# SPEC AIR SERIES
## DRAW THRU
## DIRECT GAS-FIRED
## VENTILATION UNIT
## TECHNICAL MANUAL

**⚠ WARNING:**

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

**FOR YOUR SAFETY**

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

**FOR YOUR SAFETY**

If you smell gas:

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

***Made in the USA***

ASHRAE 90.1 COMPLIANT

CERTIFIED ®

DESIGN CERTIFIED ®

CAMBRIDGE® AIR SOLUTIONS

*Enriching Lives*

## LIMITED WARRANTY

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



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# SPEC AIR SERIES
## TECHNICAL MANUAL

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## HAZARD SUMMARY

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

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

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

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

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

**⚠ WARNING:**
Any unauthorized modification of this equipment shall void the warranty.

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

**⚠ WARNING:**
Recirculation of room air is not permitted.

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

If the failure or malfunction of this unit creates a hazard to other fuel burning equipment in the building (e.g. when the unit is providing the ventilation air to a boiler room), the unit is to be interlocked to open inlet air dampers or other such devices.

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

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

# TYPICAL SYSTEM OVERVIEW

## CONTROL SYSTEMS:
## MAXITROL SERIES 44

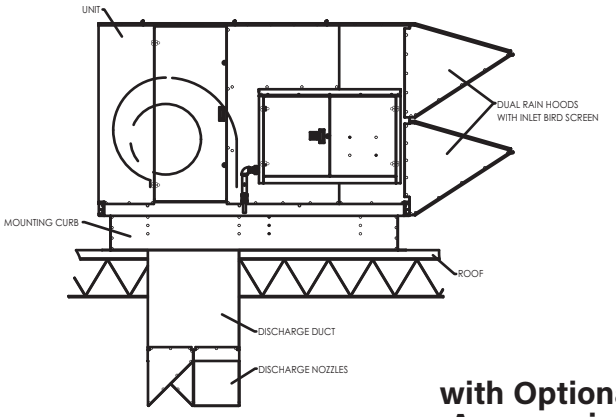
The Maxitrol Series 44 modulation controls maintain a constant space temperature by increasing or decreasing the discharge temperature. The Space Temperature Selector is set to maintain the space temperature of the heated space by controlling the unit output between the MIN and MAX setting on the amplifier.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

## MAXITROL SERIES 44 / TAMPER PROOF

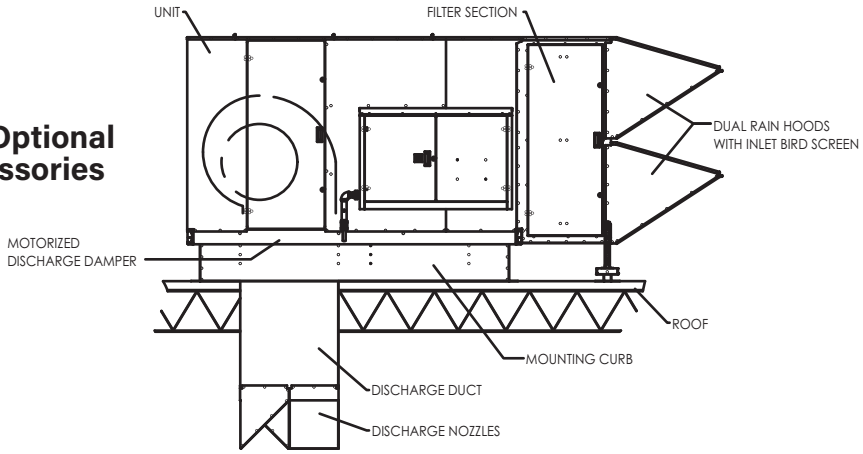
The Maxitrol Series 44 / Tamper Proof temperature control system is similar to the Maxitrol Series 44 controls above except the adjustable Space Temperature Selector control is replaced by two other controls. The adjustable portion of the temperature selector is typically mounted in the Remote Control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

## TYPICAL SYSTEM OVERVIEW
# HORIZONTAL MOUNT ROOF TOP CONFIGURATION

### Standard Unit




### with Optional Accessories




# UNIT / ACCESSORY WEIGHTS

**Horizontal Mount** (Weights Shown In Pounds)

| | Model | | | |
|---|---|---|---|---|
| **Component** | **V18** | **V20** | **V25** | **V30** |
| **Base Unit[1]** | 1275 | 1260 | 1750 | 2270 |
| **Rain Hood - Dual** | 120 | 150 | 210 | 310 |
| **Filters** | 20 | 30 | 45 | 60 |
| **V-Bank Filter Section** | 200 | 215 | 275 | 395 |
| **Discharge Duct - 50"** | 65 | 80 | 95 | 110 |
| **Discharge Nozzles** | 20 | 25 | 35 | 50 |
| **Discharge Damper** | 20 | 25 | 30 | 40 |
| **Curb 14"** | 100 | 120 | 180 | 210 |
| | | | | |
| **3HP motor** | 70 | | | |
| **5HP motor** | 75 | | | |
| **7.5HP motor** | 120 | | | |
| **10HP motor** | | 135 | | |
| **15HP motor** | | 220 | | |
| **20HP motor** | | | 230 | |
| **25HP motor** | | | | 250 |

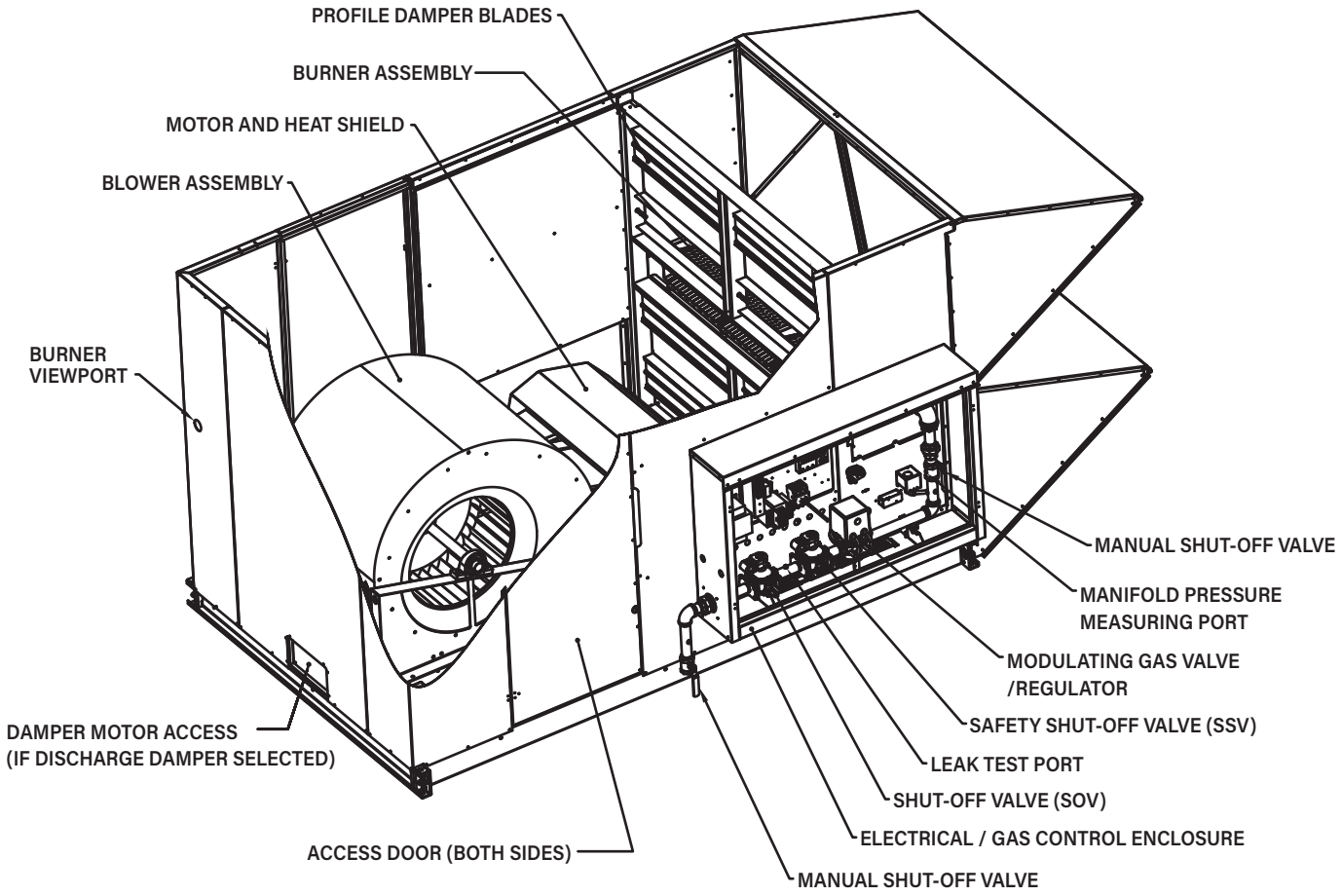
1. Primary drive motor not included

## TYPICAL SYSTEM OVERVIEW

# UNIT OPERATION

Cambridge Spec Air Ventilation units provide tempered, continuous fresh air ventilation to a facility to meet occupied space ventilation requirements. Units can also provide simple freeze-protection heating and intermittent ventilation during unoccupied times. Units may drive relief dampers or mechanical exhaust fans via an optional dry contact interlock. An entering air thermostat acts as an economizer by deactivating burner operation during mild weather.

# UNIT CONFIGURATION



# INSTALLATION INSTRUCTIONS
# UNCRATING INSTRUCTIONS

1. Verify the number of items on the Bill of Lading versus the number of items received.

2. Check for shipping damage. **If damage is found, immediately file a claim with carrier before proceeding further. Take photographs of any damage.**

3. Check items received to make sure they agree with ordering information including verification of data on the ventilation air 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 unit for service and maintenance functions. Ensure the positioning of the unit does not inhibit fork truck operation, storage rack access, or other operations within the facility. Ensure the unit inlet and outlet are not blocked or severely restricted, such that it would affect the rated airflow through the unit or affect the desired air distribution pattern of the unit. If upon review of the proposed installation, a problem is discovered which may be considered detrimental to the performance of the unit, or restricts its serviceability, or deviates from the instructions or drawings which may be provided, it is the responsibility of the installer to communicate that information to the person or persons responsible for providing the installation instructions or drawings prior to proceeding with the installation.

**IMPORTANT**

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

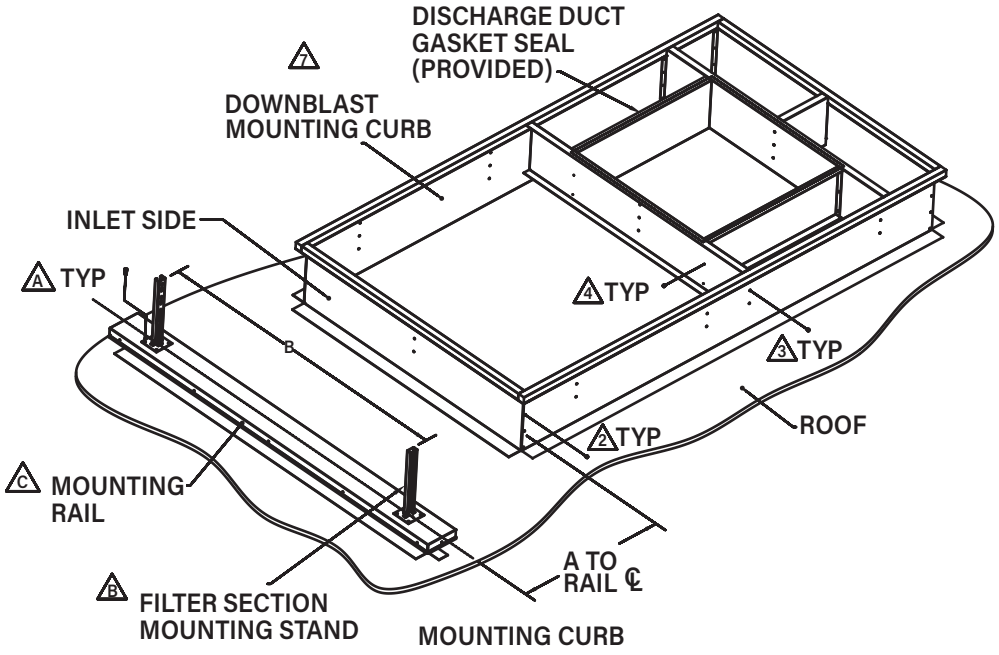
**IMPORTANT**

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

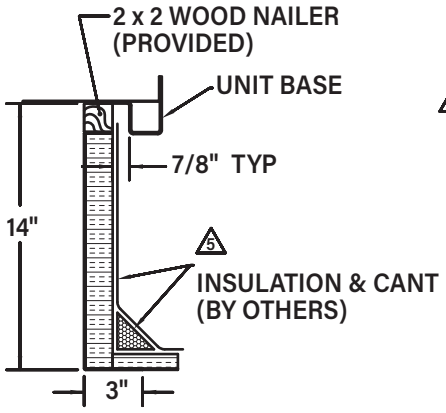
## INSTALLATION INSTRUCTIONS

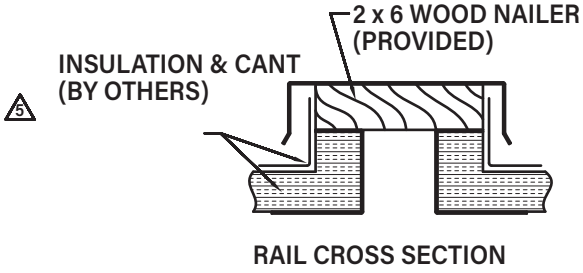
# CURB AND ROOF PREPARATION
# V18 - V30

**(Shown for Roof Top Configuration - Downblast Application)**




See page 9 for drawing references and installation instructions.




