

S-SERIES DIRECT GAS-FIRED INDUSTRIAL BLOW-THRU® SPACE HEATER 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

S-SERIES

BLOW-THRU® SPACE HEATER

TECHNICAL MANUAL

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.

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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.

⚠ WARNING:

Recirculation of room air is not permitted.

Adequate building relief must be provided so as to not over pressurize the building when the 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, or 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 unit 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.

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 aircraft hangars.

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.

Installation in Car Wash Facilities

A non-recirculating, S-Series Space Heater used in a Car Wash tunnel application may be designated as a T-Series Heater on the nameplate.

This S-Series Technical Manual also applies to all T-Series Heaters.

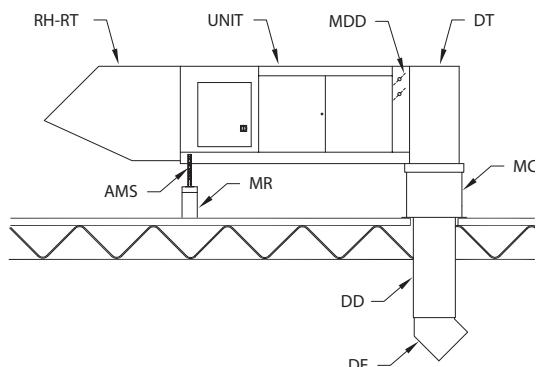
IMPORTANT

If in doubt regarding installation application, contact Cambridge Customer Service Group at 1-800-473-4569 during the hours of 8:00 a.m. to 5:00 p.m. Central Time, Monday through Friday.

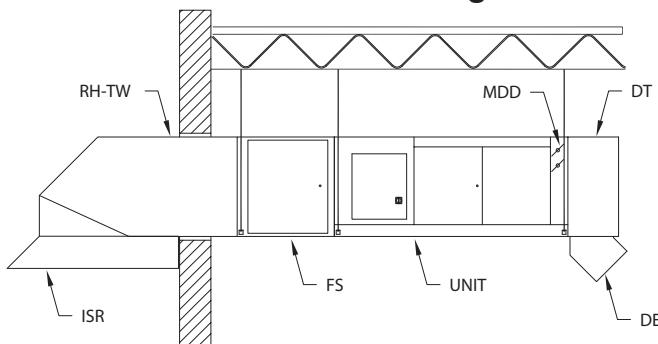
TYPICAL SYSTEM OVERVIEW

ACCESSORY IDENTIFICATION

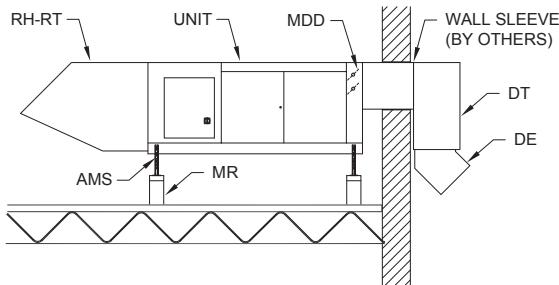
Roof Top Mounting



Thru Wall Mounting



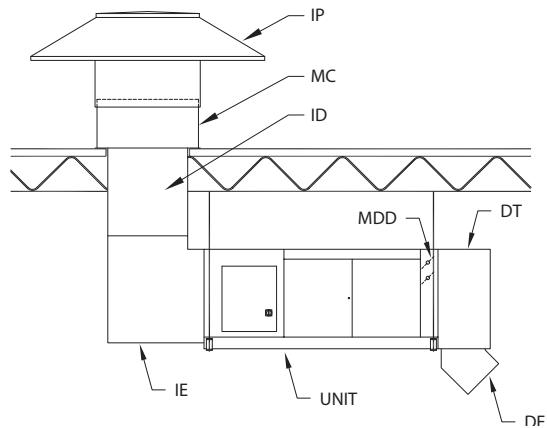
Roof Top / Thru Wall Mounting



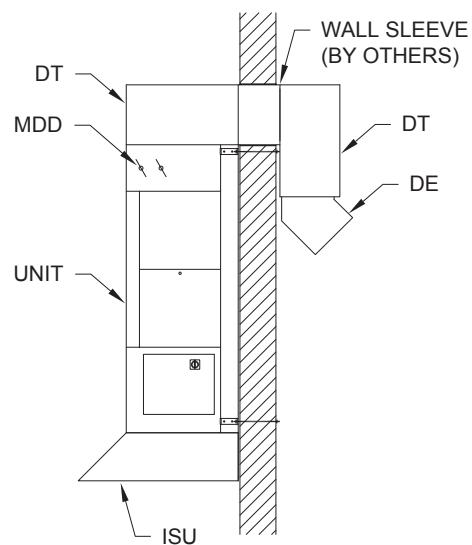
Component Identification

AMS	Adjustable Mounting Stand
DD	Discharge Duct
DE	Directional Elbows
DT	Downturn
FS	Filter Section
ID	Inlet Duct
IE	Inlet Elbow
IP	Inlet Plenum
ISR	Inlet Skirt-Rain Hood
ISU	Inlet Skirt-Unit
MC	Mounting Curb
MDD	Motorized Discharge Damper
MR	Mounting Rail
RH-RT	Rain Hood-Roof Top
RH-TW	Rain Hood-Thru Wall

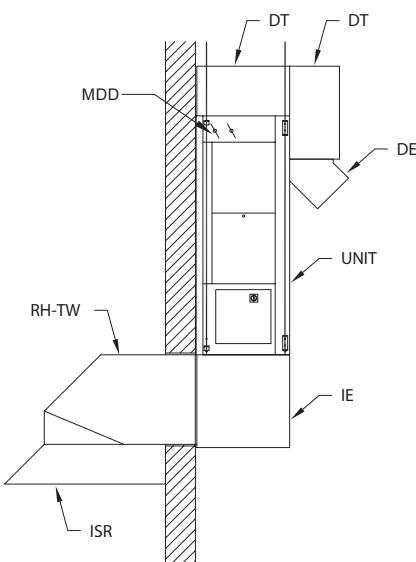
Under Roof Mounting



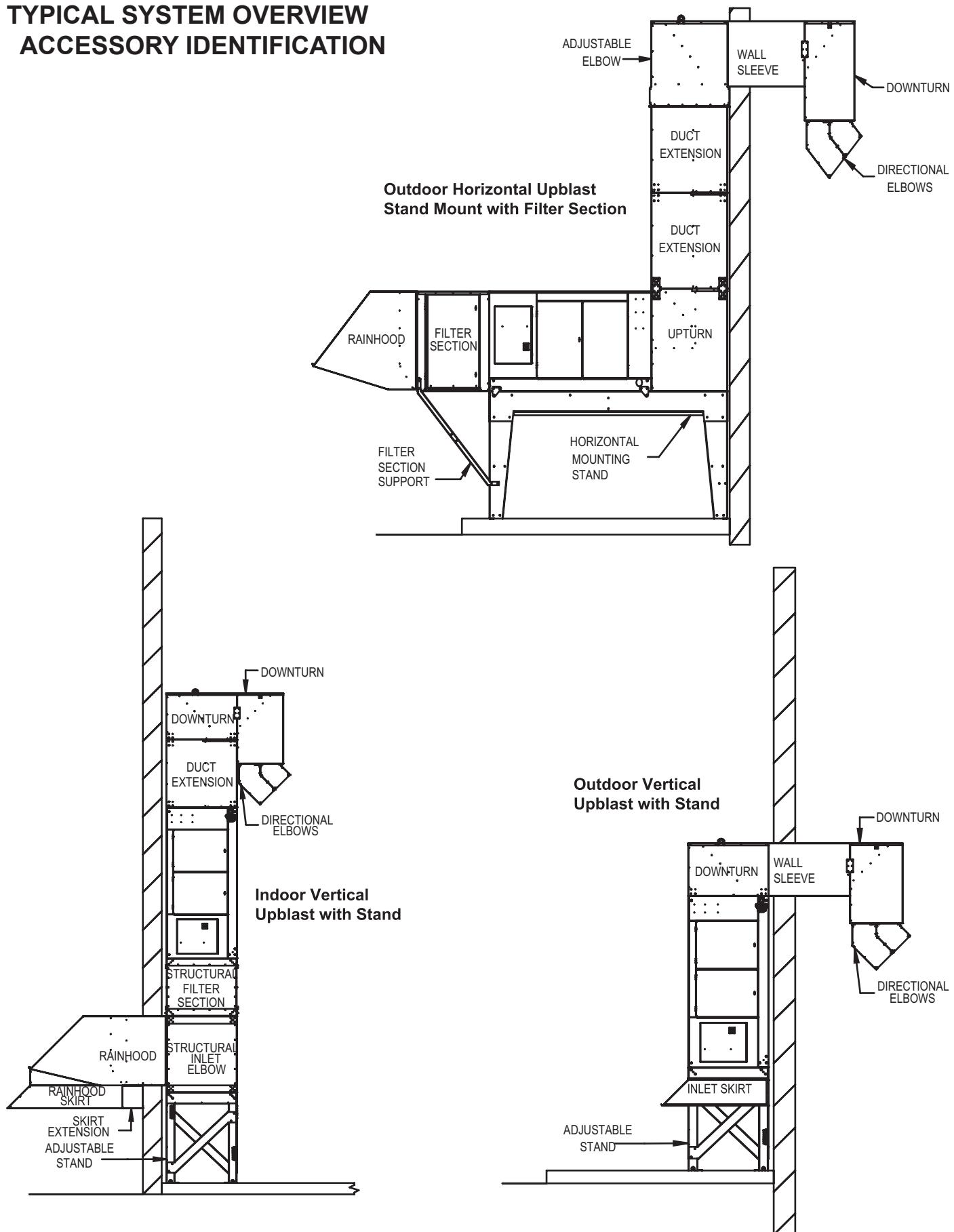
Outdoor Vertical Mounting



Indoor Vertical Mounting



TYPICAL SYSTEM OVERVIEW ACCESSORY IDENTIFICATION



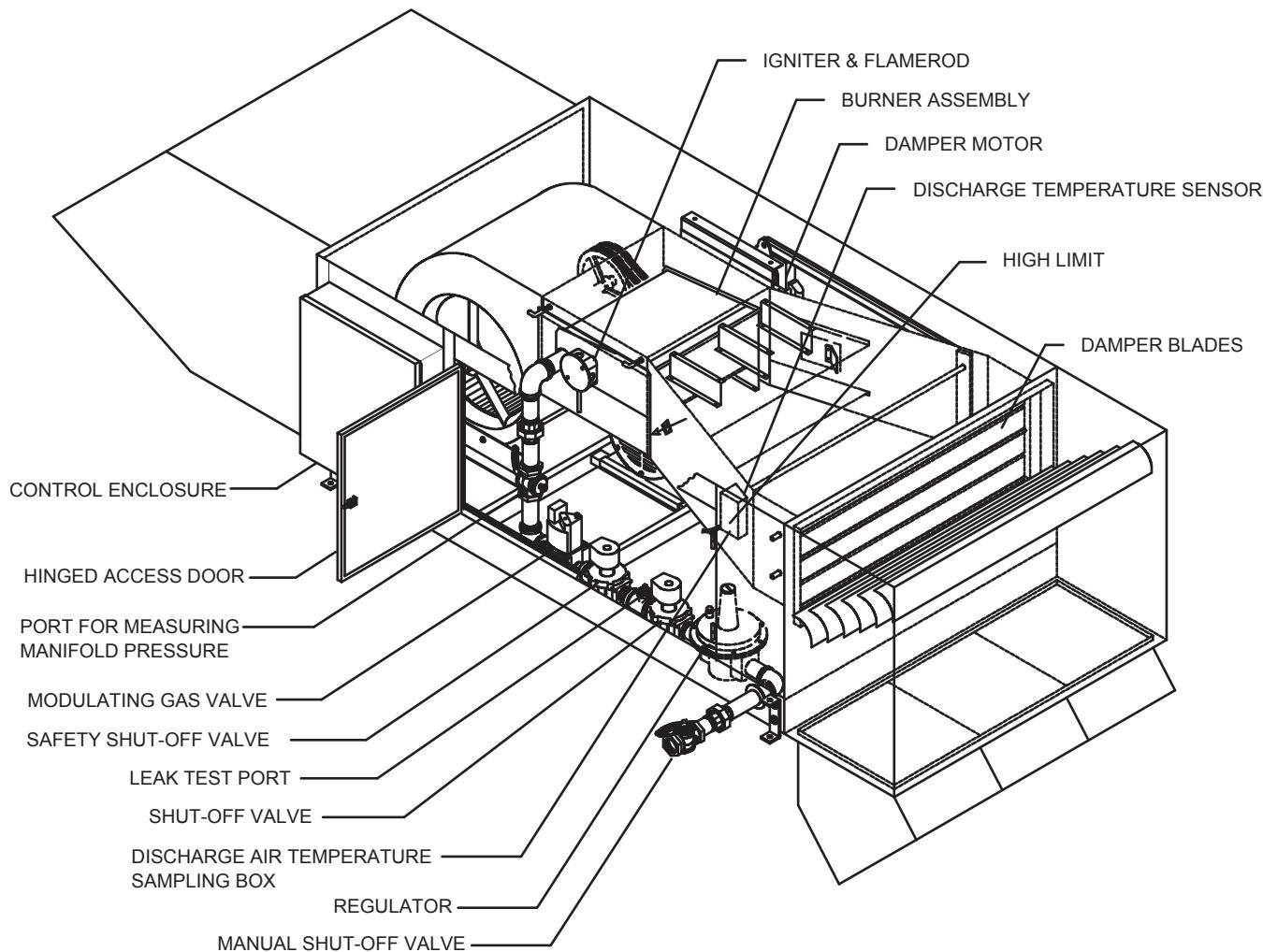
TYPICAL SYSTEM OVERVIEW

HEATER OPERATION

Cambridge S-Series Blow-Thru® heaters are utilized to meet the space heating requirements of commercial or industrial buildings. The control system is typically designed to cycle the heaters on and off in response to the rise and fall of the space temperature. The heater will discharge air at the temperature selected (up to

160°F). The operating thermostat is typically located near the perimeter of the building in a location which is out of the direct path of the heated discharge air, insulated from cold surfaces, and shielded from cold drafts created by air infiltrating the building.

HEATER CONFIGURATION



INSTALLATION INSTRUCTIONS

UNCRATING INSTRUCTIONS

1. Verify that the number of items on the Bill of Lading matches the number of items received.
2. Check for shipping damage. Take photographs of any damage.

IMPORTANT

If damage is found, immediately file a claim with the carrier before proceeding further.

3. Check the items received to make sure they agree with the ordering information including verification of data on the unit nameplate.

IMPORTANT

Do not discard any components or accessories.

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 locations, or other operations within the facility. Ensure the heater inlet and outlet are not blocked or severely restricted in any way that would affect the rated airflow through the heater or affect the desired air distribution pattern of the heater.

It is the responsibility of the installer to communicate any potential problems with the installation to the person or persons responsible for providing the installation instructions or drawings prior to proceeding with the installation.

IMPORTANT

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.

IMPORTANT

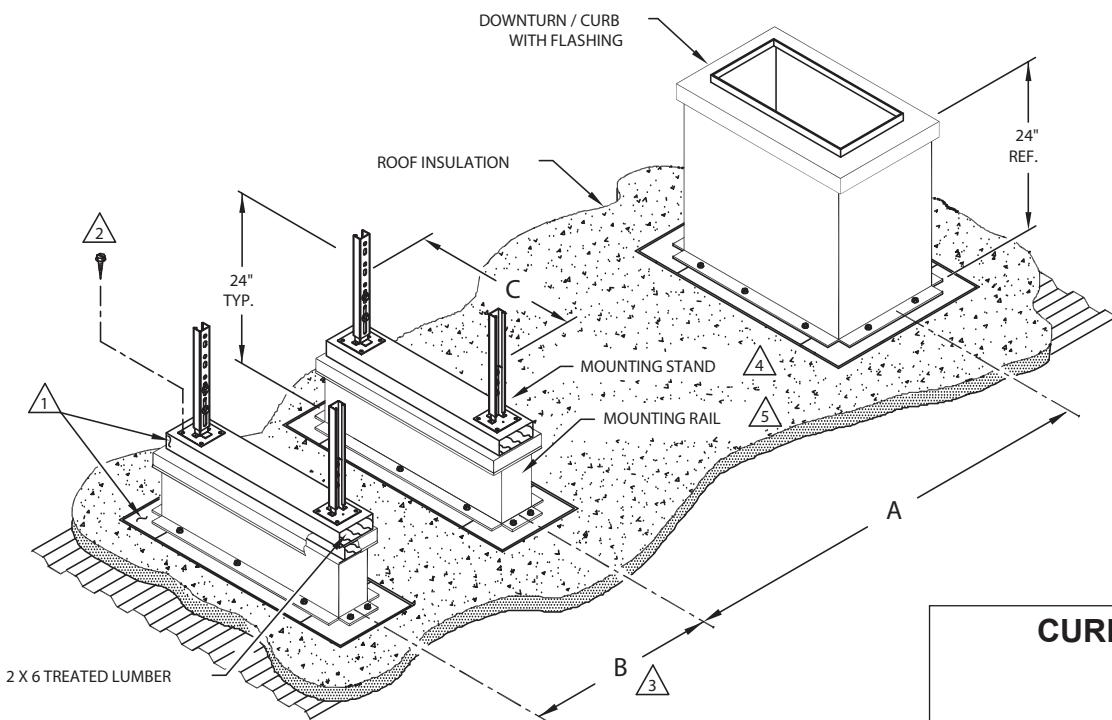
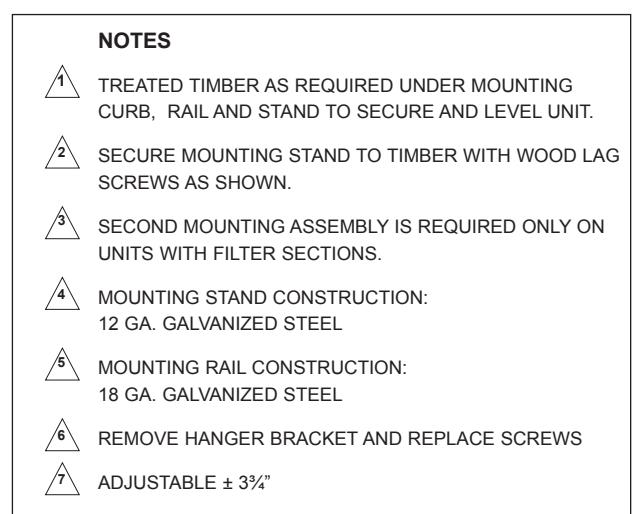
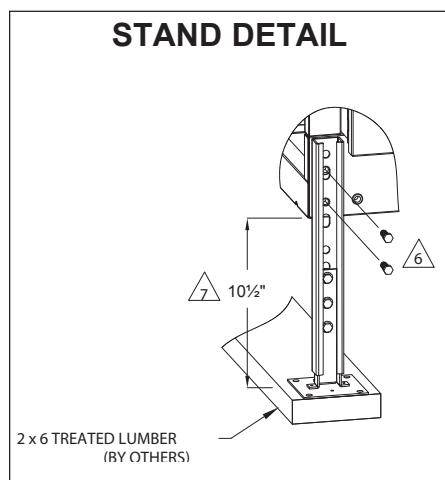
Field constructed intake accessories should be designed to minimize the entry of snow and rain.

IMPORTANT

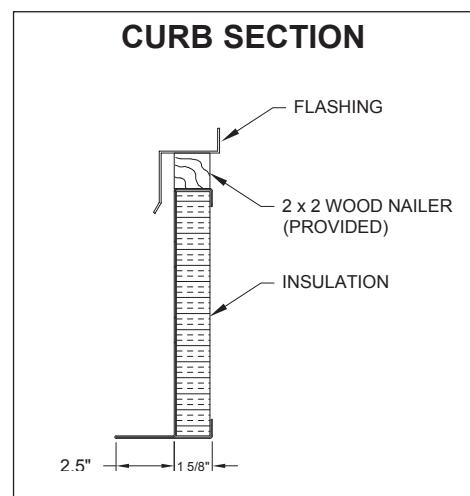
The minimum clearance from the face of the electrical control enclosure to surrounding grounded surfaces for service activities is 42". Adequate clearance of 42" for burner removal is also required. Access for service functions is also required on the side of the unit opposite the control enclosure for a distance of 24".

INSTALLATION INSTRUCTIONS

ROOF TOP MOUNTING - CURB / STAND / RAIL

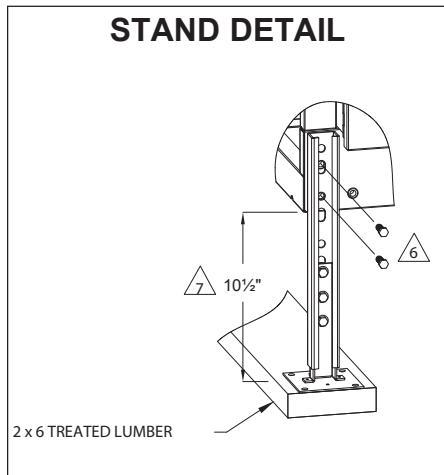


Model	A	B	C
S400/S800	65 1/2"	33 1/4"	25 3/8"
S950/S1200/S1600	78 5/8"	33 1/4"	42"
S1850/S2200/S3200	90 1/4"	36 1/4"	47 1/8"

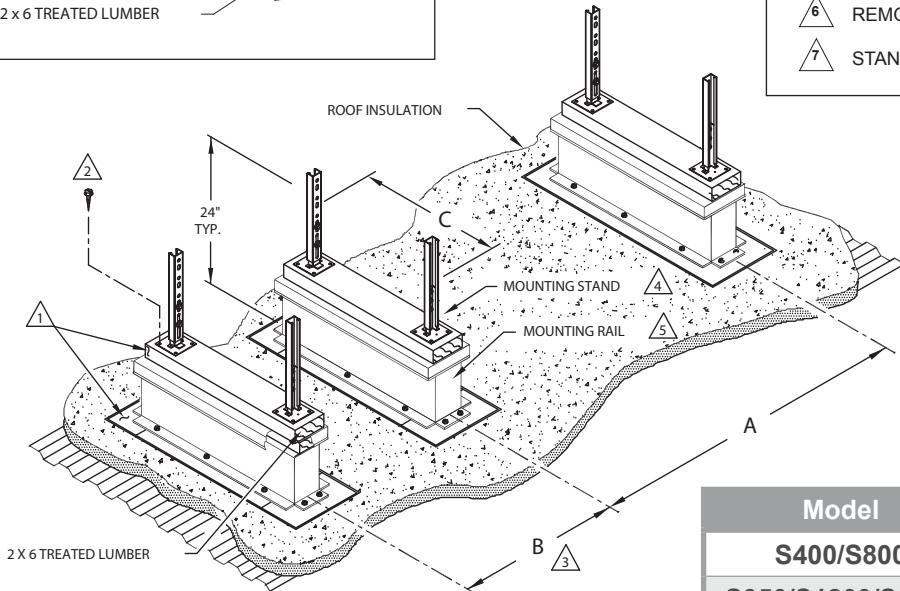


INSTALLATION INSTRUCTIONS

ROOF TOP / THRU WALL MOUNTING - STAND / RAIL

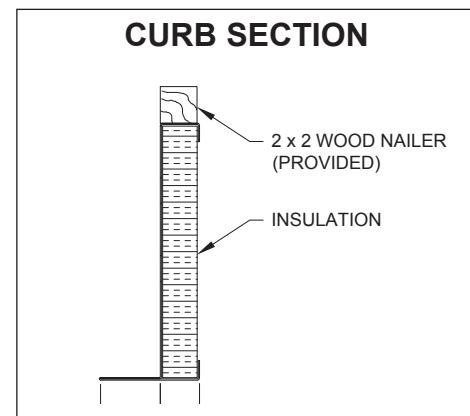
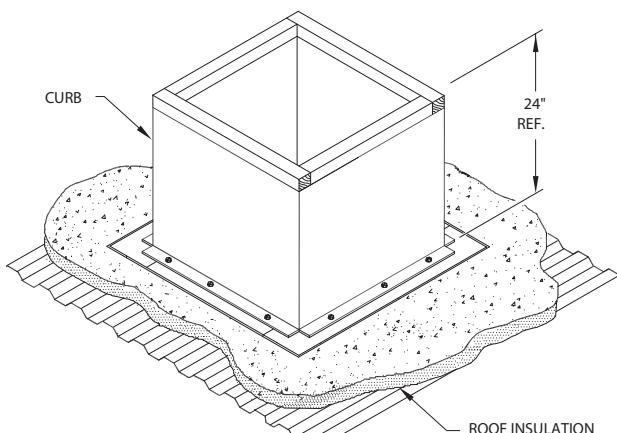


- NOTES**
- 1 TREATED TIMBER AS REQUIRED UNDER MOUNTING RAIL AND STAND TO SECURE AND LEVEL UNIT.
 - 2 SECURE MOUNTING STAND TO TIMBER WITH WOOD LAG SCREWS AS SHOWN.
 - 3 THIRD MOUNTING ASSEMBLY IS REQUIRED ONLY ON UNITS WITH FILTER SECTIONS.
 - 4 MOUNTING STAND CONSTRUCTION: 12 GA. GALVANIZED STEEL
 - 5 MOUNTING RAIL CONSTRUCTION: 18 GA. GALVANIZED STEEL
 - 6 REMOVE HANGER BRACKET AND REPLACE SCREWS
 - 7 STAND IS ADJUSTABLE $\pm 3\frac{3}{4}$ "



Model	A	B	C
S400/S800	57 7/8"	33 1/4"	25 3/8"
S950/S1200/S1600	69 7/8"	33 1/4"	42"
S1850/S2200/S3200	75 1/4"	36 3/4 "	47 1/8"

UNDER ROOF MOUNTING - CURB



INSTALLATION INSTRUCTIONS

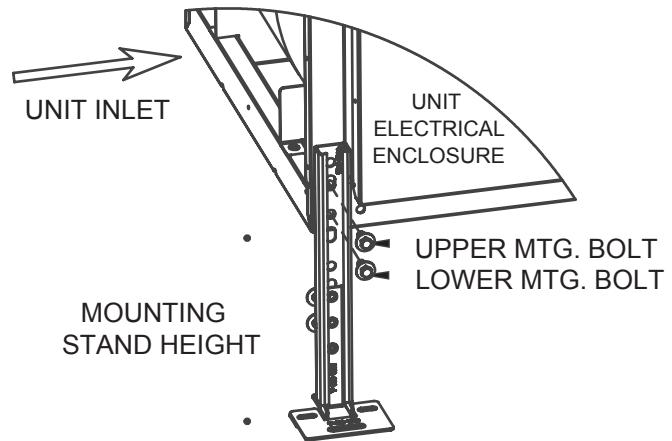
ADJUSTABLE MOUNTING STAND

An adjustable mounting stand is used in conjunction with a mounting rail as the rear heater support on the roof top mounting package. The rail provides a roof interface for both rubber and built-up roof decks. An additional mounting stand and mounting rail is required when a filter section is specified.

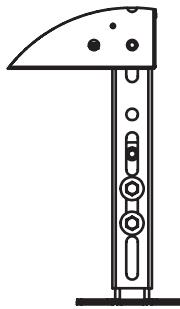
The 12" adjustable stand provides a height range of 6 $\frac{3}{4}$ " to 14 $\frac{1}{4}$ ". The 24" adjustable stand provides a height range of 18 $\frac{3}{4}$ " to 26 $\frac{1}{4}$ ".

MOUNTING INSTRUCTIONS

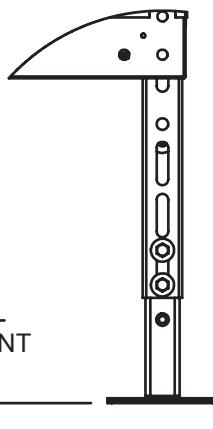
1. Remove hanger bracket from unit base. Reuse 3/8"-16 x 1" cap screws provided.
2. The 12" mounting stand is factory assembled to provide a mounting height of 10 $\frac{1}{2}$ ". (12" total when mounted on 2" nominal lumber) The 24" mounting stand is factory assembled to provide a mounting height of 22 $\frac{1}{2}$ ". (24" total when mounted on 2" nominal lumber)
3. If height adjustment is required, relocate slot adjusting bolts per table below.
4. Heater inlet should be lowered to 1/8" per foot below the discharge of the unit to allow any ingested moisture to drain out of the unit onto the roof surface.



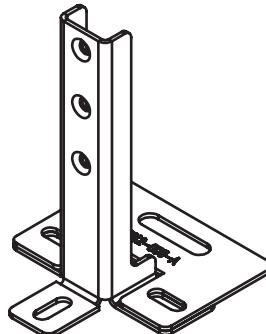
MINIMUM STAND HEIGHT



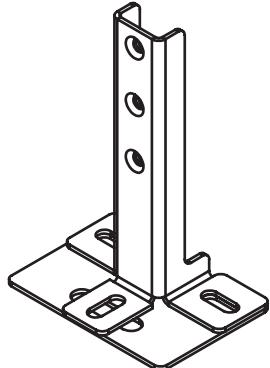
MAXIMUM STAND HEIGHT



STANDARD CONFIGURATION



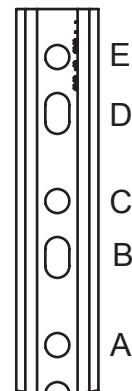
OVERHANGING CURB CONFIGURATION



ADJUSTMENT RANGE

MOUNTING BOLT LOCATION

Model	6 $\frac{3}{4}$ " to 10"		10" to 14 $\frac{1}{4}$ "	
	Lower	Upper	Lower	Upper
S400/S800	A	B	C	D
S950/S1200/S1600	A	B	C	D
S1850/S2200/S3200	A	B	C	D



INSTALLATION INSTRUCTIONS

ROOF TOP MOUNTING

⚠ WARNING:

Due to the size and weight of this equipment, it is recommended the heater mounting 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 for service and maintenance functions.

IMPORTANT

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

⚠ 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 additional references.

1. Prepare roof penetration to the dimensions below. See page 6 for Roof Top Mounting - Curb/Stand/Rail drawing.

IMPORTANT

Accurate measurements are critical and will affect the installation process. Verify that the roof opening aligns with the curb opening.

2. Secure the mounting curb and mounting rail(s) per the structural engineer and roof manufacturer's recommendations.

IMPORTANT

The roof curb and mounting rail(s) should be installed so that the heater will mount level.

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

3. Attach the mounting stands (page 9) to the heater while the heater is on the ground. Adjust the height of the stands so the heater inlet is 1/8" per foot below level lower than the discharge. This allows any ingested moisture to drain out of the heater, through weep holes located at the inlet of the heater, onto the roof surface.
4. Lower the discharge duct through the mounting curb and the roof opening and secure the counterflashing to the mounting curb.
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 brackets.

⚠ WARNING:

Do not attach lifting means to heater accessories. Make connections to heater only.

IMPORTANT

Inlet accessories may be attached on the ground or on the roof depending on the method chosen by the installer.

6. Caulk all the joints between the heater and the accessories with silicone caulk to prevent water leaks.

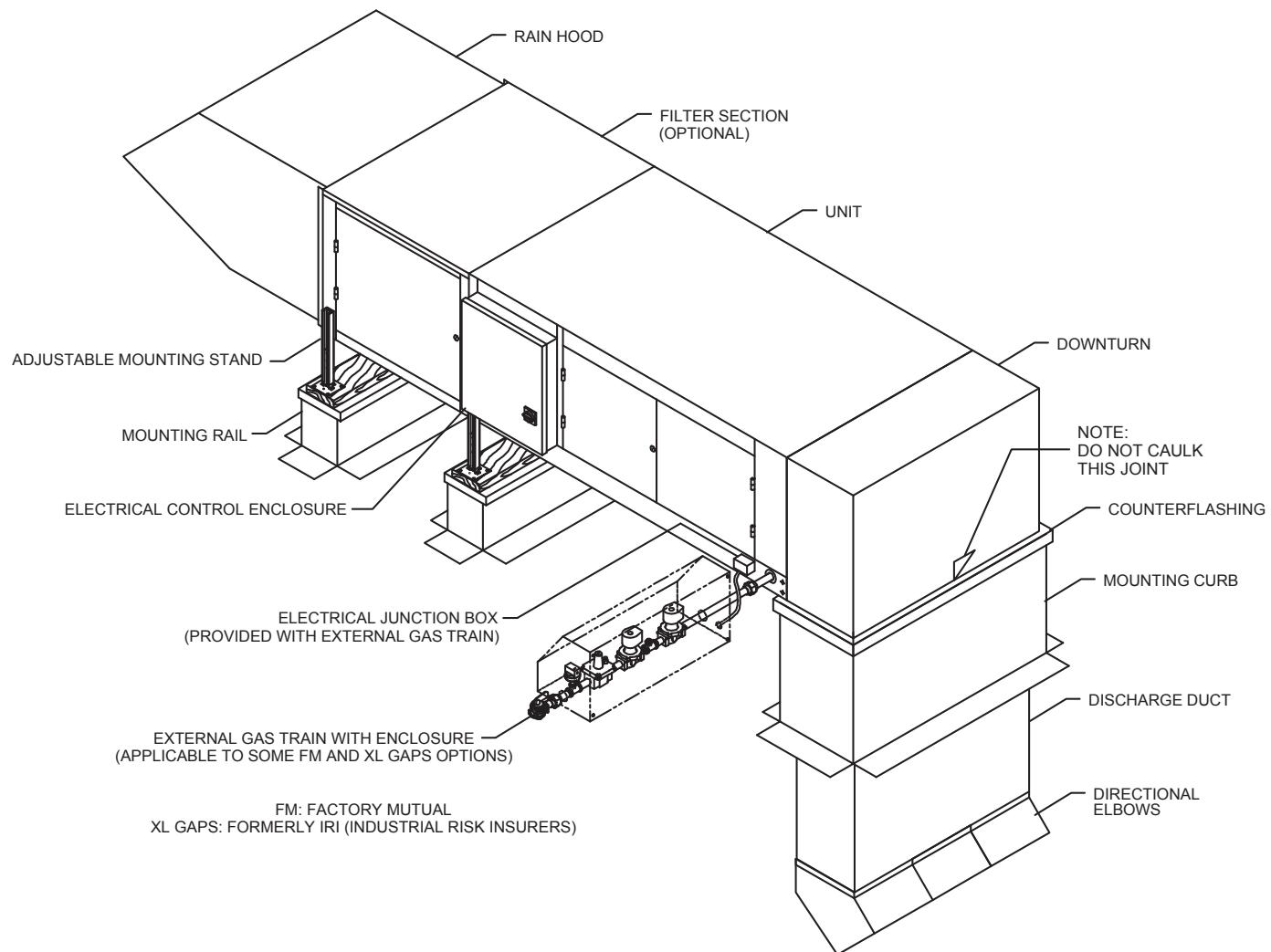
IMPORTANT

Do not caulk the downturn/counterflashing for the curb interface.

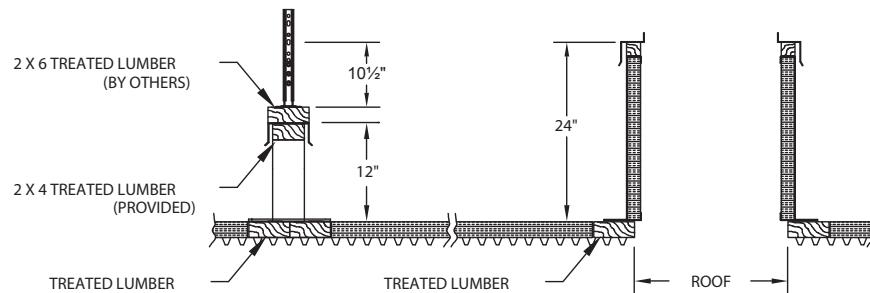
7. Seal all roof penetrations to prevent roof leaks.
8. Install the directional elbows (page 50). Consult the job layout for the orientation of the elbows.

Model	Weight	Roof Opening*	
		L	W
S400/S800	550 lbs.	13"	24 $\frac{3}{4}$ "
S950/S1200/S1600	800 lbs.	15"	41 $\frac{1}{2}$ "
S1850/S2200/S3200	1500 lbs.	24 $\frac{1}{4}$ "	46 $\frac{1}{2}$ "

TYPICAL INSTALLATION ROOF TOP MOUNTING



CURB / RAIL / STAND DETAIL



* Dimensions allow for $\frac{3}{4}$ " clearance on each side

INSTALLATION INSTRUCTIONS

THRU WALL MOUNTING

⚠ WARNING:

Due to the size and weight of this equipment, it is recommended the heater mounting 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.

⚠ 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 additional references.

1. Prepare wall penetration to the dimensions below.
2. Connect inlet accessories to the unit including filter section (optional) and rain hood prior to lifting the heater in place. Note the inlet skirt for rain hood (optional) is installed from the outside of the building (page 20).
3. Install hanging rods to adequate ceiling supports and align with the hanging brackets on the unit. Refer to hanging rod size shown on table below. Locate the hanging rods so that the weep holes provided in the rain hood are located a minimum of 3" beyond the outside wall surface.
4. Remove the lag bolts used to fasten the unit to the skid. Do not remove the hanging brackets from the side of the heater. On S400/S800 model heaters, rotate the mounting brackets 180° and retighten the securing hardware.

5. Use a forklift or comparable lifting device to raise and position the heater. Take precautions to prevent equipment damage (dents and/or scratches) when the heater is being lifted into position.

6. Use washers and double lock nuts to secure the unit on the hanging rods.

IMPORTANT

The discharge end of the heater should be raised slightly (1/8" per foot above level. This allows any ingested moisture to drain out of the heater through weep holes located in the rain hood to the exterior of the building).

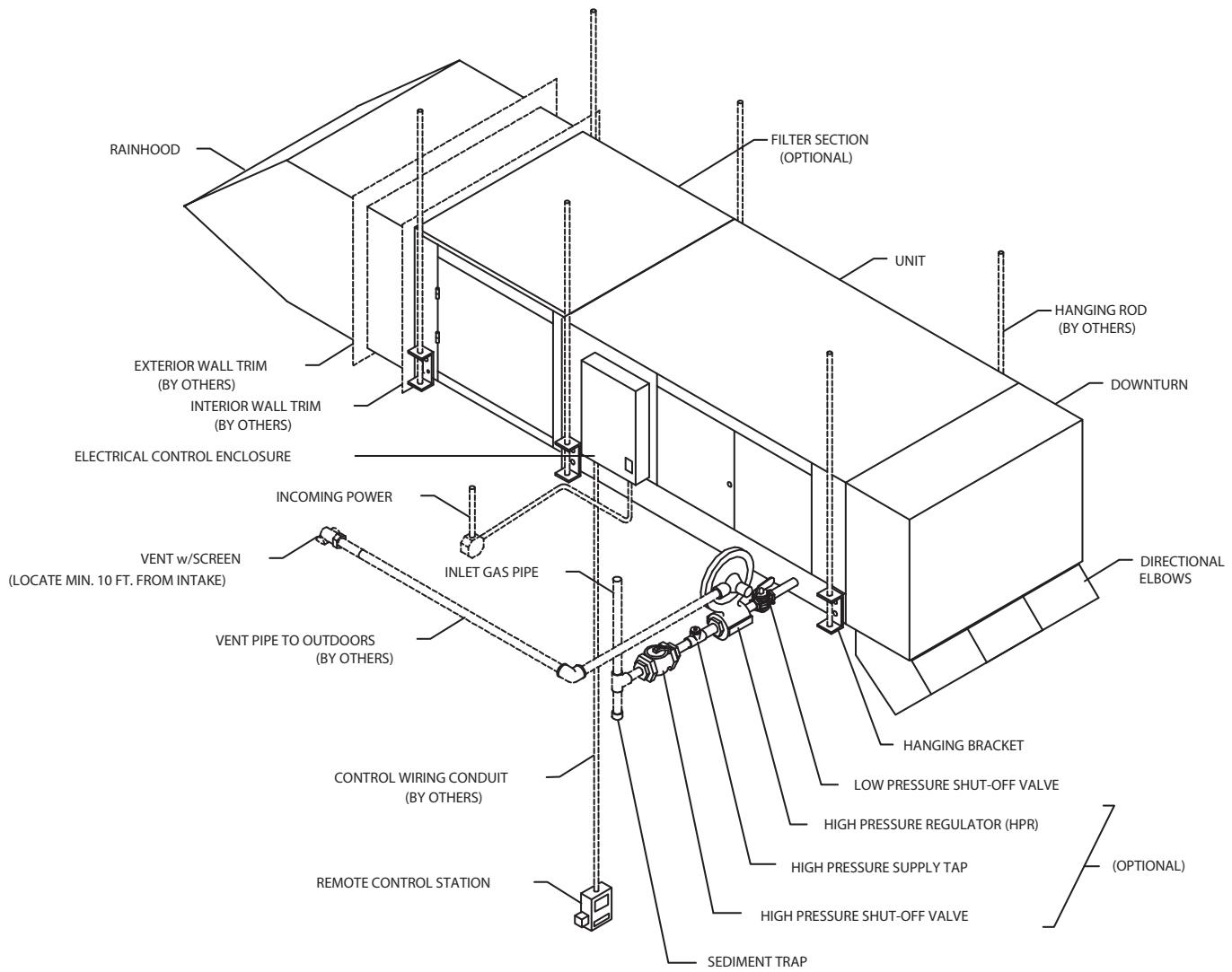
7. Apply shims, by others, at the bottom of the rain hood to take up slack in the opening, leaving a small joint between the top of the rain hood and the wall.
8. Install fiberglass insulation in the gaps around the wall opening and the rain hood. Apply enough material to accommodate the full thickness of the wall.
9. Install finish trim pieces (by others) to the top, sides and bottom of the rain hood on both the inside and outside wall surfaces.
10. Apply silicone caulk at the joint between the top of the rain hood and the outside wall surface. Make certain this is a continuous bead and that it runs the entire width of the rain hood. Caulk all other exposed joints.
11. Install the directional elbows (page 50). Consult the job layout for the orientation of the elbows.

Model	Weight	Hanging Rods					Wall Opening**	
		Qty.	Size	A	B*	C	H	W
S400/S800	550 lbs.	4 (6*)	3/8" dia.	57 7/8"	33 1/4"	27 7/8"	26"	25 1/2"
S950/S1200/S1600	800 lbs.	4 (6*)	3/8" dia.	69 7/8"	33 1/4"	43 7/8"	29"	42 1/4"
S1850/S2200/S3200	1500 lbs.	4 (6*)	1/2" dia.	75 3/4"	36 3/4"	48 7/8"	38 3/4"	47 1/4"

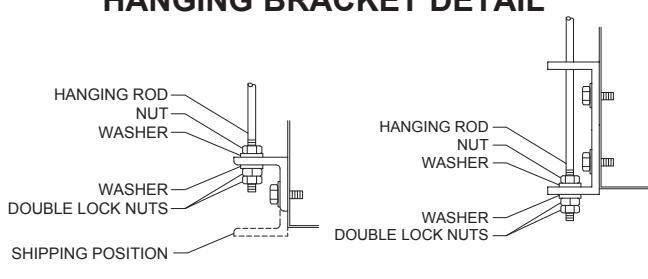
*For optional filter section

** Dimensions allow for 1" clearance on each side

TYPICAL INSTALLATION THRU WALL MOUNTING

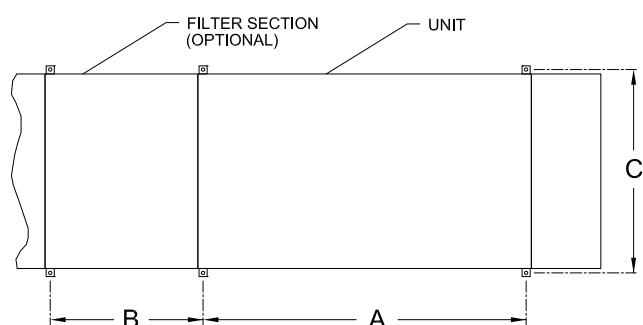


HANGING BRACKET DETAIL



L BRACKET
FOR S400 - S800 UNITS **C BRACKET**
FOR S950 - S3200 UNITS

HANGING ROD DETAIL



INSTALLATION INSTRUCTIONS

ROOF TOP / THRU WALL MOUNTING

⚠ WARNING:

Due to the size and weight of this equipment, it is recommended the heater mounting 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 winds.

