

# The Modulating **delta**

## Modulating Gas Fired Combination Heaters



### \* INSTALLATION AND MAINTENANCE \* M A N U A L

#### NOTICE

Warranty Registration Card must be filled out by the customer and mailed within thirty (30) days of installation in order to gain warranty coverage.

When receiving the Delta Performance appliance, any claims for damage or shortage in shipment must be filed immediately against the transportation company by the consignee.

Leave all documentation received with appliance with owner for future reference.

#### WARNING

**If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or death.**

#### FOR YOUR SAFETY

- Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.
- WHAT TO DO IF YOU SMELL GAS
  - Do not try to light any appliance
  - Do not touch any electrical switch; do not use any phone in your building.
  - Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
  - If you cannot reach your gas supplier, call the fire department.

Installation and service must be performed by a qualified installer, service agency or the gas supplier.

**DANGER**

**The MODULATING DELTA must be vented and supplied with combustion and ventilation air as detailed in the MODULATING DELTA Vent Supplement, which is included in the installation envelope. Once installation is completed, inspect the vent and combustion air system thoroughly to ensure systems are leak free, tight and comply with the instructions given in the MODULATING DELTA Vent Supplement and are within all requirements of applicable codes. Failure to comply with the installation requirements on the venting and combustion air piping and ventilation will cause severe personal injury or death.**

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The following terms are used throughout this manual to bring attention to the presence of potential hazards or to important information concerning the product.

**DANGER**

Indicates the presence of a hazardous situation which, if ignored, will result in death, serious injury or substantial property damage.

**NOTICE**

Indicates special instructions on installation, operation or maintenance, which are important to equipment but not related to personal injury hazards.

**WARNING**

Indicates a potentially hazardous situation which, if ignored, can result in death, serious injury or substantial property damage.

**BEST PRACTICES**

Indicates recommendations made by Triangle Tube for the installers which will help to ensure optimum operation and longevity of the equipment

**CAUTION**

Indicates a potentially hazardous situation which, if ignored, may result in minor injury or property damage.

**NOTICE**

Triangle Tube reserves the right to modify the technical specifications and components of its products without prior notice.

**DANGER**

Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system which has been under water.

**DANGER**

**WHAT TO DO IF YOU SMELL GAS**

- Do not try to light any appliance
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

Installation and service must be performed by a qualified installer, service agency or the gas supplier.

**WARNING**

Should overheating occur or the gas supply fails to shut off, turn OFF the manual gas control valve external to the appliance.

**CAUTION**

To prevent damage to inner tank, installer must:

- Fill inner tank prior to outer tank during start-up.
- Relieve primary system pressure below 15 psig prior to draining inner tank.

**WARNING**

**Qualified Installer:**

Prior to installing this product read all instructions included in this manual. Perform all installation steps required in this manual in the proper order given. Failure to adhere to the guidelines within this manual can result in severe personal injury, death or substantial property damage.

**Homeowner:**

- This product should be maintained / serviced and inspected annually by a qualified Service Technician.
- This manual is intended for use by a qualified Installer/Service Technician.

**NOTICE**

Please reference the appliance's model number and the serial number from the rating label when inquiring about service or troubleshooting.

**NOTICE**

Triangle Tube accepts no liability for any damage resulting from incorrect installation or from the use of components or fittings not specified by Triangle Tube.

**WARNING**

**Bacteria can develop in the domestic water system if certain minimum water temperatures are not maintained.**

**DANGER**

**Water temperature over 125°F can cause severe burns instantly or death from scalds.**

- Children, disabled and elderly are at highest risk of being scalded.
  - **Never leave them unattended in or near shower, bathtub or sink.**
  - **Never allow small children to use a hot water faucet or draw their own bath.**
- If any one using hot water in the building fits the above description or codes require specific water temperatures at hot water faucet, we recommend:
  - a) ensure the factory equipped thermostatic mixing valve is installed and working properly.
  - b) to set the thermostatic mixing valve for the lowest temperature which satisfies your hot water need.

**CAUTION**

**Protection must be taken against excessive temperature and pressure!**

**TO PROTECT AGAINST EXCESSIVE TEMPERATURE AND PRESSURE**

- Check if the Temperature and Pressure (T&P) relief valve is in the location provided. (Domestic Water)
- Check if the 30 psi relief valve supplied is in the location provided. (Primary water)
- To avoid injury, install the relief devices to comply with local code requirements.



**OPERATING RESTRICTIONS**

- Maximum working pressure for inner (domestic water) tank is 150 psig.
- Maximum working pressure for outer (primary water) tank is 45 psig.
- Inner tank has factory installed Temperature & Pressure Relief Valve with an AGA rating of 200,000 Btu/hr.
- Outer tank has a factory installed 30 psig relief valve rated at 535,000 Btu/hr
- Electrical rating: 120 V, 60 Hz, less than 12 amperes
- pH & chloride limits for the MODULATING DELTA are:
  - Chloride, less than 80 mg/l.
  - pH, 6.0 - 8.0.
- 186° F Maximum operating temperature - primary side.
- 120° F Maximum outlet temperature from mixing valve - domestic side.

**NOTICE**

**Any water conditioning system must be installed and maintained in accordance with manufacturer’s specifications.**

**CODE RESTRICTIONS**

Single wall heat exchanger in the MODULATING DELTA complies with National Standard Plumbing Code, provided that:

- Outer tank water (including additives) is practically non-toxic, having toxicity rating or Class of 1, as listed in Clinical Toxicology of Commercial Products,
- Outer tank pressure is limited to maximum 30 psig by approved relief valve.

Single wall heat exchangers are permitted under the Uniform Plumbing code - Paragraph L3.2. if they satisfy all of the following requirements.

1. The heat transfer medium is potable water or contains only substances which are recognized as safe by the U.S. Food and Drug Administration.
2. The pressure of the heat transfer medium is maintained less than the normal minimum operating pressure of the potable water system
3. The equipment is permanently labeled to indicate that only additives recognized as safe by the FDA shall be used in the heat transfer medium.

Or, per Uniform Plumbing Code paragraph L3.3 as follows:

Other heat exchanger designs may be permitted where approved by the Administrative Authority.

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**SECTION I - Pre-Installation Items**

**Code Compliance**

This product must be installed in accordance to the following:

- All applicable local, state, national and provincial codes, ordinances, regulations and laws.
- The National Fuel Gas Code NFPA 54/ANSI Z223.1 - Latest edition.
- National Electric Code ANSI/NFPA 70.
- For installations in Canada -“Installation Code for Gas Burning Equipment” CSA B149 and CSA C22.1, Canadian Electrical Code.

**Determining Product Location**

Before locating the MODULATING DELTA check for convenient locations to:

- Domestic water supply piping
- Heating system piping
- Venting
- Gas supply piping
- Electrical service

Ensure the area chosen for the installation of the MODULATING DELTA is free of any combustible materials, gasoline and other flammable liquids.

**WARNING**

**Failure to remove or maintain the area free of combustible materials, gasoline and other flammable liquids or vapors can result in severe personal injury, death or substantial property damage.**

Ensure the MODULATING DELTA and its controls are protected from dripping or spraying water during normal operation or service.

The MODULATING DELTA should be installed in a location so that any water leaking from the tank or piping connections or relief valves will not cause damage to the area surrounding the appliance or any lower floors in the structure.

- When such a location is unavoidable, a suitable drain pan with adequate drainage should be placed under the appliance. The drain pan must not restrict the flow of combustion air to the appliance.

**Replacement of Existing Boiler/Water Heater**

If the MODULATING DELTA is replacing an existing boiler / hot water heater system, the following items should be checked and corrected prior to installation:

- Primary and domestic piping leaks and corrosion.
- Improper location and sizing of the expansion tank on the primary heating loop.
- Improper sizing of the thermal expansion tank (if used) on the domestic supply line.
- Vent condition and sizing.

**Recommended Clearances**

The MODULATING DELTA is approved for zero clearance to combustibles, excluding the vent hood and vent piping.

Vent hood and vent piping - 2 inches from combustible materials unless otherwise stated by the vent pipe manufacturer.

Primary and domestic hot water piping - 1 inch from combustible material.

### BEST PRACTICES

To provide serviceability to the appliance it is suggested that the following clearances be maintained:

**Top and vent hood area - 36 inches.**

**Front and burner area - 24 inches.**

**Rear and primary piping areas - 12 inches.**

### WARNING

**When installing the MODULATING DELTA in a confined space, sufficient air must be provided for proper combustion and venting and to allow under normal operating condition proper air flow around the product to maintain ambient temperatures within safe limits to comply with the National Fuel Gas Code NFPA 54 - latest edition.**

### Flooring and Foundation

The MODULATING DELTA is approved for installation on combustible floors, but never on carpeting.

### WARNING

**Do not install the MODULATING DELTA on carpeting even with a metal or wood foundation base. Fire can result causing severe personal injury, death or substantial property damage.**

Installer should provide a solid brick or concrete foundation pad, at least 2 inches above the floor level if:

- There is a potential for the floor to become flooded. The height of the foundation should be such to sufficiently elevate the appliance.

- The floor is dirt, sand, gravel or other loose material.
- The flooring is severely uneven or sloped.

The minimum foundation size required is 24 inches x 23 inches.

### Residential Garage Installations

When installing the MODULATING DELTA in a residential garage the following special precautions per NFPA 54/ANSI Z223.1 must be taken:

- Mount the appliance with a minimum 18 inches above the floor level of the garage. Ensure the burner and ignition devices / controls are no less than 18 inches above the floor level.
- Locate or protect the appliance in a manner so it cannot be damaged by a moving vehicle.

### Freeze Protection Feature

The control has an freeze protection feature built in. This feature monitors the supply temperature and responds as follows when no call for heat is present:

- 45°F CH circulator is ON
- 37°F CH circulator is ON and burner operates at low fire.
- 50°F Burner OFF and CH circulator operates for approximately 10 minutes

### WARNING

**The freeze protection feature is disabled during a hard lockout. If the heating system is left unattended in cold weather, appropriate safeguards or alarms should be installed to prevent property damage. An optional control/interface is available from Triangle Tube which will provide a set of alarm contacts which will close during a hard lockout.**

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### SECTION II - Appliance Preparation

#### Handling Instructions

The MODULATING DELTA is generally easier to handle and maneuver once removed from the shipping carton and pallet.

To remove the shipping carton and pallet:

- a. Remove the shipping straps and open the top of the carton to remove the wood shipment insert.
- b. Lift the carton over the appliance to remove. If ceiling height is limited, the carton maybe cut open using care not to damage the exterior jacket of the appliance.

- c. Remove the front burner hood to prevent damage prior to lifting the appliance from the shipping pallet.

#### WARNING

**When lifting or moving the appliance do not use the burner or its components as a means of a handle. Hand-truck the appliance from the rear only.**

- d. Discard all packing materials.

### SECTION III - Domestic Piping

#### General Piping Requirements

- All plumbing must meet or exceed all local, state and national plumbing codes.
- Use pipe dope or tape suitable for potable water.
- Use isolation valves to isolate system components.
- Install unions for easy removal of the MODULATING DELTA from the system piping.

#### Domestic Supply Pressure

For applications in which the domestic supply pressure exceeds **70 psig** it is recommended to install a pressure reducing valve on the cold water supply.

Maintaining the cold water supply at or below **70 psig** will prevent normal thermal expansion from repeatedly forcing the T&P relief valve open.

#### Thermal Expansion

If the cold water supply to the domestic inner tank contains a backflow preventer, check valve and / or a pressure reducing valve, the installer must install a domestic thermal expansion tank on the cold water supply. (See Fig. 2 page 11)

Installing a thermal expansion tank will prevent normal thermal expansion from repeatedly forcing the T&P relief valve open.

When installing a thermal expansion tank ensure the charge pressure of the tank is equal to the cold water supply pressure at the point of installation. Consult the thermal expansion tank manufacturer's instructions for further information on installation and sizing.

#### CAUTION

**The Temperature / Pressure relief valve is not intended for constant duty, such as relief of pressure due to normal thermal expansion.**

#### Water Hammer

Water hammer is the effect of sudden pressure changes occurring in the domestic piping. These pressure changes are typically the result of "fast acting" positive shut-off valves closing. These types of valves can be typically found on dishwashers and clothes washers.

The effects of water hammering can cause damage to system components and tank welds on the appliance.

Installation of hammer arresters is recommended at these types of appliances, which incorporate "fast-acting" positive shut-off valves. Consult the manufacturer of water hammer arresters for recommendation on sizing and installation requirements.

#### Temperature / Pressure Relief Valve

The MODULATING DELTA has a factory installed Temperature / Pressure Relief valve.

The installer must install discharge piping onto the T&P relief valve. The discharge piping must be:

- Made of material serviceable for temperatures of 250°F or greater.
- Directed so that any hot water discharge flows away from all persons.
- Directed to a suitable place of drainage.
- Installed as to allow complete draining of the T&P relief valve and the discharge piping.
- Terminated with a plain end, not with threads.

### CAUTION

Failure to properly direct the discharge piping of the T&P relief valve may result in flooding of the area adjacent to the appliance and/or lower floors in the structure causing substantial property damage.

The installer **must not** install the T&P relief valve discharge piping in a manner that is:

- Excessively long: Using more than 2 elbows and/or 15 feet of discharge piping can reduce the discharge capacity.
- Terminated directly into a drain: The discharge piping must terminate within 6 inches of the drain. Check with local plumbing codes for termination guidelines.
- The discharge piping is plugged, reduced in size or restricted in any manner.
- The discharge piping is subject to freezing.

### WARNING

**DO NOT install any valves between the T&P relief valve and the discharge piping. DO NOT plug the T&P relief valve or the discharge piping. Improper placement and piping of the T&P relief valve can cause severe personal injury, death or substantial property damage.**

### Thermostatic Mixing Valve

The MODULATING DELTA contains a factory equipped thermostatic mixing valve with built-in check valve. The operating range of the thermostatic mixing is 90°F to 120°F.

For applications with a domestic recirculation loop, the recirculation pump should be controlled by an aquastat. The maximum recommended setting of the aquastat is 10°F lower than the thermostatic mixing valve setting.

### DANGER

For proper operation of the thermostatic mixing valve and to prevent potential scalding hazards, the recirculation loop should be controlled by an aquastat. **DO NOT use continuous recirculation or timers.**

### Mixing Valve Installation

1. Remove the jacket top panel by pushing up on the corners.
2. Remove the mixing valve from the carton located inside the front control cover.
3. Apply pipe dope to the male threads located on the “H” (hot) side of the mixing valve and the internal threads of the domestic hot water supply tee.
4. Thread the “H” side of the mixing valve in to the domestic hot water supply tee, align valve and tighten using two wrenches to avoid pipe damage.

### Domestic Cold Water Supply Piping Assembly Installation

1. Locate the domestic cold water supply piping assembly at the top of the appliance.
2. Apply pipe dope to the male threads of the domestic cold water supply piping assembly and the internal threads of the cold water supply tee.
3. Thread the domestic cold water supply piping assembly in to the domestic cold water supply tee, align the branch with the domestic system piping and tighten using two wrenches to avoid pipe damage.

### U-Tube Assembly

The MODULATING DELTA is supplied with a U-Tube Assembly that directs cold water to the thermostatic mixing valve.

To install the U-Tube Assembly the installer must:

1. Disconnect the cold inlet adapter/union from the thermostatic mixing valve.
2. Use needle-nose pliers to remove the plastic check valve assembly from the adapter.
3. Solder the U-Tube Assembly onto the adapter. See Fig. 1.
4. Once the adapter has sufficiently cooled, re-insert the check valve assembly making sure of orientation and reconnect onto the mixing valve.
5. Solder the remaining end of the U-tube to the adapter on the cold inlet piping

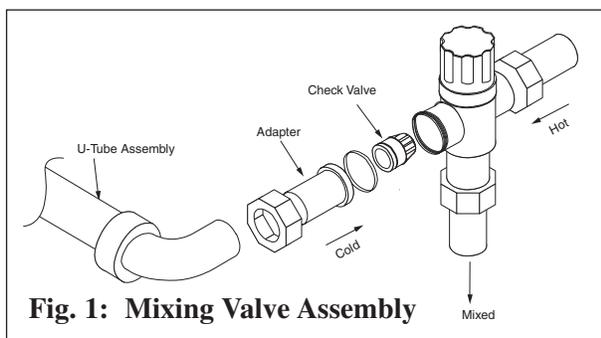
If the installation requires domestic hot water for a commercial dishwasher, the installer may insert a tee connection between the appliance and the mixing valve to provide high temperature domestic hot water. The installer must reference local plumbing codes to ensure if this type of application is permissible.

### DANGER

**The thermostatic mixing valve MUST be installed and utilized on the MODULATING DELTA. Removal of the thermostatic mixing valve will result in severe personal injury or death.**

### CAUTION

**The manual valve on the U-Tube assembly must remain in the full open position for proper operation of the thermostatic mixing valve.**



**Fig. 1: Mixing Valve Assembly**

## Domestic Drain Valve

- The installer must install a drain valve and drain leg as shown in Fig. 2 page 11.
- The drain valve should be positioned close to the floor to aid in the siphon action required to drain the inner tank.

## Multiple Appliances Installation

For applications using multiple appliances the domestic piping should be piped using a balanced manifold arrangement.

The installer should remove the thermostatic mixing valve from the appliances and install a single thermostatic mixing valve at the outlet of the hot water manifold. The thermostatic mixing valve should be sized according to the required flow rate and pressure drop. Refer to the thermostat mixing valve manufacturer specification and installation instructions for more details. Reference Fig. 4, page 12 for piping diagram.

## Storage Tank Application

For applications requiring large volumes of domestic hot water in a relative short period, the installer may include a storage type tank (see Fig. 5 page 13) in the domestic piping. The installer must:

1. Relocate the thermostatic mixing valve from the MODULATING DELTA to the outlet of the storage tank.
2. Provide recirculation from the storage tank back to the MODULATING DELTA using a bronze type circulator. Recommended flow rate is 5 to 10 gpm maximum.