RAIL CROSS SECTION

| | Model | | | |
|---|---|---|---|---|
| Reference (inch) | V18 | V20 | V25 | V30 |
| A | 33" | 33" | 33" | 33 7/8" |
| B | 48 5/8" | 54 5/8" | 66 5/8" | 88 3/8" |

# INSTALLATION INSTRUCTIONS
## CURB AND ROOF PREPARATION

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

**IMPORTANT**

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

**IMPORTANT**

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

**⚠ CAUTION:**
To prevent contaminated air from being drawn into the unit, install the unit'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 unit. Consult local codes for applicable building code provisions for ventilation air.

**IMPORTANT**

*The Spec Air Series product line is suitable for horizontal mount - roof top configurations only.*

1. Prepare the roof for installation. (See page 9 for roof opening dimensions for your specific unit.) The gas and electrical connections must not penetrate the unit base or mounting curb. Cambridge Air Solutions recommends using pitch pockets or roof boots to seal the penetrations.

**IMPORTANT**

*Accurate measurements are critical and will affect installation process.*

| Roof Opening | | |
|---|---|---|
| **Model** | **W (inch)** | **L (inch)** |
| **V18** | 26½" | 26½" |
| **V20** | 30½" | 30½" |
| **V25** | 36" | 36" |
| **V30** | 42" | 42" |

2. Place exterior curb sides together as shown and secure using large Tek screws (as required).
3. Install the curb/duct cross supports as shown and secure using large Tek screws (note dimension locations).
4. Install the center supports as shown and secure using large Tek screws note dimension locations.
5. Insulation and cant (if required) by others.

**IMPORTANT**

*Gas and electrical connections must not penetrate unit base or mounting curb. Pitch pockets or roof boots (by others) recommended.*

**FILTER SECTION ONLY**

A. Secure mounting stands to rail wood nailer with wood lag screws and add waterproof sealant.

B. Mounting stand construction: 12 Ga. galvanized steel. Required for filter section installation.

C. Mounting rail construction: 16 Ga. galvanized steel. Required for filter section installation.

6. Secure the roof curb (and mounting rail if required) to the support structure per the recommendations of the structural engineer and roof manufacturer.

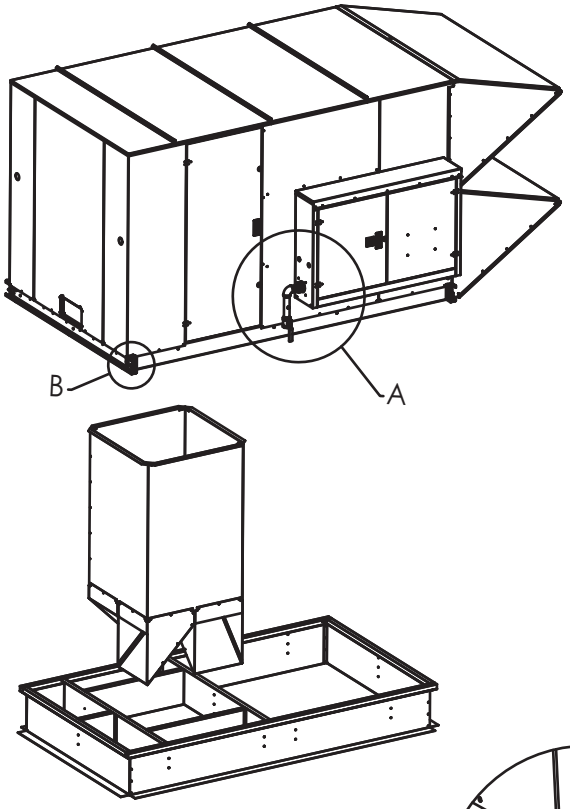
**IMPORTANT**

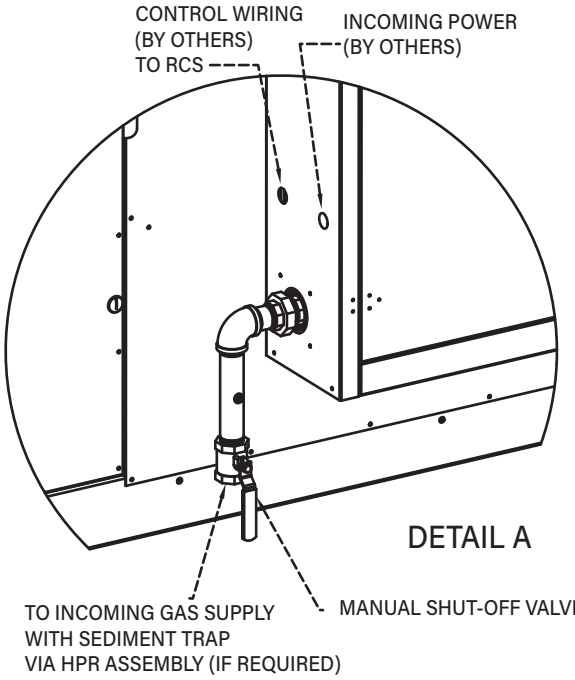
*The roof curb or support structure should be installed such that the unit will sit level.*

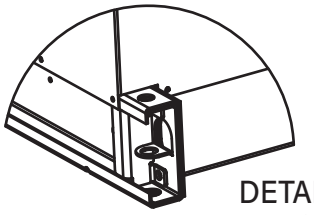
7. Install the provided roof curb gasket seal.

## TYPICAL INSTALLATION

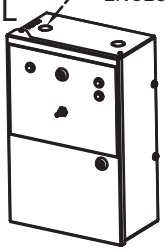
# UNIT PREPARATION AND INSTALLATION V18 - V30



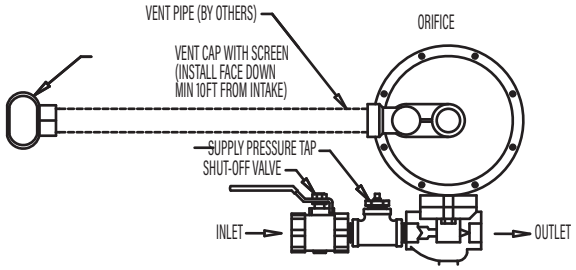



DETAIL B
LIFTING PROVISIONS
TYP EACH CORNER




1. Position and install the discharge nozzles by screwing them onto the bottom of the discharge duct.
2. Lower the discharge duct through the roof opening.
3. Use a crane or comparable lifting device to raise and position the equipment onto the mounting curb. Use a spreader bar to prevent damage and connect slings to the lifting eyes.
4. Caulk all joints of the unit's accessories installed in the field. Use a clear or gray silicone caulking to prevent water leaks.
5. Seal all roof penetrations to prevent roof leaks.




HIGH PRESSURE REGULATOR ASSEMBLY (HPR)
TYP, IF REQUIRED

# INSTALLATION INSTRUCTIONS
## GAS PIPING

**IMPORTANT**

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

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

**⚠ CAUTION:**

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

**⚠ WARNING:**

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

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

**IMPORTANT**

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

**IMPORTANT**

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

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

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

**⚠ CAUTION:**

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

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

**⚠ CAUTION:**

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

# INSTALLATION INSTRUCTIONS
## ELECTRICAL

**IMPORTANT**

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

> **⚠ WARNING:**
> High voltage electrical input to this equipment is required. EXTREME caution should be exercised. This equipment must be electrically grounded in accordance with local codes or in accordance with National Electrical Code NFPA 70.

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

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

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

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

**IMPORTANT**

**Observe the special notes and instructions on the wiring diagrams including the following:**

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

**IMPORTANT**

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

5. Wire the Remote Control Station and other temperature control options using Class 2 wiring per Cambridge Air Solutions wiring diagram and National Electrical Code Article 725 or local codes.
6. Run conduit and primary wiring to the disconnect switch inside of the control enclosure on the unit per National Electrical Code NFPA 70.
7. Return the wiring diagram to the manual holder. Replace and fasten all access covers.

> **⚠ CAUTION:**
> Do not attempt to start the ventilation air unit at this time.
> Premature start-up can result in damage to the equipment and components.

# START-UP INSTRUCTIONS



After start-up, please complete and fax the Spec Air 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 may void the warranty.**

## 1. VISUAL INSPECTION OF EQUIPMENT

a. Check for any physical damage from shipping or installation that could render the unit inoperable.

b. Verify all unit accessories and filters (if applicable) have been properly installed.

c. Check for loose components (belts, plugs, terminal screws, etc.).

d. Verify the access doors and controls enclosure are free from obstructions, such that they can be fully opened.

e. Verify the field wiring, both primary and control, has been installed according to the Cambridge Air Solutions wiring diagram and the National Electrical Code.

f. Verify that a sediment trap has been provided upstream of other gas train components.

g. Verify the high pressure regulator and/or vent limiter, if applicable, have been vented to the outside of the building at least 10 feet from any intake opening.

h. Verify the factory supplied manual gas shut-off cock is installed external to the unit and downstream of the high pressure regulator, if applicable.

i. Verify that the gas piping unions are tight.

j. Verify that the burner union is tight.

## 2. ELECTRICAL SUPPLY VOLTAGE VERIFICATION

Remove electrical control enclosure access door and check the electrical supply voltage at the disconnect switch. For electrical control enclosure drawings, see page 41.

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

### 3. GAS SUPPLY PRESSURE VERIFICATION

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

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

### 4. BLOWER ROTATION CHECK

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

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

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

**IMPORTANT**

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

**IMPORTANT**

*Indications of loose belts include barking or squealing when the blower starts. If these symptoms occur, please refer to the BELT TENSIONING section of the MAINTENANCE INSTRUCTIONS (page 34). Periodic belt adjustments may be required.*

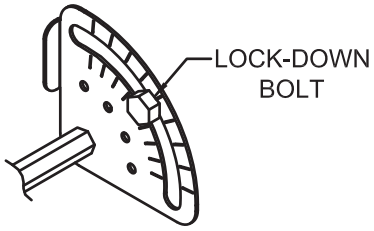
### 5. BURNER PROFILE DAMPER PRESSURE DROP CHECK

**IMPORTANT**

*The blower access doors must be closed when adjusting the profile plate.*

a. Turn the blower service switch to the "LOCAL" position. (Note: The burner service switch must remain in the "OFF" position)

b. Check the pressure drop across the burner with an inclined manometer or similar differential pressure measuring device (not provided). The pressure drop across the burner profile plate shall be 0.68" WC for units without filters and 0.72" WC for units with filters.




c. To change the profile plate pressure drop on units with a Manual Profile Adjust mechanism, locate the adjusting mechanism in the gas train enclosure, loosen the lock-down bolt, and rotate the hex shaft to increase or decrease the pressure drop, as required. Hold the hex shaft and re-tighten the lock-down bolt to secure the mechanism.

**IMPORTANT**

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

**6. MOTOR AMP DRAW CHECK**

**IMPORTANT**

*The unit access doors must be closed for this test.*

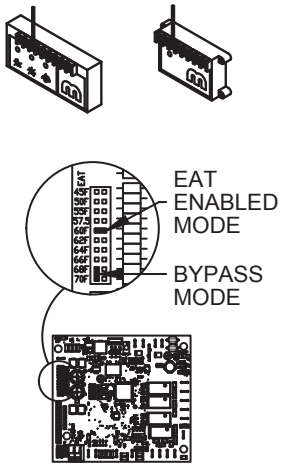
a. Check the motor current at the overload relay on all three legs.

b. Turn the blower service switch to the "OFF" position.

**IMPORTANT**

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

**7. CALCULATING AND ADJUSTING BURNER MANIFOLD PRESSURE**




a. Turn the disconnect switch off.

b Disconnect #3 wire from the amplifier to drive the modulating valve to full open and keep the unit in continuous high fire.

c. If the ambient temperature is at or above the Entering Air Thermostat (EAT) setpoint on the multi-functional PC board, then note the setpoint position and set the EAT to its highest setting (see page 49). If the ambient temperature exceeds its highest setting, remove the set point jumper and rotate 90˚ for the bypass mode.

d. Remove the 1/8" NPT plug from the manual shut-off valve located just prior to the burner and connect a manometer for the purpose of measuring the manifold pressure.

e. Refer to the unit nameplate for the Manifold Differential Pressure (MDP) (inch WC) for which the unit was specified.

Record the Nameplate Manifold Differential Pressure

f. Turn the disconnect switch on.

g. Turn the blower service switch to the "LOCAL" position. The blower motor will start. Monitor the pressure reading on the manometer. Record the Manifold Static Pressure (Blower Only).

h. Using the formula below, calculate the required manifold pressure:

**Nameplate Manifold Differential Pressure**
_____inch WC
**+ Manifold Static Pressure (Blower Only)**
_____inch WC
**= Calculated Manifold Pressure**
_____inch WC

**IMPORTANT**

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

i. Turn the burner service switch to the "LOCAL" position. After a delay for pre-purge and igniter warm-up, the burner will light.

j. Observe the manometer reading and compare to the Calculated Manifold Pressure above. If the manifold pressure reading does not equal this value, adjust the manifold pressure regulator until the proper manifold pressure is obtained. See page 39 for gas train drawing.