⚠ 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 additional references.

1. Prepare wall penetration to the dimensions below. See page 7 for Roof Top/Thru Wall Mounting Stand/Rail drawing.

IMPORTANT

Accurate measurements are critical and will affect installation process.

2. Secure the mounting rails per the structural engineer and roof manufacturer's recommendations.

IMPORTANT

The mounting rails should be installed so that the heater will mount level. Cambridge recommends mounting the heater a minimum of 24" off the roof surface in areas where snow accumulation could impact heater operations

3. Attach the mounting stands (page 9) to the heater while the heater is on the ground. Adjust the height of the stands so the heater inlet is slightly (1/8" per foot below level) lower than the discharge. This allows any ingested moisture to drain out of the heater, through weep holes located at the inlet of the heater, onto the roof surface.

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

⚠ WARNING:

Do not attach lifting means to heater accessories. Make connections to heater only.

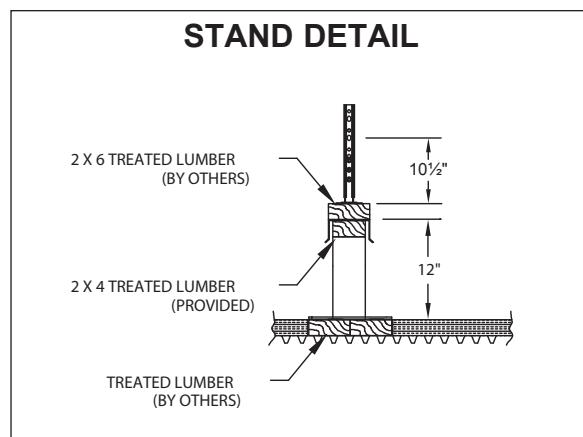
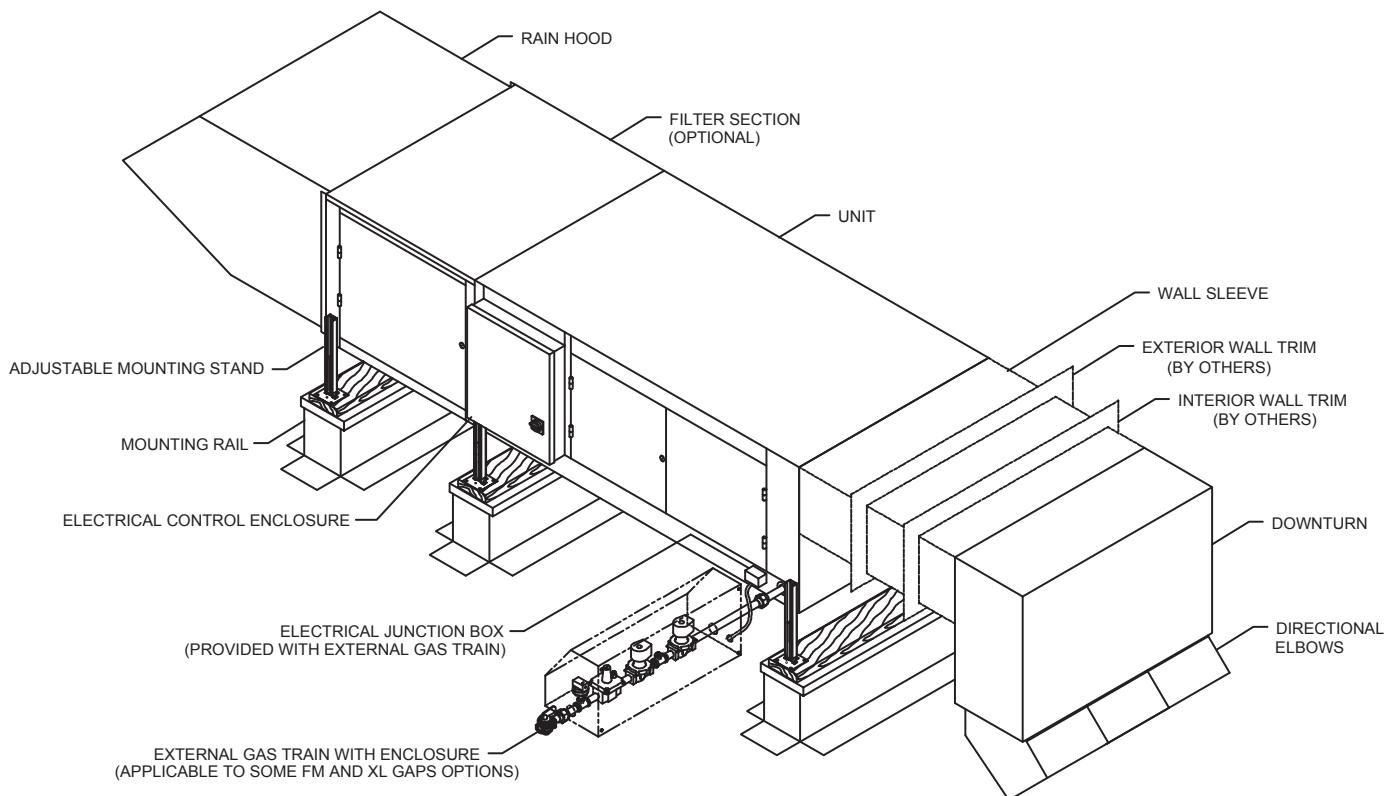
IMPORTANT

Inlet accessories may be attached on the ground or on the roof depending on the method chosen by the installer.

5. Install the wall sleeve to the heater discharge.
6. Install fiberglass insulation in gaps around the wall opening and wall sleeve. Apply enough material to accommodate the full thickness of the wall.
7. Install finish trim pieces (by others) to top, sides and bottom of the wall sleeve on both the inside and outside wall surfaces.
8. Apply silicone caulk at the joint between the top of the wall sleeve and the outside wall surface. Make certain this is a continuous bead and that it runs the entire width of the wall sleeve. Caulk all other exposed joints.
9. Seal all roof penetrations to prevent roof leaks.
10. Install the downturn and directional elbows (page 50). Consult the job layout for the orientation of the elbows.

Model	Weight	Wall Opening*	
		H	W
S400/S800	550 lbs.	16"	28 $\frac{1}{4}$ "
S950/S1200/S1600	800 lbs.	18"	45"
S1850/S2200/S3200	1500 lbs.	27 $\frac{1}{2}$ "	50"

TYPICAL INSTALLATION ROOF TOP / THRU WALL MOUNTING



* Dimensions allow for 1½" clearance on each side

INSTALLATION INSTRUCTIONS UNDER ROOF MOUNTING

⚠ WARNING:

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

IMPORTANT

The mounting curb or mounting structure should be installed such that the heater's inlet plenum will mount level.

3. Seal all roof penetrations to prevent roof leaks.
4. Lower the inlet duct through the mounting curb and the roof opening.
5. Secure the inlet plenum to the curb.
6. Connect inlet accessories to the heater including filter section (optional) and inlet elbow prior to lifting the heater in place.
7. Install hanging rods to adequate ceiling supports and align with the hanging brackets on the heater. Refer to hanging rod size shown on table below.
8. Remove the lag bolts used to fasten the unit to the skid. Do not remove the hanging brackets from the side of the heater. On S400/S800 model heaters, rotate the hanging brackets 180°, and retighten the securing hardware.
9. Use a forklift or comparable lifting device to raise and position the heater. Take precautions to prevent equipment damage (dents and/or scratches) when the heater is being lifted into position.
10. Use washers and double lock nuts to secure equipment on the hanging rods.
11. Install the directional elbows (page 50). Consult the job layout for the orientation of the elbows.

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.

⚠ 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 additional references.

1. Prepare roof penetration to the dimensions below. See page 7 for Under Roof Mounting - Curb drawing

IMPORTANT

Accurate measurements are critical and will affect the installation process. Verify that the roof opening aligns with the curb opening.

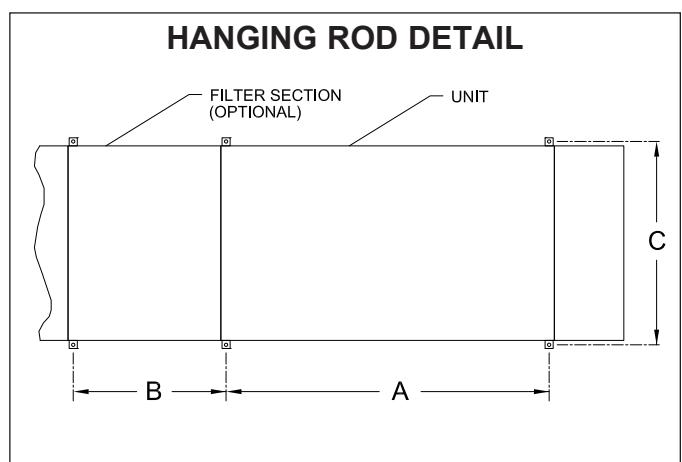
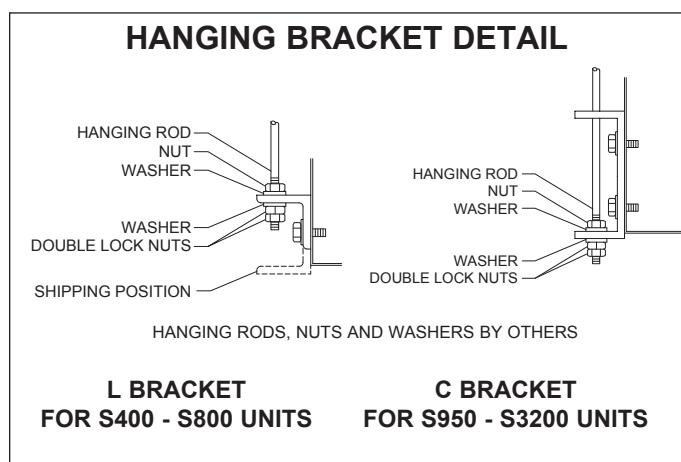
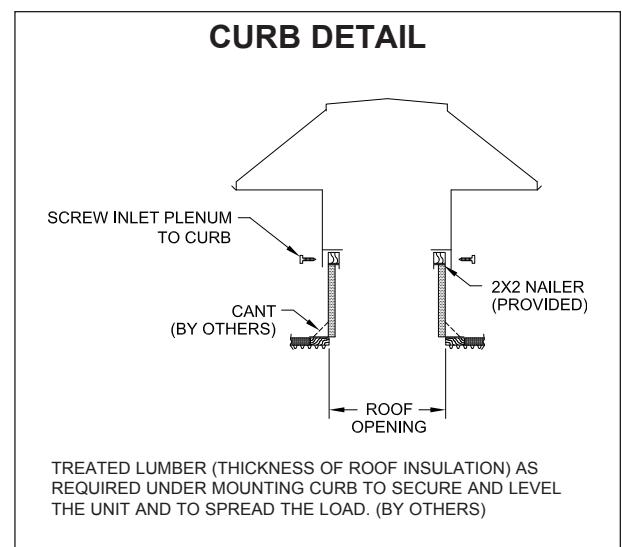
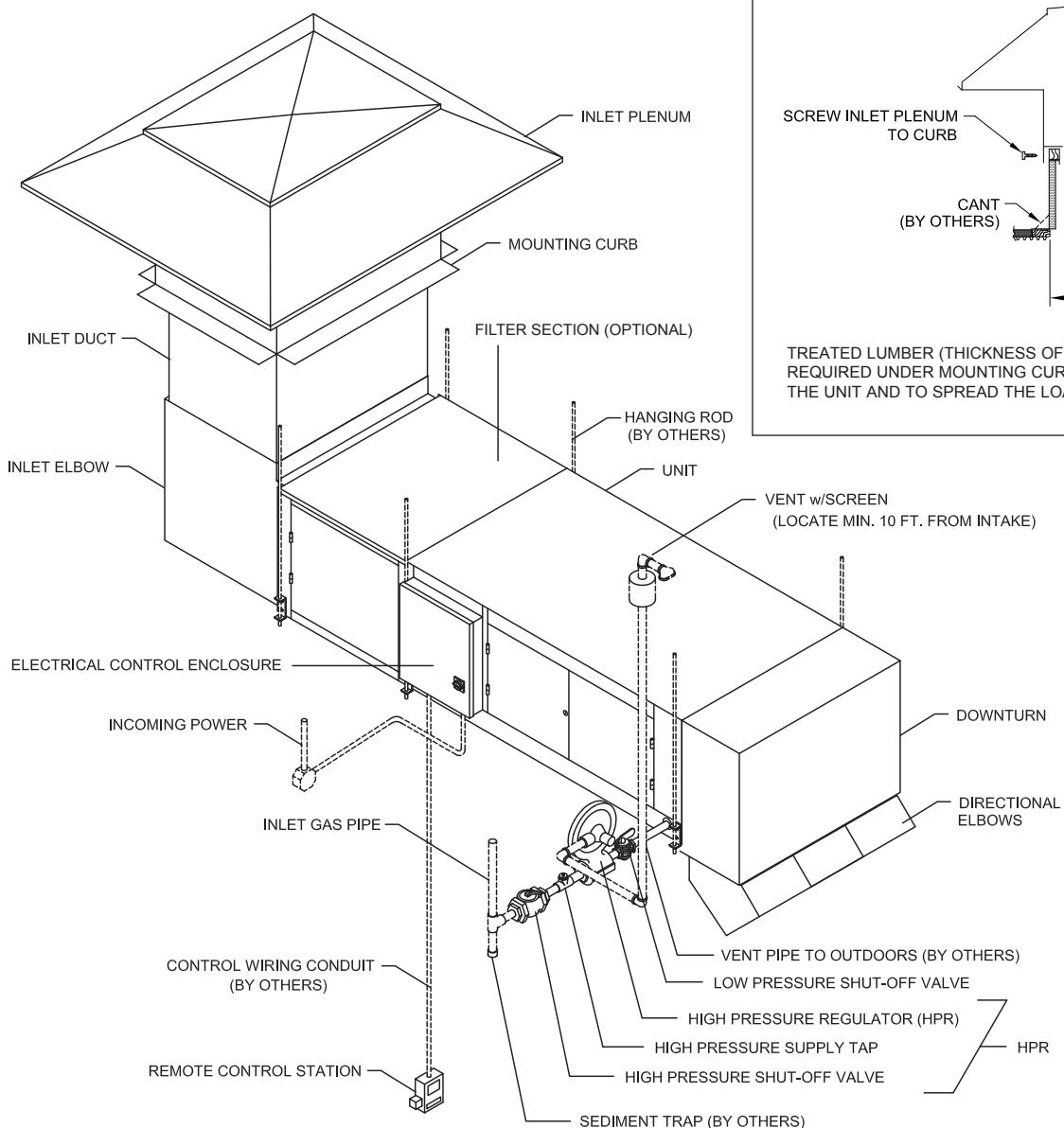
2. Install the mounting curb and the mounting structure per the structural engineer and roof manufacturer's recommendations.

Model	Weight	Qty.	Size	Hanging Rods			Roof Opening**	
				A	B*	C	L	W
S400/S800	550 lbs.	4 (6*)	3/8" dia.	57 7/8"	33 1/4"	27 7/8"	25"	25"
S950/S1200/S1600	800 lbs.	4 (6*)	3/8" dia.	69 7/8"	33 1/4"	43 7/8"	30"	41 1/4"
S1850/S2200/S3200	1500 lbs.	4 (6*)	1/2" dia.	75 3/4"	36 3/4"	48 7/8"	37 1/4"	46 3/4"

*For optional filter section

** Dimensions allow for 3/4" clearance on each side

TYPICAL INSTALLATION UNDER ROOF MOUNTING



INSTALLATION INSTRUCTIONS

VERTICAL INDOOR MOUNTING

⚠ WARNING:

Due to the size and weight of this equipment, it is recommended the heater mounting 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.

⚠ 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 additional references.

1. Prepare wall penetration to the dimensions below.
2. Connect the inlet accessories to the heater including the filter section (optional), the inlet elbow and the rain hood prior to standing the heater upright. Note the inlet skirt for the rain hood (optional) is installed from the outside of the building (page 20).
3. Install hanging rods to adequate ceiling and/or wall supports per the structural engineer's recommendations and align with the hanging brackets on the heater. Refer to the hanging rod size shown on the table below. Locate the hanging rods so that the weep holes provided in the rain hood are located a minimum of 3" beyond the outside wall surface.

4. Remove the lag bolts used to fasten the unit to the skid. Rotate the hanging brackets for the vertical application and retighten the securing hardware.
5. Utilizing the lifting brackets on the front of the heater, use a forklift or comparable lifting device to raise and position the heater. Take precautions to prevent equipment damage (dents and/or scratches) when the heater is being lifted into position.
6. Use washers and double lock nuts to secure equipment on hanging rods.

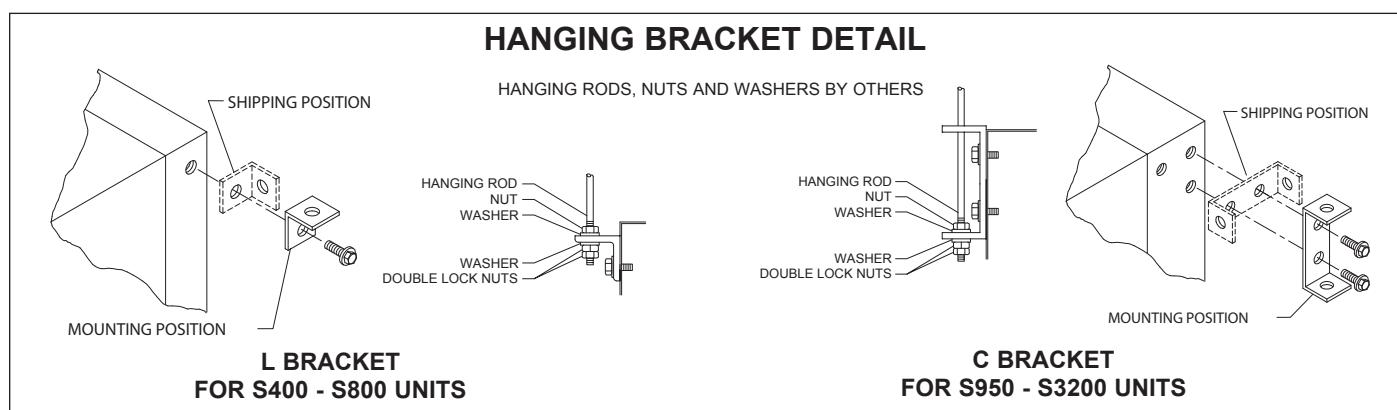
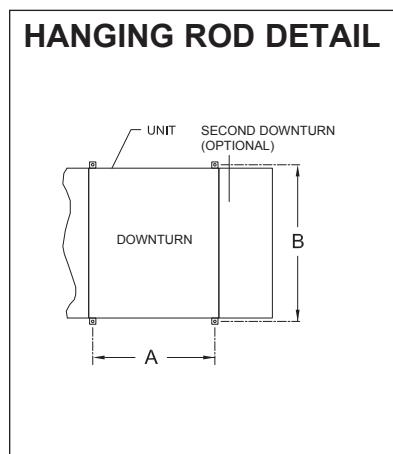
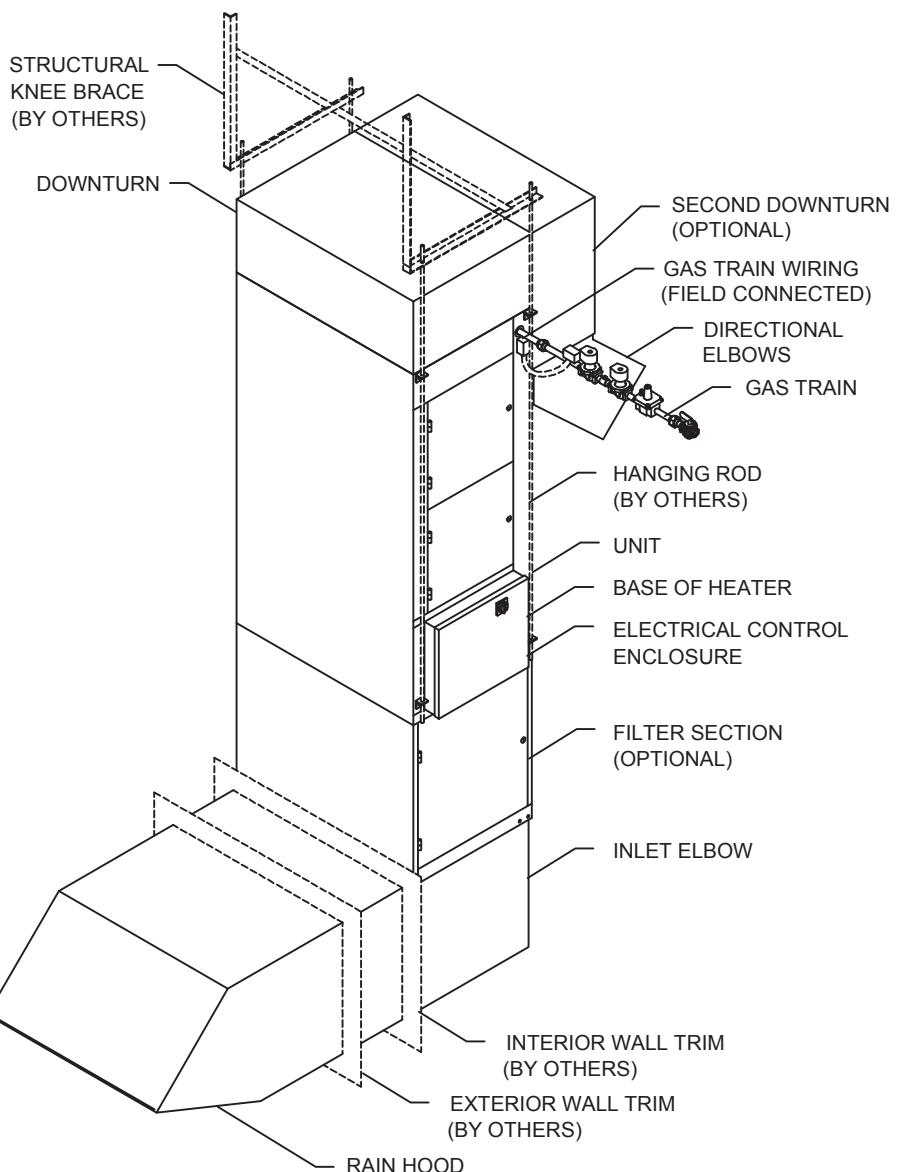
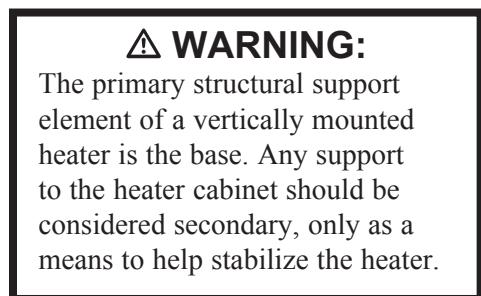
IMPORTANT

The rain hood should be sloped slightly (1/8" off level). This allows any ingested moisture to drain out of the heater through weep holes located in the rain hood to the exterior of the building.

7. Apply shims at the bottom of the rain hood to take up slack in the opening, leaving a minimal joint between the top of the rain hood and the wall.
8. Install fiberglass insulation in the gaps around the wall opening and the rain hood. Apply enough material to accommodate the full thickness of the wall.
9. Install finish trim pieces (by others) to the top, sides and bottom of the rain hood on both the inside and outside wall surfaces.
10. Apply silicone caulk at the joint between the top of the rain hood and the outside wall surface. Make certain this is a continuous bead and that it runs the entire width of the rain hood. Caulk all other exposed joints.
11. Install the second downturn and directional elbows (page 50). Consult the job layout for the orientation of the elbows.

Model	Weight	Hanging Rods				Wall Opening*	
		Qty.	Size	A	B	H	W
S400/S800	650 lbs.	4	3/8" dia.	23 3/8"	27 7/8"	26"	25 1/2"
S950/S1200/S1600	950 lbs.	4	3/8" dia.	26"	43 7/8"	29"	42 1/4"
S1850/S2200/S3200	1750 lbs.	4	1/2" dia.	34 7/8"	48 7/8"	38 3/4"	47 1/4"

TYPICAL VERTICAL INDOOR INSTALLATION



* Dimensions allow for 1" clearance on each side

INSTALLATION INSTRUCTIONS

VERTICAL OUTDOOR MOUNTING

⚠ WARNING:

Due to the size and weight of this equipment, it is recommended the heater mounting 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.

⚠ CAUTION

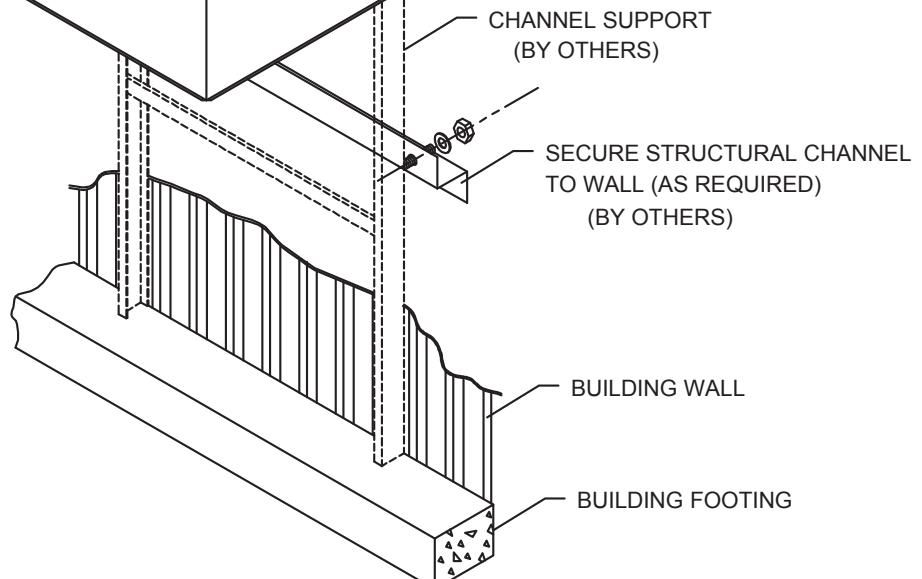
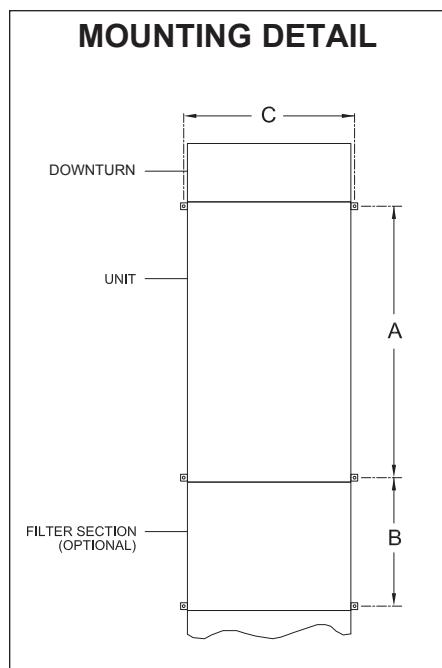
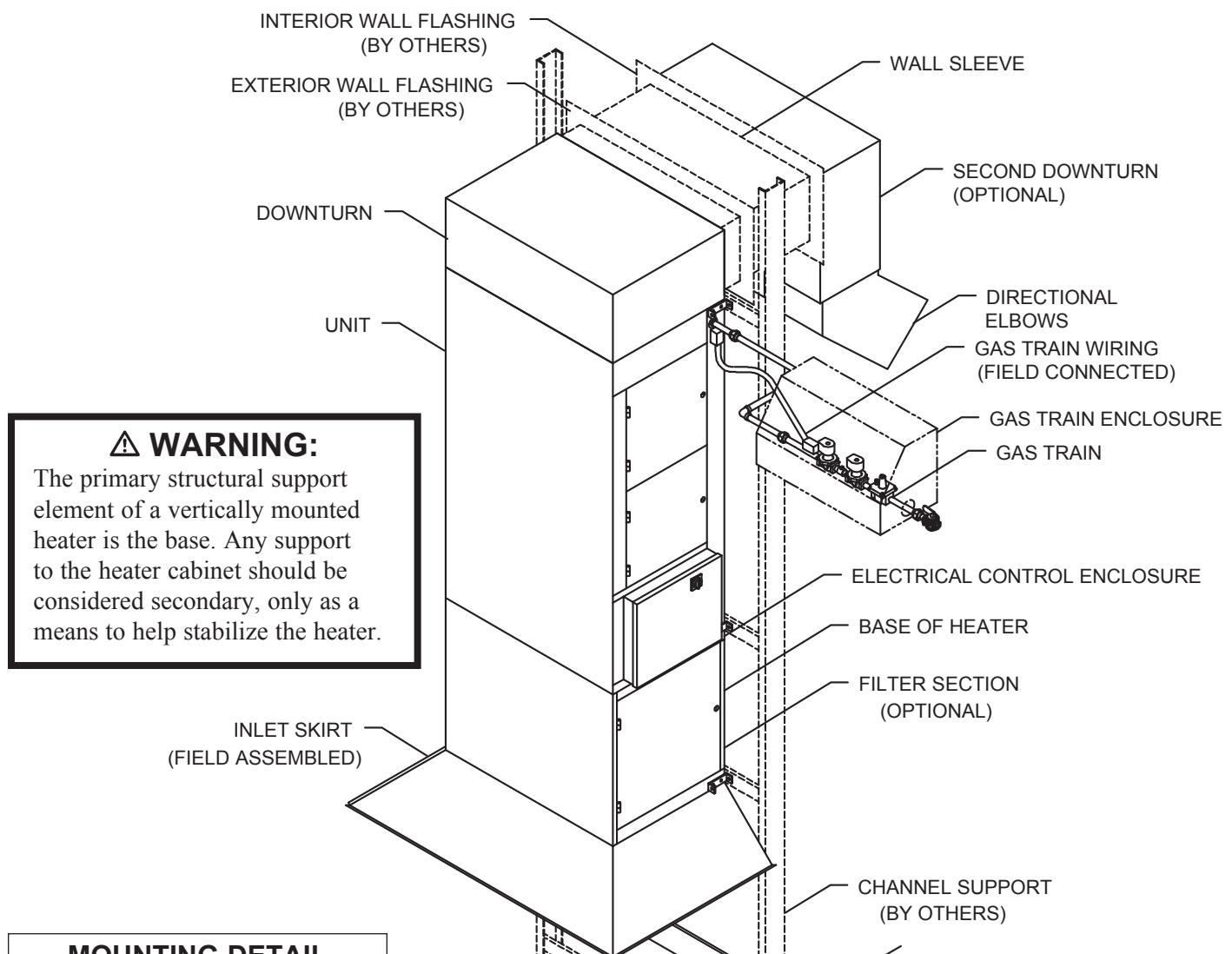
To prevent contaminated air from being drawn into the heater, install the heater's inlet at least 10 feet from any building exhaust, process exhaust, sewer stacks, or other sources that would allow contaminants to be drawn into the heater. Consult local codes for additional references.

1. Prepare wall penetration to the dimensions below.
2. Connect the inlet accessories to the heater including the filter section (optional).
3. Install structural uprights and associated wall supports per structural engineers recommendations.
4. Remove the lag bolts used to fasten the unit to the skid.
5. Utilizing the lifting brackets on the front of the heater, use a forklift or comparable lifting device to raise and position the heater. Take precautions to prevent equipment damage (dents and/or scratches) when the heater is being lifted into position.
6. Secure the heater in place with contractor supplied hardware.

7. Install the wall sleeve to the downturn.
8. Install fiberglass insulation in the gaps around the wall opening and the wall sleeve. Apply enough material to accommodate the full thickness of the wall.
9. Install finish trim pieces (by others) to the top, sides and bottom of the wall sleeve on both the inside and outside wall surfaces.
10. Apply silicone caulk at the joint between the wall sleeve and the outside wall surface. Make certain this is a continuous bead and that it runs the entire width of the wall sleeve. Caulk all other exposed joints.
11. Mount the gas train enclosure to the wall structure and connect gas piping between the heater and the enclosure.
12. Install the inlet skirt to the heater inlet and attach the skirt extension to the exterior wall (page 21).
13. Install wall sleeve, second downturn and directional elbows (page 50). Consult the job layout for the orientation of the elbows.

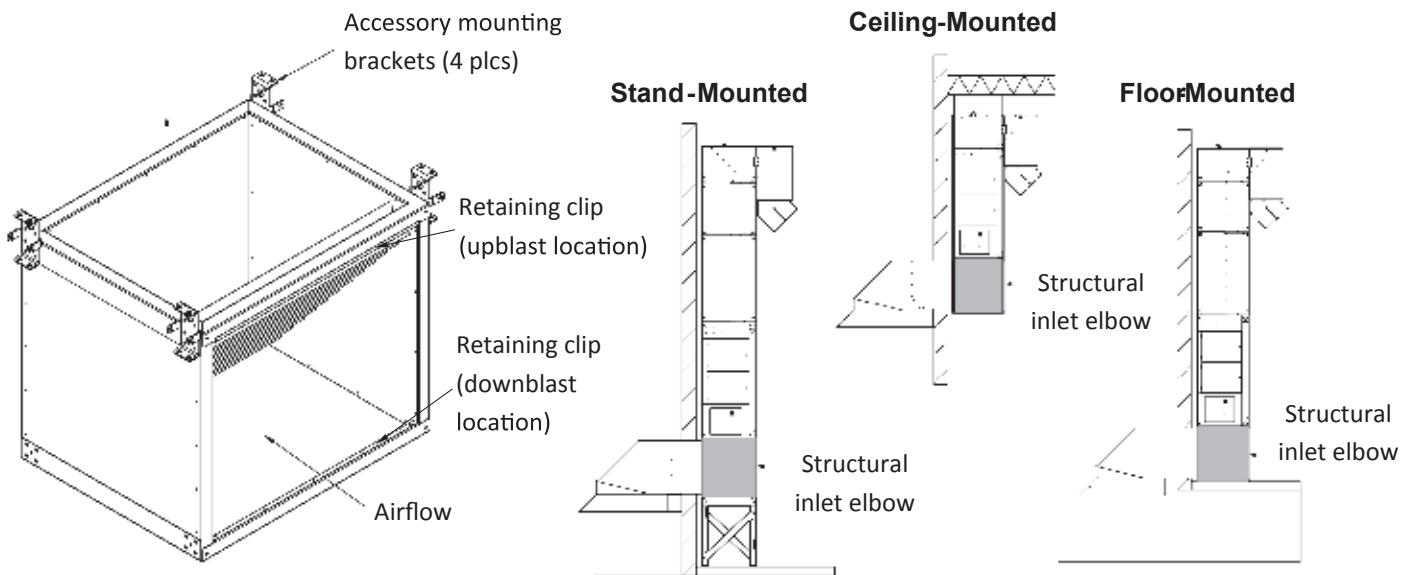
* Dimensions allow for 1½" clearance on each side

TYPICAL VERTICAL OUTDOOR INSTALLATION



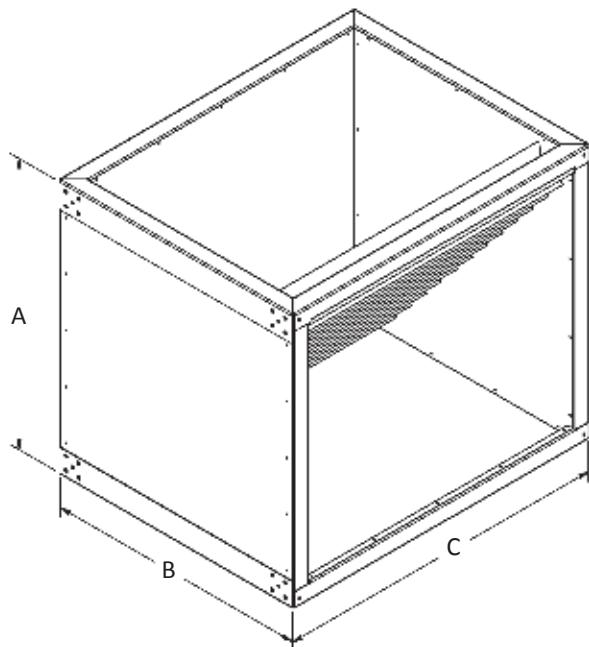
INSTALLATION INSTRUCTIONS

VERTICAL S-SERIES STRUCTURAL INLET ELBOW



The vertical S-Series structural inlet elbow is suitable for indoor or outdoor use. The elbow has been structurally reinforced to support the weight of the unit and any additional accessories applicable to your installation. It can be used in floor-mounted applications, with or without a stand, as well as ceiling-mounted applications when hanging the unit with threaded rod. The elbow is insulated to prevent condensation and reduce noise levels.

Model	Weight	A	B	C
S400/S800	150 lbs.	27 1/2"	25 3/8"	25 3/8"
S950/S1200/S1600	205 lbs.	30 3/4"	28"	42"
S1850/S2200/S3200	300 lbs.	40 3/8"	37 3/8"	47 1/8"

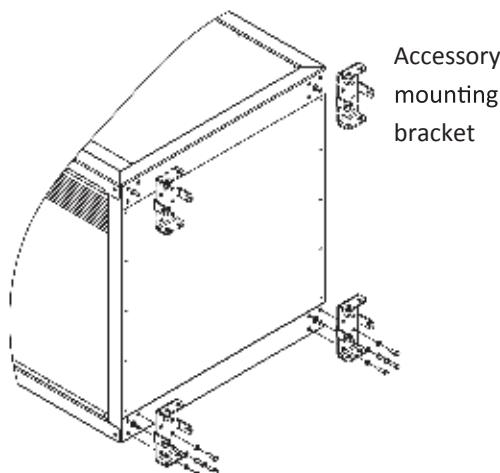


INSTALLATION INSTRUCTIONS

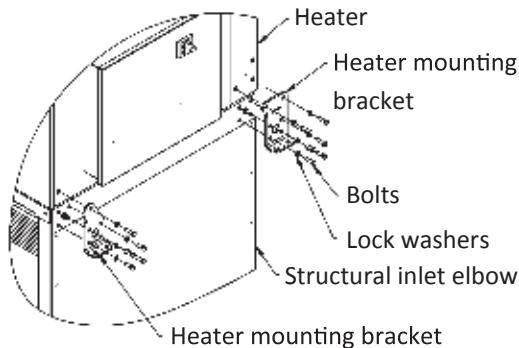
VERTICAL S-SERIES STRUCTURAL INLET ELBOW

CEILING-MOUNTED APPLICATIONS

1. Remove the accessory mounting brackets from the top of the inlet elbow and reattach them on the bottom of the inlet elbow for hanging.

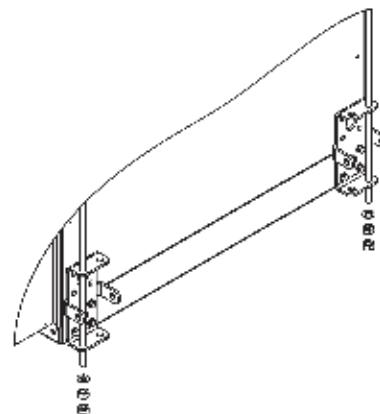


2. If heater is vertical downblast, remove the retaining clip and attach to the opposite flange.
3. Use the included heater mounting brackets to attach the inlet elbow to the heater (or filter section if applicable).
 - If filter section is included, attach heater to filter section using provided accessory mounting brackets after inlet elbow and filter section are connected.

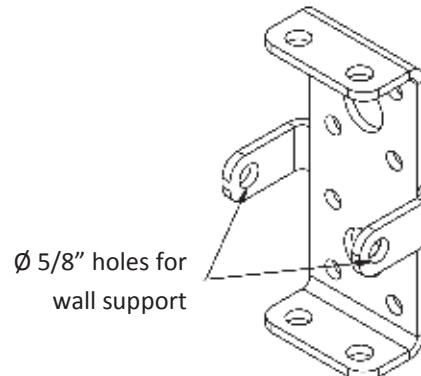


4. If not already attached, secure elbow to discharge of heater using provided heater mounting brackets.
5. Position heater with attached accessories upright and lift into place.

6. Secure threaded rod to ceiling structure as needed.
7. Double-nut the end of the rod below the mounting bracket at the bottom of the inlet elbow.



8. It is recommended to run support back to the wall to prevent swaying or tipping of heater and accessories.
 - Use the provided holes in the mounting brackets to run threaded rod (by others) to support on walls (by others).



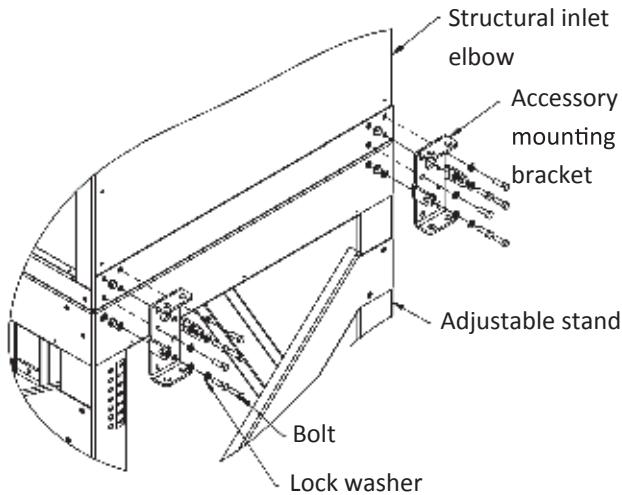
9. For indoor installations, attach thru-wall rain hood and inlet skirt if applicable.

INSTALLATION INSTRUCTIONS

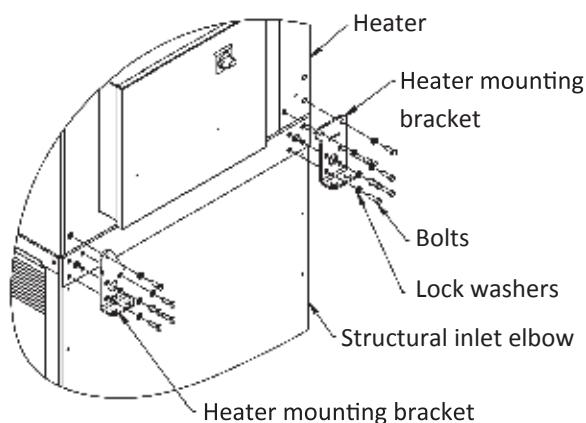
VERTICAL S-SERIES STRUCTURAL INLET ELBOW

STAND-MOUNTED APPLICATIONS

1. Once the stand is set, attach inlet elbow to stand using the provided accessory mounting brackets.

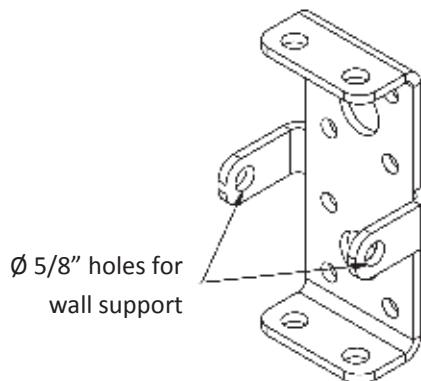


2. If filter section included, attach filter section to inlet elbow using the provided accessory mounting brackets. If filter section is not included, skip to step 3.
3. Attach heater to inlet elbow (or filter section) below using the provided heater mounting brackets.