### NOTE

**Recirculation from the storage tank can be accomplished through the drain connection if a 3rd tapping is unavailable on the storage tank. The recirculation circulator must be controlled by an aquastat.**

**SMART Series Application**

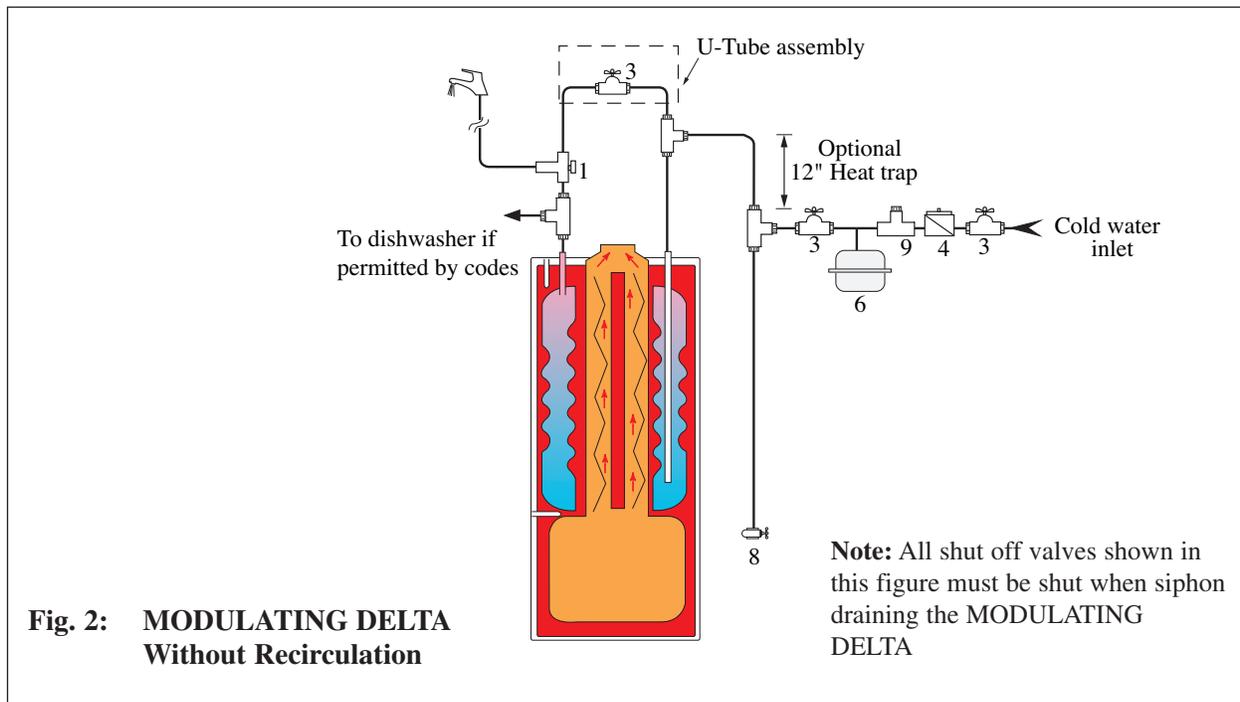
For applications requiring large volumes of domestic hot water over an extended period, the installer may include a Triangle Tube SMART Indirect Water Heater in conjunction with the MODULATING DELTA. (See Fig. 6 page 13)

The primary piping to the SMART Series tank must comply with the piping methods detailed in SECTION IV - Primary Piping or with other recognized piping methods.

Additional information regarding domestic and primary piping can be found in the SMART Installation Manual.

The domestic system recirculation, if used, is directed to the SMART Series Tank. The circulator should be controlled by an aquastat.

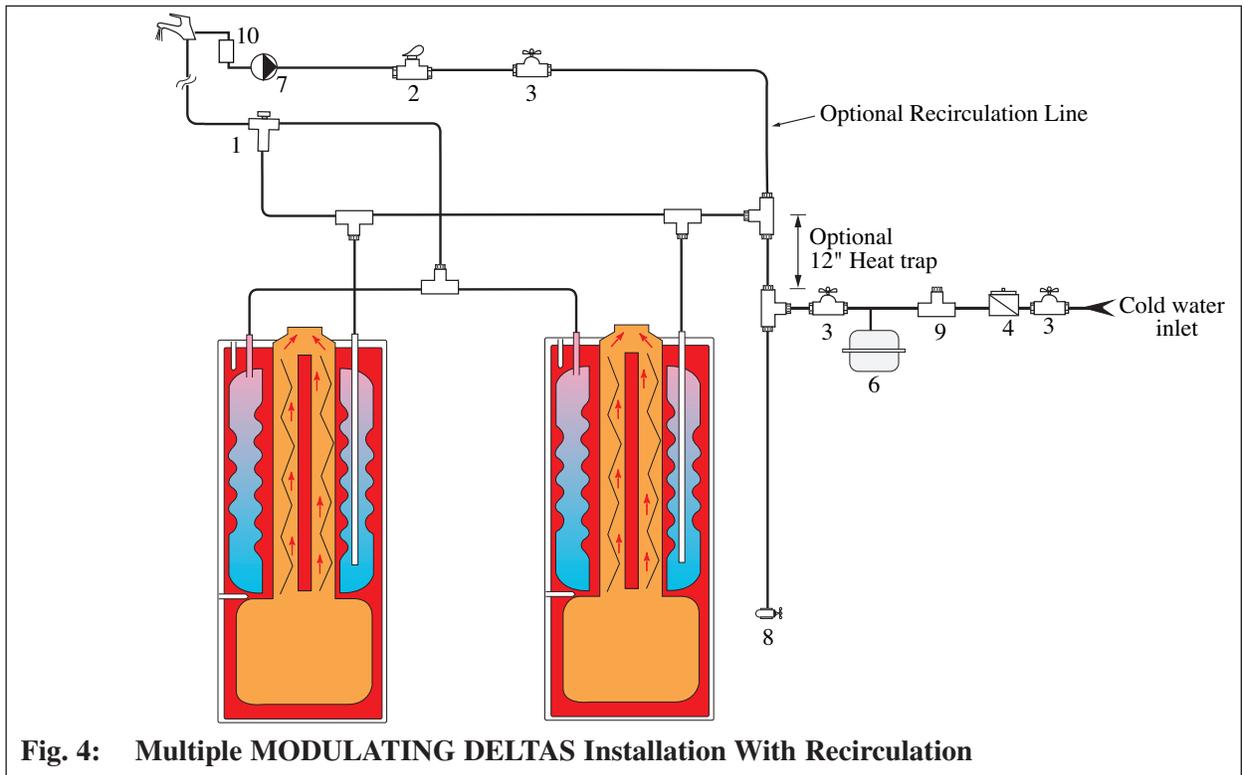
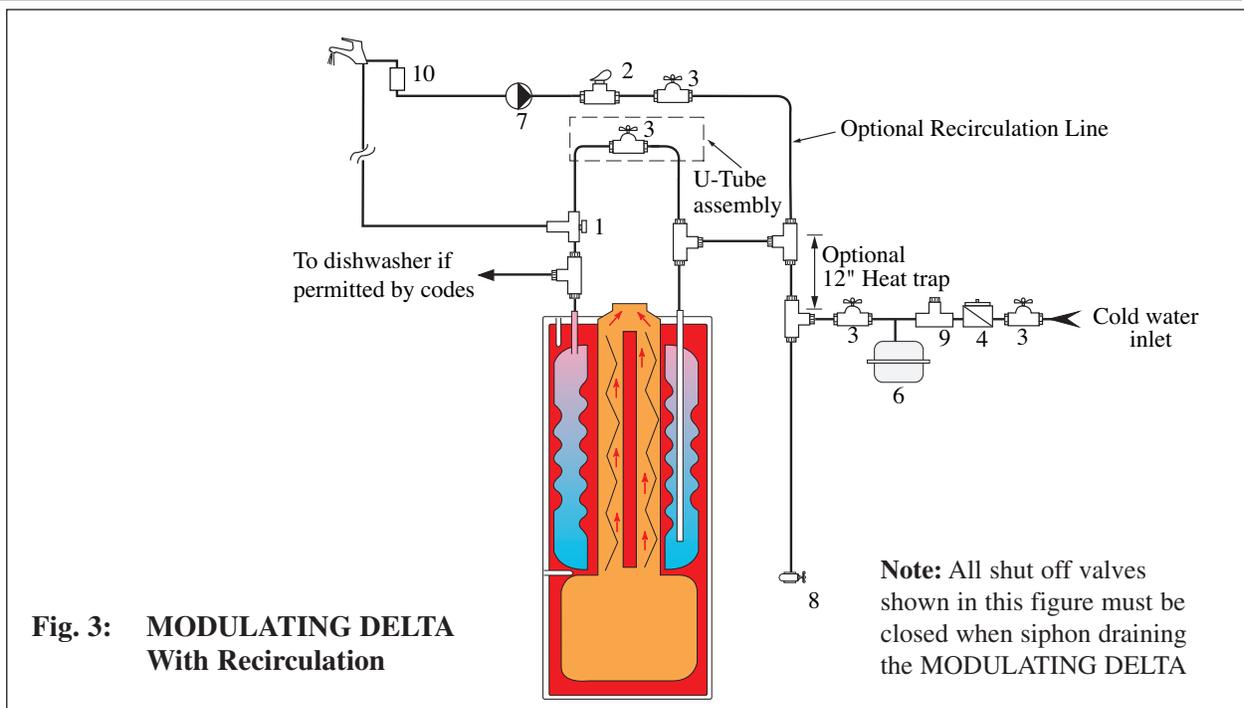
**Domestic Piping Diagrams**



**Fig. 2: MODULATING DELTA Without Recirculation**

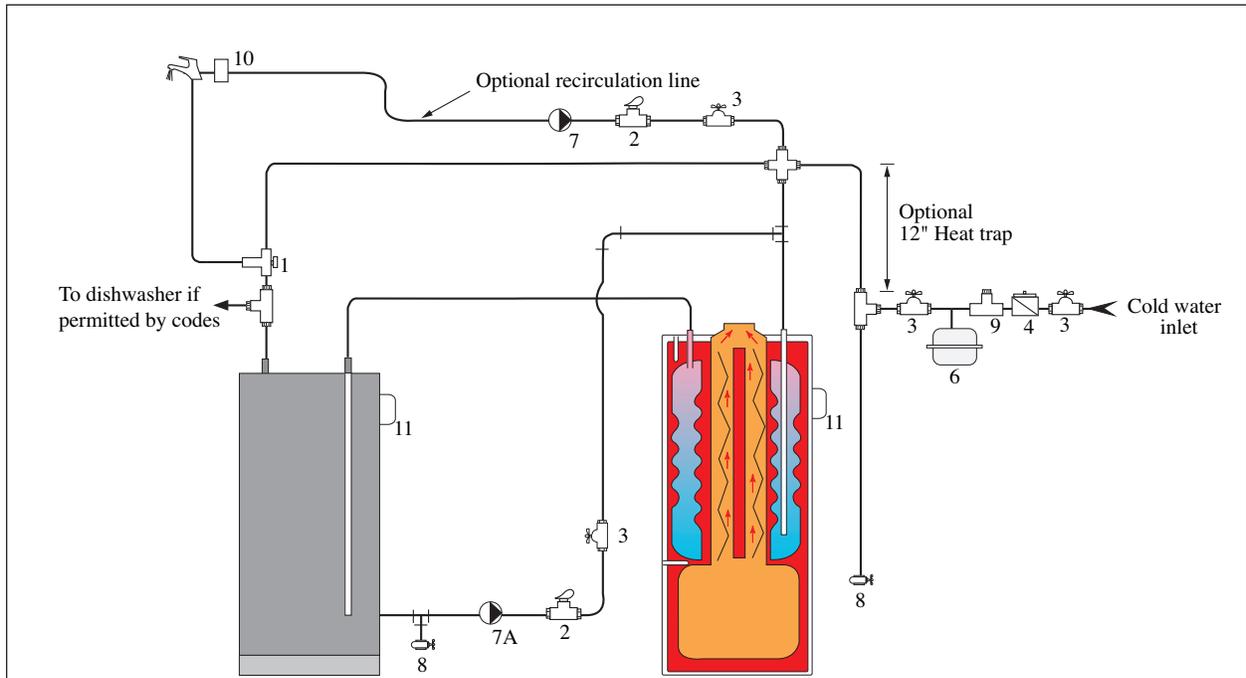
- |   |                            |
|---|----------------------------|
| 1. Mixing valve with check valve                  | 6. Thermal expansion tank* |
| 3. Shut off valve                                 | 8. Domestic drain valve    |
| 4. Backflow preventer or pressure reducing valve* | 9. Vacuum breaker*         |

\* Optional devices may be required by local codes or installation requirements

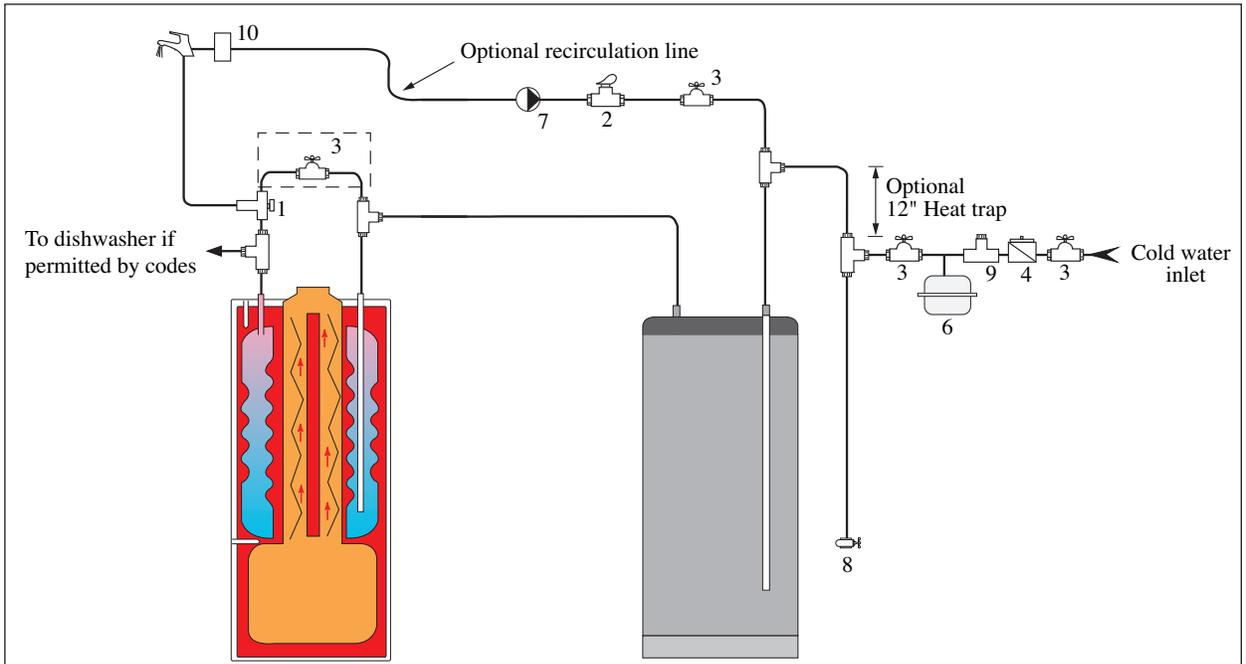


- |   |  |
|---|--|
| 1. Mixing valve with check valve                  | 7. Circulator (controlled by aquastat) |
| 2. Flow check valve                               | 8. Domestic drain valve                |
| 3. Shut off valve                                 | 9. Vacuum breaker*                     |
| 4. Backflow preventer or pressure reducing valve* | 10. Recirculation Aquastat             |
| 6. Thermal expansion tank*                        |  |

\* Optional devices may be required by local codes or installation requirements



**Fig. 5 : MODULATING DELTA with Storage Tank**



**Fig. 6: MODULATING DELTA with SMART Indirect Water Heater**

- |   |   |
|---|---|
| 1. Mixing valve with check valve                  | 7/7A. Circulator (controlled by aquastat) |
| 2. Flow check valve                               | 8. Domestic drain valve                   |
| 3. Shut off valve                                 | 9. Vacuum breaker*                        |
| 4. Backflow preventer or pressure reducing valve* | 10. Recirculation aquastat                |
| 6. Thermal expansion tank*                        | 11. Tank aquastat                         |

\* Optional devices may be required by local codes or installation requirements

### SECTION IV - Primary Piping

#### General Piping Requirements

- All plumbing must meet or exceed all local, state and national plumbing codes.
- Support all piping using hangers. DO NOT support piping by the appliance or its components.
- Use isolation valves to isolate system components.
- Install unions for easy removal of the MODULATING DELTA from the system piping.

#### Pressure Relief Valve

1. The MODULATING DELTA is supplied with a 30 psi pressure relief valve.
2. To avoid potential water damage to the surrounding area or potential scalding hazard due to the operation of the relief valve, the discharge piping:
  - Must be connected to the discharge outlet of the relief valve and directed to a safe place of disposal.
  - Length should be as short and direct as possible. The size of the discharge line should not be reduced; maintain the same size as the outlet of the relief valve.
  - Should be directed downward towards the floor at all times. The piping should terminate at least 6 inches above any drain connection to allow clear visibility of the discharge.
  - Should terminate with a plain end, not with a threaded end. The material of the piping should have a serviceable temperature rating of 250°F or greater.
  - Should not be subject to conditions where freezing could occur.
  - Should not contain any shut-off valves or obstructions. No shut-off valve should be piped between the appliance and the relief valve.

#### WARNING

**Failure to comply with the guidelines on installing the pressure relief valve and discharge piping can result in personal injury, death or substantial property damage.**

#### Low Water Cutoff Device

- The MODULATING DELTA is equipped with a factory installed pressure switch style Low Water Cut Off device.
- The minimum operating system pressure allowable with this device is 10 psig.
- Check local codes which require a low water cutoff device for compliance of this device.

#### Additional Limit Control

If a LWCO device is required by certain local jurisdictions, the following guidelines must be followed:

- The LWCO device must be designed for water installations, electrode probe-type is recommended.
- The LWCO device must be installed in a tee connection on the supply or return piping above the appliance.
- Wiring of the LWCO device to the MODULATING DELTA is done directly onto the 24V terminal strip, reference Fig. 13 page 26 for available terminals for an external limit (manual or auto reset).

If an additional high temperature limit is required by local code requirements the limit should be installed as follows:

- Install the limit in the appliance supply piping between the appliance and any isolation valve.

- Maximum set point for the limit is 186°F.
- For wiring of the limit reference Fig. 13, page 26, using the external limit/manual reset terminals on the 24V terminal strip. This will provide a "hard" lockout requiring a manual reset of the control.

### Backflow Preventer

- Use a backflow preventer valve in the make-up water supply to the appliance as required by local codes.

## Primary System Piping Applications

### BEST PRACTICE

**It is recommended on all piping applications to utilize a primary/secondary piping arrangement as a means to provide freeze protection of the appliance, which is an integral function of the appliance control and to utilize the full function of the CH circulator while maintaining the minimum flow rate, see Graph 1, page 56. For other piping arrangements, consult the Engineering Department at Triangle Tube or consult other approved/recognized design arrangements.**

### BEST PRACTICE

**On piping applications utilizing a single zone or other recognized piping design arrangements, it is recommended the installer uses flow/check valves with weighted seats at or near the appliance to prevent gravity circulation.**

### NOTICE

**To prevent potential outer tank failure, the primary system piping must be a "closed" loop system to avoid any oxygen contamination of the primary water.**

## Expansion Tank and Makeup Water

Ensure the expansion tank is properly sized for the outer tank volume (approximately 20 gallons) and the system volume and temperature.

### CAUTION

**Undersized expansion tanks will cause system water to be lost through the pressure relief valve and cause additional makeup water to be added to the system. Eventual primary tank failure can result due to this excessive makeup water addition.**

The expansion tank must be located as shown in Fig. 7 through 10, pages 18 through 21 or as per recognized design methods. Refer to the expansion tank manufacturer instructions for additional installation details.

Connect the expansion tank to an air separator only if the air separator is located on the suction side (inlet) of the system circulator. Always locate and install the system fill connection at the same location as the expansion tank connection to the system.

