



# THE Challenger Combination Boiler and/or Water Heater



## \* 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 CHALLENGER, 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.

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## Product & Safety Information

### Definitions

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

#### WARNING

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

#### CAUTION

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

#### **NOTICE**

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

#### **BEST PRACTICE**

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

#### **NOTICE**

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

## Product & Safety Information

### 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.**

### WARNING

#### 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.**

### WARNING

**DO NOT add cold make up water when the appliance is hot. Thermal shock can cause potential cracks in the heat exchanger.**

### CAUTION

#### When servicing the appliance:

- Avoid electrical shock by disconnecting the electrical supply prior to performing maintenance.

### WARNING

#### Qualified Installer:

Prior to installing this product read all instructions included in this manual and all accompanying manuals/documents with this appliance. Perform all installation steps required in these manuals in the proper order given. Failure to adhere to the guidelines within these manuals 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 model number and the serial number from the rating label, on the right panel when inquiring about service or troubleshooting.**

### WARNING

**ACV-Triangle Tube accepts no liability for any damage, injury or loss of life resulting from incorrect installation, from alteration of any factory supplied parts or from the use of parts or fittings not specified by ACV-Triangle Tube. If there is a conflict or doubt about the proper installation of the appliance or any factory supplied or replacement parts please contact ACV-Triangle Tube Technical Support.**

### WARNING

**A byproduct of any gas fired appliance (stove, fire place, clothes dryer, water heater, furnace, boiler, etc.) is carbon monoxide. In the absence of any state or local codes requiring the installation of carbon monoxide detector and alarms, ACV-Triangle Tube's recommendation is to follow the requirements of the Commonwealth of Massachusetts, see page 10.**

## Product & Safety Information

### **! DANGER**

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

### **! DANGER**

#### **HOT WATER CAN SCALD!**

**Water temperature over 125°F [52°C] 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.**
- To avoid any potential scald hazard or if codes require specific water temperatures at the hot water faucet, the installer must:
  - Install the factory supplied thermostatic mixing valve at this appliance and ensure it is working properly

and

- Set the thermostatic mixing valve to the lowest temperature which satisfies your hot water needs.
- Feel and adjust water temperature before bathing or showering.
- Water drained from the system drain valves may be extremely hot.

#### **TO AVOID INJURY:**

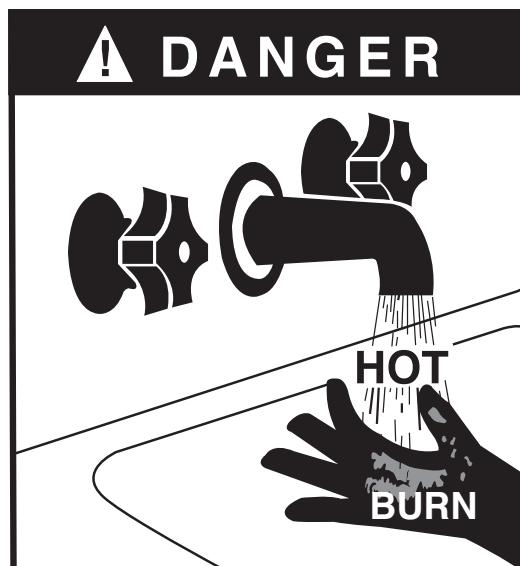
- Make sure all connections are tight.
- Direct water flow away from any person.

### **! DANGER**

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

#### **TO PROTECT AGAINST EXCESSIVE TEMPERATURE AND PRESSURE**

- Check if a 150 psi [10 bar] pressure relief valve (field supplied) is installed as recommended for standard installations or a temperature/pressure relief valve for storage tank or ACV-Triangle Tube SMART Indirect Fired Water Heater (I.F.W.H.) installations. (DHW side)
- Check if the 30 psi [2 bar] pressure relief valve supplied is installed in the recommended location. (CH side)
- To avoid injury, install the relief devices to comply with local code requirements.



## Pre-Installation Items

### SECTION I - Pre-Installation Items

#### Code Compliance

The CHALLENGER is certified to both the Boiler (ANSI Z21.13/CSA 4.9) and Water Heater (ANSI Z21.10.3/CSA4.3) standards.

Due to the CHALLENGER's unique heat exchanger design which incorporates two independent copper water tube coils; one for space heating and the other for domestic hot water, the CHALLENGER can be installed as a Boiler or Water Heater or both. The unused system does not have to be connected or filled. Parameter 1 (Installation Type) will need to be set accordingly (0= Heat and DHW, 2 = DHW Only and 3 = Heat Only), see page 52 for Setting Parameters.

This appliance must be installed in accordance to the following:

- All applicable local, state, national and provincial codes, ordinances, regulations and laws.
- For installations in Massachusetts, code requires the appliance to be installed by a licensed plumber or gas fitter, and if antifreeze is utilized, the installation of a reduced pressure backflow preventer device is required in the boiler's cold water fill or make up water supply line.
- For installation in Massachusetts all direct vented appliances must comply with the guidelines as outlined on page 10.
- Massachusetts Plumbing Board Product Approval Code # is CI-0111-219 for the CHALLENGER.
- The National Fuel Gas Code NFPA54/ ANSI Z223.1 - Latest edition.
- National Electric Code ANSI/NFPA 70.
- For installations in Canada -“Installation Code for Gas Burning Equipment” CAN/CSA B149.1 Canadian Electrical Code Part 1 CSA C22.1.

- Standards for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1, when required.

#### NOTICE

**The CHALLENGER gas manifold and gas controls meet the safe lighting and other performance requirements as specified in ANSI Z21.13 standard.**

#### Determining Product Location

Before locating the CHALLENGER check for convenient locations to:

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

Ensure the appliance location allows the combustion air and vent piping to be routed directly through the building and terminate properly in the same pressure zone outside with a minimum amount of length and bends.

Ensure the area chosen for the installation of the CHALLENGER 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 CHALLENGER and its controls are protected from dripping or spraying water during normal operation or service.

The CHALLENGER should be installed in a location so that any water leaking from the appliance, piping connections or relief valve will not cause damage to the surrounding area or any lower floors in the structure. When such location cannot be avoided, it is recommended that a suitable drain pan, adequately drained, be installed under the appliance. The pan must not restrict combustion air flow.

## Pre-Installation Items

### Boiler or Water Heater Replacement

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

- Boiler and domestic piping leaks and corrosion.
- Proper location and sizing of the expansion tank on the boiler heating loop. Proper location and sizing of the thermal expansion tank (if used) on the domestic supply line.
- If applicable, amount and quality of propylene glycol.
- Vent condition

### Clearances

The CHALLENGER is approved for following clearance to combustibles:

- Top panel - 12 inches [30.5 cm]
- Front - 0 inches
- Bottom panel - 12 inches [30.5 cm]
- Rear - 0 inches
- Right side - 4 inches [10.2 cm]
- Left side - 1.5 inches [3.8 cm]
- Boiler and Domestic Piping - 0.25 inches [0.6 cm]
- Reference the appropriate vent supplement for venting clearance requirements.