4. Continue attaching discharge accessories with provided mounting brackets as needed.

5. It is recommended to run support back to the wall to prevent swaying or tipping of heater and accessories.
 - Use the provided holes in the mounting brackets to run threaded rod (by others) to support on walls (by others).



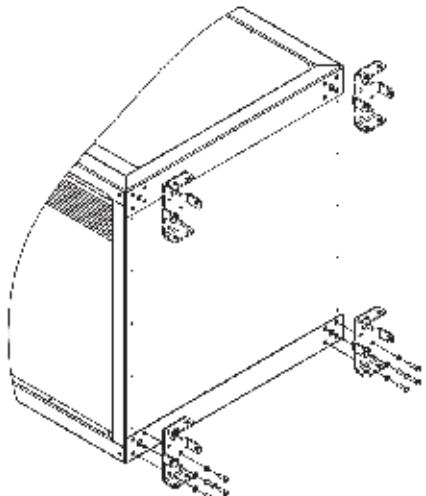
6. For indoor installations, attach thru-wall rain hood and inlet skirt if applicable.

INSTALLATION INSTRUCTIONS

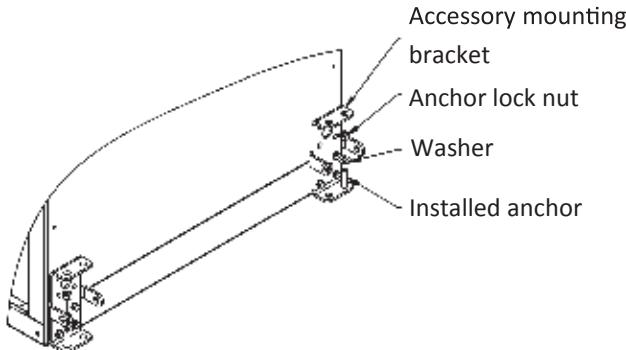
VERTICAL S-SERIES STRUCTURAL INLET ELBOW

FLOOR-MOUNTED APPLICATIONS

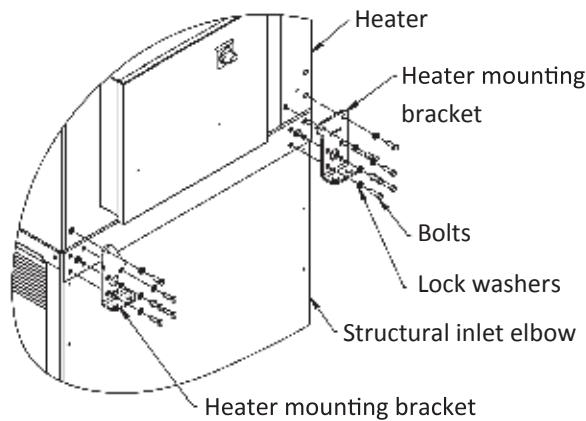
1. Remove the mounting brackets from the top of the inlet elbow and reattach them on the bottom of the inlet elbow for anchoring to the floor.



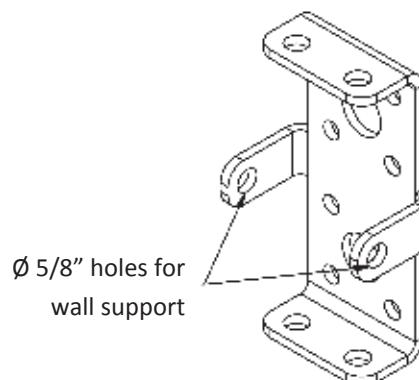
2. Determine the distance needed between the building wall and the heater.
3. Place inlet elbow where desired and mark anchor locations using holes in the attached mounting brackets.
4. Install wedge anchors, minimum 0.5"x6" (not provided), as recommended by manufacturer into concrete floor where marked.
5. Set inlet elbow over anchors.
6. Make sure inlet elbow is level using shims (by others) if necessary.
7. Once level, secure elbow to anchors with washer and lock nut (not provided).
8. Attach heater (or filter section if applicable) to inlet elbow using the provided mounting brackets.



9. Continue attaching discharge accessories to heater as needed using the provided mounting brackets.

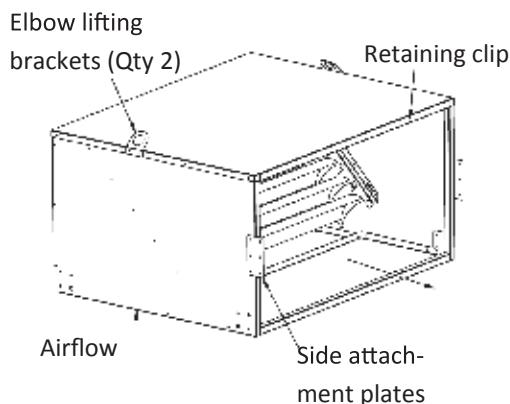


10. It is recommended to run support back to the wall to prevent swaying or tipping of heater and accessories.
 - Use the provided holes in the mounting brackets to run threaded rod (by others) to support on walls (by others).
11. For indoor installations, attach thru-wall rain hood and inlet skirt if applicable.



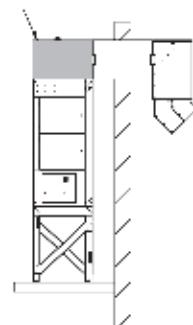
INSTALLATION INSTRUCTIONS

VERTICAL S-SERIES NON-ADJUSTABLE ELBOW

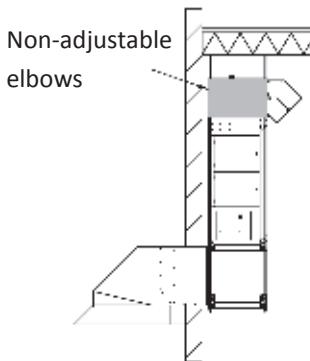


Vertical Outdoor

Non-adjustable elbows

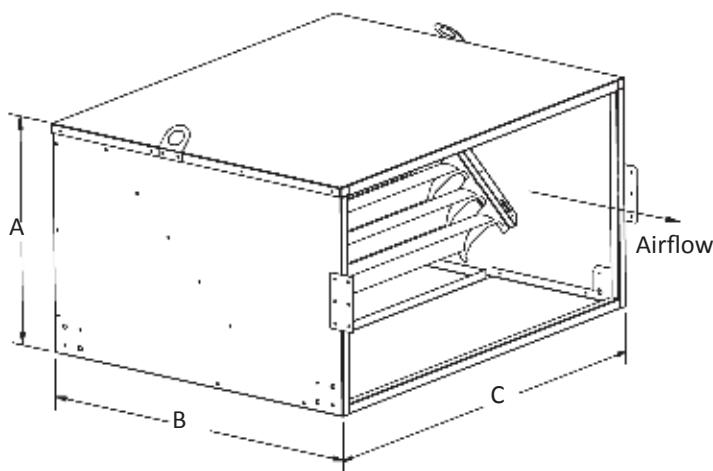


Vertical Indoor



The non-adjustable elbow is suitable for discharge ductwork to turn air 90° for either indoor or outdoor S-Series installations. It attaches to the discharge end of a vertical heater or vertical duct extensions with 4 accessory mounting brackets (shipped with the heater or vertical duct extension) that can either be suspended via threaded hanging rod or secured horizontal to the wall in stand mounted applications. The discharge end of the elbow attaches easily to wall sleeves or downturns with lugs. directional elbows (page 50) with a discharge collar can also be attached directly to the non-adjustable elbow if desired. Non-adjustable elbows are insulated to help mitigate noise and thermal losses.

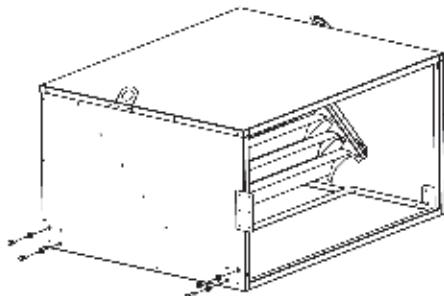
Model	Weight	A	B	C
S400/S800	45 lbs.	13"	25 3/8"	25 3/8"
S950/S1200/S1600	75 lbs.	15"	28"	42"
S1850/S2200/S3200	130 lbs.	24 5/8"	37 1/2"	47"



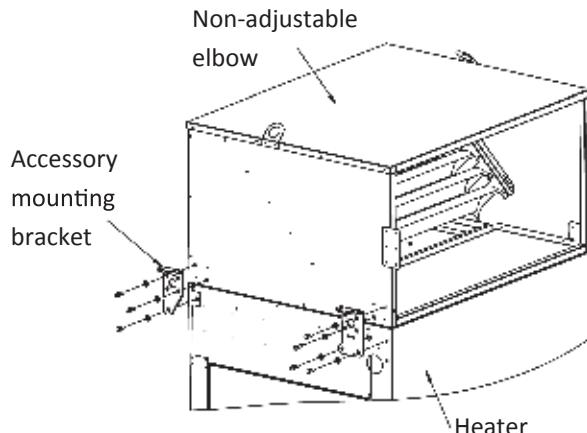
INSTALLATION INSTRUCTIONS

VERTICAL S-SERIES NON-ADJUSTABLE ELBOW

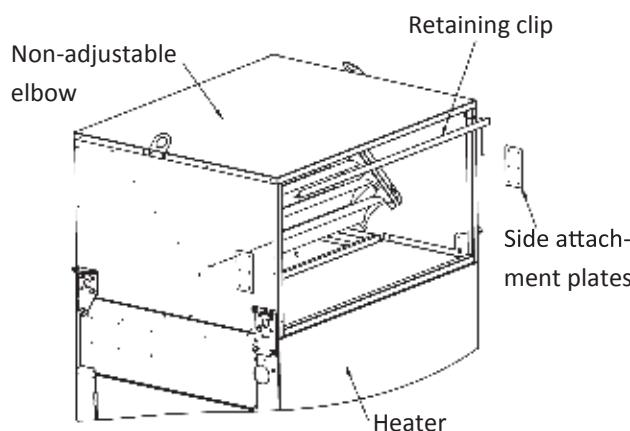
1. Prepare the non-adjustable elbow for assembly by removing the bolts and washers from the sides. For ceiling mounted applications please refer to the installation instructions for the structural inlet elbows.



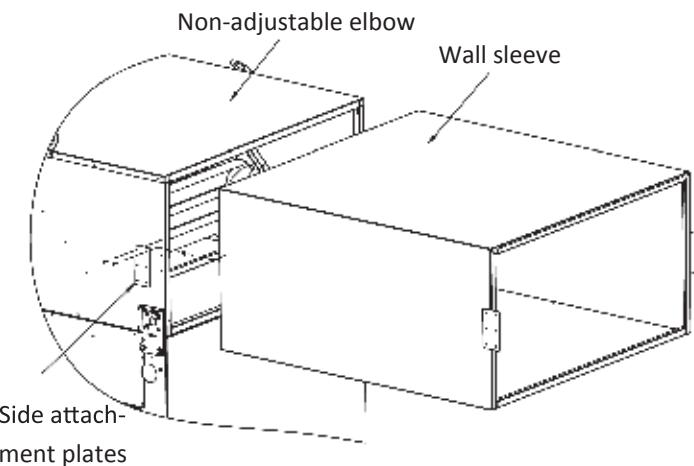
2. Prepare the upstream accessory or heater by removing the accessory mounting brackets.
3. Lift the non-adjustable elbow into place and secure it using the bolts and washers removed in the previous step.



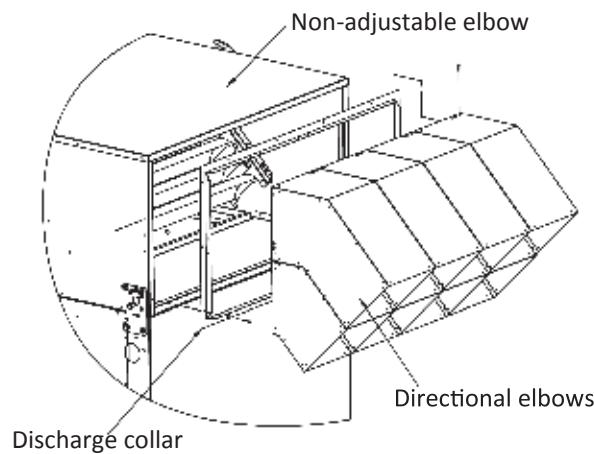
4. If not already done, remove the side attachment plates from the discharge end of the non-adjustable elbow. If attaching a discharge collar with directional elbows (page 50), also remove the retaining clip.



- 5a. If attaching a wall sleeve or a downturn with lugs, secure it using both the retaining clip and side attachment plates. Follow additional installation steps detailed in the appropriate accessory installation instructions.



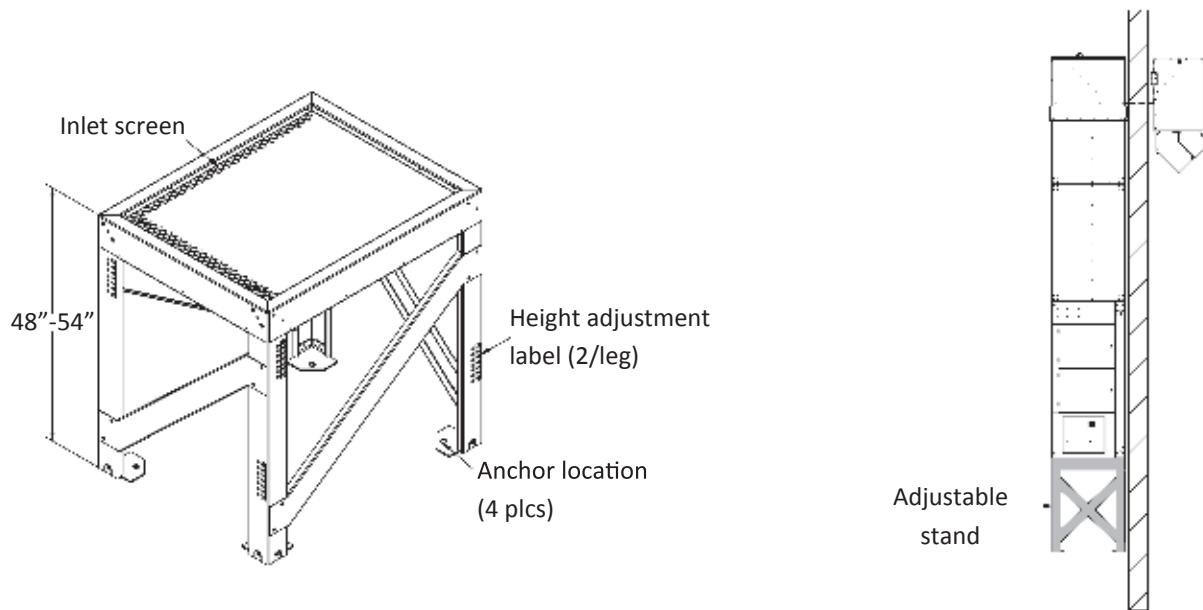
- 5b. If attaching a discharge collar and directional elbows (page 50) replace the screws removed in step 4. Attach the discharge collar to the discharge face of the non-adjustable elbow and secure using self-tapping screws. Arrange the directional elbows in the desired configuration before securing them to the discharge collar.



6. Seal all seams between heater and accessories using appropriate contractor grade caulk to mitigate potential water ingestion and pressure loss.

INSTALLATION INSTRUCTIONS

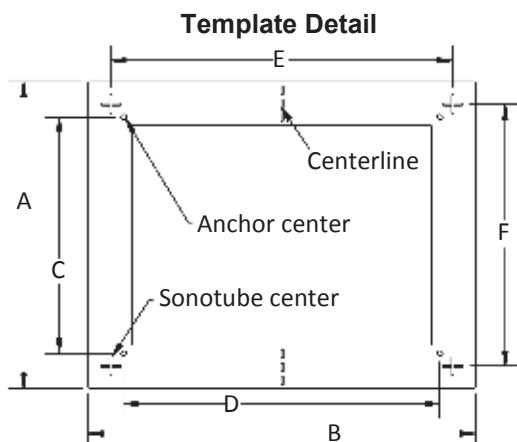
VERTICAL S-SERIES ADJUSTABLE STAND



The Vertical S-Series Adjustable Stand is suitable for use in the up blast configuration in both indoor and outdoor locations. The 48" height is low enough so the control can still be accessible without lifts or ladders, but high enough to avoid snow ingestion from the ground during winter months. The stand features 6" of adjustment (up to 54") and is suitable for applications when you prefer the heater to be easily accessible for service, yet floor space or slab size may come at a premium.

1. Determine distance needed between building wall and heater (12" recommended).

- Outer edge of template matches footprint of vertical unit and stand w/ centerline of heater indicated.



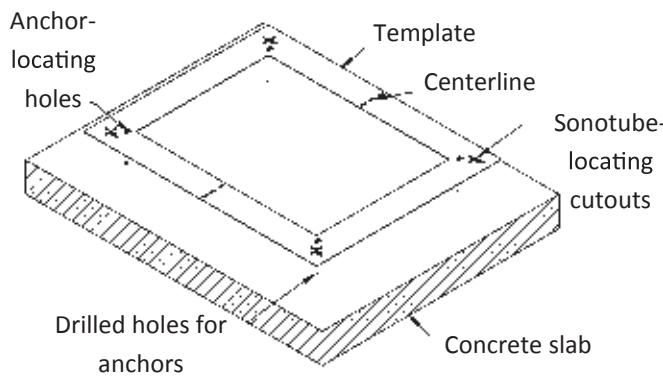
Parts List		
Item	Description	Qty.
1	Adjustable stand (assembled)	1
2	Template	1
3	Leveling shims	20

Stand Size	Weight	Heater/Stand Footprint		Anchor Locations (o)		Sonotube Locations (+)	
		A	B	C	D	E	F
S400/ S800	176 lbs.	25 1/2"	25 1/2"	16 3/4"	16 3/4"	19 7/8"	19 7/8"
S950/ S1200/ S1600	196 lbs.	28"	42"	19 1/2"	33 1/2"	36 1/2"	22 1/2"
S1850/ S2200/ S3200	222 lbs.	37 1/2"	47"	28 7/8"	38 1/2"	41 5/8"	32"

INSTALLATION INSTRUCTIONS

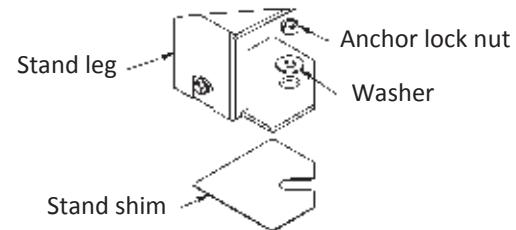
VERTICAL S-SERIES ADJUSTABLE STAND

- Use provided template to mark anchor locations on existing concrete slab. Consult structural engineer as to adequacy of existing slab for structural support.
 - If no slab available, installation of sonotubes with housekeeping pad is recommended. Use template to mark center locations of sono-tubes (indicated with "+" cutout).
 - Install sonotubes as recommended by structural engineer and use template to mark anchor locations (indicated with "o" hole) on sonotubes.

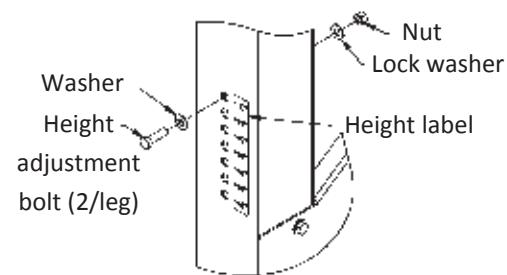


- Once concrete/sonotubes are marked, remove and discard template.
- Drill holes for anchors.
- Set stand over anchor locations.
- Install outdoor rated wedge anchors, minimum 0.5" x 6" (not provided), as recommended by manufacturer into concrete slab/sonotubes where marked.

- Make sure stand is both level and square.
 - If shimming necessary, insert provided shims where needed to level the stand.
 - Once level and square, secure base to anchors with washer and lock nut (not provided).
 - Shims are NOT intended to be used for adjusting the overall stand height. See next step.



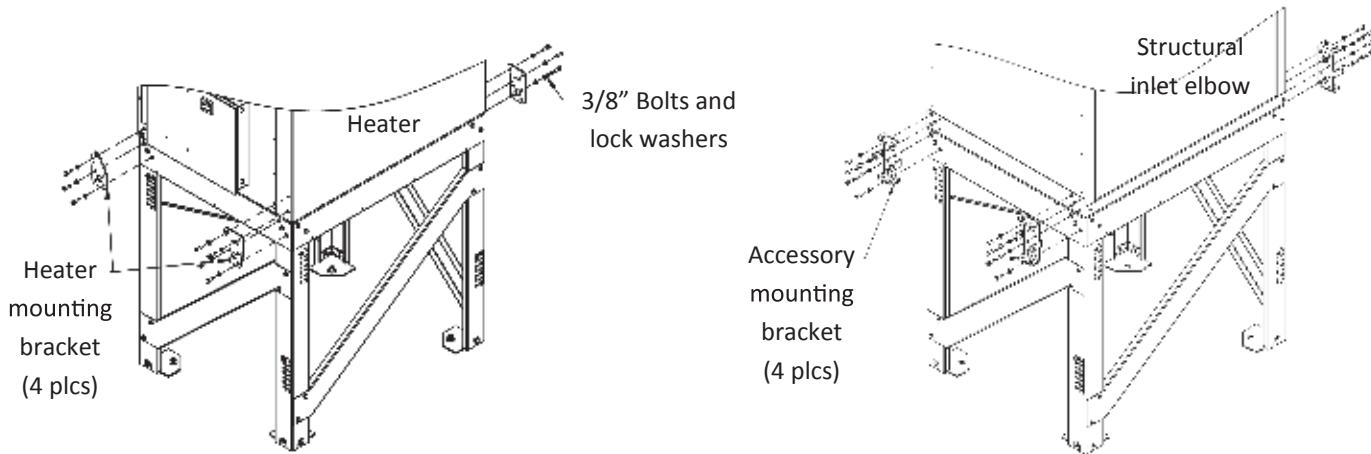
- Determine if default stand height (48") is correct for heater installation.
 - If adjustment needed, remove height adjustment bolts (2/leg), and raise stand necessary amount using the height label as a guide.
 - Reattach height adjustment bolts.



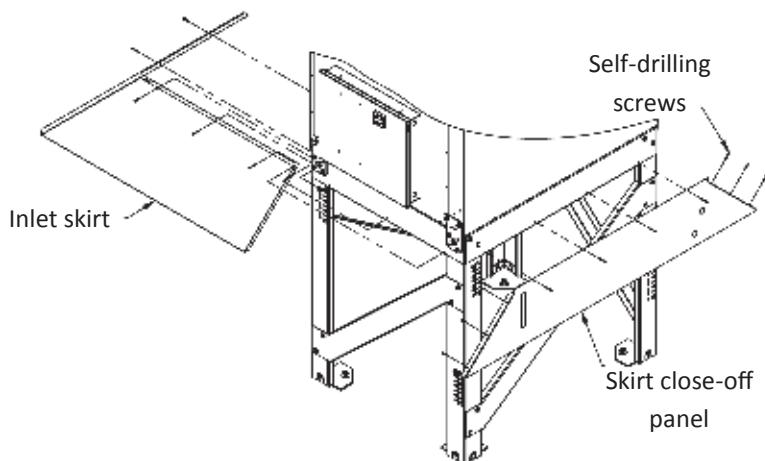
INSTALLATION INSTRUCTIONS VERTICAL S-SERIES ADJUSTABLE STAND

9. Set heater (or structural filter section, or structural inlet elbow if applicable) on stand and attach appropriate mounting brackets, securing to the stand using the provided bolts and lock washers.

- If structural filter section or structural inlet elbow included, attach heater to top of inlet accessory using included mounting brackets and hardware.

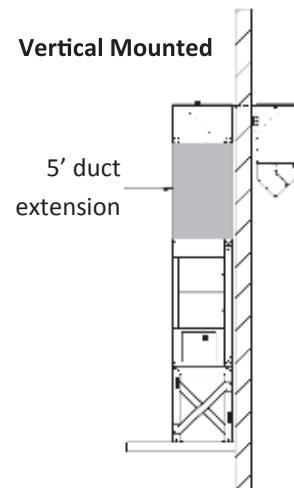
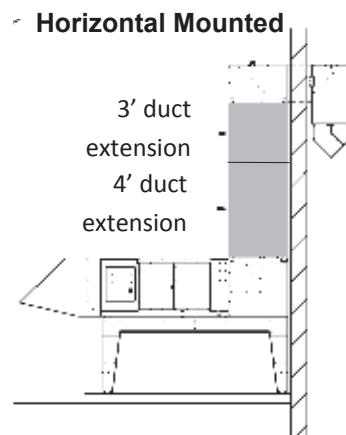
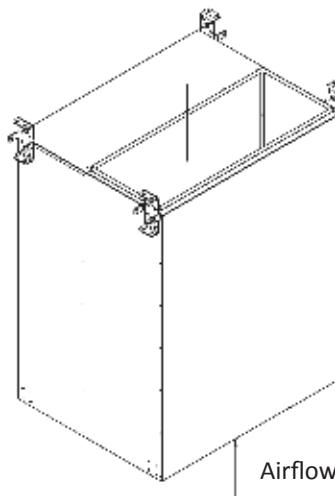


10. If provided, assemble angled inlet skirt pieces and attach to stand using self-drilling screws (not provided). Attach close-off panel to stand and skirt on side nearest wall using self-drilling screws (not provided).

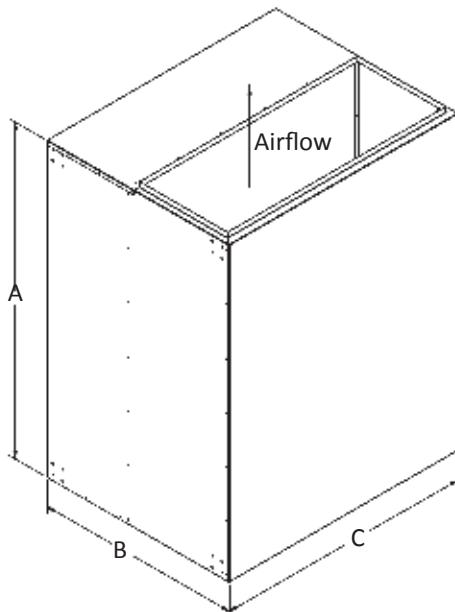


INSTALLATION INSTRUCTIONS

VERTICAL S-SERIES 3', 4', & 5' DUCT EXTENSIONS



The vertical S-Series duct extensions (3', 4', & 5') are suitable for horizontal pad mount and vertical up blast configurations in both indoor and outdoor locations. The different duct sizes allow for combinations to achieve different desired discharge heights. All ducts come with four mounting brackets which can be used for rigging, securing the duct to other accessories, and securing the duct work to the building structure. All ducts are insulated with 1" fiberglass insulation to mitigate thermal losses and reduce vibrations and noise.

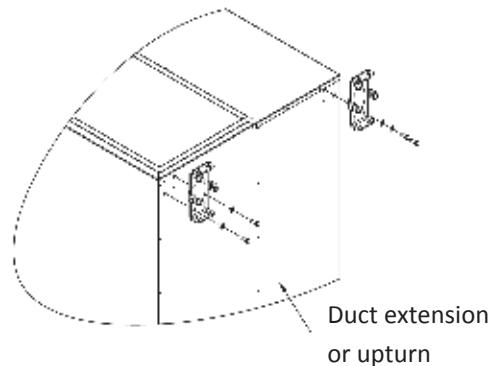


Heater Size	Duct	Weight	A	B	C
S400/S800	3'	95 lbs.	36"	25 3/8"	25 1/4"
	4'	135 lbs.	48"	25 3/8"	25 1/4"
	5'	160 lbs.	60"	25 3/8"	25 1/4"
S950/S1200/S1600	3'	120 lbs.	36"	28 1/8"	42"
	4'	165 lbs.	48"	28 1/8"	42"
	5'	200 lbs.	60"	28 1/8"	42"
S1850/S2200/S3200	3'	140 lbs.	36"	37 1/2"	47 1/8"
	4'	200 lbs.	48"	37 1/2"	47 1/8"
	5'	240 lbs.	60"	37 1/2"	47 1/8"

INSTALLATION INSTRUCTIONS

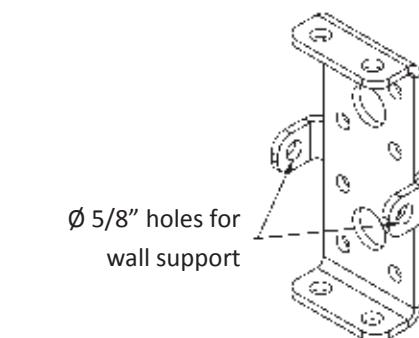
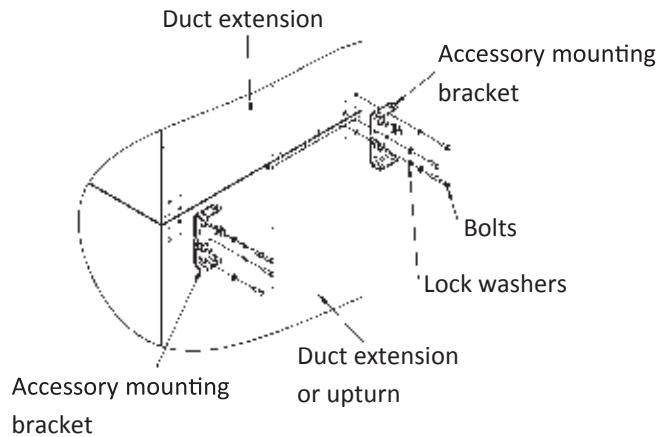
VERTICAL S-SERIES 3', 4', & 5' DUCT EXTENSIONS

1. Remove the mounting brackets from the top of the already installed upturn or duct extension. If mounting on top of the unit, remove any remaining lifting brackets.



2. Place the duct extension on top of the existing installation and use the provided brackets to secure them together.

Duct Extension/Upturn Attachment

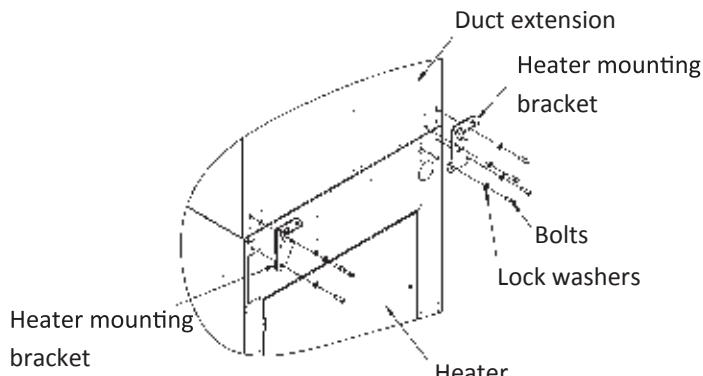


3. Continue attaching discharge accessories to the configuration as needed using the provided mounting brackets.

4. It is recommended to run support back to the wall to prevent swaying or tipping of heater and accessories.

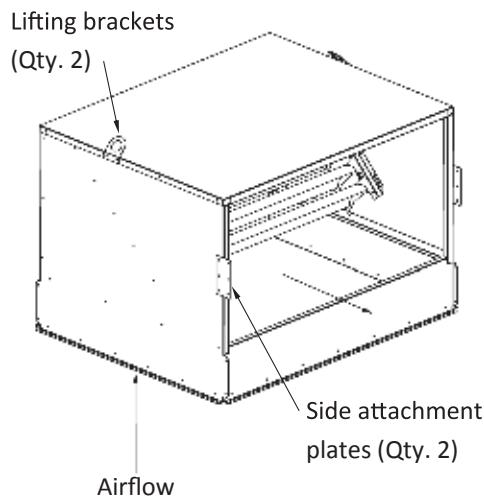
- Use the provided holes in the mounting brackets to run threaded rod (by others) to support on walls (by others).

Heater Attachment

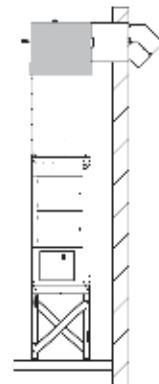


INSTALLATION INSTRUCTIONS

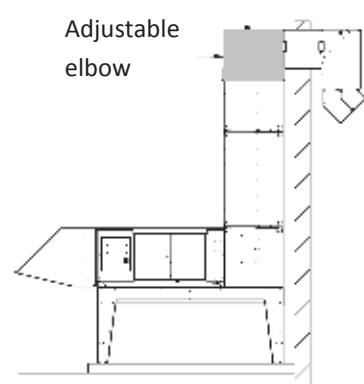
VERTICAL S-SERIES ADJUSTABLE ELBOW



Vertical Outdoor

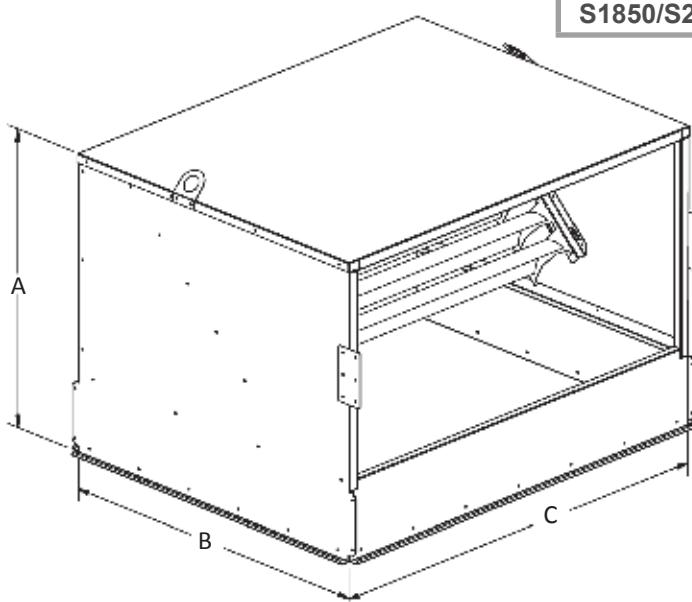


Horizontal Outdoor



The adjustable elbow is suitable for discharge ductwork to turn air 90° for either indoor or outdoor vertical S-series installations. It attaches to the discharge end of vertical duct extensions with a slip fit that allows its height to be adjusted from 0-6". The discharge end of the elbow can attach easily to wall sleeves where the height adjustability allows for an easier alignment of the wall sleeve with the wall hole. Downturns with lugs or directional elbows (page 50) with a discharge collar can also be attached directly to the adjustable elbow if needed in indoor applications. This accessory cannot directly attach to an unit due to its interference with the heater's gas train. Adjustable elbows are insulated to help mitigate noise and thermal losses.

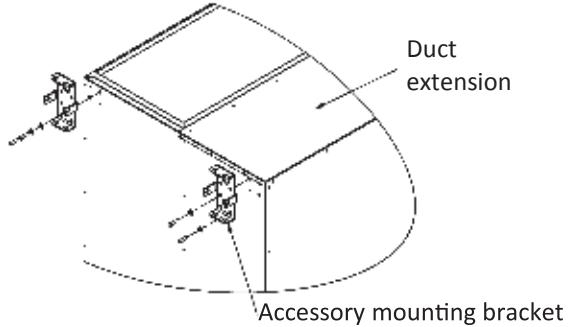
Model	Weight	A	B	C
S400/S800	55 lbs.	20 1/2"	25 1/2"	25 1/2"
S950/S1200/S1600	85 lbs.	22 5/8"	28 1/4"	42 1/4"
S1850/S2200/S3200	140 lbs.	32 1/4"	37 5/8"	47 1/4"



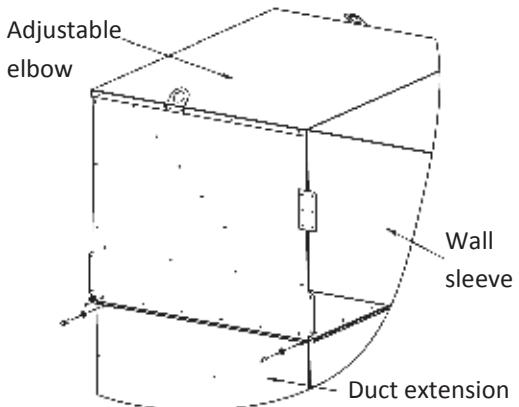
INSTALLATION INSTRUCTIONS

VERTICAL S-SERIES ADJUSTABLE ELBOW

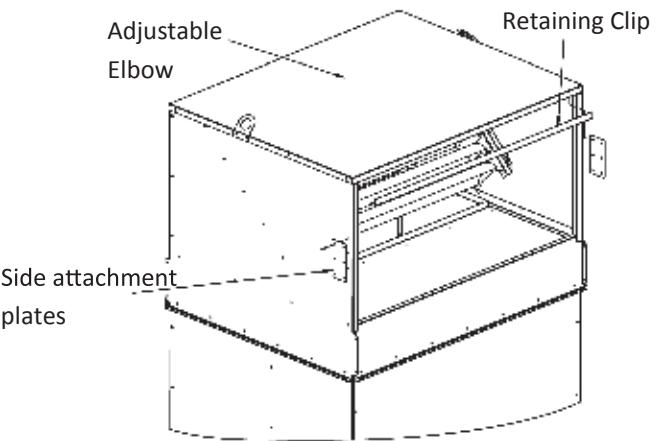
1. Prepare the upstream accessory (the vertical duct extension) by removing the accessory mounting bracket.



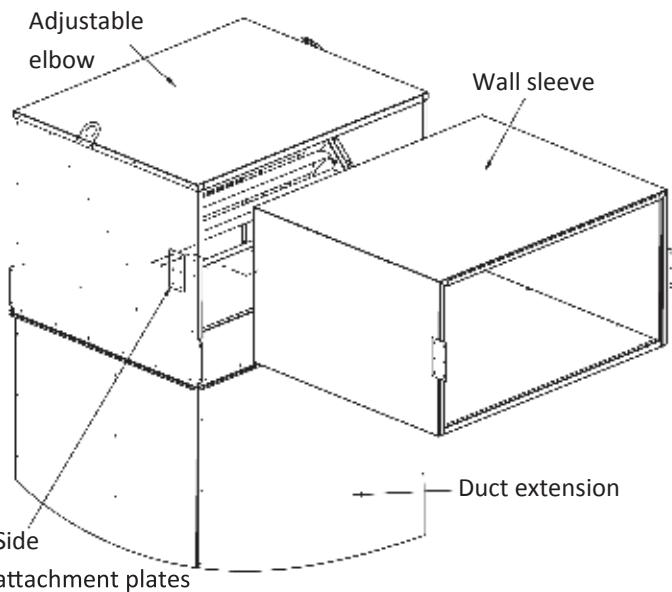
2. Lift the adjustable elbow into place on top of the duct extension. Adjust the height of the elbow to the desired height and secure the elbow to the vertical duct extension using the provided self tapping screws. If the elbow is raised to a height which allows the bolt holes used in step 1 to become exposed, replace and tighten the removed bolts and washers to help mitigate potential water ingestion and pressure loss.



3. If not already done, remove the side attachment plates from the discharge end of the adjustable elbow. If attaching a discharge collar with directional elbows (page 50), also remove the retaining clip.



- 4a. If attaching a wall sleeve or a downturn with lugs, secure it using both the retaining clip and side attachment plates. Follow additional installation steps detailed in the appropriate accessory installation instructions.



- 4b. If attaching a discharge collar and directional elbows (page 50) replace the removed screws that were securing the side attachment plates. Attach the discharge collar to the discharge face of the adjustable elbow and secure using self-tapping screws. Arrange the directional elbows in the desired configuration before securing them to the discharge collar.

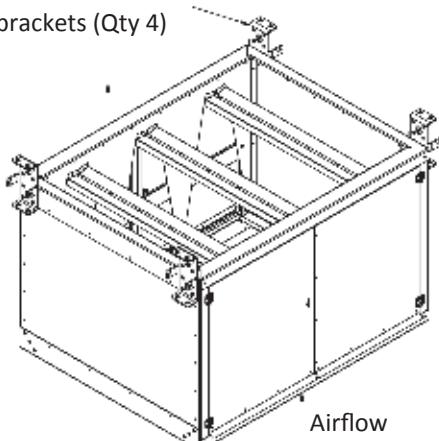
5. Seal all seams between accessories using appropriate contractor grade caulk to mitigate potential water ingestion and pressure loss.

INSTALLATION INSTRUCTIONS

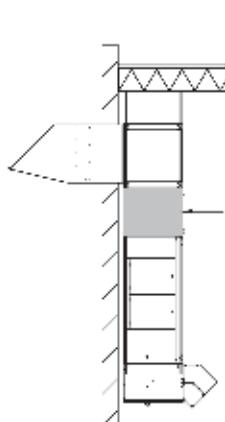
VERTICAL S-SERIES STRUCTURAL FILTER SECTION

Accessory mounting

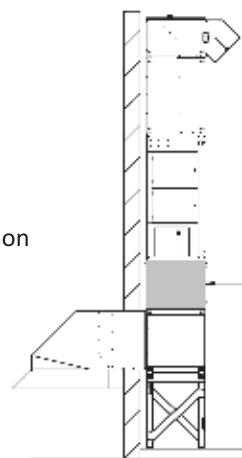
brackets (Qty 4)



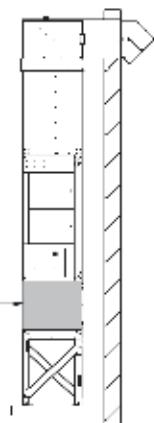
Indoor Down Blast



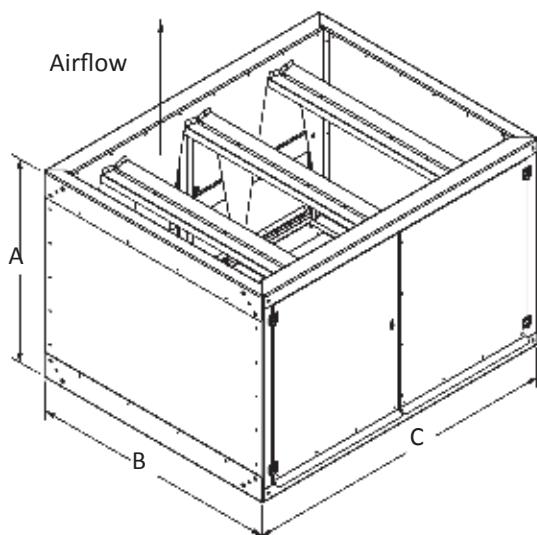
Indoor Up Blast



Outdoor Up Blast



The Structural Filter Section is designed to be used with any S-Series vertical installation (indoor/outdoor, up/down blast). It is designed to be load bearing and can support the weight of the unit with all necessary additional ductwork. It is designed with a set of doors on both sides to ensure that it can never be installed backwards. It can either be hung from the ceiling or mounted on top of the 4' adjustable mounting stand or structural inlet elbow with 4 accessory mounting brackets. It is capable of using permanent, disposable, or MERV-13 filters. All Structural Filter Sections are insulated and double skinned to help mitigate con-densation, noise, and thermal losses.