## Diaphragm (Bladder) Expansion Tank

Always install an automatic air vent on the top of the air separator to remove residual air from the system.

## Closed-Type (Standard) Expansion Tank

It is recommended to pitch any horizontal piping toward the expansion tank 1 inch per 5 feet of piping. Use 3/4" piping for the expansion tank to allow air within the system to rise.

For proper operation of the expansion tank and system, remove the factory installed automatic air vent from the MODULATING DELTA and plug the connection.

### CAUTION

**DO NOT** install automatic air vents on a closed-type expansion tank system. Air must remain in the system and be returned to the expansion tank to provide an air cushion. An automatic air vent would cause air to be vented from the system resulting in a water-logged expansion tank.

### Circulator

The MODULATING DELTA is supplied with a circulator that is pre-wired to allow for domestic priority. Locate the circulator in the return or supply piping as shown in the piping diagrams included in this manual.

### Sizing Primary Piping

See Figs: 7 through 10, pages 18 - 21, for recommended piping arrangements based on various applications. In all diagrams, the space heating system is isolated from the MODULATING DELTA using primary / secondary piping connections.

Size the piping and system components required in the space heating system using recognized design methods.

### System Piping - Zone Circulators

Connect the MODULATING DELTA to the system piping as shown in Fig. 9 page 20 when zoning with zone circulators. The circulator supplied with the MODULATING DELTA should not be used for a heat zone. It must supply only the primary loop.

Install a separate circulator for each zone of space heating.

To control the zone circulators refer to Fig. 16, page 30 or Fig. 17 Page 31.

### NOTICE

To ensure adequate flow rate through the MODULATING DELTA, maintain a minimum 1 inch diameter on the system piping connecting the appliance to and from the primary / secondary connection.

### System Piping - Zone Valves

Connect the MODULATING DELTA to the system piping with primary secondary piping as shown in Fig. 8 page 19 when zoning with zone valves.

To control the system circulator refer to Fig. 14, page 28.

### NOTICE

To ensure adequate flow rate through the MODULATING DELTA, maintain a minimum 1 inch diameter on the system piping connecting the appliance to and from the primary / secondary connection.

### System Piping - Radiant Heating with Mixing Valve

Connect the MODULATING DELTA to the system piping as shown with a radiant system using a thermostatic mixing valve as shown in Fig. 9 page 20. The primary / secondary piping ensures sufficient return temperature to the MODULATING DELTA.

### NOTICE

**If the radiant system tubing contains no oxygen barrier, a stainless steel heat exchanger must be used. Failure to install a heat exchanger could lead to premature failure of the outer tank and void any warranty claim.**

### WARNING

**Radiant heating system piping should include a means of regulating the primary return water. The return water temperature to the appliance should be maintained at 130°F or higher. Failure to prevent low return water temperature to the appliance could cause premature failure of the appliance and its burner system resulting in severe personal injury, death or substantial property damage.**

### NOTICE

**If the return system temperature is not maintained above 130°F, the appliance will begin high fire rate and shut down the primary circulator to prevent condensation from occurring within the appliance.**

Size the heating system piping and circulator to provide the flow needed for the radiant system.

To control the zone circulators reference Figs. 16 or 17, pages 30 & 31.

### NOTICE

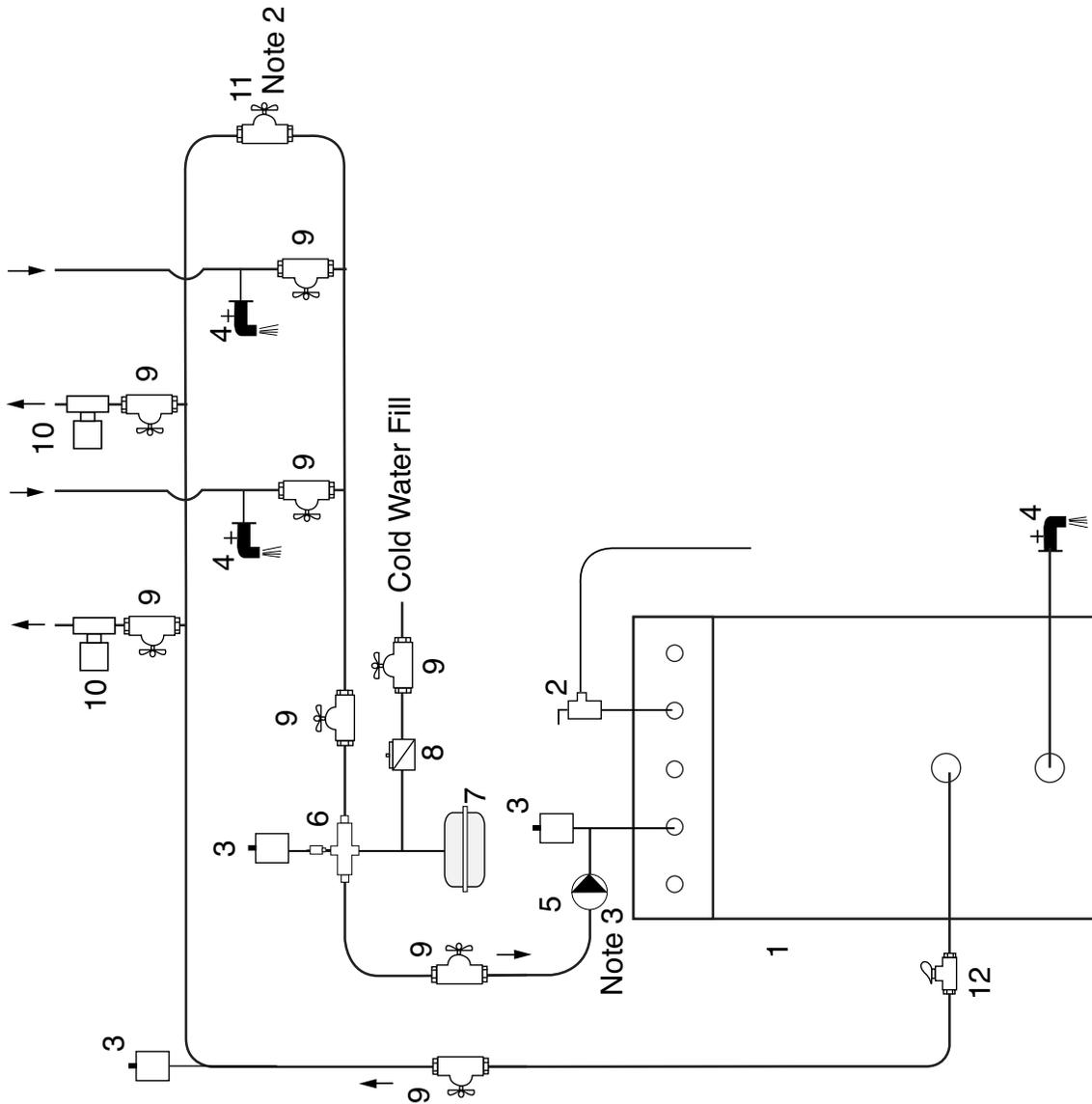
**To ensure adequate flow rate through the MODULATING DELTA, maintain a minimum 1 inch diameter on the system piping connecting the appliance to and from the primary / secondary connection.**

### System Piping - Multiple Appliances Installation

Use a primary / secondary connection to the space heating piping as shown in Fig. 10 page 21 or other recognized design methods.

**Notes:**

1. Install a minimum of 12 straight pipe diameters upstream of all circulators.
2. Adjust bypass for a minimum of 3 gpm under any operating condition.
3. Verify primary circulator is properly sized to overcome the system pressure drop and provide adequate flow through the appliance.



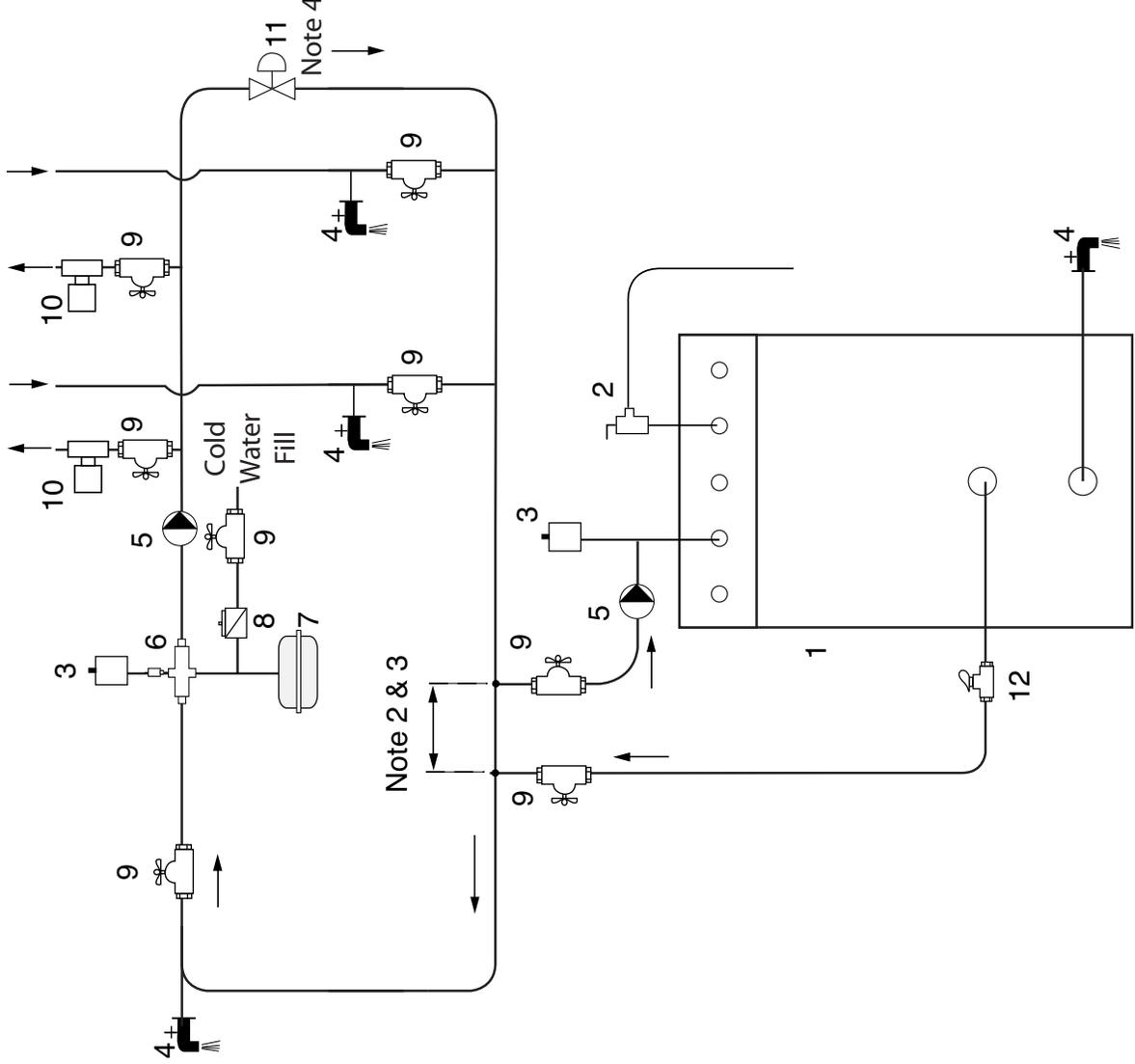
- |     |                          |
|-----|--------------------------|
| 1.  | Modulating Delta         |
| 2.  | Pressure Relief Valve    |
| 3.  | Automatic Air Vent       |
| 4.  | Drain/Purge Valve        |
| 5.  | Circulator               |
| 6.  | Air Separator            |
| 7.  | Expansion Tank-Diaphragm |
| 8.  | Automatic Fill Valve     |
| 9.  | Isolation Valve          |
| 10. | Zone Valve               |
| 11. | Bypass Valve             |
| 12. | Flow Check Valve         |

Fig. 7: Primary Piping - Zoning with Zone Valves

**Notes:**

1. Install a minimum of 12 straight pipe diameters upstream of all circulators.
2. Install closely spaced tees a maximum of 4 pipe diameters center to center.
3. Install a minimum of 6 straight pipe diameters upstream and down stream of closely spaced tees.
4. Adjust pressure differential bypass valve on the zone with highest pressure drop to avoid velocity noise.

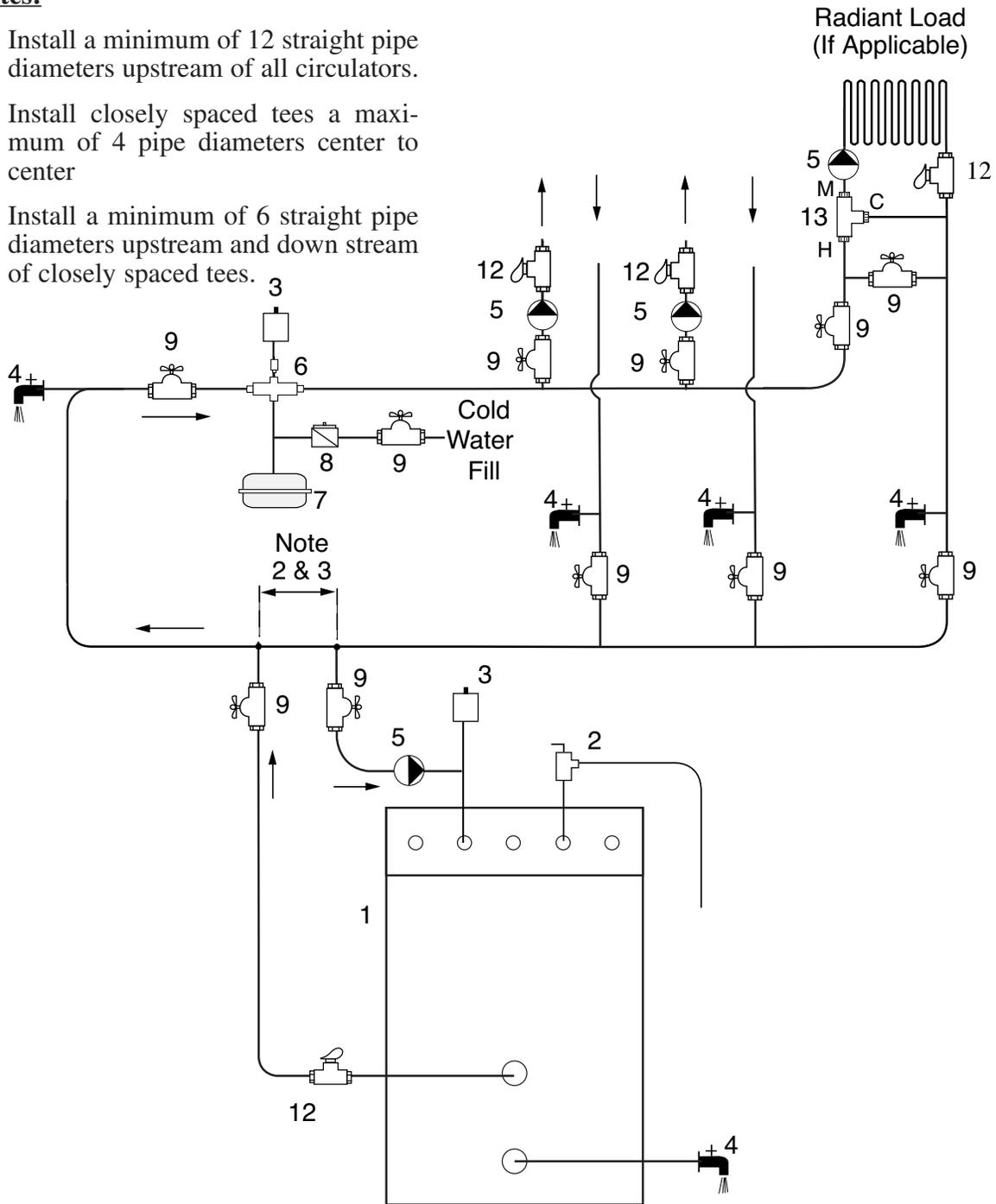
- |     |                            |
|-----|----------------------------|
| 1.  | Modulating Delta           |
| 2.  | Pressure Relief Valve      |
| 3.  | Automatic Air Vent         |
| 4.  | Drain/Purge Valve          |
| 5.  | Circulator                 |
| 6.  | Air Separator              |
| 7.  | Expansion Tank - Diaphragm |
| 8.  | Automatic Fill Valve       |
| 9.  | Isolation Valve            |
| 10. | Zone Valve                 |
| 11. | Bypass Valve               |
| 12. | Flow Check Valve           |



**Fig. 8: Primary Piping - Zoning with Zone Valves - Preferred Piping**

**Notes:**

1. Install a minimum of 12 straight pipe diameters upstream of all circulators.
2. Install closely spaced tees a maximum of 4 pipe diameters center to center
3. Install a minimum of 6 straight pipe diameters upstream and down stream of closely spaced tees.



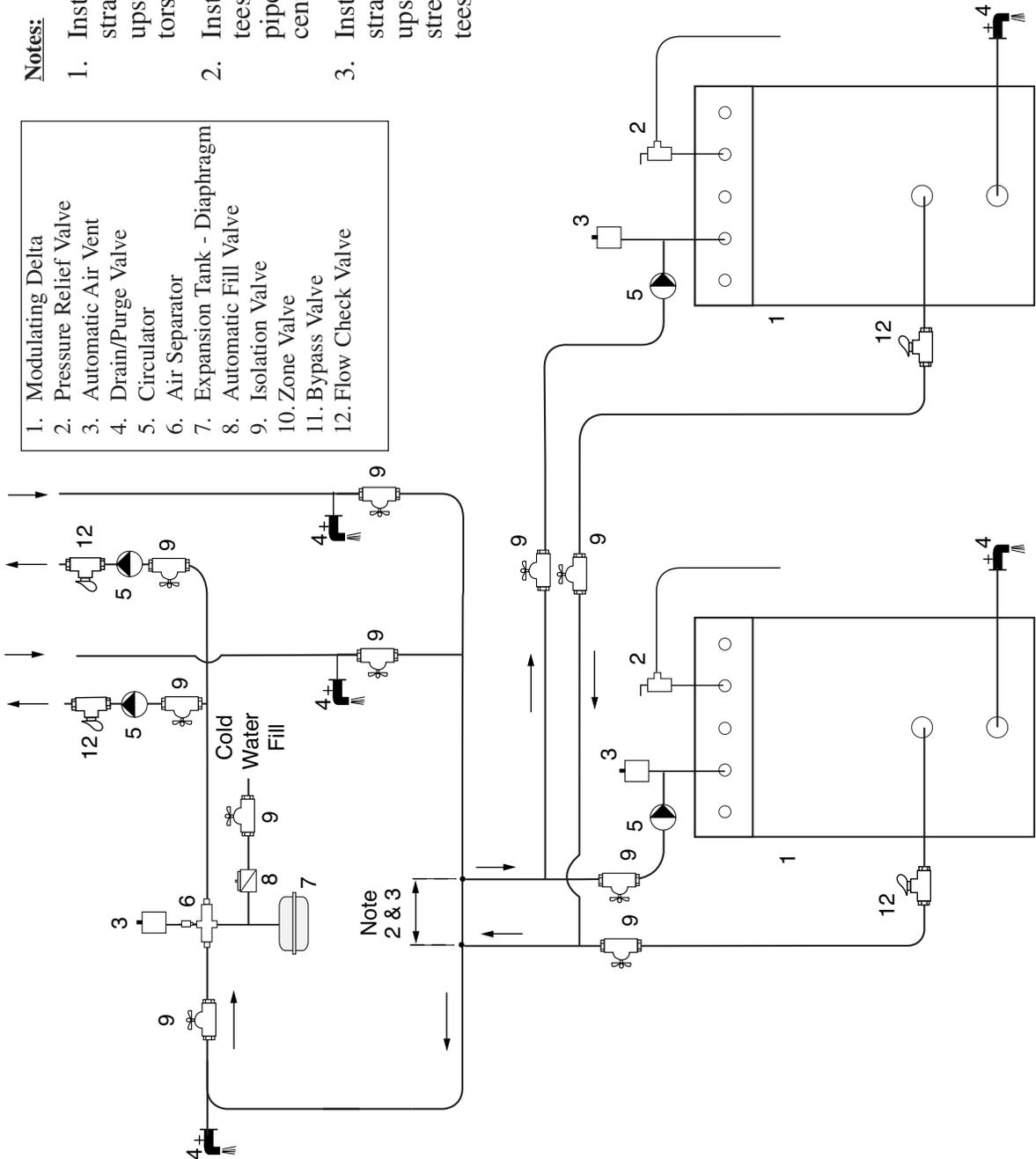
**Fig. 9: Primary Piping - Zoning with Circulators**

1. Modulating Delta	6. Air Separator	11. Bypass Valve
2. Pressure Relief Valve	7. Expansion Tank - Diaphragm	12. Flow Check Valve
3. Automatic Air Vent	8. Automatic Fill Valve	13. Mixing Valve
4. Drain/Purge Valve	9. Isolation Valve	
5. Circulator	10. Zone Valve	

**Notes:**

1. Install a minimum of 12 straight pipe diameters upstream of all circulators.
2. Install closely spaced tees a maximum of 4 pipe diameters center to center
3. Install a minimum of 6 straight pipe diameters upstream and down stream of closely spaced tees.