#### BEST PRACTICE

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

**Top panel - 24 inches [61 cm].**

**Front - 24 inches [61 cm].**

**Bottom panel - 24 inches [61 cm].**

**Rear - 0 inches**

**Sides - 6 inches [15.2 cm]**

#### NOTICE

When maintaining the approved clearance or less than recommended service clearances, some product labeling may become hidden and unreadable.

#### ⚠ WARNING

If the enclosure in which the appliance is installed is less than 45 cubic feet [1.3 m<sup>3</sup>], the space must be ventilated. See page 8 Ventilation Air Requirements for guidelines and requirements.

#### ⚠ WARNING

When installing the CHALLENGER in a confined space, sufficient air must be provided to allow, under normal operating conditions, proper air flow around the product to maintain ambient temperatures within safe limits to comply with the National Fuel Gas Code NFPA 54 - Standard.

### Residential Garage Installations

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

- Mount the appliance a minimum 18 inches [458 mm] above the floor level of the garage. Ensure the burner and ignition devices / controls are no less than 18 inches [458 mm] above the floor level.
- Locate or protect the appliance in a manner so it cannot be damaged by a moving vehicle.

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## Pre-Installation Items

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### Boiler Freeze Protection Feature

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

- 42°F [6°C] Boiler circulator and burner are ON.
- 50°F [10°C] Boiler circulator and burner are OFF.



#### CAUTION

The boiler freeze protection feature is designed to protect the boiler, installed in a primary/secondary piping arrangement. See Section IV for primary/secondary piping examples. See Section X for antifreeze guidelines.



#### CAUTION

The boiler freeze protection feature is disabled during a hard lockout, (burner does not operate) however the CH circulator will operate.

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## Combustion Air and Venting

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### SECTION II- Combustion Air and Venting

#### Combustion Air Contamination



If the CHALLENGER combustion air inlet is located in any area likely to cause or contain contamination, or if products, which could contaminate the air cannot be removed, the combustion air must be repiped and terminated to another location. Contaminated combustion air will damage the appliance and its burner system, resulting in possible severe personal injury, death or substantial property damage.



Do not operate a CHALLENGER if the combustion air inlet is located near a laundry room or pool facility. These areas will always contain hazardous contaminants.

Pool, laundry products, common household and hobby products often contain fluorine or chlorine compounds. When these chemicals pass through the burner and vent system, they can form strong acids. These acids can create corrosion of the heat exchanger, burner components and vent system, causing serious damage and presenting a possible threat of flue gas spillage or water leakage into the surrounding area.

Please read the information listed below. If contaminating chemicals are located near the area of the combustion air inlet, the installer should pipe the combustion air inlet to an area free of these chemicals per SECTION VI of this installation manual.

#### Potential contaminating products

- Spray cans containing chloro/fluorocarbons
- Permanent Wave Solutions
- Chlorinated wax
- Chlorine - based swimming pool chemicals / cleaners
- Calcium Chloride used for thawing ice
- Sodium Chloride used for water softening
- Refrigerant leaks
- Paint or varnish removers
- Hydrochloric acid / muriatic acid
- Cements and glues
- Antistatic fabric softeners used in clothes dryers
- Chlorine-type bleaches, detergents, and cleaning solvents found in household laundry rooms
- Adhesives used to fasten building products and other similar products

#### Areas likely to contain these products

- Dry cleaning / laundry areas and establishments
- Beauty salons
- Metal fabrication shops
- Swimming pools and health spas
- Refrigeration Repair shops
- Photo processing plants
- Auto body shops
- Plastic manufacturing plants
- Furniture refinishing areas and establishments
- New building construction
- Remodeling areas
- Garages with workshops

## Combustion Air and Venting

### Ventilation Air Requirements

For installations, involving only the CHALLENGER, in which the minimum service clearances are maintained as listed on page 5, no ventilation openings are required.

For installations with less than the minimum service clearances involving only the CHALLENGER, the space / enclosure must provide two openings for ventilation. The openings must be sized to provide 1 square inch [6 square centimeters] of free area per 1,000 BTUH [0.3 Kw] of appliance input. The openings shall be placed 12 inches [30.5 cm] from the top of the space and 12 inches [30.5 cm] from the floor of the space.

For installations in which the CHALLENGER shares the space with air movers (exhaust fan, clothes dryers, fireplaces, etc.) and other combustion equipment (gas or oil) the space must be provided with adequate air openings to provide ventilation and combustion air to the equipment. To properly size the ventilation / combustion air openings, the installer must comply with the National Fuel Gas Code NFPA 54, ANSI Z223.1 for installations in the U.S or CAN/CSA B149.1 for installations in Canada/

#### **WARNING**

**The space must be provided with ventilation / combustion air openings properly sized for all make-up air requirements (exhaust fans, clothes dryers, fireplaces, etc.) and the total input of all appliances located in the same space as the CHALLENGER. The input of a CHALLENGER which uses combustion air directly from the outside, is excluded thus additional free area for the openings is not required. Failure to provide or properly size the openings could result in severe personal injury, death or substantial property damage.**

### Combustion Air and Vent Piping

The CHALLENGER requires a Category IV venting system, which is designed for pressurized venting and condensate.

The CHALLENGER is certified as Direct Vent (sealed combustion) appliance. A Direct Vent appliance utilizes uncontaminated outdoor air (piped directly to the appliance) for combustion.

#### **NOTICE**

**Install combustion air and vent pipe as detailed in the CHALLENGER PVC, CPVC,PP and SS Vent Supplement 2013-38 included in the appliance installation envelope. Refer to instructions for parts list and method of installation.**

#### **NOTICE**

**Contact ACV-Triangle Tube for other venting options including PVC Concentric Vent/Air Termination Supplement 2008-04 or CHALLENGER Concentric Vent/Air System Supplement 2011-60. Refer to these instructions for parts list and method of installation.**

#### **DANGER**

**Verify installed combustion air and vent piping are sealed gas tight and meet all provided instructions and applicable codes, failure to comply will result in severe personal injury or death.**

## Combustion Air and Venting

### Removal of an Existing Boiler and or Water Heater from a Common Vent System

#### BEST PRACTICE

**When an existing boiler and/or water heater is removed from a common venting system, the common venting system is likely to be too large for proper venting of the remaining appliances. At the time of removal of an existing boiler and/or water heater, the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation.**

1. Seal any unused openings in the common venting system.
2. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
3. Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
4. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.

5. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar or pipe.
6. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers, and any other gas-burning appliance to their previous condition of use.
7. Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CAN/CSA B149.1, Installation codes. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Part II of the National Fuel Gas Code ANSI Z223.1/NFPA 54 and/or CAN/CSA B149.1, Installation codes.

#### DANGER

**Do not install the CHALLENGER into a common vent with other gas or oil appliances. This may cause flue gas spillage or appliance malfunction, resulting in possible severe personal injury, death or substantial property damage.**

## Combustion Air and Venting

### Commonwealth of Massachusetts Installations Only

For direct-vent appliances, mechanical-vent heating appliances or domestic hot water equipment, where the bottom of the vent terminal and the air intake is installed below four feet above grade the following requirements must be satisfied:

1. If there is not one already present, on each floor level where there are bedroom(s), a carbon monoxide detector and alarm shall be placed in the living area outside the bedroom(s). The carbon monoxide detector shall comply with NFPA 720 (2005 Edition).
2. A carbon monoxide detector shall also be located in the room that houses the appliance or equipment and shall:
  - a. Be powered by the same electrical circuit as the appliance or equipment such that only one service switch services both the appliance and the carbon monoxide detector;
  - b. Have battery back-up power;
  - c. Meet ANSI/UL 2034 Standards and comply with NFPA 720 (2005 Edition); and
  - d. Have been approved and listed by the Nationally Recognized Testing Laboratory as recognized under 527 CMR.
3. A Product-approved vent terminal must be used, and if applicable, a Product-approved air intake must be used. Installation shall be in strict compliance with the manufacturer's instructions. A copy of the installation instructions shall remain with the appliance or equipment at the completion of the installation.

4. A metal or plastic identification plate shall be mounted at the exterior of the building, four feet directly above the location of vent terminal. The plate shall be of sufficient size to be easily read from a distance of eight feet away, and read "Gas Vent Directly Below".

#### **NOTICE**

**Installer must provide tag identification plate and ensure the lettering meets code requirements.**

For direct-vent appliances, mechanical-vent heating appliances or domestic hot water equipment, where the bottom of the vent terminal and the air intake are installed above four feet above grade the following requirements must be satisfied:

1. If there is not one already present, on each floor level where there are bedroom(s), a carbon monoxide detector and alarm shall be placed in the living area outside the bedroom(s). The carbon monoxide detector shall comply with NFPA 720 (2005 Edition).
2. A carbon monoxide detector shall:
  - a. Be located in the room that houses the appliances or equipment;
  - b. Be either hard wired or battery powered or both; and
  - c. Shall comply with NFPA 720 (2005 Edition)
3. A Product-approved vent terminal must be used, and if applicable, a Product-approved air intake must be used. Installation shall be in strict compliance with the manufacturer's instructions. A copy of the installation instructions shall remain with the appliance or equipment at the completion of the installation.

## Appliance Preparations

### SECTION III - Appliance Preparations

#### Shipping and Handling Instructions

##### **⚠ WARNING**

To avoid damage to gas fitting and piping at bottom of appliance, appliance must be shipped with rear or back of appliance (longest box length) laying down flat.

The CHALLENGER is generally easier to handle and maneuver once removed from the shipping carton.

To remove the shipping carton:

##### **⚠ CAUTION**

Use care not to lift the appliance from piping or damage can occur. Use care not to drop or bump the appliance as damage to the appliance may result.

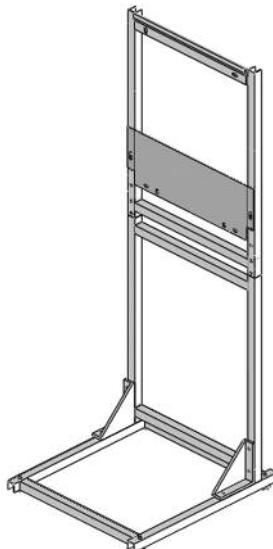
1. Remove any shipping straps and the top shipping carton.
2. Carefully lift the appliance out of the carton.
3. Discard all packing materials.

#### Wall Mounting Installation

##### **NOTICE**

Prior to mounting appliance install piping support bracket according to instructions on page 13.

The CHALLENGER should be wall mounted using the bracket provided with the appliance and is not designed for floor installation. If floor installation is required an optional floor stand part number PSSTND04 is available through ACV-Triangle Tube. Appliance is not to be installed on carpeting.



**Fig. 1: Optional Floor Stand Assembly,  
Part Number: PSSTND04**

##### **NOTICE**

The wall used for mounting the CHALLENGER must be vertically plumb and capable of supporting a minimum 110 pounds [50 kg]. Failure to comply with these requirements could result in personal injury, death or substantial property damage.

## Appliance Preparations

### Wall Mounting Guidelines

1. The wall-mounting bracket is designed for stud spacing of 12 inch [30.5 cm] or 16 inch [40.6 cm] on centers. For unconventional stud spacing, a solid / secure mounting surface must be provided for installation of the bracket.
2. For applications using wood studs, install the bracket using the lag screws provided with the appliance. Ensure both lag screws are installed securely in the studs.
3. For applications using metal studs, install the bracket to the studs using 3/16" [5 mm] toggle bolts and washers (provided by others)
4. DO NOT mount or attempt to mount the wall bracket to hollow sheet rock or lath walls using anchors. Only install appliance to studs or equivalent wood structure.
5. For applications using solid walls (rock, concrete, brick, cinder block, etc.), install the wall bracket using anchors (double expansion shields) bolts and washers provided with the appliance.
6. The appliance is too heavy and bulky for a single person to lift and attempt to mount; a minimum of 2 people is required for mounting the appliance.

#### **NOTICE**

**Use extreme care not to drop the appliance or cause bodily injury while lifting or mounting the appliance onto the bracket. Once mounted verify that the appliance is securely attached to the bracket and wall. Failure to comply with the above guidelines could result in property damage, personal injury or death.**

### Stud Walls -Installation

1. Locate the studs in the general area of the appliance placement.
2. Place the wall-mounting bracket on the wall centering the mounting slots with the

stud centers and ensuring the upper edge of the bracket is away from the wall.

3. Level the bracket, while maintaining it's centering with the studs and use a pencil to mark the location of the mounting slots/holes.
4. Remove the bracket from the wall and drill 1/4" [6 mm] diameter hole by 3" [76 mm] deep positioned in the center of each mark. For applications using metal studs and 3/16" [5 mm] toggle bolts, drill the required clearance hole.
5. Reposition the bracket onto the wall and align mounting slots/holes. Insert the two lag screws provided (or toggle bolts for metal studs) through the mounting slots/holes and loosely tighten.
6. Level bracket and tighten screws (bolts for metal studs) securely making sure not to over-tighten to avoid damaging drywall or plaster.