Model	Weight	A	B	C
S400/S800	150 lbs.	30 3/8"	25 3/8"	25 3/8"
S950/S1200/S1600	175 lbs.	25 3/8"	28"	42"
S1850/S2200/S3200	235 lbs.	30 3/8"	37 1/8"	47"

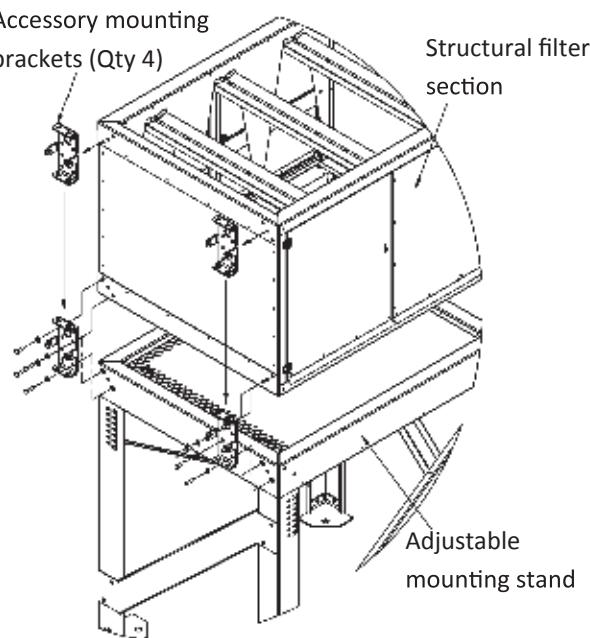
Model	Filters	
	Quantity	Dimensions
S400/S800	2	20" x 25" x 2"
S950/S1200/S1600	4	20" x 25" x 2"
S1850/S2200/S3200	12	16" x 25" x 2"

INSTALLATION INSTRUCTIONS

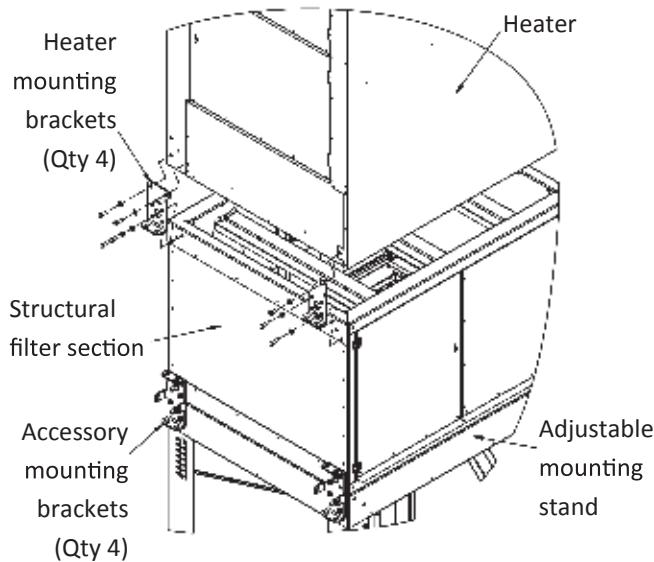
VERTICAL S-SERIES STRUCTURAL FILTER SECTION

MOUNTING STAND OR STRUCTURAL INLET ELBOW MOUNTING APPLICATIONS

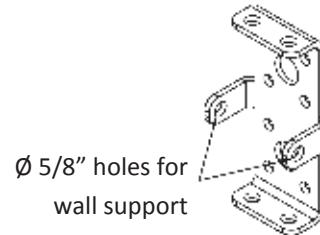
1. Lift the structural filter section into place on top of the adjustable mounting stand or structural inlet elbow and remove the 4 accessory mounting brackets from the discharge end of the structural filter section. Fasten them together securely using the 4 accessory mounting brackets.



2. Lift the heater into place and secure by using 4 of the heater mounting brackets.



3. Attach all additional accessories following appropriate installation instructions.
4. It is recommended to run support back to the wall to prevent swaying or tipping of heater and accessories.
 - Use the provided holes in the mounting brackets to run threaded rod (by others) to support on walls (by others).



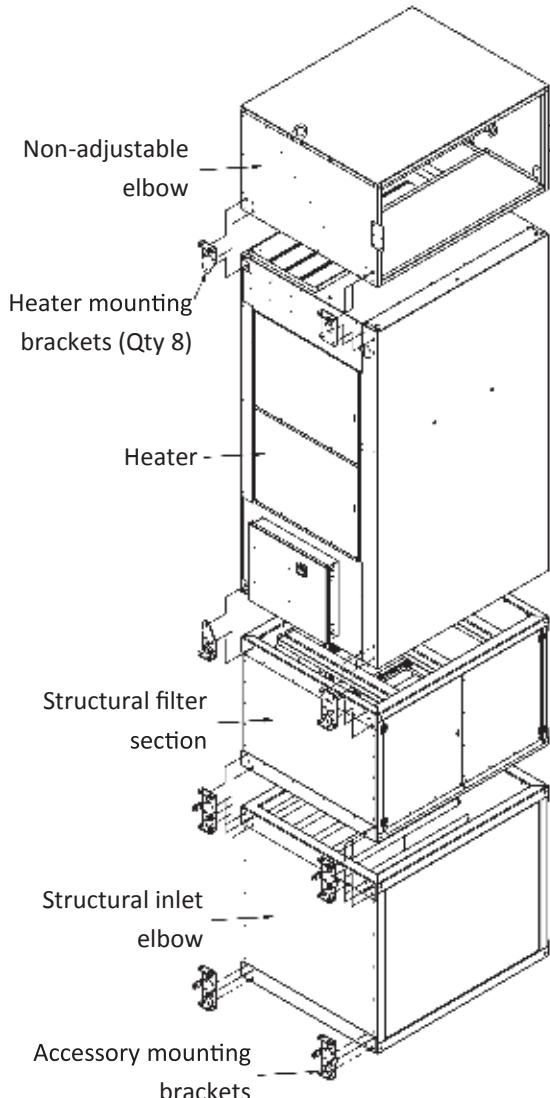
5. Seal all seams between accessories using appropriate contractor grade caulk to mitigate potential water ingestion and pressure loss.

INSTALLATION INSTRUCTIONS

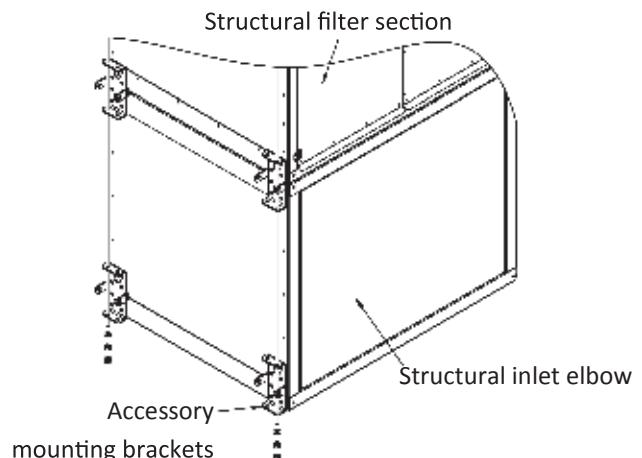
VERTICAL S-SERIES STRUCTURAL FILTER SECTION

CEILING-MOUNTED APPLICATIONS

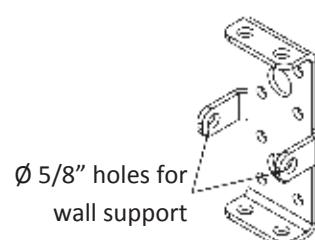
1. Remove the heater mounting brackets from the heater and all accessory mounting brackets from all necessary accessories (structural inlet elbow, structural filter section, vertical duct extensions, adjustable inlet elbow, and non-adjustable inlet elbow).
2. Use the removed mounting brackets to attach the heater and all previously mentioned accessories together. This should be done in a manner to ensure that only the structural filter section, structural inlet elbow, or heater bears the load as the vertical duct extensions, adjustable elbow, and non-adjustable elbow are all non-load bearing accessories. This likely means that the unit configuration should be assembled horizontally.



3. After having the configuration assembled, carefully lift entire assembled configuration into place and secure to the ceiling using threaded rod as directed by structural engineers.
4. Double nut the end of the rod below the lowest mounting bracket.



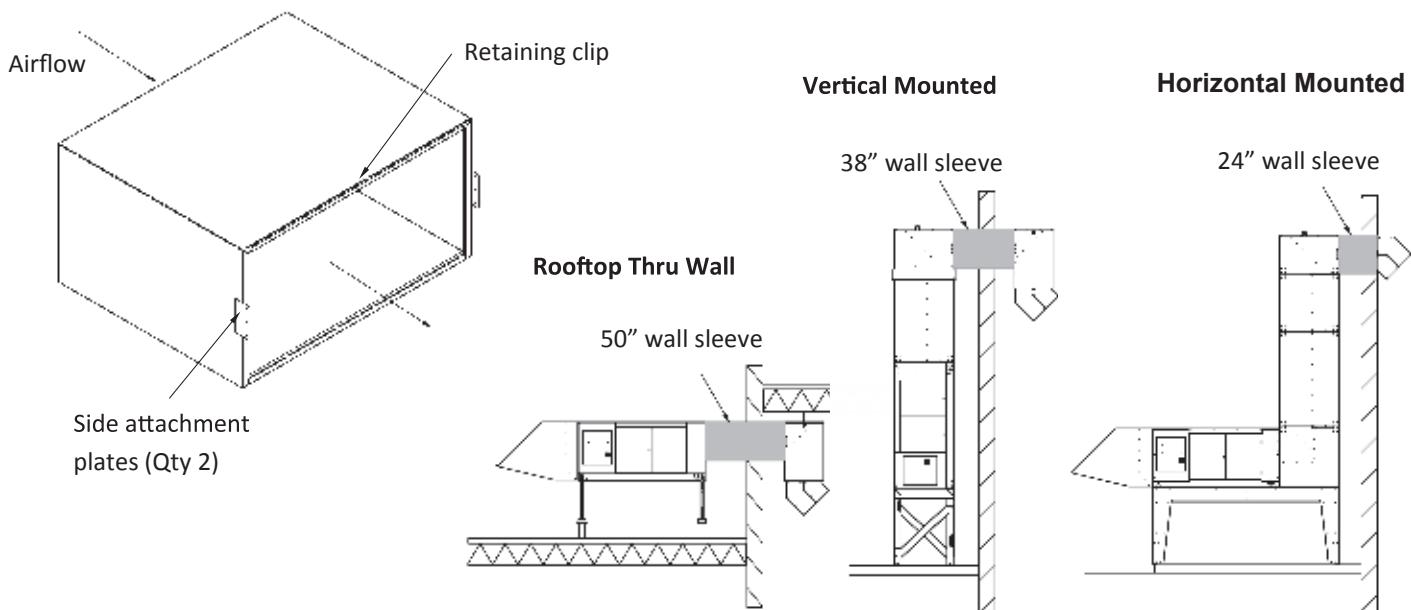
5. It is recommended to run support back to the wall to prevent swaying or tipping of heater and accessories.
 - Use the provided holes in the mounting brackets to run threaded rod (by others) to support on walls (by others).



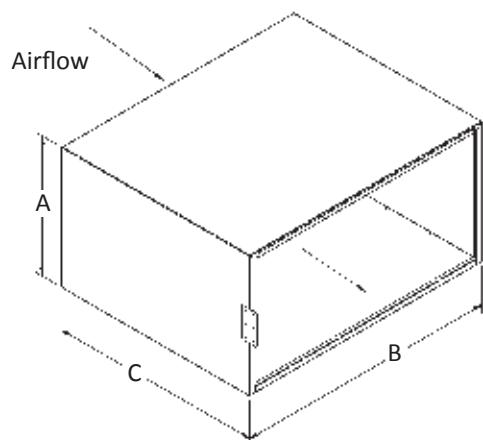
6. Attach thru-wall rain hood and all additional accessories.
7. Seal all seams between accessories using appropriate contractor grade caulk to mitigate potential water ingestion and pressure loss.

INSTALLATION INSTRUCTIONS

S-SERIES 24", 38", & 50" WALL SLEEVES



The S-Series wall sleeves (24", 38", and 50") are suitable for discharge duct work for either vertical or horizontal configurations. They are designed to be attached at its inlet side by a retaining clip and two side brackets. The discharge end is designed to hold either additional accessories by the same method (a retaining clip and two side brackets) or a set of directional elbows (page 50) and discharge collar. All wall sleeves are insulated to help mitigate noise and thermal losses.

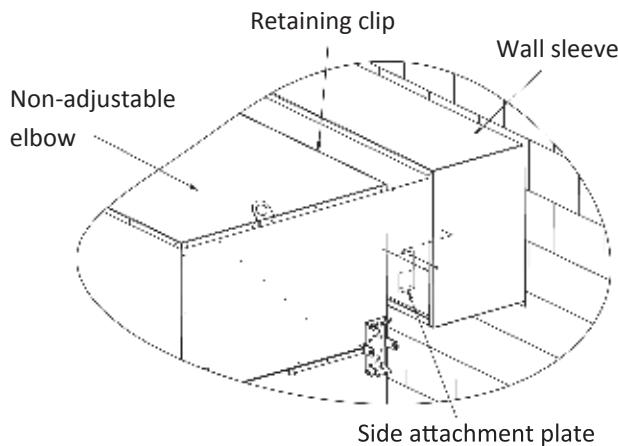


Heater Size	Sleeve	Weight	A	B	C
S400/S800	24"	35 lbs.	13"	25 3/8"	24"
	38"	50 lbs.	13"	25 3/8"	38"
	50"	65 lbs.	13"	25 3/8"	50"
S950/S1200/S1600	24"	50 lbs.	15"	42"	24"
	38"	75 lbs.	15"	42"	38"
	50"	95 lbs.	15"	42"	50"
S1850/S2200/S3200	24"	60 lbs.	24 1/8"	47"	24"
	38"	90 lbs.	24 1/8"	47"	38"
	50"	115 lbs.	24 1/8"	47"	50"

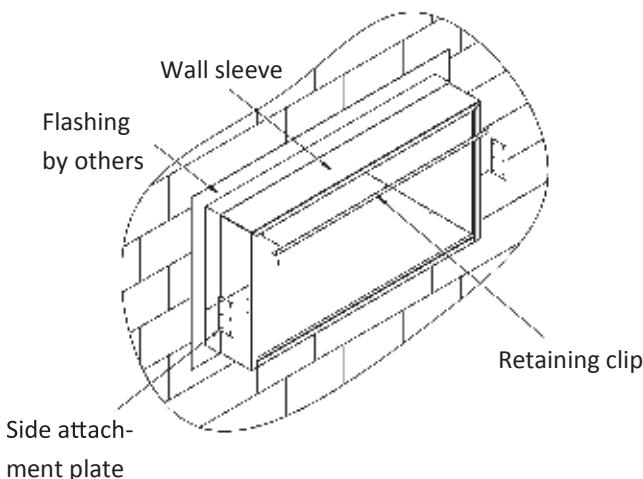
INSTALLATION INSTRUCTIONS

S-SERIES 24", 38", & 50" WALL SLEEVES

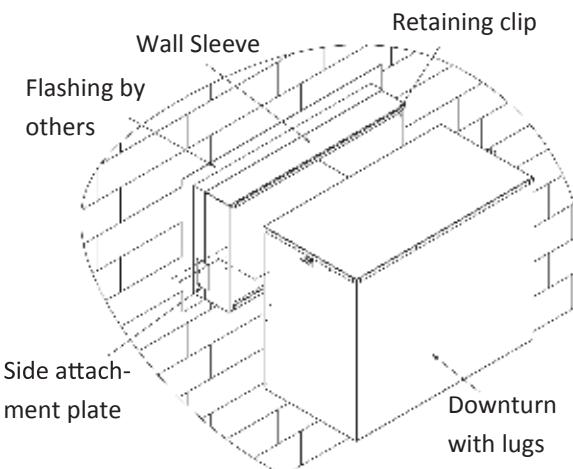
1. After preparing the wall by cutting the appropriately sized hole, prepare the upstream accessory (either the adjustable or non-adjustable discharge elbow) by removing the side attachment plates.
2. Slide the wall sleeve through the wall opening and attach the inlet side of the wall sleeve to the upstream accessory by use of it's retaining clip. Reattach the side attachment plates removed in step 1 and use self tapping screws to secure the wall sleeve.



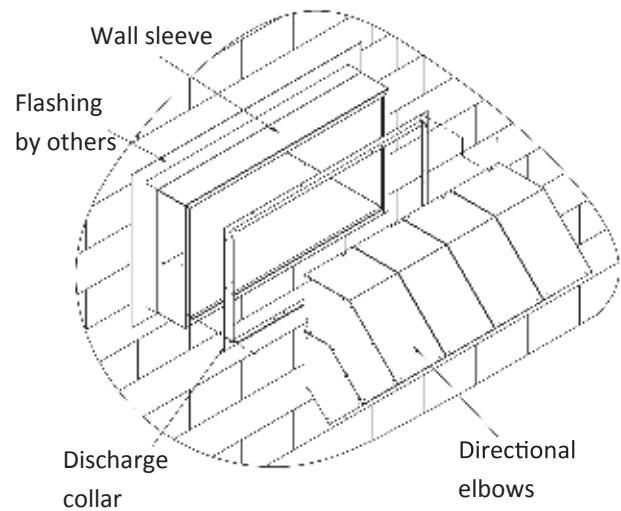
3. Use the appropriate framing techniques to frame, insulate, and flash the hole through which the wall sleeve is protruding.
4. If not already done, remove the side attachment plates from the discharge end of the wall sleeve. If attaching a discharge collar with directional elbows (page 50), also remove the retaining clip.



- 5a. If attaching a downturn with lugs, secure it using both the retaining clip and side attachment plates. Support the downturn by attaching threading rods to the lugs as noted in the installation sheet for the Downturn with Lugs.

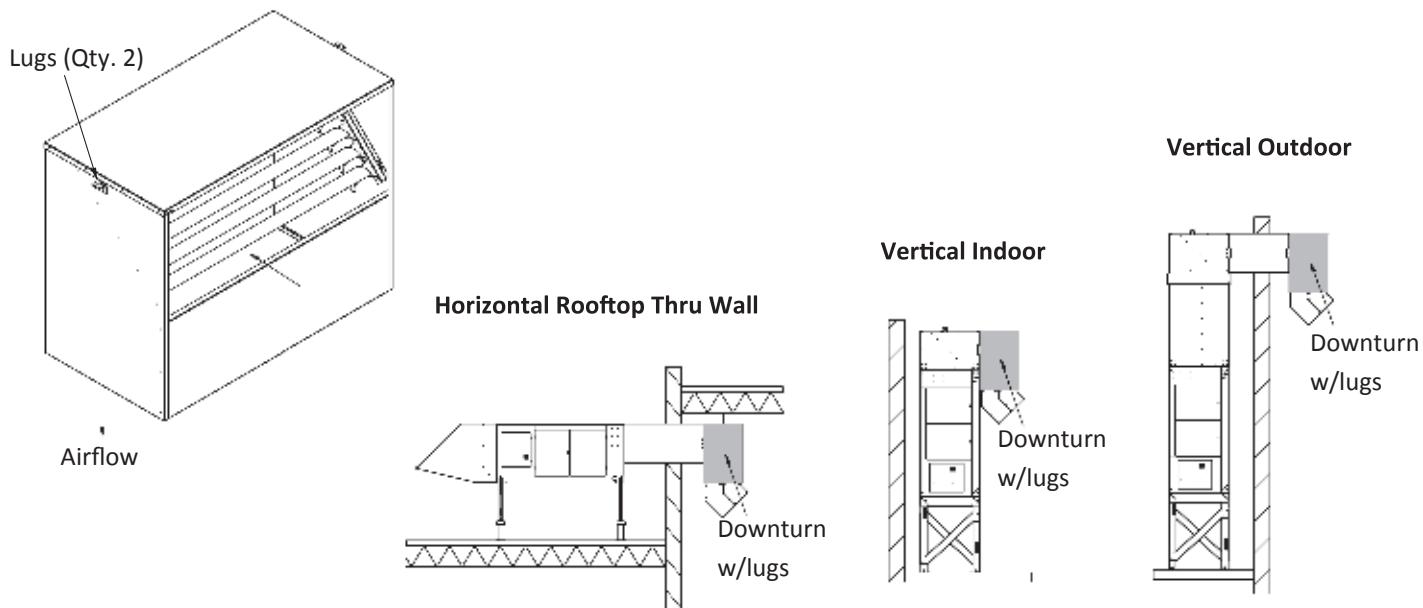


- 5b. If attaching a discharge collar and directional elbows (page 50) replace the removed screws that were securing the side attachment plates. Attach the discharge collar to the discharge face of the wall sleeve and secure using self tapping screws. Arrange the directional elbows in the desired configuration before securing them to the discharge collar.



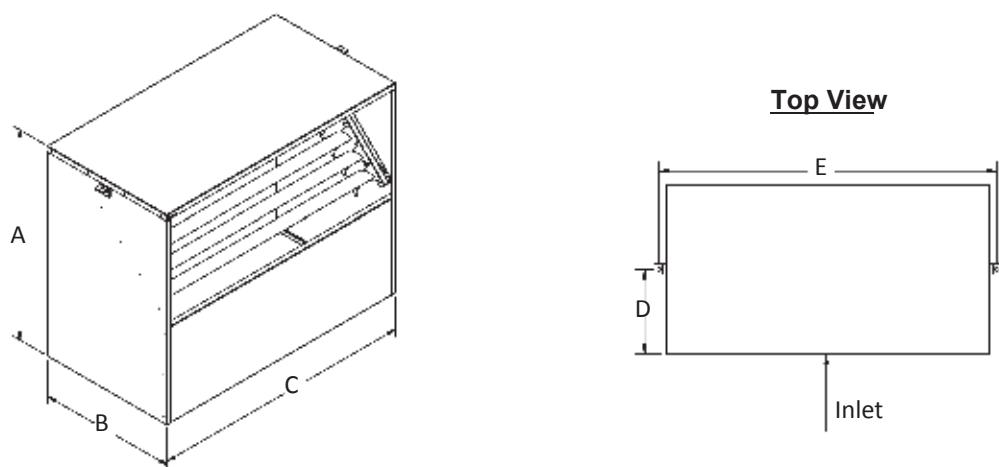
INSTALLATION INSTRUCTIONS

S-SERIES DOWNTURN WITH LUGS



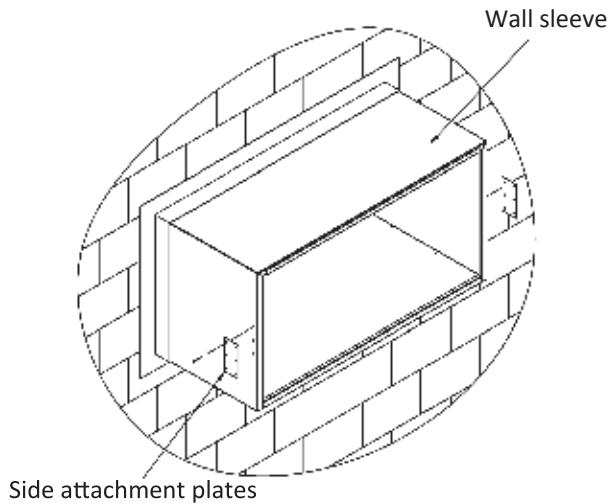
The S-Series downturn with lugs is suitable for discharge ductwork to turn air 90° for either vertical or horizontal S-Series in-stallations. It is designed to be attached at its inlet side to a retaining clip and two side brackets on the upstream accessory (either a wall sleeve or a discharge elbow). The discharge end is designed to hold a discharge collar with directional elbows (page 50). The lugs are designed to be secured to the ceiling via threaded hanging rod. Downturns with lugs are insulated to help mitigate noise and thermal losses.

Model	Weight	A	B	C	Mtg. Dimensions	
					D	E
S400/S800	35 lbs.	25 1/4"	13"	25 3/8"	6 1/8"	28"
S950/S1200/S1600	70 lbs.	28"	15"	42"	7 3/8"	44 5/8"
S1850/S2200/S3200	125 lbs.	28"	24 1/2"	47"	12 3/8"	49"

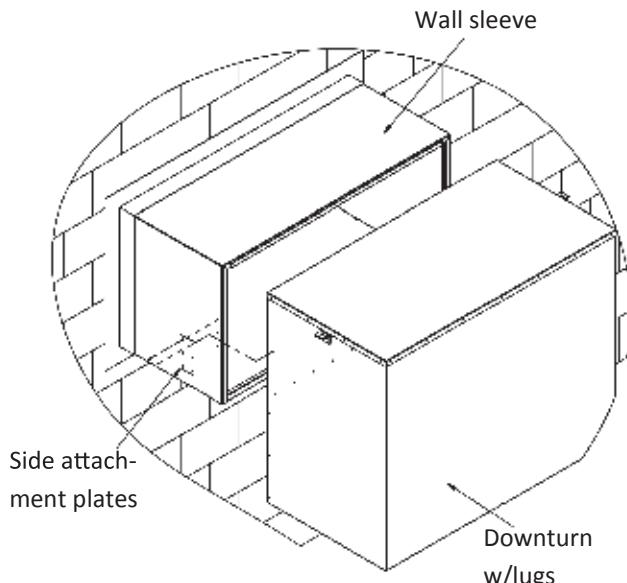


INSTALLATION INSTRUCTIONS S-SERIES DOWNTURN WITH LUGS

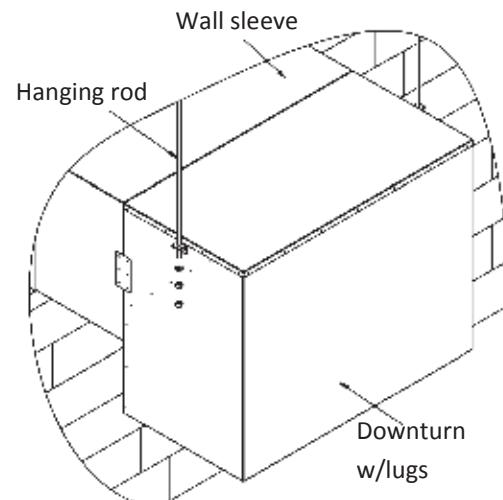
1. Prepare the upstream accessory (wall sleeve, adjustable elbow, or non adjustable elbow) by removing the side attachment plates.



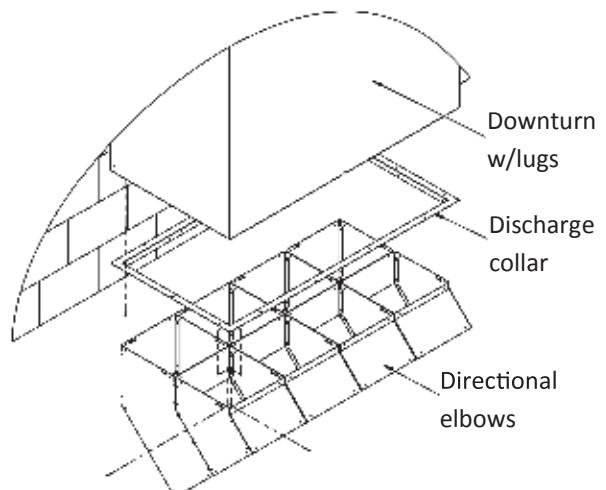
2. Lift the downturn with lugs into place and secure it using the using both the retaining clip and side attachment plates.



3. Secure threaded hanging rod to the ceiling as required by structural engineer.
4. Secure threaded hanging rod to downturn with lugs



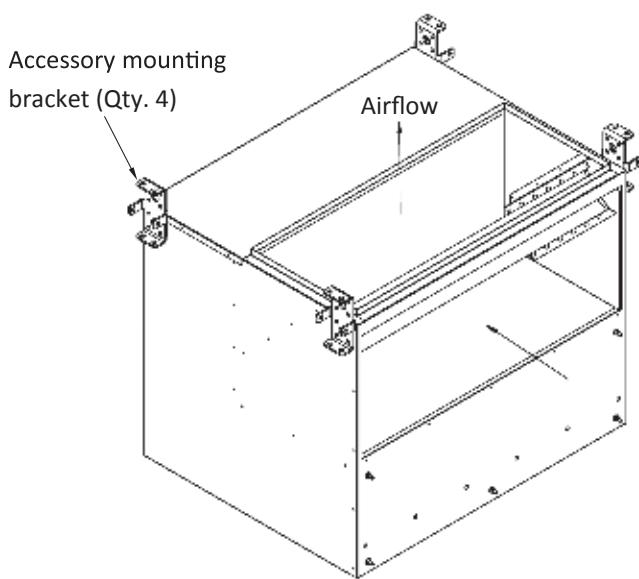
5. If attaching a discharge collar and directional elbows (page 50): Attach the discharge collar to the discharge face of the downturn with lugs and secure using self tapping screws. Arrange the directional elbows in the desired configuration before securing them to the discharge collar.



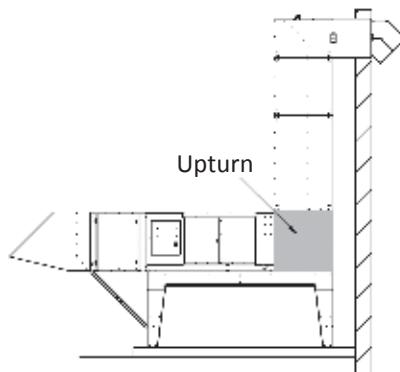
6. Seal all seams between accessories using appropriate contractor grade caulk to mitigate potential water ingestion and pressure loss.

INSTALLATION INSTRUCTIONS

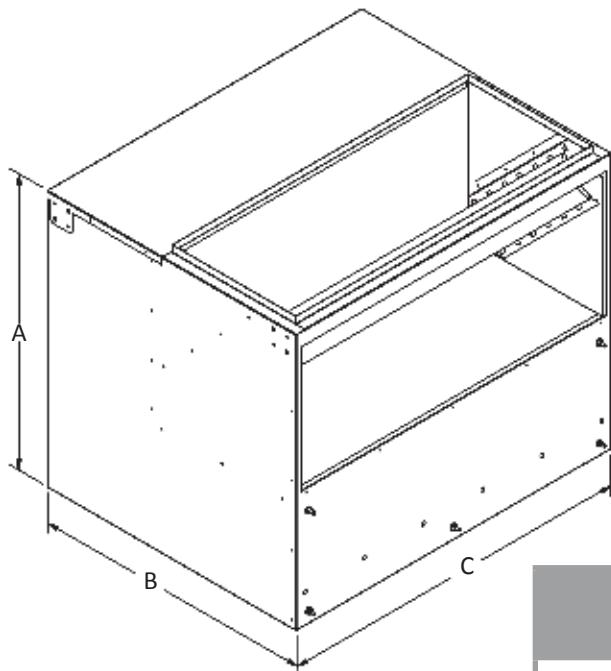
S-SERIES UPTURN



Horizontal Mount



The S-Series upturn is suitable for supporting vertical discharge ductwork after turning airing 90° upward from a horizontal mounted unit. It is designed to be secured to the unit with the unit's retaining bracket and the upturn's threaded PEM studs. The vertical duct extensions are designed to be attached to the upturn with 4 accessory mounting brackets. Upturns are insulated to help mitigate noise and thermal losses.

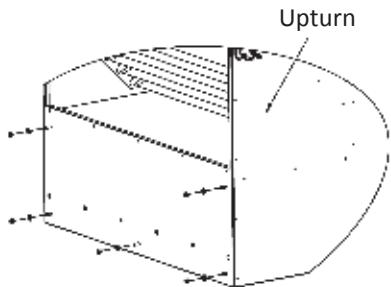


Model	Weight	A	B	C
S400/S800	75 lbs.	26 5/8"	25 3/8"	25 3/8"
S950/S1200/S1600	115 lbs.	29 1/4"	28"	42"
S1850/S2200/S3200	175 lbs.	38 1/2"	37 1/2"	47 1/4"

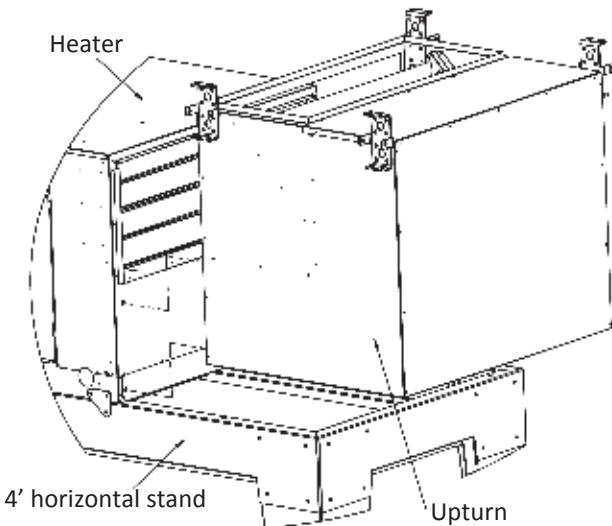
INSTALLATION INSTRUCTIONS

S-SERIES UPTURN

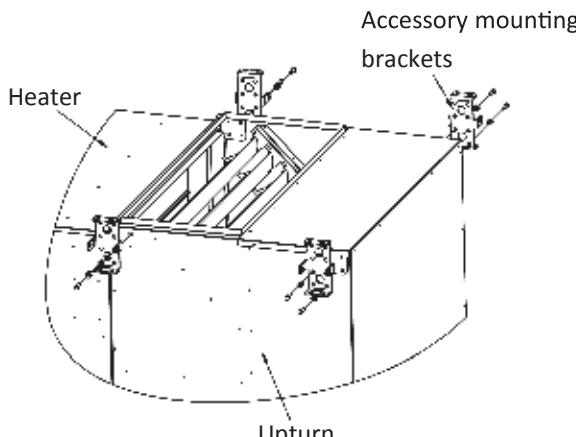
1. Prepare the upturn by removing the nuts and washers from the threaded PEM studs on the front face of the upturn.



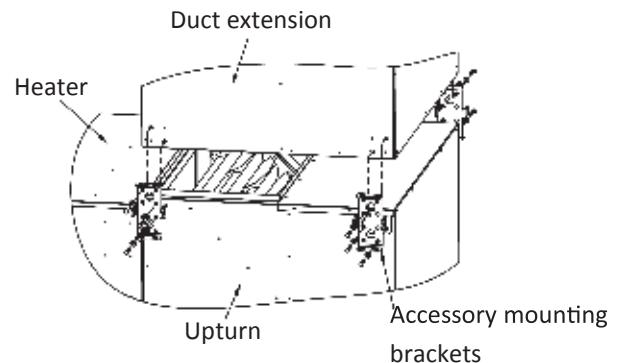
2. Lift the upturn into place on top of the 4' stand, being sure to catch the lip of the upturn on the unit's retaining clip. Replace the washers and nuts removed from step 1 onto the threaded PEM studs now inside of the unit and tighten securely.



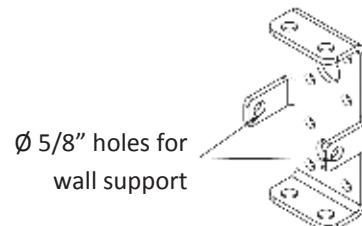
3. Remove the accessory mounting brackets on the upturn in preparation to attach the duct extension.



4. Lift the duct extension into place and secure it with the accessory mounting brackets removed in the previous step.



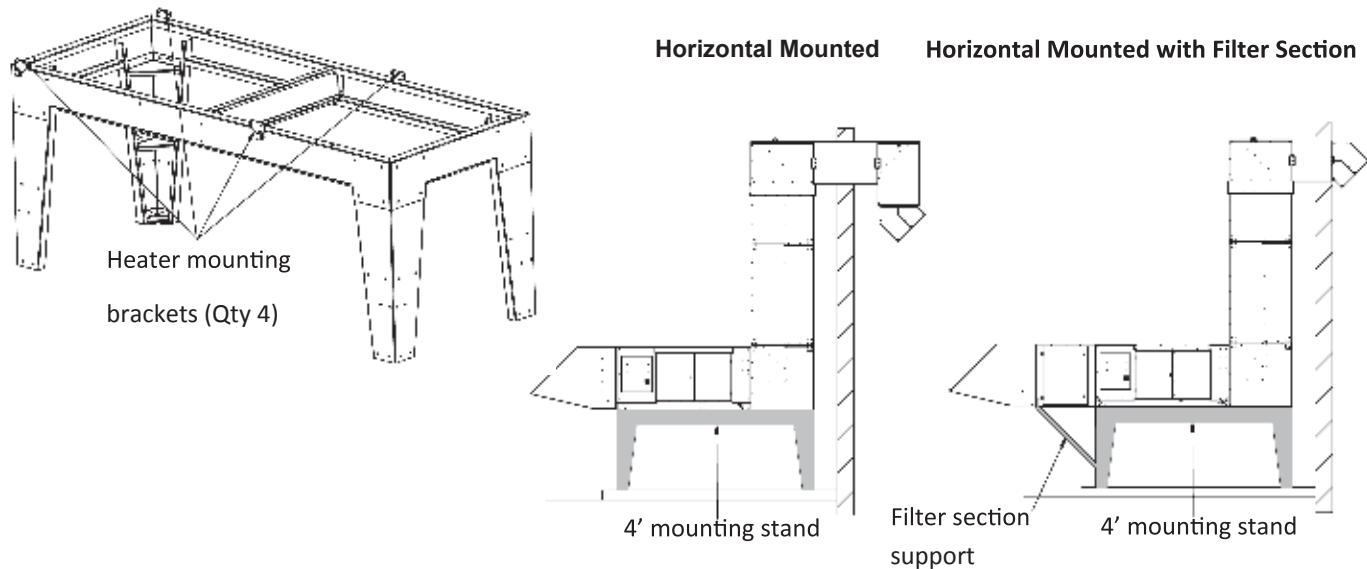
5. It is recommended to run support back to the wall to prevent swaying or tipping of heater and accessories. Use the provided mounting brackets to run threaded rod (by others) to support on walls (by others).



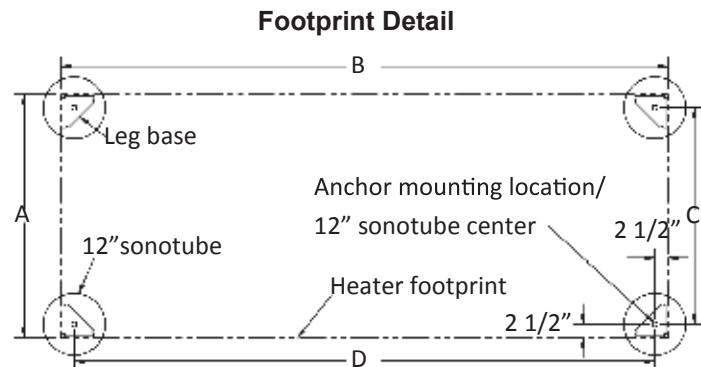
6. Seal all seams between accessories using appropriate contractor grade caulk to mitigate potential water ingestion and pressure loss.

INSTALLATION INSTRUCTIONS

HORIZONTAL S-SERIES 4' MOUNTING STAND



The horizontal S-Series mounting stand is suitable for outdoor pad mounted configurations. The 48" height is ideal for easy maintenance access while still remaining high enough to avoid potential snow ingestion from the ground during winter months. It is designed to be installed perpendicular to the building and includes room for both the unit and upturn to be situated on the frame. Additional support legs are provided if a filter section is ordered.



Parts List		
Item	Description	Qty.
1	4' mounting stand (assembled)	1
2	Leveling shims	20

Note:

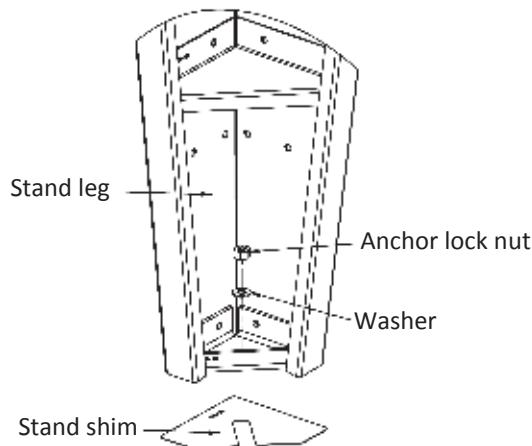
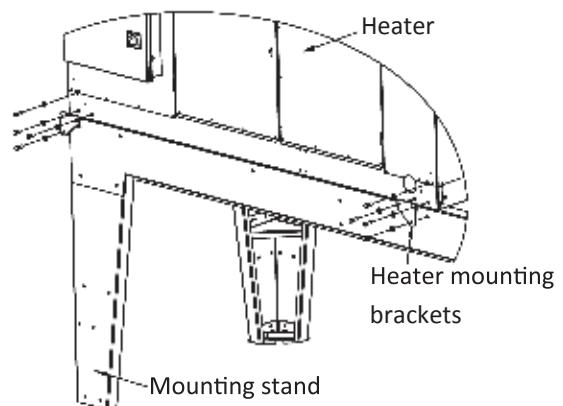
- The anchors' mounting locations are centered on the 12" sonotubes

Stand Size	Weight (lbs.) (w/F.S. supports)	Stand Footprint		Anchor/Sonotube Locations	
		A	B	C	D
S400/S800	330	25 3/8"	85 3/8"	20 1/4"	80 1/8"
S950/S1200/S1600	370	42"	100 1/8"	36 7/8"	95"
S1850/S2200/S3200	400	47"	117 1/2"	41 7/8"	112 3/8"

INSTALLATION INSTRUCTIONS

HORIZONTAL S-SERIES 4' MOUNTING STAND

1. Determine distance needed between building wall and mounting stand/vertical duct extensions (12" recommended).
2. Mark anchor locations on existing concrete slab. Consult structural engineer as to adequacy of existing slab for structural support.
 - If no slab available, installation of sonotubes with housekeeping pad is recommended. Use provided dimensions on previous page to mark center locations of sonotubes.
 - Install sonotubes as recommended by structural engineer. Anchors should be centered on 12" sonotubes.
3. Drill holes for anchors, clean out debris from holes and set stand over holes.
4. Install outdoor rated wedge anchors, minimum 0.5"x6" (not provided), as recommended by manufacturer into concrete slab/sonotubes where marked.
5. Make sure stand is both level and square.
 - If shimming necessary, insert provided shims where needed to level the stand.
 - Once level and square, secure base to anchors with washer and lock nut (not provided).
 - Shims are NOT intended to be used for adjusting the overall stand height.
6. Remove heater mounting brackets from stand.
7. Set heater on stand and secure using the heater mounting brackets removed in the previous step.

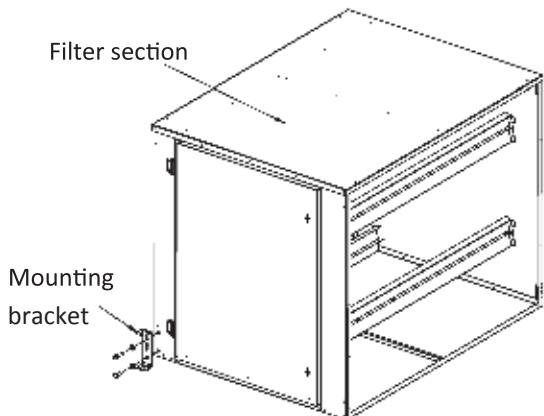


INSTALLATION INSTRUCTIONS

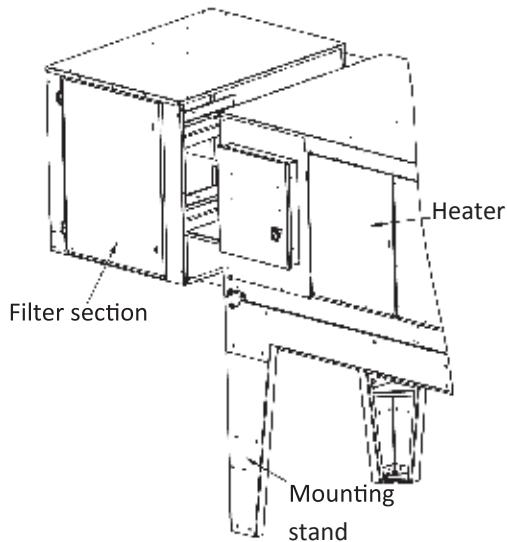
HORIZONTAL S-SERIES 4' MOUNTING STAND

Only complete the following steps if installing a filter section:

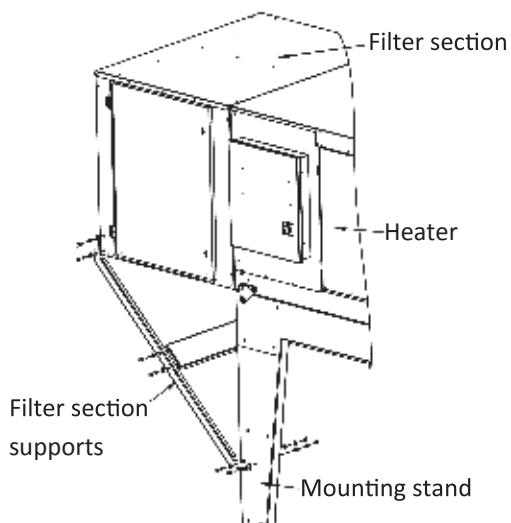
8. If attached, remove mounting bracket from filter section. Any filters inside of the unit will need to be removed before the next step to provide access to internal mounting flange.



