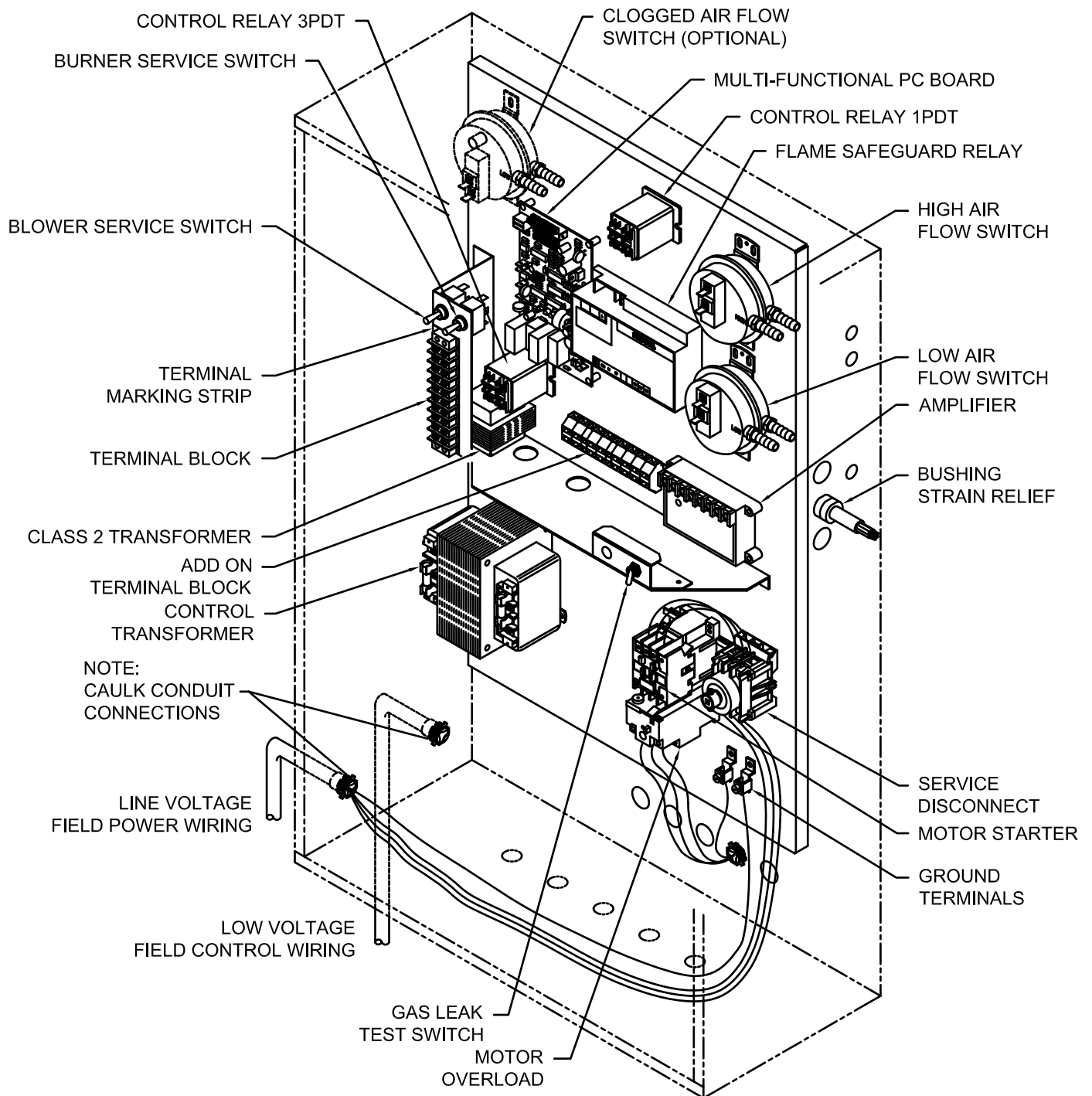
Horizontal Mount
> 400 MBH
XL GAPS Compliant formerly
Industrial Risk Insurers (IRI)
CSA Certified