**IMPORTANT**

*The pressure drop across the burner profile damper that was adjusted in Step 5 (page 14) must not fall below 0.51 inches WC for natural gas units and 0.55 inches WC for natural gas with a filter section or filters in the rainhood. If the pressure drop is below these values the low airflow switch will shutoff power to the burner. This is an indication of low airflow or burner overfiring. To correct this condition, either adjust the manifold pressure regulator to reduce the manifold pressure or increase the blower speed, provided the motor full load amps are not exceeded.*

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

**8. GAS VALVE LEAK CHECK**

All units should be evaluated for the gas tightness of the gas valve seat. Units are equipped with a leak test facility to assist in checking this seal. A momentary switch and a gas port for measuring pressure between valves are provided as the leak test hardware (page 40). Refer to the Individual Component Description Section (page 49) for more information regarding the leak test switch. The procedures for the gas valve leak check are as follows:

a. Connect a 0 to 10 inches water column (inch WC) manometer to the 1/8" NPT tapped fitting on the manual shut-off valve located just prior to the burner for the purpose of monitoring an increase in pressure. Verify that the manometer is properly zeroed.

b. Close the manual burner shut-off valve, hold the momentary leak test switch in the closed position, and wait 30 seconds to read the manometer. If the reading is greater than 0 inch WC, refer to the Maintenance Instruction Section for information on Gas Valve Cleaning (page 33) for cleaning the safety shut-off valve (SSV) which is closest to the burner and retest. If the reading is 0 inch WC, remove the manometer and reinstall the pipe plug.

c To check the gas tightness of the shut-off valve (SOV) in the gas train which is farthest from the burner connect the manometer to the leak test port between the valves and verify that the manometer is properly zeroed. Wait 30 seconds to read the manometer. If the reading is greater than 0 inch WC, refer to the Maintenance Instruction Section (page 32) for information on Gas Valve Cleaning for the shut-off valve (SOV) gas valve and retest. If the reading is 0 inch WC, remove the manometer and reinstall the pipe plug.

**9. GAS TRAIN LEAK CHECK**

a. Turn the blower and burner service switches to the "LOCAL" position.

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

c. Turn the blower and burner service switches to the "OFF" position.

**⚠ WARNING:**
Do not use flame to leak check piping.

**⚠ WARNING:**
Any gas leak detected must be repaired before the ventilation air unit is placed into service.

**10. MINIMUM FIRE SETTING**

**IMPORTANT**
*All access doors must be closed during this procedure.*

a. For units with an A1044 amplifier: Reinstall #3 wire on the amplifier that was removed in Step 7.b. (See page 15).

b. Connect a meter set to read DC microamps (μA) in order to verify the minimum fire flame signal during the adjustment process. Connect the meter by removing the red wire from terminal FP of the flame safeguard relay (FSR) and attaching the positive lead of the meter to terminal FP and the negative lead to the red wire.

c. Turn the blower and burner switches to the "LOCAL" position.

d. After the burner has ignited, remove the #8 wire from the amplifier to drive the modulating valve to minimum fire.

e. Look through the burner viewport in the front of the unit to verify that the burner flame is a very small ribbon (approximately 1-1/2" to 2" long) that is evenly spread across the burner (without gaps).

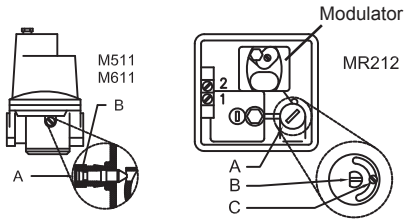
f. Verify that the minimum fire flame signal is steady and above 2.0 microamps (μA).

**IMPORTANT**

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

g. Minimum Fire Adjustment

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




ii. Replace the cap (A). Tighten the lock screw (C) on the MR212 valve prior to reinstalling the cap and housing cover.

iii. Turn the blower and burner service switches to the "OFF" position.

iv. Reinstall the #8 wire on the amplifier that was removed in Step 10.d. (See page 17).

v. Remove the meter and reattach the red wire to terminal FP on the FSR board.

## 11. LOW FIRE START ADJUSTMENT

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

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

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

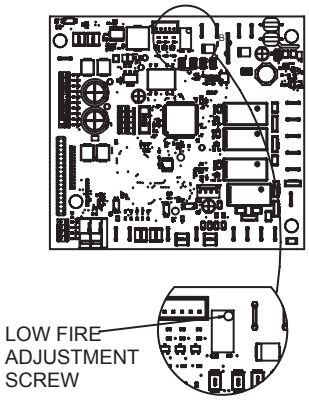
a. Connect a meter in the flame sense circuit as in step 10.b (page 17).

b. Connect a manometer to the burner static pressure port. Turn the blower service switch to the "LOCAL" position and the burner service switch to the "OFF" position and measure the burner static pressure.

c. Connect a DC voltmeter to terminals "MV OUT" on the multi-functional PC board.

d. Turn the burner service switch to the "LOCAL" position and monitor the modulating valve voltage, flame length, manifold differential pressure, and the time required to establish flame signal after the gas valves are energized. (This may need to be repeated several times to note all of the above information)

e. If adjustment is required, the Low Fire Start adjustment screw is located on the multi-functional PC board as shown in the drawing. Only minor adjustments are normally required to obtain the proper setting.




**12. FINAL UNIT PREPARATION**

a. Turn the disconnect switch off.

b. Set the Entering Air Thermostat (EAT) to the specified temperature setting. Refer to the Individual Component Description Section for additional information (page 49).

c. Set the "MIN" and "MAX" setting of the amplifier to the application specifications.

d. For adjustment of the Clogged Filter Switch, refer to the procedure that is provided with this manual.

e. Verify the blower and burner service switches are in the "REMOTE" position.

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

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

h. Replace and fasten all covers and panels. Turn the disconnect switch on.

**13. REMOTE CONTROL STATION OPERATIONAL CHECK**

a. Identify the type of Remote Control Station, if applicable, that is utilized on this application. Refer to Individual Component Description Section for additional information (page 45).

b. Turn the blower and burner service switches to the "REMOTE" position and, if applicable, turn the Remote Control Station mode selector switch to the "HEATING" position.

c.1. If the Remote Control Station utilizes a thermostat, refer to the Operating Instructions for the Electronic Thermostat (page 23) or the TSS Controller (page 25) to set the thermostat at its highest setting.

c.2. If another device in the Remote Control Station controls the operation of the unit, activate this device.

c.3. If the ventilation air unit is not equipped with a Remote Control Station, activate that part of the control system which will initiate the blower and burner operation.

d. After a short delay for damper operation, the blower should operate, followed by burner ignition after a delay for prepurge and igniter warm-up.

e. Adjust the applicable temperature control and verify the unit output changes. See (page 44).

f. Reset the thermostat, if applicable, and the temperature control to the desired temperature.

g. Turn the mode selector switch to the "SUMMER VENTILATION" position. Verify the blower operates.

## SHUT-DOWN INSTRUCTIONS

1. Turn the mode selector switch of the Remote Control Station to the "OFF" position.

2. Turn the service disconnect switch off.

3. Turn the blower and burner service switches to the "OFF" position.

4. Close the supply gas cock.

5. Turn off the electric supply to the unit.

**IMPORTANT**

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

# OPERATING INSTRUCTIONS
## OPERATING SEQUENCE

### For occupancy switch control system:

POWER ON

1. Control transformer energized.
2. Operator must select “SUMMER VENT” or “HEAT” mode.
3. Operator must select “OCCUPIED” or “UNOCCUPIED” state.

SUMMER VENT – OCCUPIED OR UNOCCUPIED

1. Mode switch in “SUMMER VENT” and state switch in “OCCUPIED” or “UNOCCUPIED.”
2. Damper motor (optional) opens and activates the end switch.
3. Blower motor starts and runs continuously to meet ASHRAE 62.1 Ventilation Requirements.

HEAT - OCCUPIED

1. Mode switch in “HEAT” and state switch in “OCCUPIED.”
2. Damper motor (optional) opens and activates the end switch.
3. Blower motor starts and runs continuously to meet ASHRAE 62.1 Ventilation Requirements.
4. Low airflow switch closes.
5. If inlet temperature is above entering air thermostat set point skip to step (12).
6. After the purge delay continue with igniter warm up timing.
7. Gas valve opens.
8. Burner lights.
9. Igniter is de-energized.
10. Low Fire Start is de-energized after 15 seconds.
11. Unit runs and modulates discharge temperature to maintain space temperature set point.
12. Repeat steps (2) through (12).

HEAT – UNOCCUPIED

1. Mode switch in “HEAT” and state switch in “UNOCCUPIED.”
2. Unit does not run.

### For operating thermostat with manual occupancy switch control system:

POWER ON

1. Control transformer energized.
2. Operator must select “SUMMER VENT” or “HEAT” mode.
3. Operator must select “OCCUPIED” or “UNOCCUPIED” state.

SUMMER VENT – OCCUPIED OR UNOCCUPIED

1. Mode switch in “SUMMER VENT” and state switch in “OCCUPIED” or “UNOCCUPIED.”
2. Damper motor (optional) opens and activates the end switch.
3. Blower motor starts and runs continuously to meet ASHRAE 62.1 Ventilation Requirements.

HEAT - OCCUPIED

1. Mode switch in “HEAT” and state switch in “OCCUPIED.”
2. Damper motor (optional) opens and activates the end switch.
3. Blower motor starts and runs continuously to meet ASHRAE 62.1 Ventilation Requirements.
4. Low airflow switch closes.
5. If inlet temperature is above entering air thermostat set point skip to step (12).
6. After the purge delay continue with igniter warm up timing.
7. Gas valve opens.
8. Burner lights.
9. Igniter is de-energized.

10. Low Fire Start is de-energized after 15 seconds.
11. Unit runs and modulates discharge temperature to maintain space temperature set point.
12. Repeat steps (2) through (12).

HEAT – UNOCCUPIED

1. Mode switch in "HEAT" and state switch in "UNOCCUPIED."
2. Thermostat calls for heat.
3. Damper motor (optional) opens and activates the end switch.
4. Blower motor starts.
5. Low airflow switch closes.
6. If inlet temperature is above entering air thermostat set point skip to step (13).
7. After the purge delay continue with igniter warm up timing.
8. Gas valve opens.
9. Burner lights.
10. Igniter is de-energized.
11. Low Fire Start is de-energized after 15 seconds.
12. Unit runs at maximum discharge temperature to reach thermostat set point.
13. Repeat steps (2) through (12).

**For temperature setback control system:**

POWER ON

1. Control transformer energized.
2. Operator must select "SUMMER VENT" or "HEAT" mode.
3. Operator must set a "HEAT" schedule for the "OCCUPIED" and "UNOCCUPIED" state.
4. Operator must set a "SUMMER VENT" schedule for the "OCCUPIED" and "UNOCCUPIED" state.
5. Operator may also use the override timer dial to set the state to "OCCUPIED."

SUMMER VENT - OCCUPIED

1. Mode switch in "SUMMER VENT" and state "OCCUPIED."
2. Damper motor (optional) opens and activates the end switch.
3. Blower motor starts and runs continuously to meet ASHRAE 62.1 Ventilation Requirements.

SUMMER VENT - UNOCCUPIED

1. Mode switch in "SUMMER VENT" and state "UNOCCUPIED."
2. Unit does not run.

HEAT - OCCUPIED

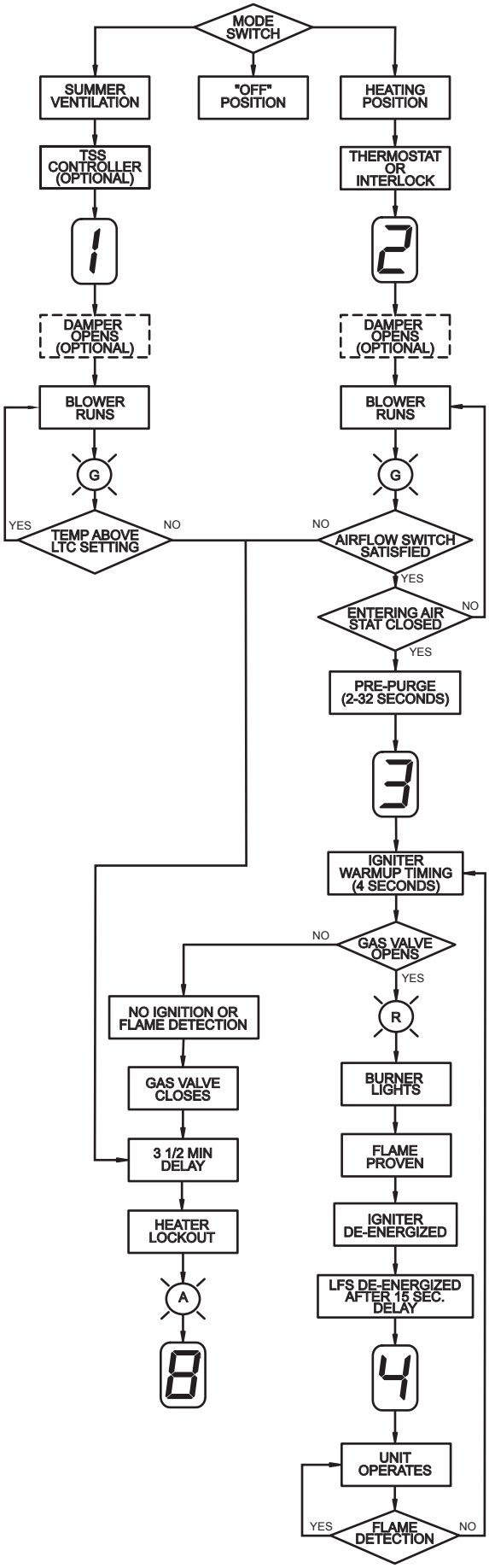
1. Mode switch in "HEAT" and state switch in "OCCUPIED."
2. Damper motor (optional) opens and activates the end switch.
3. Blower motor starts and runs continuously to meet ASHRAE 62.1 Ventilation Requirements.
4. Low airflow switch closes.
5. If inlet temperature is above entering air thermostat set point skip to step (12).
6. After the purge delay continue with igniter warm up timing.