9. Lift the filter section into place at the inlet end of heater. Secure by resting filter section onto unit's retaining bracket while using self tapping screws to fasten the internal flange of the filter section the unit's front face.



10. Using the 2 additional filter section support legs, brace, and provided fasteners to secure the filter section to the mounting stand legs at the inlet side.
11. Seal all seams between accessories using appropriate contractor grade caulk to mitigate potential water ingestion and pressure loss.

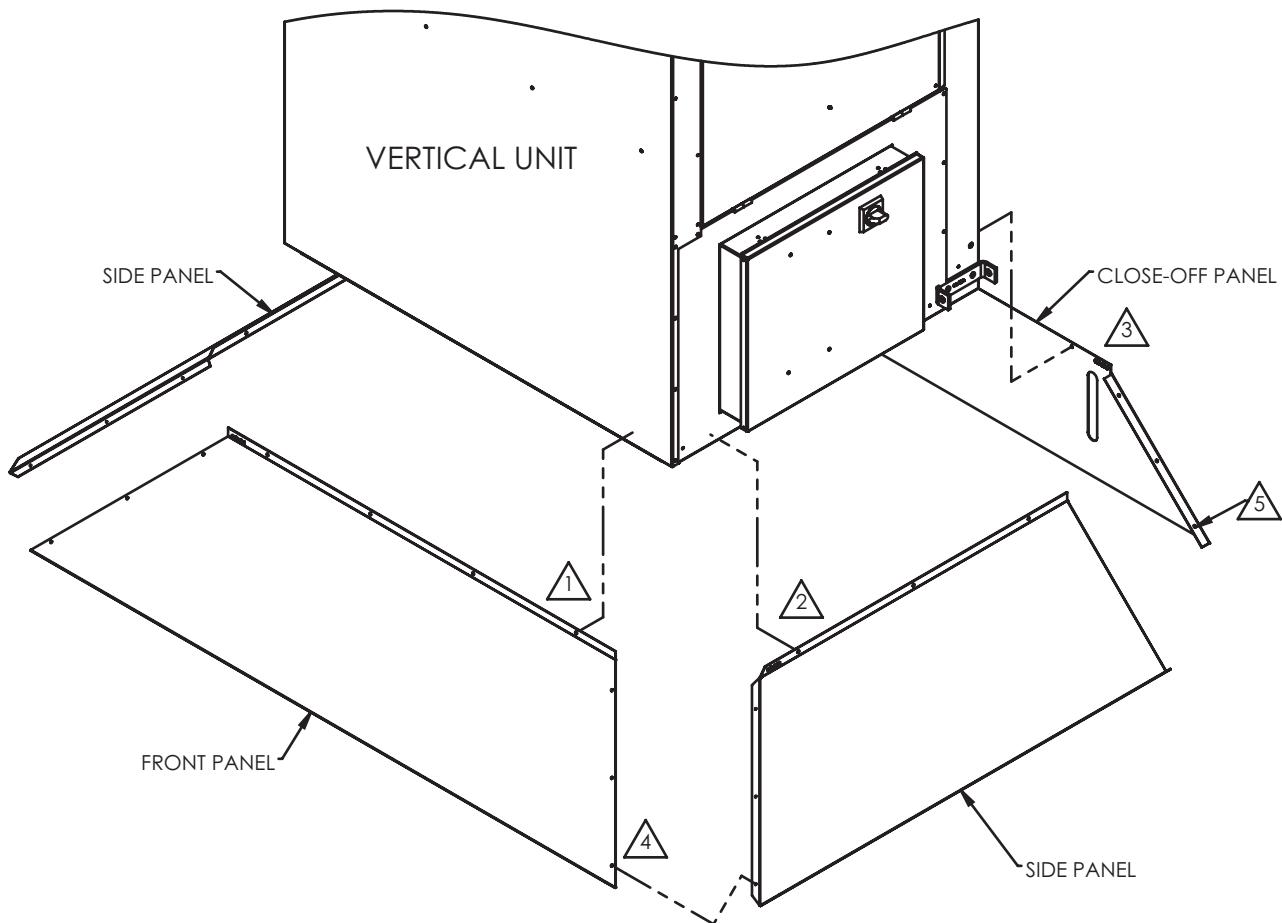


INSTALLATION INSTRUCTIONS

VERTICAL INLET SKIRT

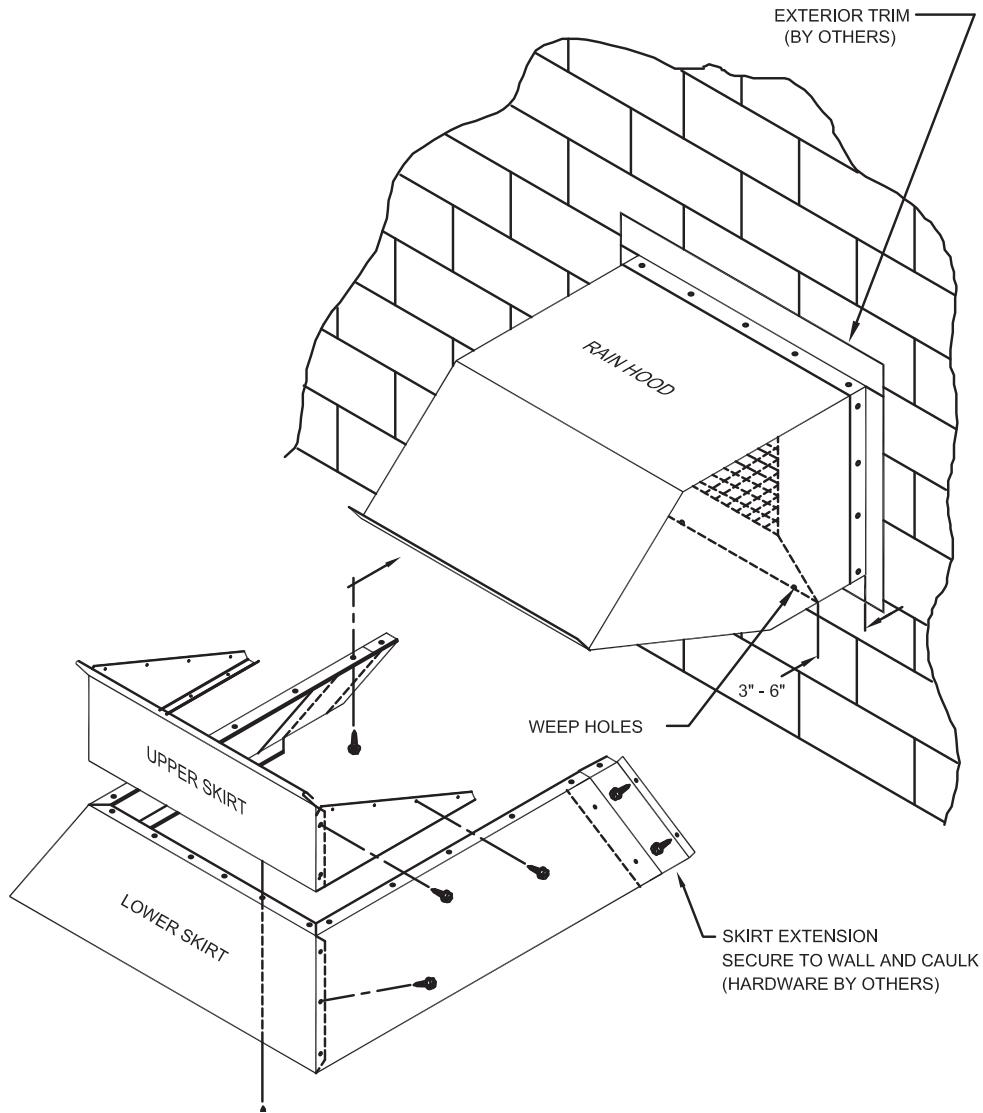
MOUNTING INSTRUCTIONS

1. Mount front panel of inlet skirt to the unit top/filter section top/vertical stand with tek screws as needed.
2. Mount side panels to the unit/filter section/vertical stand with tek screws as needed.
3. Mount close-off panel to the unit/filter section/vertical stand with tek screws as needed.
4. Secure the front panel to the side panels with tek screws through the clearance holes provided in the panels.
5. Secure the close-off panel to the side panels with tek screws through the clearance holes provided in the panels.
6. Caulk all seams (8 seams typ.)



INSTALLATION INSTRUCTIONS

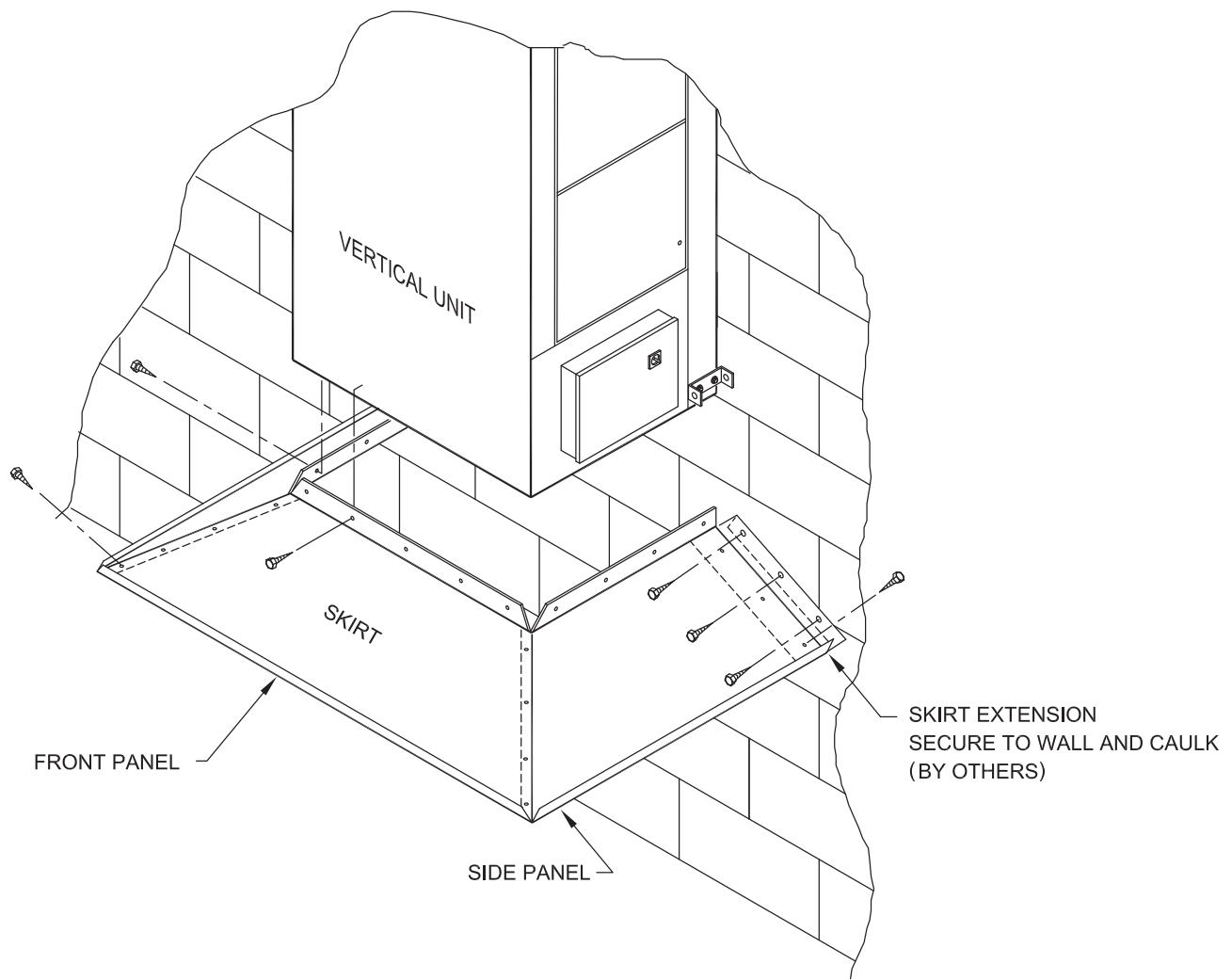
RAIN HOOD INLET SKIRT



1. Assemble the upper skirt section with the sheet metal screws provided.
2. Hang the upper skirt assembly from the rear lip of the rain hood and rotate forward into place. Secure with the sheet metal screws provided.
3. Attach the front piece of the lower skirt to the upper skirt assembly with the sheet metal screws provided.
4. Attach the side pieces of the lower skirt to the upper skirt assembly, lower skirt front piece and the bottom flanges of the rain hood with the sheet metal screws provided.
5. Clamp the skirt extensions on the inside of the inlet skirt (as shown) so that the skirt extension is flush to the exterior wall. Secure the extension to the rain hood with the sheet metal screws provided. Secure the extension to the building exterior with hardware provided by others. (Typical both sides.)
6. Caulk all seams with silicone caulk.
7. Make sure all weep holes are not obstructed to allow proper drainage.

INSTALLATION INSTRUCTIONS

UNIT INLET SKIRT

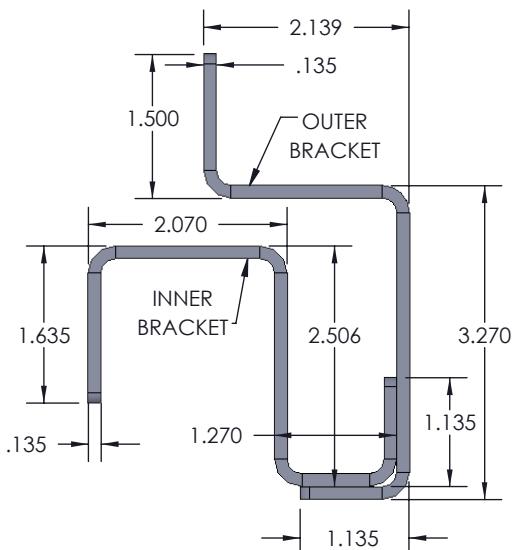
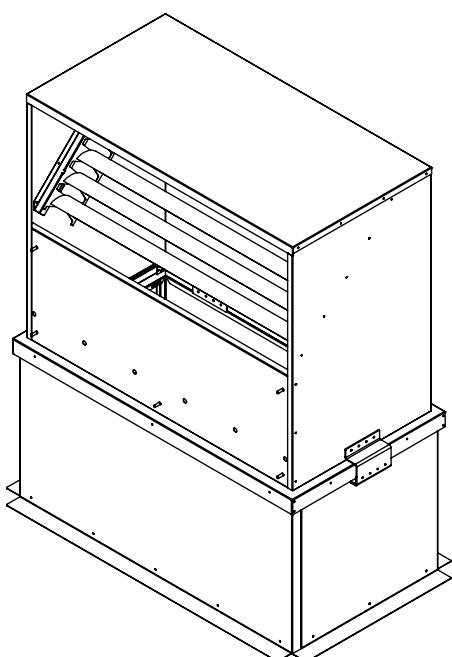


1. Attach the front panel of the inlet skirt to the unit top with the sheet metal screws provided.
2. Attach the side panels to the unit sides with the sheet metal screws provided. (Typical both sides.)
3. Secure the front panel to the side panels with the sheet metal screws provided through the clearance holes in the front panel.
4. Clamp skirt on the inside of the side panel (as shown) so that the skirt extension is flush to the exterior wall. Secure the extension to the side panel with the sheet metal screws provided. Secure the extension to the building exterior with hardware provided by others. (Typical both sides.)
5. Caulk all seams with silicone caulk.

INSTALLATION INSTRUCTIONS WIND RESTRAINT BRACKETS

Wind restraint brackets are an optional accessory that can be provided on 12" or 24" curbs. They are supplied with every 36" curb. The purpose of the wind restraint brackets are to provide more secure attachment to the roof. The wind restraint brackets provided by Cambridge do not include seismic or wind load calculations. Any required structural analysis or certification must be provided by others.

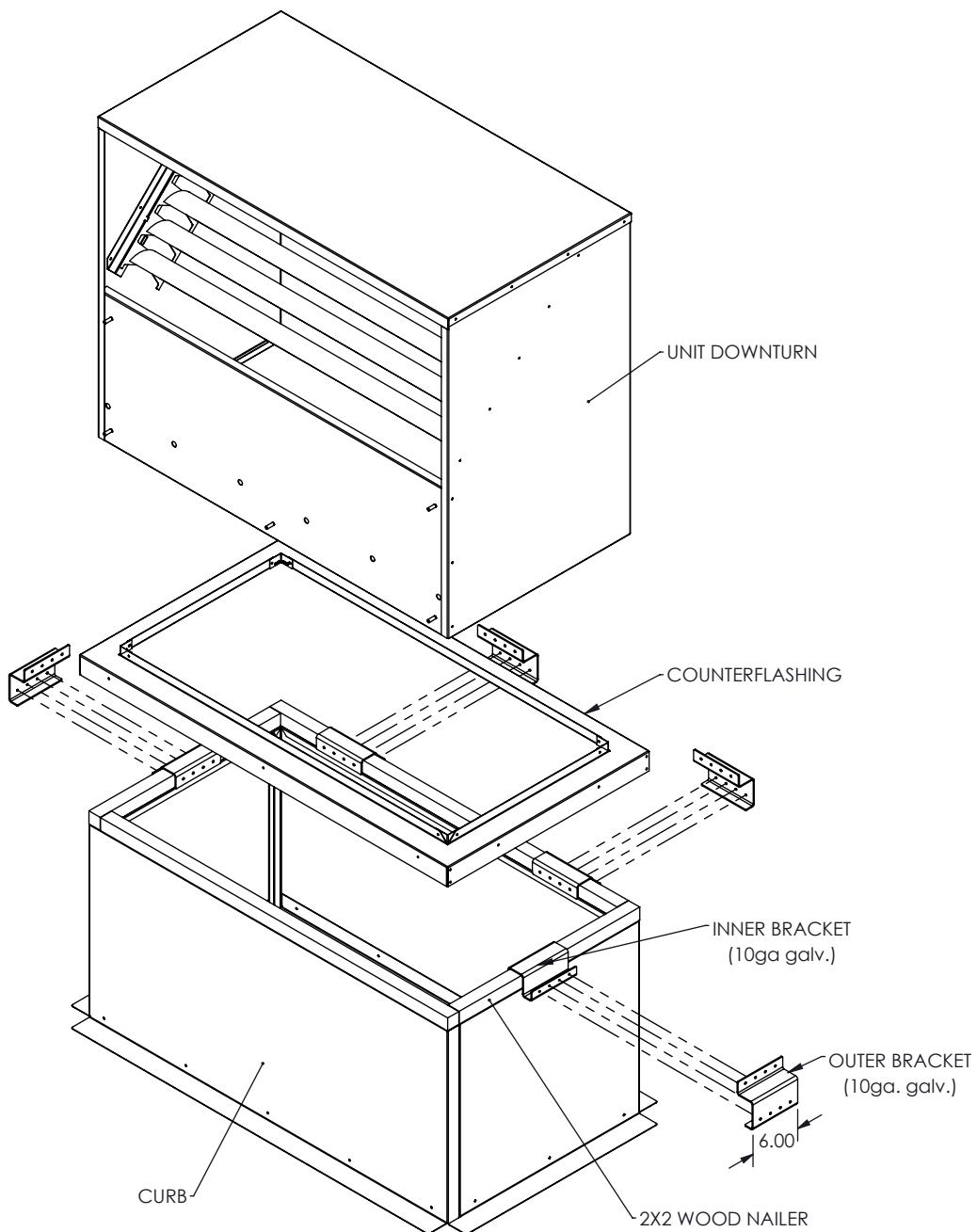
Parts List		
Item	Description	Qty
1	Inner Bracket	4
2	Outer Bracket	4
3	#10x1.5" Wood Screws	16
4	#10-16x.5" Screws	16
5	#12x0.75" TEK Screws	16



INSTALLATION INSTRUCTIONS

WIND RESTRAINT BRACKETS

1. REMOVE CURB COUNTERFLASHING
2. PULL DUCT OUT OF CURB
3. HANG INNER BRACKETS OVER WOOD NAILER ON CURB (QTY. 1 CENTERED ON EACH SIDE OF CURB AND QTY. 2 IN FRONT) AND FASTEN TO WOOD NAILER USING PROVIDED #10x1-1/2" WOOD SCREWS (QTY. 4/BRACKET)
4. REINSERT DUCT
5. REINSTALL CURB COUNTERFLASHING USING WOOD SCREWS
6. FASTEN OUTER BRACKETS TO INNER BRACKETS USING PROVIDED #10-16x0.5" SCREWS (QTY. 4/BRACKET)
7. FASTEN OUTER BRACKETS TO UNIT DOWNTURN USING PROVIDED #12 TEK SCREWS (QTY. 4/BRACKET)



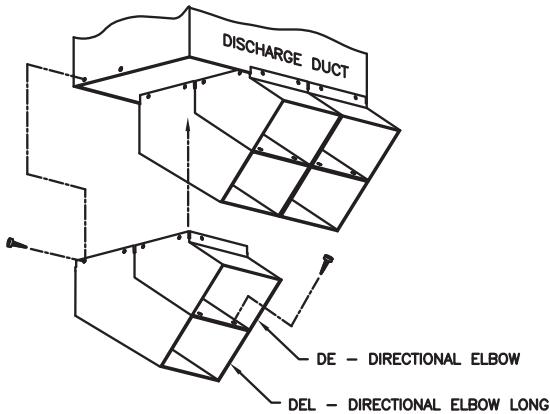
INSTALLATION INSTRUCTIONS

DIRECTIONAL ELBOWS

Directional Elbows are typically provided with each Cambridge S-Series heater. The purpose of the directional elbows is to direct the air discharging from the heater downward at a 45° angle. The best results are typically achieved by directing all elbows in the same direction. The elbows can be rotated in 90° increments if the application requires distributing the air in different directions.

DUCT MOUNTING

Directional Elbows on roof top units will typically be installed on the end of the discharge duct.

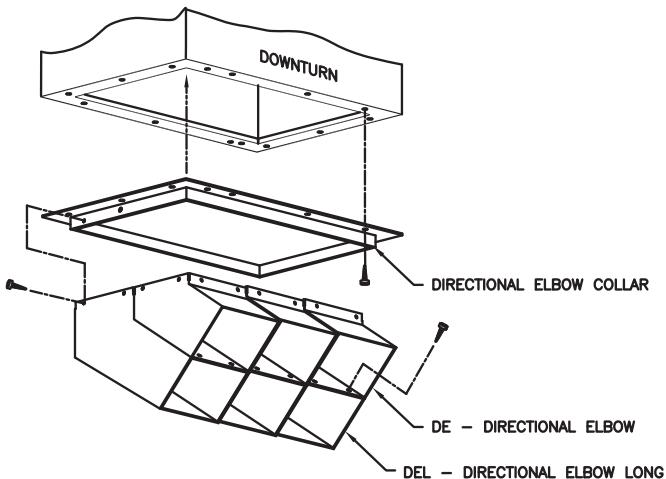


MOUNTING INSTRUCTIONS

1. Attach Directional Elbows (one at a time) over the outside of the discharge duct with sheet metal screws (by others) through the holes provided.
2. Fasten Directional Elbows together with sheet metal screws (by others) through the holes provided.

DOWNTURN MOUNTING

Directional Elbows on thru wall, under roof, pad mount or vertical units will typically be mounted on the end of the downturn.



MOUNTING INSTRUCTIONS

1. Attach the Directional Elbow Collar to the Downturn discharge as shown with self-tapping sheet metal screws (by others) through the holes provided.
2. Fasten Directional Elbows together with sheet metal screws (by others) through the holes provided.
3. Install Directional Elbow assembly over the Directional Elbow Collar and attach with self-tapping sheet metal screws (by others) through the holes provided.

DIRECTIONAL ELBOW QUANTITIES

Model	DE	DEL	Opening
S400	2	—	11 $\frac{1}{4}$ " x 11 $\frac{1}{4}$ "
S800	2	—	11 $\frac{1}{4}$ " x 11 $\frac{1}{4}$ "
S950	3	—	11 $\frac{1}{4}$ " x 11 $\frac{1}{4}$ "
S1200	3	—	13 $\frac{1}{4}$ " x 13 $\frac{1}{4}$ "
S1600	3	—	13 $\frac{1}{4}$ " x 11 $\frac{1}{4}$ "
S1850	3	3	11 $\frac{1}{4}$ " x 11 $\frac{1}{4}$ "
S2200	4	4	11 $\frac{1}{4}$ " x 11 $\frac{1}{4}$ "
S3200	4	4	11 $\frac{1}{4}$ " x 11 $\frac{1}{4}$ "

INSTALLATION INSTRUCTIONS GAS PIPING

IMPORTANT

Refer to the heater name 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, strainers and external gas trains must be installed such that the minimum operating supply pressure for obtaining the maximum gas capacity is provided.

IMPORTANT

Units with external gas trains must be installed so that the equivalent distance from the outlet of the gas train to the inlet of the heater does not exceed 4 feet.

1. Check with the local utility or gas supplier to determine the gas supply pressure.

CAUTION:

If the gas supply pressure is in excess of the maximum standing pressure indicated (14" WC, or 1 PSIG, or 2 PSIG, or 5 PSIG) on the heater nameplate, a separate positive shutoff high pressure regulator must be added upstream of the heater's individual manual shutoff 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 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.

2. Properly size the gas supply piping for the rated input capacity, per local codes, and/or the National Fuel Gas Code, NFPA 54/ANSI 223.1 or the CAN/CSA 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 unit access door from fully opening.
5. Install the gas piping to the unit in accordance with local codes or, in their absence, in accordance with the National Fuel Gas Code, NFPA 54, NFPA 54/ANSI 223.1 or the CAN/CSA B149 Installation Codes.

IMPORTANT

A 1/8" NPT tap is supplied with the heater for measuring the gas supply pressure. If the gas supply pressure exceeds that indicated on the nameplate, the installer must install a 1/8" NPT tap and high pressure manual shutoff valve upstream of the high gas pressure regulator.

⚠ CAUTION:

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

NON-RECIRCULATING DIRECT GAS FIRED INDUSTRIAL AIR HEATER			
ANS Z83.4 <input type="checkbox"/> • CSA3.7 <input type="checkbox"/> - <input type="checkbox"/>			
FOR INDUSTRIAL / COMMERCIAL USE			
MINIMUM CLEARANCE TO COMBUSTIBLES:			
TOP	FRONT	REAR	BOTTOM
0 in.	0 in.	0 in.	0 in.
NOTE: ACCESS REQUIRED FOR SERVICE ACTIVITY (42") ON CONTROL ENCLOSURE SIDE AND (24") ON MOTOR/DRIVE SIDE.			
MODEL NO. <input type="text"/>		SERIAL NO. <input type="text"/>	
THIS UNIT IS SPECIFICALLY DESIGNED FOR THE FOLLOWING OPERATING PARAMETERS:			
GAS TYPE <input type="checkbox"/> NAT. GAS <input type="checkbox"/> LP GAS			
MAX. INPUT RATE GALLONS PER HOUR	<input type="text"/>	MAX. GAS SUPPLY PRESSURE FOR THE PURPOSE OF MAX. INPUT ADJUSTMENT	<input type="text"/> IN. W.C.
MIN. INPUT RATE GALLONS	<input type="text"/>	MANIFOLD DIFFERENTIAL PRESSURE (IN. W.C.)	<input type="text"/>
MAX. GAS SUPPLY PRESSURE (IN. W.C.)	<input type="checkbox"/> 14 <input type="checkbox"/> 20 <input type="checkbox"/> 30 <input type="checkbox"/> 50 <input type="checkbox"/> 70 <input type="checkbox"/> 100	MAX. DISCHARGE TEMPERATURE (°F)	<input type="text"/>
MIN. GAS SUPPLY PRESSURE (IN. W.C.) (TO MAINTAIN FLAME SIGNAL)	<input type="text"/> 10	MAX. TEMPERATURE RISE (°F)	<input type="text"/>
MIN. AMBIENT TEMPERATURE (°F)			
-40			
ELECTRICAL <input type="text"/> VOLTS <input type="text"/> PHASE <input type="text"/> HERTZ <input type="text"/> AMPERES <input type="text"/> H.P. <input type="text"/>			

IMPORTANT

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. Apply test pressure to the supply piping system and check for leaks. Use liquid gas detector.

⚠ WARNING:

Do not use flame for leak checking.

⚠ CAUTION:

If the test pressure is in excess of 1/2 PSIG (3.45 KPA), the heater and its manual shutoff valve must be disconnected from the gas supply system during pressure testing. Failure to comply will void 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 shutoff valve during pressure testing.

⚠ WARNING:

Do not attempt to start unit at this time. Premature start-up can result in damage to equipment and components.

INSTALLATION INSTRUCTIONS

ELECTRICAL WIRING

IMPORTANT

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

⚠ 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 or the Canadian Electrical Code C22.1.

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

IMPORTANT

Do not proceed with installation unless the supply voltage agrees with the nameplate voltage. If supply voltage does not agree with nameplate voltage, check with your local agent or Cambridge Air Solutions' Customer Service Group at 1-800-473-4569 to determine what changes are required.

2. Install the supply wiring and adequate Branch Circuit Protection in accordance with National Electric Code ANSI/NFPA 70 or Canadian Electrical Code C22.1.
3. Mount the remote control station. This panel should be located inside of the building and convenient to the operator without being susceptible to damage.
4. Any temperature sensors should be located along a perimeter wall and out of the direct path of the discharge air or air infiltration. Consult the design drawing and/or Cambridge's Customer Service Group for placement assistance. Do not locate remote mounted temperature sensors immediately adjacent to overhead doors because infiltration air can affect the sensor when the door is closed and the sensor may not adequately sense the temperature when the door is open. In this application, the sensor should be located on the first column in from the outside wall when feasible.

⚠ CAUTION:

Observe special notes and instructions on Wiring and Connection Diagrams regarding sensor installation:

The wiring for any temperature sensors or set point controls mounted remotely from the remote control station must be shielded, twisted-pair wiring and must be run separately from other AC line voltage wiring. This also applies to other remotely mounted controls utilized in the EDSM and EDR control systems.

If the thermistor is not mounted remotely from the remote control station, trim the excess wire length from the thermistor, as required.

Shielded wire which is routed to the heater's electrical control enclosure 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 at the remote control station end only.

5. Wire the remote control station and other temperature control options using Class 2 wiring per the Cambridge wiring diagram and National Electrical Code Article 725 or Canadian Electrical Code C22.1 section 16 or local codes.
6. Connect the supply wiring to the disconnect switch inside of the heater's electrical enclosure per National Electrical Code, Article 430, ANSI/NFPA 70 or Canadian Electrical Code C22.1 Sections 12 and 28.

IMPORTANT

Power and control wiring inlets on all outdoor units must be sealed with silicone caulk (see page 56).

7. Return the wiring diagram to the manual holder. Replace and fasten all access covers.

⚠ WARNING:

Do not attempt to start unit at this time. Premature start-up can result in damage to equipment and components.

REMOTE CONTROL STATION AND TEMPERATURE SENSOR LOCATIONS

The standard remote control station offerings for S-Series heaters are the Remote Control Station – Security (RCS-S) and the Temperature Setback System (TSS). For the purpose of this discussion, both the RCS-S & TSS will be considered to be remote control stations. An electronic thermostat is included in the RCS. Remote control stations (RCS) and temperature sensor(s) should be mounted inside the building, not exposed to the weather. Choosing the locations for the RCS and the temperature sensor(s) may depend on several factors:

- **What is the nature of the area to be heated by this heater?**

- o Is it in a warehouse?
- o Is it a shipping/ receiving area?
- o Is it in a manufacturing plant?
- o How large is the area to be heated?
- o Where are the major sources of cold air infiltration?
- o How sensitive is the area to temperature changes?

- **What is available regarding mounting surfaces for the RCS and sensors?**

- o Exterior wall.
- o Columns located along the exterior wall.
- o Interior columns located one or two bays into the building from the dock doors.

- **Considerations for RCS location include:**

- o Accessibility by service technicians without the need for a man lift.
- o Protection from damage from cranes, fork trucks, material handling, etc.
- o Accessibility by plant employees who may be interested in changing the thermostat settings without permission.
- o The RCS may be located in an equipment/operations room with the temperature sensors run to the conditioned space.

- **Considerations for temperature sensor location include:**

- o Locating the sensor so it is not in the heater discharge, which can cause the heater to short cycle.
- o Locating the sensor near any heat sources such as ovens, transformers, infrared heaters, etc. could cause it to short cycle or not turn on.
- o Locating the sensor so that it can readily respond to changing temperature conditions, such as opening a dock door or overhead door.
- o Locating the sensor immediately adjacent to a dock door, an overhead door or a wall opening could subject the sensor to a cold airstream, causing the heater to run more than necessary, increasing the gas bill unnecessarily.
- o “Burying” the temperature sensor in a location surrounded by product so that the sensor is unable to readily respond to changing conditions.
- o Mounting the sensor at a height above the floor, typically about 5' AFF, so that it is sensing the temperature being felt by the employees in the area.
- o For freeze protection jobs, mounting the sensor at roof joist level, so that it is sensing the temperature being felt by the sprinkler piping (wet system).
- For a unit with TAS-2 (Temperature Averaging System)
 - o TAS-2 can be used in conjunction with the RCS to average the space temperature between two distant points within a facility.
 - o The TAS-2 assembly comes with a total of four thermistors, two sets of two thermistors, which are wired in series. Once installed, each set is wired back to the thermostat in parallel.
 - The result is a series/parallel combination intended to simulate a single thermistor response.
 - o In a dock area, it often is beneficial to install the sensors on columns to the right and left of the RCS (also mounted on a column), perhaps 1 – 2 columns away from the RCS.

• **Wiring**

- o Wiring from the heater to the RCS is 24 VAC Class 2 control wiring, 7 to 10 wires (typical), 18 AWG minimum.
 - It should be run separately from the power wiring.
 - Consideration should be given to the appropriate wire gauge needed for the length of wire required.
- o For remote temperature sensors, use 2-wire shielded twisted-pair, 18 AWG minimum.
 - The 2-wire shielded twisted-pair is low voltage DC control wiring. It can be run in the same conduit with other low voltage DC control wiring.
 - It should be run separately from the AC power wiring.
 - Consideration should be given to the appropriate wire gauge needed for the length of wire required.
 - The shield should be grounded at the RCS end only.

o For Electronic Discharge – Space Modulation (EDSM) and Electronic Discharge – Remote (EDR).

- Run 2-wire shielded twisted-pair, 18 AWG minimum, from the heater to terminals 21 & 22 the RCS.
- The 2-wire shielded twisted-pair is low voltage DC control wiring. It can be run in the same conduit with other low voltage DC control wiring.
- It should be run separately from the AC power wiring.
- Consideration should be given to the appropriate wire gauge needed for the length of wire required.
- The shield should be grounded at the RCS end only.

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.

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.

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

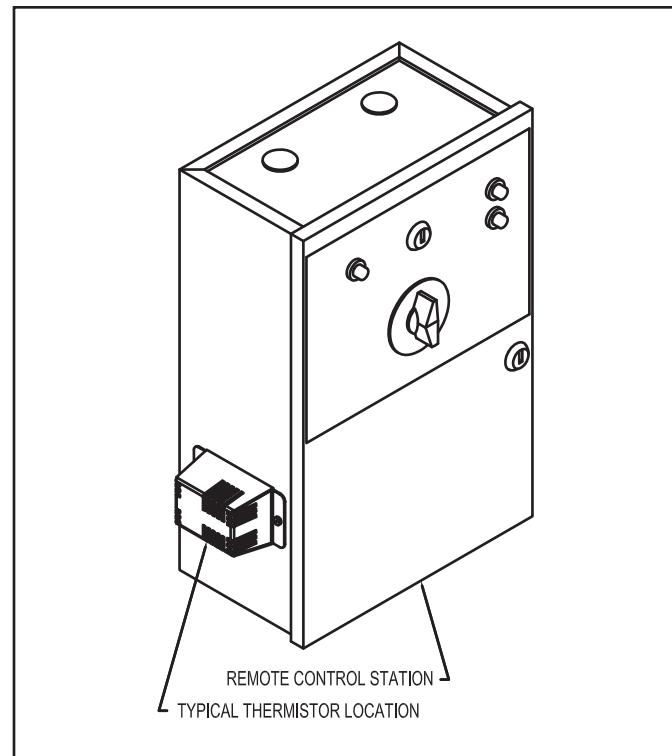
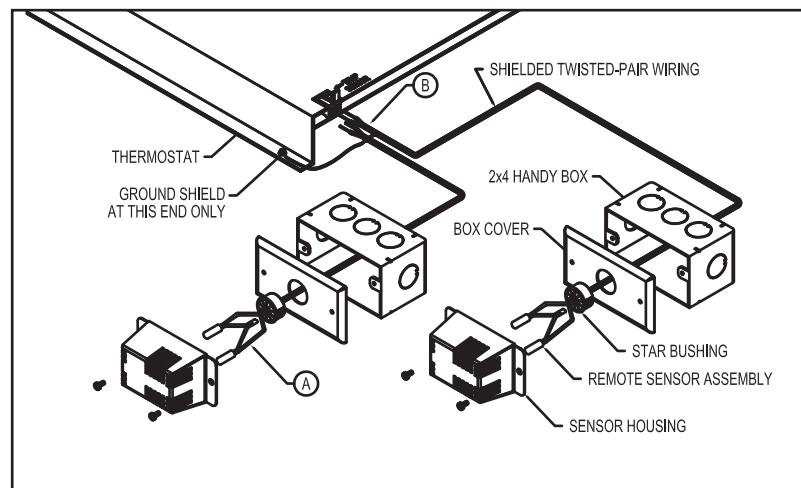
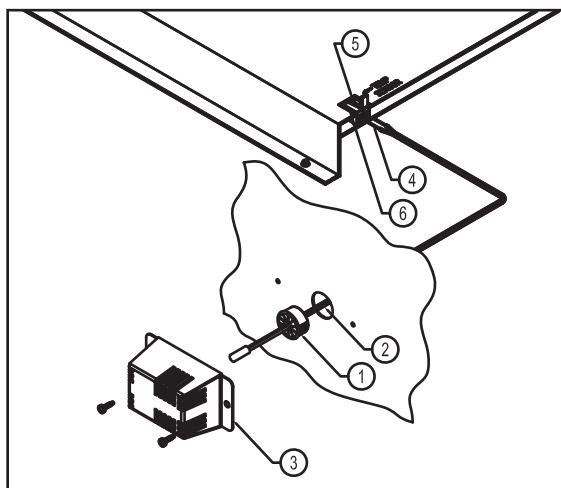


Figure 1

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.



START-UP INSTRUCTIONS

START-UP PROCEDURE

1. Visual Inspection Of Equipment
(page 56)
2. Electrical Supply Voltage Verification
(page 56)
3. Gas Supply Pressure Verification
(page 56)
4. Blower Rotation Check
(page 57)
5. Motor Amp Draw Check
(page 57)
6. Burner Manifold Pressure Adjustment
(page 57)
7. Minimum Fire Adjustment
(page 58)
8. Calibration Check
(page 59)
9. Gas Train Leak Check
(page 60)
10. Gas Valve Leak Check
(page 60)
11. Final Heater Preparation
(page 61)
12. Remote Control Station Check
(page 61)

After start-up, please complete and fax the S-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.

IMPORTANT

Read the following instructions carefully. Any unauthorized modifications to or deviations from these instructions will 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 that all heater accessories and filters (if applicable) have been properly installed.
- c. Check for loose components (belts, plugs, screws, blower wheel lugs, etc.).
- d. On units with external gas trains, verify that the distance from the last safety shut-off valve to the heater does not exceed four feet.
- e. Verify that the field wiring, both primary and control, has been installed according to the Cambridge wiring diagram, National Electrical Code, and local electrical codes.
- f. Verify that a sediment trap has been installed upstream of all gas controls.
- g. Verify that the high pressure regulator, if applicable, has been vented to the outside at least 10' from the heater intake.
- h. Verify that the unions in the gas piping located at the burner and just external to the heater housing, are tight.

2. ELECTRICAL SUPPLY VOLTAGE VERIFICATION

Check the electrical supply voltage at the disconnect switch.

IMPORTANT

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 agent or Cambridge Air Solutions' Customer Service Group at 1-800-473-4569 to determine what changes are required.

3. GAS SUPPLY PRESSURE VERIFICATION

Check the gas supply pressure.

IMPORTANT

Do not proceed with start-up unless the gas supply pressure agrees with 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 agent or Cambridge Air Solutions' Customer Service Group at 1-800-473-4569 to determine the size and capacity requirements.

⚠ WARNING:

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

4. BLOWER ROTATION CHECK

- a. Open the access door on the electrical control enclosure side and turn the disconnect switch to the "ON" position.
- b. Turn the blower service switch to the "LOCAL" position. 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 clockwise from the control enclosure side.

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 motor starter. 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 instructions (page 45)

IMPORTANT

The damper will remain in the open position as long as the blower service switch is in the "LOCAL" position or the Low Temperature Cutout (LTC) function has not timed out.

5. MOTOR AMP DRAW CHECK

IMPORTANT

The heater access doors must be closed for this test.

- a. Turn the blower service switch to the "LOCAL" position and let the motor warm up.

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

IMPORTANT

The average amps must not exceed 103% of the Motor Nameplate FLA. High amperage may indicate excessive blower RPM.

6. BURNER MANIFOLD PRESSURE ADJUSTMENT

- a. Turn the disconnect switch to the "OFF" position.
- b. Drive the modulating valve to fully open.
- b.1. For EDL, EDR, EDSM, and EDSM/TP control systems, remove the wire from terminal #3 on the amplifier (see Figure 1).

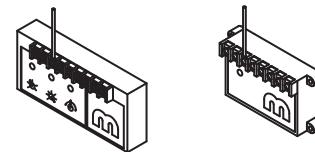


Figure 1

- b.2.a. For EDSC control systems, remove the wires from terminals #T1 and #T2 of the amplifier and connect an 1100 Ω resistor across terminals #T1 and #T2 of the amplifier.

OR

Remove the discharge temperature sensor from the discharge duct.

- b.2.b. Provide a control signal (4-20 mA / 0-10 VDC) to the amplifier by setting the signal level thru the Building Automation System.

OR

Remove the wires from terminals #5 and #6 of the amplifier and connect a current/voltage signal generator to terminals #5 and #6 of the amplifier. (Note polarity of the terminals: #5 is negative and #6 is positive).

- b.2.c. Set the modulation level to 100% (20 mA / 10 VDC).

- c. Remove the 1/8" 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.
- d. Refer to the heater nameplate for the Manifold Differential Pressure (MDP) and record below.

- e. Turn the disconnect switch to the “ON” position.
- f. Turn the blower service switch to the “LOCAL” position. The blower motor will start. Observe the pressure reading on the manometer and record below. (Note whether the reading is positive or negative.)
- g. Using the formula below, determine the required manifold pressure reading for the manometer.

Nameplate MDP _____ " WC

Manifold Static Pressure
(Blower Only) + _____ " WC

Manifold Pressure Reading = _____ " WC

IMPORTANT

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

IMPORTANT

The high limit may trip on warm days. If this occurs allow the high limit to cool. Turn the blower and burner service switches to the "OFF" position. Access high limit and manually reset. Close the unit access doors and turn the blower and burner service switches to the "LOCAL" position.