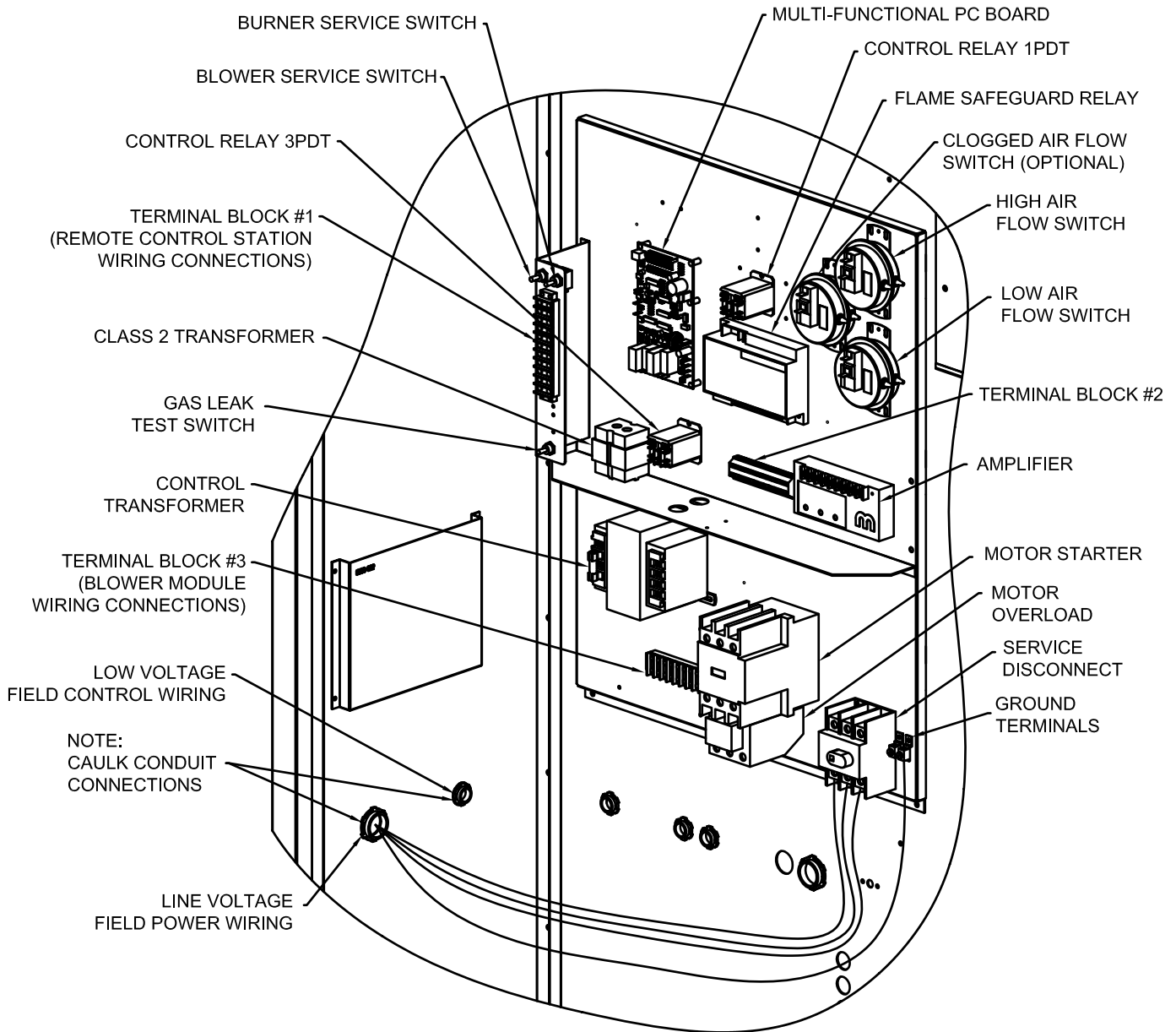
REFERENCE
ELECTRICAL CONTROL ENCLOSURE ISOMETRIC DRAWING
M110 - M115



REFERENCE ELECTRICAL CONTROL ENCLOSURE ISOMETRIC DRAWING M118 - M136

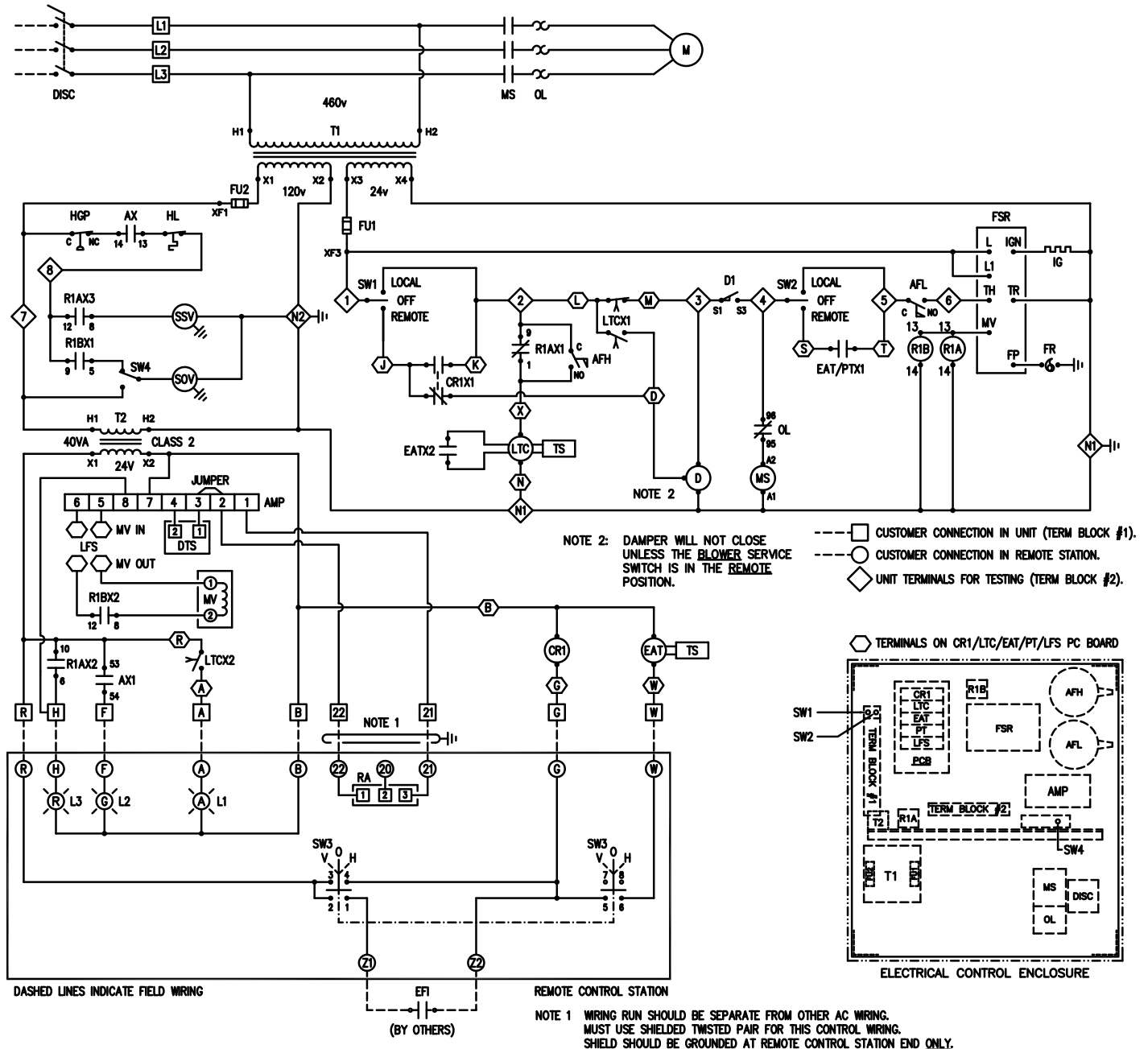


ELECTRICAL CONTROL ENCLOSURE ISOMETRIC DRAWING M140



REFERENCE ELECTRICAL WIRING DIAGRAMS

Series 14

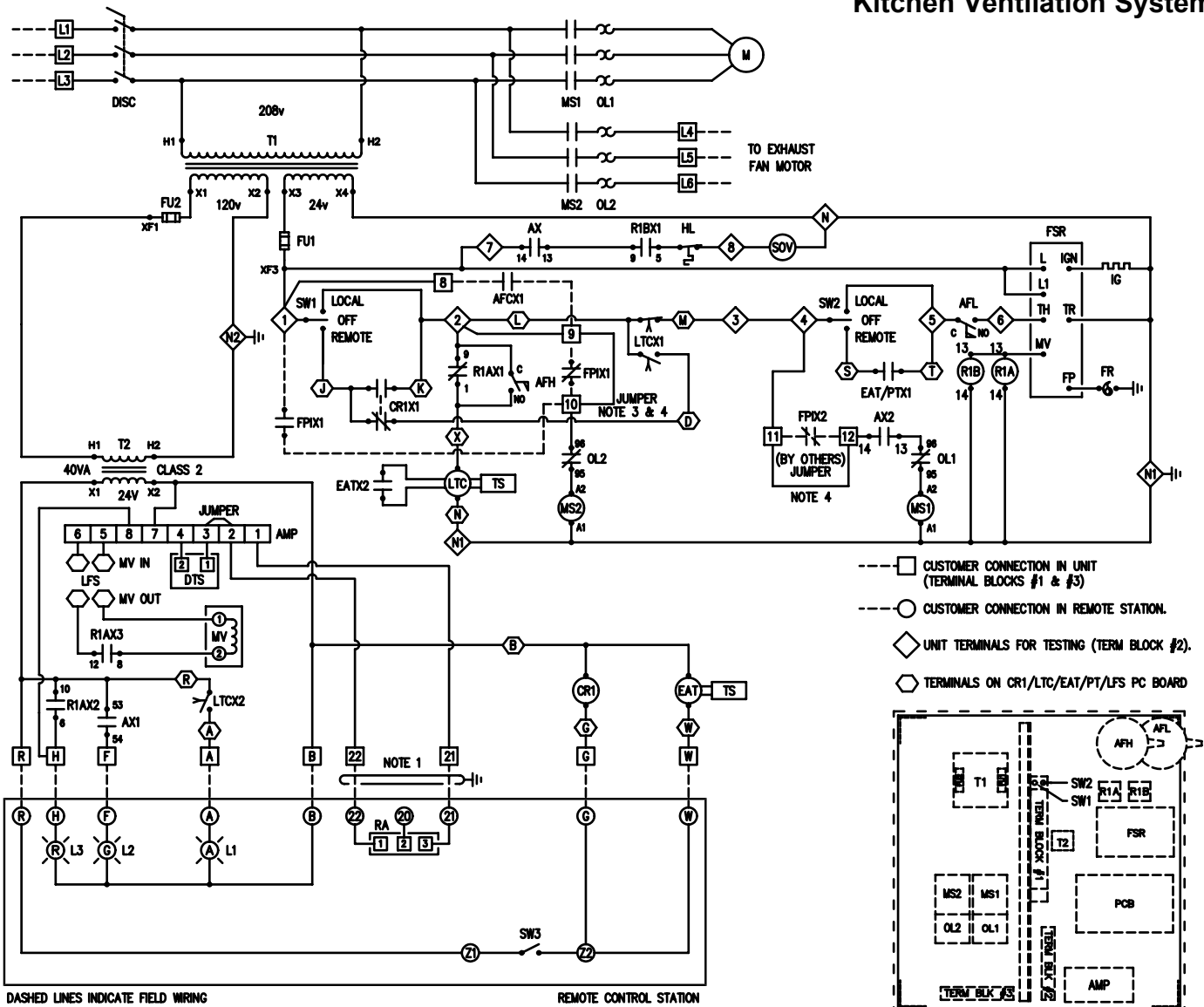


SYMBOL	DESCRIPTION
AFL	Air Flow Switch - Low
AFH	Air Flow Switch - High
AMP	Amplifier Solid State
AX1	Auxiliary Contact
AX	Auxiliary Contact
CR1	Control Relay
D & D1	Damper Motor & End Switch
DISC	Service Disconnect Non - Fused
DTS	Discharge Temperature Sensor
EAT	Entering Air Thermostat
EFI	Exhaust Fan Interlock
FR	Flame Rod
FSR	Flame Safeguard Relay

SYMBOL	DESCRIPTION
FU1	Fuse 24 Volt Control
FU2	Fuse 120 Volt Control
HGP	High Gas Pressure Switch
HL	High Limit
L1	Light - Alarm
L2	Light - Fan
L3	Light - Heat
LFS	Low Fire Start
LTC	Low Temperature Cutout
M	Motor
MS	Motor Starter
MV	Modulating Valve

SYMBOL	DESCRIPTION
OL	Overload Relay
PT	Purge Timer
RA	Relay Adjust
RIA&RIB	Relay Gas Valve
SOV	Shut-Off Valve - Gas
SSV	Safety Shut-Off Valve - Gas
SW1	Service Switch - Fan
SW2	Service Switch - Heat
SW3	Switch - Fan/Off/Heat
SW4	Switch - SOV Leak Test
T1	Multi-Tap Transformer (24&120 Volt)
T2	Class 2 Transformer (24 Volt)
TS	Temperature Sensor

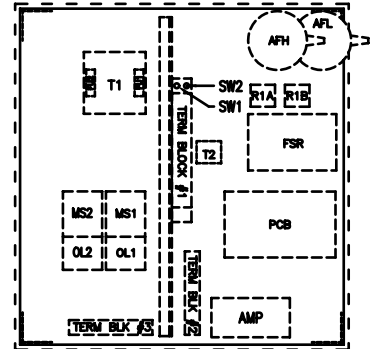
Series 14 Kitchen Ventilation System



DASHED LINES INDICATE FIELD WIRING

REMOTE CONTROL STATION

- □ CUSTOMER CONNECTION IN UNIT (TERMINAL BLOCKS #1 & #3)
- ○ CUSTOMER CONNECTION IN REMOTE STATION.
- ◇ UNIT TERMINALS FOR TESTING (TERM BLOCK #2).
- ◇ TERMINALS ON CR1/LTC/EAT/PT/LFS PC BOARD



ELECTRICAL CONTROL ENCLOSURE

NOTE 1 WIRING RUN SHOULD BE SEPARATE FROM OTHER AC WIRING. MUST USE SHIELDED TWISTED PAIR FOR THIS CONTROL WIRING. SHIELD SHOULD BE GROUNDED AT REMOTE CONTROL STATION END ONLY.

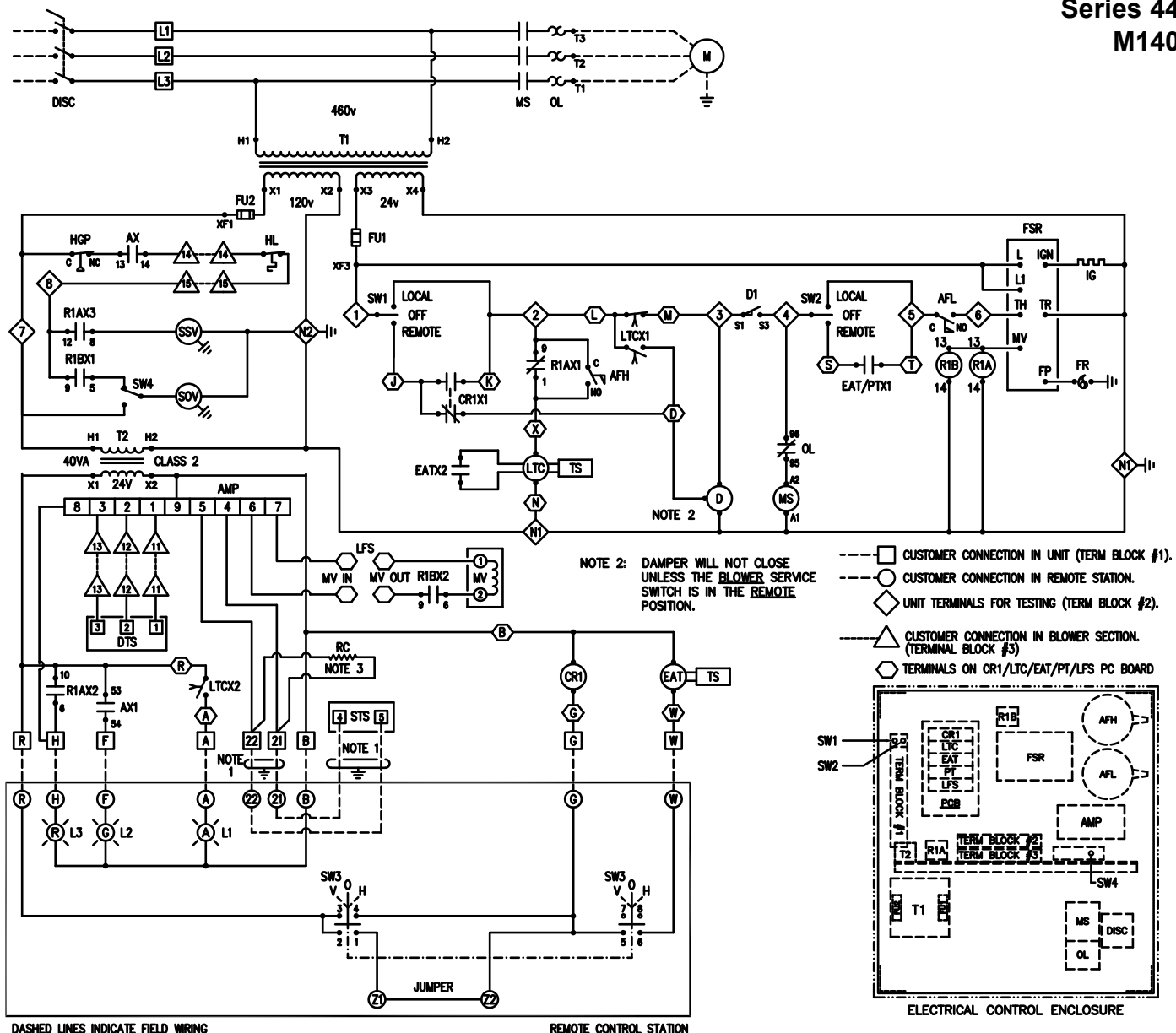
NOTE 3 FPI WILL ONLY DEACTIVATE HEATER AS SHOWN. TO DEACTIVATE EXHAUST FAN AND HEATER, INTERCHANGE FPI AND JUMPER.

