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

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

FOR YOUR SAFETY
If you smell gas:
1. Open windows.
2. Don’t touch electrical switches.
3. Extinguish any open flame.
4. Immediately call your gas supplier.

Made in the USA
LIMITED WARRANTY

Cambridge Engineering, Inc. (“Manufacturer”) warrants that its products (“the Products”) to be free from defects in material and workmanship. Manufacturer’s S-Series Products shall be warranted for a period of 24 months from the date of shipment, except that burner assemblies are warranted for five years from date of shipment.

Buyer’s sole and exclusive remedy for any nonconformity with this warranty shall be, at Manufacturer’s option, repair or replacement of nonconforming parts, provided that Buyer shall return to Manufacturer, shipping prepaid, said non-conforming part(s) bearing a durable tag indicating the Serial Number of the Product from which the part was taken. In addition, Manufacturer may opt not to repair or replace nonconforming Product or part(s), but instead may refund to Buyer the price thereof, in lieu of repair or replacement. In no event shall Manufacturer be liable for more than a refund of the purchase price or replacement value of the Product or part(s), whichever is less. This Warranty does not apply to field labor charges.

This Warranty does not apply and shall be void as to any Products that are misused or misapplied, that are installed, operated or maintained not in conformity with Manufacturer’s design, specifications, instructions, or Technical Manual, or are installed, operated or maintained in violation of any applicable national or local codes or industry standards.

Manufacturer does not warrant Products, if they are abused, improperly operated or maintained, subjected to abnormal wear and tear, damaged due to improper gas or electric service, damaged in transit, or that have been repaired or modified by others without Manufacturer’s written authorization. Buyer shall have no right to enforce this Warranty unless it has complied with all of its obligations under the contract for purchase/lease of the Products, including without limitation, being current on all payment terms.

THIS LIMITED WARRANTY IS MANUFACTURER’S ONLY WARRANTY WITH RESPECT TO THE PRODUCTS, AND IT IS IN LIEU OF AND SUPERSEDES ANY AND ALL OTHER WARRANTIES OF ANY KIND WHATSOEVER, WHETHER WRITTEN, ORAL OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THE REMEDIES AFFORDED BUYER BY THIS WARRANTY ARE THE ONLY REMEDIES AFFORDED BUYER FOR ANY NONCONFORMITY WITH THIS WARRANTY OR FOR ANY DEFECT IN PRODUCTS, SERVICES, OR REPRESENTATIONS PROVIDED BY MANUFACTURER IN CONNECTION WITH SUCH PRODUCTS. IN NO EVENT SHALL MANUFACTURER BEAR ANY LIABILITY FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND WHATSOEVER, INCLUDING WITHOUT LIMITATION PERSONAL INJURY (INCLUDING DEATH), PROPERTY DAMAGE, LOST PROFITS OR OTHER ECONOMIC LOSS.

Buyer acknowledges that the foregoing warranty, limitations, and exclusions are a reasonable allocation of commercial risks by and among sophisticated business entities and are not subject to dispute as to their commercial reasonableness, fairness or ability to satisfy the essential purposes of the parties’ transaction.
Contents
Hazard Summary .................................................................................................................. 2
Typical System Overview ................................................................................................. 3
Accessory Identification ................................................................................................. 3
Heater Operation ............................................................................................................. 4
Heater Configuration ....................................................................................................... 4
Installation Instructions ................................................................................................. 5
Uncrating Instructions .................................................................................................... 5
Mounting Location .......................................................................................................... 5
Roof Top Mounting - Curb / Stand / Rail ......................................................................... 6
Roof Top / Thru Wall Mounting - Stand / Rail ................................................................. 7
Under Roof Mounting - Curb ......................................................................................... 7
Roof Top Mounting .......................................................................................................... 8
Thru Wall Mounting ....................................................................................................... 10
Roof Top / Thru Wall Mounting ..................................................................................... 12
Under Roof Mounting ..................................................................................................... 14
Vertical Indoor Mounting ............................................................................................... 16
Vertical Outdoor Mounting ............................................................................................. 18
Rain Hood Inlet Skirt ...................................................................................................... 20
Unit Inlet Skirt ................................................................................................................ 21
Gas Piping ....................................................................................................................... 22
Electrical Wiring ............................................................................................................ 23
Start-Up Instructions .................................................................................................... 24
Calibration Procedures ................................................................................................. 29
Operating Instructions ................................................................................................. 32
Operating Sequence ....................................................................................................... 32
Electronic Thermostat .................................................................................................. 33
TSS Controller .............................................................................................................. 35
Maintenance Instructions ............................................................................................. 44
Troubleshooting Instructions ....................................................................................... 48
Troubleshooting Guide ................................................................................................. 48
Damper Motor Replacement & Adjustment ................................................................. 54
Reference ........................................................................................................................ 56
Electrical Control Enclosure Isometric Drawing ......................................................... 56
Electrical Wiring Diagrams ......................................................................................... 57
Electrical Connection Diagram .................................................................................. 62
Gas Train Drawings ....................................................................................................... 63
Individual Component Descriptions ........................................................................... 67
Gas Control Systems .................................................................................................... 68
ANSI/ASHRAE/IESNA Standard 90.1 ........................................................................ 73

Copyright © 2015
Cambridge Engineering, Inc.
All Rights Reserved
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
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.

**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**

Cambridge Engineering, Inc. 4 S-Series Technical Manual
1. Verify that the number of items on the Bill of Lading matches the number of items received.

2. Check for shipping 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 required to be above 15 feet, 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

NOTES

TREATED TIMBER REQUIRED UNDER MOUNTING CURB, RAIL AND STAND TO SECURE AND LEVEL UNIT.

SECURE MOUNTING STAND TO TIMBER WITH WOOD LAG SCREWS AS SHOWN.

SECOND MOUNTING ASSEMBLY IS REQUIRED ONLY ON UNITS WITH FILTER SECTIONS.

MOUNTING STAND CONSTRUCTION:
12 GA. GALVANIZED STEEL

MOUNTING RAIL CONSTRUCTION:
18 GA. GALVANIZED STEEL

REMOVE HANGER BRACKET AND REPLACE SCREWS

ADJUSTABLE ±3.75"

<table>
<thead>
<tr>
<th>Model</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>S400/S800</td>
<td>65.5&quot;</td>
<td>33&quot;</td>
<td>25.5&quot;</td>
</tr>
<tr>
<td>S950/S1200/S1600</td>
<td>78.5&quot;</td>
<td>33&quot;</td>
<td>42.12&quot;</td>
</tr>
<tr>
<td>S1850/S2200/S3200</td>
<td>90.12&quot;</td>
<td>36.5&quot;</td>
<td>47.12&quot;</td>
</tr>
</tbody>
</table>

Cambridge Engineering, Inc.
S-Series Technical Manual
INSTALLATION INSTRUCTIONS
ROOF TOP / THRU WALL MOUNTING - STAND / RAIL