### Wall Bracket Installation - Solid Walls

1. Locate the general area of the appliance placement.
2. Place the wall-mounting bracket on the wall ensuring the upper edge of the bracket is away from the wall.
3. Level the bracket and use a pencil to mark the location of the mounting slots/holes on the wall.
4. Remove the bracket from the wall and drill a 5/8" [16 mm] diameter hole by 1-3/8" [35 mm] deep positioned in the center of each mark.
5. Install the anchors (provided) flush or slightly recessed in the drilled holes with threaded side facing down.
6. Reposition the bracket on the wall and align mounting slots/holes. Insert the two bolts with washers (provided) through the mounting slots/holes and loosely tighten.
7. Level bracket and tighten bolts securely.

## Appliance Preparations

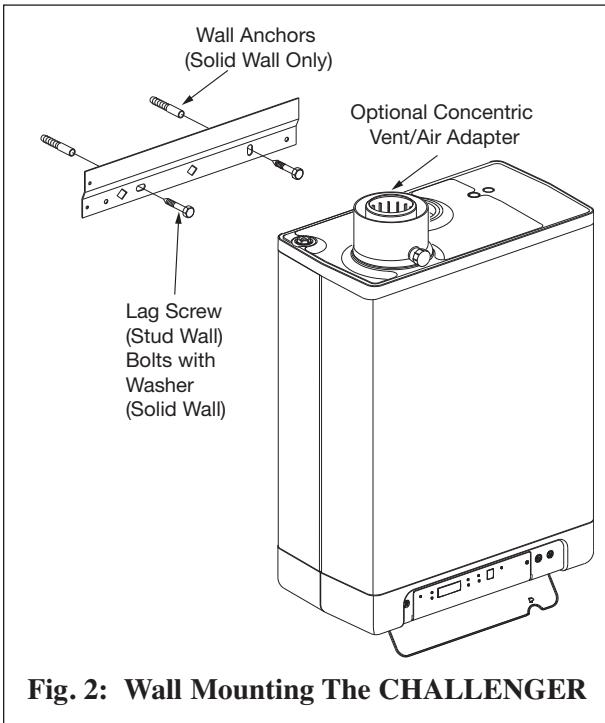


Fig. 2: Wall Mounting The CHALLENGER

### Appliance Mounting

1. Obtain assistance in lifting the appliance onto the wall bracket.
2. Install the appliance making sure the appliance mounting lip located along the upper edge of the rear jacket panel engages the wall-mounting bracket. Ensure the appliance is seated properly and is secure.

### Piping Support Bracket

#### **CAUTION**

Appliance must be installed using the supplied copper fittings and piping support bracket. DO NOT braze directly to copper appliance pipes or damage may result to internal parts (gaskets and flow switch).

1. Pre-install the 4 brass compression fittings into the piping support bracket as shown in Fig. 4, page 15. Use retaining clips to hold fittings in place.

#### BEST PRACTICE

Apply pipe joint compound suitable for potable water systems to the compression ferrule and compression nut threads of all brass fittings before installation. Install appliance pipes into the fittings until bottom of hex on gas pipe fitting rests against the top of the piping support bracket before tightening any compression nuts. Do not over tighten compression nuts. If fitting leaks loosen compression nut first and then retighten.

2. Prior to mounting the appliance on the wall and with the rear or back of appliance laying flat, slip the appliance piping into the fittings until bottom of hex on gas pipe fitting rests against the top of the piping support bracket before tightening any compression nuts.
3. Tighten all fittings to appliance piping connections with two wrenches.

#### **WARNING**

Use a two wrench method when tightening piping near the appliance and its piping connections. Use one wrench to prevent the appliance connections from turning and the second to tighten adjacent piping. Failure to support the appliance piping connections could damage piping.

4. Once appliance is mounted according to Appliance Mounting instructions on this page, secure piping support bracket to wall with hardware supplied.

## Boiler Piping

### SECTION IV - Boiler 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 CHALLENGER from the system piping.

#### **WARNING**

**Use a two wrench method when tightening piping onto the appliance connections. Use one wrench to prevent the appliance piping from turning / twisting. Failure to support the appliance piping and connections in this manner could cause damage to the appliance and its components.**

#### Pressure Relief Valve (PRV)

1. The CHALLENGER has a ASME Maximum Allowable Working Pressure of 43.5 PSI [3 bar]. The appliance is supplied with a 30 psi [2 bar] pressure relief valve and must be piped using the PRV connection as shown in Fig. 3 page 15.
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 [153 mm]

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 [121°C] 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 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.**