NOTE 4 IF FIRE PROTECTION INTERLOCK IS CONNECTED TO THESE TERMINALS, REMOVE THIS JUMPER.

SYMBOL	DESCRIPTION
AFL	Air Flow Switch - Low
AFH	Air Flow Switch - High
AMP	Amplifier Solid State
AX	Auxiliary Contact
AX1	Auxiliary Contact
AX2	Auxiliary Contact
CR1	Control Relay
DISC	Service Disconnect Non - Fused
DTS	Discharge Temperature Sensor
EAT	Entering Air Thermostat
FPI	Fire Protection Interlock
FR	Flame Rod
FSR	Flame Safeguard Relay

SYMBOL	DESCRIPTION
FU1	Fuse 24 Volt Control
FU2	Fuse 120 Volt Control
HL	High Limit
IG	Igniter
L1	Light - Alarm
L2	Light - Fan
L3	Light - Heat
LFS	Low Fire Start
LTC	Low Temperature Cutout
M	Motor - Supply Fan
MS1	Motor Starter - Supply Fan
MS2	Motor Starter - Exhaust Fan
MV	Modulating Valve

SYMBOL	DESCRIPTION
OL1	Overload Relay - Supply Fan
OL2	Overload Relay - Exhaust Fan
PT	Purge Timer
RA	Remote Heat Adjust
RIA&RIB	Relay-Gas Valve
SOV	Shut-Off Valve - Gas
SW1	Service Switch - Fan
SW2	Service Switch - Heat
SW3	Switch - Off/On
T1	Multi-Tap Transformer (24&120 Volt)
T2	Class 2 Transformer (24 Volt)
TS	Temperature Sensor



DASHED LINES INDICATE FIELD WIRING

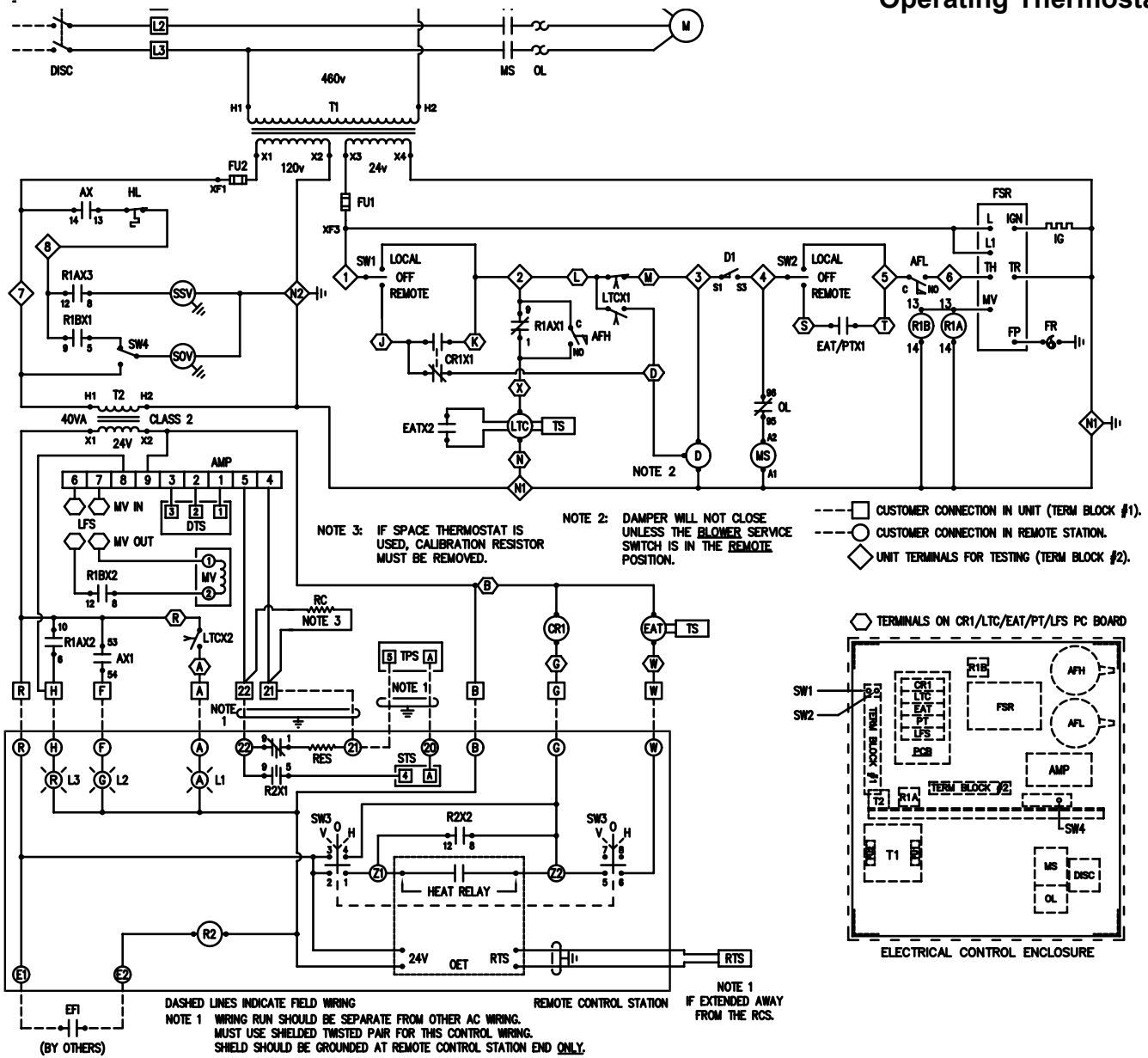
REMOTE CONTROL STATION

NOTE 1: WIRING RUN SHOULD BE SEPARATE FROM OTHER AC WIRING. MUST USE SHIELDED TWISTED PAIR FOR THIS CONTROL WIRING. SHIELD SHOULD BE GROUNDED AT REMOTE CONTROL STATION END ONLY.

NOTE 3: IF SPACE THERMOSTAT IS USED, CALIBRATION RESISTOR MUST BE REMOVED.

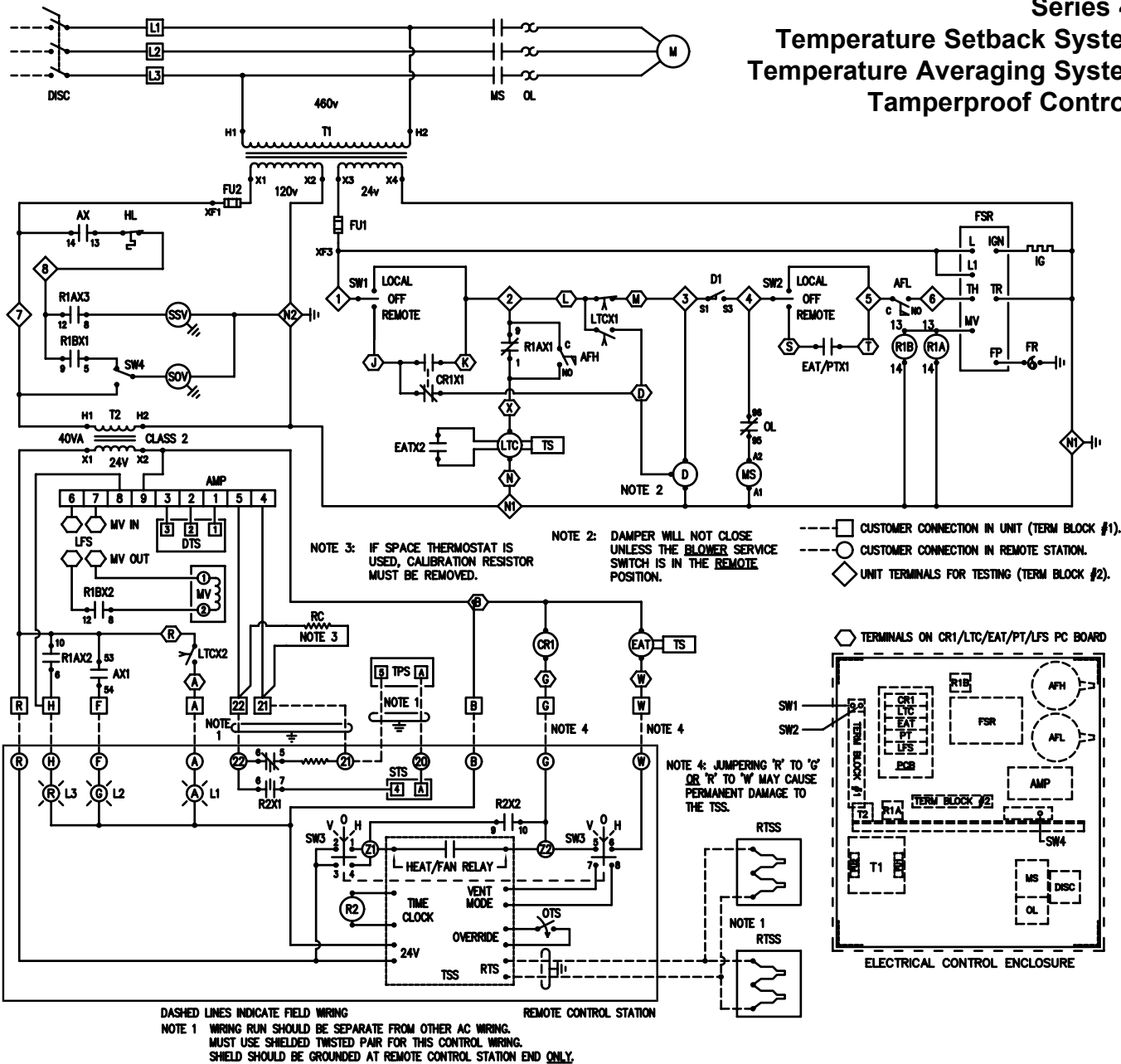
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
AFL	Air Flow Switch - Low	FU2	Fuse - 120 Volt Control	PT	Purge Timer
AFH	Air Flow Switch - High	HGP	High Gas Pressure Switch	RIA&RIB	Relay Gas Valve
AMP	Amplifier Solid State	HL	High Limit	RC	Resistor - Calibration
AX1	Auxiliary Contact	IG	Igniter	SOV	Shut-Off Valve - Gas
AX	Auxiliary Contact	L1	Light - Alarm	SSV	Safety Shut-Off Valve - Gas
CR1	Control Relay	L2	Light - Fan	STS	Space Temperature Selector
D & D1	Damper Motor & End Switch	L3	Light - Heat	SW1	Service Switch - Fan
DISC	Service Disconnect Non - Fused	LFS	Low Fire Start	SW2	Service Switch - Heat
DTS	Discharge Temperature Sensor	LTC	Low Temperature Cutout	SW3	Switch - Fan/Off/Heat
EAT	Entering Air Thermostat	M	Motor	SW4	Switch - SOV Leak Test
FR	Flame Rod	MS	Motor Starter	T1	Multi-Tap Transformer (24&120 Volt)
FSR	Flame Safeguard Relay	MV	Modulating Valve	T2	Class 2 Transformer (24 Volt)
FU1	Fuse 24 Volt Control	OL	Overload Relay	TS	Temperature Sensor