NOTES
⚠️ TREATED TIMBER REQUIRED UNDER MOUNTING RAIL AND STAND TO SECURE AND LEVEL UNIT.
⚠️ SECURE MOUNTING STAND TO TIMBER WITH WOOD LAG SCREWS AS SHOWN.
⚠️ THIRD MOUNTING ASSEMBLY IS REQUIRED ONLY ON UNITS WITH FILTER SECTIONS.
⚠️ MOUNTING STAND CONSTRUCTION: 12 GA. GALVANIZED STEEL
⚠️ MOUNTING RAIL CONSTRUCTION: 18 GA. GALVANIZED STEEL
⚠️ REMOVE HANGER BRACKET AND REPLACE SCREWS
⚠️ FACTORY PRESET AT 10.5”, ADJUSTABLE ±3.75”

STAND DETAIL

UNDER ROOF MOUNTING - CURB

Model | A  | B  | C  |
------|----|----|----|
S400/S800 | 58” | 33.25” | 25.5” |
S950/S1200/S1600 | 70” | 33.13” | 42.12” |
S1850/S2200/S3200 | 75.75” | 36.5” | 47.12” |

CURB SECTION
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.

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 24” off the roof surface in areas where snow accumulation could impact heater operations.

3. Lower the discharge duct through the mounting curb and the roof opening and secure the counterflashing to the mounting curb.

4. Attach mounting stands to heater.

5. Use a crane or comparable lifting device to raise and position the equipment. Block the heater where necessary. 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. Using the adjustable mounting stand, lower the heater inlet slightly (1/8" below level) so that any ingested moisture will drain out of the heater and onto the roof surface.

7. 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.

8. Seal all roof penetrations to prevent roof leaks.

9. Install the directional elbows. Consult the job layout for the orientation of the elbows.

<table>
<thead>
<tr>
<th>Model</th>
<th>Weight</th>
<th>Roof Opening</th>
</tr>
</thead>
<tbody>
<tr>
<td>S400/S800</td>
<td>550 lbs.</td>
<td>L 13&quot; W 24.25&quot;</td>
</tr>
<tr>
<td>S950/S1200/S1600</td>
<td>800 lbs.</td>
<td>L 15&quot; W 41.5&quot;</td>
</tr>
<tr>
<td>S1850/S2200/S3200</td>
<td>1500 lbs.</td>
<td>L 24.25&quot; W 46.75&quot;</td>
</tr>
</tbody>
</table>
TYPICAL INSTALLATION
ROOF TOP MOUNTING

NOTE:
DO NOT CAULK
THIS JOINT

CURB / RAIL / STAND DETAIL

2 X 6 TREATED LUMBER
(BY OTHERS)

2 X 4 TREATED LUMBER
(PROVIDED)

TREATED LUMBER
(BY OTHERS)

TREATED LUMBER (THICKNESS OF ROOF INSULATION)
REQUIRED UNDER MOUNTING STANDS AND CURB TO SECURE
AND LEVEL THE UNIT AND TO SPREAD THE LOAD. (BY OTHERS)
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 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.

⚠️ 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.

7. Apply shims 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. Consult the job layout for the orientation of the elbows.

<table>
<thead>
<tr>
<th>Model</th>
<th>Weight</th>
<th>Hanging Rods</th>
<th>Wall Opening</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Qty.</td>
<td>Size</td>
<td>A</td>
</tr>
<tr>
<td>S400/S800</td>
<td>550 lbs.</td>
<td>4 (6&quot;)</td>
<td>58&quot;</td>
</tr>
<tr>
<td>S950/S1200/S1600</td>
<td>800 lbs.</td>
<td>4 (6&quot;)</td>
<td>70&quot;</td>
</tr>
<tr>
<td>S1850/S2200/S3200</td>
<td>1500 lbs.</td>
<td>4 (6&quot;)</td>
<td>75.75&quot;</td>
</tr>
</tbody>
</table>

*For optional filter section

Cambridge Engineering, Inc. 10 S-Series Technical Manual
TYPICAL INSTALLATION
THRU WALL MOUNTING

- Rainhood
- Exterior Wall Trim (by others)
- Interior Wall Trim (by others)
- Electrical Control Enclosure
- Hanging Rod
- Downturn
- Directional Elbows
- Remote Control Station
- Sediment Trap (by others)
- Low Pressure Shut-Off Valve (optional)
- High Pressure Supply Tap (optional)
- High Pressure Regulator (HPR)
- High Pressure Shut-Off Valve
- Control Wiring Conduit (by others)
- Inlet Gas Pipe
- Vent Pipe to Outdoors (by others)
- Vent with Screen (locate min. 10 ft. from intake)
- Incoming Power (by others)
- Exterior Wall Trim

HANGING BRACKET DETAIL

L BRACKET
FOR S400 - S800 UNITS

C BRACKET
FOR S950 - S3200 UNITS

HANGING ROD DETAIL

Shipping Position

HANGING RODS, NUTS AND WASHERS BY OTHERS
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.

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

⚠️ 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.

4. Using the adjustable mounting stand, lower the heater inlet slightly (1/8” below level) so that any ingested moisture will drain out of the unit and onto the roof surface.

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 directional elbows. Consult the job layout for the orientation of the elbows.

<table>
<thead>
<tr>
<th>Model</th>
<th>Weight</th>
<th>Wall Opening</th>
</tr>
</thead>
<tbody>
<tr>
<td>S400/S800</td>
<td>550 lbs.</td>
<td>H: 14”, W: 25”</td>
</tr>
<tr>
<td>S950/S1200/S1600</td>
<td>800 lbs.</td>
<td>H: 16”, W: 43”</td>
</tr>
<tr>
<td>S1850/S2200/S3200</td>
<td>1500 lbs.</td>
<td>H: 22”, W: 48”</td>
</tr>
</tbody>
</table>
TYPICAL INSTALLATION
ROOF TOP / THRU WALL MOUNTING

STAND DETAIL

- **2 X 6 TREATED LUMBER** (by others)
- **10.5"**
- **2 X 4 TREATED LUMBER** (provided)
- **12"**
- **TREATED LUMBER** (by others)
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
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.

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.

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. Consult the job layout for the orientation of the elbows.

<table>
<thead>
<tr>
<th>Model</th>
<th>Weight</th>
<th>Hanging Rods</th>
<th>Roof Opening</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Qty.</td>
<td>Size</td>
<td>A</td>
</tr>
<tr>
<td>S400/S800</td>
<td>4 (6&quot;)</td>
<td>3/8&quot; dia.</td>
<td>58&quot;</td>
</tr>
<tr>
<td>S950/S1200/S1600</td>
<td>4 (6&quot;)</td>
<td>3/8&quot; dia.</td>
<td>70&quot;</td>
</tr>
<tr>
<td>S1850/S2200/S3200</td>
<td>4 (6&quot;)</td>
<td>1/2&quot; dia.</td>
<td>75.75&quot;</td>
</tr>
</tbody>
</table>

*For optional filter section
TYPICAL INSTALLATION
UNDER ROOF MOUNTING

CURB DETAIL

TREATED LUMBER (THICKNESS OF ROOF INSULATION) REQUIRED UNDER MOUNTING CURB TO SECURE AND LEVEL THE UNIT AND TO SPREAD THE LOAD. (BY OTHERS)

HANGING ROD DETAIL

HANGING BRACKET DETAIL

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

⚠️ 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) so ingested moisture will run outside 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 directional elbows. Consult the job layout for the orientation of the elbows.