*(cont'd on next page)*

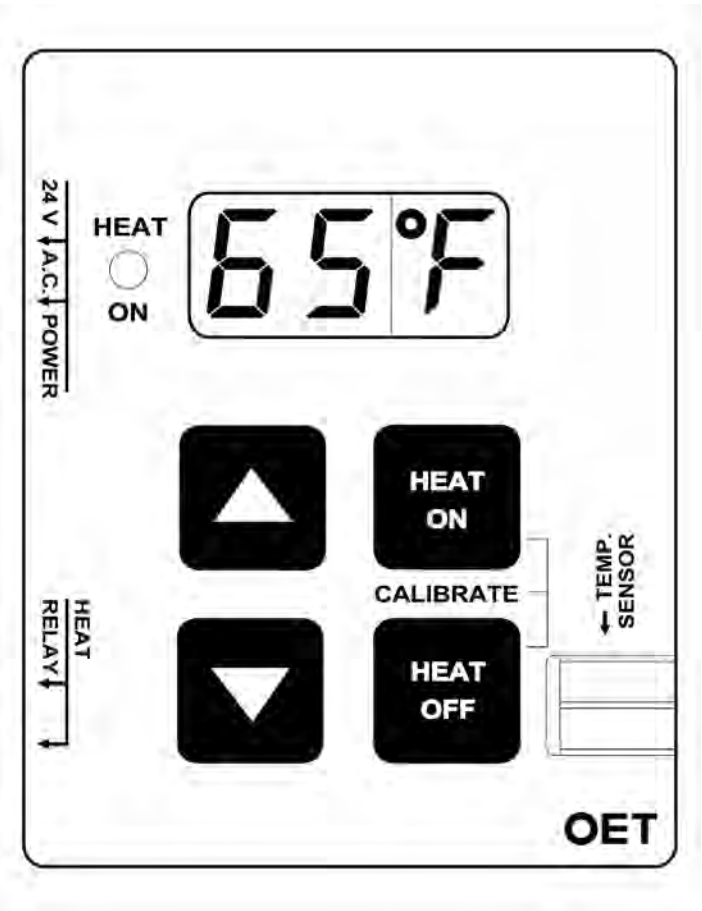
7. Gas valve opens
8. Burner lights
9. Igniter is de-energized
10. Low Fire Start is de-energized after 15 seconds
11. Unit runs and modulates discharge temperature to maintain space temperature set point
12. Repeat steps (2) through (12)

HEAT – UNOCCUPIED

1. Mode switch in “HEAT” and state switch in “UNOCCUPIED”
2. Thermostat calls for heat
3. Damper motor (optional) opens and activates the end switch
4. Blower motor starts
5. Low airflow switch closes
6. If inlet temperature is above entering air thermostat set point skip to step (13)
7. After the purge delay continue with igniter warm up timing
8. Gas valve opens
9. Burner lights
10. Igniter is de-energized
11. Low Fire Start is de-energized after 15 seconds
12. Unit runs at maximum discharge temperature to reach thermostat set point
13. Repeat steps (2) through (12)



## OPERATING INSTRUCTIONS
# ELECTRONIC THERMOSTAT




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

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

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

## SETTING TEMPERATURES

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

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

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

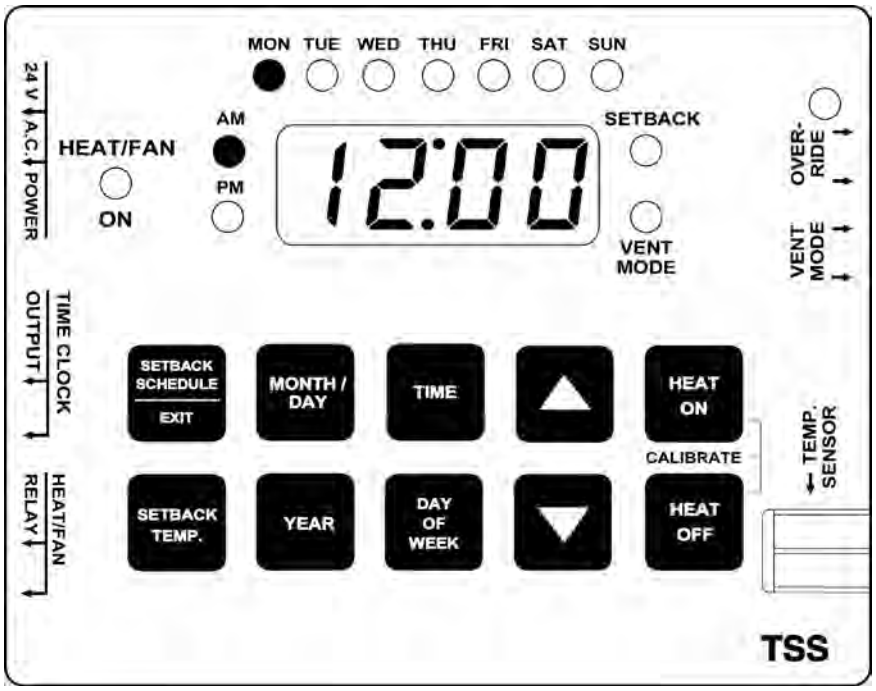

## TEMPERATURE CALIBRATION

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

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


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

## OPERATING INSTRUCTIONS
# TSS CONTROLLER




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

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

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

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

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

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

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


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

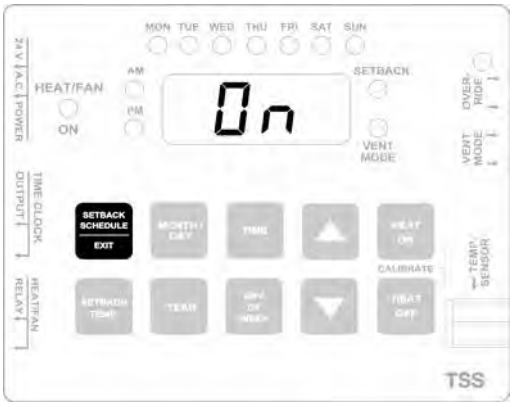

3. Press and hold the **MONTH/DAY** button while pressing the **UP** or the **DOWN** button until the current date is displayed.


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


## SETTING AUTOMATIC ADJUSTMENT FOR DAYLIGHT SAVING TIME

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

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




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


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


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

## SETTING TEMPERATURES

The TSS Controller has two temperature control modes with the keyswitch on the front of the enclosure in the HEATING position. The HEATING mode controls the unit when the ON time schedule is in effect. The SETBACK mode controls the unit 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 unit 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 unit will turn on. When the unit raises the space temperature above the HEAT OFF setting, the unit will turn off. This difference provides an adjustable range of operation for the unit, which minimizes temperature swings. The minimum on time and off time for the unit 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.

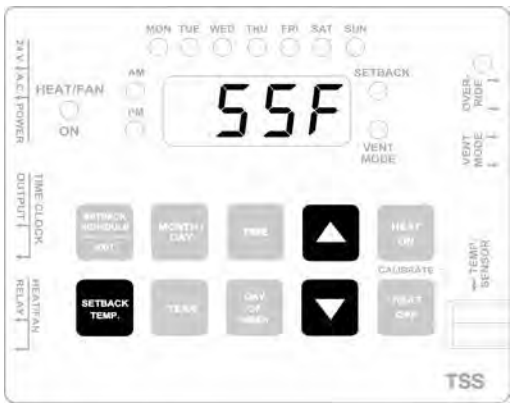
1. Press and hold the **HEAT ON** button while pressing the **UP** or the **DOWN** button until the desired temperature for the unit to turn ON is displayed.

2. Press and bold the **HEAT OFF** button while pressing the **UP** or the **DOWN** button until the desired temperature for the unit 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 unit 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 unit is operating during a scheduled ON cycle and a subsequent overlapping program is encountered, that program will be ignored.

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

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

## HEATING SCHEDULE

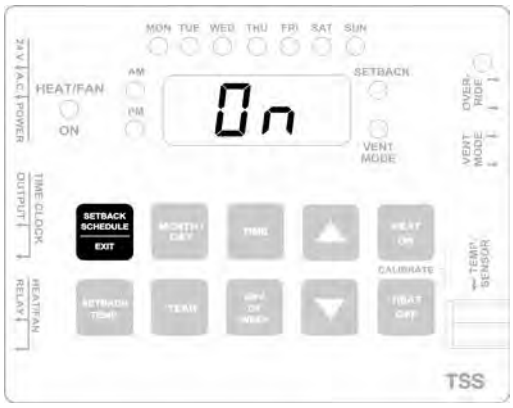
| Cycle | Time | AM/PM | Day |
|---|---|---|---|
| On | | | M-F |
| Off | | | M-F |
| On 1 | | | |
| Off 1 | | | |
| On 2 | | | |
| Off 2 | | | |
| On 3 | | | |
| Off 3 | | | |
| On 4 | | | |
| Off 4 | | | |
| On 5 | | | |
| Off 5 | | | |
| On 6 | | | |
| Off 6 | | | |
| On 7 | | | |
| Off 7 | | | |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

## SUMMER VENTILATION SCHEDULE

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

1. Switch the keyswitch on the front of the enclosure to the desired operating mode. Allow ten seconds before proceeding.

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



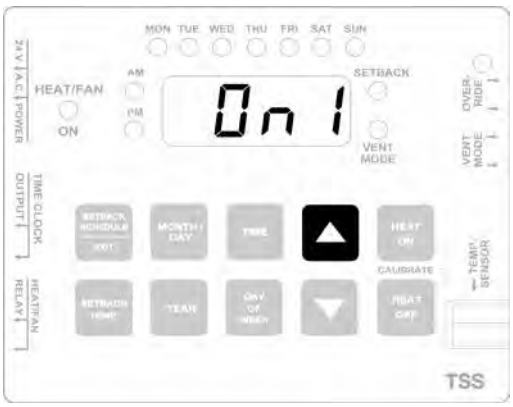

3. Press and bold the **TIME** button while pressing the **UP** or the **DOWN** button to scroll to the desired ON time for Monday through Friday.


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


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


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

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




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

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

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


11. Press and hold. the **TIME** button while pressing the **UP** or the **DOWN** button to scroll to the desired OFF time.

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

13. Repeat steps 7-12 until all required program cycles have been entered.

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

15. Verify that the correct current time and light for day of the week are still displayed.

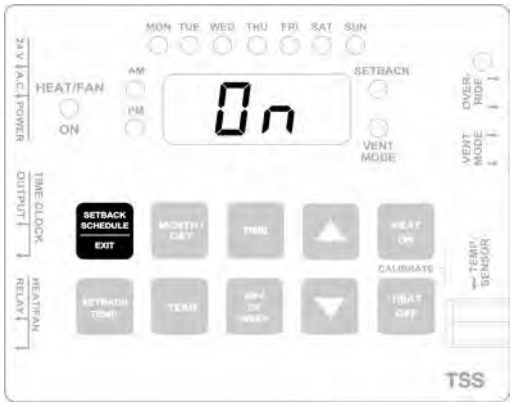
## HOLIDAY SETBACK SCHEDULE

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

### HOLIDAY SETBACK SCHEDULE

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

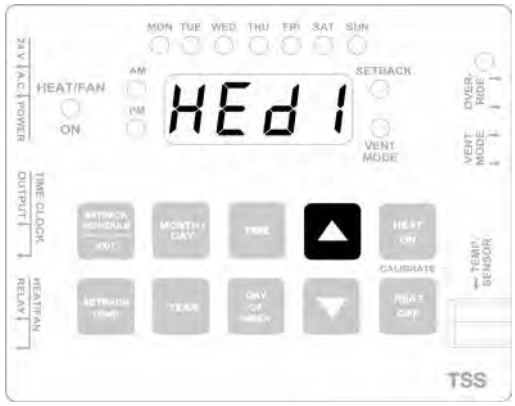
1. Press the **SETBACK SCHEDULE/EXIT** button to enter the scheduling program at the first ON cycle.




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


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


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




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


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

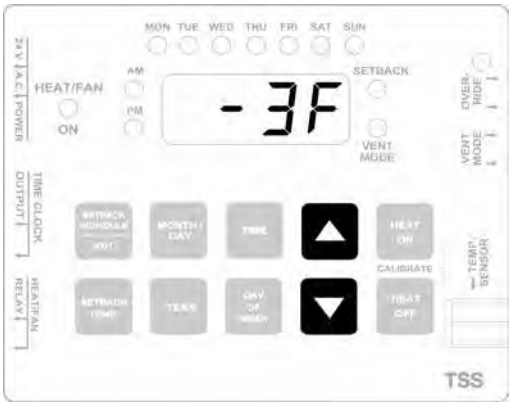
7. Press the **SETBACK SCHEDULE/EXIT** button to exit the scheduling program.