Series 44 Tamperproof Controls Operating Thermostat



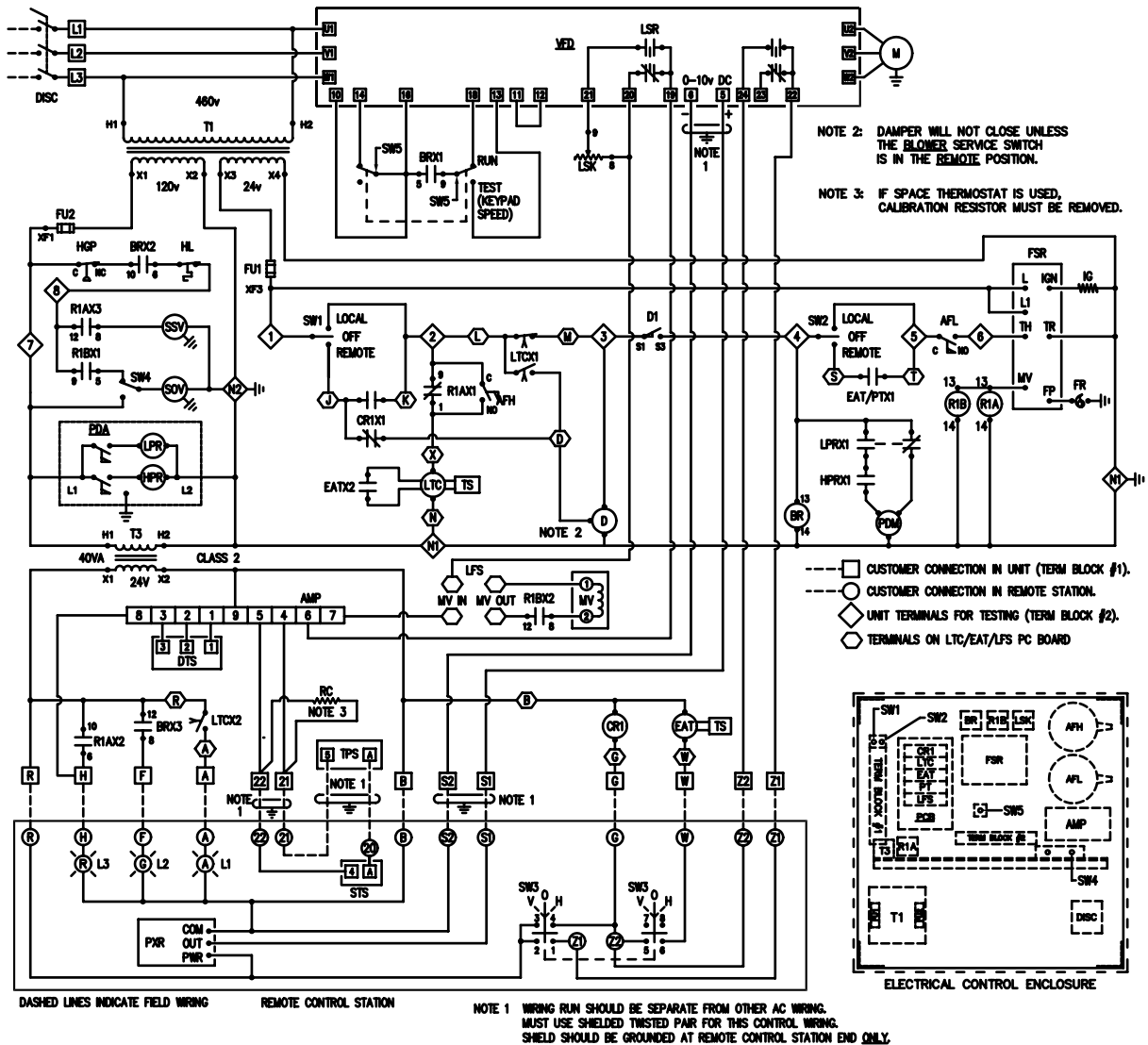
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
AFL	Air Flow Switch - Low	HL	High Limit	RC	Resistor - Calibration
AFH	Air Flow Switch - High	IG	Igniter	RTS	Remote Temperature Sensor
AMP	Amplifier Solid State	L1	Light - Alarm	SOV	Shut-Off Valve - Gas
AX1	Auxiliary Contact	L2	Light - Fan	SSV	Safety Shut-Off Valve - Gas
AX	Auxiliary Contact	L3	Light - Heat	STS	Space Temperature Selector
CR1	Control Relay	LFS	Low Fire Start	SW1	Service Switch - Fan
D & D1	Damper Motor & End Switch	LTC	Low Temperature Cutout	SW2	Service Switch - Heat
DISC	Service Disconnect Non - Fused	M	Motor	SW3	Switch - Fan/Off/Heat
DTS	Discharge Temperature Sensor	MS	Motor Starter	SW4	Switch - SOV Leak Test
EAT	Entering Air Thermostat	MV	Modulating Valve	T1	Multi-Tap Transformer (24&120 Volt)
EFI	Exhaust Fan Interlock	OET	Operating Electronic Thermostat	T2	Class 2 Transformer (24 Volt)
FR	Flame Rod	OL	Overload Relay	TPS	Tamper Proof Space Sensor
FSR	Flame Safeguard Relay	PT	Purge Timer	TS	Temperature Sensor
FU1	Fuse 24 Volt Control	RIA&RIB	Relay Gas Valve		
FU2	Fuse 120 Volt Control	R2	Relay - Intermittent/Continuous		

Series 44
Temperature Setback System
Temperature Averaging System
Tamperproof Controls



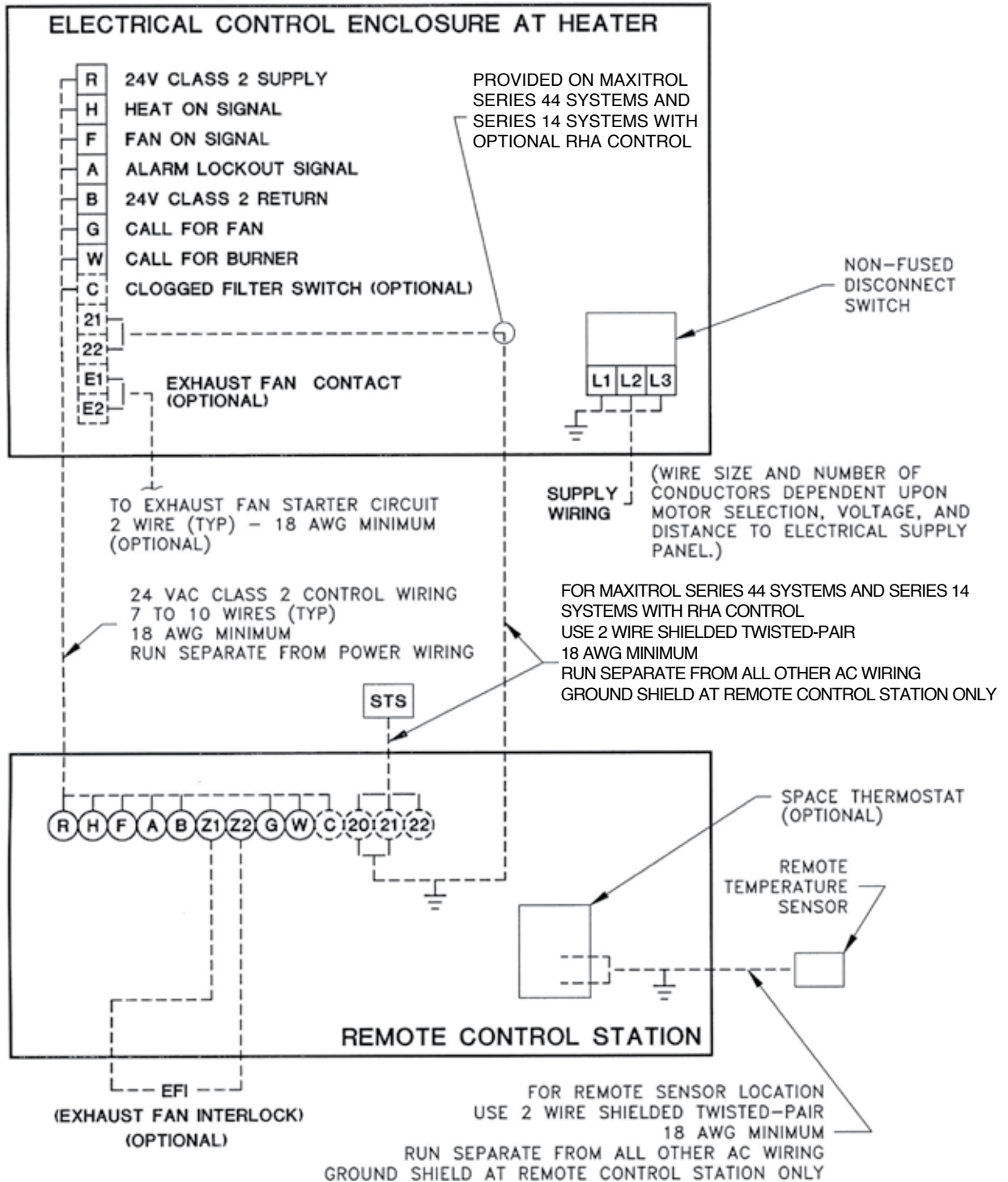
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
AFL	Air Flow Switch - Low	HL	High Limit	R2	Relay - Intermittent/Continuous
AFH	Air Flow Switch - High	IG	Igniter	RC	Resistor - Calibration
AMP	Amplifier Solid State	L1	Light - Alarm	RTS	Remote Temperature Sensor
AX1	Auxiliary Contact	L2	Light - Fan	SOV	Shut-Off Valve - Gas
AX	Auxiliary Contact	L3	Light - Heat	SSV	Safety Shut-Off Valve - Gas
CR1	Control Relay	LFS	Low Fire Start	STS	Space Temperature Selector
D & D1	Damper Motor & End Switch	LTC	Low Temperature Cutout	SW1	Service Switch - Fan
DISC	Service Disconnect Non - Fused	M	Motor	SW2	Service Switch - Heat
DTS	Discharge Temperature Sensor	MS	Motor Starter	SW3	Switch - Fan/Off/Heat
EAT	Entering Air Thermostat	MV	Modulating Valve	SW4	Switch - SOV Leak Test
FSR	Flame Safeguard Relay	OTS	Override Timer Switch	T1	Multi-Tap Transformer (24&120 Volt)
FU1	Fuse 24 Volt Control	OL	Overload Relay	T2	Class 2 Transformer (24 Volt)
FU2	Fuse 120 Volt Control	PT	Purge Timer	TPS	Tamper Proof Space Sensor
		RIA&RIB	Relay - Gas Valve	TS	Temperature Sensor
				TSS	Temperature Setback System