<table>
<thead>
<tr>
<th>Model</th>
<th>Weight</th>
<th>Qty.</th>
<th>Hanging Rods</th>
<th>Wall Opening</th>
</tr>
</thead>
<tbody>
<tr>
<td>S400/S800</td>
<td>550 lbs.</td>
<td>4</td>
<td>3/8&quot; dia.</td>
<td>23.38&quot; 25&quot; 24.5&quot;</td>
</tr>
<tr>
<td>S950/S1200/S1600</td>
<td>800 lbs.</td>
<td>4</td>
<td>3/8&quot; dia.</td>
<td>26&quot; 44&quot; 28&quot; 41&quot;</td>
</tr>
<tr>
<td>S1850/S2200/S3200</td>
<td>1500 lbs</td>
<td>4</td>
<td>1/2&quot; dia.</td>
<td>34.88&quot; 49&quot; 38&quot; 46.5&quot;</td>
</tr>
</tbody>
</table>
**WARNING:**
The primary structural support element of a vertically mounted heater is the base. Any support to the heater cabinet should be considered secondary, only as a means to help stabilize the heater.

**HANGING ROD DETAIL**

**HANGING BRACKET DETAIL**

**L BRACKET**
FOR S400 - S800 UNITS

**C BRACKET**
FOR S950 - S3200 UNITS
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 and the roof manufacturer before installing this equipment.

辀 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.

辀 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 including the skirt extension to the exterior wall (page 21).

13. Install discharge accessories to the wall sleeve. Consult the job layout for the orientation of the elbows.

<table>
<thead>
<tr>
<th>Model</th>
<th>Weight</th>
<th>Mounting Holes</th>
<th>Wall Opening</th>
</tr>
</thead>
<tbody>
<tr>
<td>S400/S800</td>
<td>550 lbs.</td>
<td>58° 33.25° 28°</td>
<td>14° 25°</td>
</tr>
<tr>
<td>S950/S1200/S1600</td>
<td>800 lbs.</td>
<td>70° 33.13° 44°</td>
<td>16° 43°</td>
</tr>
<tr>
<td>S1850/S2200/S3200</td>
<td>1500 lbs.</td>
<td>75.75° 36.5° 49°</td>
<td>26° 48°</td>
</tr>
</tbody>
</table>
TYPICAL VERTICAL OUTDOOR INSTALLATION

EXTERIOR WALL FLASHING
(BY OTHERS)

SECOND DOWNTURN

DIRECTIONAL ELBOWS

GAS TRAIN WIRING
(FIELD CONNECTED)

GAS TRAIN ENCLOSURE

GAS TRAIN

ELECTRICAL CONTROL ENCLOSURE

FILTER SECTION
(OPTIONAL)

CHANNEL SUPPORT
(BY OTHERS)

BUILDING WALL

BUILDING FOOTING

SECURE STRUCTURAL CHANNEL
TO WALL (AS REQUIRED)
(BY OTHERS)

UNIT

INLET SKIRT
(FIELD ASSEMBLED)

INLET SKIRT

MOUNTING DETAIL

FILTER SECTION
(OPTIONAL)

UNIT

A

B

C
1. Assemble the lower skirt section with the sheet metal screws provided.
2. Assemble the upper skirt section with the sheet metal screws provided.
3. Attach the upper skirt assembly to the lower skirt assembly with the sheet metal screws provided.
4. Hang the upper skirt portion from the rear lip of the rain hood and rotate forward into place. Secure 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.
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 the skirt extension 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
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.

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 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, ANSI Standard Z223.1 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, ANSI Standard Z223.1 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.

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.

IMPORTANT
Units with external gas trains must be installed so that the distance from the last safety shut-off valve to the heater does not exceed 4 feet.

6. Apply test pressure to the supply piping system and check for leaks. Use liquid gas detector. Do not use flame.

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 Engineering’s 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.

5. Wire the remote control station and other temperature control options using Class II 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 to prevent moisture accumulation.

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.
START-UP INSTRUCTIONS

START-UP PROCEDURE

1. Visual Inspection Of Equipment  
   (page 24)
2. Electrical Supply Voltage Verification  
   (page 24)
3. Gas Supply Pressure Verification  
   (page 24)
4. Blower Rotation Check  
   (page 25)
5. Motor Amp Draw Check  
   (page 25)
6. Burner Manifold Pressure Adjustment  
   (page 25)
7. Minimum Fire Adjustment  
   (page 26)
8. Calibration Check  
   (page 27)
9. Gas Train Leak Check  
   (page 27)
10. Gas Valve Leak Check  
    (page 28)
11. Remote Control Station Check  
    (page 28)
12. Final Heater Preparation  
    (page 29)

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.
   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 Engineering’s 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 Engineering’s 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 discharge 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 (pag 45)*

**IMPORTANT**

*The damper will remain in the open position as long as the blower service switch is not returned to the “REMOTE” 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. For EDL, EDR, EDSM, and EDSM/TP control systems, remove the wire from terminal #3 on the amplifier (see Figure 1). This will drive the modulating valve to full open.

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.

\[
\text{Manifold Pressure Reading} = \text{Nameplate MDP} + \text{Manifold Static Pressure (Blower Only)} + \text{Manifold Static Pressure (Blower Only)}
\]

**Note:**

*Figure 1*
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. Reconnect the wire to terminal #3 on the amplifier.

l. When performing a start-up proceed to the next step, otherwise perform Final Heater Preparation (page 29).

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.

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 29).

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.

a. Remove the cover of the Discharge Air Temperature Sampling Box. Refer to the Heater Configuration (page 4) for the Discharge Air Temperature Box location, and the Individual Component Description Section (page 67) 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. On EDL control systems, the discharge temperature should match the temperature shown on the dial located on the amplifier. The dial should be set to 160°F.

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. If the space temperature is warm, a test resistance of 7,500 ±250 Ω should be connected in the circuit in place of the STS. The MAX dial on the amplifier should be set to 160°F.

On EDR control systems, jumper terminals 20 and 22 and turn the dial on the 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.

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 ± 3°F for heaters setup for 130°F, or 160 ±0/-5°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 29).

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 29).

9. GAS TRAIN LEAK CHECK

a. For 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.

IMPORTANT
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. Replace access panels. Turn the blower and burner switches to the "LOCAL" position.

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.

4. With the burner operating, spray the complete gas train with leak detector solution, checking all pipe connections and plugs.
\begin{center}
\textbf{WARNING:}
Any gas leak detected must be repaired before unit is placed into service.
\end{center}

d. Turn the blower and burner service switches to the “OFF” position.

e. Reconnect the wire to terminal #3 on the amplifier

f. When performing a start-up proceed to the next step, otherwise perform Final Heater Preparation (page 29).