## TEMPERATURE CALIBRATION

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

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


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



# MAINTENANCE INSTRUCTIONS

**⚠ WARNING:**
Turn the disconnect switch off when performing service or maintenance functions.

## BLOWER BEARING LUBRICATION

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

## MOTOR BEARING LUBRICATION

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

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

## BELT TENSIONING

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

| Model | Motor HP | Belt(s) | | Center Span Deflection | Force (lbs) | |
|---|---|---|---|---|---|---|
| | | Qty | Type | | New Belts | Used Belts |
| V18 | 3 | 1 | BX | 1/4" | 4½ - 6 | 4 - 5½ |
| V18/ V20 | 5 | 2 | BX | 7/16" | 5 - 7 | 4½ - 6½ |
| V18/ V20 | 7½ | 2 | BX | 7/16" | 6 - 8 | 5½ - 7 |
| V20 | 10 | 2 | BX | 7/16" | 6½ - 8½ | 6 - 7½ |
| V20 | 15 | 2 | BX | 7/16" | 7 - 9 | 6 - 8 |
| V25 | 7½ | 2 | BX | 9/16" | 6 - 8 | 5½ - 7 |
| V25/ V30 | 10 | 2 | BX | 9/16" | 6½ - 8½ | 6 - 7½ |
| V25/ V30 | 15 | 2 | BX | 9/16" | 7 - 9 | 6 - 8 |
| V25/ V30 | 20 | 3 | BX | 9/16" | 6½ - 8½ | 6 - 7½ |
| V30 | 25 | 3 | BX | 9/16" | 7 - 9 | 6 - 8 |
| V30 | 25 | 4 | BX | 9/16" | 6½ - 8½ | 6 - 7½ |
| V30 | 30 | 4 | BX | 9/16" | 6½ - 8½ | 6 - 7½ |

## BLOWER CLEANING

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

## BURNER CLEANING

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

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

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

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

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

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

## GAS VALVE CLEANING

All solenoid valves should be cleaned periodically. The time between cleanings will vary depending on the medium and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive noise, or leakage will indicate that cleaning is required. Refer to step 8, Gas Valve Leak Check, of the Start-up Procedures (see page 16).

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

**IMPORTANT**

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

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

## ASCO GAS VALVES: SERIES 8214

Disassemble the valve (See page 35) and clean all parts as follows:

**IMPORTANT**

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

1. Remove the solenoid enclosure.

2. Remove the bonnet screws, valve bonnet, bonnet gasket, core/diaphragm sub-assembly and body gasket.

3. All parts are now accessible to clean or replace.

4. Lubricate the bonnet gasket and body gasket with a light coat of Dow Corning® 200 Fluid lubricant or an equivalent high-grade silicone fluid.

5. Apply a light coat of RemGrit TFL 50® Dry Lubricant to: the valve seat; the valve body surface where diaphragm assembly contacts the valve body and body gasket; and internal surface of the valve bonnet where the diaphragm assembly contacts the bonnet when the valve is in the energized (open) position.

**IMPORTANT:**

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

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

**⚠ CAUTION:**

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

6. Replace the body gasket and the core/diaphragm sub-assembly with the closing spring attached. Locate the bleed hole in the core/diaphragm sub-assembly approximately 30˚ CCW from the valve inlet.

7. Replace the valve bonnet and the bonnet screws (6). Torque the screws in a crisscross manner to 100 ± 10 in-lbs. Replace the solenoid and make the electrical hookup.

**⚠ WARNING:**

To prevent the possibility of severe personal injury or property damage, check the valve for proper operation before returning to service. Also perform a gas valve leak check and gas train leak check in accordance with steps 8 and 9 of the Start-up Procedures (See pages 16 & 17).

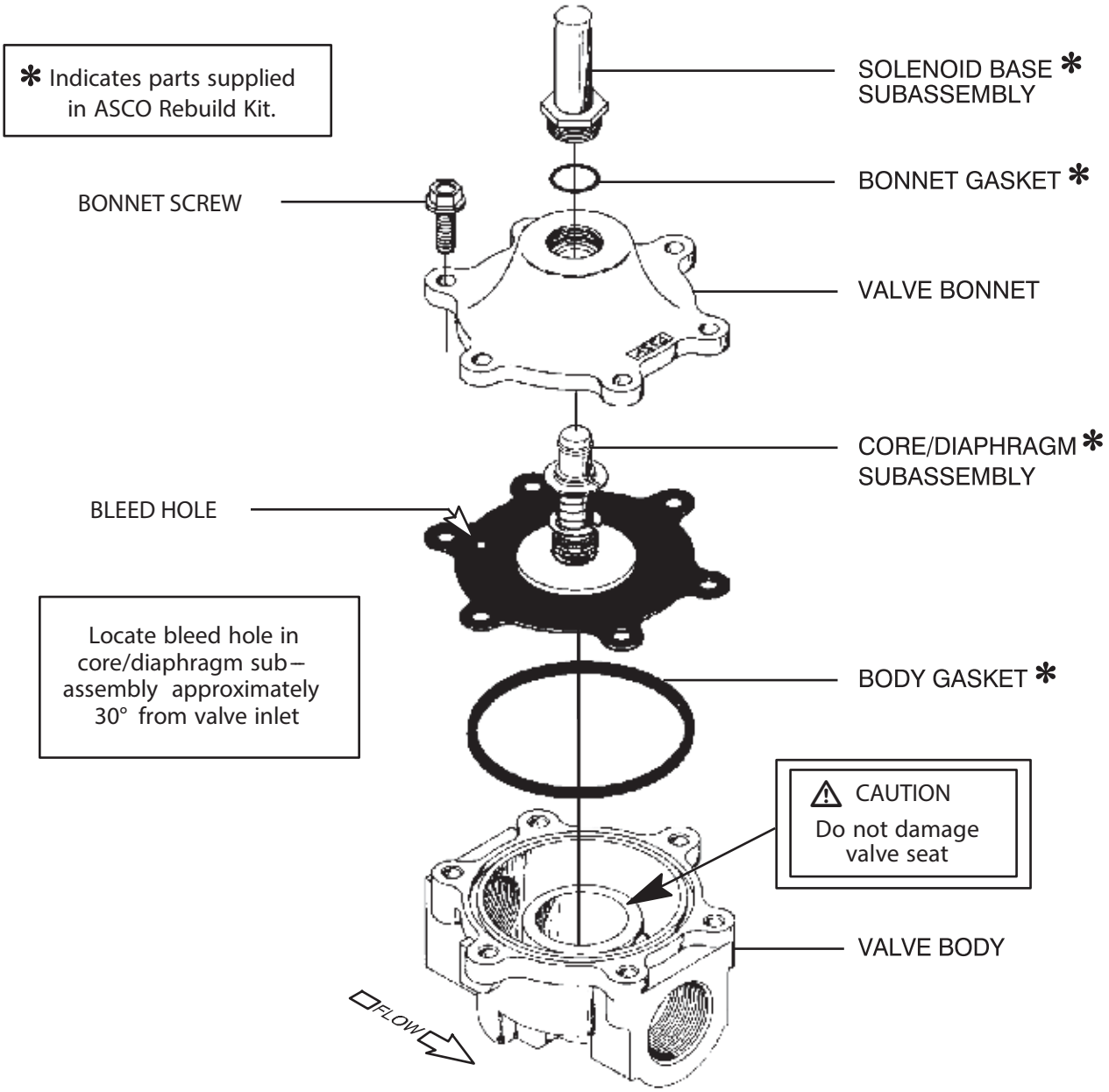
### ORDERING INFORMATION FOR ASCO REBUILD KITS

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

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

### GAS TRAIN LEAK CHECK

Periodically check the gas control assembly, internal and external piping for leaks. Refer to step 9, Gas Train Leak Check, of the Start-up Procedures (see page 17). All relief vents on the gas controls should be checked for blockage (gas pressure regulators and pressure switches).




**Disassembled View of ASCO Valve**

# FILTERS

Filters may be installed in the V-bank filter section. These may be of the disposable or permanent type. Filters are removed and replaced from the V-bank filter section by opening the filter access door. A filter puller tool may be required to reach the far side filters. For the V30 only, the filter retainer must be removed prior to removing the filters.

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

**Disposable Filters** are pleated 2" thick panel filters which slide into tracks provided in the V-Bank filter section only.

## CLEANING AND REPLACEMENT

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

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

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

### Filters Selection

| Unit Size | Filter Size (inches) and Quantity | | |
|---|---|---|---|
| | 16x25 | 20x20 | 20x25 |
| V18 | | 8 | |
| V20 | | | 10 |
| V25 | 20 | | |
| V30 | | | 24 |

## REFERENCE

# UNIT ROOF OPENINGS

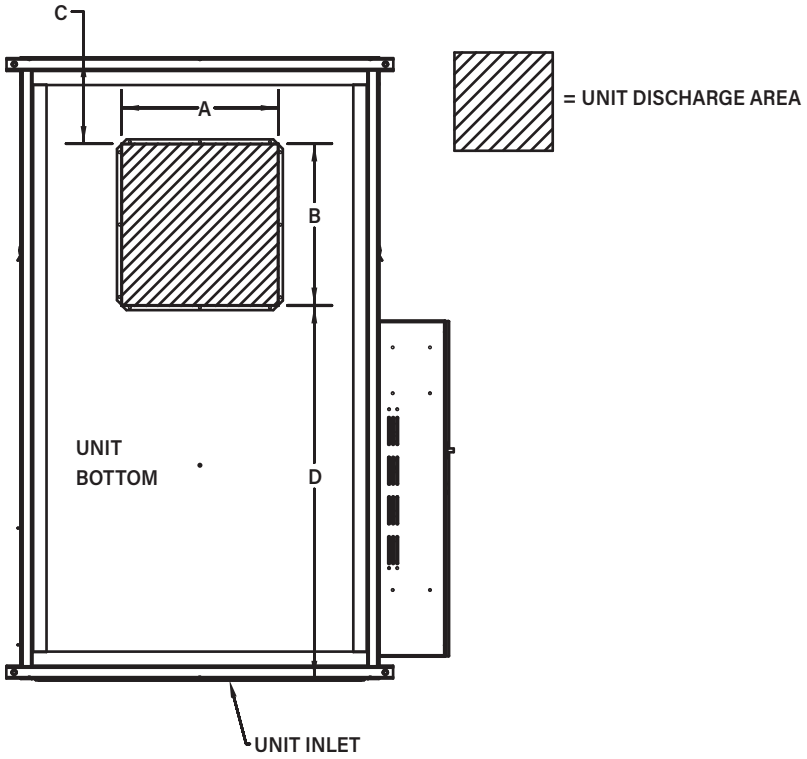
### Horizontal Mount

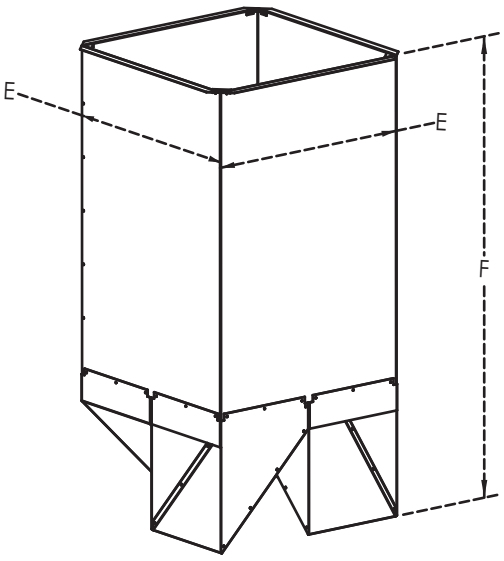
| Roof Opening | | |
|---|---|---|
| **Model** | **W (inch)** | **L (inch)** |
| **V18** | 26½" | 26½" |
| **V20** | 30½" | 30½" |
| **V25** | 36" | 36" |
| **V30** | 42" | 42" |

*DIMENSIONS ALLOW FOR 1½" CLEARANCE ON EACH SIDE*

## UNIT DISCHARGE DIMENSIONS

| | Reference (inch) | | | | | |
|---|---|---|---|---|---|---|
| | Discharge Opening | | | | Discharge Duct Size | |
| **Model** | **A** | **B** | **C** | **D** | **E** | **F** |
| **V18** | 19 7/8" | 18 1/4" | 13 1/4" | 63" | 23 1/2" | 65 1/2" |
| **V20** | 23 7/8" | 24 5/8" | 13 1/4" | 57" | 27 1/2" | 67 1/2" |
| **V25** | 31 1/8" | 31 1/4" | 18 3/4" | 62 1/2" | 33" | 70 1/4" |
| **V30** | 36" | 36 5/8" | 18 5/8" | 57" | 39" | 73 3/8" |