- |                               |
|-------------------------------|
| 1. Modulating Delta           |
| 2. Pressure Relief Valve      |
| 3. Automatic Air Vent         |
| 4. Drain/Purge Valve          |
| 5. Circulator                 |
| 6. Air Separator              |
| 7. Expansion Tank - Diaphragm |
| 8. Automatic Fill Valve       |
| 9. Isolation Valve            |
| 10. Zone Valve                |
| 11. Bypass Valve              |
| 12. Flow Check Valve          |



**Fig. 10: Primary Piping - Zoning with Circulators - Multiple Appliances**

**SECTION V - Gas Piping**

**Gas Supply Piping Connection**

**NOTICE**

**The gas supply piping must be installed in accordance to all applicable local, state and national codes and utility requirements.**

1. Refer to Fig. 11 to pipe gas supply to the burner.
  - a. Install a pipe nipple and union at the factory supplied 3/4" NPT gas coupling, for ease of service.
  - b. Install a manual shutoff valve in the gas supply piping as shown in Fig. 11. For installations in Canada, the installer must tag and identify the main shutoff valve.
  - c. Install a drip leg on the gas supply line prior to connecting to the MODULATING DELTA gas train as shown in Fig. 11.
2. Support the gas piping using hangers. Do not support the piping by the appliance or its components.
3. Purge all air from the gas supply piping.
4. Before placing the MODULATING DELTA into operation, check and test all connections for leaks.

Close the manual shutoff valve during any pressure test with less than 13" w.c..

Disconnect the MODULATING DELTA and its gas valve from the gas supply piping during any pressure test greater than 13" w.c..

**WARNING**

**Do not check for gas leaks with an open flame. Use a gas detection device or bubble test. Failure to check for gas leaks can cause severe personal injury, death or substantial property damage.**

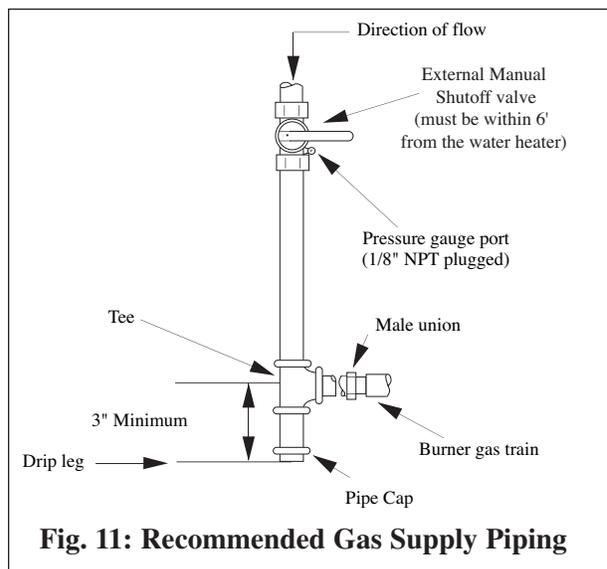
5. Use pipe dope compatible with natural and propane gases. Apply sparingly only to the male threads of pipe joints so that pipe dope does not block gas flow.

**WARNING**

**Failure to apply pipe dope as detailed above can result in severe personal injury, death or substantial property damage.**

**WARNING**

**Use a two-wrench method of tightening gas piping near the appliance and its gas valve. Use one wrench to prevent the gas valve line connection from turning and the second to tighten adjacent piping. Failure to support the gas valve connection piping could damage the valve and the gas line components.**



**Fig. 11: Recommended Gas Supply Piping**

**NATURAL GAS**

**Pipe Sizing - Natural Gas**

1. Refer to Table 1 for pipe length and diameter requirements. Based on rated MODULATING DELTA input (divide by 1,000 to obtain cubic feet per hour).
  - Table 1 is based on Natural Gas with a specific gravity of 0.60 and a pressure drop through the gas piping of 0.30”w.c..
  - For additional gas piping sizing information, refer to ANSI Z223.1. For Canadian installations refer to B149.1 or B149.2.

2. Install 100% lockup gas pressure regulator in the gas supply line if inlet pressure can exceed 13”w.c at any time. Adjust the lockup pressure regulator for 13”w.c maximum.

**WARNING**

**DO NOT adjust or attempt to measure gas valve outlet pressure. The gas valve is factory-set for the correct outlet pressure. This setting is suitable for natural gas and propane and requires no field adjustment. Attempts by the installer to adjust or measure the gas valve outlet pressure could result in damage to the valve, causing potential severe personal injury, death or substantial property damage.**

**Natural Gas Supply Pressure Requirements**

1. Pressure required at the gas valve inlet supply pressure port:
  - Maximum 13”w.c. at flow or no flow conditions to the burner.
  - Minimum 5”w.c. during flow conditions to the burner. Must be verified during start up and with all gas appliances operating.

**Table 1: Gas Piping Sizing - Natural Gas**

Length of Pipe in Feet	Capacity of Pipe in Cubic Feet of Gas Per Hour (based on 0.60 specific gravity, 0.30" w.c. pressure drop)				
	SCH 40	1/2"	3/4"	1"	1-1/4"
10	132	278	520	1050	1600
20	92	190	350	730	1100
30	73	152	285	590	860
40	63	130	245	500	760
50	56	115	215	440	670
75	45	93	175	360	545
100	38	79	150	305	460
150	31	64	120	250	380

**PROPANE GAS**

**Pipe Sizing - Propane Gas**

1. Contact the local propane gas supplier for recommended sizing of piping, tanks and 100% lockup gas regulator.

**Propane Gas Supply Pressure Requirements**

1. Adjust the propane supply regulator provided by the gas supplier for 13" w.c. maximum pressure
2. Pressure required at the gas valve inlet supply pressure port:
  - Maximum 13" w.c. at flow or no flow conditions to the burner
  - Minimum 5" w.c. during flow conditions to the burner. Must be verified during start up and with all gas appliances operating.

**Table 2: Propane Orifice Diameter**

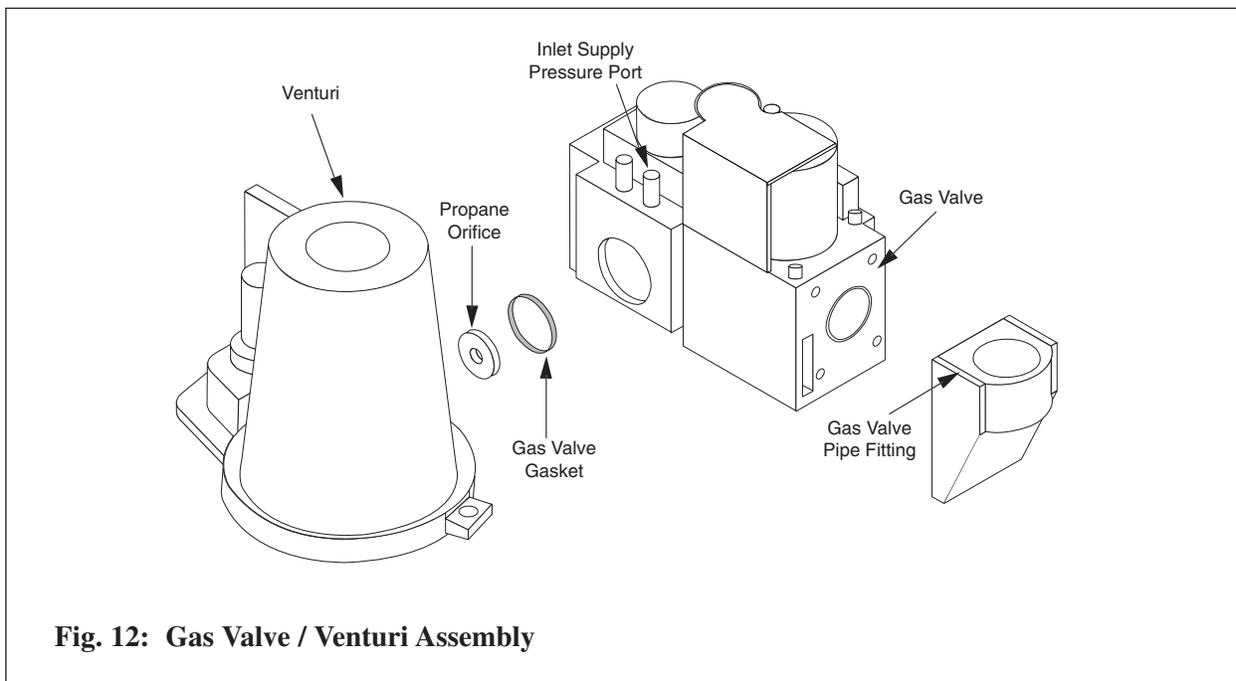
Model	Orifice Diameter
PG-150 & PG PLUS-150	0.169
PG-199 & PG PLUS-199	0.221

**WARNING**

**DO NOT adjust or attempt to measure gas valve outlet pressure. The gas valve is factory-set for the correct outlet pressure. This setting is suitable for natural gas and propane and requires no field adjustment. Attempts by the installer to adjust or measure the gas valve outlet pressure could result in damage to the valve, causing potential severe personal injury, death or substantial property damage.**

**WARNING**

**Prior to start up, ensure the appliance is set to fire propane. Check the rating label for the type of fuel. Check the gas valve for propane conversion label. If there is a conflict or doubt on the burner set up, remove the gas valve and check for proper propane orifice. See Fig. 12 and Table 2. Failure to ensure proper burner setup could result in severe personal injury, death or substantial property damage.**



**Fig. 12: Gas Valve / Venturi Assembly**

### SECTION VI - Internal Wiring

#### WARNING

**ELECTRICAL SHOCK HAZARD. For your safety, disconnect electrical power supply to the appliance before servicing or making any electrical connections to avoid possible electric shock hazard. Failure to do so can cause severe personal injury or death.**

#### CAUTION

**Prior to servicing label all wires before disconnection. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.**

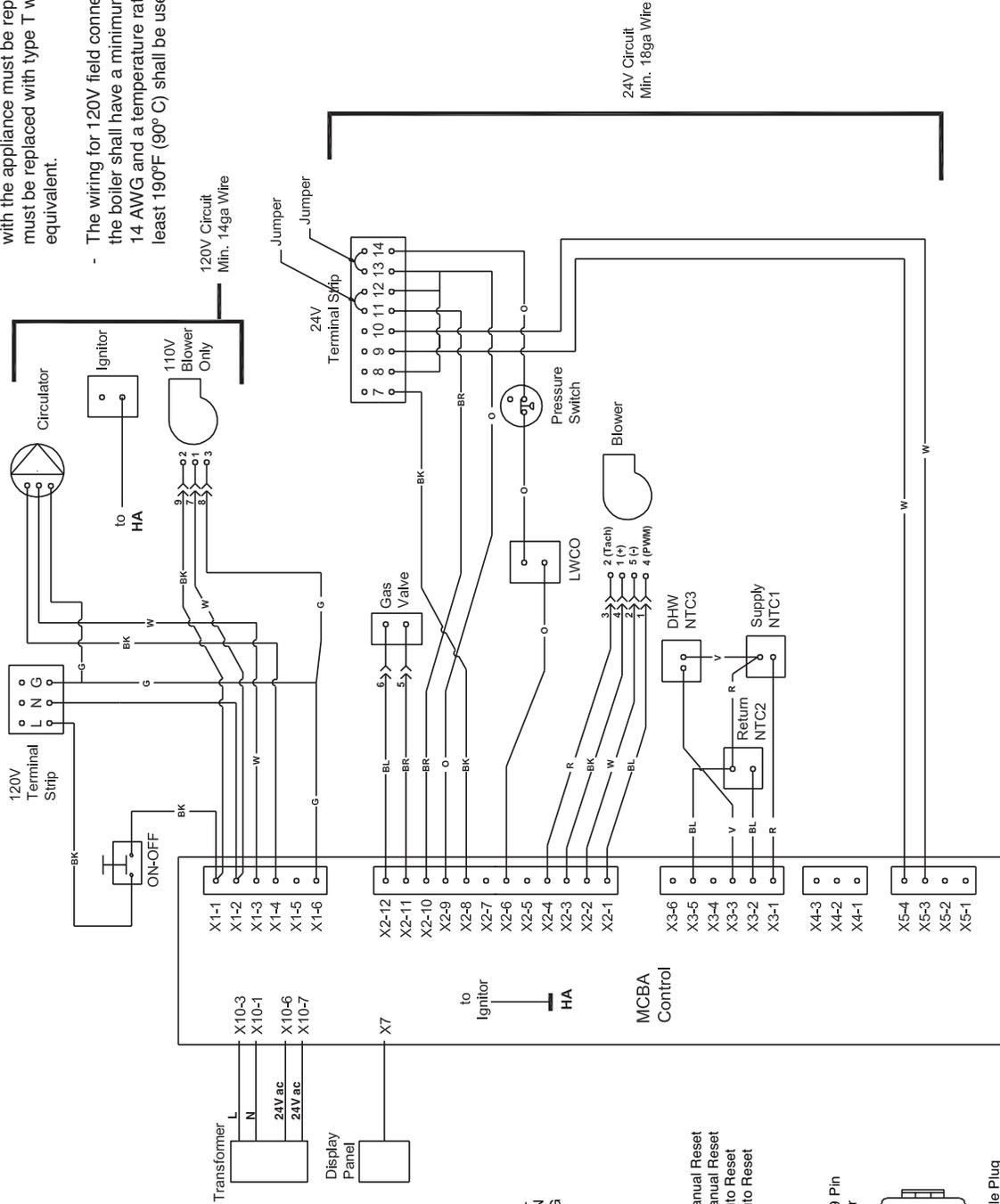
### General Requirements

- Wiring must be N.E.C Class 1.
- If original wiring installed in the appliance must be replaced, use only type T, 90°C wire or equivalent.
- The MODULATING DELTA must be electrically grounded as required by National Electrical Code ANSI/NFPA 70 and/or CSA C22.1 Canadian Electrical Code - latest edition(s).

**Fig. 13: Wiring Diagram**

**Note:**

- If any of the original wire as supplied with the appliance must be replaced, it must be replaced with type T wire or its equivalent.
- The wiring for 120V field connections to the boiler shall have a minimum size of 14 AWG and a temperature rating of at least 190°F (90° C) shall be used.



**Wire Color Code Key**

- BK - Black
- W - White
- G - Green
- BL - Blue
- R - Red
- O - Orange
- V - Violet
- Y - Yellow
- BR - Brown

**120V Wire Terminal Key**

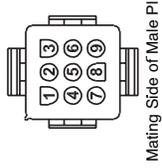
- L - Incoming Supply L
- N - Incoming Supply N
- G - Incoming Supply G

**24V Wire Terminal Key**

- 7 - Thermostat (T-T)
- 8 - Thermostat (T-T)
- 9 - Outdoor Sensor
- 10 - Outdoor Sensor
- 11 - External Limit - Manual Reset
- 12 - External Limit - Auto Reset
- 13 - External Limit - Auto Reset
- 14 - External Limit - Auto Reset

**Wiring Legend**

>> - Location in 9 Pin Connector



### SECTION VII - External Wiring

#### Installation Compliance

All field wiring made during installation must comply with:

- National Electrical Code NFPA 70 and any other national, state, provincial or local codes or requirements.
- In Canada, CSA C22.1 Canadian Electrical Code Part 1, and any other local codes.

#### WARNING

##### **ELECTRICAL SHOCK HAZARD**

**Before making any electrical connection to the MODULATING DELTA, disconnect electrical power supply at the service panel. Failure to comply can cause severe personal injury or death.**

#### Line Voltage Connections

1. Connect 120 VAC power wire to the line voltage terminals strip located behind the control cover.
2. Route the incoming 120 VAC power wire through the left side jacket panel.
3. The appliance is provided with a service switch. Check local code requirements for compliance.

#### NOTICE

**If local electrical codes or conditions require an additional service switch, the installer must provide and install a fused disconnect or 15 amp (minimum) service switch.**

#### Thermostat Wiring

1. Connect room thermostat or the end switch (isolated contact only) of a relay control panel to terminals 7 and 8 on the low voltage terminal strip located behind the control cover.

2. For proper operation, install the room thermostat on an inside wall away from influences of heat and cold, i.e. water pipes, areas of draft, lighting fixtures and fireplaces.
3. Set the thermostat anticipator (if applicable) as follows:
  - Set for 0.2 amps when wired directly to terminals 7 and 8 on the low voltage terminal strip located behind the control cover.
  - Set to match the total electrical power requirements of the connected devices when wired to zone relays or other devices. Refer to the relay manufacturers' specifications and the thermostat instructions for additional information on the anticipator setting.

#### Outdoor Reset Sensor

1. The MODULATING DELTA may operate with a variable primary operating temperature using an optional 12 K outdoor sensor from Triangle Tube.