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.

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. \textbf{On single redundant valve applications} (heaters rated less than 400,000 Btu/hr), close the manual burner shut-off valve and wait 30 seconds to read the manometer. If the reading is greater than 0" WC, replace the gas valve and retest. If the reading is 0" WC, remove the manometer and reinstall the pipe plug.

\textbf{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 second gas valve and retest. If the reading is 0" WC, remove the manometer and reinstall the pipe plug.

To check the gas tightness of the first 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 first gas valve and retest. If the reading is 0" WC, remove the manometer and reinstall the pipe plug.

c. When performing a start-up proceed to the next step, otherwise perform Final Heater Preparation (page 29).

11. REMOTE CONTROL STATION CHECK

a. Turn the mode selector switch on the remote control station to the “OFF” position

b. If the ambient temperature is at or above the Entering Air Thermostat (EAT) setpoint, note the setpoint position. Pull the jumper off the temperature 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.

\begin{center}
\textbf{Figure 1}
\end{center}

c. Turn the blower and burner service switches to the “REMOTE” position.

d. Turn the mode selector switch to the “HEATING” position.

e. 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

\textbf{For Remote Control Station - Security (RCS-S)}, refer to the Operating Instructions for the Operating Electronic Thermostat (OET) (page 33).

\textbf{For Temperature Setback System (TSS)}, refer to the Operating and Programming Instructions for the TSS Controller (page 35).

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

f. After the motorized discharge damper opens, the blower motor will start.
g. After a delay for prepurge and igniter warmup, the burner will ignite.

h. 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.

i. 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.

j. 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.

12. FINAL HEATER PREPARATION

a. Reset the jumper for the EAT on the multi-functional PC board to the desired setpoint.

**WARNING:**
All safety controls must be returned to normal operating conditions.

b. Ensure the discharge temperature setting(s) comply(ies) 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.

**IMPORTANT**
*Turn the disconnect handle to the “OFF” position before closing the control enclosure door.*

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

g. Turn the disconnect switch to the “ON” position.

**IMPORTANT**
If technical assistance is needed, call the 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.

CALIBRATION PROCEDURES
EDL CONTROL SYSTEMS (MAXITROL SERIES 14)

1. Turn the burner service switch to the “OFF” position and allow the Discharge Air Temperature Sampling Box time to cool.

2. Turn the blower service switch to the “OFF” position.

3. Open the unit access door on the control enclosure side.

4. Remove the access cover from the Discharge Air Temperature Sampling Box and remove the two mounting screws from the DTS. Refer to the Individual Component Description Section (pages 67-72) for additional information.

5. Carefully remove the DTS from the sampling box, turn it over and adjust the DTS calibration potentiometer shown in the drawing. To raise the discharge temperature, adjust the potentiometer 90° counterclockwise.

6. Carefully reinstall the DTS. Replace the Discharge Air Temperature Sampling Box cover, and close the unit access doors.

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, and then return to step 3.b. Do not rush this step.

9. Repeat steps 2. through 4 until the manifold pressure and discharge temperature comply with the guidelines of the Calibration Check procedure step 5 (page 27).

10. Reinstall the amplifier that was removed in step 1.

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

1. Remove the two mounting screws from the Maxitrol A1044 Amplifier located in the Electrical Control Enclosure. Refer to the Electrical Control Enclosure Isometric Drawing (page 56) for additional information.

2. Turn the amplifier over and adjust the amplifier calibration potentiometer shown in the drawing. To raise the discharge temperature, use a Phillips screwdriver to adjust the potentiometer counterclockwise. To lower the discharge temperature, adjust the potentiometer clockwise.

3. Wait for the discharge temperature and manifold pressure to stabilize after making adjustments. Do not rush this step.

4. In rare cases, the amplifier calibration potentiometer will reach its adjustment limit before the proper discharge temperature is achieved. If this occurs, the Discharge Temperature Sensor (DTS) will need to be adjusted:
   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 and remove the two mounting screws from the DTS. Refer to the Individual Component Description Section (pages 67-72) for additional information.
   e. Carefully remove the DTS from the sampling box, turn it over and adjust the DTS calibration potentiometer shown in the drawing. To raise the discharge temperature, adjust the potentiometer 90˚ counterclockwise.
   f. Carefully reinstall the DTS. 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 pre-purge and igniter warm-up, the burner will light.
   h. Wait for the discharge temperature and manifold pressure to stabilize, and then return to step 3.b. Do not rush this step.
   i. Repeat steps 2 through 4 until the manifold pressure and discharge temperature comply with the guidelines of the Calibration Check procedure step "e" (page 27).
   j. Reinstall the amplifier that was removed in step 1.

**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 70) for RHA details, and Heater Configuration (page 4) for 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 "e" (page 27).

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 discharge damper opens.
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 discharge damper opens.
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.
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.
The Cambridge Engineering 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 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 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.

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.
The Cambridge Engineering 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

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Time</th>
<th>AM/PM</th>
<th>Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>On</td>
<td></td>
<td>M-F</td>
<td>M-F</td>
</tr>
<tr>
<td>Off</td>
<td></td>
<td>M-F</td>
<td></td>
</tr>
<tr>
<td>On 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 14</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SUMMER VENTILATION SCHEDULE

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Time</th>
<th>AM/PM</th>
<th>Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>On</td>
<td></td>
<td>M-F</td>
<td>M-F</td>
</tr>
<tr>
<td>Off</td>
<td></td>
<td>M-F</td>
<td></td>
</tr>
<tr>
<td>On 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On 14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off 14</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. Switch the keyswitch on the front of the enclosure to the desired operating mode. Allow ten seconds before proceeding.

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

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

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

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

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

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

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

9. Press and bold the DAY OF WEEK button while pressing the UP or the DOWN button until the light for the desired day is illuminated.
10. Press the **UP** button once to step to the next OFF cycle.

![Image of control panel with 'OFF' indicator]

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.

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSD 1</td>
<td></td>
</tr>
<tr>
<td>HED 1</td>
<td></td>
</tr>
<tr>
<td>HSD 2</td>
<td></td>
</tr>
<tr>
<td>HED 2</td>
<td></td>
</tr>
<tr>
<td>HSD 3</td>
<td></td>
</tr>
<tr>
<td>HED 3</td>
<td></td>
</tr>
<tr>
<td>HED 4</td>
<td></td>
</tr>
<tr>
<td>HED 5</td>
<td></td>
</tr>
<tr>
<td>HSD 6</td>
<td></td>
</tr>
<tr>
<td>HED 6</td>
<td></td>
</tr>
<tr>
<td>HSD 7</td>
<td></td>
</tr>
<tr>
<td>HED 7</td>
<td></td>
</tr>
<tr>
<td>HSD 8</td>
<td></td>
</tr>
<tr>
<td>HED 8</td>
<td></td>
</tr>
<tr>
<td>HSD 9</td>
<td></td>
</tr>
<tr>
<td>HED 9</td>
<td></td>
</tr>
</tbody>
</table>
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.
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 Shell Alvana #2, Exxon Unirox N2, Mobil Mobilith SHC100, Mobil 532, Mobil Mobilux #2, Texaco Multifak #2 or Texaco Premium RB lubricants.