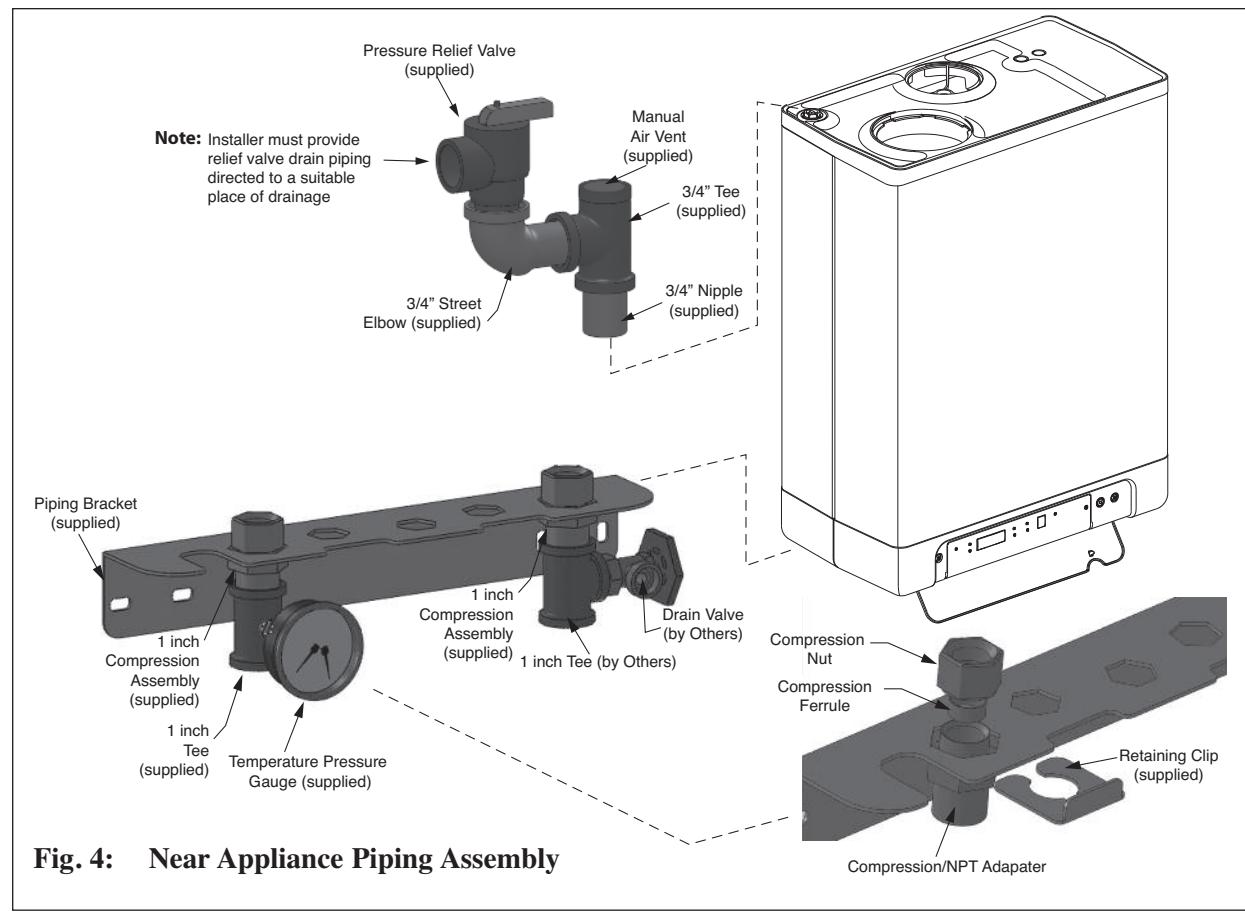
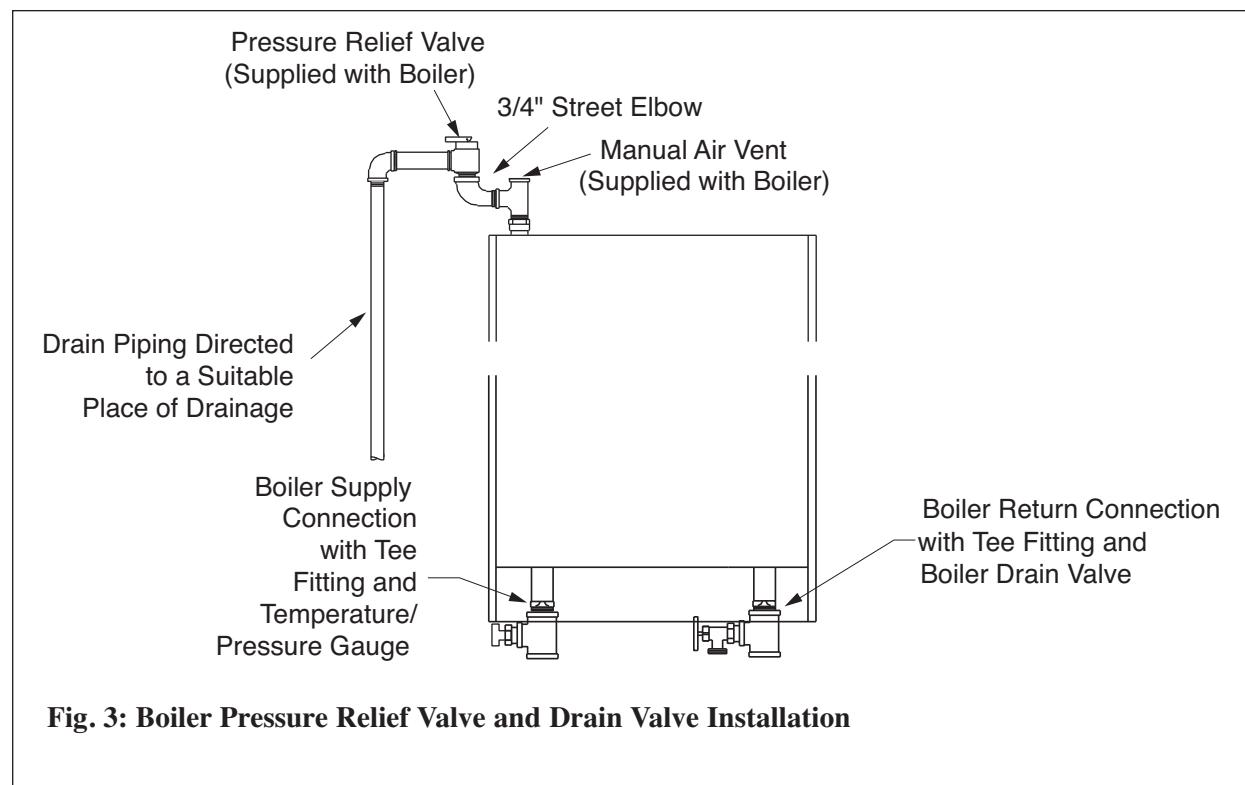
#### Low Water Cut Off / CH Pressure Sensor

#### **NOTICE**

**The Low Water Cut Off (LWCO) only applies for space heating. Operation of the LWCO does not prevent a domestic hot water call for heat.**

- The CHALLENGER is equipped with a factory installed pressure sensor type LWCO.
- The minimum operating Central Heating (CH) system pressure is 7 psig [0.5 bar].
- If CH System pressure is below 7 psig [0.5 bar] the main display will flash a soft lockout of "LOP" followed by the pressure reading. Once CH system pressure is increased above 7 psi [0.5 bar] normal boiler operation will be restored. If the appliance is installed as domestic hot water heater only, set parameter 1 (installation type) to 2 (domestic only) to eliminate the "LOP" error in the main display, see page 52 for setting parameters.
- Check local codes if a LWCO is required. If so, determine if this device meets their requirements.

## Boiler Piping



## Boiler Piping

### Additional Limit Control

If a Low Water Cut Off (LWCO) is required by certain local jurisdictions or when the boiler is installed above the system piping, the following guidelines must be followed:

- The LWCO must be designed for water installations, electrode probe-type is recommended.
- The LWCO must be installed in a tee connection on the boiler supply piping above the appliance.
- Wiring of the LWCO to the CHALENGER should be done in series with the 120 VAC service to the appliance .

If the installation is to comply with ASME CSD-1 or Canadian requirements, an additional high temperature limit may be needed. Consult local code requirements to determine compliance. The limit should be installed as follows:

- Install the limit in the boiler supply piping between the boiler and any isolation valve.
- Maximum set point for the limit is 200°F [93°C].
- Wiring of the limit device to the CHALENGER should be done in series with the 120 VAC service to the appliance.