- h. Turn the burner service switch to the “LOCAL” position. After a delay for prepurge and igniter warm-up, the burner will light. Allow 15 seconds for the low fire start to time out.
- i. Observe the manometer reading and compare to the manifold pressure determined above. If the manifold pressure reading does not equal this value, adjust the control regulator until the proper manifold pressure is obtained.
- j. Turn the blower and burner service switches to the “OFF” position.
- k. **For EDL, EDR, EDSM, and EDSM/TP control systems**, reconnect the wire to terminal #3 on the amplifier.

For EDSC control systems, remove the 1100 Ω resistor and reconnect the wires to terminals #T1 and #T2 of the amplifier.

OR

Replace the discharge temperature sensor in the discharge duct.

If used, remove the signal generator and reconnect the wires to terminals #5 and #6 of the amplifier

- l. When performing a start-up proceed to the next step, otherwise perform Final Heater Preparation (page 59).

7. MINIMUM FIRE ADJUSTMENT PROCEDURE

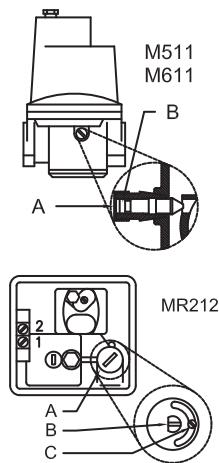
The minimum fire setting is preset at the factory at approximately 20°F rise. This minimum fire setting is not critical in space heating applications where the heater is cycled in response to the space temperature sensed by an operating thermostat. In this case, the heater should operate at the maximum discharge temperature, far from the minimum fire setpoint.

IMPORTANT

If a temperature rise of less than 15°F is desired, a DC microammeter is required to monitor flame signal during the adjustment procedure. Ensure the flame current remains steady and of sufficient strength to maintain burner operation for both consistent ignition at minimum fire and locking in the flame safeguard relay. Do not allow the flame signal to drop below 2.0 microamps DC.

- a. Turn the blower service switch to the “LOCAL” position and monitor the discharge temperature.
- b. **For EDL, EDR, EDSM, and EDSM/TP control systems**, remove the wire from terminal #8 on the amplifier. This will cause the burner to light on low fire and then fall to minimum fire.
- c. Turn the burner service switch to the “LOCAL” position. After a delay for prepurge and igniter warm-up, the burner will light. Allow 15 seconds for the low fire start to time out.
- d. Monitor the discharge temperature. Subtract the temperature from step "7a" above to determine the temperature rise. If the minimum fire does not require adjustment, proceed to step "7h".
- e. **On the MR212 modulating/regulating valve**, remove the housing cover and loosen the lock screw (C).

- f. Remove the cap (A) exposing the minimum fire adjusting screw. Turn the adjusting screw (B) to obtain the desired minimum fire setting.



- g. Replace the cap (A).

On the MR212 modulating/regulating valve, tighten the lock screw (C) and replace the housing cover.

- h. Turn blower and burner service switches to the “OFF” position.
- i. Reconnect the wire to terminal #8 on the amplifier.
- j. When performing a start-up proceed to the next step, otherwise perform Final Heater Preparation (page 59).

8. CALIBRATION CHECK

The discharge temperature control system has been calibrated at the factory to the specified airflow, static pressure, and temperature rise. The actual operating conditions may require minor adjustments to the control settings to ensure the heater functions within the operating parameters of its listing. See Calibration Procedures on page 63 for more information.

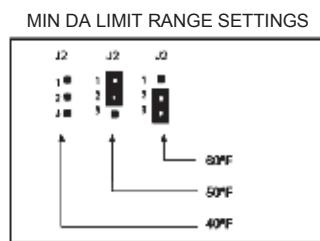
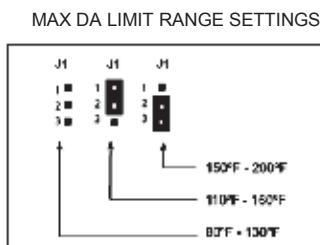
- a. Remove the cover of the discharge air temperature sampling box. Refer to the Heater Configuration (page 5) for the discharge air temperature sampling box location, and the Individual Component Description Section (page 107) for additional information. Install a thermocouple in the grommet inside the discharge air temperature Sampling Box, and then reinstall the cover. Route the thermocouple wire to a meter located outside of the unit.

b.1. **On EDL control systems**, the discharge temperature should match the discharge temperature dial located on the bracket mounted on the front of the amplifier. The dial should be set to 160°F.

b.2. **On EDSM and EDSM/TP control systems**, the discharge temperature should match the temperature shown on the MAX dial on the amplifier when the Space Temperature Selector (STS) is set to its highest setting (160°F). The discharge temperature should also read 160°F when a test resistance of $7,500 \pm 250 \Omega$ is connected in the circuit in place of the STS. If the discharge temperature is higher when the test resistance is added, the unit may be attempting to modulate its heat output, and the test resistance should be used for calibration purposes.

b.3. **On EDR control systems**, jumper terminals 20 and 22 and turn the dial on the remote heat adjust RHA to its highest setting to utilize the full temperature range of the control system. On heaters with a single temperature selection dial on the face of the control (Maxitrol part number TD114), set the dial to 90°F and verify that the override temperature selector dial, which is visible from the top of the control, is set at 40°F. The combination of these two settings should control the discharge temperature to 130°F. On heaters with dual temperature selection dials on the face of the control, set the Space Heat dial to 160°F.

b.4.1. **For EDSC control systems**, verify the Maximum Discharge Air Limit Range and the Minimum Discharge Air Limit Range jumper settings.



- b.4.2. Provide a control signal (4-20 mA / 0-10 VDC) to the amplifier by setting the signal level thru the Building Automation System.

OR

Remove the wires from terminals #5 and #6 of the amplifier and connect a current/voltage signal generator to terminals #5 and #6 of the amplifier. (Note polarity of the terminals: #5 is negative and #6 is positive).

- b.4.3. Set the modulation level to 100% (20 mA / 10 VDC).

IMPORTANT

The heater access doors must be closed for the remaining portion of this test.

- c. Turn the burner service switch to the “LOCAL” position. After a delay for prepurge and igniter warm-up, the burner will light. Allow 15 seconds for the low fire start to time out.
- d. Monitor the discharge temperature until it stabilizes. Do not rush through this step.
- e. The discharge temperature should be $130 \pm 3^{\circ}\text{F}$ for heaters setup for 130°F , or $160 +0/-5^{\circ}\text{F}$ for heaters setup for 160°F . If the discharge temperature complies with this requirement, no calibration is required. If the discharge temperature does not equal the expected value, proceed to Calibration Procedures (page 60).
- f. Remove any jumpers that were installed previously.
- g. When performing a start-up proceed to the next step, otherwise perform Final Heater Preparation (page 59).

9. GAS TRAIN LEAK CHECK

- a. **On EDL, EDR, EDSM, and EDSM/TP control systems**, remove the wire from terminal #3 on the amplifier. This will drive the modulating valve to full open.
- b. Turn the blower service switch to the “LOCAL” position. Blower motor will start after the motorized discharge damper opens.

- c. Turn the burner service switch to the “LOCAL” position. After a delay for prepurge and igniter warm-up, the burner will light. Allow 15 seconds for the low fire start to time out.

- d. With the burner operating, spray the complete gas train with leak detector solution, checking all pipe connections and plugs.

⚠ CAUTION:

Do not allow leak detector solution to come in contact with electrical components.

⚠ WARNING:

Any gas leak detected must be repaired before unit is placed into service.

- e. Turn the blower and burner service switches to the “OFF” position.
- f. Reconnect the wire to terminal #3 on the amplifier
- g. When performing a start-up proceed to the next step, otherwise perform Final Heater Preparation (page 59).

10. GAS VALVE LEAK CHECK

All heaters should be evaluated for the gas tightness of the gas valve seat. Heaters rated over 400,000 Btu/hr are equipped with a leak test facility to assist in checking this seal. A momentary switch and a gas port for measuring pressure between the valves are provided for leak testing. Refer to the Individual Component Description Section for more information regarding the leak test switch (page 106).

- a. Connect a 0-10" WC manometer to the 1/8" NPT fitting on the manual shut-off valve located just prior to the burner and verify the manometer is properly zeroed.
- b. **On single redundant valve applications** (heaters rated less than or equal to 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" WC, replace the gas valve and retest. If the reading is 0" WC, remove the manometer and reinstall the pipe plug.

On separate redundant valve applications, 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" WC, refer to the Maintenance Instruction Section for information on Gas Valve Cleaning for the safety shut-off gas valve closest (SSV) to the burner and retest. If the reading is 0" WC, remove the manometer and reinstall the pipe plug.

To check the gas tightness of the SOV shut-off valve in the gas train, connect the manometer to the leak test port between the valves and wait 30 seconds to read the manometer. If the reading is greater than 0" WC, refer to the Maintenance Instruction Section for information on Gas Valve Cleaning for the shut-off gas valve farthest from the burner (SOV) and retest. If the reading is 0" WC, remove the manometer and reinstall the pipe plug.

11. FINAL HEATER PREPARATION

a. **On EDSM and EDSM/TP control systems**, if the remote control station hasn't been tested and the ambient temperature is at or above the Entering Air Thermostat (EAT) set point, note the set point position and pull the jumper off the temperature set point (EAT Enabled Mode) and reinstall it sideways on the terminal block (Bypass Mode) as shown in Figure 1. Refer to the Individual Component Description section for additional information.

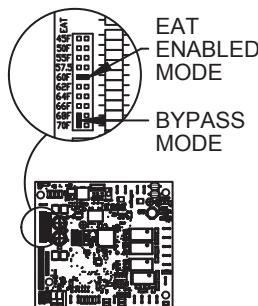


Figure 1

⚠️ WARNING:

All safety controls must be returned to normal operating conditions.

b. Ensure the discharge temperature settings comply with the application specifications.

c. If inlet ducting is utilized, determine the time required to purge it with four (4) air changes and select a prepurge time that will accommodate this time. Refer to Individual Component Description for additional information on the multi-functional PC board.

d. Perform a visual inspection of all wiring and gas valve plugs to ensure they have been properly replaced.

e. Return the Technical Manual and the Wiring Diagram to the manual holder.

f. Turn the blower and burner service switches to the "REMOTE" position.

IMPORTANT

Turn the disconnect handle to the "OFF" position before closing the control enclosure door.

g. Replace and fasten all covers and panels. Close the control enclosure and latch the door.

h. Turn the disconnect switch to the "ON" position.

12. REMOTE CONTROL STATION CHECK

a. **For EDSM and EDSM/TP control systems**, if the ambient temperature is at or above the Entering Air Thermostat (EAT) setpoint, note the setpoint position. Pull the jumper off the tem-perature setpoint (Normal Mode) and reinstall it sideways on the terminal block (Bypass Mode) as shown in Figure 1. Refer to the Individual Component Description section for additional information.

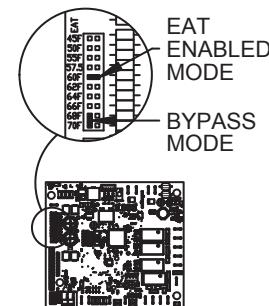


Figure 1

- b. Insert key and turn the mode selector switch to the “HEATING” position.
- c. Set the operating thermostat, if applicable, to its highest setting or activate that part of the control system which will initiate blower and burner operation.

For Remote Control Station - Security (RCS-S), refer to the Operating Instructions for the Operating Electronic Thermostat (OET) (page 64).

For Temperature Setback System (TSS), refer to the Operating and Programming Instructions for the TSS Controller (page 66).

If another interlock device controls the operation of the heater, activate this device.

- d. After the motorized discharge damper opens, the blower motor will start.
- e. After a delay for prepurge and igniter warmup, the burner will ignite.
- f. Adjust the temperature control system and verify the heater output changes correspondingly.

For EDSM, adjust the Space Temperature Selector.

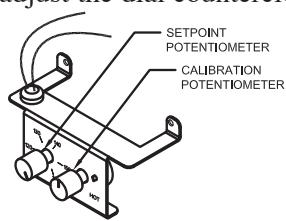
For EDR, adjust the Remote Heat Adjust.

- g. Reset the operating thermostat, if applicable, and the temperature control system, if applicable, to the desired temperature. If the Entering Air Thermostat was adjusted, reset to its previous setting.
- h. Turn the mode selector switch to the “SUMMER VENTILATION” position. Verify the blower operates. In TSS applications, the override timer may need to be activated to initiate operation.
- i. Turn the mode selector switch to the desired operating mode.

CALIBRATION PROCEDURES

EDL CONTROL SYSTEMS

(MAXITROL SERIES 14)

1. Turn the blower and burner service switches to the “OFF” position.
 2. Turn the heater disconnect switch to the “ON” position.
 3. Adjust the temperature setting on the amplifier dial to 160°.
 4. Turn the blower service switch to the “LOCAL” position. The blower motor will start.
 5. Turn the burner service switch to the “LOCAL” position. After a delay for prepurge and igniter warm-up, the burner will light. Allow 5 minutes for the sampling box temperature to stabilize.
 6. Adjust the calibration potentiometer as shown in the drawing. To raise the discharge temperature adjust the dial clockwise. To lower the discharge temperature adjust the dial counterclockwise.
- 
7. Wait for the discharge temperature and manifold pressure to stabilize. Do not rush this step.
 8. Repeat steps 6 and 7 until the mixing box temperature has stabilized at 155°-160°.
 9. Remove the thermocouple from the Sampling Box port and replace the Sampling Box cover. Close the heater access doors.
 10. Verify that the discharge temperature and manifold pressure comply with the guidelines of the Calibration Check procedure step 8b. Repeat steps 1 through 9 if necessary.
 11. Turn the disconnect switch to the “OFF” position.
 12. Turn the blower and burner service switches to the “REMOTE” position.

13. Close the electrical enclosure door and tighten the latches.
14. Turn the disconnect switch to the “ON” position.

EDSM AND EDSM/TP CONTROL SYSTEMS (MAXITROL SERIES 44)

1. Verify that the "MAX" potentiometer on the amplifier is set to 160°.
2. Turn the blower and burner service switches to the “LOCAL” position. After a delay for the prepurge and igniter warm-up, the burner will light.
3. Wait for the discharge temperature and manifold pressure to stabilize. Do not rush this step.

⚠ CAUTION:

The duct may be hot to the touch. Be mindful of hot components when performing this procedure.

- a. Turn the burner service switch to the “OFF” position and allow the Discharge Air Temperature Sampling Box time to cool.
- b. Turn the blower service switch to the “OFF” position.
- c. Open the unit access door on the control enclosure side.
- d. Remove the access cover from the Discharge Air Temperature Sampling Box. Its location is noted in the Heater Configuration on page 5. Refer to the Individual Component Description Section (pages 105-111) for additional information.
- e. Carefully adjust the DTS calibration potentiometer, which is located under the front label sticker on the side of wire terminal 3. To raise the discharge temperature, adjust the potentiometer counter-clockwise with a #0 phillips screwdriver. Do not force the potentiometer past its end of travel limit in either direction. If potentiometer is at its end of travel and desired discharge temperature cannot be reached, contact Cambridge Air Solutions' Customer Service Group.

f. Replace the Discharge Air Temperature Sampling Box cover, and close the unit access doors.

g. Turn the blower and burner service switches to the “LOCAL” position. After a delay for the prepurge and igniter warm-up, the burner will light.

h. Wait for the discharge temperature to stabilize. Do not rush this step.

i. Repeat steps 4a through 4h until the discharge temperature comply with the guidelines of the Calibration Check procedure step “8b” (page 59).

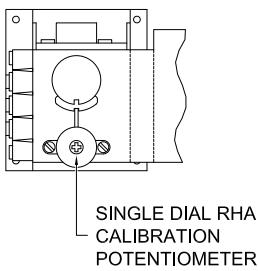
5. If a test resistor was used in place of the STS for calibration, ensure it is removed before returning the unit to normal operation. Turn the blower and burner service switches to the “REMOTE” position.

EDR CONTROL SYSTEMS (MAXITROL SERIES 14)

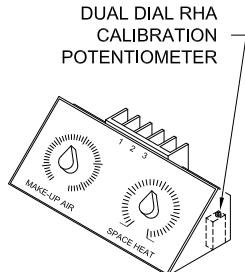
1. Turn the burner and blower service switches to the “OFF” position.
2. Label and then remove the wires from terminals 1 through 3 of the Remote Heat Adjustment (RHA) in the remote control station.
3. Remove the RHA from the remote control station. Take the RHA to the unit control enclosure. See Individual Component Description (page 106) for RHA details, and Heater Configuration (page 5) for electrical control enclosure location.
4. Remove the wires from terminals 21 and 22 of the right-hand side of Terminal Block #1 in the unit control enclosure. Connect these wires to terminals 1 and 3 of the RHA.
5. Place a jumper between terminals 2 and 3 of the RHA.
6. **For the single dial RHA**, the jumper activates the 0 to 40°F override dial. Verify the override temperature selector dial is set to 40°. Verify the dial on the face of the RHA is set to 90° to obtain a setpoint of 130°.

For the dual dial RHA, the jumper activates the Space Heat selector dial. Verify the Space Heat dial is set to 160°.

7. Turn the blower and burner service switches to the “LOCAL” position. After a delay for the prepurge and igniter warm-up, the burner will light.
8. Wait for the discharge temperature and manifold pressure to stabilize. Do not rush this step. Allow 15 seconds for the low fire start to time out.
9. **For the single dial RHA**, adjust the calibration potentiometer shown in the drawing. To raise the discharge temperature, adjust the potentiometer clockwise. To lower the discharge temperature, adjust the potentiometer counterclockwise.



For the dual dial RHA, adjust the calibration potentiometer shown in the drawing. To raise the discharge temperature, adjust the potentiometer clockwise. To lower the discharge temperature, adjust the potentiometer counterclockwise.



10. Allow the discharge temperature and manifold pressure to stabilize between adjustments until the manifold pressure and discharge temperature comply with the guidelines of the Calibration Check procedure step “8b” (page 57).
11. Turn the burner and blower service switches to the “OFF” position. Remove the wires from terminals 1 and 3 of the RHA that were connected in step 4. Reconnect the wires to terminal 21 and 22 of Terminal Block #1 in the unit control enclosure. Leave the jumper in place that was applied in step 5.
12. Return the RHA to the Remote Control Station. Reconnect the wires that were removed in step 2.
13. With the RHA reconnected in the Remote Control Station, repeat steps 7 through 10. A second technician and two-way communication may be required.
14. Turn the burner and blower service switches to the “OFF” position. Remove the jumper from terminals 2 and 3 of the RHA if one was added during step 5.

OPERATING INSTRUCTIONS

OPERATING SEQUENCE

POWER ON

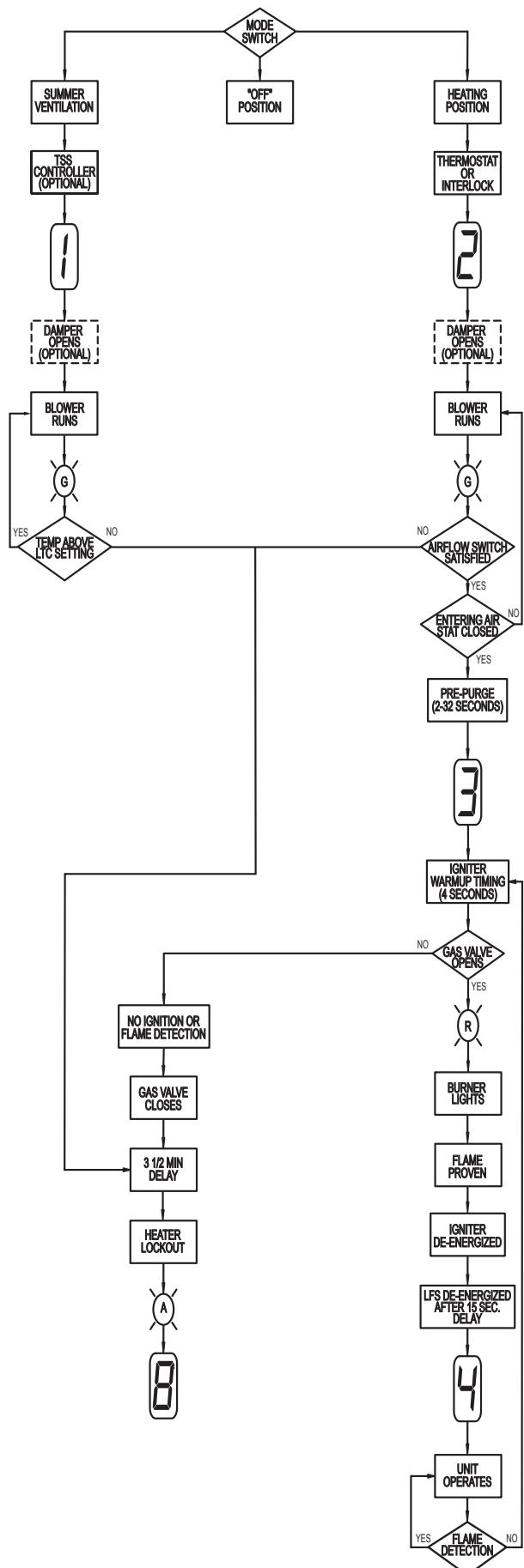
1. Control transformer energized.
2. Operator must select "SUMMER VENTILATION" or "HEATING" mode.

SUMMER VENTILATION MODE

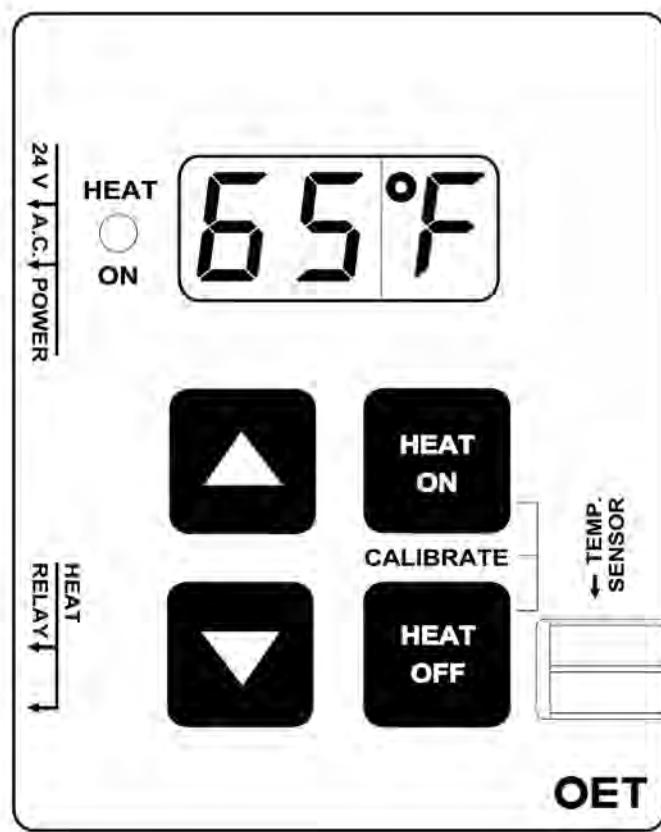
1. Mode switch in "SUMMER VENTILATION" position.
2. Optional TSS Controller schedule calls for ventilation.
3. Optional motorized damper opens.
4. Blower motor starts.
5. Unit continues to run until turned off.

HEATING MODE

1. Mode switch in "HEATING" position.
2. Thermostat or interlock calls for heat.
3. Optional motorized damper opens.
4. Blower motor starts.
5. 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.



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.



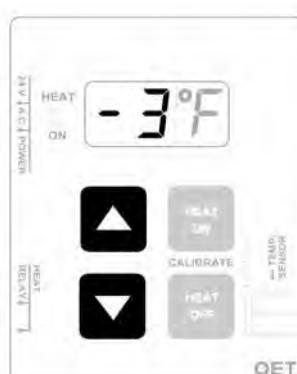
TEMPERATURE CALIBRATION

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).

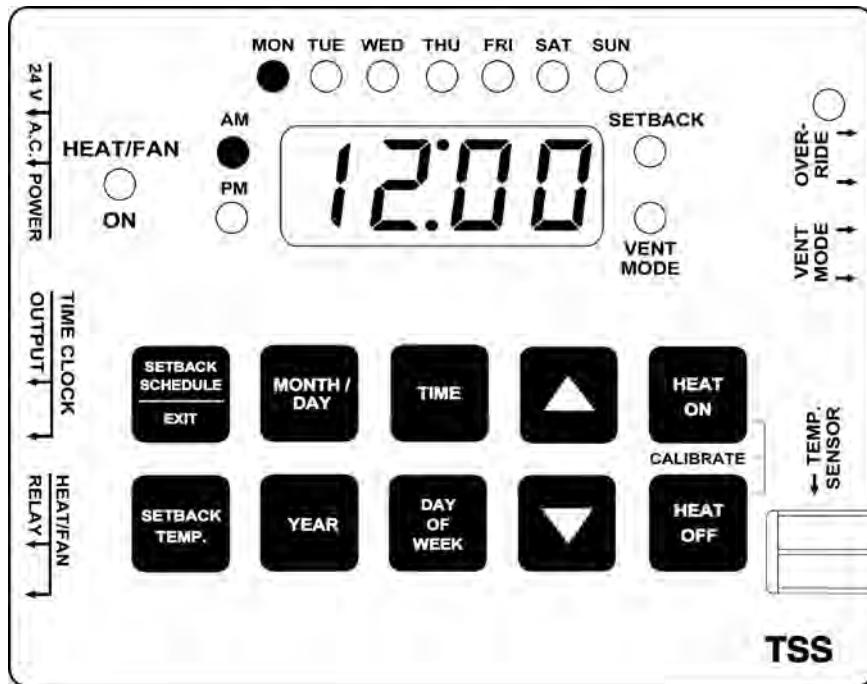


2. Pressing the **UP** or the **DOWN** button will display the current calibration difference above or below (-) the measured temperature.



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.



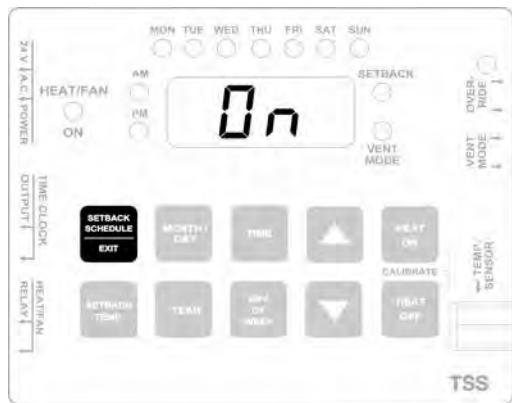
4. Press and hold the **YEAR** button while pressing the **UP** or the **DOWN** button until the current year is displayed.



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.

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.

SETTING TEMPERATURES

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)

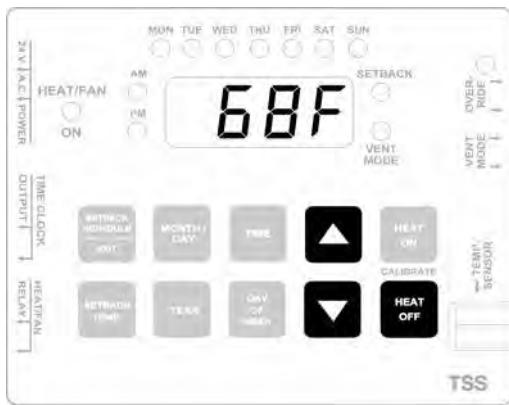
The **HEATING** mode requires two temperature settings. When the temperature drops below the **HEAT ON** setting the heater will turn on. When the heater raises the space temperature above the **HEAT OFF** setting, the heater will turn off. This difference provides an adjustable range of operation for 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.



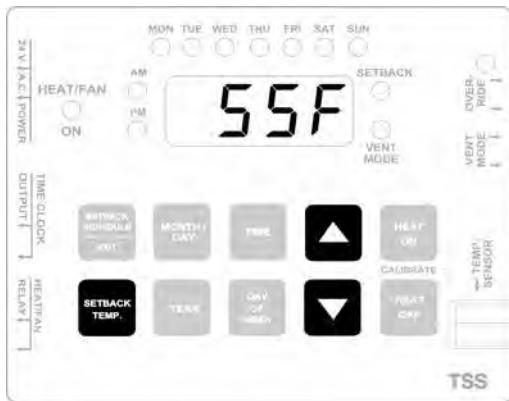
2. Press and hold the **HEAT OFF** button while pressing the **UP** or the **DOWN** button until the desired temperature for the heater to turn OFF is displayed.



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).

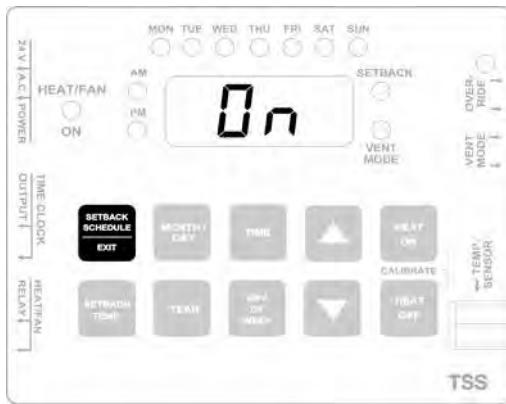
HEATING SCHEDULE

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 hold the **TIME** button while pressing the **UP** or the **DOWN** button to scroll to the desired ON time.

9. 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.

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



11. Press and hold the **TIME** button while pressing the **UP** or the **DOWN** button to scroll to the desired OFF time.
12. 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.
13. Repeat steps 7-12 until all required program cycles have been entered.
14. Press the **SETBACK SCHEDULE/EXIT** button to exit the scheduling program.
15. 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.



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



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



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



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).



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.

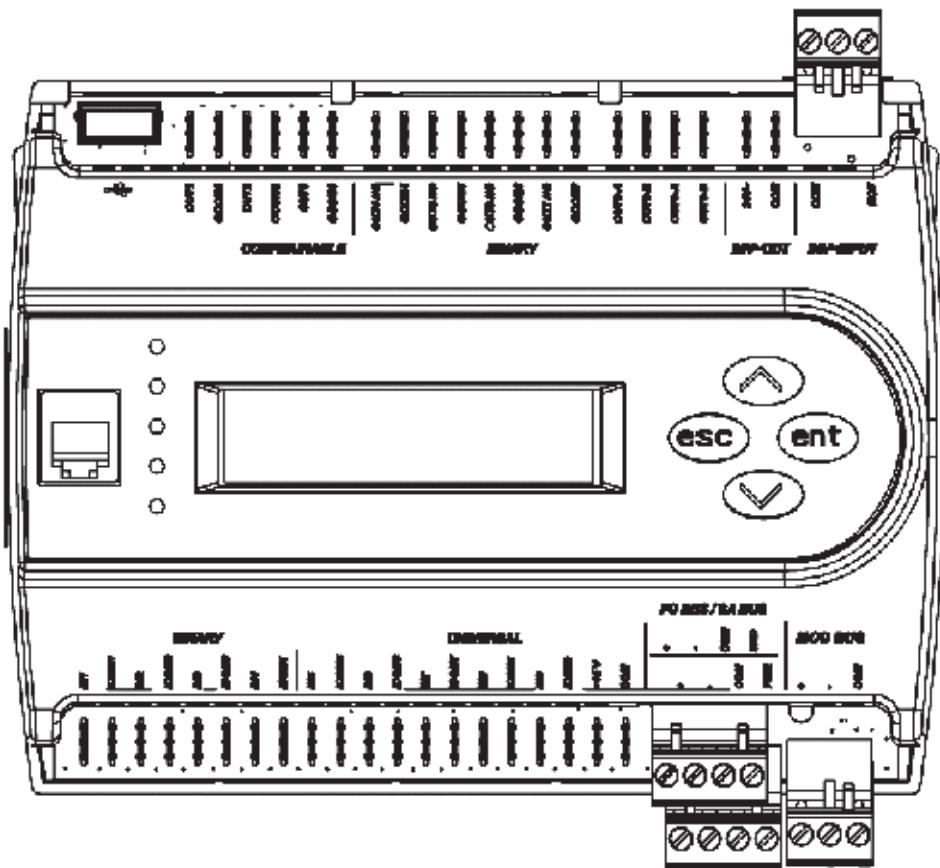


OPERATING INSTRUCTIONS

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

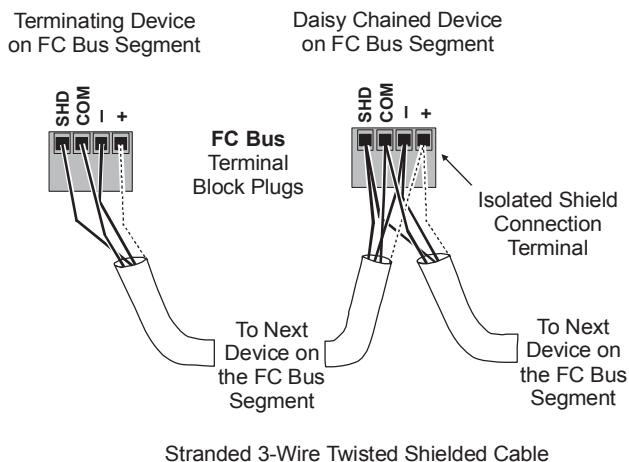


To access our online *BACnet Controller Technical Manual*, use your phone to scan this code for additional information. It includes instructions regarding points lists and setting common parameters.



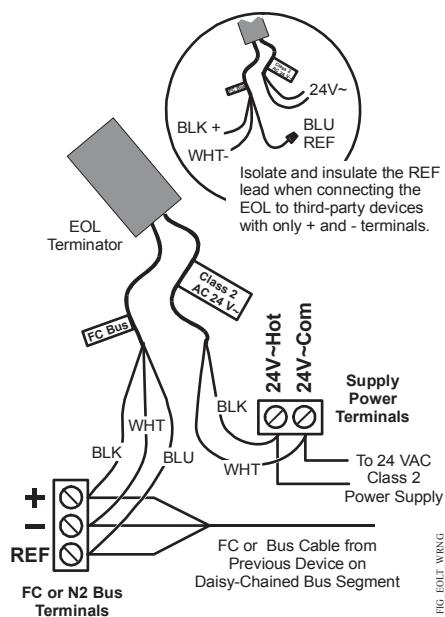
MS/TP NETWORK CONNECTION

- Use stranded 3-wire twisted, 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/RESET / OCCUPIED MODE

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

MAKEUP AIR w/RESET & 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 maintain Zone Set Point based on PID loop.
3. If Zone Temperature is above Zone Set Point plus Differential and Continuous Fan Operation is set to “No” then Supply Fan and Burner stop.
4. If Zone Temperature is above Zone Set Point plus Differential and Continuous Fan Operation is set to “Yes” then Supply Fan continues to run and Burner stops.
5. Burner will not operate if Outdoor Temperature is above Heating Lockout Set Point.

SUMMER VENT MODE

1. SF Bypass is set to “Yes”
 - a. If Zone Temperature is above Zone Set Point then Supply Fan starts.
 - b. If Zone Temperature is below Zone Set Point minus Differential then Supply Fan stops.
2. SF Bypass is set to “No”
 - a. If Zone Temperature is above Zone Set Point then Supply Fan starts.
 - b. If Zone Temperature is below Zone Set Point minus Differential then Supply Fan stops.
 - c. Supply Fan will not operate if Outdoor Temperature is above Zone Temperature.

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

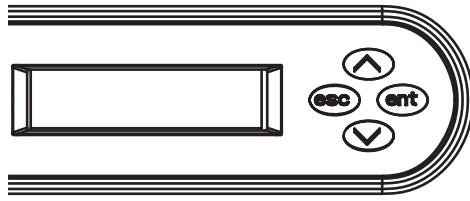
The controller will function to control the unit without the network being connected, provided that a Zone Temperature Sensor is connected.

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

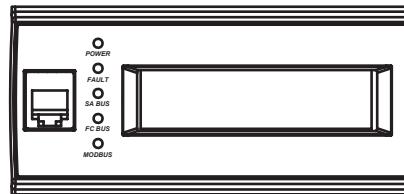
The controller includes an onboard illuminated LCD display and 4 buttons for monitoring and adjustment.



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 Mobilith AW2 grease. Grease should be bearing quality and compatible to lithium bases thickener.

MOTOR BEARING LUBRICATION

Motors are pregreased normally with Exxon Polyrex EM. Equivalent greases which are compatible with the 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	
Continuous Operation - Severe Service (High ambient, dirty or moist location, high vibration)	6 months	

FILTERS

Filters may be provided in a V-bank filter section. Filters may be of the disposable or permanent type.

Service the filters as needed based on the “loading” experienced. Clean filters typically start out with a pressure drop across the filters between 0.15 and 0.25” WC. Cleaning or replacement is generally required below the pressure drop increased by a factor of 4 times the initial clean value.

Turn off the heater before servicing the filters. Remove the filters from the filter section by opening the filter access door. Handle the filters carefully to prevent debris from being dislodged from the filter into the heater.

Permanent Filters are 2” thick expanded aluminum washable filters in aluminum frames.

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 Filters are 2” thick cotton/polyester panels with galvanized expanded metal pleat support grids and beverage board frames.

Disposable 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.

Model	Quantity	Size
S400/S800	2	20" x 25" x 2"
S950/S1200/S1600	4	20" x 25" x 2"
S1850/S2200/S3200	12	16" x 25" x 2"

BELT TENSIONING

Using a Browning Belt Tension Checker and a straight edge, verify proper belt tension according to the following table:

Model	HP	Belt(s)		Center Span Deflection	Force (lbs)	
		Qty	Type		New Belts	Used Belts
S400/ S800	1	1	A	1/4"	2 - 3	1 - 2
S400/ S800	2	1	A	1/4"	2½ - 4	1½ - 3
S950/ S1200	2	1	BX	1/4"	3 - 4½	2 - 3½
S800/ S950/ S1200	3	2	BX	1/4"	4½ - 6	4 - 5½
S1200/ S1600	5	2	BX	1/4"	3 - 5	2½ - 4
S1850/ S2200	5	2	BX	7/16"	5 - 7	4½ - 6½
S1850/ S2200	7½	2	BX	7/16"	6 - 8	5½ - 7
S2200/ S3200	10	2	BX	7/16"	6½ - 8½	6 - 7½
S2200/ S3200	15	2	BX	7/16"	7 - 9	6 - 8

Periodic belt adjustments may be required. Indications of loose belts include barking or squealing when the blower starts.

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.

⚠ CAUTION:

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 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 the next 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. Reinstall the burner using the above steps in reverse order.

GAS TRAIN LEAK CHECK

Periodically check the gas control assembly, internal and external piping for leaks. Refer to the Gas Train Leak Check procedure (page 58). All relief vents on the gas controls should be checked for blockage (gas pressure regulators and pressure switches).

GAS VALVE CLEANING

All solenoid valves should be cleaned periodically. The time between cleanings will vary depending on the medium and the 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 the Gas Valve Leak Check procedure (page 58).

⚠ WARNING:

In the extreme case, 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:

Before servicing the valve, turn off the 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.

ASCO Gas Valves: Series 8214

Disassemble the valve (page 82) 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 subassembly and body gasket.
3. Lubricate the bonnet gasket and body gasket with a light coat of Dow Corning® 200 Fluid lubricant or an equivalent high-grade silicone fluid.
4. Apply a light coat of RemGrit TFL 50® Dry Lubricant to: the valve seat; the valve body surface where the diaphragm assembly contacts the valve body and body gasket; and the 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.

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

⚠ WARNING:

Before returning to service, check the valve for proper operation and perform Gas Valve Leak Check and Gas Train Leak Check procedures (page 27-28).

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.

* Indicates parts supplied in ASCO Rebuild Kit.

BONNET SCREW

SOLENOID BASE *
SUBASSEMBLY

BONNET GASKET *

VALVE BONNET

CORE/DIAPHRAGM *
SUBASSEMBLY

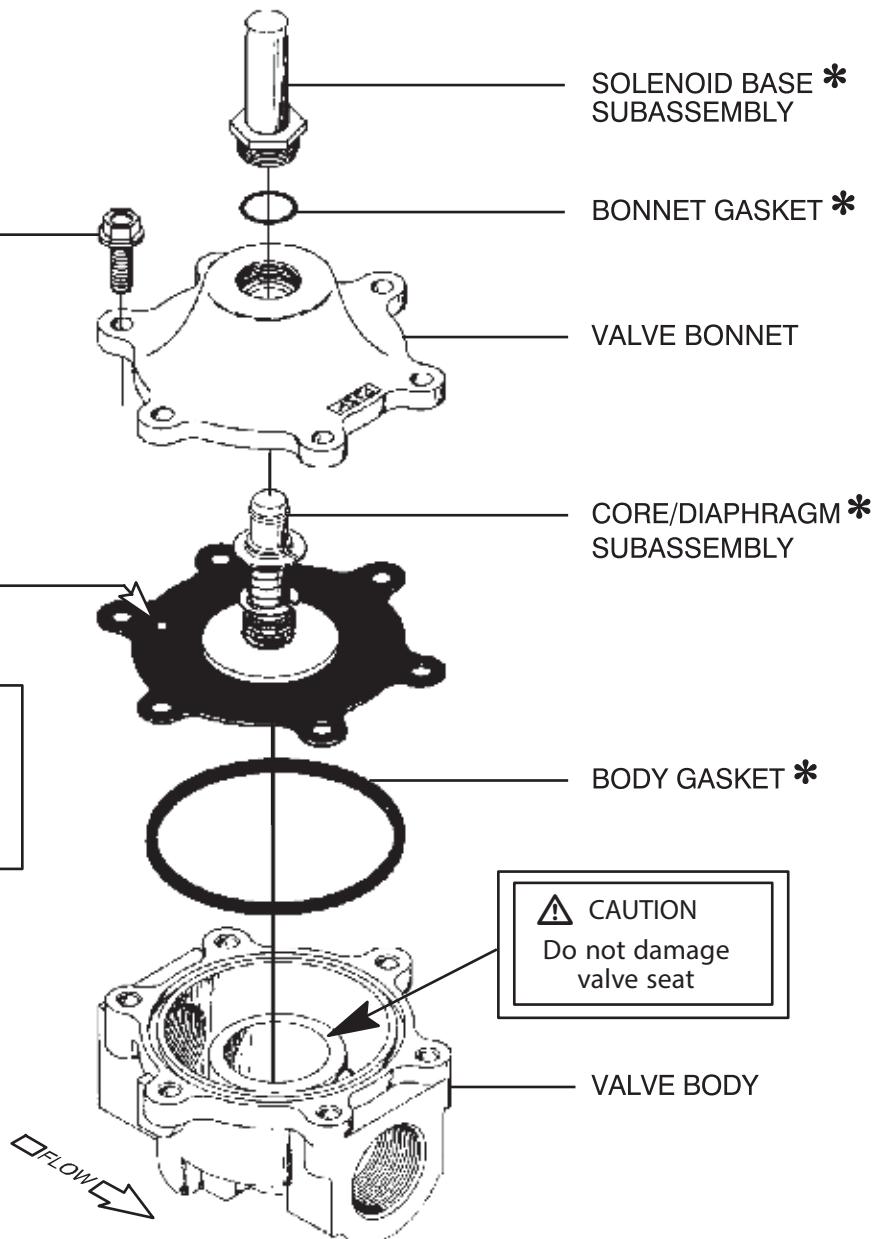
BLEED HOLE

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

BODY GASKET *

CAUTION
Do not damage valve seat

VALVE BODY



Disassembled View of ASCO Valve

TROUBLESHOOTING INSTRUCTIONS

TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
I. No Blower Operation	1. Unit in Reset a) Outside temperature below LTC setpoint in Vent Mode b) Gas Valve not energized during call for heat cycle	a) Turn unit OFF momentarily and turn unit ON. b) See Problem III.
	2. Heater Disconnect a) Disconnect in OFF position	a) Turn disconnect ON.
	3. Mode Selector Switch on RCS a) Switch in OFF position b) Defective Switch	a) Place switch in proper mode. b) Replace switch.
	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 fuse tripped due to damper motor over-stroking b) Damper end switch not made c) Defective damper motor	a) Adjust damper stroke (page 54). b) Check end switch/cam interface. 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 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 INSTRUCTIONS

TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
II. BLOWER RUNS; NO HEAT; FLAME SAFETY RELAY DOESN'T LOCK OUT	<p>1. Mode Selector Switch</p> a) Switch in VENT position b) Defective Switch <p>2. Burner Service Switch</p> a) Switch in OFF position b) Defective switch <p>3. Multi-Functional PC Board</p> a) No input voltage on Terminal W (RCS) b) Inlet temperature above EAT setpoint c) Improper wiring d) Defective board <p>4. Airflow Switch</p> a) Blower running backwards b) Belts slipping c) Blocked intake or discharge d) Clogged airflow tubing or pickup ports e) Defective switch <p>5. Flame Safeguard Relay</p> a) No input voltage b) Defective FSR	a) Place switch in HEAT position. b) Replace switch. a) Place switch in REMOTE position. b) Replace switch. a) Check voltage in RCS. b) Adjust EAT setpoint. c) Check wiring. d) Replace multi-functional PC board. 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. a) Check wiring. b) Replace FSR.
III. BLOWER RUNS; NO HEAT; FLAME SAFETY RELAY LOCKS OUT	<p>1. Igniter</p> a) No current (open igniter) b) No voltage <p>2. High Limit</p> a) High limit tripped <p>3. High or Low Gas Pressure Switches</p> a) Low gas pressure switch tripped b) High gas pressure switch tripped c) Defective gas pressure switch <p>4. Gas Valve</p> a) No input voltage b) Gas valve does not open c) Defective solenoid <p>5. Modulating Valve</p> a) Minimum fire set too low	During trial for ignition: a) Check igniter current. b) Check FSR output to igniter. a) See Problem Number VI (page 86). 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. 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. a) Adjust minimum fire on modulating valve.