MOTOR BEARING LUBRICATION
Motors are pregreased normally with Shell Dolium R. Equivalent greases which are compatible with the motor furnished grease are Chevron SRI No. 2 and Texaco Premium RB.

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

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.

<table>
<thead>
<tr>
<th>Model</th>
<th>Quantity</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>S400/S800</td>
<td>2</td>
<td>20&quot; x 25&quot; x 2&quot;</td>
</tr>
<tr>
<td>S950/S1200/S1600</td>
<td>4</td>
<td>20&quot; x 25&quot; x 2&quot;</td>
</tr>
<tr>
<td>S1850/S2200/S3200</td>
<td>12</td>
<td>16&quot; x 25&quot; x 2&quot;</td>
</tr>
</tbody>
</table>
BELT TENSIONING

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

<table>
<thead>
<tr>
<th>Model</th>
<th>HP</th>
<th>Belt(s)</th>
<th>Center Span</th>
<th>Deflection</th>
<th>Force (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Qty</td>
<td>Type</td>
<td></td>
<td></td>
<td>New Belts</td>
</tr>
<tr>
<td>S400/800</td>
<td>1</td>
<td>A</td>
<td>1/4&quot;</td>
<td>2 - 3</td>
<td>1 - 2</td>
</tr>
<tr>
<td>S400/800</td>
<td>2</td>
<td>A</td>
<td>1/4&quot;</td>
<td>2½ - 4</td>
<td>1½ - 3</td>
</tr>
<tr>
<td>S950/1200</td>
<td>2</td>
<td>BX</td>
<td>1/4&quot;</td>
<td>3 - 4½</td>
<td>2 - 3½</td>
</tr>
<tr>
<td>S800/950/1200</td>
<td>3</td>
<td>BX</td>
<td>1/4&quot;</td>
<td>4½ - 6</td>
<td>4 - 5½</td>
</tr>
<tr>
<td>S1200/1600</td>
<td>5</td>
<td>BX</td>
<td>1/4&quot;</td>
<td>3 - 5</td>
<td>2½ - 4</td>
</tr>
<tr>
<td>S1850/2200</td>
<td>5</td>
<td>BX</td>
<td>7/16&quot;</td>
<td>5 - 7</td>
<td>4½ - 6½</td>
</tr>
<tr>
<td>S1850/2200</td>
<td>7½</td>
<td>BX</td>
<td>7/16&quot;</td>
<td>6 - 8</td>
<td>5½ - 7</td>
</tr>
<tr>
<td>S2200/3200</td>
<td>10</td>
<td>BX</td>
<td>7/16&quot;</td>
<td>6½ - 8½</td>
<td>6 - 7½</td>
</tr>
<tr>
<td>S2200/3200</td>
<td>15</td>
<td>BX</td>
<td>7/16&quot;</td>
<td>7 - 9</td>
<td>6 - 8</td>
</tr>
</tbody>
</table>

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 Engineering 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 27). 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 28).

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 47) 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 name-plate. 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.

Solenoid Base *

Bonnet Gasket *

Valve Bonnet

Core/Diaphragm *

Subassembly

Bonnet Screw

Body Gasket *

Bleed Hole

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

Caution
Do not damage valve seat

Valve Body

Disassembled View of ASCO Valve
## TROUBLESHOOTING INSTRUCTIONS

### TROUBLESHOOTING GUIDE

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. No Blower Operation</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 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 II 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 | a1) Check primary power source  
a2) Reset overload relay and check motor amps/overload setting. |
| | b) Overload relay defective | 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 |
<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
</table>
| II. BLOWER RUNS; NO HEAT; FLAME SAFETY RELAY DOESN'T LOCK OUT | 1. Mode Selector Switch  
a) Switch in VENT position  
b) Defective Switch  
| a) Place switch in HEAT position.  
b) Replace switch |
|  | 2. Burner Service Switch  
a) Switch in OFF position  
b) Defective switch  
| a) Place switch in REMOTE position.  
b) Replace switch |
|  | 3. Multi-Functional PC Board  
a) No input voltage on Terminal W (RCS)  
b) Inlet temperature above EAT setpoint  
c) Improper wiring  
d) Defective board  
| a) Check voltage in RCS  
b) Adjust EAT setpoint  
c) Check wiring  
d) Replace multi-functional PC board. |
|  | 4. Airflow Switch  
a) Blower running backwards  
b) Belts slipping  
c) Blocked intake or discharge  
d) Clogged airflow tubing or pickup ports  
e) Defective switch  
| a) Reverse motor direction.  
b) Tighten and/or replace belts.  
c) Find and remove obstruction.  
d) Clean or replace tubing or pickup ports.  
e) Replace switch. |
|  | 5. Flame Safeguard Relay  
a) No input voltage  
b) Defective FSR  
| a) Check wiring.  
b) Replace FSR |
| III. BLOWER RUNS; NO HEAT; FLAME SAFETY RELAY LOCKS OUT | 1. Igniter  
a) No current (open igniter)  
b) No voltage  
| During trial for ignition:  
a) Check igniter current  
b) Check FSR output to igniter. |
|  | 2. High Limit  
a) High limit tripped  
| a) See Problem Number VI (page 51). |
|  | 3. High or Low Gas Pressure Switches  
a) Low gas pressure switch tripped  
b) High gas pressure switch tripped  
c) Defective gas pressure switch  
| a) Check gas supply for low gas pressure or no gas  
b1) Check manifold gas pressure for high pressure reading and reset pressure regulator  
b2) Check gas supply pressure against name plate  
b3) Verify the high pressure regulator is a lock-up type  
c) Replace gas pressure switch |
|  | 4. Gas Valve  
a) No input voltage  
b) Gas valve does not open  
c) Defective solenoid  
| a1) Check FSR output to R1 relay during ignition trial  
a2) Check gas valve circuit and wiring  
b1) Compare supply voltage to nameplate voltage  
b2) Clean and/or replace gas valve parts.  
c) Replace solenoid or valve assembly. |
|  | 5. Modulating Valve  
a) Minimum fire set too low  
| a) Adjust minimum fire on modulating valve |
|  | 6. Multi-Functional PC Board  
a) Low fire start set too low  
b) Thermistor open or not connected  
| a) Adjust modulating valve voltage between 10 and 13 Volts DC  
b) Properly install or replace thermistor |
### TROUBLESHOOTING INSTRUCTIONS