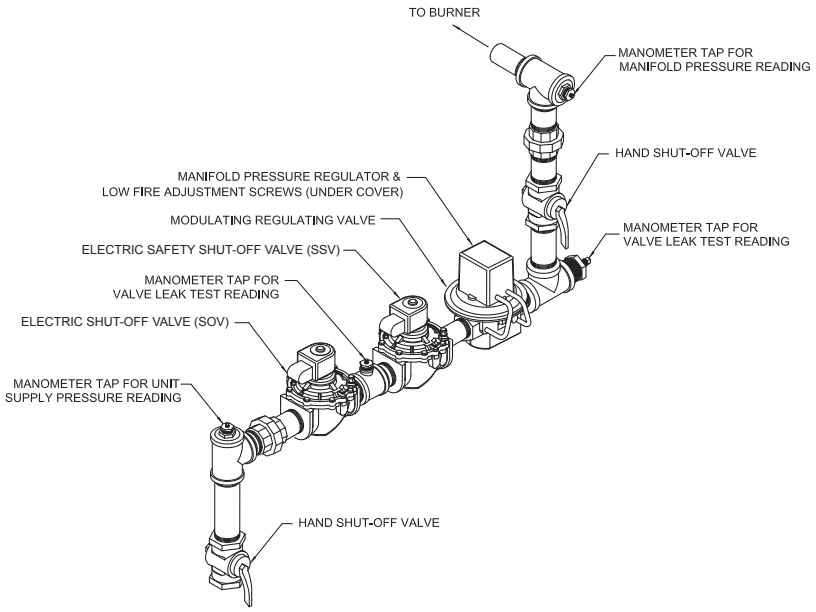


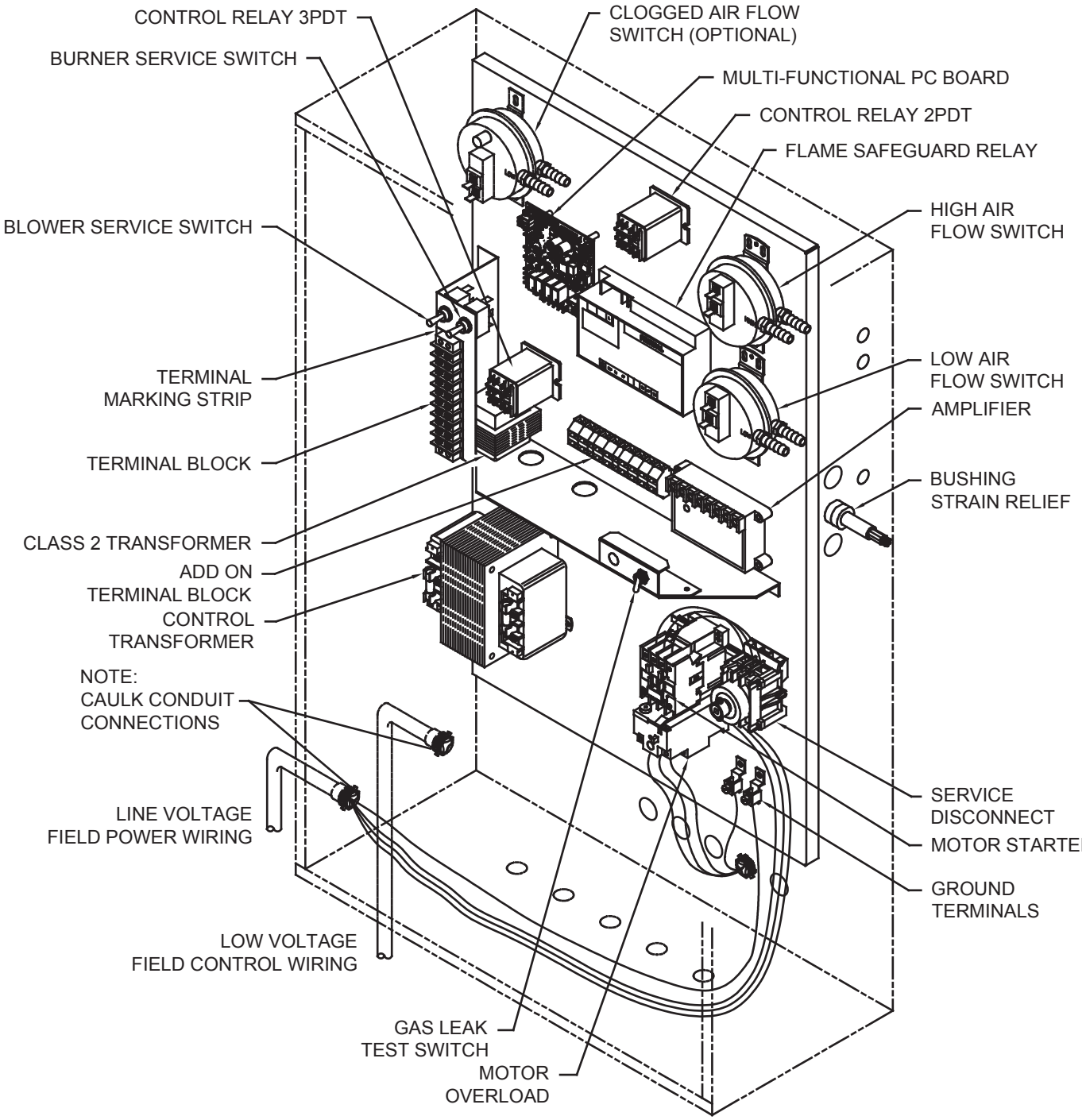
## REFERENCE

# GAS TRAIN DRAWING

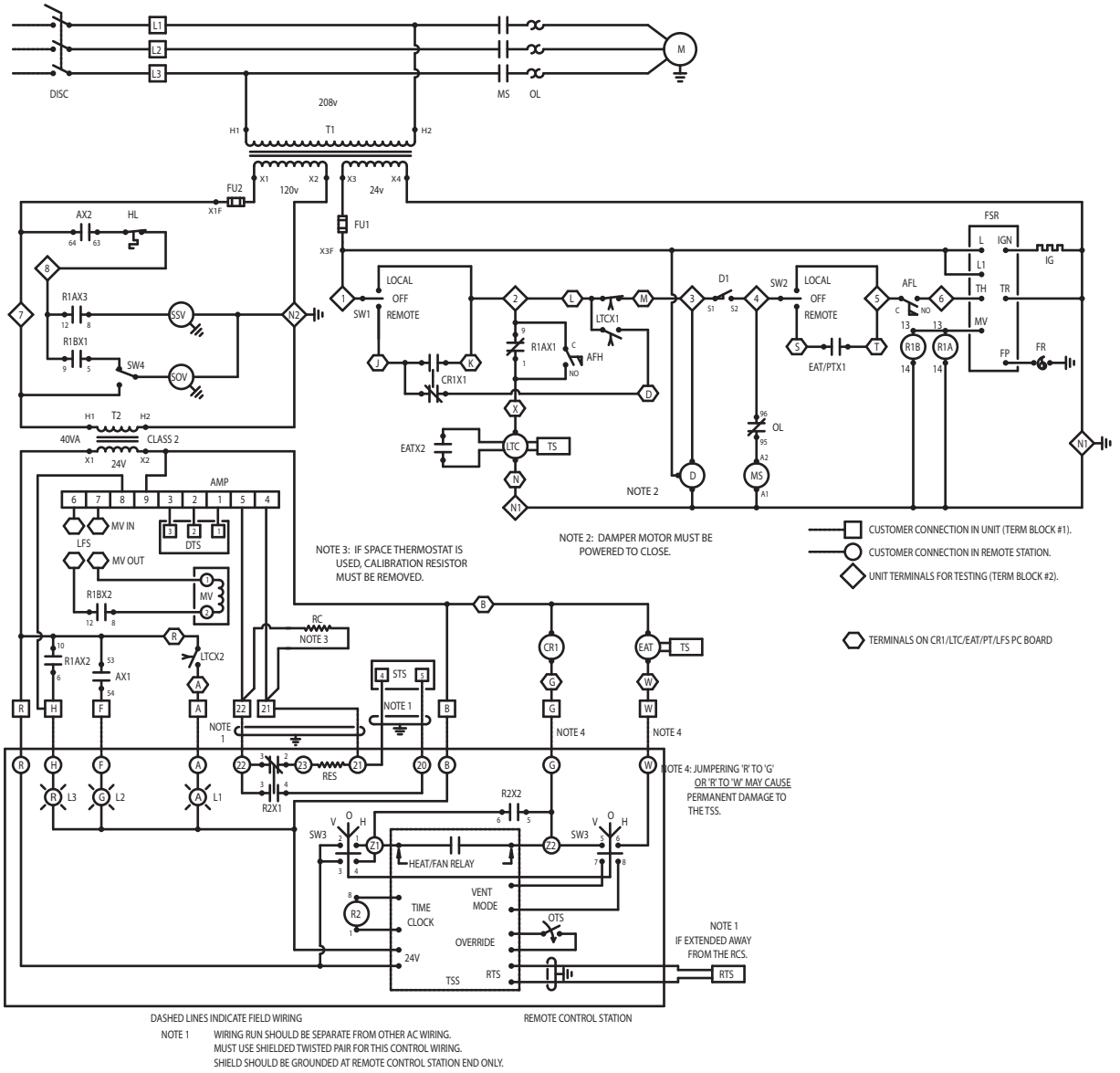
**Horizontal Mount**
**> 400 MBH**
**High Pressure**
**CSA Certified**



## REFERENCE
# ELECTRICAL CONTROL ENCLOSURE ISOMETRIC DRAWING




NOTE: Component location and / or orientation may differ from that shown above.



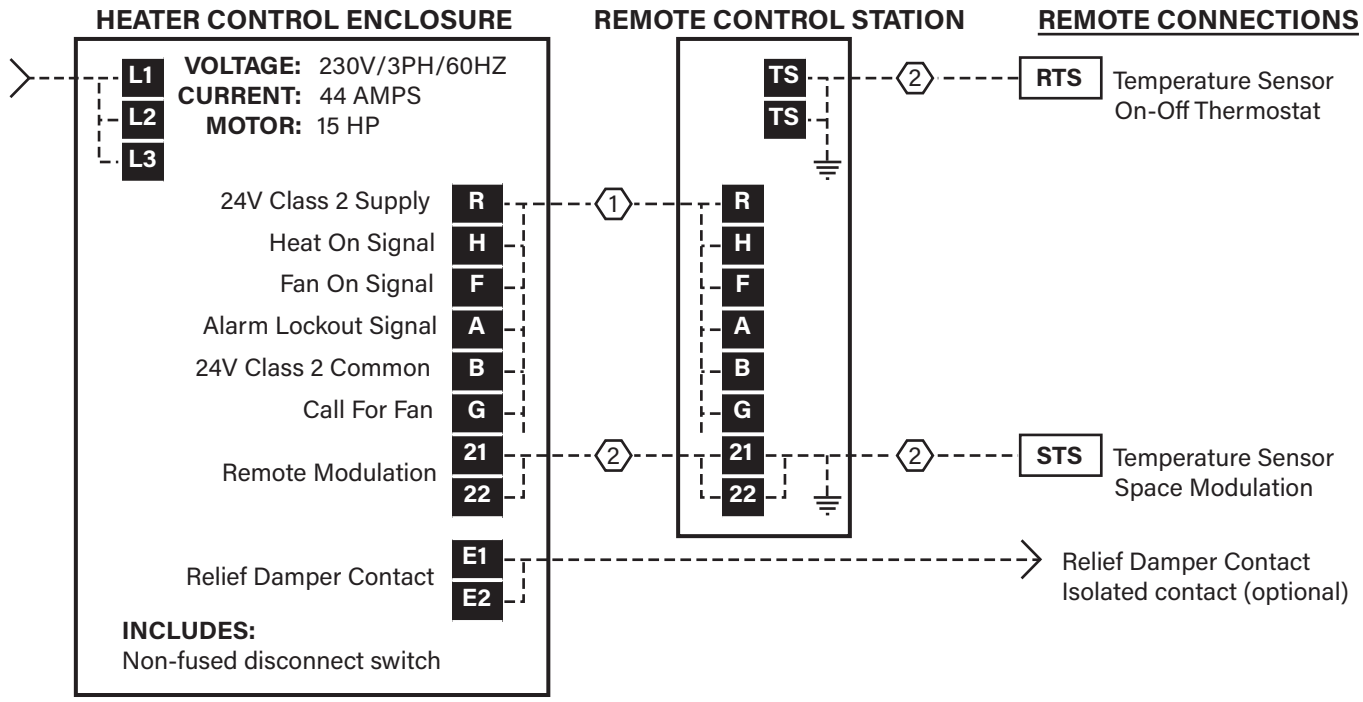

| SYMBOL | DESCRIPTION |
|---|---|
| AFL | Air Flow Switch - Low |
| AFH | Air Flow Switch - High |
| AMP | Amplifier Solid State |
| AX1 | Auxiliary Contact |
| AX | Auxiliary Contact |
| CR1 | Control Relay |
| D & D1 | Damper Motor & End Switch |
| DISC | Service Disconnect Non - Fused |
| DTS | Discharge Temperature Sensor |
| EAT | Entering Air Thermostat |
| FR | Flame Rod |
| FSR | Flame Safeguard Relay |
| FU1 | Fuse 24 Volt Control |
| FU2 | Fuse 120 Volt Control |

| SYMBOL | DESCRIPTION |
|---|---|
| HL | High Limit |
| IG | Igniter |
| L1 | Light - Alarm |
| L2 | Light - Fan |
| L3 | Light - Heat |
| LFS | Low Fire Start |
| LTC | Low Temperature Cutout |
| M | Motor |
| MS | Motor Starter |
| MV | Modulating Valve |
| OTS | Override Timer Switch |
| OL | Overload Relay |
| PT | Purge Timer |
| R1A&R1B | Relay - Gas Valve |

| SYMBOL | DESCRIPTION |
|---|---|
| R2 | Relay - Intermittent/Continuous |
| RC | Resistor - Calibration |
| RTS | Remote Temperature Sensor |
| SOV | Shut-Off Valve - Gas |
| SSV | Safety Shut-Off Valve - Gas |
| STS | Space Temperature Selector |
| SW1 | Service Switch - Fan |
| SW2 | Service Switch - Heat |
| SW3 | Switch - Fan/Off/Heat |
| SW4 | Switch - SOV Leak Test |
| T1 | Multi-Tap Transformer (24&120 Volt) |
| T2 | Class 2 Transformer (24 Volt) |
| TPS | Tamper Proof Space Sensor |
| TS | Temperature Sensor |
| TSS | Temperature Setback System |

NOTE: Refer to wiring diagram shipped with unit for specific requirements of your installation.