TROUBLESHOOTING INSTRUCTIONS

TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
III. BLOWER RUNS; NO HEAT; FLAME SAFETY RELAY LOCKS OUT (Continued)	<p>6. Multi-Functional PC Board</p> <p>a) Low fire start set too low</p> <p>b) Thermistor open or not connected (rapidly blinking LED on PC board indicates open or shorted thermistor input)</p> <p>7. Regulator</p> <p>a) Clogged vent orifice</p> <p>b) No supply pressure</p> <p>c) Improper manifold pressure</p> <p>d) Defective regulator</p> <p>8. Burner</p> <p>a) Defective burner</p>	<p>a) Adjust modulating valve voltage between 10 and 13 Volts DC.</p> <p>b) Properly install or replace thermistor.</p> <p>a) Clean or replace orifice.</p> <p>b) Check all gas cocks and piping.</p> <p>c) Adjust regulator.</p> <p>d) Replace regulator.</p> <p>a) Replace burner.</p>
IV. BLOWER RUNS; BURNER FIRES; FLAME SAFETY RELAY LOCKS OUT	<p>1. Low Flame Current</p> <p>a) Dirt build-up on ceramic body</p> <p>b) Minimum fire set too low</p> <p>c) Defective burner</p> <p>2. Multi-Functional PC Board</p> <p>a) Low fire start set too low</p> <p>3. No Flame Current</p> <p>a) Ground connection open</p> <p>b) Wire termination oxidized</p> <p>4. Fluctuating Flame Current</p> <p>a) Unit overfiring</p> <p>b) Minimum fire set too low</p> <p>c) Intermittent ground connection</p> <p>d) Loose terminal on Flame Rod</p> <p>e) Defective burner</p> <p>5. Flame Safeguard Relay</p> <p>a) Defective FSR</p> <p>6. High Limit</p> <p>a) High limit contact intermittent</p>	<p>a) Clean dirt deposit from ceramic body and install protective boot.</p> <p>b) Adjust minimum fire on modulating valve.</p> <p>c) Replace burner.</p> <p>a) Adjust modulating valve voltage between 10 and 13 Volts DC.</p> <p>a1) Reference transformer to ground.</p> <p>a2) Secure ground between control enclosure and burner.</p> <p>a3) Tighten loose ground screws.</p> <p>b) Clean terminal and reinsert.</p> <p>a) Check manifold pressure.</p> <p>b) Adjust minimum fire on modulating valve.</p> <p>c) Tighten all ground points.</p> <p>d) Remove jam nuts from Flame Rod. Reassemble with terminal located between jam nuts on Flame Rod.</p> <p>e) Replace burner.</p> <p>a) Replace FSR.</p> <p>a) Replace high limit.</p>

TROUBLESHOOTING INSTRUCTIONS

TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
V. BLOWER RUNS; UNIT HEATS; SHORT CYCLES WITHOUT RESETTING	<p>1. Air Flow Switch</p> <p>a) Blower running backwards b) Belts slipping c) Blocked intake or discharge d) Air delivery below unit specs e) Clogged airflow tubing or pick-up ports f) Defective switch</p> <p>2. Flame Safeguard Relay</p> <p>a) Defective FSR</p> <p>3. Operating Thermostat</p> <p>a) Differential temperature setting too tight b) Open or short in thermistor circuit</p> <p>4. Damper Motor End Switch</p> <p>a) End switch making intermittent contact</p>	<p>a) Reverse motor direction. b) Tighten and/or replace belts. c) Find and remove obstruction. d) Increase fan RPM for air delivery requirements. e) Clean or replace airflow tubing or pick-up ports. f) Replace switch.</p> <p>a) Replace FSR.</p> <p>a) Increase differential temperature setting. b) Check wiring or replace thermistor.</p> <p>a) Replace end switch assembly.</p>
VI. HIGH LIMIT TRIPPED	<p>1. High Limit</p> <p>a) High limit will not reset</p> <p>2. Unit Overfiring</p> <p>a) Manifold pressure too high</p> <p>3. Discharge Damper</p> <p>a) Damper blades partially closed b) Defective damper motor</p> <p>4. Low Airflow</p> <p>a) Blower running backwards b) Belts slipping c) Blocked intake or discharge</p> <p>5. Temperature Control System</p> <p>a) Temperature control system does not modulate</p>	<p>a) Replace high limit.</p> <p>a) Adjust appliance regulator to obtain temperature rise specified on nameplate.</p> <p>a) Adjust damper stroke length. b) Replace damper motor.</p> <p>a) Reverse motor direction. b) Tighten or replace belts. c) Find and remove obstruction.</p> <p>a) See problem VIII (page 86).</p>
VII. BLOWER RUNS; UNIT HEATS; WILL NOT CYCLE OFF	<p>1. Operating Thermostat</p> <p>a) Short in thermistor circuit b) Thermostat located improperly c) Thermostat differential setting too wide d) Defective thermostat</p> <p>2. Burner Service Switch</p> <p>a) Switch in LOCAL position</p> <p>3. Auxiliary Control</p> <p>a) Auxiliary contacts closed</p> <p>4. Misunderstood Control System Operation</p> <p>a) Control system doesn't function as expected</p>	<p>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.</p> <p>a) Place switch in REMOTE position.</p> <p>a) Check auxiliary circuit wiring and contacts.</p> <p>a) Review control system operational characteristics.</p>

TROUBLESHOOTING INSTRUCTIONS

TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
VIII. MODULATING VALVE DOES NOT MODULATE; CONTINUOUS HIGH FIRE	<p>1. Amplifier (A1014 or A1044 or AD1014)</p> <p>a) Wire not connected to amplifier terminal 3 or 4. Also terminal 5 on A1044 amplifier b) Jumper not installed between terminals 2 and 3 of A1014 or AD1014 c) Defective amplifier</p>	<p>a) Reinstall wire. b) Reinstall jumper. c) Replace amplifier.</p>
	<p>2. Discharge Temperature Sensor (TS114J or TS144)</p> <p>a) Discharge Air Temperature Sampling Tube clogged b) Open in sensor circuit c) Sensor cross-wired to amplifier d) Temperature Control System out of calibration</p>	<p>a) Clean Discharge Air Temperature Sampling Tube (page 69). b) Replace the sensor if the resistance measured at terminals 1 and 2 on TS114J sensor exceeds 15,000 Ω 1 and 3 or 2 and 3 on TS144 exceeds 6,000 Ω. c) Correct wiring terminations. d) Perform appropriate calibration procedure (pages 60-62).</p>
	<p>3. Space Temperature Selector (Series 44 only)</p> <p>a) Open in sensor circuit b) Induced voltage in field wiring c) Space sensor located improperly</p>	<p>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.</p>
	<p>4. Space thermostat (Series 14 only)</p> <p>a) Thermostat out of calibration b) Thermostat located improperly c) Thermostat differential setting too wide d) Thermostat defective</p>	<p>a) Recalibrate thermostat or replace. b) Thermostat in cold draft - relocate. c) Reduce differential setting. d) Replace thermostat.</p>
	<p>5. Remote Heat Adjust (TD114 or CEI 4175-0-960)</p> <p>a) Short in Remote Heat Adjust circuit b) Induced voltage in field wiring</p>	<p>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.</p>
	<p>6. Modulating Valve (M511, M611 or MR212)</p> <p>a) Foreign material holding valve open b) Modulating valve misassembled</p>	<p>a) Disassemble valve and remove foreign material. b) Disassemble valve and assemble correctly.</p>

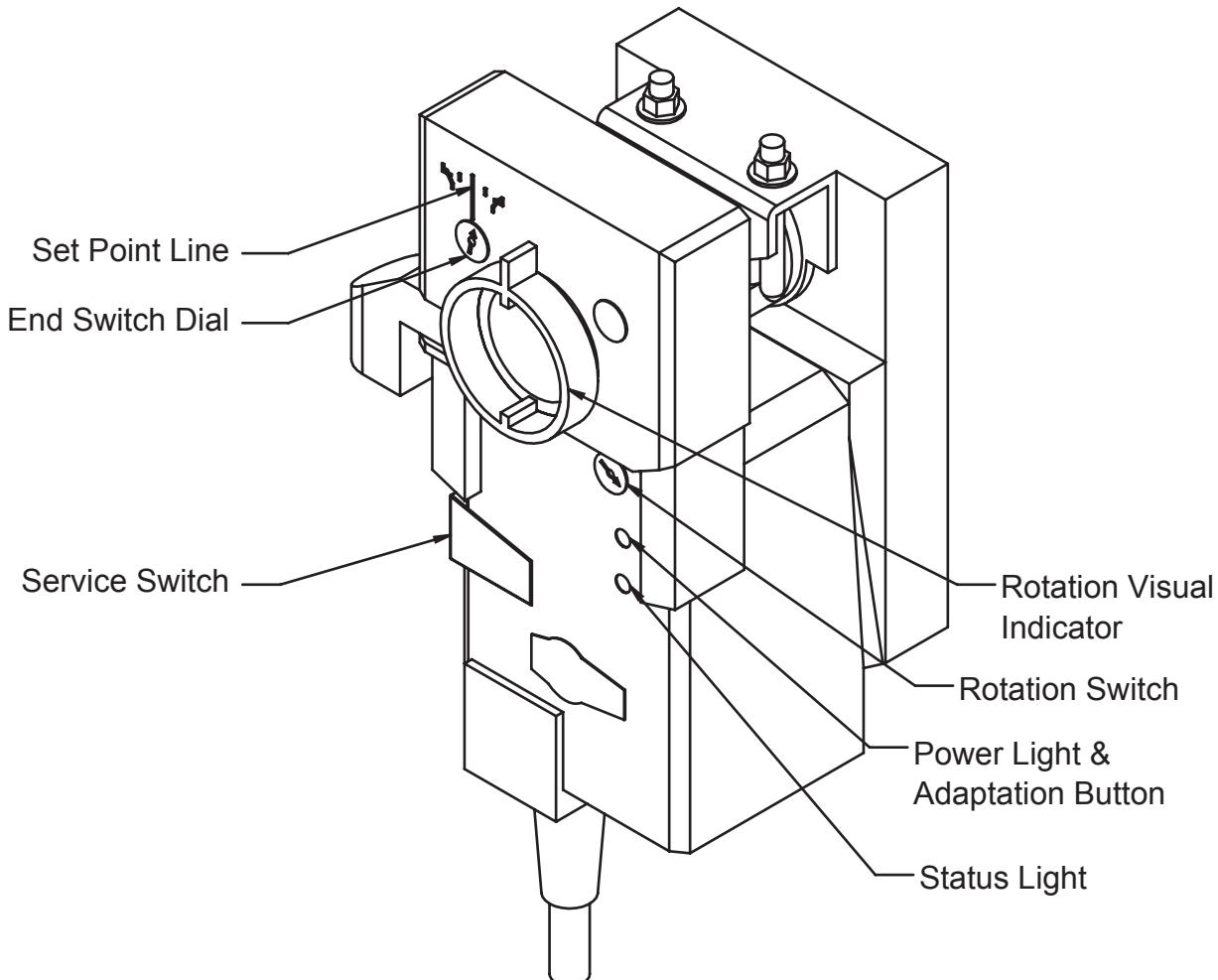
TROUBLESHOOTING INSTRUCTIONS

TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
IX. MODULATING VALVE DOES NOT MODULATE;	1. Class 2 Transformer a) No voltage output to amplifier	a1) Check for short in modulating valve coil. a2) Replace transformer.
CONTINUOUS LOW FIRE	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 $40\ \Omega$ or greater than $85\ \Omega$. 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 (TS114J 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 TS114J is less than $8,000\ \Omega$; terminals 1 and 3 or 2 and 3 on TS144 is less than $2,900\ \Omega$. b) Perform temperature control system calibration.
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 appropriate calibration procedure (pages 60–62). c) Replace amplifier.
	3. Space Temperature Selector (T244 or TS244/TD244) a) Induced voltage in field wiring	a) Utilize shielded, twisted pair wiring.
	4. Remote Heat Adjust (TD114 or CEI 4175-0-960) a) Induced voltage in field wiring	a) Utilize shielded, twisted pair wiring.

TROUBLESHOOTING INSTRUCTIONS DAMPER MOTOR REPLACEMENT & ADJUSTMENT

1. Verify the heater disconnect switch is turned “OFF” and the service switches are in the “OFF” position.
2. Remove the junction box cover and disconnect the damper motor wires going to snap connectors 1, 3, and N1.
3. Release the wire strain relief using pliers and remove the damper motor wire from the bundle.
4. Remove the end switch from the damper motor by pulling out and unclipping the connections.
5. Disconnect the cotter pin from the motor drive pin to release the drive linkage.
6. Unscrew the motor bracket screws using a 3/8” socket.
7. Flip the motor bracket and unscrew the damper motor from the damper motor bracket using a Philips screwdriver.
8. Attach the new damper motor using the Phillips screws.
9. Attach the damper motor bracket back to the heater.
10. Feed the damper wire into the junction box and connect the red wire to snap connector 1, the white wire to 3, and the black wire to N1.
11. Include the new damper motor wire with the end switch wire and reattach the strain relief using pliers.
12. Reattach the junction box cover.
13. Turn the disconnect switch “ON” and turn the service switches to the “REMOTE” position.



WHAT ARE SOME COMMON PROBLEMS OR ERRORS?

Installation

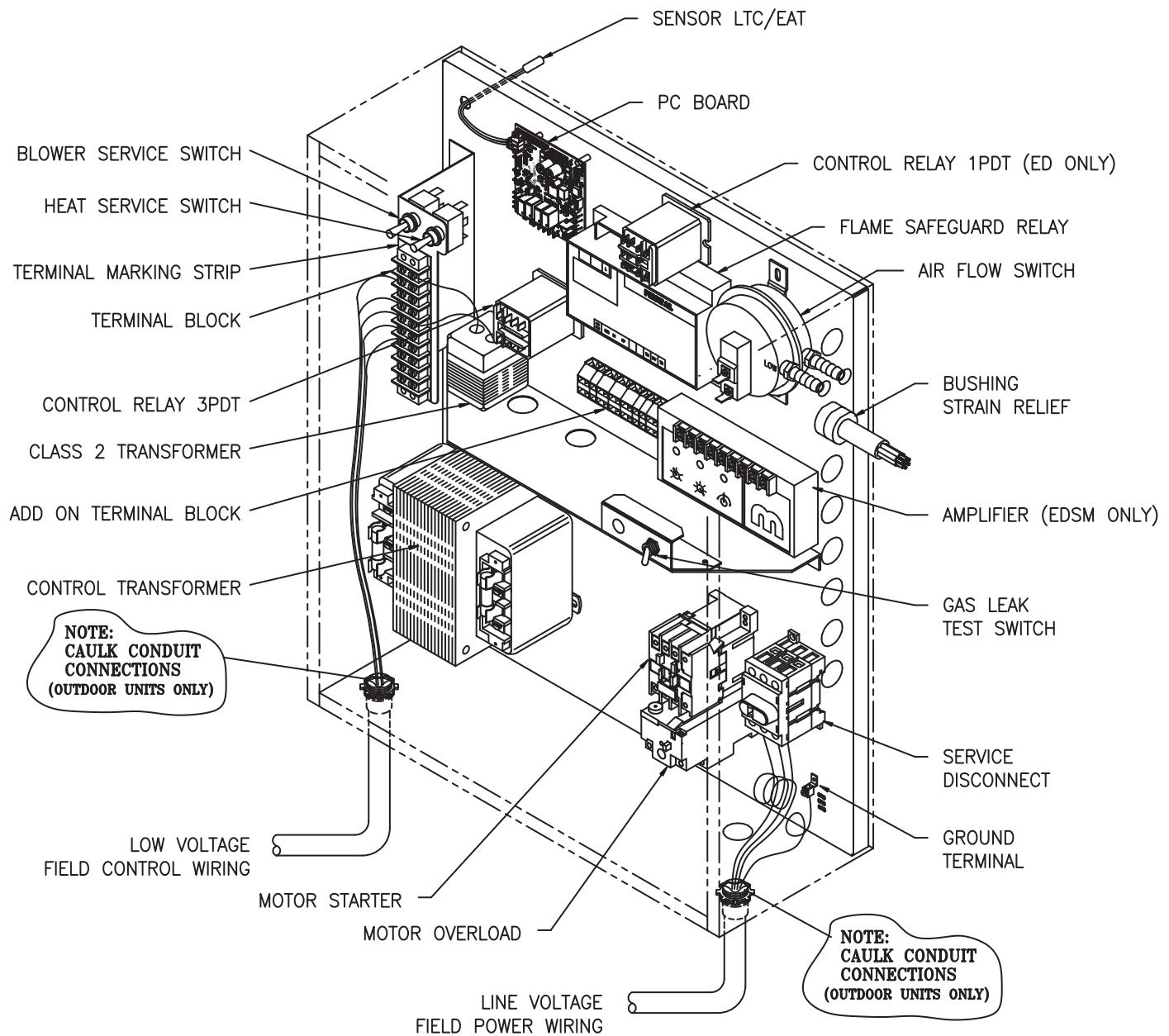
- **Swapping the power wires**
 - The lights flicker and the damper motor stutters
 - Hot and neutral switched
 - The damper is open in with the blower switch in local but does not close when the switch is in “OFF”
 - Hot and control wire switched
- **The end switch is not seated**
 - Damper opens and closes
 - The arrow on end switch does not move
 - The blower turns on when damper is closed
 - The blower never turns on
- **The end switch is installed in wrong slot**
 - Similar problems to an end switch not seated
 - May have no operation errors
- **The end switch is not set**
 - The blower never turns on
 - The blower is always on
- **The direction switch on the damper motor is set backwards**
 - In “LOCAL” the damper closes
 - In “OFF” the damper opens

Operation

- **The damper motor is running slowly**
 - The damper experienced a high current event and will run slowly for a number of cycles
- **The damper is closing when powered**
 - Reversed direction switch from the factory
- **The damper is not opening and lights on the damper are flickering**
 - Power and neutral wire switched
- **The damper opens but the blower does not come on**
 - The end switch is not seated correctly
 - The end switch is not set correctly

REFERENCE

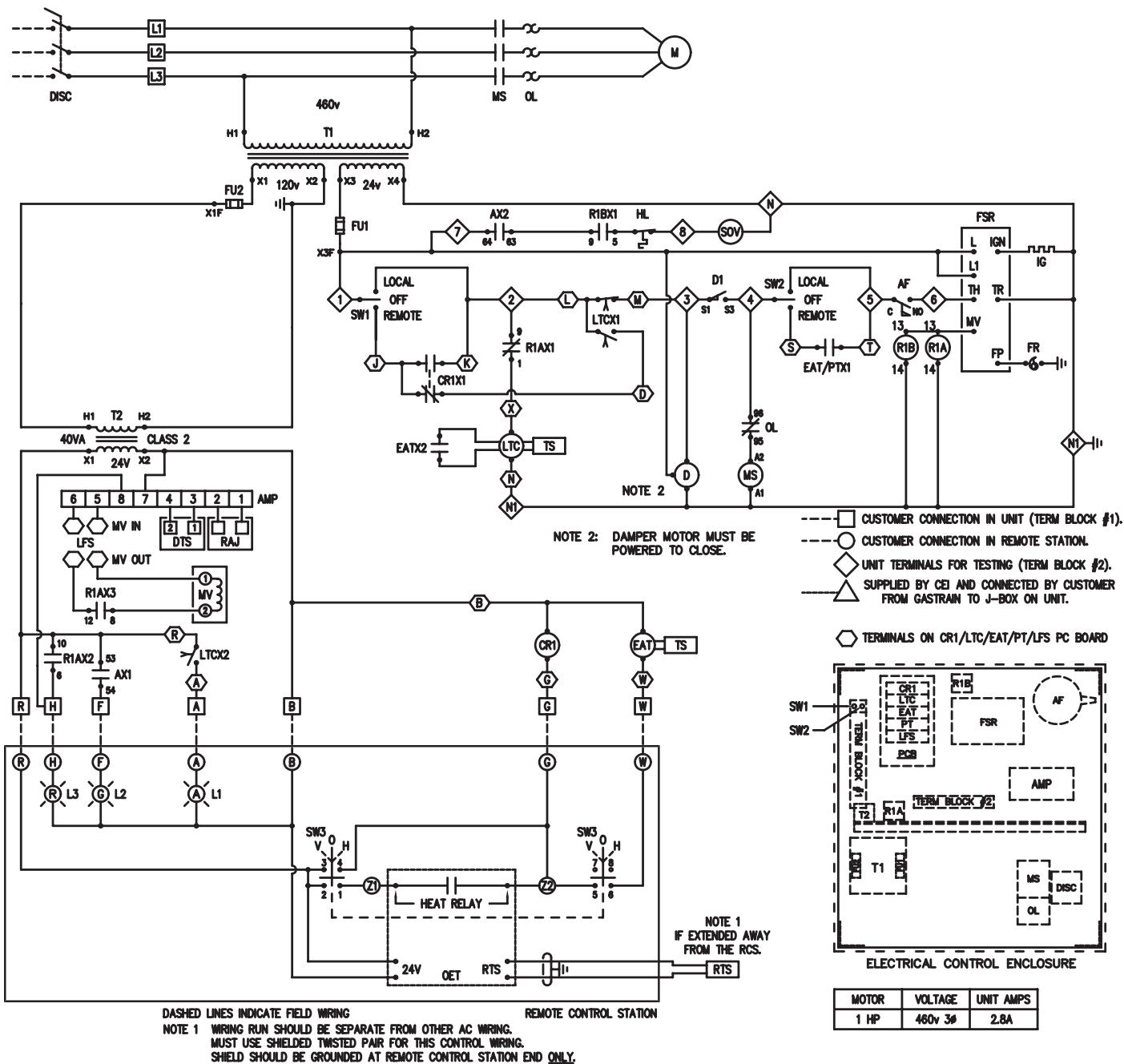
ELECTRICAL CONTROL ENCLOSURE ISOMETRIC DRAWING



REFERENCE ELECTRICAL WIRING DIAGRAMS

400,000 BTU & BELOW

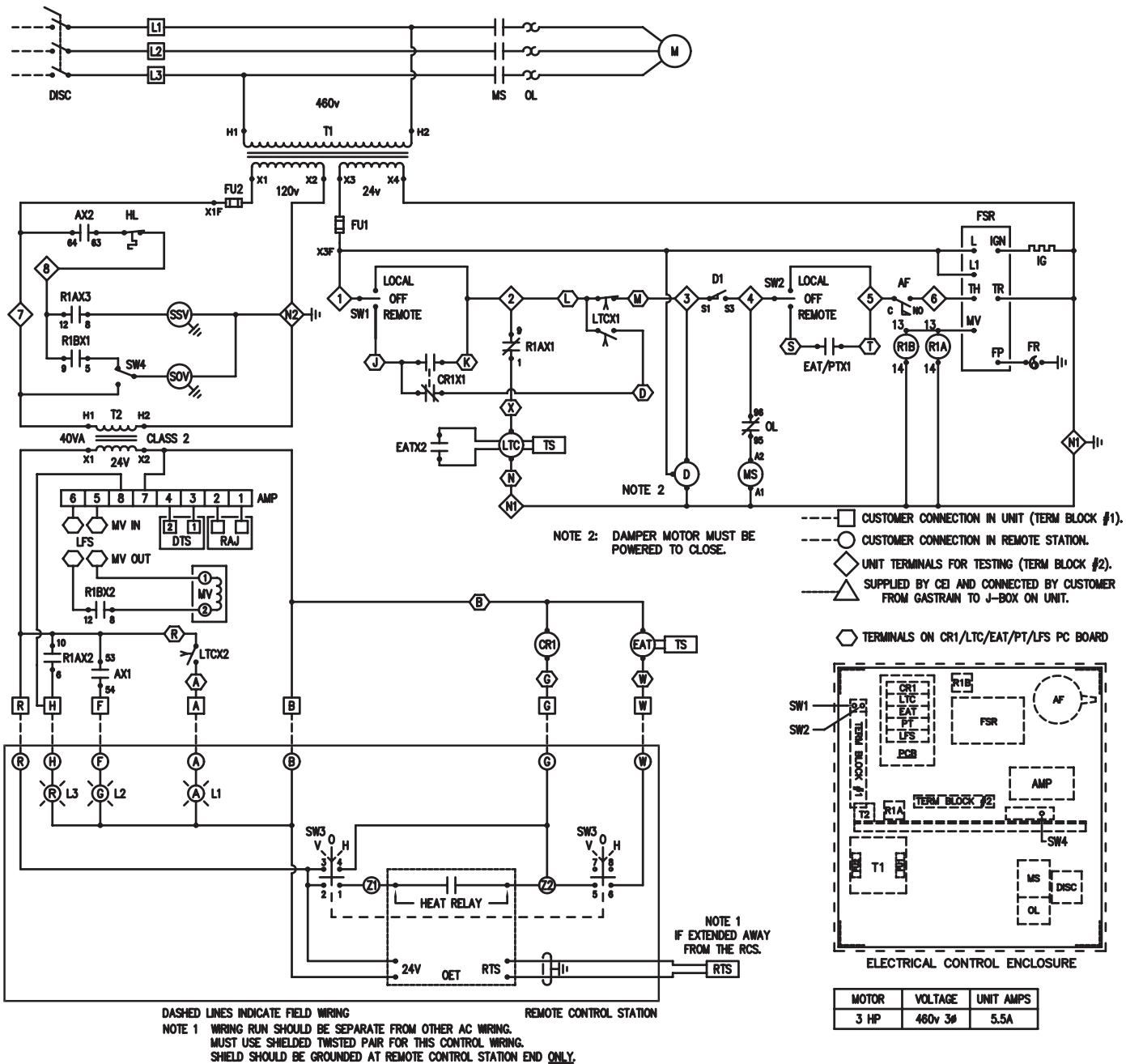
EDL Controls



Symbol	Description
AF	Air Flow Switch
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
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
LTC	Low Temperature Cutout
M	Motor
MS	Motor Starter
MV	Modulating Valve

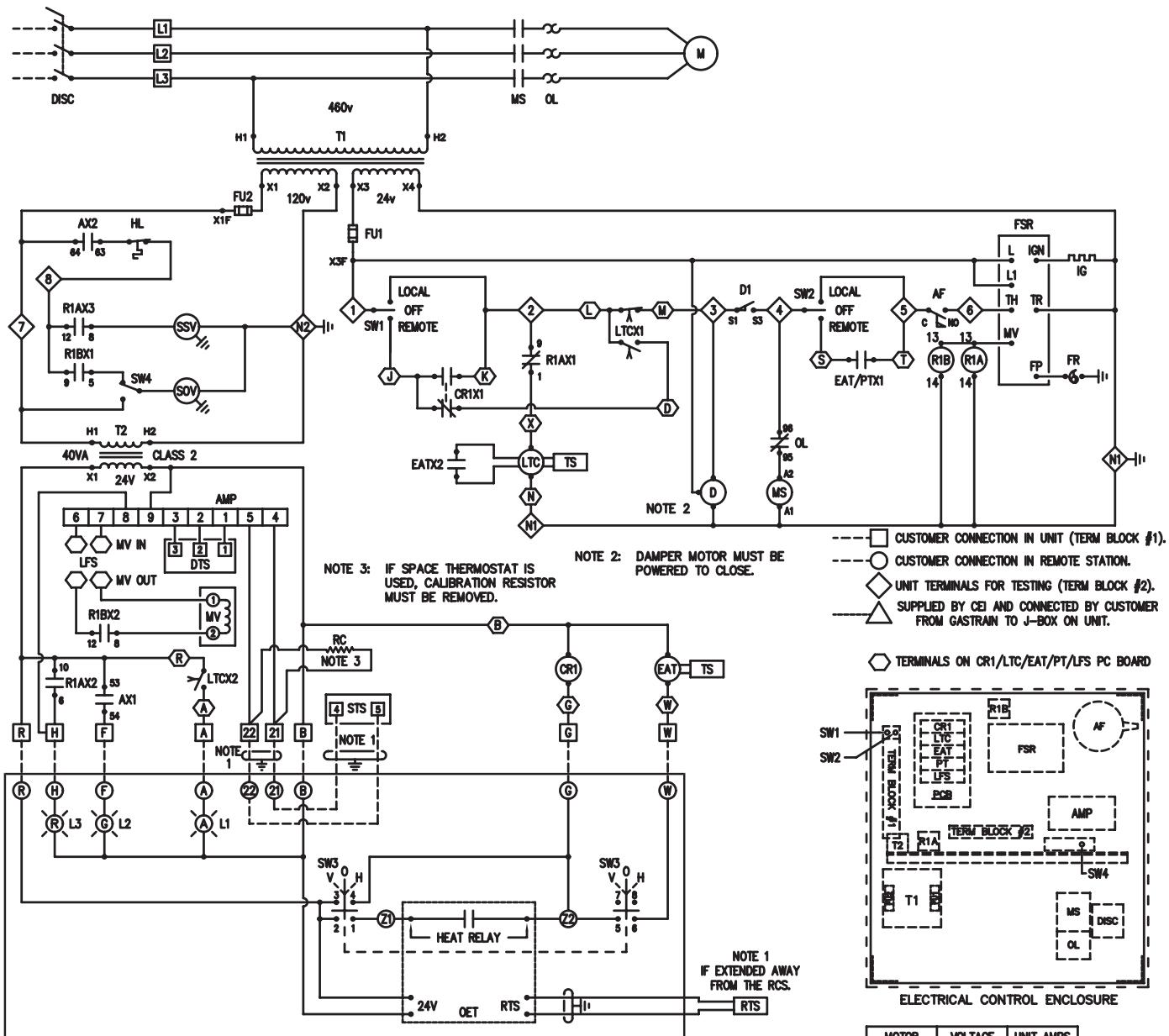
Symbol	Description
OL	Overload Relay
PCB	Printed Circuit Board
RTS	Remote Temperature Sensor
R1	Relay - Gas Valve
SOV	Shut-Off Valve - Gas
SW1	Service Switch - Fan
SW2	Service Switch - Heat
SW3	Switch - Fan/Off/Heat
T1	Multi-Tap Transformer (24 & 120 Volt)
T2	Class 2 Transformer (24 Volt)
TS	Temperature Sensor - LTC/EAT



Symbol	Description
AF	Air Flow Switch
AMP	Amplifier Solid State
AX1	Auxiliary Contact
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M	Motor
MV	Modulating Valve
MS	Motor Starter

Symbol	Description
OL	Overload Relay
RTS	Remote Temperature Sensor
R1	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)

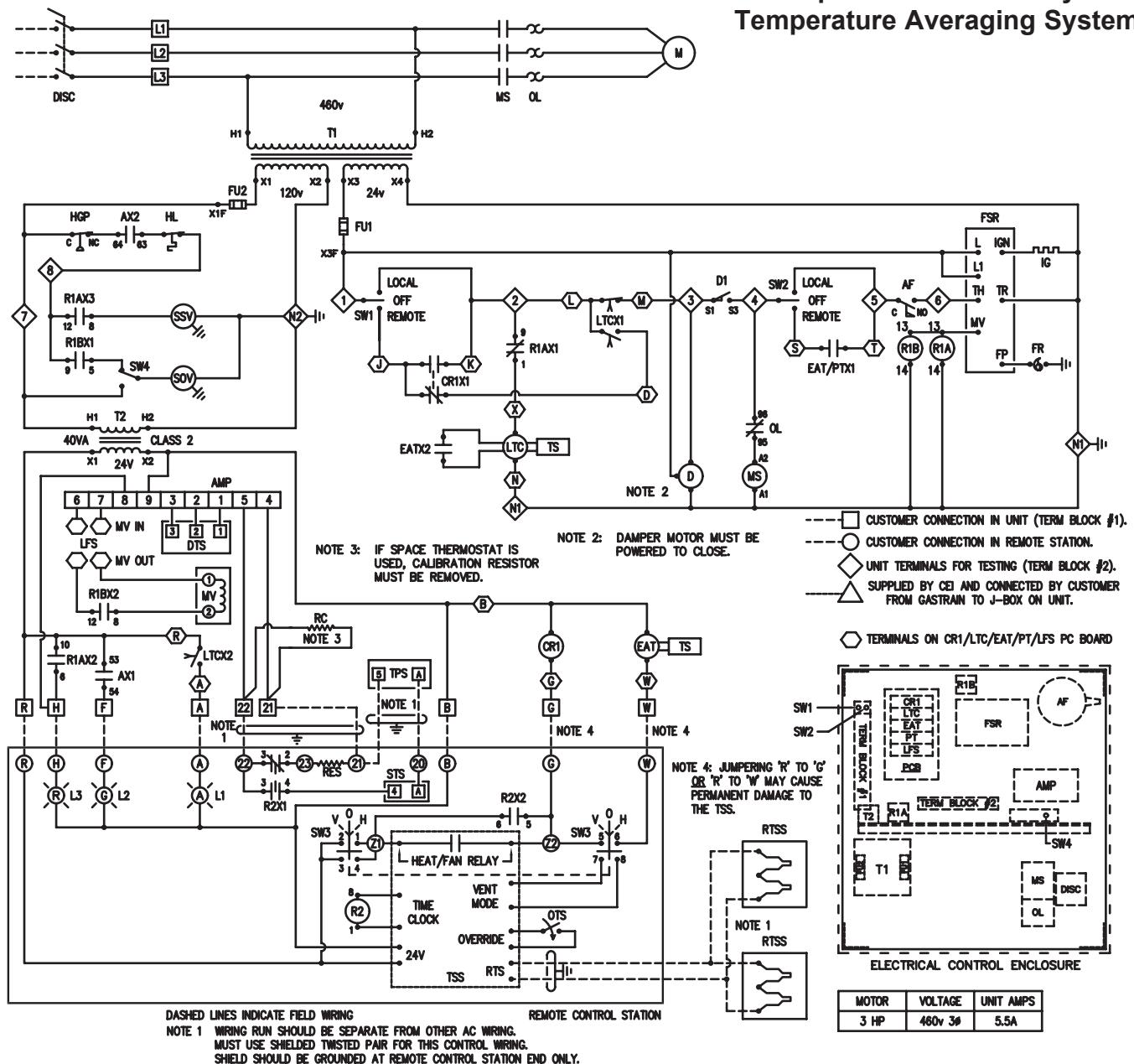


Symbol	Description
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AX	Auxiliary Contact
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DISC	Service Disconnect Non - Fused
DTS	Discharge Temperature Sensor
EAT	Entering Air Thermostat
FR	Flame Rod
FSR	Flame Safeguard Relay
FU1	Fuse 24 Volt Control

Symbol	Description
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
MS	Motor Starter
MV	Modulating Valve
OL	Overload Relay

Symbol	Description
R1	Relay - Gas Valve
RC	Calibration Resistor
RTS	Remote Temperature Sensor
SOV	Shut-Off Valve - Gas
SSV	Safety Shut-Off Valve - Gas
STS	Space Temperature Selector
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)

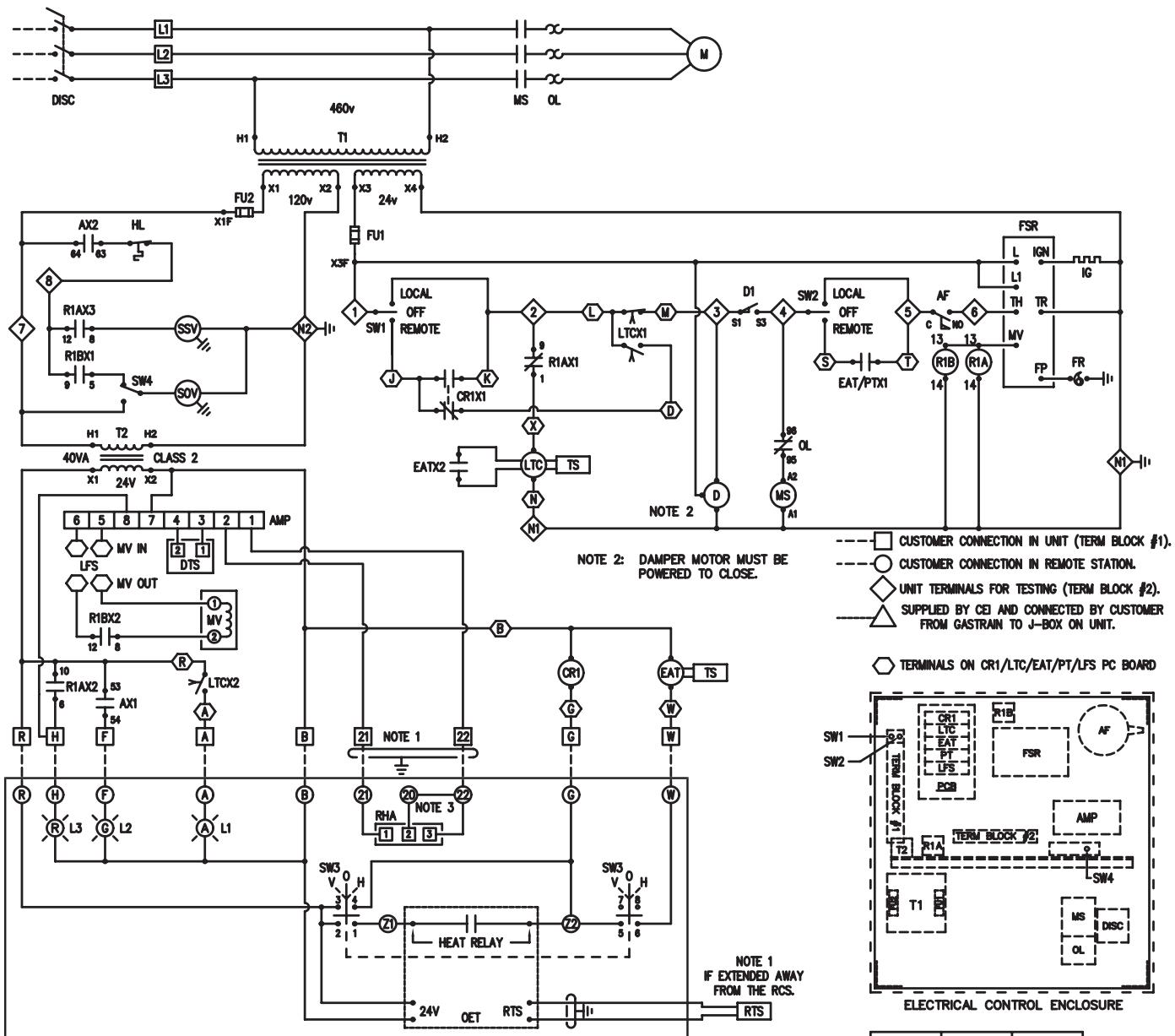
400,000 BTU & ABOVE
EDSM/TP Controls
Temperature Setback System
Temperature Averaging System



Symbol	Description
AF	Air Flow Switch
AMP	Amplifier Solid State
AX1	Auxiliary Contact
AX	Auxiliary Contact
CR1	Control Relay
D & D1	Damper Motor & End Switch
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L2	Light - Fan
L3	Light - Heat
LFS	Low Fire Start
LTC	Low Temperature Cutout
M	Motor
MS	Motor Starter
MV	Modulating Valve
OL	Overload Relay
OTS	Override Timer Switch
RC	Calibration Resistor

Symbol	Description
RTSS	Remote Temperature Sensor
R1	Relay - Gas Valve
SOV	Shut-Off Valve - Gas
SSV	Safety Shut-Off Valve - Gas
STS	Space Temperature Selector
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)
TPS	Tamperproof Sensor
TSS	Programmable Thermostat/Timer



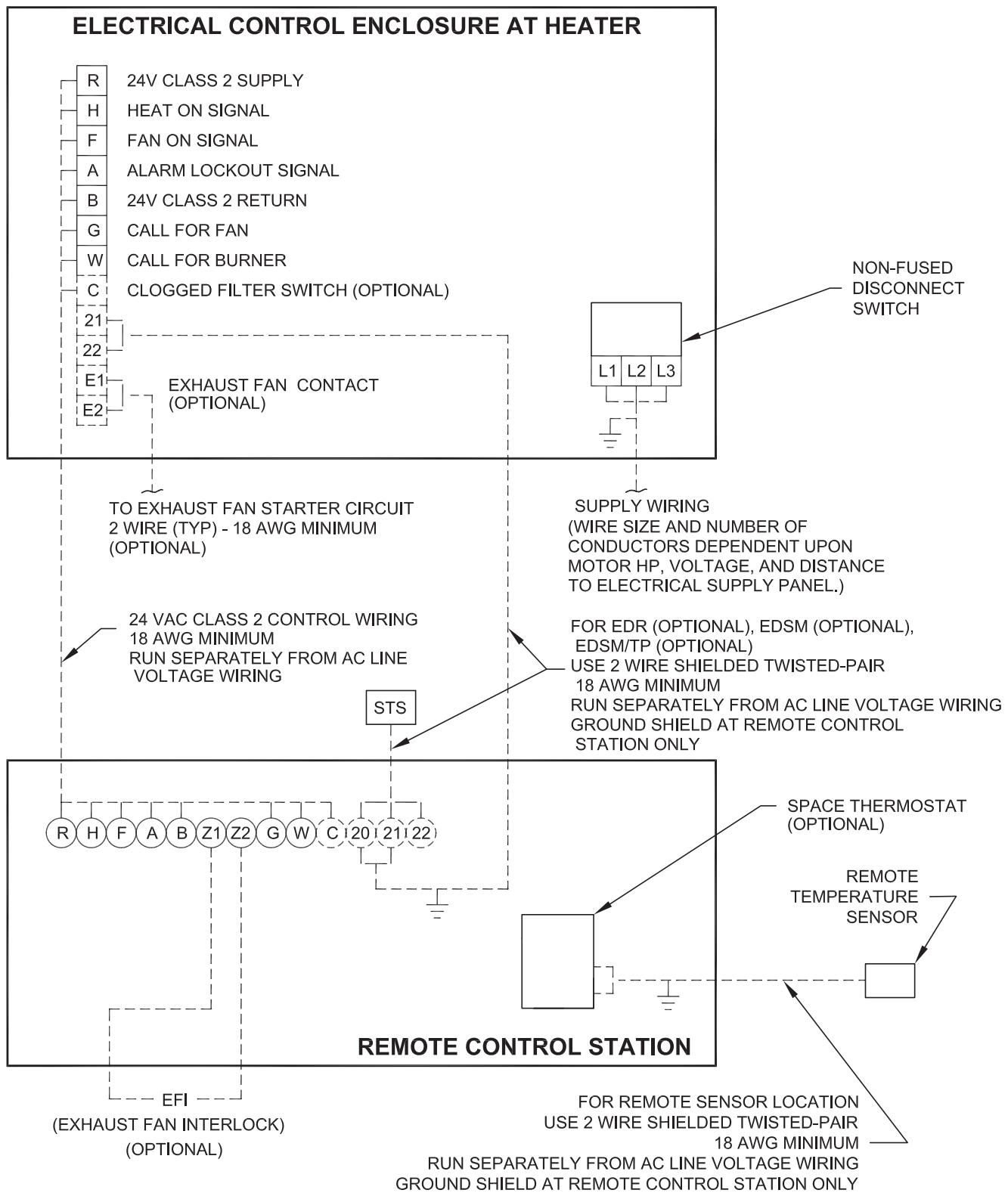
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FU1	Fuse 24 Volt Control