#### TROUBLESHOOTING GUIDE

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>III. BLOWER RUNS; NO HEAT; FLAME SAFETY RELAY LOCKS OUT</strong> (Continued)</td>
<td><strong>7. Regulator</strong>&lt;br&gt;a) Clogged vent orifice&lt;br&gt;b) No supply pressure&lt;br&gt;c) Improper manifold pressure&lt;br&gt;d) Defective regulator</td>
<td>a) Clean or replace orifice&lt;br&gt;b) Check all gas cocks and piping&lt;br&gt;c) Adjust regulator.&lt;br&gt;d) Replace regulator.</td>
</tr>
<tr>
<td></td>
<td><strong>8. Burner</strong>&lt;br&gt;a) Defective burner</td>
<td>a) Replace burner.</td>
</tr>
<tr>
<td><strong>IV. BLOWER RUNS; BURNER FIRES; FLAME SAFETY RELAY LOCKS OUT</strong></td>
<td><strong>1. Low Flame Current</strong>&lt;br&gt;a) Dirt build-up on ceramic body&lt;br&gt;b) Minimum fire set too low&lt;br&gt;c) Defective burner</td>
<td>a) Clean dirt deposit from ceramic body and install protective boot.&lt;br&gt;b) Adjust minimum fire on modulating valve&lt;br&gt;c) Replace burner.</td>
</tr>
<tr>
<td></td>
<td><strong>2. Multi-Functional PC Board</strong>&lt;br&gt;a) Low fire start set too low</td>
<td>a) Adjust modulating valve voltage between 10 and 13 Volts DC</td>
</tr>
<tr>
<td></td>
<td><strong>3. No Flame Current</strong>&lt;br&gt;a) Ground connection open&lt;br&gt;b) Wire termination oxidized</td>
<td>a1) Reference transformer to ground.&lt;br&gt;a2) Secure ground between control enclosure and burner.&lt;br&gt;a3) Tighten loose ground screws&lt;br&gt;b) Clean terminal and reinsert</td>
</tr>
<tr>
<td></td>
<td><strong>4. Fluctuating Flame Current</strong>&lt;br&gt;a) Unit overfiring&lt;br&gt;b) Minimum fire set too low&lt;br&gt;c) Intermittent ground connection&lt;br&gt;d) Loose terminal on Flame Rod&lt;br&gt;e) Defective burner</td>
<td>a) Check manifold pressure.&lt;br&gt;b) Adjust minimum fire on modulating valve.&lt;br&gt;c) Tighten all ground points&lt;br&gt;d) Remove jam nuts from Flame Rod. Reassemble with terminal located between jam nuts on Flame Rod.&lt;br&gt;e) Replace burner.</td>
</tr>
<tr>
<td></td>
<td><strong>5. Flame Safeguard Relay</strong>&lt;br&gt;a) Defective FSR</td>
<td>a) Replace FSR</td>
</tr>
<tr>
<td></td>
<td><strong>6. High Limit</strong>&lt;br&gt;a) High limit contact intermittent</td>
<td>a) Replace high limit.</td>
</tr>
<tr>
<td><strong>V. BLOWER RUNS; UNIT HEATS; SHORT CYCLES WITHOUT resetting</strong></td>
<td><strong>1. Air Flow Switch</strong>&lt;br&gt;a) Blower running backwards&lt;br&gt;b) Belts slipping&lt;br&gt;c) Blocked intake or discharge&lt;br&gt;d) Air delivery below unit specs&lt;br&gt;e) Clogged airflow tubing or pick-up ports&lt;br&gt;f) Defective switch</td>
<td>a) Reverse motor direction&lt;br&gt;b) Tighten and/or replace belts&lt;br&gt;c) Find and remove obstruction.&lt;br&gt;d) Increase fan RPM for air delivery requirements.&lt;br&gt;e) Clean or replace airflow tubing or pick-up ports&lt;br&gt;f) Replace switch.</td>
</tr>
<tr>
<td></td>
<td><strong>2. Flame Safeguard Relay</strong>&lt;br&gt;a) Defective FSR</td>
<td>a) Replace FSR.</td>
</tr>
<tr>
<td></td>
<td><strong>3. Operating Thermostat</strong>&lt;br&gt;a) Differential temperature setting too tight&lt;br&gt;b) Open or short in thermistor circuit</td>
<td>a) Increase differential temperature setting&lt;br&gt;b) Check wiring or replace thermistor</td>
</tr>
<tr>
<td></td>
<td><strong>4. Damper Motor End Switch</strong>&lt;br&gt;a) End switch making intermittent contact</td>
<td>a) Replace end switch assembly.</td>
</tr>
<tr>
<td>Problem</td>
<td>Possible Cause</td>
<td>Corrective Action</td>
</tr>
<tr>
<td>---------</td>
<td>---------------</td>
<td>-------------------</td>
</tr>
</tbody>
</table>
| **VI. HIGH LIMIT TRIPPED** | 1. **High Limit**  
a) High limit will not reset | a) Replace high limit. |
| | 2. **Unit Overfiring**  
a) Manifold pressure too high | a) Adjust appliance regulator to obtain temperature rise specified on nameplate. |
| | 3. **Discharge Damper**  
a) Damper blades partially closed  
b) Defective damper motor | a) Adjust damper stroke length.  
b) Replace damper motor. |
| | 4. **Low Airflow**  
a) Blower running backwards  
b) Belts slipping  
c) Blocked intake or discharge | a) Reverse motor direction.  
b) Tighten or replace belts.  
c) Find and remove obstruction |
| | 5. **Temperature Control System**  
a) Temperature control system does not modulate | a) See problem VIII. |
| **VII. BLOWER RUNS; UNIT HEATS; WILL NOT CYCLE OFF** | 1. **Operating Thermostat**  
a) Short in thermistor circuit  
b) Thermostat located improperly  
c) Thermostat differential setting too wide  
d) Defective thermostat | a) Check thermistor wiring and/or replace thermistor.  
b1) Thermostat in cold draft-relocate.  
b2) Thermostat not satisfied-turn down  
c) Reduce differential setting.  
d) Replace thermostat. |
| | 2. **Burner Service Switch**  
a) Switch in LOCAL position | a) Place switch in REMOTE position. |
| | 3. **Auxiliary Control**  
a) Auxiliary contacts closed | a) Check auxiliary circuit wiring and contacts |
| | 4. **Misunderstood Control System Operation**  
a) Control system doesn’t function as expected | a) Review control system operational characteristics. |
| **VIII. MODULATING VALVE DOES NOT MODULATE; CONTINUOUS HIGH FIRE** | 1. **Amplifier (A1014 or A1044 or AD1014)**  
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 | a) Reinstall wire.  
b) Reinstall jumper.  
c) Replace amplifier. |
| | 2. **Discharge Temperature Sensor (TS114 or TS144)**  
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 | a) Clean Discharge Air Temperature Sampling Tube (page 69).  
b) Replace the sensor if the resistance measured at terminals 1 and 2 on TS114 sensor exceeds 11,000 Ω; terminals 1 and 3 or 2 and 3 on TS144 exceeds 6,000Ω.  
c) Correct wiring terminations.  
d) Perform appropriate calibration procedure (pages 29-31) |
# TROUBLESHOOTING INSTRUCTIONS