### Backflow Preventer

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

### Boiler System Piping Applications

#### BEST PRACTICE

**It is required on all piping applications to utilize a primary/secondary piping arrangement. Maintain the minimum boiler flow rate, see Graphs 5-10 on pages 79-81.**

### Expansion Tank and Makeup Water

Ensure the expansion tank is properly sized for the boiler water volume (approximately 1 gallon [4 L]) and the system water 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 boiler heat exchanger failure can result due to this excessive makeup water addition.**

The expansion tank must be located as shown in Fig. 5 and Fig. 6 on page 18 when using a primary/secondary piping arrangement 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 Expansion Tank

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

## Boiler Piping

### Closed-Type Expansion Tank

It is recommended to pitch any horizontal piping upwards toward the expansion tank 1 inch per 5 feet [2.5cm / 1.5 M] of piping. Use 3/4" piping to the expansion tank to allow air within the system to rise.



#### 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 CHALLENGER must be supplied with a Central Heating (CH) circulator with flow check. The circulator when wired directly to the CHALLENGER will allow for domestic hot water priority and to provide circulation for the freeze protection feature of the boiler control. See Graph 5-10 on page 79-81 for pressure drop and minimum flow rate through the boiler.

### Sizing Primary Piping

See Fig. 7 and 8, page 20, for recommended piping arrangements based on various applications. Size the piping and system components required in the space heating system, using recognized design methods.

### System Piping - Zone Circulators

Connect the CHALLENGER to the system piping as shown in Fig. 7 page 20 when zoning with zone circulators.

The installer must provide a separate circulator for each zone of space heating.

#### NOTICE

To ensure an adequate flow rate through the CHALLENGER, the boiler supply and return piping size must be a minimum of 1 inch.

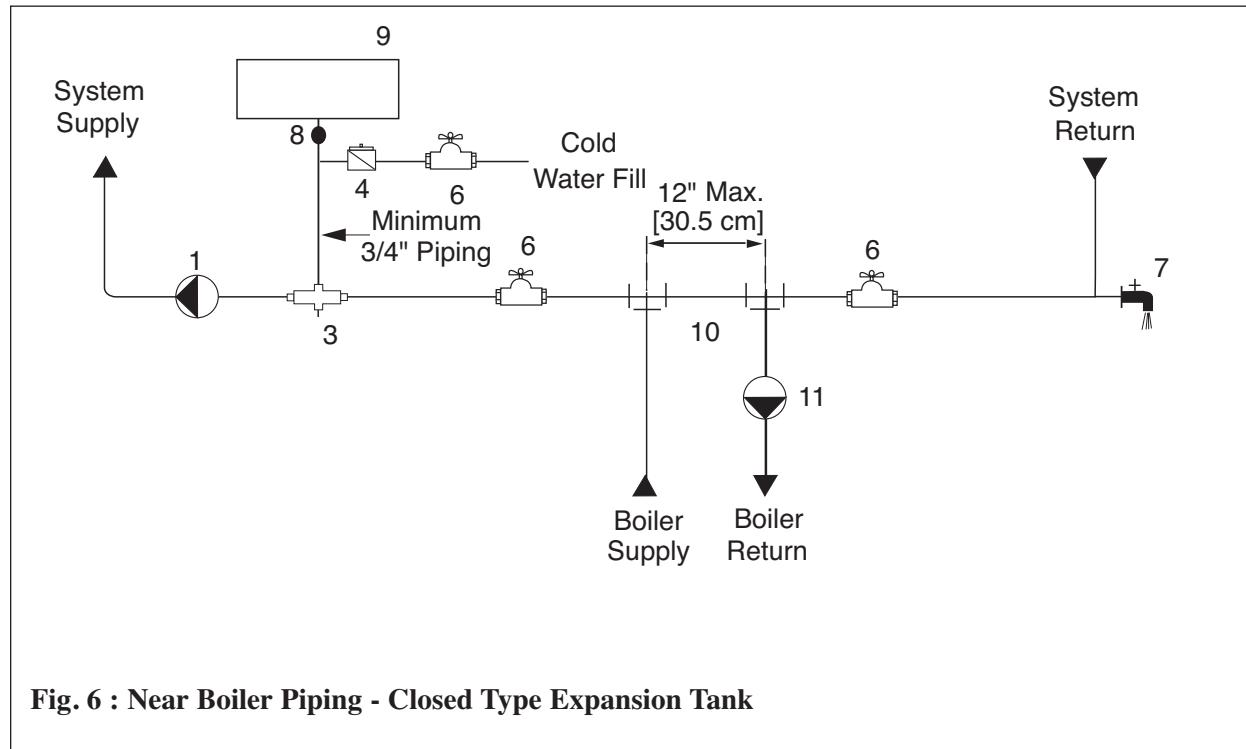
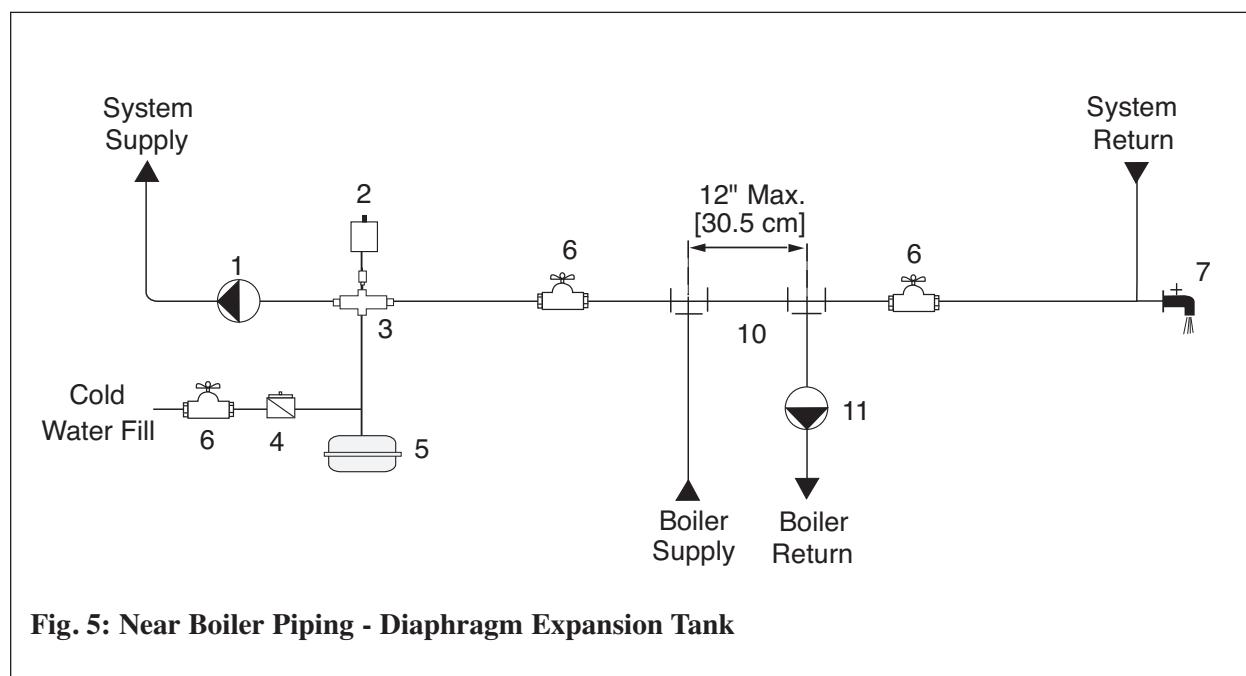
### System Piping - Zone Valves

Connect the CHALLENGER to the system piping as shown in Fig. 8 page 20 when zoning with zone valves. The primary / secondary piping ensures that the boiler loop has sufficient flow.