#### NOTICE

**If the installer opts for a fixed operating temperature for the primary system, the outdoor sensor is not required and should not be installed.**

#### NOTICE

**Variable range of primary operating temperature using the optional outdoor sensor is 140°F to 186°F.**

2. Mount the outdoor sensor on an exterior wall. Ensure the sensor is shielded from direct sunlight and is not influenced by an external heat or cooling source.
3. Wire the outdoor sensor to terminals 9 and 10, on the low voltage terminal strip located behind the control cover.
4. Route sensor wires through the provided openings on the left jacket panel.

**Additional 24V Limit Wiring**

The MODULATING DELTA provides 24V terminal connections for additional limit controls. These limit terminal connections will provide a "hard" lockout requiring a manual reset of the control, or a "soft" lockout in which the control will automatically reset.

For limit control requiring a manual reset (hard lockout) remove jumper and use low voltage terminals 11 and 12.

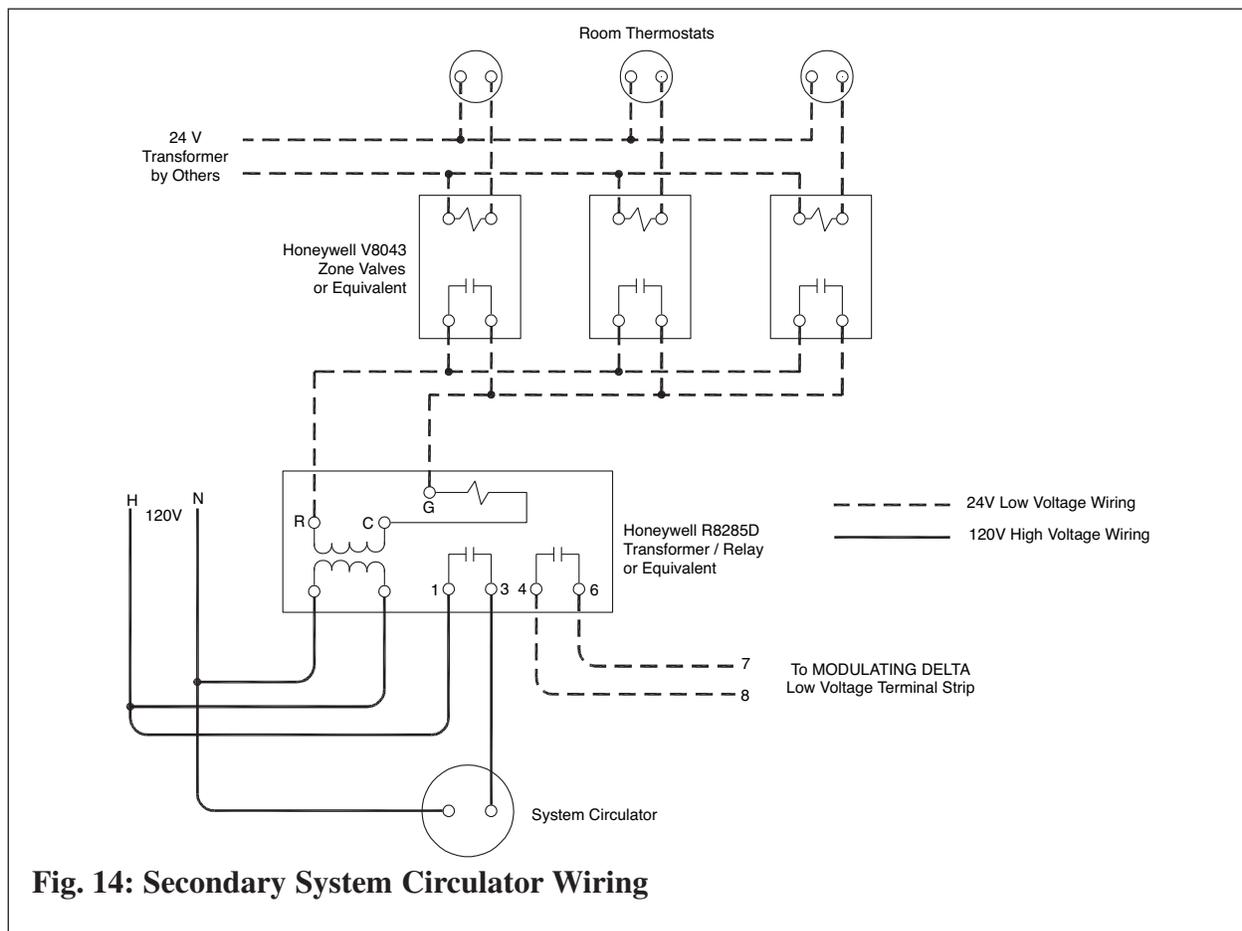
For limit control that will reset automatically when the condition is corrected (soft lockout) remove jumper and use low voltage terminals 13 and 14.

**System Circulator - Zone Valve Application**

To energize the system circulator shown as Item 5 in Fig. 8 page 19 reference Fig. 14. Installer to provide a Transformer / Relay such as Honeywell R8285 or equivalent and Zone Valves with isolated end switch such as Honeywell V8043 or equivalent.

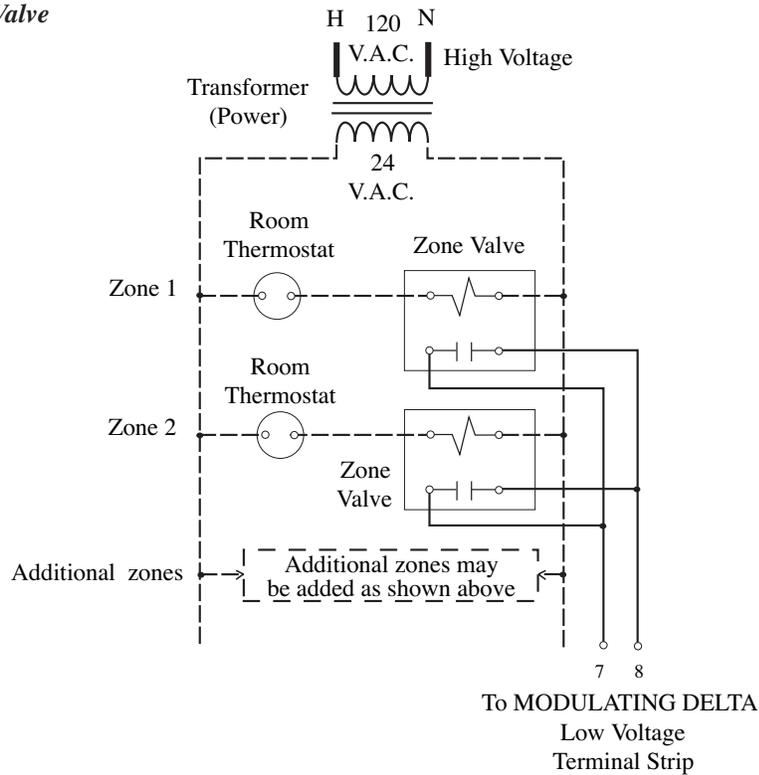
**Storage Tank Recirculation**

To energize the recirculation circulator between the MODULATING DELTA and a storage tank as shown as Item 7A in Fig. 6 page 13 reference Fig. 18 page 31. Installer to provide a transformer/relay such as Honeywell R845A or equivalent.



**Fig. 14: Secondary System Circulator Wiring**

4 Wire Zone Valve



3 Wire Zone Valve

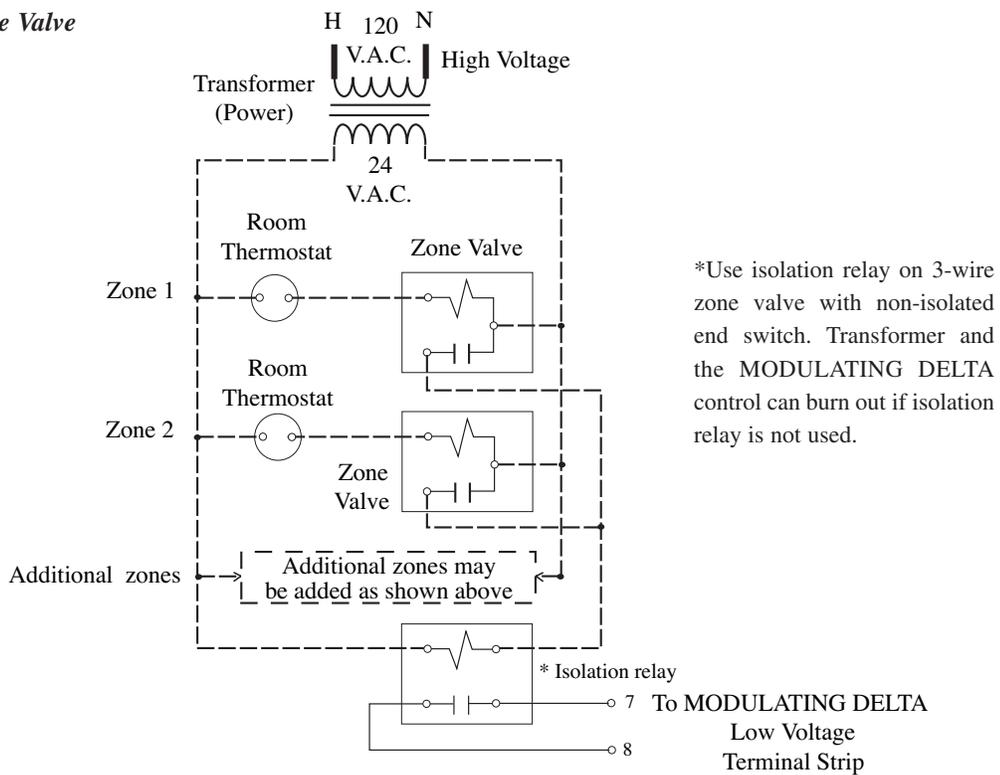


Fig. 15: Multiple Zone Field Wiring Using Zone Valves

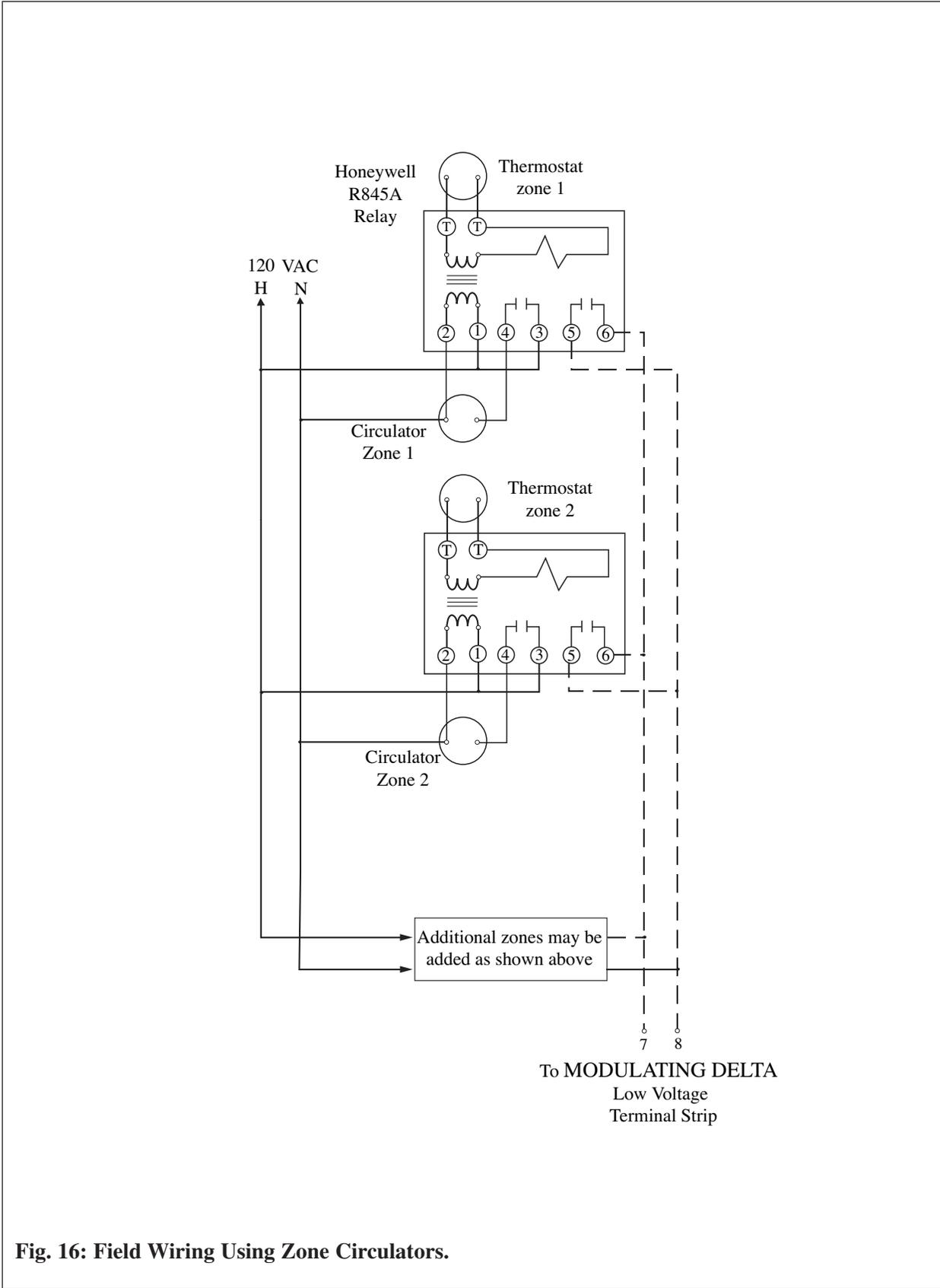
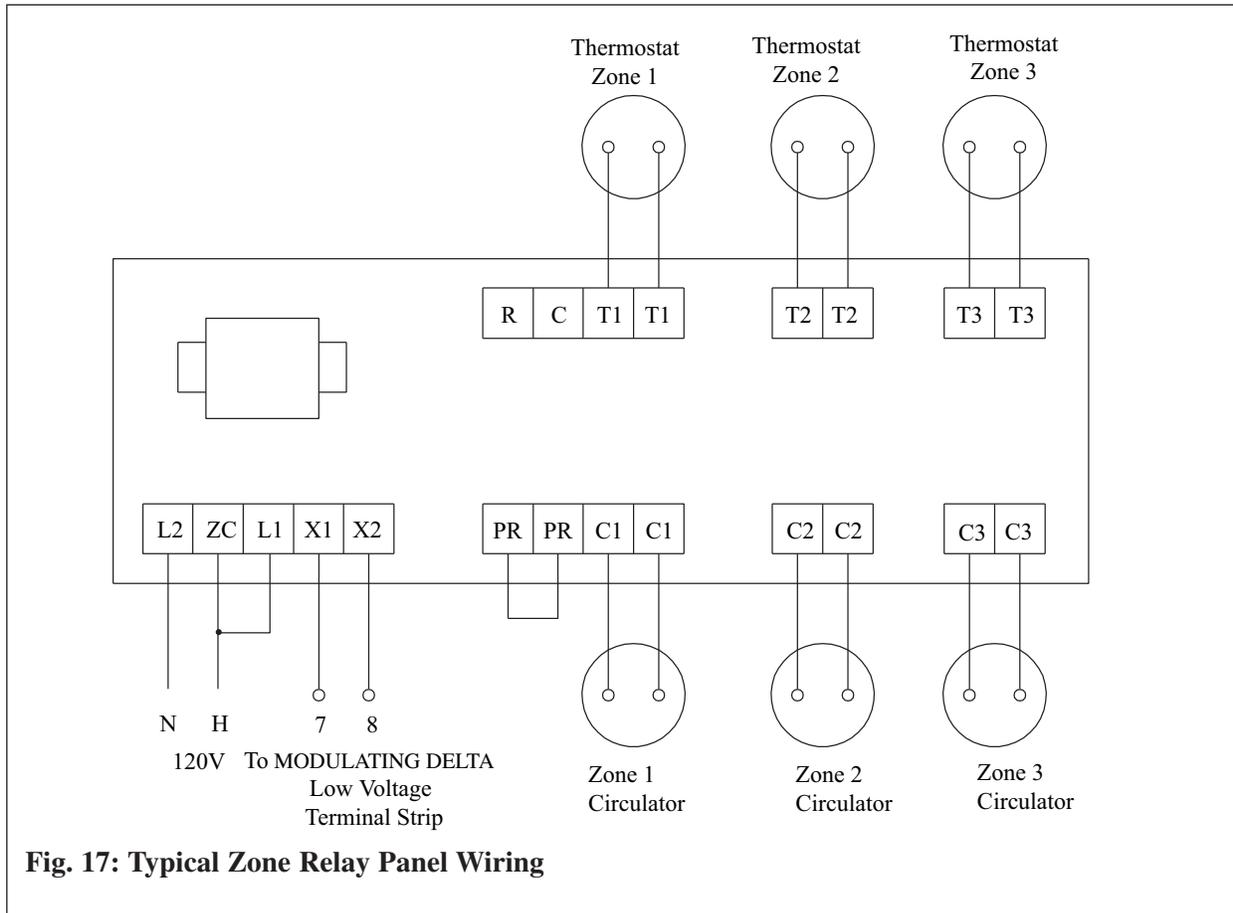
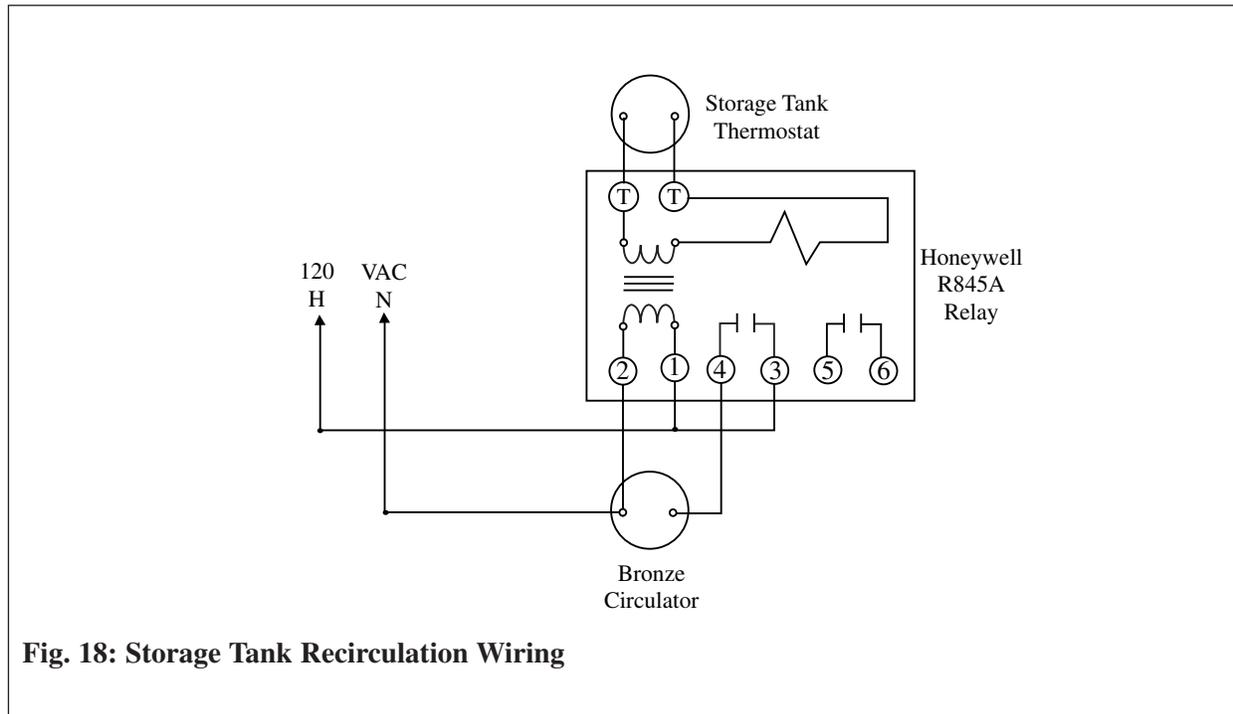


Fig. 16: Field Wiring Using Zone Circulators.