## TROUBLESHOOTING GUIDE

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
</table>
| VIII. MODULATING VALVE DOES NOT MODULATE; CONTINUOUS HIGH FIRE (Continued) | 3. Space Temperature Selector (Series 44 only) a) Open in sensor circuit  
b) Induced voltage in field wiring  
c) Space sensor located improperly | a) Replace the sensor if the resistance measured is more than: 7,000 Ω for the T244; 5,500 Ω for the TS244; or 2,250 Ω for the TD244.  
b) Utilize shielded, twisted pair wiring  
c) Sensor in cold draft - relocate |
| | 4. Space thermostat (Series 14 only) a) Thermostat out of calibration  
b) Thermostat located improperly  
c) Thermostat differential setting too wide  
d) Thermostat defective | a) Recalibrate thermostat or replace.  
b) Thermostat in cold draft - relocate.  
c) Reduce differential setting.  
d) Replace thermostat. |
| | 5. Remote Heat Adjust (TD114 or CEI 4175-0-960) a) Short in Remote Heat Adjust circuit  
b) Induced voltage in field wiring | a) Replace Remote Heat Adjust if resistance measure between terminals 1 and 3 of Remote Heat Adjust is less than 6,000 Ω.  
b) Utilize shielded, twisted pair wiring. |
| | 6. Modulating Valve (M511, M611 or MR212) a) Foreign material holding valve open  
b) Modulating valve misassembled | a) Disassemble valve and remove foreign material.  
b) Disassemble valve and assemble correctly |
| IX. MODULATING VALVE DOES NOT MODULATE; CONTINUOUS LOW FIRE | 1. Class II Transformer a) No voltage output to amplifier | a1) Check for short in modulating valve coil.  
a2) Replace transformer. |
| | 2. Modulating Valve a) Valve coil is open or shorted  
b) Plunger jammed  
c) Ruptured main or balancing diaphragm | a) Replace valve coil if its resistance is less than 40 Ω or greater than 85 Ω.  
b) Clean or replace plunger.  
c) Check diaphragm condition and replace if defective. |
| | 3. Amplifier a) No output voltage to valve | a) With the wire removed from terminal 3 of amplifier, replace amplifier if the valve voltage does not exceed 18 Volts DC. |
| | 4. Discharge Temperature Sensor (TS114 or TS144) a) Short in sensor circuit  
b) Temperature control system out of calibration | a) Replace the sensor if the resistance measured at: terminals 1 and 2 on TS114 is less than 8,000 Ω; terminals 1 and 3 or 2 and 3 on TS144 is less than 2,900 Ω.  
b) Perform temperature control system calibration |
## TROUBLESHOOTING INSTRUCTIONS

### TROUBLESHOOTING GUIDE

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
</table>
| **IX. MODULATING VALVE DOES NOT MODULATE; CONTINUOUS LOW FIRE** (Continued) | 5. Space Temperature Selector (T244 or TS244/TD244)  
a) Short in sensor circuit | a) Replace the sensor if the resistance measure is less than 5,000 Ω for the T244 or 3,500 Ω for the S244 and 1,950 Ω for the TD244. |
| | 6. Remote Heat Adjust (TD114 or CEI 4175-0-960)  
a) Open in the Remote Heat Adjust control circuit | a) Replace the control if the resistance measured at terminals 1 and 3 exceeds 12,000 Ω. |
| | 7. Multi-Functional PC Board  
a) Terminal X has power  
b) Defective board | a) Determine power source.  
b) Replace board. |
| **X. ERRATIC OR PULSATING FLAME** | 1. High Pressure Regulator  
a) Vent undersized  
b) Defective regulator | a) Enlarge vent piping size or reduce vent piping length.  
b) Replace regulator. |
| | 2. Amplifier  
a) Hunting  
b) Temperature control system out of calibration  
c) Defective amplifier | a) Adjust sensitivity control dial counterclockwise.  
b) Perform appropriate calibration procedure (pages 29-31)  
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. Before reinstalling the damper motor into the heater assembly, remove the black plastic weather cover from the damper motor by removing the screw that secures the cover to the damper assembly using either a flat tip screw driver or a # T20 Torx tip. It may be necessary to twist the cover slightly to disengage it from its mounting to the end of the motor after the screw is removed.

2. Verify the damper motor is in the CLOSED position (Drive tube is retracted with a minimum of 1/4" gap between the drive tube and the body of the damper assembly).

3. Verify the inner cam has fully engaged the lower limit switch plunger and the lower limit switch (next to the body of the damper motor) shows continuity between the common (C) terminal and the normally open (NO) terminal.

**CAUTION:**
If the lower limit switch does not indicate continuity, the damper motor must be driven to the fully CLOSED position BEFORE connecting the damper linkage tube to drive tube of damper motor assembly.

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

4. Verify the cam location on the upper cam is set just short of the four o’clock position with respect to the switch plunger being the twelve o’clock reference position. If it is beyond the four o’clock position, use a deep well 1/2” hex socket or nut driver and manually rotate the cam counterclockwise a few clicks, as required, to obtain the correct starting position. (Refer to Figure 1.)

5. Verify the heater disconnect switch is turned OFF and the service switches are in the OFF position.

6. Connect the wires to the terminals as shown in Figure 2 and reinstall the cover.

7. Remove the push-in plug (located in the weather cover) to have access to the upper cam adjusting nut.

8. Connect the motor pivot to the damper motor support bracket using the 3/8" diameter clevis pin.

**IMPORTANT**
*Do not connect the damper linkage tube at this time.*

9. Remove the wire from the “G” terminal of the terminal block. (This is to avoid a “Call-for-Fan” signal from the remote control station during the next two steps).
10. Suspend the damper motor assembly from the damper motor support bracket. Turn the disconnect switch on and turn the blower service switch to the “LOCAL” position for approximately 5 seconds.

**IMPORTANT**
*Do not restrain the drive tube from turning freely.*

11. Turn the blower service switch to the “REMOTE” position until the damper motor drive tube stops turning. (Drive tube is now fully retracted).

12. Turn the disconnect switch off. Manually trip the motor starter overload using the manual trip lever located on the overload between the overload and the motor starter.

13. Slide the damper linkage tube into the drive tube and align the hole in the drive tube with the hole in the damper linkage tube by manually rotating the drive tube in 1/2 turn increments until the 5/16” diameter clevis pin can pass through both parts. Lubrication of the damper linkage tube may be required. Maintain the damper blades in the tightly-held, fully closed position during this adjustment.

14. Turn the disconnect switch on and turn the blower service switch to the “LOCAL” position. The damper will open to the point the upper cam engages the upper limit switch.

15. Remove the plastic plug from the damper view-port (located on the exterior side of the heater housing toward the discharge end). It may be helpful to place a flashlight inside the heater housing to observe the damper linkage tube travel to ultimately rest against the hex shaft.

16. Using a deep-well, 1/2” hex socket or nut driver, turn the upper cam hex nut clockwise in one click increments until the damper linkage tube rests against the hex shaft. (Refer to Figure 3.)