#### NOTICE

To ensure an adequate flow rate through the CHALLENGER, the boiler supply and return piping size must be a minimum of 1 inch.

## Boiler Piping



- |                             |                                   |
|-----------------------------|-----------------------------------|
| 1. System circulator        | 7. Drain/purge valve              |
| 2. Automatic air vent       | 8. Tank fitting                   |
| 3. Air separator            | 9. Closed type expansion tank     |
| 4. Automatic fill valve     | 10. Primary/secondary connection  |
| 5. Diaphragm expansion tank | 11. CH circulator with flow check |
| 6. Isolation valve          |                                   |

---

## Boiler Piping

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### System Piping - Radiant Heating

The heat exchanger design of the CHALLENGER allows operation in a condensing mode. This feature requires no regulation of the return water temperature back to the boiler in radiant heating applications.

The maximum boiler water supply temperature can be maintained by the CHALLENGER, potentially eliminating the need for a mixing system to achieve the desired temperature if all zones of heat are at the same temperature set point.

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

#### **NOTICE**

**The boiler system piping must be a “closed” system to avoid any oxygen contamination and potential failure of the outer tank of the SMART.**

The CHALLENGER’s domestic piping should not be utilized. Refer to the installation manual provided with the SMART for additional installation details.

See Parameter 1 and Note 3, page 52 for parameter, wiring and operational details using the SMART I.F.W.H. with a CHALLENGER boiler.

### System Piping - Special Application

If the boiler is used in conjunction with a chilled water/medium system, the boiler and chiller must be piped in parallel. Install flow/check valves to prevent the chilled medium from entering the boiler.

If the boiler is used to supply hot water to the heating coils of an air handler where they may be exposed to chilled air circulation, install flow/check valves or other automatic devices to prevent gravity circulation of the boiler water during cooling cycles.

### System Piping - SMART Indirect Fired Water Heater (I.F.W.H.)

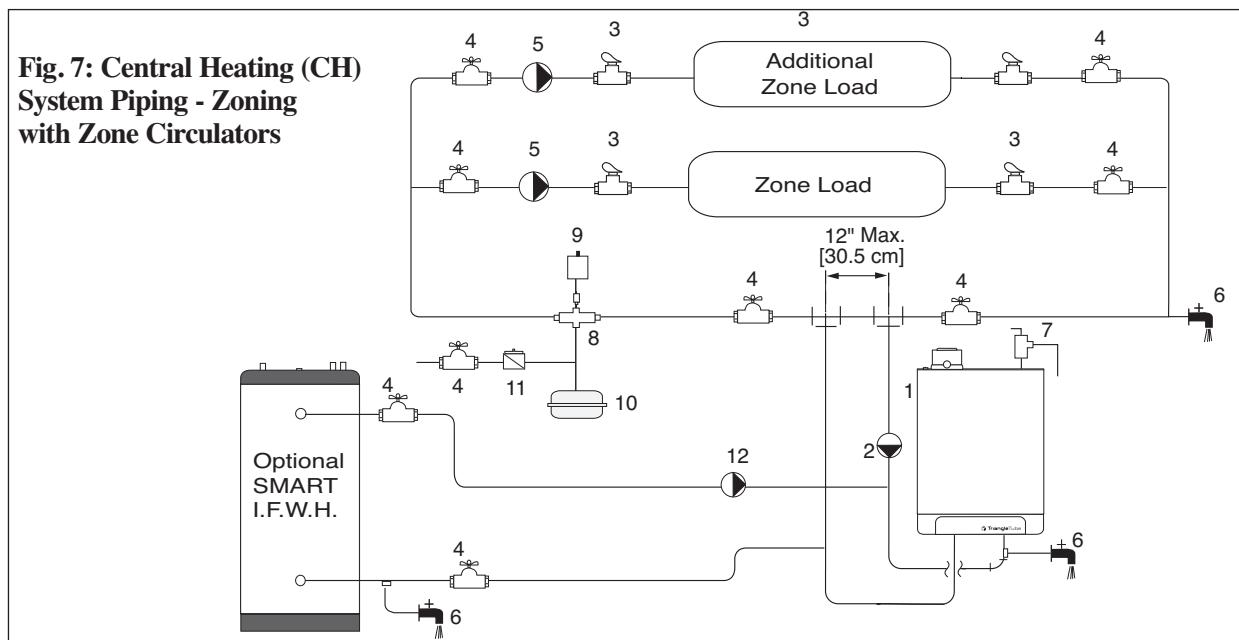
See Figs. 7 and 8, page 20 for recommended piping for a ACV-Triangle Tube SMART I.F.W.H.. This application will provide higher domestic hot water flow rates for a short period of time (dump load) and will recover the SMART tank faster than a domestic storage tank. The SMART’s boiler piping should be piped off the primary loop.

#### **NOTICE**

**To ensure an adequate flow rate through the CHALLENGER, the boiler supply and return piping size must be a minimum of 1 inch.**