Series 44 Tamperproof Controls Variable Frequency Drive Room Pressure Controller



SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
AFL	Air Flow Switch - Low	HL	High Limit	PXR	Pressure Transducer
AFH	Air Flow Switch - High	HPR	Relay - High Pressure	RIA&RIB	Relay Gas Valve
AMP	Amplifier Solid State	IG	Igniter	SOV	Shut-Off Valve - Gas
AX1	Auxiliary Contact	L1	Light - Alarm	SSV	Safety Shut-Off Valve - Gas
AX	Auxiliary Contact	L2	Light - Fan	STS	Space Temperature Selector
BR	Relay - Blower	L3	Light - Heat	SW1	Service Switch - Fan
CR1	Control Relay	LFS	Low Fire Start	SW2	Service Switch - Heat
D & D1	Damper Motor & End Switch	LPR	Relay - Low Pressure	SW3	Switch - Fan/Off/Heat
DISC	Service Disconnect Non - Fused	LSK	Low Speed Kit	SW4	Switch - SOV Leak Test
DTS	Discharge Temperature Sensor	LSR	Relay - Low Speed	SW5	Service Switch - Run/Test
EAT	Entering Air Thermostat	LTC	Low Temperature Cutout	T1	Multi-Tap Transformer (24&120 Volt)
FR	Flame Rod	M	Motor	T3	Class 2 Transformer (24 Volt)
FSR	Flame Safeguard Relay	MV	Modulating Valve	TPS	Tamper Proof Space Sensor
FU1	Fuse 24 Volt Control	PDA	Profile Damper Adjustment	TS	Temperature Sensor
FU2	Fuse 120 Volt Control	PDM	Profile Damper Motor	VFD	Variable Frequency Drive
HGP	High Gas Pressure Switch	PT	Purge Timer		

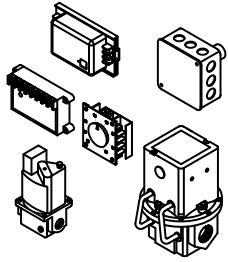
CONNECTION DIAGRAM (Typical)



REFER TO WIRING DIAGRAM SHIPPED WITH HEATER FOR SPECIFIC REQUIREMENTS OF YOUR INSTALLATION.

GAS CONTROL SYSTEMS

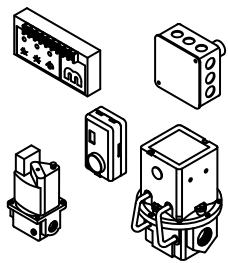
Maxitrol Series 14



The Maxitrol Series 14 controls electronically modulate the burner input to maintain a selected discharge temperature. The discharge temperature is set on the amplifier (AD1014) between 55°F and 90°F with the standard controls. As an option, the discharge

temperature can be set on a Remote Heat Adjust (TD114) control between 55°F and 130°F. The Remote Heat Adjust control can be mounted in the heater control enclosure or in the Remote Control Station.

Maxitrol Series 44



The Maxitrol Series 44 controls electronically modulate the burner input to maintain a constant space temperature by increasing or decreasing the discharge temperature. The Space Temperature Selector (T244A) is set to maintain the space

temperature of the heated space by controlling the heater output between the MIN and MAX setting on the amplifier. The MIN dial setting determines the minimum discharge temperature the heater will deliver (40°F to 80°F). The MAX dial setting determines the maximum discharge temperature the heater will deliver (80°F to 140°F)

Intermittent/Continuous Control (ITC)

The Intermittent/Continuous Control allows the burner input to be modulated to be operated continuously at modulating discharge temperature for make-up air (see Maxitrol 44 above) or operated intermittently based on a thermostat at maximum discharge temperature for space heating.

Requires Maxitrol 44 controls and a signal to switch between modes (Exhaust Fan Interlock, Temperature Setback System, Manual Make-Up Air Switch, etc.)

Signal Conditioner (SC25S)

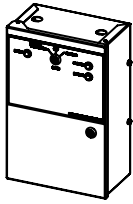
The SC25S analog signal conditioner converts a 0-10 VDC or 4-20 mA control signal to an output level capable of driving the Selectra modulating gas valve (M511, M611 or MR212). A 3-position DIP switch configures the SC25S for a 0-10 VDC or 4-20 mA input signal.

A timer circuit initially fixes the modulator output to 0 VDC or 20 VDC whenever 24 VAC is applied to the SC25S by an external source. After the start time interval has elapsed, the modulator output voltage is proportional to the control signal input. The start time interval is user selectable between 5 and 30 second.

The SC25S monitors and limits minimum and maximum discharge air temperatures. The SC25S senses the discharge air temperature using a TS194 (Q) sensor w/ MT mixing tube. If the sensed discharge air temperature approaches the set minimum or maximum limit, the SC25S will override the control signal and reduce DC voltage (high limit) or increase DC voltage (low limit) in order to maintain discharge air temperatures between the set limits. When measured discharge air temperature is between the limit settings, the DC output is a function of the control signal (4-20 mA, 0-10 VDC) only.

REMOTE CONTROL STATION COMPONENTS

Remote Control Station (RCS-S)



The Remote Control Station is a lockable NEMA 1 enclosure (9" wide x 14" high x 5" deep) equipped with a three position key lock selector switch (Summer Ventilation – Off – Heating) and indicating lights for blower operation (green), burner operation (red), and reset (amber). An auxiliary

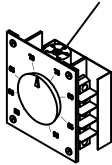
contact wired between terminals Z1 and Z2 is required to control heater operation in the heating mode. This can be accomplished by an Exhaust Fan Interlock, a Manual Make-up Air Switch, an Operating Electronic Thermostat, etc.

IMPORTANT

A number of the components listed below can be combined to yield a custom Remote Control Station to address a wide variety of applications.

Maxitrol Series 14 Remote Heat Adjustment Dial (RA)

OVERRIDE TEMPERATURE
 SELECTOR DIAL



The adjustment dial on the remote heat adjust (TD114) is either mounted on the exterior of the door of the Remote Control Station or mounted inside the Remote Control Station for tamperproof applications.

The remote heat adjustment control permits manual adjustment of the discharge temperature from 55°F to 90°F. The override temperature selector dial, visible from the top of the remote heat adjustment control, increases the discharge temperature above the setting on the dial face by the increment selected (10°F to 40°F) when a jumper or switch contact is provided across terminals 20 and 22.

Maxitrol 14 Space Temperature Override

The Maxitrol Series 14 with Space Thermostat control system uses the Maxitrol Series 14 controls described above along with an electronic space thermostat switch contact to automatically increase the discharge temperature.

Maxitrol Series 44 / Tamperproof



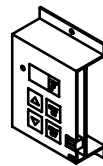
The Maxitrol Series 44 / Tamperproof controls function identically to the Maxitrol Series 44 controls (see gas control system) except the space temperature selector (T244A) is replaced with two devices. The adjustable portion, the space temperature selector (TD244A), is mounted inside the Remote Control Station, and the non-adjustable

(tamperproof) space sensor (TS244A) is mounted in the space being heated.

Maxitrol Series 44 / Hazardous Area

The Maxitrol Series 44 / Hazardous Area is the same as the Maxitrol Series 44 / Tamperproof, except the space sensor (TS244A) is replaced by a space sensor with epoxy coated circuitry (ES225A). The standard Remote Control Station is not suitable for hazardous areas and would need to be mounted outside of the hazardous area.

Operating Electronic Thermostat (OET)

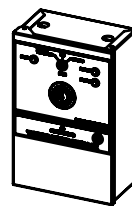


The operating electronic thermostat is wired between terminals Z1 and Z2 to control heater ON/OFF operation in the heating mode (see page 65).

Non-Adjustable Thermostat (TTP)

The non-adjustable thermostat is a fixed temperature, solid state, epoxy sealed thermostat with a specified temperature setpoint, either: 41°F, 50°F, 55°F, 60°F, or 65°F. It is wired between terminals Z1 and Z2.

Temperature Setback System (TSS)



The temperature setback system is a combination seven-day programmable timer with independent programs for summer ventilation/heating modes and integral electronic thermostat with separate selectable day/night setback temperatures (see page 67). The thermostat contact is wired between Z1 and Z2.

Clogged Filter Light (CF)

The clogged filter light is an alarm light mounted in the Remote Control Station to indicate a clogged filter condition. Includes an adjustable pressure switch mounted in the make-up air heater control enclosure to monitor the pressure drop across the filters.

Manual Make-Up Air Switch (MMS)

A manual make-up air toggle switch is used to manually turn the heater on and off. It is either mounted on the exterior of the door of the Remote Control Station or mounted inside the Remote Control Station for tamperproof applications.

Exhaust Fan Interlock (EFI)

An exhaust fan interlock is used to interlock the make-up air heater as a slave to an exhaust fan. Terminals are provided in the Remote Control Station for wiring of dry contacts (by others).

THERMISTOR SENSOR

The thermistor enclosure is packed inside the Remote Control Station for shipment. It can be mounted on the exterior sides or bottom of the Remote Control Station (see Figure 1). It can also be mounted in a remote location within 500 feet of the Remote Control Station using 18 gauge stranded, twisted-pair, shielded cable. The thermistor is wired to the TEMP. SENSOR terminal block on the thermostat.

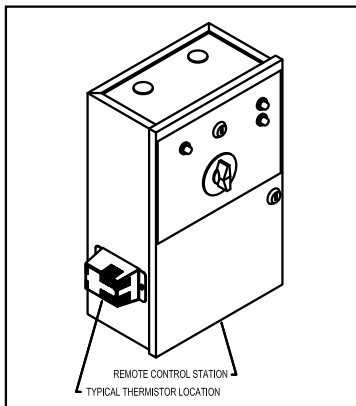


Figure 1

THERMISTOR INSTALLATION

(See Figure 2)

1. Insert the star bushing through the opening in the enclosure.
2. Run the thermistor leads through the star bushing.
3. Attach the cover to the enclosure over the thermistor sensor.
4. Separate and strip the ends of the lead wires 3/8".
5. Open the terminal blocks for the sensor connections.
6. Insert the lead wires and close the terminal blocks to the locked position.

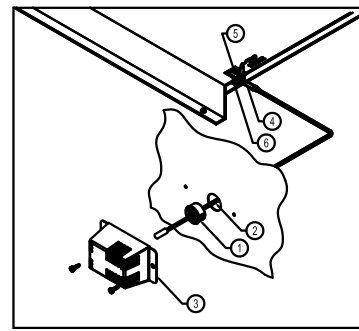


Figure 2

NOTE: For remote sensors connected with shielded cable, ground the shield at the thermostat end only.

TEMPERATURE AVERAGING (TAS-2) OPTION

(See Figure 3)

The TAS-2 option allows one thermostat to have two sensing locations. Each enclosure has two thermistor sensors prewired in series (see A). The sensor leads are then connected to the thermostat in parallel (see B). The thermostat display will show the average of the temperatures at the two sensing locations. The TAS-2 is a unique application. Consult the design drawing and/or your Cambridge Representative for placement assistance.