Symbol	Description
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
MS	Motor Starter
MV	Modulating Valve
OL	Overload Relay

Symbol	Description
RHA	Remote Heat Adjust
RTS	Remote Temperature Sensor
R1	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 - LTC/EAT

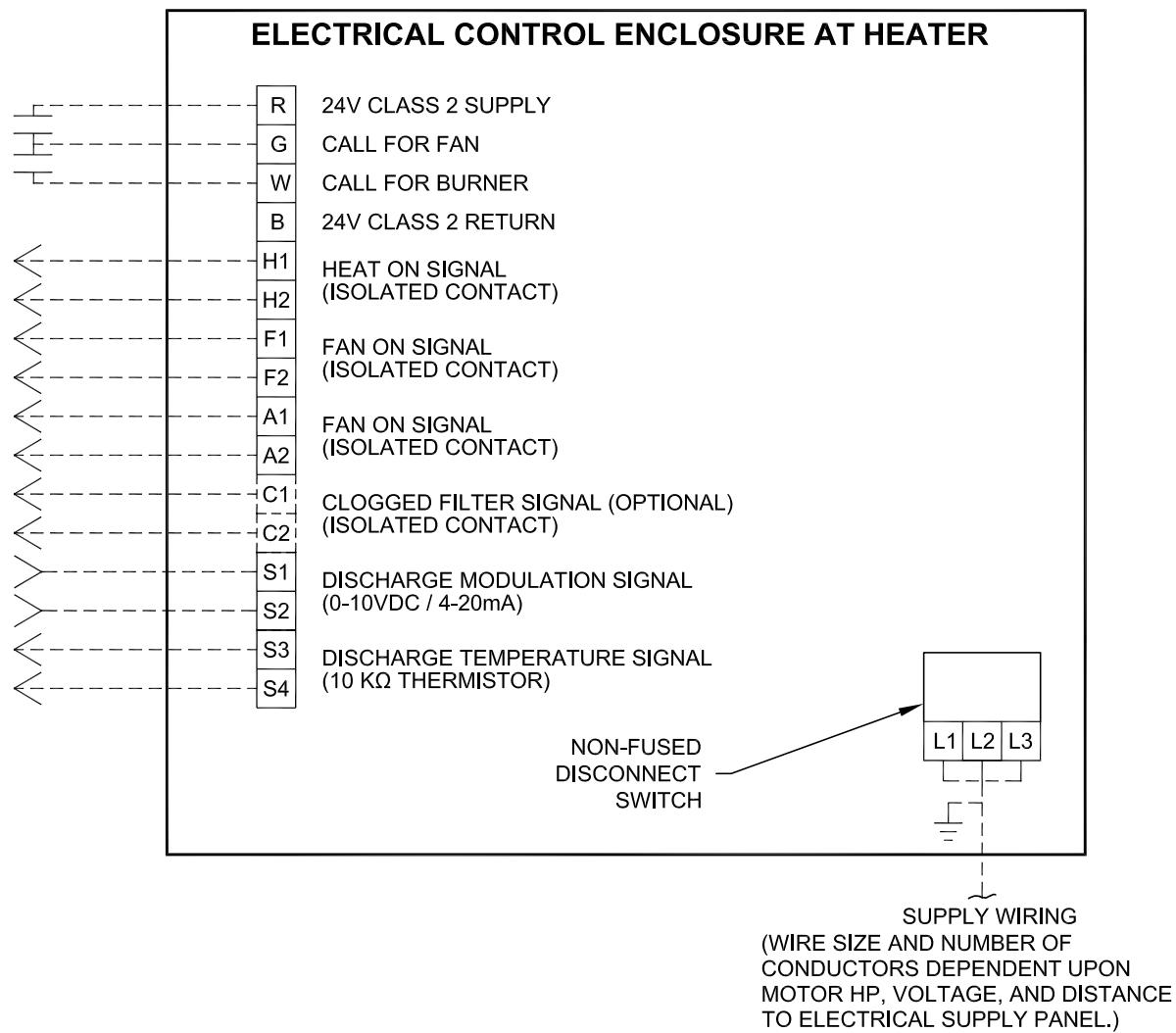
REFERENCE

REMOTE CONTROL STATION ELECTRICAL CONNECTION DIAGRAM



REFERENCE

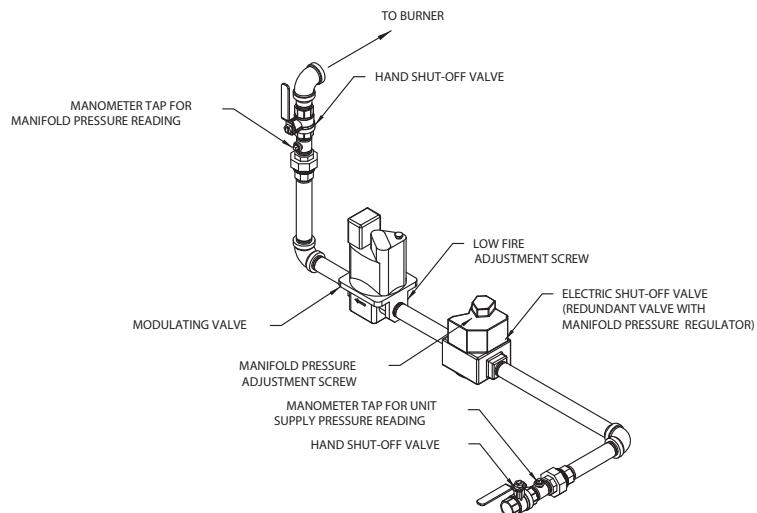
BUILDING AUTOMATION SYSTEM



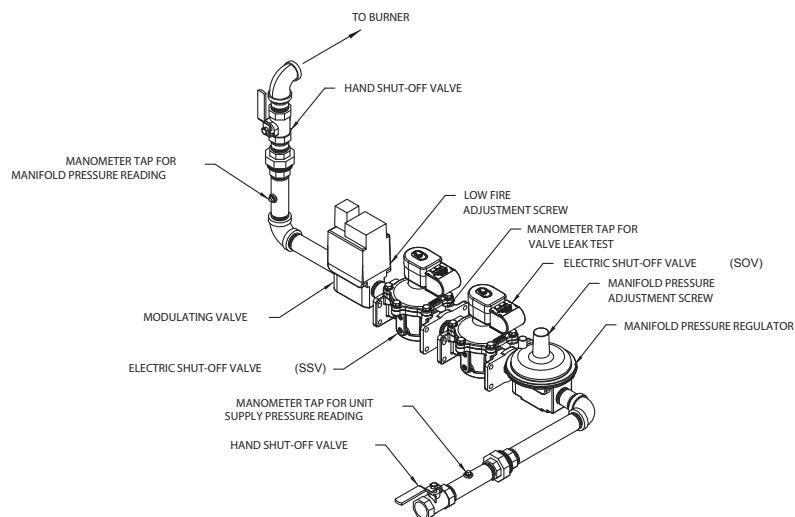
REFERENCE

GAS TRAIN DRAWINGS

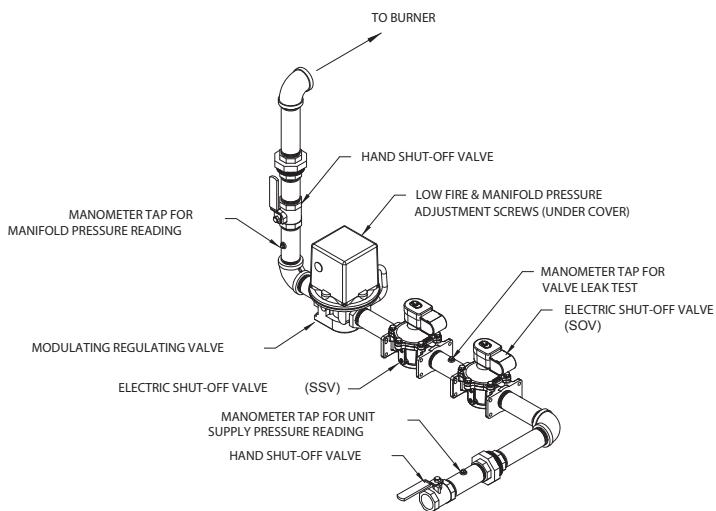
Under 400 MBH
CSA Certified¹
FM Compliant²
XL GAPS Compliant³



Over 400 MBH
Low Pressure
CSA Certified¹
XL GAPS Compliant³



Over 400 MBH
High Pressure
CSA Certified¹

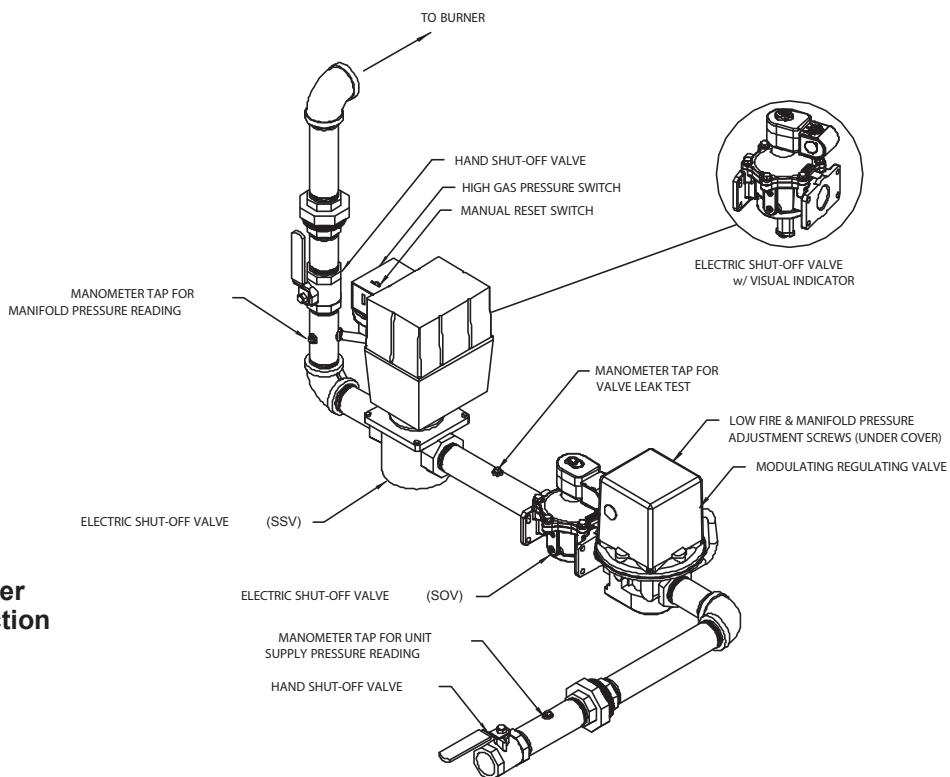
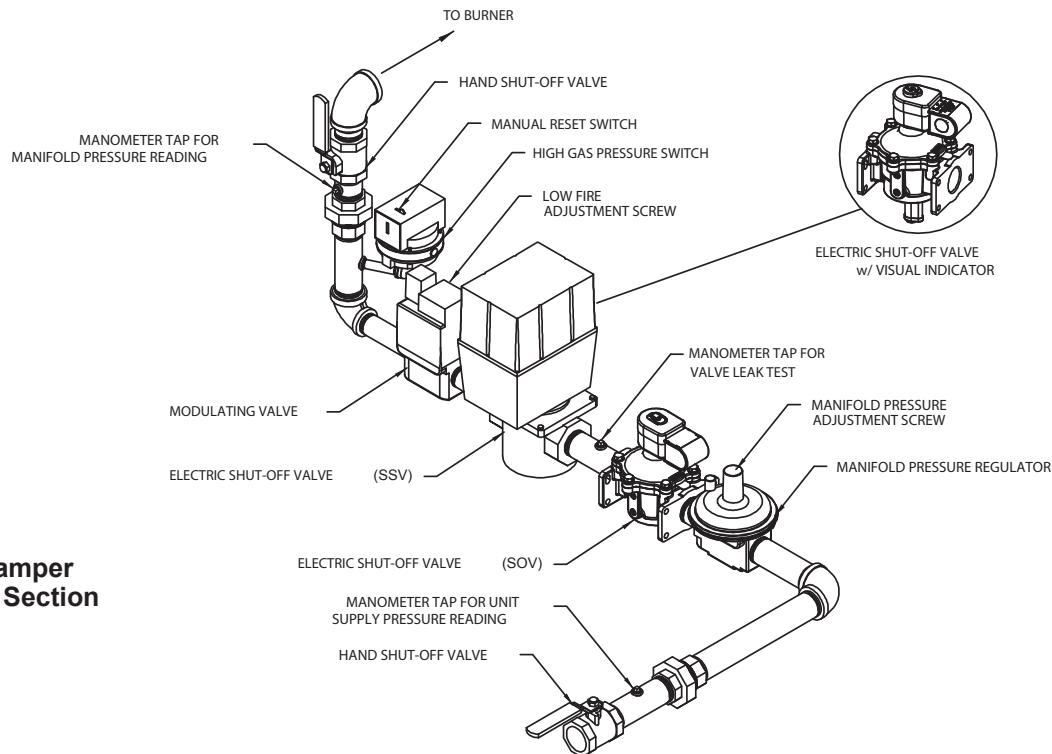


¹ Certified by CSA International to comply with ANSI Standard Z83.4/CSA3.7

² Complies with Factory Mutual insurance requirements

³ Complies with XL Insurance Global Asset Protection Services requirements

REFERENCE GAS TRAIN DRAWINGS



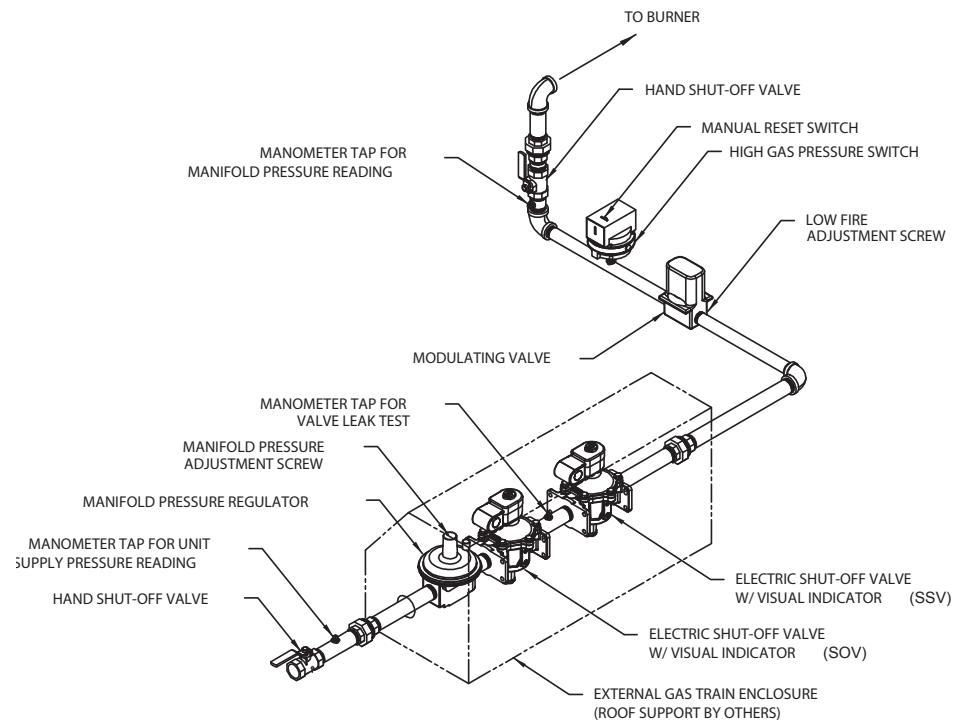
¹ Certified by CSA International to comply with ANSI Standard Z83.4/CSA3.7

² Complies with Factory Mutual insurance requirements

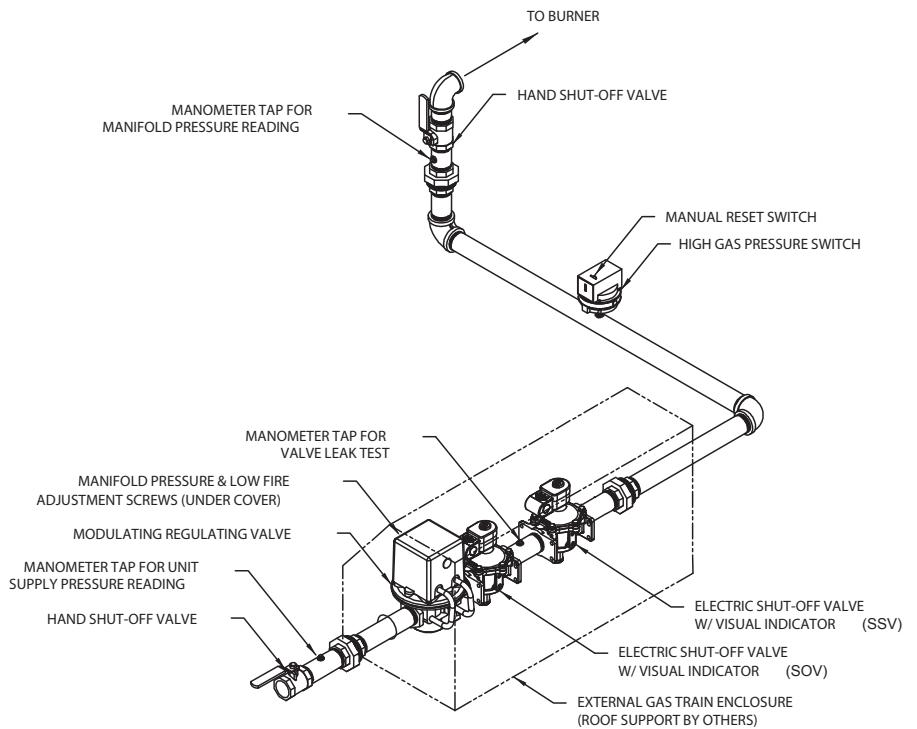
REFERENCE

GAS TRAIN DRAWINGS

Over 400 MBH
Without Discharge Damper
or with Filter Section
Low Pressure
CSA Certified¹
FM Compliant²



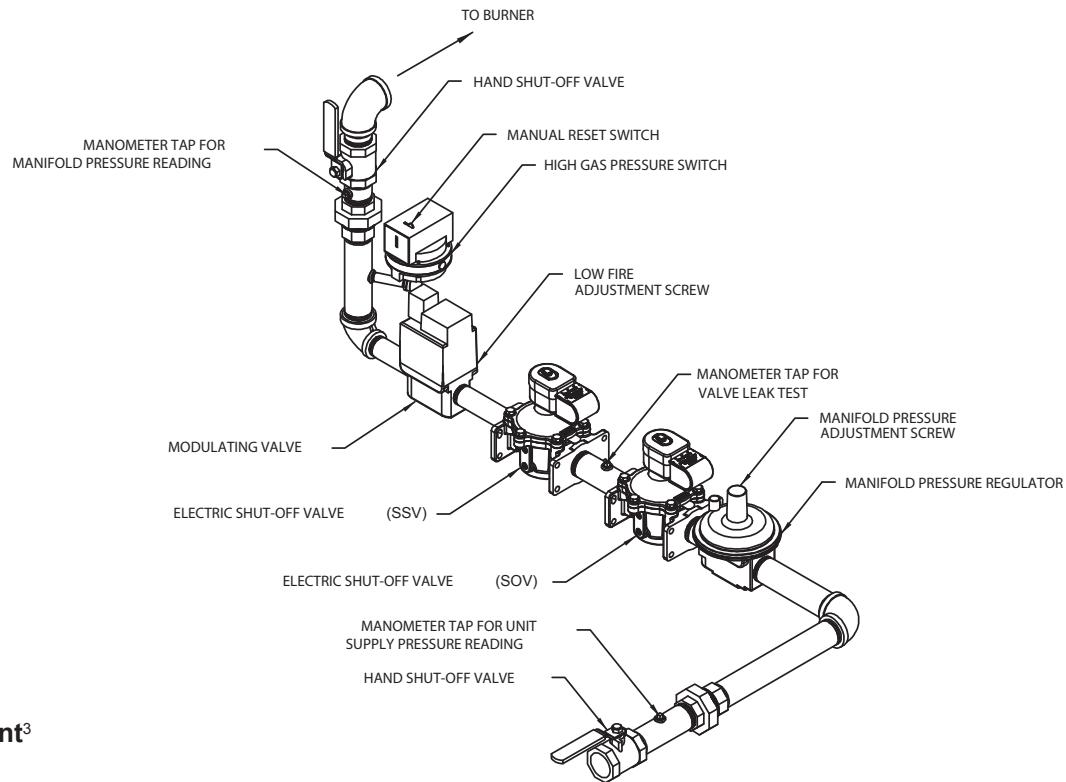
Over 400 MBH
Without Discharge Damper
or with Filter Section
High Pressure
CSA Certified¹
FM Compliant²



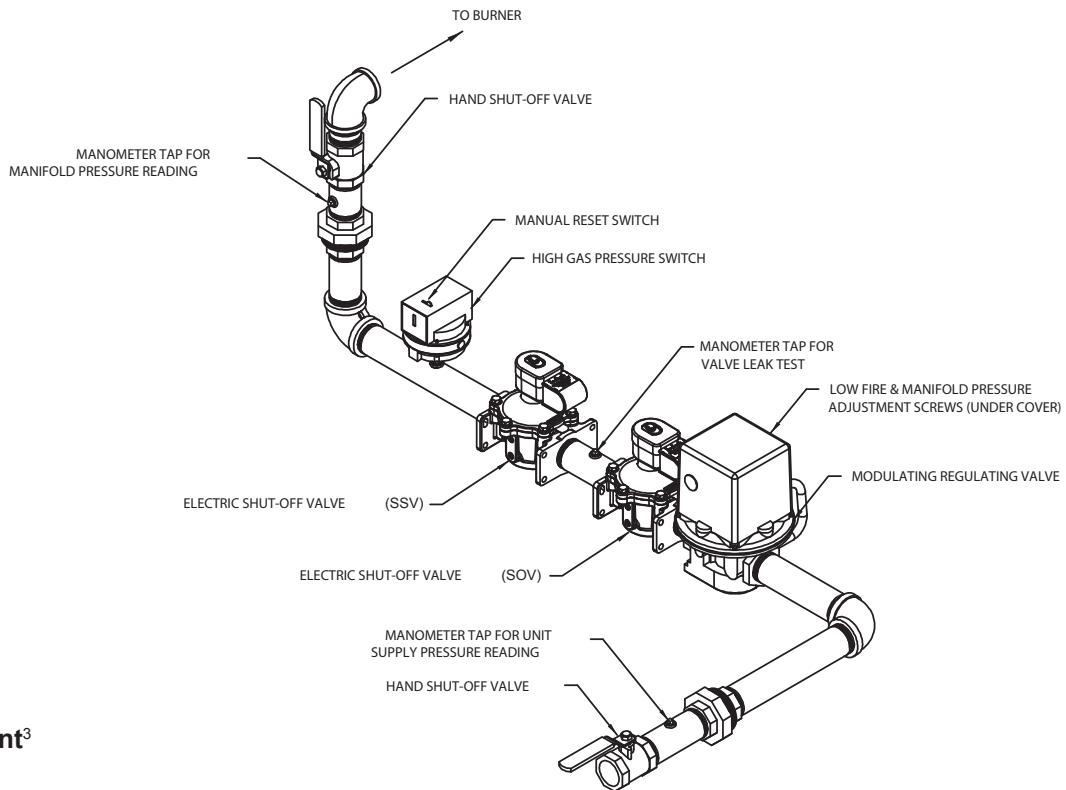
¹ Certified by CSA International to comply with ANSI Standard Z83.4/CSA3.7

² Complies with Factory Mutual insurance requirements

REFERENCE GAS TRAIN DRAWINGS



**Over 400 MBH
Low Pressure
CSA Certified¹
XL GAPS Compliant³**



**Over 400 MBH
High Pressure
CSA Certified¹
XL GAPS Compliant³**

¹ Certified by CSA International to comply with ANSI Standard Z83.4/CSA3.7

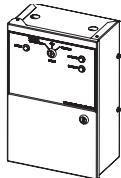
² Complies with Factory Mutual insurance requirements

³ Complies with XL Insurance Global Asset Protection Services requirements

INDIVIDUAL COMPONENT DESCRIPTIONS

REMOTE CONTROL STATIONS

REMOTE CONTROL STATION - SECURITY (RCS-S)



The RCS-S is a lockable NEMA 1 enclosure (9”W x 14”H x 5”D) equipped with a three position key-lock selector switch (Summer Ventilation - Off - Heating); an Operating Electronic Thermostat (OET); and indicating lights for blower operation (green), burner operation (red), and reset (amber).

The operator can control the heater from this panel provided the heater mounted disconnect is in the “ON” position and the service switches are in the “REMOTE” position. The OET utilizes an encapsulated thermistor to sense space temperature. The adjustable differential is set by the selection of the ON and OFF temperatures. See instructions for the OET (page 64).

TEMPERATURE SETBACK SYSTEM (TSS)



The TSS is a lockable NEMA 1 enclosure (9”W x 14”H x 5”D) equipped with a three position selector switch (Summer Ventilation - Off - Heating); a combination seven day programmable timer and thermostat; an override timer; and indicating lights for blower operation (green), burner operation (red), and reset (amber).

The operator can control the heater from this panel provided the heater mounted disconnect is in the “ON” position and the service switches are in the “REMOTE” position. The TSS utilizes an encapsulated thermistor to sense space temperature. The adjustable differential is set by the selection of the ON and OFF temperatures. This control can accommodate separately programmed schedules for both the ventilation and heating modes. See the operating and programming instructions for the TSS Controller (page 66).

REMOTE CONTROL STATION COMPONENTS

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 electrical control enclosure to monitor the pressure drop across the filters.

EXHAUST FAN INTERLOCK (EFI)

An exhaust fan interlock is used to interlock the makeup air heater to an exhaust fan such that the heater comes on when an exhaust fan comes on. Terminals are provided in the remote control station for wiring of dry contacts (by others).

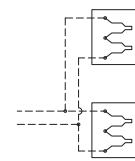
MANUAL MAKE-UP AIR SWITCH (MMS)

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 for tamperproof applications.

NON-ADJUSTABLE THERMOSTAT (TTP)

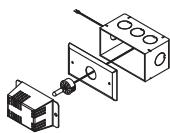
The non-adjustable thermostat is a fixed temperature, solid state, epoxy sealed thermostat with a specified temperature setpoint, either: 41°F, 50°F, 55°F, 60°F, or 65°F. It is wired between terminals Z1 and Z2.

TEMPERATURE AVERAGING SYSTEM (TAS-2)



The TAS-2 option is used in conjunction with the RCS-S or TSS to average the space temperature between two distant points within a facility. It consists of four thermistors which are wired in a series/parallel combination in order to simulate a single thermistor response.

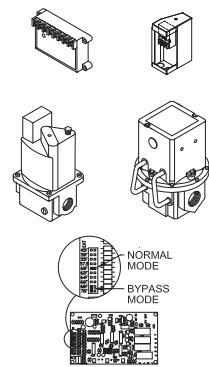
REMOTE TEMPERATURE SENSOR (RTS)



The thermistor is wired to the remote temperature sensor terminal block. If remote location of the sensor is desired, the connecting cable must be wired between the thermistor and this point.

The thermistor enclosure (SH-1) is packed in 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 using 18 gauge stranded, twisted-pair, shielded cable.

GAS CONTROL SYSTEMS

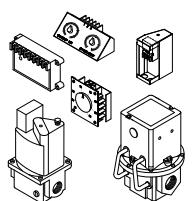


ELECTRONIC DISCHARGE-LOCAL (EDL)

The EDL temperature control system utilizes Maxitrol's Series 14 modulation controls. The discharge temperature sensor, which is mounted in the discharge, transmits a resistance signal back to the amplifier that corresponds to the discharge temperature.

The amplifier creates a voltage output to drive the modulating valve to maintain the preselected temperature that is set on the dial located on the amplifier. This control permits adjustment of the discharge temperature (110 to 160°F) from inside the heater control enclosure.

ELECTRONIC DISCHARGE-REMOTE (EDR)



The EDR temperature control system utilizes Maxitrol's Series 14 modulation controls. The discharge temperature sensor, which is mounted in the discharge, transmits a resistance signal back to the amplifier that corresponds to the discharge temperature.

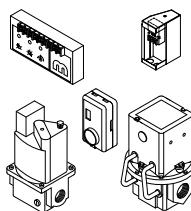
The amplifier creates a voltage output to drive the modulating valve to maintain the preselected temperature that is set on the Remote Heat Adjust (RHA).

Heaters which are specified with a temperature rise of less than 130°F are supplied with a single adjusting knob on the dial face of the RHA. This control permits manual adjustment of the discharge air temperature from 55 to 130°F. The override temperature selector dial, which is visible from the top of the RHA control,

increases the discharge temperature above the setting on the dial face by the increment selected (10 to 40°F) when a jumper or switch contact is provided across terminals 20 and 22.

Heaters which are specified with a temperature rise above 130°F are supplied with dual adjusting knobs on the dial face of the RHA. This control permits manual adjustment of the discharge temperature from 55 to 105° or 120 to 160°F. A jumper or switch contact is required across terminals 20 and 22 to activate the higher temperature selection.

ELECTRONIC DISCHARGE-SPACE MODULATION (EDSM)



The EDSM temperature control system utilizes Maxitrol's Series 44 modulation controls. The Space Temperature Selector (STS) is set to the desired space temperature and it transmits a resistance output to the amplifier (AMP) to control the discharge temperature. The

discharge temperature sensor (DTS), which is mounted in the discharge, transmits a resistance signal back to the amplifier that corresponds to the discharge temperature. The amplifier creates a voltage output to drive the modulating valve (MV) to maintain the selected space temperature 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 to 80°F). The MAX dial setting determines the maximum discharge temperature the heater will deliver (100 to 160°F). When the space temperature drifts from the STS setpoint by more than 3°F, the modulating valve is driven to the MIN or MAX discharge temperature, as applicable.

ELECTRONIC DISCHARGE-SPACE MODULATION/TAMPER PROOF (EDSM/TP)



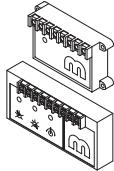
The EDSM/TP temperature control system functions identical to the EDSM control system. The difference is the STS is replaced with two devices. The adjustable temperature selector is typically mounted inside the remote control station and the non-adjustable space sensor (RTSS) is mounted in the space.

ELECTRONIC DISCHARGE-SPACE MODULATION/HAZARDOUS AREA

The Hazardous Area temperature control system functions identical the EDSM/TP, 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.

GAS CONTROL COMPONENTS

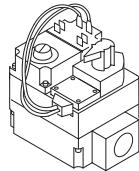
AMPLIFIER (AMP)



The amplifier creates a voltage output to drive the modulating valve to maintain the selected discharge temperature. On EDL control systems, the discharge temperature is set at the amplifier. On EDR control systems, the discharge temperature is set on the

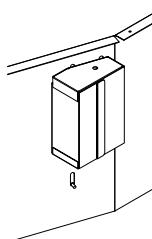
RHA. On EDSM control systems, the range of the discharge temperature is set at the amplifier, however, the STS controls when more or less heat is required.

COMBINATION VALVE



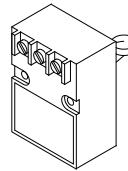
The combination valve serves as a manifold pressure regulator and redundant gas shut-off valve. This control is typically used for gas capacities below 400,000 Btu/hr. The valve operates on 24 Volts AC power. The combination valve is rated for a maximum gas supply pressure of 14" WC.

DISCHARGE AIR TEMPERATURE SAMPLING BOX



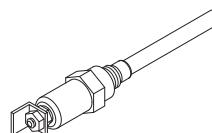
The discharge air temperature sampling box is located on the side of the discharge, and is accessible from the electrical control enclosure side of the unit. The sampling box houses the high limit (HL) and the discharge temperature sensor (DTS). This box should not be tampered with unless performing the Calibration Procedures (pages 60–62).

DISCHARGE TEMPERATURE SENSOR (DTS)



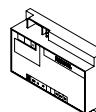
The DTS is mounted in the discharge of the heater. It senses the average discharge temperature and transmits a resistance signal back to the amplifier that corresponds to the discharge temperature.

FLAME ROD (FR)



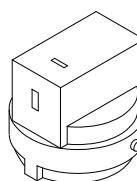
The flame rod senses the presence of flame and signals the flame safeguard relay. The presence of flame is detected by the flame rectification of the AC signal that is supplied to the flame rod thus creating the DC response. The resulting current flow produced can be measured with a DC microammeter. The reading should be steady and between 2.0 and 6.0 microamps (μ A).

FLAME SAFEGUARD RELAY (FSR)



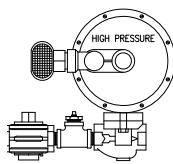
The flame safeguard relay supplies 24 Volts AC to the igniter for 4 seconds before the gas valve is energized. If the burner does not light (flame is not established within 7 seconds), this control will lock out gas flow until the control is reset. If flame signal is lost during burner operation, the control will allow one retry for ignition.

HIGH/LOW GAS PRESSURE SWITCH (HGP, LGP)



This 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 3" WC above manifold gas pressure. The low pressure switch should be set at 2" WC. The adjustment screw is located under the top plate. The low gas pressure switch will have to be reset whenever gas supply has been interrupted.

HIGH PRESSURE REGULATOR (HPR)



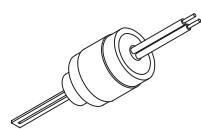
The HPR option is required when the gas supply pressure exceeds the nameplate rating for the heater. Unless otherwise specified, the HPR assembly is also furnished with a high gas pressure manual shut-off valve and a tap for measuring the upstream gas pressure. The HPR must be a positive lock-up type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

INTERMITTENT/CONTINUOUS CONTROL

The Intermittent/Continuous Control allows the burner input to be modulated to be operated continuously at modulating discharge temperature for make-up air (see EDSM on page 68) or operated intermittently based on a thermostat at maximum discharge temperature (see EDL on page 68) for space heating.

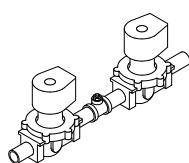
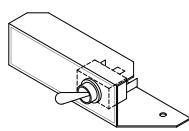
Requires EDSM controls and a signal to switch between modes (Exhaust Fan Interlock, Temperature Setback System, Manual Make-Up Air Switch, etc.)

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 vinyl sleeve for shock mounting and sealing in the mounting tube.

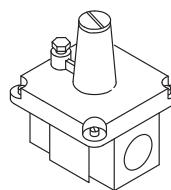
LEAK TEST FACILITY (SW4)



The leak test facility is provided on all heaters over 400,000 Btu/hr. It consists of a momentary switch for the shut-off valve (SOV) in the gas train and a gauge port between the (SOV) and (SSV) shut-off valve. By holding the gas valve momentary switch closed, the (SOV) gas valve is energized which allows gas pressure to build on the seat of the SSV safety shut-off gas valve. The gauge port between valves is

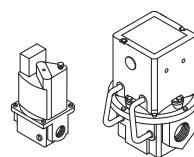
used to determine if the SOV shut-off gas valve seat is properly sealed.

MANIFOLD PRESSURE REGULATOR



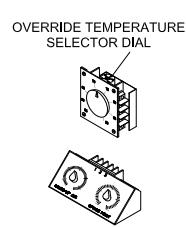
The manifold pressure regulator controls the burner manifold pressure. When the MR212 valve is used, this modulating valve also serves as the manifold pressure regulator. The maximum gas supply pressure rating is normally determined by the exposed pressure rating of the regulating device. RV61 and RV81 regulators are rated at 1 psig; and the MR212 is rated at 5 psig. (For units rated at 400,000 Btu/hr or below, see the combination valve below.)

MODULATING VALVE (MV)



The MV responds to a 4 to 24 Volt DC signal from the amplifier to modulate the flow of gas to the burner. On the M511 or M611 valve, the low fire adjusting screw is located on the far side of the valve under the dust cover. On the MR212 valve, the low fire adjusting screw is located under the large dust cover. The MR212 modulating valve also serves as the manifold pressure regulator.

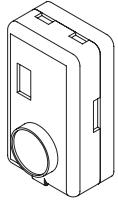
REMOTE HEAT ADJUSTMENT (RHA)



As discussed under the component description for the EDR control system, the RHA may have a single or dual adjusting knob(s) on the dial face. The single adjusting knob control permits manual adjustment of the discharge air temperature from 55 to 130°F. The override temperature selector dial which is visible from the top of the RHA control, increases the discharge temperature above the setting on the dial face by the increment selected when a jumper or switch contact is provided across terminals 20 and 22.

Heaters which are specified with a temperature rise above 130°F are supplied with dual adjusting knobs on the dial face of the RHA. This control permits manual adjustment of the discharge temperature from 55 to 105°F or 120 to 160°F. A jumper or switch contact is required across terminals 20 and 22 to activate the higher temperature selection.

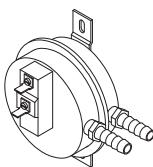
SPACE TEMPERATURE SELECTOR (STS)



The STS is part of the EDSM control system. The STS senses the space temperature and provides a resistance signal back to the amplifier that corresponds to the temperature variation from setpoint. A 3°F drift from the set temperature will cause the heater to modulate to the extreme end of the preset range on the amplifier.

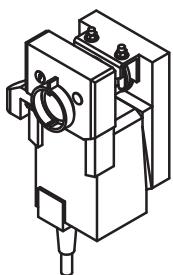
HEATER COMPONENTS

AIRFLOW SWITCH (AF)



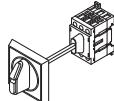
The airflow switch senses the pressure drop across the burner. It is factory set and not adjustable. It is designed to prevent burner operation if the airflow drops significantly below the minimum design airflow of the heater.

DAMPER MOTOR (D, D1)



The damper motor operates on 24 Volts AC and switches 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 external 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. For detailed instructions refer to Damper Motor Replacement & Adjustment (page 89).

DISCONNECT SWITCH (DISC)



The disconnect switch is provided on all heaters and includes the disconnect rod and lockable operating knob. The disconnect switch must be in the "OFF" position to gain access to the control enclosure. Once the control enclosure is open, experienced service technicians may activate the electrical circuit by twisting the disconnect rod clockwise to assist in troubleshooting. The disconnect rod must be turned back to the "OFF" position before attempting to secure the enclosure door.

EXHAUST FAN CONTACT (EFC)

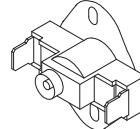
The exhaust fan contact is an auxiliary dry contact that is mechanically interlocked to the heater's motor starter and is provided with terminals located in the electrical enclosure. The EFC is typically wired into an exhaust fan control circuit to activate the exhaust fan when the heater is on.

FUSE BLOCK (FU1, FU2)



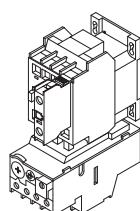
The fuse block provides line fusing for branch circuit protection. It is wired in conjunction with the non-fused disconnect switch.

HIGH TEMPERATURE LIMIT (HL)



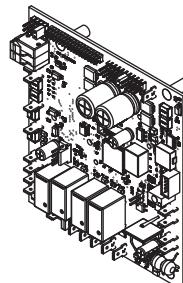
The high limit opens when discharge temperature exceeds 180°F. This limit must be manually reset.

MOTOR STARTER (MS, OL, AUX)



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 as follows:

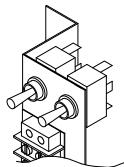
- 1) **Blower Relay (CR1)** which is energized on "call for blower" from the remote control station.
- 2) The **LTC (Low Temperature Cutout)** circuit functions to shut down the blower in approximately 3 1/2 minutes if either of the following occurs: (a) The inlet temperature drops below the LTC setpoint (40, 45, 50, or 55°F) in the ventilation mode; or (b) the gas valve fails to remain energized during a heating cycle.

- 3) The **EAT (Entering Air Thermostat)** circuit functions automatically to turn off the burner when the outdoor temperature reaches the EAT setpoint (45, 50, 55, 57.5, 60, 62, 64, 66, 68 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 is provided to limit the initial heater firing for the first 15 seconds of a heating cycle. The voltage to the modulating valve is adjusted between 9 and 13 Volts DC by an adjustable potentiometer on the PC board.

The multi-functional PC board has a single digit LED display to identify current mode of unit operation as follows:

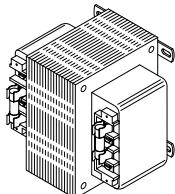
- 1: Ventilation mode
- 2: Heating mode, pre-purge
- 3: Low fire start
- 4: Normal heating mode
- 8: Unit in reset

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.

TRANSFORMER (T1, T2)



Heaters supplied with an output of greater than 400,000 Btu/hr are furnished with a dual voltage transformer unless the supply voltage is 115 volts. The transformer furnished depends on the supply voltage (208, 230, 460 or 575 volts). This transformer provides the secondary control voltage of 24 and 115 Volts. Heaters rated below 400,000 Btu/hr or supplied for 115 Volts are furnished with the 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; FNM-1.6 for 150 VA 115 Volt; and FNM-2.25 for 200 VA 115 Volt. Consult the heater wiring diagram to identify the proper fusing. Do not increase the fuse rating over that which is specified.

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.

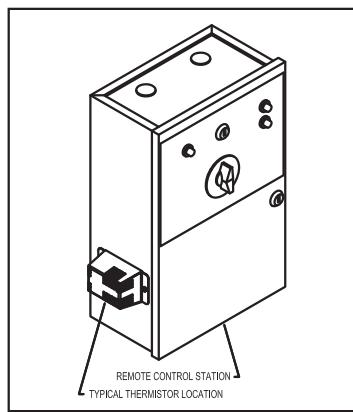


Figure 1

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.

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

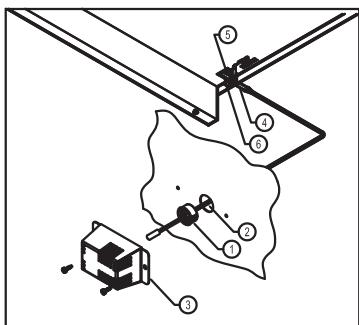


Figure 2

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.

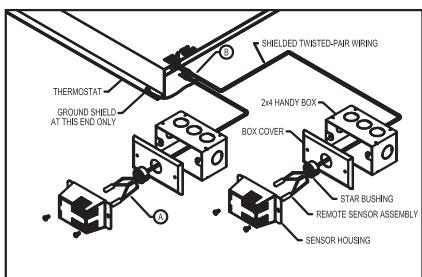


Figure 3

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 90.1-2010. 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 TSS Controller 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 TSS Controller 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.

Units 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 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 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

REVISION HISTORY LOG

Revised Date	Version	Description
4-11-2023	S-TM8-0423	Began revision history log. Updated images throughout to reflect new multi-functional PC board. Updated Operating Sequence flowchart to identify multi-function PC board mode numbers. Updated multi-functional PC board description to identify unit operating modes.



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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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