## CONNECTION DIAGRAM (Typical)




---- Wiring by others

(1) 24 VAC Class 2 wiring
18 AWG minimum up to 250'
Run separate from power wiring

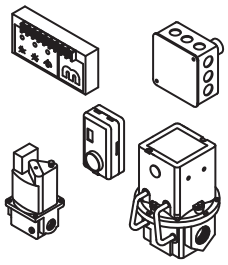
(2) Shielded twisted pair wiring
18 AWG minimum up to 350'
Run separate from all AC wiring
Ground shield at control end only

Refer to wiring diagram supplied with heater for specific requirements of your application

NOTE: Refer to wiring diagram shipped with unit for specific requirements of your installation.

# GAS CONTROL SYSTEMS

## Maxitrol Series 44



The Maxitrol Series 44 controls electronically modulate the burner input to maintain a constant space temperature by increasing or decreasing the discharge temperature. The Space Temperature Selector (T244A) is set to maintain the space temperature of the heated space by controlling the unit output between the MIN and MAX setting on the amplifier. The MIN dial setting determines the minimum discharge temperature the unit will deliver (40°F to 80°F). The MAX dial setting determines the maximum discharge temperature the unit will deliver (80°F to 140°F)

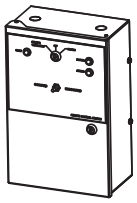
## Intermittent/Continuous Control (ITC)

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

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

# REMOTE CONTROL STATION COMPONENTS

## Remote Control Station (RCS-S)



The Remote Control Station is a lockable NEMA 1 enclosure (9" wide x 14" high x 5" deep) equipped with a three position key lock selector switch (Summer Ventilation – Off – Heating) and indicating lights for blower operation (green), burner operation (red), and reset (amber). A Manual Occupancy Switch controls the unit operation while in the heating mode.

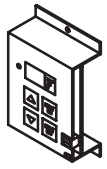
**IMPORTANT**

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

## Maxitrol Series 44 / Tamperproof

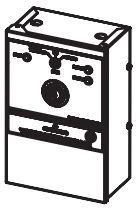
The Maxitrol Series 44 / Tamperproof controls function identically to the Maxitrol Series 44 controls (see gas control system) except the space temperature selector (T244A) is replaced with two devices. The adjustable portion, the space temperature selector (TD244A), is mounted inside the Remote Control Station, and the non-adjustable (tamperproof) space sensor (TS244A) is mounted in the space being heated.

## Operating Electronic Thermostat (OET)



The operating electronic thermostat is wired between terminals Z1 and Z2 to control unit ON/OFF operation in the heating/unoccupied mode (see page 23).

## Temperature Setback System (TSS)



The temperature setback system is a combination seven-day programmable timer with independent programs for summer ventilation/heating modes and integral electronic thermostat with separate selectable day/night setback temperatures (see page 25). The thermostat contact is wired between Z1 and Z2.

The TSS exists in a lockable NEMA 1 enclosure (9" wide x 14" high x 5" deep) equipped with a three position key lock selector switch (Summer Ventilation - Off - Heating) and indicating lights for blower operation (green), burner operation (red), and reset (amber).

## 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 ventilation air unit control enclosure to monitor the pressure drop across the filters.

## Manual Occupancy Switch

A manual occupancy toggle switch is used to manually turn the unit on and off. It is mounted on the exterior of the door of the Remote Control Station.

## THERMISTOR SENSOR

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

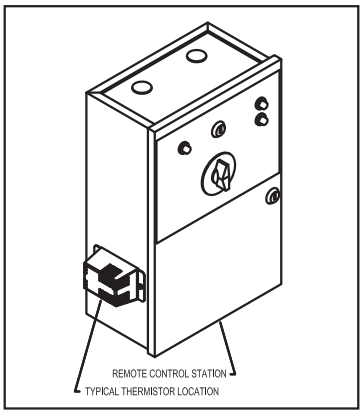



Figure 1

### THERMISTOR INSTALLATION
(See Figure 2)

1. Insert the star bushing through the opening in the enclosure.

2. Run the thermistor leads through the star bushing.

3. Attach the cover to the enclosure over the thermistor sensor.

4. Separate and strip the ends of the lead wires 3/8".

5. Open the terminal blocks for the sensor connections.

6. Insert the lead wires and close the terminal blocks to the locked position.

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

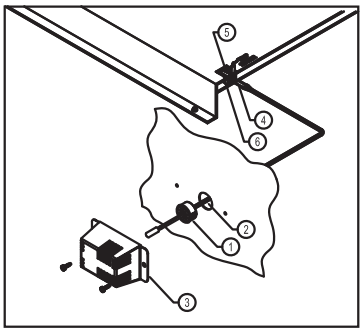
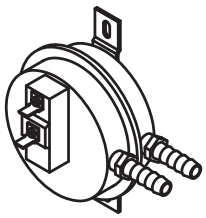


Figure 2

## INDIVIDUAL UNIT COMPONENT DESCRIPTIONS

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

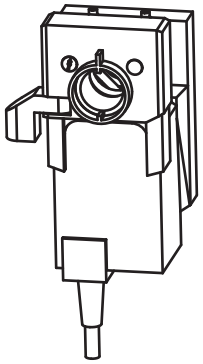


The air flow switches sense the pressure drop across the burner profile plate. They are factory set and not adjustable. They are designed to prevent burner operation if the pressure drop across the burner drops below 0.40 inch WC or increases above 0.75 inch WC for natural gas applications.

### AMPLIFIER (AMP)
The amplifier creates a voltage output to drive an electronic proportioning gas valve to maintain the selected space temperature (Maxitrol Series 44). On Maxitrol Series 44 control systems, the range of the discharge temperature is set on the amplifier (A1044), but the space temperature selector controls when more or less heat is required.

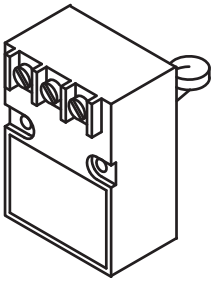
### CONVENIENCE OUTLET
A 115 volt GFI duplex receptacle, if selected, is provided outside the unit's electrical enclosure. The electrical supply source for this device is the unit's control power transformer (5 amps max.).

## DAMPER MOTOR (D)



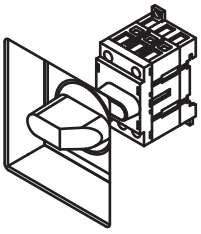
The optional damper motor operates on 24 Volts AC and transmits power to the motor starter when the damper blades are fully open by the closure of the damper end switch. The damper end switch is an adjustable internal auxiliary switch which has been factory set to operate when the damper is fully open. The damper motor will power closed when the unit cycles off. Refer to detailed instructions regarding the replacement and adjustment of the damper motor (see page 51).

## DISCHARGE TEMPERATURE SENSOR (DTS)



The discharge temperature sensor is mounted on the fan housing and is a component of the Series 44 temperature control systems. It senses the average fan discharge temperature and transmits a resistance signal back to the amplifier that corresponds to the discharge temperature. The Maxitrol Series 44 and Maxitrol Series 44/ Tamperproof temperature control systems use the Maxitrol Series 44 sensor (TS144).

## DISCONNECT SWITCH (DISC)

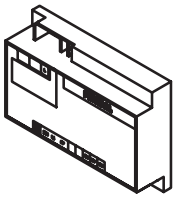


The non-fused disconnect switch is provided on all units and includes a lockable operating knob. The disconnect must be off before accessing the electrical control enclosure. Once the control enclosure is open, experienced service technicians may activate the electrical circuit to assist in troubleshooting.

## RELIEF DAMPER/EXHAUST FAN CONTACT (EFC)

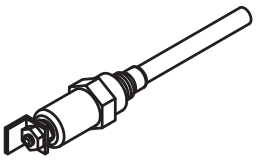
The relief damper contact is an auxiliary dry contact that is mechanically interlocked to operation of the unit's motor starter and is provided with terminals located in unit's electrical enclosure. The dry contact is typically wired into an exhaust fan control circuit so that the ventilation unit drives the relief damper or exhaust fan.

## FLAME SAFEGUARD RELAY (FSR)



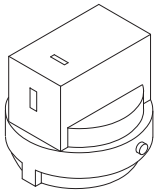
The flame safeguard relay supplies 24 Volts AC to the igniter for 4 seconds prior to the gas valve being energized. If the burner does not light (flame is not established within 7 seconds), this control will lock out. If flame signal is lost during burner operation, the control will allow one retry for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

## FLAME ROD (FR)



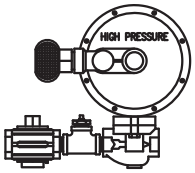
The flame rod senses the presence of flame, and signals the flame safeguard relay. The presence of flame is detected by the flame rectification of the AC signal that is supplied to the flame rod, thus creating the DC response. The resulting current flow produced can be measured with a DC microammeter.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

## HIGH and LOW GAS PRESSURE SWITCH (HGP, LGP)



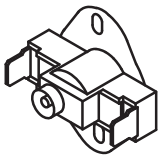
The high gas pressure switch is a manual reset safety device to lock out the burner operation should large gas pressure fluctuations occur. The high gas pressure switch should be set at 25% above manifold gas pressure. The adjustment screw is located under the top plate.

## HIGH PRESSURE REGULATOR (HPR)



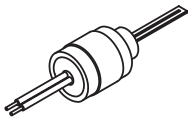

The high pressure regulator is required when the gas supply pressure exceeds the nameplate rating for the unit. The high pressure regulator assembly is also furnished with a high gas pressure manual shut-off valve and a tap for measuring the upstream gas pressure. The high pressure regulator is a positive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

## HIGH TEMPERATURE LIMIT (HL)



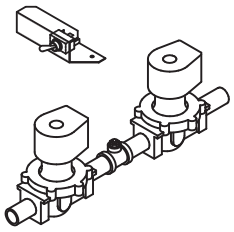
The high temperature limit opens when the discharge air temperature exceeds 152˚F. This limit must be manually reset.

## IGNITER (IG)



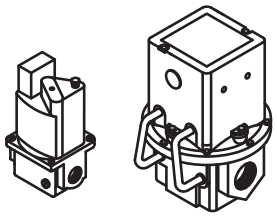
The hot surface igniter is the ignition source for lighting the gas in the burner. It is made of silicon carbide which is very fragile. Care should be used in handling. It operates on 24 Volts and the current ranges from 1.3 to 1.7 amps. It will reach temperatures in excess of 2400˚F during the ignition trial. It is furnished with a sleeve for shock mounting and sealing the igniter in the mounting tube.

## LEAK TEST FACILITY (SW4)



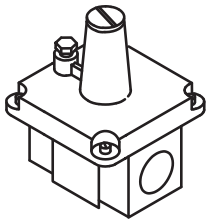
The leak test facility is provided on all units over 400,000 Btu/hr and consists of a momentary switch for the first safety shut-off valve in the gas train and a gauge port between the first and second safety shut-off valve. By holding the gas valve momentary switch closed, the first gas valve is energized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

## MODULATING VALVE (MV)



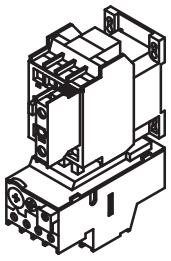
The modulating valve responds to a 4 to 24 Volt DC signal from the amplifier to modulate the flow of gas to the burner. On the Maxitrol M611 valve, the minimum fire adjusting screw is located on the far side of the valve under the dust cover. On the Maxitrol MR212 valve, the minimum fire adjusting screw is located under the large dust cover. The MR212 modulating valve also serves as the manifold pressure regulator to control the burner manifold pressure. The MR212 is rated for 5 PSIG.

## MANIFOLD PRESSURE REGULATOR



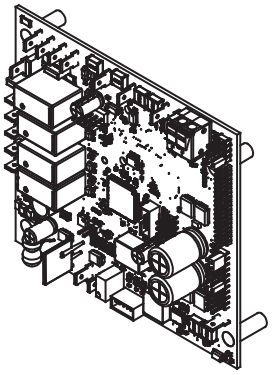
The manifold pressure regulator controls the burner manifold pressure. When the MR212 valve is used, this modulating valve also serves as the pressure regulator. The maximum gas supply pressure rating is normally determined by the exposed pressure rating of the regulating device. The RV61 and RV81 are rated at 1 PSIG; and the MR212 is rated at 5 PSIG.

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



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

## MULTI-FUNCTIONAL PC BOARD



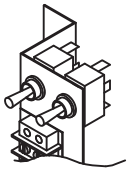
The multi-functional PC board provides five (5) separate functions for heaters with the Maxitrol Series 14 or Series 44 controls. The functions are as follows:

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

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

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

## SERVICE SWITCH (SW1, SW2, SW3)

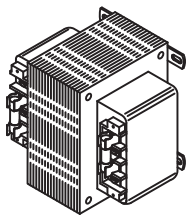


The service switches are mounted in the electrical control enclosure. In the "LOCAL" or "OFF" position, the service technician has local control of the unit. These switches must be placed in the "REMOTE" position for normal control from the Remote Control Station.