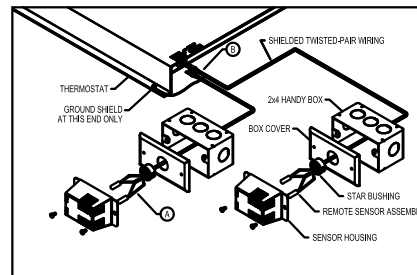
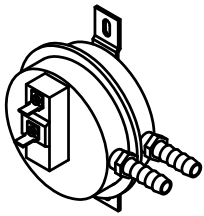


Figure 3

INDIVIDUAL HEATER COMPONENT DESCRIPTIONS

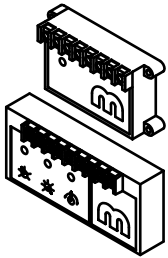
AIR FLOW SWITCH, High and Low (AFH & AFL)



The air flow switches sense the pressure drop across the burner profile plate. They are factory set and not adjustable. They are designed to prevent burner operation if the pressure drop across the burner drops below 0.40 inch WC or

increases above 0.85 inch WC for natural gas applications or below 0.60 inch WC or above 1.12 inches WC for LP gas applications.

AMPLIFIER (AMP)



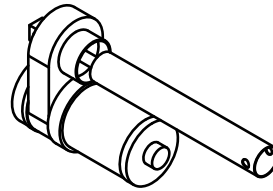
The amplifier creates a voltage output to drive an electronic proportioning gas valve to maintain the selected discharge temperature (Maxitrol Series 14) or space temperature (Maxitrol Series 44). On Maxitrol Series 14 control systems, the discharge temperature is set either on the amplifier (AD1014) or the

Remote Heat Adjust (TD114). On Maxitrol Series 44 control systems, the range of the discharge temperature is set on the amplifier (A1044), but the space temperature selector controls when more or less heat is required.

CONVENIENCE OUTLET

A convenient 115 volt GFI duplex receptacle is provided inside the heater's electrical enclosure. The electrical supply source for this device can be either the heater's control power transformer (5 amps max.) or a separate outside source (15 amps max.).

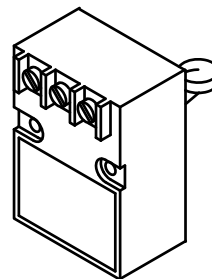
DAMPER MOTOR (D)



The damper motor operates on 24 Volts AC and transmits power to the motor starter when the damper blades are fully open by the closure of the damper end switch. The damper end switch is an adjustable internal auxiliary

switch which has been factory set to operate when the damper is fully open. The damper motor will power closed when the heater cycles off. The damper motor will not close unless the blower service switch is in the "REMOTE" position. Refer to detailed instructions regarding the replacement and adjustment of the damper motor (see page 95).

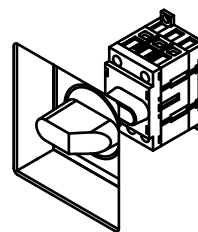
DISCHARGE TEMPERATURE SENSOR (DTS)



The discharge temperature sensor is mounted on the fan housing and is a component of the Maxitrol Series 14 and Series 44 temperature control systems. It senses the average fan discharge temperature and transmits a resistance signal back to the amplifier that corresponds to the discharge temperature. The

Maxitrol Series 44 and Maxitrol Series 44/Tamperproof temperature control systems use the Maxitrol Series 44 sensor (TS144). The Maxitrol Series 14 control systems use the Maxitrol Series 14 sensor (TS114). The Maxitrol SC25S signal conditioner utilizes a Maxitrol discharge temperature sensor TS194Q.

DISCONNECT SWITCH (DISC)

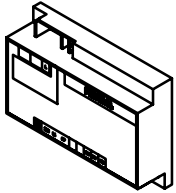


The non-fused disconnect switch is provided on all heaters and includes a lockable operating knob. The disconnect must be off before accessing the electrical control enclosure. Once the control enclosure is open, experienced service technicians may activate the electrical circuit to assist in troubleshooting.

EXHAUST FAN CONTACT (EFC)

The exhaust fan contact is an auxiliary dry contact that is mechanically interlocked to operation of the heater's motor starter and is provided with terminals located in heater's electrical enclosure. The dry contact is typically wired into an exhaust fan control circuit to activate the exhaust fan as a slave to the make-up air heater.

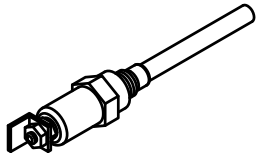
FLAME SAFEGUARD RELAY (FSR)



The flame safeguard relay supplies 24 Volts AC to the igniter for 4 seconds prior to the gas valve being energized. If the burner does not light (flame is not established within 7 seconds), this control will lock out. If flame signal

is lost during burner operation, the control will allow one retry for ignition.

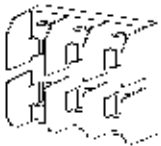
FLAME ROD (FR)



The flame rod senses the presence of flame, and signals the flame safeguard relay. The presence of flame is detected by the flame rectification of the AC signal that is supplied to the

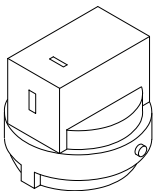
flame rod, thus creating the DC response. The resulting current flow produced can be measured with a DC microammeter. The reading should be steady and between 2.0 and 6.0 microamps (μA).

FUSE BLOCK



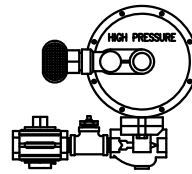
The fuse block provides line fusing for branch circuit protection. It is wired in conjunction with the non-fused disconnect switch.

HIGH and LOW GAS PRESSURE SWITCH (HGP, LGP)



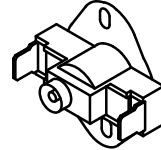
The high gas pressure switch is a manual reset safety device to lock out the burner operation should large gas pressure fluctuations occur. The high gas pressure switch should be set at 25% above manifold gas pressure. The adjustment screw is located under the top plate.

HIGH PRESSURE REGULATOR (HPR)



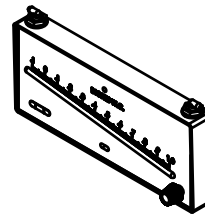
The high pressure regulator is required when the gas supply pressure exceeds the nameplate rating for the heater. The high pressure regulator assembly is also furnished with a high gas pressure manual shut-off valve and a tap for measuring the upstream gas pressure. The high pressure regulator is a positive lock-up type regulator which must be vented to the outdoors. It is sized according to the gas supply pressure and the capacity requirements of the heater.

HIGH TEMPERATURE LIMIT (HL)



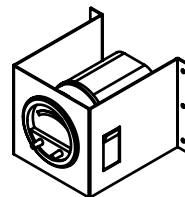
The high temperature limit opens when the discharge air temperature exceeds 150°F. This limit must be manually reset.

INCLINED MANOMETER



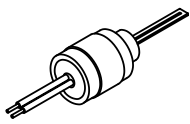
An inclined manometer with a range of -0.1 to 1.0 inch WC is provided on each heater with manual profile damper adjustment to indicate the pressure drop across the burner profile plate. The pressure drop should be set without the burner operating (blower only) at 0.68 inch WC for natural gas applications and 0.90 inch WC for LP applications. If the heater is supplied with a filter section or filters in the rainhood, increase the manometer reading to 0.72 inch WC for natural gas and to 0.94 inch WC for LP gas heaters.

DIFFERENTIAL PRESSURE SWITCH/GAUGE



A differential pressure switch/gauge is available as part of the Automatic Profile Adjust system to control the pressure drop across the burner profile plate. The differential pressure switch drives a Profile Damper Adjust Motor to maintain approximately 0.68 inch WC for natural gas applications, or approximately 0.90 inch WC for LP applications.

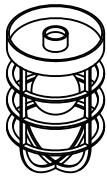
IGNITER (IG)



The hot surface igniter is the ignition source for lighting the gas in the burner. It is made of silicon carbide which is very fragile. Care should be used in handling. It operates on 24

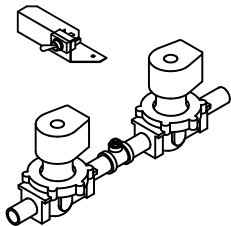
Volts and the current ranges from 1.3 to 1.7 amps. It will reach temperatures in excess of 2400°F during the ignition trial. It is furnished with a sleeve for shock mounting and sealing the igniter in the mounting tube.

INTERIOR LIGHT(S)



Available for the heater cabinet, electrical control enclosure, and/or gas train enclosure. Light switches are located inside the heater's electrical enclosure. Furnished with safety guards. 100 watts maximum, each. A separate electrical supply source is required.

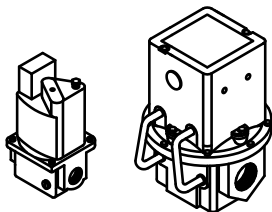
LEAK TEST FACILITY (SW4)



The leak test facility is provided on all heaters over 400,000 Btu/hr and consists of a momentary switch for the first safety shut-off valve in the gas train and a gauge port between the first and second safety shut-off valve. By holding the gas valve momentary switch closed, the first gas valve is energized which allows

gas pressure to build on the seat of the second gas valve. The gauge port between valves is used to determine if the first gas valve seat is properly sealed.

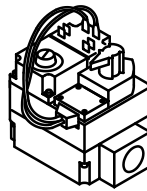
MODULATING VALVE (MV)



The modulating valve responds to a 4 to 24 Volt DC signal from the amplifier to modulate the flow of gas to the burner. On the Maxitrol M511 or M611 valve, the minimum fire adjusting screw is located on the far side

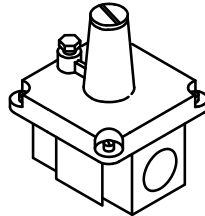
of the valve under the dust cover. On the Maxitrol MR212 valve, the minimum fire adjusting screw is located under the large dust cover. The MR212 modulating valve also serves as the manifold pressure regulator to control the burner manifold pressure. The MR212 is rated for 5 PSIG.

COMBINATION VALVE



The combination valve serves as a manifold pressure regulator and redundant gas shut-off valve. This control is typically used for gas capacities below 400,000 Btu/hr. The valve operates on 24 Volts AC power. The combination valve is rated for a maximum gas supply pressure of 14 inches WC.

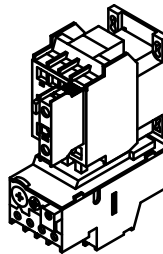
MANIFOLD PRESSURE REGULATOR



The manifold pressure regulator controls the burner manifold pressure. When the MR212 valve is used, this modulating valve also serves as the pressure regulator. The maximum gas supply pressure rating is normally determined by the exposed pressure

rating of the regulating device. The RV61 and RV81 are rated at 1 PSIG; and the MR212 is rated at 5 PSIG. (For make-up air heaters rated at 400,000 Btu/hr or below, see the combination valve above.)

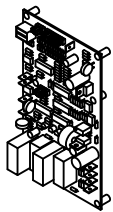
MOTOR STARTER (MS), OVERLOAD (OL), & AUXILIARY CONTACT (AX, AX1)



The motor starter assembly consists of a motor starter, overload relay and auxiliary contact. The overload relay protects the motor from excessive current or single phasing. If the overload relay trips, it must be reset manually. The auxiliary contacts are used in the gas valve safety circuit as an indication the blower is operating,

and as an optional exhaust fan contact for interlocking other equipment with the operation of the heater.