**Fig. 17: Typical Zone Relay Panel Wiring**



**Fig. 18: Storage Tank Recirculation Wiring**

### SECTION VIII - Start Up Preparation

#### Check System and Domestic Water Chemistry

##### WARNING

Do not use petroleum-base cleaning or sealing compounds in the primary system. Damage to seals and gaskets in the system components could occur, resulting in substantial property damage.

##### NOTICE

System water including additives must be practically non-toxic, having a toxicity rating or Class of 1, as listed in Clinical Toxicology of Commercial Products.

#### Water pH Level 6.0 to 8.0

Maintain the primary system water pH between 6.0 and 8.0. Check using litmus paper or contact a water treatment company for a chemical analysis.

If the pH does not meet this requirement, do not operate the MODULATING DELTA or leave the appliance filled until the condition is corrected.

#### Water Hardness Less Than 7 Grains

For areas with unusually hard water (hardness above 7 grains) consult a water treatment company.

#### Chloride Concentration Less Than 80 mg/L

For those installations that use a water softener or conditioner, consult the water treatment company.

##### NOTICE

Any water conditioning system must be installed and maintained in accordance with the water conditioner's manufacturer's specifications and within the operating guidelines of the MODULATING DELTA.

#### Chlorinated Water

Do not use the MODULATING DELTA inner or outer tank to heat a swimming pool or spa directly.

Maintain the chlorine level of the water in the inner and outer tanks at levels considered safe for drinking.

#### Flush Primary and Domestic System to Remove Sediment

The installer must flush both the primary and domestic system to remove any sediment to allow proper operation of the MODULATING DELTA.

Flush the systems until the water runs clean and is free of sediment.

For primary zoned systems, each zone should be flushed through a purge valve. Purge valves and isolation valves should be installed on each zone to allow for proper flushing of the system.

#### Check and Test Antifreeze

For primary systems containing antifreeze solutions, follow the antifreeze manufacturer's instructions in verifying the inhibitor level and to ensure the fluid characteristics are within specification requirements.

Due to the degradation of inhibitors over time, antifreeze fluids must be periodically replaced. Refer to the manufacturer of the antifreeze for additional instructions.

### NOTICE

**System water, including additives must be practically non-toxic, having a toxicity rating of Class 1, as listed in Clinical Toxicology of Commercial Products.**

### Use of Antifreeze in the Primary System

#### WARNING

**NEVER use automotive or ethylene glycol antifreeze or undiluted antifreeze in the primary system as freeze protection. This can cause severe personal injury, death or substantial property damage if ignored.**

Determine the antifreeze fluid quantity using the system water content volume and following the antifreeze manufacturer instructions.

The primary outer tank volume of the MODULATING DELTA is approximately 20 gallons. Remember to include the volume of the expansion tank.

Check with local codes requirements for the installation of back flow preventers or actual disconnect from the make up water supply line.

Ensure the concentration of antifreeze to water does not exceed a 50/50 ratio.

### NOTICE

**System water including additives must be practically non-toxic, having a toxicity rating of Class 1, as listed in Clinical Toxicology of Commercial Products.**

### Filling the Inner (Domestic) Tank and System

#### WARNING

**Proceed with filling instructions for the inner and outer tanks only after ensuring the water meets the requirements listed in this installation manual. Failure to comply could result in damage and improper operation of the appliance.**

#### CAUTION

**Never operate the MODULATING DELTA unless both the inner and outer tanks are completely filled.**

#### CAUTION

**Always fill the inner tank prior to filling and pressurizing the outer tank. Failure to properly fill the inner tank could result in damage to the inner tank.**

1. Ensure the domestic drain valve is closed.
2. Open the isolation valves on the domestic cold supply piping to the MODULATING DELTA and on the domestic hot outlet piping to the building (if provided).
3. Vent any air from the domestic piping system by opening faucets near the appliance. Continue filling the domestic system until there is a constant flow of water from the faucets.
4. Close the hot water faucets.

### Filling the Outer (Primary) Tank and System

1. Close the primary drain valve located on the rear of the appliance and any manual or automatic air vent in the system.
2. Open all system isolation valves.

3. Fill the outer tank to correct system pressure. Correct pressure will vary with each application.

### NOTICE

Typical residential system fill pressure is 12 psi. System pressure will increase when system temperature increases. Operating pressure of the system should never exceed 25 psi.

4. Allow air to escape from the outer tank by opening the automatic air vent provided with the MODULATING DELTA.
5. Purge air in each zone of the primary system through the purge valve. Open air vents to allow air to be purged in the zones.
6. Once the system is completely filled and purged of all air, check the system pressure and check for leaks.

### Check For Gas Leaks

#### WARNING

**Prior to start-up and during initial operation, smell near the floor and around the appliance for gas odorant or any unusual odor. Do not proceed with the start-up if there is any indication of a gas leak. Any leaks found must be repaired immediately.**

#### WARNING

**DO NOT adjust or attempt to measure gas valve outlet pressure. The gas valve is factory-set for the correct outlet pressure. This setting is suitable for natural gas and propane and requires no field adjustment. Attempts by the installer to adjust or measure the gas valve outlet pressure could result in damage to the valve, causing potential severe personal injury, death or substantial property damage.**

#### WARNING

**Propane installations only - The propane supplier mixes an odorant with the propane to make its presence detectable. In some cases the odorant can fade and the gas may no longer have an odor.**

**Prior to start-up of the appliance and periodically after start-up, have the propane supplier check and verify the odorant level.**

### Check Thermostat Circuit

- Disconnect the external thermostat wires from terminals 7 and 8 on the low voltage terminal strip.
- Connect a voltmeter across the wire ends of the external thermostat wiring.
- Close each thermostat, zone valve and relay in the external circuit one zone at a time and check the voltage reading across the wire ends.
- There should **NEVER** be voltage measured at the wire ends.
- If voltage is measured at the panel under any condition, check and correct the external wiring.

#### NOTICE

**In systems using 3-wire zone valves backfeed of voltage to the appliance is a common problem. Use an isolation relay to prevent voltage from the external circuit entering the MODULATING DELTA control panel.**

### SECTION IX - Start-Up Procedures

#### Final Checks Before Start-up

- Verify the MODULATING DELTA and the primary and domestic systems are full of water and all system components are correctly set for operation.
- Verify Start-up Preparation items outlined on pages 32 thru 34 have been completed.
- Verify all electrical connections are correct and securely fasten.
- Inspect vent piping and combustion air inlet piping for signs of deterioration from corrosion, physical damage or sagging. Verify combustion air piping and vent piping are intact and correctly installed. See appropriate venting guide.
- Verify Burner Configuration - Propane Only.

Check for proper labeling on the gas valve and the rating label for propane configuration.

If there is doubt on the burner configuration, remove the gas valve and check for proper propane orifice. See Fig.12 and Table 2 on page 24. Refer to Propane Conversion Instructions for additional information on assembly of the gas valve.

#### Appliance Start-up

1. Turn the ON-OFF switch located on the front jacket panel to the OFF position. Turn the electrical supply or any external service switch to the appliance in the ON position.
2. Read and follow the Operating Instructions outlined on page 37 to start the appliance.

#### If Appliance Does Not Start Correctly

1. Verify CH (parameter 2) and DHW (parameter 3) Systems are turned ON or set to "01". Read the Boiler Display Parameter Section of the manual on page 42 for more information.

2. Check for loose electrical connections, blown fuse (external or internal to the MCBA Control) or open service switch.
3. Is the gas supply valve open at the appliance and meter?
4. Is incoming gas supply pressure more than 5" w.c. for natural or propane with all gas appliances operating and less than 13" w.c. with all gas appliance turned off.
5. Are the heating thermostats set below room temperature?

If none of these conditions correct the problem, refer to the MODULATING DELTA Troubleshooting guide.

#### Check the Appliance and System

- Check Domestic Piping.

Check domestic piping and system components for leaks. If found, shut down the appliance and repair immediately.

- Check Primary Piping.

Check primary system piping and components for leaks. If found, shut down the appliance and repair immediately.

Purge any remaining air from the system piping. Air in the system piping will interfere with circulation creating heat distribution problems and system noise.

- Check Vent Piping and Combustion Air Piping.

Check for gas-tight seal at every connection and seam of the venting and combustion air inlet.

#### WARNING

**Venting system must be sealed gas-tight to prevent flue gas spillage and potential carbon monoxide emissions, which will result in severe personal injury or death.**

Check Gas Piping

Check around the appliance for gas odor following the procedure outlined in this manual on Page 34.

**WARNING**

**If any gas leaks are found or suspected, shut the appliance down immediately. Use a gas detection device or bubble test to locate the source of the gas leak and repair at once. Do not operate the appliance until the leak is corrected. Failure to comply with this procedure could result in severe personal injury, death or substantial property damage.**

Verify Flame Pattern and Combustion

Check the flame pattern through the inspection port of the burner. The flame should be stable and the full length of the burner head openings.

**WARNING**

**The combustion testing and adjustments must be performed by a qualified installer, service agency or the gas supplier. All combustion measurements must be performed with calibrated equipment to ensure proper reading and accuracy.**

Test for CO<sub>2</sub> or O<sub>2</sub> and for CO during high and low firing rates. To manually place the appliance into high or low fire mode, reference page 40, the combustion reading should be within the range listed in Table 3. **The CO level should not exceed 100 ppm when combustion is correct.**

**WARNING**

**The combustion levels should be measured at high and low firing rates, refer to page 40 on how to set the firing rates. If the combustion levels are not within the range given in Table 3 for the firing rate, shut the appliance down and contact Triangle Tube's Engineering Department. Failure to comply with this requirement could result in severe personal injury, death or substantial property damage.**

**Table 3: Recommended Combustion Levels**

	Natural Gas	Propane
O <sub>2</sub> Min.	2.30%	2.70%
O <sub>2</sub> Max.	4.50%	4.30%
CO <sub>2</sub> Min	9.30%	11.10%
CO <sub>2</sub> Max	10.50%	12.00%
CO Max	100 ppm	100 ppm

Measure Input - Natural Gas Only

1. Ensure the appliance is firing at maximum firing rate. To manually place the appliance into high fire mode, reference page 40.
2. Operate the appliance for approximately 10 minutes.
3. Turn off all gas appliances within the building, except the MODULATING DELTA.
4. At the gas meter, record the time required to use one cubic foot of gas.
5. Calculate Natural gas input using the following equation:  

$$3600 \times 1000 / \text{number of second recorded for one cubic foot of gas} = \text{BTU/H.}$$
6. The BTU/H calculated should approximate the input rating listed on the appliance.

## FOR YOUR SAFETY READ BEFORE LIGHTING

### WARNING

**If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life.**

- A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. **DO NOT** try to light the burner by hand.
- B. **BEFORE OPERATING**, smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.  
**WHAT TO DO IF YOU SMELL GAS**
  - Do not try to light any appliance.
  - Do not touch any electric switch; do not use any phone in your building
  - Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.
- C. Use only your hand to turn the external manual gas valve. Never use tools. If the valve will not turn by hand, don't try to repair it; call a qualified service technician. Force or attempted repair may result in a fire or explosion.
- D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

## OPERATING INSTRUCTIONS

1. **STOP!** Read the safety information above. This appliance is equipped with an ignition device which automatically lights the burner. **DO NOT** try to light the burner by hand.
2. Set room thermostat(s) to lowest setting. Turn the external manual gas valve handle clockwise  "CLOSE" (valve handle shall be perpendicular to gas piping).
3. Turn the service switch on the control panel OFF.
4. Remove the front jacket panel on the appliance.
5. Turn the external manual gas valve handle counter clockwise  to "OPEN" gas supply (valve handle shall be parallel to gas piping).
6. Wait five (5) minutes to clear out any gas. If you then smell gas in the jacket enclosure or around the appliance, **STOP!** Follow "B" in the safety information above. If you don't smell gas, go to the next step.
7. Turn the service switch on the control panel "ON".
8. Set room thermostat(s) to desired setting(s).
9. The control panel display will show a sequence of numbers (0,1,2,3,4,etc.) as the left digit. Sequence digit 3 or 4 indicates the appliance is firing. Sequence digit 0 means there is no call for heat (all external thermostats are satisfied).
10. If the appliance will not operate with a call for heat and the system piping is not hot, follow the instructions "To Turn Off Gas to Appliance", below and call your service technician or gas supplier.
11. Replace the front jacket panel. Make sure the panel is seated firmly in place and all mounting screws are tightened.

## TO TURN OFF GAS TO APPLIANCE

1. Set the room thermostat to lowest setting.
2. Turn the service switch on the control panel to "OFF"
3. Turn the external manual gas valve handle clockwise  to "CLOSE".

### Set Domestic DHW Temperature

1. Press the MODE button until the display shows PARA. This is the parameter mode of the control.
2. Press the STEP button until the first digit on the display shows “1”. The last three digits on the display shows the domestic hot water storage temperature.
3. Press the “+” or “-” button to change the setting of the storage temperature setting.
4. Press the “STORE” button to save the setting.

#### NOTICE

**Factory setting of Parameter 1 is 140°F. The temperature range of Parameter 1 is 68°F to 140°F. Any setting lower than the factory setting of 140°F will affect domestic capacity and performance.**

#### NOTICE

**Digits and characters shown as [####], in the following outline, represent the control panel display. The last three digits on the display is the measured primary water temperature and is shown in the manual with [---].**

### Operation Verification - Domestic Hot Water.

1. Press and hold the “+” button for 2 seconds. The display should flash a “c” follow by “OFF” indicating the CH mode has been disabled. Parameter 3 should read as “00” for a verification.
2. Raise the DHW setting (Parameter 1) if needed to initiate a call for heat. The display should show:

[A---] Self check on Power up.

[B---] no call for heat request.

[1---] The prepurge cycle. The blower becomes energized and the 10 second prepurge cycle begins.

[2---] The burner will begin the ignition sequence. The control module will energize and open the gas valve and begin the spark for ignition.

- If the burner flame proves within 4.5 seconds, the burner will begin to modulate to full input rate after an approximate 10 second flame stabilization period.

- If the burner flame is not proven within 4.5 seconds, the control module will repeat the ignition sequence. If the flame is not proven after 5 attempts, the control will lockout and display [E-B2]

- To verify flame failure lockout, close the manual shut off valve on the gas supply piping to the appliance and repeat ignition sequence. When verification is complete, ensure the manual shut-off valve is returned to the open position.

[4---] This indicates normal operation for DHW. The burner will begin modulating its input based on the length of demand for DHW. The burner will not go into the low input rate for the 1 minute flame stabilization period that occurs in CH central heating mode.

3. Lower the DHW set point (Parameter 1) to satisfy the call for heat.

[1---] The post purge cycle begins. The control module closes the gas valve and the blower continues for a 30 second post purge.

[B---] Appliance is in standby MODE waiting for a CH or DHW call for heat.

4. Verify the DHW operation of the appliance by repeating the operation sequence several times.

## Start-Up Procedures



5. Return the DHW setpoint (Parameter 1) and room thermostat to the desired setting.
6. Press and hold the “+” button for 2 seconds to enable the space heating, the display will flash a “c” followed by the CH setpoint temperature. Parameter 3 should read as “01” for a verification.

### Set Primary CH Target Temperature

1. Press the MODE button until the display shows “PARA”. This is the parameter mode of the control.
2. Press the STEP button until the first digit on the display shows “4”. The last three digits on the display shows the outlet water temperature setting (high limit).
3. Press the “+” or “-” button to change the setting of the outlet temperature (high limit).

#### NOTICE

**If an outdoor sensor is used, then the setting of the primary CH Target temperature is the target temperature when the outdoor temperature is at or below 0°F. When the outdoor temperature is higher than 0°F the control will calculate the target temperature between the minimum and maximum temperature settings.**

4. Press the “STORE” button to save the setting.

### Operation Verification - Space Heating

#### NOTICE

**Digits and characters shown as [E---], in the following outline, represent the control panel display. The last three digits on the display is the measured primary water temperature and is shown in the manual with [---].**

1. Press and hold the “-” button for 2 seconds. The display should flash a “d” follow by “OFF” indicating the DHW mode has been disabled Parameter 2 should read as “00” for a verification.

2. Set the room thermostat to the lowest setting.
3. Turn off power to the appliance, wait a few seconds and turn on power to the appliance.

4. The following displays should occur:

[A---] Self check on power up

[B---] No call for heat

5. Initiate a call for heat by raising the set point of the room thermostat to the highest setting. The following display should occur.

[1---] This is the prepurge cycle. The blower and the CH circulator become energized. The blower has a 10 second prepurge cycle.

[2---] This is the ignition cycle. The control module will energize and open the gas valve and begin the spark for ignition.

- If the burner flame proves within 4.5 seconds, the burner will continue to fire at an ignition fan speed for approximately 10 seconds to stabilize the flame.

- If the burner flame is not proven within 4.5 seconds, the control module will repeat the ignition sequence. If the flame is not proven after 5 attempts the control will lockout and the display will show [E-B2]

- To verify flame failure lockout, close the manual shut off valve on the gas supply piping to the appliance and repeat ignition sequence. When verification is completed, ensure the manual shut off valve is returned to the open position.

[3---] This is the normal operation cycle. After the flame is proven and stabilized the burner will fire at low input for approximately 1 minute. After this time period, the control module will begin to modulate the burner firing rate based on actual primary outlet temperature and the set point temperature.

- Allow the appliance to operate and allow the primary outlet temperature to reach the set point temperature.

[5---] This begins the burner shutdown and post purge cycle. The CH circulator will continue to run until the room thermostat is satisfied.

- Lower the room thermostat set point below the room temperature to end the call for heat.

[1---] This begins a post purge cycle. When the room thermostat is satisfied, the appliance will shutdown. The control module will close the gas valve and the blower will continue for 30 seconds for a post purge cycle before shutting down. If another call for heat is initiated during the post purge cycle, the burner will remain off for an additional 30 seconds before starting a new ignition sequence and the circulator will be energized.

[7---] The CH circulator will continue for a 1 minute post pump cycle. The MODULATING DELTA is in STANDBY mode waiting for a call for heat.

- Verify the operation of the appliance by repeating the operational sequence several times.
- Return the room thermostat to a desired setting. Press and hold the “-” button for 2 seconds to enable the DHW mode. The display should flash a “d” followed by DHW, set temperature. Parameter 2 should read as “01” for a verification.