**IMPORTANT**
*Damper blades should be snug to avoid fluttering in the high velocity air stream.*

17. Turn the blower service switch to the “REMOTE” position and, after the damper motor closes, turn the disconnect switch off.

18. Reinstall the plastic plug from the damper view-port and the weather cover push-in plug.

19. Reconnect the wire removed in step 9 to terminal “G”.

20. Reset the motor starter overload.

21. Verify that both service switches are in the “REMOTE” position, close the electrical enclosure door and turn the disconnect switch on.
REFERENCE

ELECTRICAL WIRING DIAGRAMS

400,000 BTU & BELOW
EDL Controls

Symbol Description
AF Air Flow Switch
AMP Amplifier Solid State
AXI 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 (HSI)

Symbol Description
FU1 Fuse 24 Volt Control
FU2 Fuse 120 Volt Control
HL High Limit
IG Ignitor
L1 Light - Alarm
L2 Light - Fan
L3 Light - Heat
LTC Low Temperature Cutout
M Motor
MS Motor Starter
MV Modulating Valve
OL Overload Relay
PCB Printed Circuit Board
RTS Remote Temperature Sensor
RI 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

DASHED LINES INDICATE WIRING RUN SHOULD BE SEPARATE FROM OTHER AC WIRING.
MUST USE SHIELDED TWISTED PAIR FOR THIS CONTROL WIRING.
SHOULD BE GROUNDED AT CONTROL STATION END ONLY.

NOTE 1: CUSTOMER CONNECTION IN UNIT (TERM BLOCK #1).
NOTE 2: CUSTOMER CONNECTION IN REMOTE STATION.
UNIT TERMINALS FOR TESTING (TERM BLOCK #2).
SUPPLIED BY CO AND CONNECTED BY CUSTOMER FROM GASKET TO J-BOX ON UNIT.
TERMINALS ON CR/LTC/EAT/PT/IF/FS PC BOARD.
REFERENCES

ELECTRICAL CONNECTION DIAGRAM

ELECTRICAL CONTROL ENCLOSURE AT HEATER

- R: 24V CLASS 2 SUPPLY
- H: HEAT ON SIGNAL
- F: FAN ON SIGNAL
- A: ALARM LOCKOUT SIGNAL
- B: 24V CLASS 2 RETURN
- G: CALL FOR FAN
- W: CALL FOR BURNER
- C: CLOGGED FILTER SWITCH (OPTIONAL)
- 21: EXHAUST FAN CONTACT (OPTIONAL)
- 22: TO EXHAUST FAN STARTER CIRCUIT
- E1: 2 WIRE (TYP) - 18 AWG MINIMUM
- E2: (OPTIONAL)
- L1, L2, L3: 24 VAC CLASS 2 CONTROL WIRING
- 7 TO 10 WIRES (TYP)
- 18 AWG MINIMUM
- RUN SEPARATE FROM POWER WIRING
- STS: FOR EDR (OPTIONAL), EDSM (OPTIONAL), EDSM/TP (OPTIONAL)
- USE 2 WIRE SHIELDED TWISTED-PAIR
- 18 AWG MINIMUM
- RUN SEPARATE FROM ALL OTHER AC WIRING
- GROUND SHIELD AT REMOTE CONTROL STATION ONLY
- EFI: (EXHAUST FAN INTERLOCK) (OPTIONAL)
- DASHED LINES INDICATE FIELD WIRING

REMOTE CONTROL STATION

- SPACE THERMOSTAT (OPTIONAL)
- REMOTE TEMPERATURE SENSOR
- FOR REMOTE SENSOR LOCATION
- USE 2 WIRE SHIELDED TWISTED-PAIR
- 18 AWG MINIMUM
- RUN SEPARATE FROM ALL OTHER AC WIRING
- GROUND SHIELD AT REMOTE CONTROL STATION ONLY
REFERENCE
GAS TRAIN DRAWINGS

Under 400 MBH
CSA Certified\(^1\)
FM Compliant\(^2\)
IRI Compliant\(^3\)

Over 400 MBH
Low Pressure
CSA Certified\(^1\)
IRI Compliant\(^3\)

Over 400 MBH
High Pressure
CSA Certified\(^1\)

\(^1\) Certified by CSA International to comply with ANSI Standard Z83.4/CSA3.7
\(^2\) Complies with Factory Mutual insurance requirements
\(^3\) Complies with Industrial Risk Insurers insurance requirements
REFERENCE

GAS TRAIN DRAWINGS

Over 400 MBH
With Discharge Damper
and without Filter Section
Low Pressure
CSA Certified\(^1\)
FM Compliant\(^2\)

Over 400 MBH
With Discharge Damper
and without Filter Section
High Pressure
CSA Certified\(^1\)
FM Compliant\(^2\)

\(^1\) Certified by CSA International to comply with ANSI Standard Z83.4/CSA3.7
\(^2\) Complies with Factory Mutual insurance requirements
\(^3\) Complies with Industrial Risk Insurers insurance requirements
REFERENCE

GAS TRAIN DRAWINGS

Over 400 MBH
Without Discharge Damper or with Filter Section
Low Pressure
CSA Certified\(^1\)
FM Compliant\(^2\)

Over 400 MBH
Without Discharge Damper or with Filter Section
High Pressure
CSA Certified\(^1\)
FM Compliant\(^2\)

\(^1\) Certified by CSA International to comply with ANSI Standard Z83.4/CSA3.7
\(^2\) Complies with Factory Mutual insurance requirements
\(^3\) Complies with Industrial Risk Insurers insurance requirements
REFERENCE

GAS TRAIN DRAWINGS

Over 400 MBH
Low Pressure
CSA Certified\(^1\)
IRI Compliant\(^3\)

Over 400 MBH
High Pressure
CSA Certified\(^1\)
IRI Compliant\(^3\)

\(^1\) Certified by CSA International to comply with ANSI Standard Z83.4/CSA3.7
\(^2\) Complies with Factory Mutual insurance requirements
\(^3\) Complies with Industrial Risk Insurers insurance requirements
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 33).

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 35).

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 make-up air heater as a slave to an exhaust fan. Terminals are provided in the remote control station for wiring of dry contacts (by others).

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.
**THERMISTOR (RTS)**

The thermistor is wired to the 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°F 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 to control the discharge temperature. 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 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 (80 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 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 and the DTS. This box should not be tampered with unless performing the Calibration Procedures (pages 29-31).

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 (μA).

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 25% 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 (IGN)

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

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

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
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 internal auxiliary switch which has been factory set to operate when the damper is fully open. The damper motor will power closed when the heater cycles off. The damper motor will not close unless the blower service switch is in the “REMOTE” position. For detailed instructions refer to Damper Motor Replacement & Adjustment (page 54).

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 as a slave to the heater.

FUSE BLOCK
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 out-
door 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.

**SERVICE SWITCH (SS)**

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**

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.
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.** __________

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
<th>Technician</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Cambridge Engineering, Inc. 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.