## SPACE TEMPERATURE SELECTOR (STS)

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

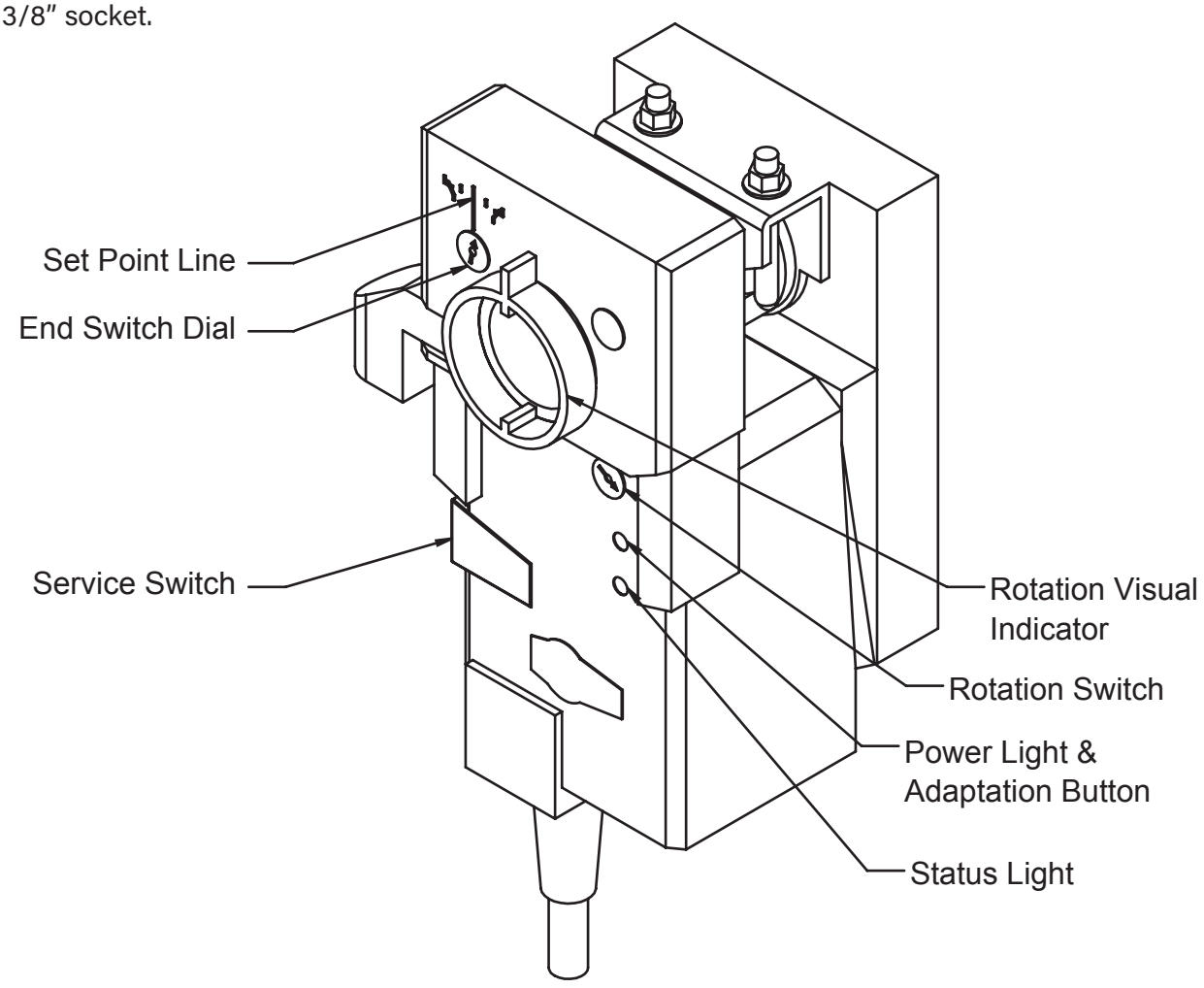
## TRANSFORMER (T1, T2)



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

## DAMPER MOTOR REPLACEMENT & ADJUSTMENT

1. Verify the unit disconnect switch is turned “OFF” and the service switches are in the “OFF” position.
2. Remove the junction box cover and disconnect the damper motor wires. Take note of the wire connections prior to disconnecting wires.
3. Release the wire strain relief using pliers and remove the damper motor wire from the bundle.
4. Inside the access hatch on the rear of the unit, remove the end switch from the damper motor by pulling out and unclipping the connections.
5. Loosen the shaft clamp using a 10mm deep socket.
6. Unscrew the motor bracket screws using a 3/8” socket.
7. Flip the motor bracket and unscrew the damper motor from the damper motor bracket using a Philips screwdriver.
8. Attach the new damper motor using the Phillips screws.
9. Attach the damper motor bracket back to the heater.
10. Feed the damper wire into the junction box and as they were originally provided from the factory.
11. Include the new damper motor wire with the end switch wire and reattach the strain relief using pliers.
12. Reattach the junction box cover.
13. Turn the disconnect switch “ON” and turn the service switches to the “REMOTE” position.



## TROUBLESHOOTING GUIDE

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

## TROUBLESHOOTING GUIDE

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

## TROUBLESHOOTING GUIDE

| Problem | Possible Cause | Corrective Action |
|---|---|---|
| **III. BLOWER RUNS; NO HEAT; FLAME SAFEGUARD RELAY LOCKS OUT (Continued)** | **6. Multi-Functional PC Board**<br>a) Low fire start set too low<br><br>b) Thermistor shorted (rapidly blinking LED on PC board indicates open or shorted thermistor input) | a) Adjust modulating valve voltage between 10 and 13 Volts DC.<br>b) Properly install or replace thermistor. |
| | **7. Regulator**<br>a) Clogged vent orifice<br>b) No supply pressure<br>c) Improper manifold pressure<br>d) Defective regulator | a) Clean or replace orifice.<br>b) Check all gas cocks and piping.<br>c) Adjust regulator.<br>d) Replace regulator. |
| | **8. Burner**<br>a) Defective burner | a) Replace burner. |
| **IV. BLOWER RUNS; BURNER FIRES; FLAME SAFEGUARD RELAY LOCKS OUT** | **1. Low Flame Current**<br>a) Dirt build-up on insulator<br><br>b) Minimum fire set too low<br>c) Defective burner | a) Clean dirt deposit from insulator. surface and install protective boot.<br>b) Adjust minimum fire on modulating valve.<br>c) Replace burner. |
| | **2. Multi-Functional PC Board**<br>a) Low fire start set too low | a) Adjust modulating valve voltage between 9 and 13 Volts DC. |
| | **3. No Flame Current**<br>a) Ground connection open<br><br><br>b) Wire termination oxidized | a1) Reference transformer to ground.<br>a2) Secure FSR grounded.<br>a3) Tighten loose ground screws.<br>b) Clean terminal and reinsert. |
| | **4. Fluctuating Flame Current**<br>a) Unit overfiring<br>b) Minimum fire set too low<br>c) Intermittent ground connection<br>d) Defective burner | a) Check manifold pressure.<br>b) Adjust minimum fire on modulating valve.<br>c) Tighten all ground points.<br>d) Replace burner. |
| | **5. Flame Safeguard Relay**<br>a) Defective FSR | a) Replace FSR. |
| | **6. High Limit**<br>a) High limit contact intermittent | a) Replace high limit. |
| **V. BLOWER RUNS; UNIT HEATS; SHORT CYCLES WITHOUT RESETTING** | **1. Air Flow Switch**<br>a) Blower running backwards<br>b) Belts slipping<br>c) Blocked intake or discharge<br>d) Air delivery below minimum requirements<br>e) Clogged airflow tubing or pick-up ports<br><br>f) Defective switch | a) Reverse motor direction.<br>b) Tighten and/or replace belts.<br>c) Find and remove obstruction.<br>d) Increase fan RPM for air delivery requirements.<br>e) Clean or replace airflow tubing or pick-up ports.<br>f) Replace switch. |
| | **2. Flame Safeguard Relay**<br>a) Defective FSR | a) Replace FSR. |

## TROUBLESHOOTING GUIDE

| Problem | Possible Cause | Corrective Action |
|---|---|---|
| **V. BLOWER RUNS; UNIT HEATS; SHORT CYCLES WITHOUT RESETTING (Continued)** | **3. Operating Thermostat**<br>a) Differential temperature setting too tight | a) Increase differential temperature setting. |
| | **4. Damper Motor End Switch**<br>a) End switch making intermittent contact | a) Replace end switch assembly. |
| **VI. HIGH LIMIT TRIPPED** | **1. High Limit**<br>a) High limit will not reset | a) Replace high limit. |
| | **2. Burner Overfiring**<br>a) Manifold pressure too high | a) Adjust manifold pressure regulator to obtain temperature rise specified on unit nameplate. |
| | **3. Discharge Damper**<br>a) Damper blades partially closed<br>b) Defective damper motor | a) Adjust damper stroke length.<br>b) Replace damper motor. |
| | **4. Low Airflow**<br>a) Blower running backwards<br>b) Belts slipping<br>c) Blocked intake or discharge | a) Reverse motor direction.<br>b) Tighten or replace belts.<br>c) Find and remove obstruction. |
| | **5. Temperature Control System**<br>a) Temperature control system does not modulate | a) See problem VIII for Electronic Discharge Control systems. |
| **VII. BLOWER RUNS; UNIT HEATS; WILL NOT CYCLE OFF** | **1. Operating Thermostat**<br>a) Short in thermistor circuit<br>b) Thermostat located improperly<br>c) Thermostat differential setting too wide<br>d) Defective thermostat | a) Check thermistor wiring and/or replace thermistor.<br>b1) Thermostat in cold draft-relocate.<br>b2) Thermostat not satisfied-turn down.<br>c) Reduce differential setting.<br>d) Replace thermostat. |
| | **2. Burner Service Switch**<br>a) Switch in LOCAL position | a) Place switch in REMOTE position. |
| | **3. Auxiliary Control**<br>a) Auxiliary contacts closed | a) Check auxiliary circuit wiring and contacts. |
| | **4. Misunderstood Control System Operation**<br>a) Control system doesn't function as expected | a) Review control system operational characteristics. |
| **VIII. MODULATING VALVE DOES NOT MODULATE; CONTINUOUS HIGH FIRE** | **1. Space Temperature Selector (Series 44 only)** (T244 or TS244/TD244)<br>a) Open in sensor circuit<br>b) Induced voltage in field wiring<br>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.<br>b) Utilize shielded, twisted pair wiring.<br>c) Sensor in cold draft - relocate |
| | **2. Modulating Valve (M611 or MR212)**<br>a) Foreign material holding valve open<br>b) Modulating valve misassembled | a) Disassemble valve and remove foreign material.<br>b) Disassemble valve and assemble correctly. |

## TROUBLESHOOTING GUIDE

| Problem | Possible Cause | Corrective Action |
|---|---|---|
| **IX. MODULATING VALVE DOES NOT MODULATE;**<br><br>**CONTINUOUS LOW FIRE** | **1. Class 2 Transformer**<br>a) No voltage output to amplifier | a1) Check for short in modulating valve coil.<br>a2) Replace transformer. |
| | **2. Modulating Valve**<br>a) Valve coil is open or shorted<br><br>b) Plunger jammed<br>c) Ruptured main or balancing diaphragm | a) Replace valve coil if its resistance is less than 40 Ω or greater than 85 Ω.<br>b) Clean or replace plunger.<br>c) Check diaphragm condition and replace if defective. |
| | **3. Amplifier**<br>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. |
| | **5. Space Temperature Selector (T244A or TS244A/TD244A)**<br>a) Short in sensor circuit | a) Replace the sensor if the resistance measure is less than 5,000 Ω for the T244A or 3,500 Ω for the TS244A and 1,950 Ω for the TS244A. |
| | **7. High Airflow Switch**<br>a) Pressure drop across burner too high<br>b) Defective Airflow Switch | a) Measure pressure drop and adjust profile damper.<br>b) Replace Airflow Switch. |
| **X. ERRATIC OR PULSATING FLAME** | **1. High Pressure Regulator**<br>a) Vent undersized<br><br>b) Defective regulator | a) Enlarge vent piping size or reduce vent piping length.<br>b) Replace regulator. |
| | **2. Amplifier**<br>a) Hunting<br><br>b) Temperature control system out of calibration<br>c) Defective amplifier | a) Adjust sensitivity control dial counter-clockwise.<br>b) Perform temperature control system calibration.<br>c) Replace amplifier. |
| | **3. Space Temperature Selector (T244A or TS244A/TD244A)**<br>a) Induced voltage in field wiring | a) Utilize shielded, twisted pair wiring. |

## ANSI/ASHRAE/IESNA STANDARD 90.1

**Overview**
Energy efficient, Genuine Cambridge® direct gas-fired heating equipment can comply with the requirements of ANSI/ASHRAE/IESNA Standard 90.1. Compliance is shown on the Cambridge unit 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 units to comply with Standard 90.1:

- **Controls** (Section 6.4.3)
  *Total airflow of all units less than 10,000 cfm* - The Cambridge Air Solutions Temperature Setback System (TSS) will meet the standard. A properly configured building DDC system with the necessary programming for zone control, automatic shutdown and setback can also meet the standard.

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

  *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 unit. The Cambridge Air Solutions Motorized Discharge Damper (MDD) will meet the standard.

- **Labeling** (Section 6.4.1.5.1)
  The unit must be labeled to indicate that it complies with the requirements of the standard. The nameplate of Cambridge units includes the required labeling.

- **Efficiency** (Section 6.4.1.3)
  Direct gas-fired heating equipment has no minimum efficiency requirement. However Cambridge Air Solutions certifies that its equipment has a 100% combustion efficiency (Ec) and a 92% thermal efficiency (Et).

## MAINTENANCE LOG

**MODEL NO.** _____ **SERIAL NO.** _____

Date Activity Technician

# REVISION HISTORY LOG

| Revised Date | Version | Description |
|---|---|---|
| 4-25-2023 | SPEC AIR -TM1-0423 | Began revision history log. Updated images throughout to reflect new multi-functional PC board. Updated Operating Sequence flowchart to identify multi-function PC board mode numbers. Updated multi-functional PC board description to identify unit operating modes. |
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*Cambridge Air Solutions reserves the right to change specifications, modify the design and/or substitute equivalent materials without notice as the result of code requirements, product enhancements, ongoing research/development and vendor changes beyond our control.*


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