### Control Display

Standby Mode **5tby**

After the appliance is turned on, the control panel will display STANDBY mode as shown in the figure above.

This is the standard mode for the MODULATING DELTA. The control automatically returns to this mode after 20 minutes if no keys have been pressed on the display. Any parameters that were modified are then enabled.

The first character shows (on left side of display) the current status of the appliance depending on the condition of both the appliance and the burner. The last 3 characters indicate the current temperature.

If the burner is blocked due to a “soft” lockout, the display alternates between a 9 followed by the primary outlet temperature and a “b” with a two digit error code.

**TO TEMPORARILY PLACE THE BURNER INTO HIGH FIRE TEST MODE:** press the MODE button until “5tby” is displayed. Then press and hold both the MODE and “+” button simultaneously until the first digit flashes “H”.

While in the test mode:

- high limit will function
- CH circulator will function
- the test mode will time out in approximately 10 minutes

**TO TEMPORARILY PLACE THE BURNER INTO LOW FIRE TEST MODE:** press the MODE button until “5tby” is displayed. Then press and hold both the mode and “-” button simultaneously until the first digit flashes “L”.

Display	Boiler function
H---	Test function: Burner on, high fire mode
L---	Test function: Burner on, low fire mode

Press and hold the “+” and “-” button simultaneously to deactivate the high or low fire test mode, while in the “5tby” mode.

## Standby Mode Display

Display	Function
0---	STANDBY, no demand for heat
1---	Fan prepurge (10 seconds) or post purge cycle
2---	Ignition sequence
3---	Burner ON for space heating (CH)
4---	Burner ON for domestic water heating (DHW)
5---	Pre-check for air flow prior to prepurge cycle
6---	Burner OFF due to reaching temperature set point
7---	Post pump cycle for primary space heating (1 minute)
9---	Burner blocked:
b 18	Supply temperature too high (202°F) .Burner will remain OFF until outlet temperature drops below set point.
b 19	Return temperature too high (202°F). Burner will remain OFF until temperature drops below set point.
b 24	Return temperature is measured higher than supply temperature. Burner will remain OFF until corrected.
b 25	Supply temperature increased too quickly. Burner will remain OFF for a 10 minute period. Burner will recycle, increasing waiting period 1 minute for a max. 15 minutes
b 26	LWCO pressure device or external limit (terminals 13 & 14) is OPEN. Burner off for 150 seconds, auto reset.
b 28	No blower signal
b 29	Blower signal present, Burner will remain OFF until condition terminates
b 30	Temperature rise between the supply and return is more than 54°F. Burner will remain OFF for 150 seconds. Burner will recycle increasing waiting period 1 minute for a max. 20 cycle.
b 33	The IDWH Sensor is short-circuited.
b 38	The IDHW Sensor is not properly connected to the low voltage terminal strip.

## NOTICE

If the “+” button is held in for 2 seconds while in the “*STBY*” mode the CH system (Parameter 3) will be turned OFF and the display will show “*cOFF*”. Press and hold the “+” button to turn the CH system back ON, the display will show “*c*” followed by CH set point temperature (Parameter 4) or CH target temperature. If the “-” button is held in for 2 seconds while in the “*STBY*” mode DHW system (Parameter 2) will be turned OFF and the display will show “*dOFF*”. Press and hold “-” button to turn the DHW system back ON, the display will show “*d*” followed by domestic set point temperature (Parameter 1).

### Setting The Control Parameters

#### Parameter Mode

To access PARAMETER mode when the system is in STANDBY mode, press the MODE button once.

To scroll through the list of parameters, simply press the STEP button. To modify a parameter value, use the “+” or “-” keys. Then press STORE to save the value you just changed. The display flashes once to confirm the data has been saved.

To activate the parameters you changed, press MODE once more (which brings you into INFORMATION mode). However, if you do not press a key, the system returns to STANDBY mode after 20 minutes and automatically enables the changes.

Key: Display  
  Pressing MODE once

Key:	Display	Description of parameters
 STEP		Domestic Hot Water Storage Temperature Setting ( <b>See Note 1</b> )
 STEP		Domestic Hot Water Setup ( <b>See Note 2</b> )
 STEP		Space Heating Setup ( <b>See Note 3</b> )
 STEP		Maximum temperature in space heating (CH) mode. In applications using an outdoor sensor, this is the boiler outlet target temperature at an outdoor temperature of 0°F or less

**Note 1:** This parameter is factory set to 140°F. It is important to note the control adds 46°F to this setting, to establish the operating limit during a DWH call for heat

**Note 2:** This parameter should not be changed from the factory setting. The performance of the DHW will be affected and can become unreliable.

**Note 3:** This parameter should not be changed from the factory setting. The performance of the CH (Central/Space Heating) will be affected and can become unreliable.

Accessing Control Information

Information Mode **INFO**

To switch from STANDBY mode to INFORMATION mode, press MODE twice. Press STEP until the system displays the information you need. The point located behind the first position flashes to indicate that the appliance is in INFO mode.

Key:	Display	
	<b>PPPP</b>	Pressing MODE once
	<b>INFO</b>	Pressing MODE twice

Key:	Display	Description of parameters
	<b>1---</b>	Measured CH outlet (supply) water temperature
	<b>2---</b>	Measured CH inlet (return) water temperature
	<b>3---</b>	Measured DHW storage temperature
	<b>4---</b>	Measured outdoor temperature (Optional outdoor sensor required)
	<b>5-22</b>	This parameter is not used
	<b>6---</b>	Calculated (target) outlet water temperature
	<b>7---</b>	Rate of increase in the outlet water temperature °F/sec
	<b>8---</b>	Rate of increase in the return water temperature °F/sec
	<b>9---</b>	Rate of increase in the DHW temperature °F/sec

**Note :** The last three digits on the display is the measured or calculated temperature or rate of increase and is shown in the manual with **[---]**.

If STEP is pressed after parameter 9, the display will show **A-32**.

### Error (Hard Lockout) Mode

If a system fault occurs while the appliance is running, the system goes into lockout and the display starts to flash with the first digit as an **E** and the next two digits give the code for this fault.

For a detailed description of the error codes, reference the MODULATING DELTA Troubleshooting Guide.

#### CAUTION

**The freeze protection feature is disabled during a Hard Lockout.**

#### WARNING

**During a hard lockout or low water condition the appliance will not re-start without service. If the heating system is left unattended in cold weather appropriate safeguards or alarms should be installed to prevent property damage. An optional control/interface is available from Triangle Tube which will provide a set of alarm contact which will close during a hard lockout.**

Display	Hard Lockout
E 00	Flame detected prior to burner startup
E 02	Failed ignition after 5 attempts
E 03	Gas valve harness not properly connected
E 04	Power supply lost after lockout occurred
E 05	Internal control failure
E 06	Internal control failure
E 07	Internal control failure
E 08	Internal control failure
E 09	Internal control failure
E 11	Internal control failure
E 12	External limit (terminals 11 & 12) control is OPEN
E 13	Internal control failure
E 14	Internal control failure
E 15	Internal control failure
E 16	Internal control failure
E 17	Internal control failure
E 18	Supply Temperature exceeds 204°F
E 19	Return temperature exceeds 204°F
E 25	Supply temperature increased too rapidly
E 28	No blower signal present
E 29	Blower signal does not reset to zero
E 31	Supply temperature sensor is short circuited
E 32	Return temperature sensor is short circuited
E 36	Supply temperature sensor is OPEN
E 37	Return temperature sensor is OPEN
E 44	Internal control failure
E 60	Internal Control error - failure to read parameters
E 61	Internal control failure
E 65	Inadequate power supply to the fan

### Setting the Thermostatic Mixing Valve

#### NOTICE

The thermostatic mixing valve controls the outlet hot water temperature delivered to the faucets.

#### WARNING

**POTENTIAL SCALD HAZARD** The mixing valve must be installed on the **MODULATING DELTA**. Removal of the mixing valve will create a potential scald hazard resulting in severe personal injury or death.

- Use a L-Key to remove the set screw securing the knob to the valve.
- Remove the knob and lock ring from the valve.
- Replace the knob and adjust the set temperature of the valve to the desired temperature.

#### NOTICE

To calibrate the outlet temperature, allow the water to run for approximately 2 minutes and measure the water with a thermometer. To adjust the valve setting, rotate the knob clockwise to decrease the water temperature or counter-clockwise to increase the water temperature.

- Once the desired temperature is achieved, remove the knob and refit the lock ring onto the valve aligning the ring indicator mark with the valve's "Mix" marking.
- Locate the tab on the inner face of the knob into the retainer in the locking ring. Secure the knob with setscrew.
- Record the valve performance on the Installation Record included in this manual.

#### DANGER

For proper operation of the thermostatic mixing valve, the manual valve on the U-tube assembly **MUST** remain open to avoid a potential scald hazard.

### SECTION X- Check-Out Procedures

#### NOTICE

**Perform the following check-out procedures as outlined and check off items as completed. When procedures are completed, the installer should complete the installation record on page 47.**

#### Check-out Procedures

- Inner tank is filled with water.
- Outer Tank is filled with water.
- Water chemistry checked and verified as outlined on pag 32.
- The automatic air vent on the appliance and any place within the system are open one full turn.
- Air is purged from the heating zones and primary system.
- Domestic piping is purged of air and has been checked for leaks.
- Burner has been confirmed as properly configured for Propane application. (If applicable).
- Thermostat circuit wiring checked and verify that no voltage is present at Terminals 7 and 8 as outlined on page 34.
- Operating Instructions on page 37 were followed during start-up.
- Combustion levels and flame pattern verified as outlined on page 36.
- Measure the rate of input on Natural Gas as outlined on page 36.
- Check the incoming gas pressure to ensure a minimum pressure of 5”w.c during flow conditions to all appliances and a maximum pressure of 13”w.c during flow and non-flow conditions for Natural and Propane.
- The thermostatic mixing valve is adjusted to the desired domestic hot water outlet temperature.
- Adjusted balancing valves and system limit controls to provide design temperatures to the primary space heating system.
- In multiple zone applications verify, flow of primary heating water to each zone is adjusted correctly .
- Check and verify room thermostats functions properly and the thermostats heat anticipator (if used) was properly set.
- Observed several operating cycles for proper operation of the MODULATING DELTA and the system.
- Set the room thermostat(s) to the desired room temperature.
- Reviewed all instructions shipped with the MODULATING DELTA with the homeowner or maintenance personnel.
- Completed the Installation Record on page 47.
- Ensure all manuals and other documentation are returned to the Installation envelope and given to the owner for safekeeping.

**SECTION XI - Installation Record**

MODULATING DELTA Model Number: \_\_\_\_\_

Serial Number: \_\_\_\_\_

Date of Installation: \_\_\_\_\_

Fuel:     Natural Gas     Propane

Measured Rate of Input: \_\_\_\_\_ Btu/hr

Combustion Readings:

CO<sub>2</sub>    \_\_\_\_\_ %

O<sub>2</sub>    \_\_\_\_\_ %

CO    \_\_\_\_\_ ppm

The following items were completed during installation:

- Installation instructions have been followed and completed
- Check-out procedures have been followed and completed
- Information regarding the unit and installation received and left with owner / maintenance personal.

Installer Information

(Company) \_\_\_\_\_

(Address) \_\_\_\_\_

(Address) \_\_\_\_\_

(Phone Number) \_\_\_\_\_

### SECTION XII - Maintenance Schedule

#### Service Technician

At least on an annual basis the following maintenance should be performed by a qualified service technician:

#### General

- Attend to any reported problems.
- Inspect the interior of the combustion chamber; clean and vacuum if necessary.
- Clean the condensate trap in the vent system and fill with fresh water.
- Check for leaks; water, gas, flue and condensate.
- Verify flue vent piping and air inlet piping are in good condition and sealed tight.
- Check primary system water pressure/primary system piping/primary expansion tank.
- Check domestic water pressure/domestic system piping/domestic thermal expansion tank.
- Check ignition electrode (sand off any white oxide; clean and reposition).
- Check all control wiring and connections.
- Check burner flame pattern (stable and uniform) and flame.

Additional items if combustion or performance is poor:

- Clean baffles and flue ways.
- Remove burner assembly and clean burner head using compressed air only.

Once the maintenance items are completed, review the service with the owner.

#### Owner Maintenance

Periodically:

- Check the area around the appliance.
- Check the combustion air inlet and ventilation openings for blockage.
- Check the pressure gauge.
- Check the operation of the domestic mixing valve.

Monthly:

- Check vent piping.
- Check combustion air inlet piping.
- Check the pressure relief valve.
- Check the temperature/pressure relief valve.
- Check the vent condensate drain system.
- Check the automatic air vents in the primary system.

Every 6 months:

- Check both primary piping and gas supply piping for corrosion or potential signs of leakage.
- Operate the pressure relief valve.
- Operate the temperature/pressure relief valve.

#### **WARNING**

**Follow the maintenance procedures given throughout this manual. Failure to perform the service and maintenance or follow the directions in this manual could result in damage to the MODULATING DELTA or in system components, resulting in severe personal injury, death or substantial property damage.**

### SECTION XIII - Maintenance Procedures

#### MAINTENANCE PROCEDURES

##### WARNING

The MODULATING DELTA should be inspected and serviced annually, preferably at the start of the heating season, by a qualified service technician. In addition, the maintenance and care of the appliance as outlined on page 48 and further explained on pages 49 through 53 should be performed to assure maximum efficiency and reliability of the appliance. Failure to service and maintain the MODULATING DELTA and the system components could result in equipment failure, causing possible severe personal injury, death or substantial property damage.

##### NOTICE

The following information provides detailed instruction for completing the maintenance items outline in the maintenance schedule on page 48. In addition to this maintenance, the MODULATING DELTA should be serviced at the beginning of the heating season by a qualified service technician.

#### Reported Problems

Any problems reported by the owner should be checked, verified and corrected before proceeding with any maintenance procedures.

#### Check Surrounding Area

Verify that the area surrounding the MODULATING DELTA is free of combustible / flammable materials or flammable vapors or liquids. Remove immediately if found.

Refer to the list of potential materials listed in the MODULATING DELTA Vent Supplement. If any of these products are in the room from which the appliance takes its combustion air, they must be removed immediately or the combustion air intake must be relocated to another area.

#### Inspect Burner Area

Remove the burner hood and inspect the appearance of the burner components.

Vacuum any dirt or debris from the burner components.

Remove the venturi inlet elbow to check for dirt and debris. Remove any obstructions.

##### WARNING

**Do not use solvents to clean any of the burner components. The components could be damaged, resulting in unreliable or unsafe operation.**

#### Check System (Primary and Domestic) Piping

Inspect all piping on the Primary Heating system and the Domestic system for leaks and verify that the piping is leak free.

Inspect the fittings and components on the appliance and verify they are leak free.

##### WARNING

**Eliminate all primary water system leaks. Continual fresh make-up water will reduce the outer tank life causing tank failure. Leaking water may also cause severe property damage to the surrounding area.**

### Check Combustion/ Ventilation Air Openings

Verify that all combustion air and ventilation openings to the mechanical room or building are open and unobstructed. Check the operation and wiring of any automatic ventilation dampers.

Check and verify the vent discharge and the combustion air intake are free of debris and obstructions.

### Inspect Vent System and Combustion Air Piping

Visually inspect the venting system and combustion air piping (if installed) for blockage, deterioration or leakage. Repair any vent joints that show signs of deterioration as per the vent manufacturer's instructions.

When combustion air is ducted to the appliance, verify that the air inlet piping is connected and sealed.

#### WARNING

**Failure to inspect the vent system and combustion air inlet piping and have any deficiencies repaired, can result in severe personal injury or death.**

### Check Primary System

Verify all system components are correctly installed and operating correctly.

Check the cold fill pressure for the system. Typical cold water fill pressure is 12 psig.

Verify the system pressure as the appliance operates at high temperature to ensure the pressure does not exceed 25 psig. Excessive pressure reading indicates expansion tank sizing is incorrect or system performance problems.

Inspect air vent and air separators in the system. Remove the caps on automatic air vents and briefly depress the valve stem to flush vent. Replace the cap when completed. Ensure vents do not leak, replace any leaking vents.

### Check Domestic System

Verify all system components are correctly installed and operating correctly.

Check the outlet domestic temperature of the mixing valve and compare with the recorded temperature made during start-up.

### Check Expansion Tank

Refer to Primary Piping, Page 15 for recommended location of the expansion tank and air eliminators.

Close -Type Tank:

- Ensure tank is partially filled with water leaving an air gap as a cushion. Refer to the manufacturer's instruction for proper fill level.
- Ensure the tank is fitted with a device that reduces gravity circulation of air-saturated tank water back into the system. This device prevents air from bubbling up through the water as it returns from the system.
- Ensure no automatic air vents are used in the system. This will allow air to escape from the system instead of returning to the tank.

Diaphragm Tank:

- Ensure the system contains a minimum of one automatic air vent. Preferred location of the air vent should be atop an air eliminator.
- Remove the tank from the system and check the charge pressure. For residential applications the charge pressure is typically 12 psig. If tank does not hold a charge pressure, then the membrane is damaged and the tank should be replaced.

### Check Primary Relief Valve

Inspect the relief valve and lift the lever to verify flow at least annually or as recommended on the warning tag of the valve.

#### WARNING

**Before manually operating the pressure relief valve, ensure the discharge piping is directed to a suitable place of disposal to avoid a potential scald hazard. The discharge piping must be full size without restriction and installed to permit complete drainage of both the valve and line.**

If after closing the valve, the valve fails to seat properly or continually weeps, replace the relief valve. Ensure the cause of the relief valve to weep is the valve itself, not due to system over-pressurization caused by an expansion tank that is waterlogged or undersized.

### Check Temperature / Pressure Relief Valve

Inspect the T&P relief valve and lift the lever to verify flow at least annually or as recommended on the warning tag of the valve.

#### WARNING

**Before manually operating the pressure relief valve ensure the discharge piping is directed to a suitable place of disposal to avoid a potential scald hazard. The discharge piping must be full size without restriction and installed to permit complete drainage of both the valve and line.**

If after closing the valve, the valve fails to seat properly or continually weeps, replace the relief valve. Ensure the cause of the weeping is the valve itself and not due to thermal expansion or a faulty or under-pressurized thermal expansion tank.

### Inspection of Ignition Electrode

Remove the ignition electrode from the burner mounting plate.

Remove any white oxides accumulated on the electrode using fine grit sandpaper or steel wool. If the electrode does not clean to a satisfactory condition, replace the ignitor.

When replacing the ignition electrode, ensure the gasket is in good condition and correctly positioned. Replace gasket if necessary.

### Check All Gaskets

Ensure all gaskets are in good condition, correctly positioned and sealed. Replace gasket(s) if necessary, contact Triangle Tube for replacement part(s).

### Check Control Wiring

Inspect all control wiring located behind the control panel and at the burner. Ensure wiring is in good condition and properly connected.

### Check Parameter Limit Settings

Check Parameter 1 and 4 for proper settings. Check Parameter 2 and 3 for a "01" setting.

### Perform Start-up and Checkout Procedures

Start the appliance and perform the start-up procedure as listed in this manual.