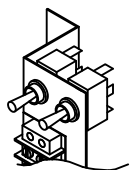
MULTI-FUNCTIONAL PC BOARD



The multi-functional PC board provides five (5) separate functions for heaters with the Maxitrol Series 14 or Series 44 controls. The functions are as follows:

- 1) Blower Relay (CR1) which is energized on a “call for blower” from the Remote Control Station.
- 2) The LTC (Low Temperature Cutout) circuit functions to turn off the blower in approximately 3 1/2 minutes if any of the following occurs: (a) The inlet temperature drops below the selectable LTC setpoint (40°F, 45°F, 50°F, or 55°F) in the ventilation mode; (b) the gas valve fails to remain energized during a heating cycle or (c) the high airflow switch contacts indicate the burner profile plate pressure drop is too high.
- 3) The EAT (Entering Air Thermostat) circuit functions automatically to turn off the burner when the outdoor temperature reaches the selectable EAT setpoint (45°F, 50°F, 55°F, 57.5°F, 60°F, 62°F, 64°F, 66°F, 68°F or 70°F).
- 4) The PT (Purge Timer) circuit function is preset at the factory to provide four air changes within the heater cabinet prior to an ignition attempt (normally set at 4 or 8 seconds). If inlet ducting is attached to the heater, the delay time can be increased to 8, 16, or 32 seconds, as applicable.
- 5) The patented LFS (Low Fire Start) circuit function limits the initial heater firing for the first 15 seconds of a heating cycle to obtain proper ignition. The voltage to the modulating valve is adjusted between 9 and 13 Volts DC by an adjustable potentiometer on the multi-functional PC board.

SERVICE SWITCH (SW1, SW2, SW3)



The service switches are mounted in the electrical control enclosure. In the “LOCAL”

or “OFF” position, the service technician has local control of the heater. These switches must be placed in the “REMOTE”

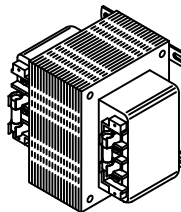
position for normal control from the Remote Control Station.

SPACE TEMPERATURE SELECTOR (STS)



The space temperature selector is part of the Maxitrol Series 44 control system. The space temperature selector senses the space temperature. A 3°F drift above the set temperature will cause the heater to modulate to the MIN setting on the amplifier and a 3°F drift below the set temperature will cause the heater to modulate to the MAX setting.

TRANSFORMER (T1, T2)



Heaters are furnished with a dual voltage transformer unless the primary voltage is 115 Volts. The transformer furnished depends on the primary voltage (208, 230, 460 or 575 Volts). This transformer provides secondary control voltages of 24 and 115 Volts. Heaters supplied for 115 Volts are furnished with a 24 Volt secondary transformer only. Secondary fusing is provided in all Class I transformer circuits to protect the downstream components from short circuit. Fuse sizing is as follows: FNM-6.25 for 150 va 24 Volt and FNM-1.6 for 150 va 115 Volt. Consult the heater wiring diagram to identify the proper fusing for the heater in question. Do not increase the fuse rating over that which is specified.

DAMPER MOTOR REPLACEMENT & ADJUSTMENT

1. Before re-installing the damper motor into the heater assembly, remove the black plastic weather cover from the damper motor by removing the screw that secures the cover to the damper assembly using either a flat tip screw driver or a 1/4" nut driver. It may be necessary to twist the cover slightly to disengage it from its mounting to the end of the motor after the screw is removed.
2. Verify the damper motor is in the closed position (Drive tube is retracted with a minimum of 1/4" gap between drive tube and body of the damper assembly).
3. Verify the inner cam has fully engaged the lower limit switch plunger and the lower limit switch (next to the body of the damper motor) shows continuity between the common (C) terminal and the normally open (NO) terminal.

CAUTION:

If the lower limit switch does not indicate continuity, the damper motor must be driven to the fully closed position before connecting the damper linkage to the drive tube of the damper assembly.

CAUTION:

If the drive tube bottoms out against the damper motor housing, damage to the PC board or tripping of the onboard fuse may result. If the fuse trips, place the blower service switch in the "OFF" position for 15 seconds to allow the fuse to reset. Proceed with steps 4 through 10 BEFORE connecting the damper motor to the linkage arm.

4. Verify the cam location on the upper cam is set just short of the four o'clock position with respect to the switch plunger being the twelve o'clock reference position. If it is beyond the four o'clock position, use

a deep well 1/2" hex socket or nut driver to manually rotate the cam counterclockwise a few clicks, as required, to obtain the correct starting position (see Figure 1).

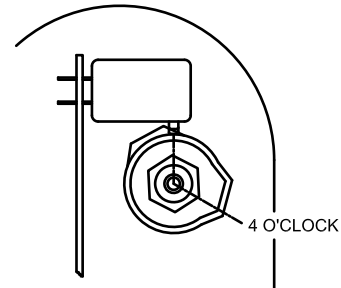


Figure 1

5. Verify the heater disconnect switch is turned off and the Service Switches are in the "OFF" position.
6. Connect wires to terminals as shown in Figure 2 and re-install the weather cover.

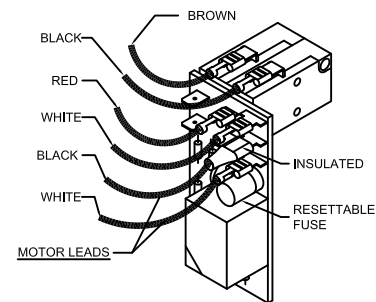


Figure 2

7. Remove the push-in plug (located in the weather cover) to have access to the upper cam adjusting nut.
8. Connect the motor pivot to the damper motor support bracket using the 3/8" diameter clevis pin. **Do not connect the damper linkage at this time.**

9. Remove the wire from the “G” terminal of the terminal block. (This is to avoid a “Call-for-Fan” signal from the Remote Control Station during the next two steps).
10. Let the damper assembly hang down (suspended by the damper motor support bracket) and turn the heater disconnect on and momentarily turn the blower service switch to the “LOCAL” position (for approximately 5 seconds). **Do not restrain the drive tube from turning freely.** Then, turn the blower service switch to the “REMOTE” position until the damper motor drive tube stops turning. (Drive tube is now fully retracted).
11. Turn the heater disconnect switch off and manually trip the motor starter overload. The manual trip lever is located on the overload between the overload and the motor starter.
12. Connect the damper linkage to the drive tube by manually rotating the drive tube in 1/2 turn increments until the 3/8" diameter bolt can seat into the nut on the damper linkage. Maintain the damper blades in the tightly-held, fully closed position during this adjustment.
13. Turn the heater disconnect switch on and place the blower service switch to the “LOCAL” position. Damper will open to the point the upper cam engages the upper limit switch.
14. Using the deep-well, 1/2" hex socket or nut driver, turn the upper cam hex nut in a clockwise direction in one click increments until the damper blades fully open.
15. Turn the blower service switch to the “REMOTE” position and, after the damper motor closes, turn the heater disconnect off.
16. Re-install the weather cover push-in plug.
17. Re-connect the wire removed in step 9 to terminal “G” and reset the motor starter overload.
18. Verify both service switches are in the “REMOTE” position, close the electrical enclosure door and turn the heater disconnect switch on.

CAUTION:

Do not over-drive the damper motor as damage to the PC board or tripping of the onboard fuse may result. If the fuse trips, place the blower service switch in the “OFF” position for 15 seconds to allow fuse to reset.

TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
I. No Blower Operation	1. Make-up air heater in Reset a) Outside temperature below LTC setpoint in Vent Mode b) Gas Valve not energized during call for heat cycle c) Pressure drop across burner too high d) Sustained excessive winds present e) High Air Flow Switch defective	a) Turn heater "OFF" momentarily and turn heater "ON." b) See Problem III. c) Adjust Profile Plate Damper. d) Wait until winds abate and reset. e) Replace High Air Flow Switch.
	2. Heater Disconnect a) Disconnect in OFF position	a) Turn disconnect ON.
	3. Mode Selector Switch on RCS a) Switch in OFF position	a) Place switch in proper mode.
	4. Operating Thermostat a) Thermostat satisfied b) Open in thermistor circuit c) Defective thermostat	a) Adjust thermostat, if applicable. b) Check wiring or replace thermistor. c) Replace thermostat.
	5. Blower Service Switch a) Switch in OFF position b) Defective switch	a) Place switch in REMOTE position. b) Replace switch.
	6. Control Transformer a) No input voltage b) Blown control fuse c) Defective transformer	a) Check disconnect and supply fusing. b) Replace control fuse. c) Replace transformer.
	7. Class 2 Transformer a) No output voltage b) Defective transformer	a) Check supply voltage. b) Replace transformer.
	8. Multi-Functional PC Board a) No input voltage on Terminal G (RCS) b) Improper wiring c) Defective board	a) Check voltage in RCS. b) Check wiring. c) Replace multi-functional PC board.
	9. Damper Motor a) Damper End Switch not made b) Damper motor not operating c) Defective damper motor	a) Check end switch/cam interface. b) Check end switch/cam interface. b1) Check damper fuse. b2) Check diodes on switch assy. c) Replace damper motor.
	10. Motor Protection a) Overload relay tripped b) Overload relay defective	a1) Check primary power source. a2) Reset overload relay and check motor amps/overload setting. b) Replace overload relay.
	11. Motor Starter a) Coil open (Defective) b) Contacts welded closed (Defective)	a) Replace starter. b) Replace starter.
	12. Motor a) No input voltage b) Improper voltage c) Defective motor	a) Check primary power source. b) Consult factory. c) Replace motor.
	13. Blower Damage a) Defective or locked bearings b) Physical damage	a) Replace bearings. b) Replace or repair blower.
	14. Belts a) Belt Slipping b) Belt broken or missing	a) Tighten belts. b) Replace belts.

TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
II. BLOWER RUNS; NO HEAT; FLAME SAFEGUARD RELAY DOESN'T LOCK OUT	1. Mode Selector Switch a) Switch in VENT position	a) Place switch in HEAT position.
	2. Burner Service Switch a) Switch in OFF position	a) Place switch in REMOTE position.
	3. Multi-Functional PC Board a) No input voltage on Terminal W (RCS) b) Thermostat satisfied c) Improper wiring d) Defective board	a) Check voltage in RCS. b) Adjust thermostat. c) Check wiring to multi-functional PC board. d) Replace multi-functional PC board.
	4. Airflow Switch a) Blower running backwards b) Belts slipping c) Blocked intake or discharge d) Clogged airflow tubing or pickup ports e) Defective switch	a) Reverse motor direction. b) Tighten and/or replace belts. c) Find and remove obstruction. d) Clean or replace tubing or pickup ports. e) Replace switch.
	5. Flame Safeguard Relay (FSR) a) No input voltage b) Defective FSR	a) Check wiring. b) Replace FSR.
	6. Entering Air Thermostat (EAT) a) EAT set too low	a) Increase EAT setting.
III. BLOWER RUNS; NO HEAT; FLAME SAFEGUARD RELAY LOCKS OUT	1. Igniter a) No current (open igniter) b) No voltage	During trial for ignition: a) Check igniter current. b) Check FSR output to igniter.
	2. High Limit a) High limit tripped	a) See Problem Number VI.
	3. High or Low Gas Pressure Switches a) Low gas pressure switch tripped b) High gas pressure switch tripped c) Defective gas pressure switch	a) Check gas supply for low gas pressure or no gas. b1) Check manifold gas pressure for high pressure reading and reset pressure regulator. b2) Check gas supply pressure against name plate. b3) Verify the high pressure regulator is a lock-up type. c) Replace gas pressure switch.
	4. Gas Valve a) No input voltage b) Gas valve does not open c) Defective solenoid	a1) Check FSR output to R1 relay during ignition trial. a2) Check gas valve circuit and wiring. b1) Compare supply voltage to nameplate voltage. b2) Clean and/or replace gas valve parts. c) Replace solenoid or valve assembly.
	5. Modulating Valve a) Minimum fire set too low	a) Adjust minimum fire on modulating valve.
	6. Multi-Functional PC Board a) Low fire start set too low b) Thermistor open or not connected	a) Adjust modulating valve voltage between 10 and 13 Volts DC. b) Properly install or replace thermistor.

TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
III. BLOWER RUNS; NO HEAT; FLAME SAFEGUARD RELAY LOCKS OUT (Continued)	7. Regulator a) Clogged vent orifice b) No supply pressure c) Improper manifold pressure d) Defective regulator	a) Clean or replace orifice. b) Check all gas cocks and piping. c) Adjust regulator. d) Replace regulator.
	8. Burner a) Defective burner	a) Replace burner.
IV. BLOWER RUNS; BURNER FIRES; FLAME SAFEGUARD RELAY LOCKS OUT	1. Low Flame Current a) Dirt build-up on insulator b) Minimum fire set too low c) Defective burner	a) Clean dirt deposit from insulator. surface and install protective boot. b) Adjust minimum fire on modulating valve. c) Replace burner.
	2. Multi-Functional PC Board a) Low fire start set too low	a) Adjust modulating valve voltage between 9 and 13 Volts DC.
	3. No Flame Current a) Ground connection open b) Wire termination oxidized	a1) Reference transformer to ground. a2) Secure FSR grounded. a3) Tighten loose ground screws. b) Clean terminal and reinsert.
	4. Fluctuating Flame Current a) Unit overfiring b) Minimum fire set too low c) Intermittent ground connection d) Defective burner	a) Check manifold pressure. b) Adjust minimum fire on modulating valve. c) Tighten all ground points. d) e) Replace burner.
	5. Flame Safeguard Relay a) Defective FSR	a) Replace FSR.
	6. High Limit a) High limit contact intermittent	a) Replace high limit.
	V. BLOWER RUNS; UNIT HEATS; SHORT CYCLES WITHOUT RESETTING	1. Air Flow Switch a) Blower running backwards b) Belts slipping c) Blocked intake or discharge d) Air delivery below minimum requirements e) Clogged airflow tubing or pick-up ports f) Defective switch
2. Flame Safeguard Relay a) Defective FSR		a) Replace FSR.
3. Operating Thermostat a) Differential temperature setting too tight		a) Increase differential temperature setting.
4. Damper Motor End Switch a) End switch making intermittent contact		a) Replace end switch assembly.

TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
VI. HIGH LIMIT TRIPPED	1. High Limit a) High limit will not reset	a) Replace high limit.
	2. Burner Overfiring a) Manifold pressure too high	a) Adjust manifold pressure regulator to obtain temperature rise specified on heater nameplate.
	3. Discharge Damper a) Damper blades partially closed b) Defective damper motor	a) Adjust damper stroke length. b) Replace damper motor.
	4. Low Airflow a) Blower running backwards b) Belts slipping c) Blocked intake or discharge	a) Reverse motor direction. b) Tighten or replace belts. c) Find and remove obstruction.
	5. Temperature Control System a) Temperature control system does not modulate	a) See problem VIII for Electronic Discharge Control systems.
VII. BLOWER RUNS; UNIT HEATS; WILL NOT CYCLE OFF	1. Operating Thermostat a) Short in thermistor circuit b) Thermostat located improperly c) Thermostat differential setting too wide d) Defective thermostat	a) Check thermistor wiring and/or replace thermistor. b1) Thermostat in cold draft-relocate. b2) Thermostat not satisfied-turn down. c) Reduce differential setting. d) Replace thermostat.
	2. Burner Service Switch a) Switch in LOCAL position	a) Place switch in REMOTE position.
	3. Auxiliary Control a) Auxiliary contacts closed	a) Check auxiliary circuit wiring and contacts.
	4. Misunderstood Control System Operation a) Control system doesn't function as expected	a) Review control system operational characteristics.
	VIII. MODULATING VALVE DOES NOT MODULATE; CONTINUOUS HIGH FIRE	1. Amplifier (A1014 or A1044) a) Wire not connected to amplifier terminal 3 or 4. b) Jumper not installed between terminals 2 and 3 of A1014 amplifier only. c) Defective amplifier
	2. Discharge Temperature Sensor (TS114 or TS144) a) Open in sensor circuit b) Sensor cross-wired to amplifier	a) Replace the sensor if the resistance measured at terminals 1 and 2 on TS114 sensor exceeds 11,000 Ω; terminals 1 and 3 or 2 and 3 on TS144 exceeds 6,000Ω. c) Correct wiring terminations.
	3. Space Temperature Selector (Series 44 only) (T244 or TS244/TD244) a) Open in sensor circuit b) Induced voltage in field wiring c) Space sensor located improperly	a) Replace the sensor if the resistance measured is more than: 7,000 Ω for the T244; 5,500 Ω for the TS244; or 2,250 Ω for the TD244. b) Utilize shielded, twisted pair wiring. c) Sensor in cold draft - relocate

TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
VIII. MODULATING VALVE DOES NOT MODULATE; CONTINUOUS HIGH FIRE (Continued)	4. Space thermostat (Series 14 only) a) Thermostat out of calibration b) Thermostat located improperly c) Thermostat differential setting too wide d) Thermostat defective	a) Recalibrate thermostat or replace. b) Thermostat in cold draft - relocate. c) Reduce differential setting. d) Replace thermostat.
	5. Remote Heat Adjust (TD114) a) Short in Remote Heat Adjust circuit b) Induced voltage in field wiring	a) Replace Remote Heat Adjust if resistance measure between terminals 1 and 3 of Remote Heat Adjust is less than 6,000 Ω . b) Utilize shielded, twisted pair wiring.
	6. Modulating Valve (M511, M611 or MR212) a) Foreign material holding valve open b) Modulating valve misassembled	a) Disassemble valve and remove foreign material. b) Disassemble valve and assemble correctly.
IX. MODULATING VALVE DOES NOT MODULATE; CONTINUOUS LOW FIRE	1. Class 2 Transformer a) No voltage output to amplifier	a1) Check for short in modulating valve coil. a2) Replace transformer.
	2. Modulating Valve a) Valve coil is open or shorted b) Plunger jammed c) Ruptured main or balancing diaphragm	a) Replace valve coil if its resistance is less than 40 Ω or greater than 85 Ω . b) Clean or replace plunger. c) Check diaphragm condition and replace if defective.
	3. Amplifier a) No output voltage to valve	a) With the wire removed from terminal 3 of amplifier, replace amplifier if the valve voltage does not exceed 18 Volts DC.
	4. Discharge Temperature Sensor (TS114 or TS144) a) Short in sensor circuit b) Temperature control system out of calibration	a) Replace the sensor if the resistance measured at: terminals 1 and 2 on TS114 is less than 8,000 Ω ; terminals 1 and 3 or 2 and 3 on TS144 is less than 2,900 Ω . b) Perform temperature control system calibration.

TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
IX. MODULATING VALVE DOES NOT MODULATE; CONTINUOUS LOW FIRE (Continued)	5. Space Temperature Selector (T244A or TS244A/TD244A) a) Short in sensor circuit	a) Replace the sensor if the resistance measure is less than 5,000 Ω for the T244A or 3,500 Ω for the TS244A and 1,950 Ω for the TS244A.
	6. Remote Heat Adjust (TD114) a) Open in the Remote Heat Adjust control circuit	a) Replace the control if the resistance measured at terminals 1 and 3 exceeds 12,000 Ω .
	7. High Airflow Switch a) Pressure drop across burner too high b) Defective Airflow Switch	a) Measure pressure drop and adjust profile damper. b) Replace Airflow Switch.
	8. Multi-Functional PC Board a) Temp sensor wires not seated properly in terminal block. b) Defective board	a) Reinstall sensor wires. b) Replace board.
X. ERRATIC OR PULSATING FLAME	1. High Pressure Regulator a) Vent undersized b) Defective regulator	a) Enlarge vent piping size or reduce vent piping length. b) Replace regulator.
	2. Amplifier a) Hunting b) Temperature control system out of calibration c) Defective amplifier	a) Adjust sensitivity control dial counter-clockwise. b) Perform temperature control system calibration. c) Replace amplifier.
	3. Space Temperature Selector (T244A or TS244A/TD244A) a) Induced voltage in field wiring	a) Utilize shielded, twisted pair wiring.
	4. Remote Heat Adjust (TD114) a) Induced voltage in field wiring	a) Utilize shielded, twisted pair wiring.

ANSI/ASHRAE/IESNA STANDARD 90.1

Overview

Energy efficient, Genuine Cambridge® direct gas-fired heating equipment can comply with the requirements of ANSI/ASHRAE/IESNA Standard 90.1. Compliance is shown on the Cambridge heater nameplate.

Purpose of ASHRAE Standard 90.1

ASHRAE Standard 90.1 provides minimum requirements for the energy efficient design and construction of new commercial buildings in the United States. The standard covers the entire building, setting minimum equipment efficiency levels for components that may be used, rather than setting standards for component manufacturing. The provisions of this standard do not apply to single family houses, low rise residential buildings and buildings (or portions of buildings) that use energy primarily for industrial, manufacturing or commercial processes.

Compliance Requirements:

The following are required for Cambridge heaters to comply with Standard 90.1:

- **Controls** (Section 6.4.3)

Total airflow of all heaters less than 10,000 cfm - The Cambridge Air Solutions Temperature Setback System (TSS) will meet the standard. A properly configured building DDC system with the necessary programming for zone control, automatic shutdown and setback can also meet the standard.

Total airflow of all heaters exceeds 10,000 cfm - The Cambridge Air Solutions Temperature Setback System (TSS) with optimum start control will meet the standard. A properly configured building DDC system with the necessary programming for zone control, automatic shutdown, setback and optimum start can also meet the standard.

Heaters intended to operate continuously - No special controls are required to meet the standard.

- **Damper** (Section 6.4.3.4.3)

A damper is required on each heater. The Cambridge Air Solutions Motorized Discharge Damper (MDD) will meet the standard.

- **Labeling** (Section 6.4.1.5.1)

The heater must be labeled to indicate that it complies with the requirements of the standard. The nameplate of Cambridge heaters includes the required labeling.

- **Efficiency** (Section 6.4.1.3)

Direct gas-fired heating equipment has no minimum efficiency requirement. However Cambridge Air Solutions certifies that its equipment has a 100% combustion efficiency (Ec) and a 92% thermal efficiency (Et).

MAINTENANCE LOG

MODEL NO. _____ SERIAL NO. _____

Date _____ Activity _____ Technician _____

MAINTENANCE LOG

MODEL NO. _____ SERIAL NO. _____

Date Activity Technician



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Cambridge Air Solutions reserves the right to change specifications, modify the design and/or substitute equivalent materials without notice as the result of code requirements, product enhancements, ongoing research/development and vendor changes beyond our control.



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