Verify the cold water fill pressure is correct and the operating pressure of the primary system is within normal operating range.

Complete the checkout procedures as referenced in this manual.

### Check Burner Flame

Remove burner cover and inspect the flame through the observation port on the burner mounting plate.

If flame pattern does not cover the entire burner surface, shut the appliance down and allow it to cool thoroughly.

Close the manual gas valve on the gas supply line and disconnect the gas piping to remove the burner assembly from the appliance. Remove control cover and disconnect electrical quick connects going to burner assembly.

Remove two nuts securing the burner mounting plate. See warning on page 53. Remove the burner assembly and screws to the burner head. Remove burner head and inspect for deterioration. Use compressed air or a vacuum to clean the burner head.

Remove the venturi and gas valve assembly from the blower.

Use the vacuum cleaner or compressed air to clean the interior of the blower assembly. Inspect the blower blades to ensure they are clean and not damaged.

Re-assemble the venturi and gas valve onto the blower. Ensure the venturi gasket is in good condition and positioned correctly.

Re-assemble the burner head onto the burner-mounting plate. Ensure the burner head gasket is in good condition and positioned correctly.

Secure burner mounting plate to the appliance with two nuts. Re-assemble the electrical quick connects to burner assembly, control cover and gas supply. Open the manual gas valve and place the appliance back into service.

Verify flame pattern & re-install burner cover.

### Check Flame Signal

The flame signal should be at least  $2\mu$  A. Refer to the MODULATING DELTA Trouble-shooting Guide for information on checking the flame signal.

Check the ignitor for fouling or damaged insulation if a low flame signal is read.

### Check Combustion Levels

Refer to page 36 of this manual for measuring combustion levels and burner adjustments.

### Review With Owner

Ensure the owner understands the importance to perform the maintenance schedule specified in this manual.

Remind the owner of the importance to call a licensed contractor should the appliance or system exhibit any unusual behavior.

## Handling of Previously Fired Combustion Chamber Insulation

### WARNING

The combustion chamber insulation contains ceramic fibers, which are classified as a possible human carcinogen. When exposed to extremely high temperatures, the ceramic fibers, which contain crystalline silica, can be converted into cristobalite.

### Avoid Breathing and Contact with Skin and Eyes

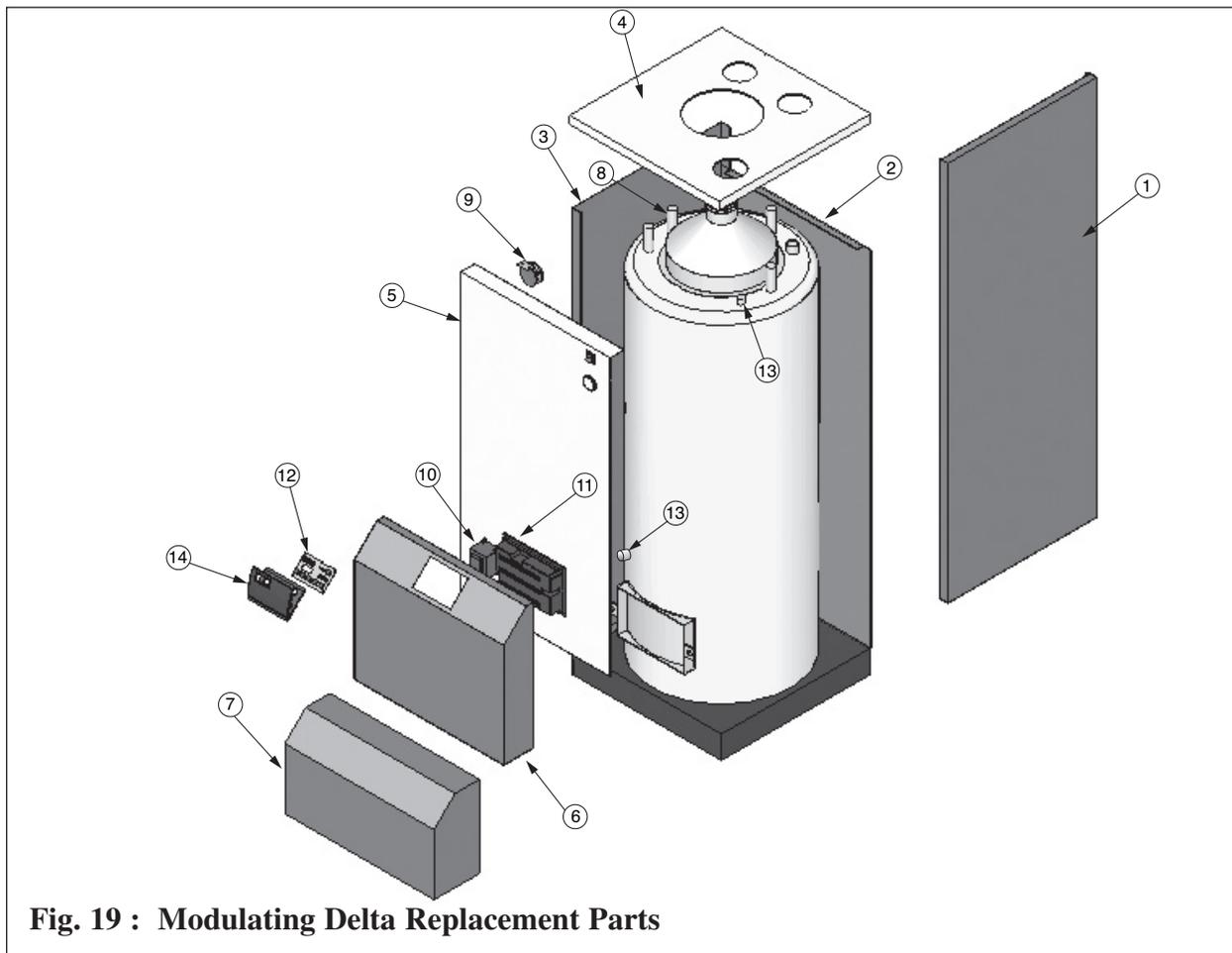
When removing or repairing the combustion chamber insulation follow these precaution measures:

1. Use a NIOSH approved respirator which meets OSHA requirements for cristobalite dust, similar to N95. Contact NIOSH at 1-800-356-4676 or on the web at [www.cdc.gov/niosh](http://www.cdc.gov/niosh) for latest recommendations.

2. Wear long sleeved, loose fitting clothing, gloves and eyes protection.
3. Assure adequate ventilation.
4. Wash with soap and water after contact.
5. Wash potentially contaminated clothes separately from other laundry and rinse washing machine thoroughly.
6. Discard used insulation in an air tight plastic bag.

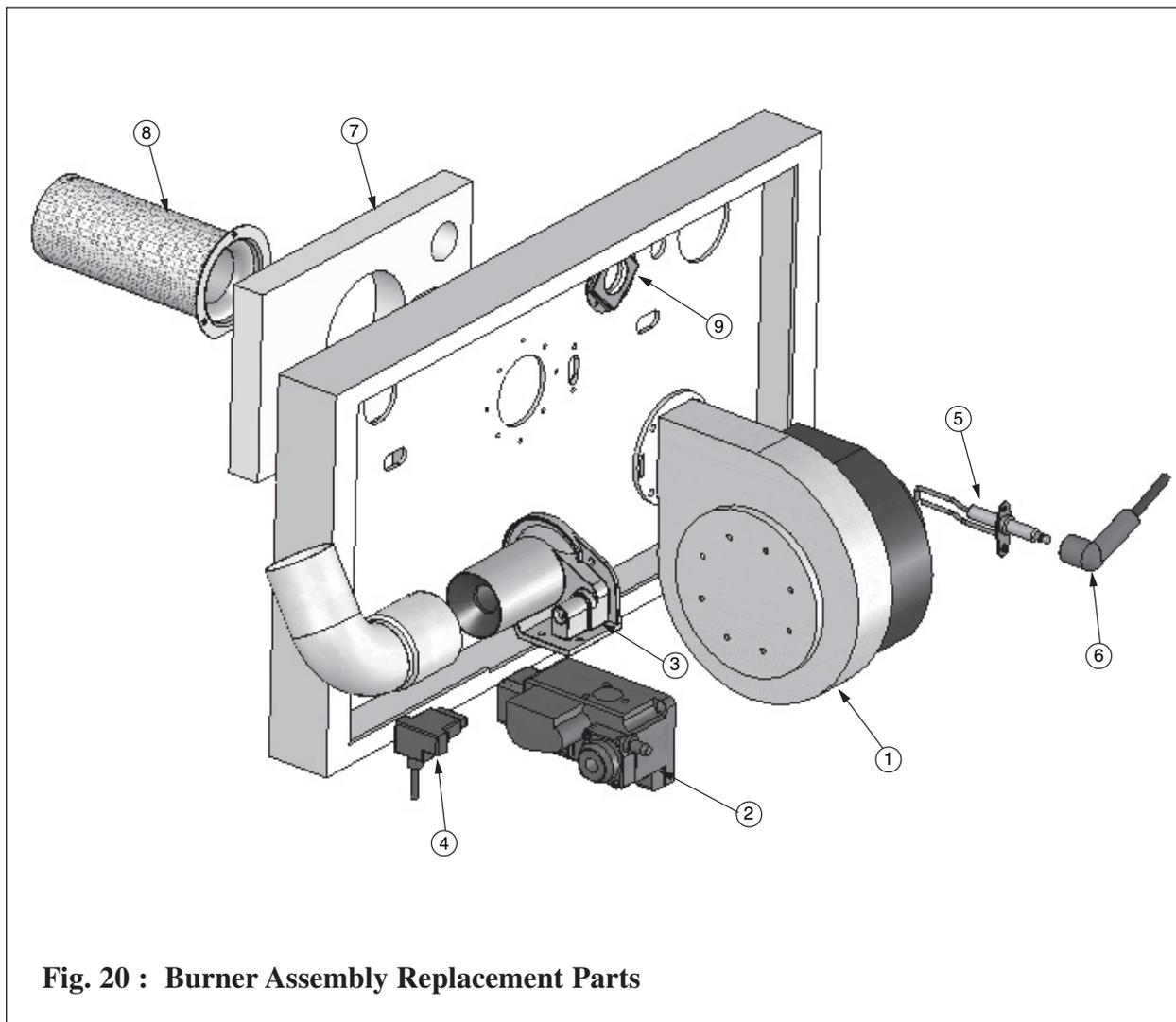
### NIOSH Stated First Aid:

Eye/Skin: Immediately irrigate  
Breathing: Clean fresh air



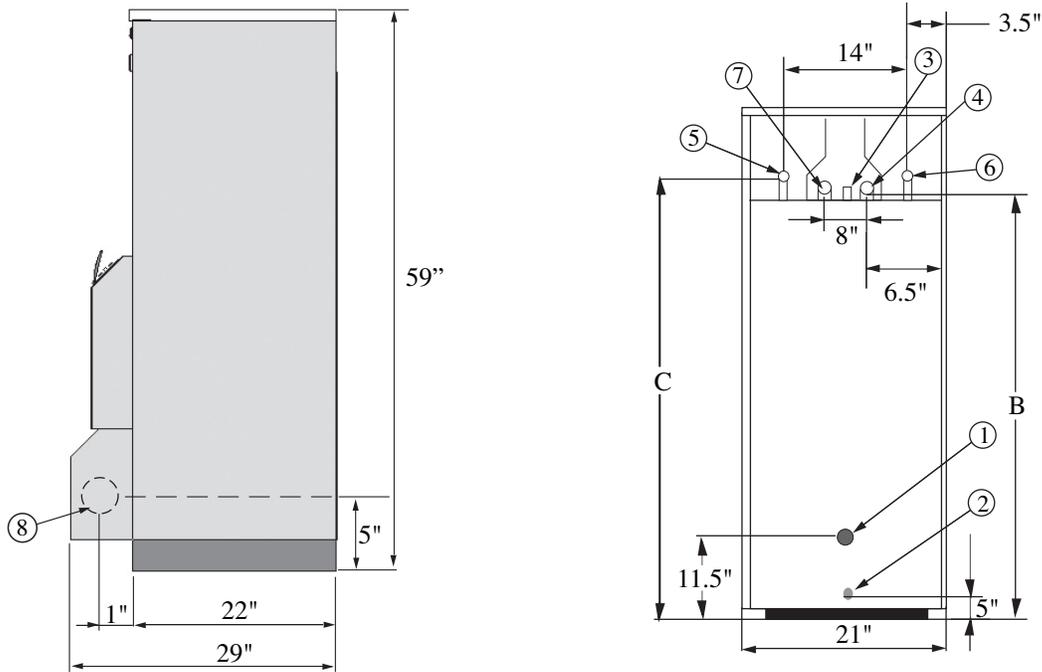
**Fig. 19 : Modulating Delta Replacement Parts**

Item	Part No.	Description
1	HMJKTMR01	Jacket Right Side Panel
2	HMJKTMB01	Jacket Back Panel
3	HMJKTML01	Jacket Left Side Panel
4	HMJKTMT01	Jacket Top Panel
5	HMJKTMF01	Jacket Front Panel
6	HMJKTMFL01	Control Cover Panel
7	HMCOV05	Burner Hood Panel
8	MDRKIT01	Domestic NTC Sensor
9	MDRKIT02	Air Switch
10	PSRKIT19	Transformer
11	MDRKIT03	Control Module
12	MDRKIT04	Controle Module Display
13	MDRKIT05	Primary NTC Sensor
14	MDRKIT06	Control Module Display Cover
15	MDRKIT07	Low Water Cut Off (not shown)
16	MDRKIT11	Flue Hood Gasket



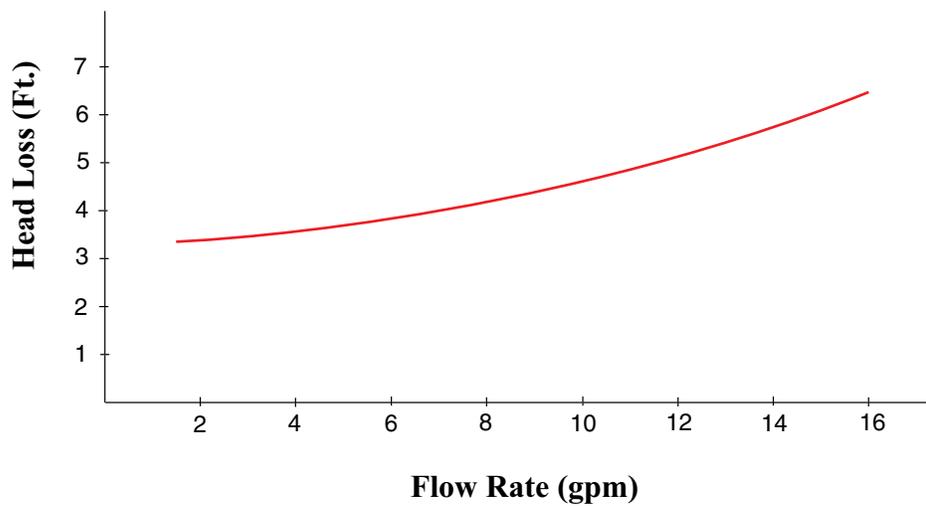
**Fig. 20 : Burner Assembly Replacement Parts**

Item	Part No.	Description
1	PSRKIT13	Blower with Gasket
2	PSRKIT01	Gas Valve
3	-----	Venturi
4	PGRKIT15	Gas Valve Rectifier Plug
5	MDRKIT08	Igniter with Gasket
6	PSRKIT14	Ignition Cable
7	MDRKIT09	Burner Plate Insulation & Gasket
8	PSRKIT37	Burner Head
9	MDRKIT10	Sight Glass Assembly



**Fig. 21: Side View**

- |  |   |
|--|---|
| 1. Primary supply, $\phi$ 1" NPT   | 5. Domestic cold water inlet, $\phi$ 3/4" NPT |
| 2. Primary drain valve connection, $\phi$ 1/2" NPT                       | 6. Domestic hot water outlet, $\phi$ 3/4" NPT |
| 3. Domestic temperature/pressure relief valve (150 psi), $\phi$ 3/4" NPT | 7. Primary return & air vent, $\phi$ 1" NPT   |
| 4. Primary pressure relief valve (30 psi), $\phi$ 3/4" NPT               | 8. Gas connection, 3/4" NPT                   |



**Note:** Minimum allowable flow rate at full input:  
 PG-150- & PG PLUS-150 7 gpm  
 PG-199- & PG PLUS-199 10 gpm

**Table 4 : Product Data**

Model	Fuel	Input BTU/hr	AFUE %	DOE Heating Capacity BTU/Hr.	Net IBR Rating BTU/Hr.	Shipping Weight
		Note 1	Note 2	Note 3	Note 4	Lbs.
PG-150	Natural & Propane	150,000	84	126,000	107,500	345
PG-199	Natural & Propane	199,000	84	167,500	142,500	345
PG PLUS-150 (Note 5)	Natural & Propane	150,000	85	127,500	108,500	345
PG PLUS-199 (Note 5)	Natural & Propane	199,000	86	171,500	145,500	345

**Note 1:** Input ratings are shown for sea level applications. The appliance automatically derates the input at approximately 2% for every 1,000 feet of altitude. No alterations to the appliance is required.

**Note 2:** Based on the given AFUE the MODULATING DELTA PG PLUS Models meet the energy efficiency guidelines established by Energy Star.

**Note 3:** The heating capacity is based on the test requirements of the U.S. Department of Energy.

**Note 4:** The IBR rating is based on a piping and pick up allowance of 1.15. This allowance should be sufficient for the standard radiation requirements for a building load.

**Note 5:** The PG PLUS Models must not vent as a Category I (Chimney Vent) appliance.

Model	Domestic Capacity		10 Min. Peak Flow		Continuous Flow @ 70°F	
	Gals.	Gals.	Gals.	Gals.	Rating gph	Rise gph
PG-150 & PG PLUS-150	20	22	70	230	190	190
PG-199 & PG PLUS-199	17	20	80	290	250	250

## Additional Quality Heating Products Available from Triangle Tube

### Phase III Indirect Fired Water Heaters



- Exclusive Tank-in-Tank design
- Stainless steel construction
- Available in 8 sizes and 2 models
- Limited LIFETIME residential warranty
- 15 year limited commercial warranty
- Self cleaning/self descaling design
- 2" polyurethane insulation

### Prestige Condensing Wall Mounted Boiler



- 96% Efficiency (Low temperature application)
- Fully modulating
- Natural gas or propane
- Stainless Steel Construction
- Direct vent with standard schedule 40 PVC
- Outdoor Reset
- Low Nox

### Maxi-flo Pool and Spa Heat Exchangers



- Construction of high quality corrosion resistant stainless steel (AISI 316)
- Also available in Titanium
- Specially designed built-in flow restrictor to assure maximum heat exchange
- Compact and light weight
- Available in 5 sizes that can accommodate any size pool or spa



Freeway Center - 1 Triangle Lane - Blackwood, NJ 08012  
Tel: (856) 228 8881 - Fax: (856) 228 3584  
<http://www.triangle tube.com>  
E-mail: [Info@triangle tube.com](mailto:Info@triangle tube.com)