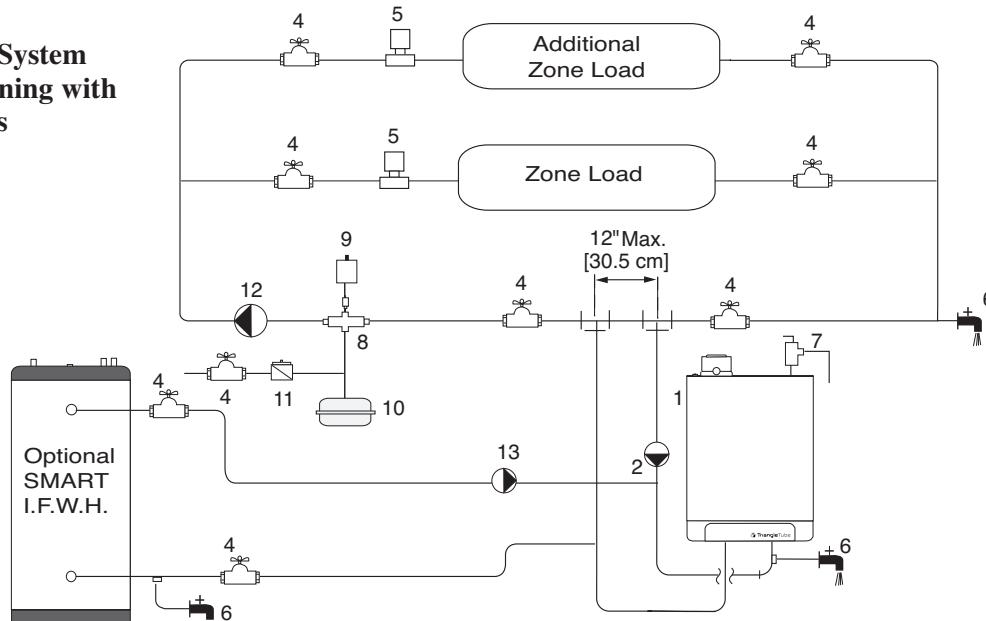
## Boiler Piping

**Fig. 7: Central Heating (CH) System Piping - Zoning with Zone Circulators**



- |                                      |                                    |
|--------------------------------------|------------------------------------|
| 1. CHALLENGER boiler                 | 7. Pressure relief valve           |
| 2. Boiler circulator with flow check | 8. Air separator                   |
| 3. Flow/check valve                  | 9. Automatic air vent              |
| 4. Isolation valve                   | 10. Diaphragm expansion tank       |
| 5. Zone circulator                   | 11. Automatic fill valve           |
| 6. Drain/purge valve                 | 12. DHW circulator with flow check |

**Fig. 8: CH System Piping - Zoning with Zone Valves**



- |                                      |                                    |
|--------------------------------------|------------------------------------|
| 1. CHALLENGER boiler                 | 8. Air separator                   |
| 2. Boiler circulator with flow check | 9. Automatic air vent              |
| 4. Isolation valve                   | 10. Diaphragm expansion tank       |
| 5. Zone valve                        | 11. Automatic fill valve           |
| 6. Drain/purge valve                 | 12. System circulator              |
| 7. Pressure relief valve             | 13. DHW circulator with flow check |

## Domestic Piping

### SECTION V - Domestic Piping

#### **! WARNING**

##### **HOT WATER CAN SCALD!**

- Water temperatures over 125°F [52°C] can cause severe burns instantly, or death from scalds.
- Feel water before bathing or showering.
- Consumer Product Safety Commission and some states recommend temperatures settings of 130°F [54°C] or less. Setting thermostat higher than 130°F [54°C] will increase risk of scald injury and cause severe personal injury or death.
- Water heated to a temperature suitable for clothes washing, dish washing and other sanitizing needs will scald and cause permanent injury.
- Children and elderly, infirm, or physically handicapped persons are more likely to be injured by hot water. Never leave them unattended in or near a bathtub. If anyone using hot water in the building fits this description, or if state laws or local codes require certain water temperatures at hot water faucets, take special precautions.
  - Install the factory supplied thermostatic mixing valve at the water heater. Installation must comply with valve manufacturer's recommendation and instructions.
  - Use the lowest practical temperature setting.
  - Check water temperature after any adjustment. You must follow "Setting the Thermostatic Mixing Valve" procedures.



#### **General Notes**

- Household water usage patterns will affect water temperature at any faucet or shower. Occasionally check temperature at each point of use, then adjust thermostatic mixing valve accordingly. Always recheck temperature after adjusting.
- Lowering the thermostatic mixing valves as indicated in these instructions will reduce water temperature levels. Consult your installer or service technician.

#### **Operating Restrictions**

- Minimum DHW flow rate is 0.5 gpm [2 lpm] to initiate a domestic call for heat.
- Maximum DHW outlet temperature is 149°F [65°C].
- Minimum domestic working pressure is 40 psig [3 bar].

#### **NOTICE**

When the CHALLENGER is installed in a domestic well application, the cut in pressure of the domestic well pump's control must be set to 40 psig [3 bar] to ensure more consistent domestic flow and temperature performance.

## Domestic Piping

- Maximum domestic working pressure is 150 psig [10 bar].
- Water quality limitations (based on E.P.A National Secondary Drinking Water Regulations):
  - Chloride, less than 150 ppm or mg/l
  - pH value min. 6.5, max. 8.5
  - Total hardness 3 - 7 grains/gallon or 50-120 ppm or mg/l.
  - Total Dissolved Solids (TDS), less than 120 ppm or mg/l.
  - Iron less than 0.3 ppm or mg/l.
  - Aluminum, less than 0.2 ppm or mg/l.
  - Copper, less than 1 ppm or mg/l.
  - Manganese, less than 0.05 ppm or mg/l.
  - Zinc, less than 5 ppm or mg/l.

### BEST PRACTICE

**In hard water areas (more than 7 grains of hardness) soften the cold domestic supply water to the appliance to prevent scaling.**

### NOTICE

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

### Pressure Relief Valve - Standard Installations

The domestic water heater (if utilized) shall have a field supplied pressure relief valve installed within 6" [152 mm] of the DHW HOT outlet connection with the relief valve spindle installed in the vertical position.

The domestic water heater (if utilized) requires a field supplied pressure relief valve identified with the ASME V or HV symbol and set to

relieve at or below 150 psi [ 10 bar] of domestic water pressure and a minimum relieving capacity of 124,000 Btu/hr with 3/4" NPT threads. For safe operation of the domestic water heater, the relief valve must not be removed from its designated location of installation or plugged.

1. The CHALLENGER is not supplied with a 150 psi [10 bar] pressure relief valve and must be piped using a Pressure Relief Valve connected as shown in Fig. 11 page 26.
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 [152 mm] 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 [121°C] 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 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.**

## Domestic Piping

### Temperature & Pressure (T&P) Relief Valve-Storage Tank or SMART Installations



#### CAUTION

To reduce risk of excessive pressures and temperatures in a storage tank or ACV-Triangle Tube SMART I.F.W.H., install temperature and pressure protective equipment required by local codes, but no less than a combination temperature and pressure relief valve certified by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment or materials, as meeting the requirements for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems, ANSI Z21.22. This valve must be marked with the maximum working pressure of the domestic water heater (150 psi).

- The storage tank or SMART must be protected with a field supplied T&P relief valve.
- Size the T&P relief valve by the following specifications, unless they conflict with local codes: 3/4" NPT with an AGA Rating of 124,000 BTU/hr.

### T&P Relief Valve Discharge Piping

T&P relief valve discharge piping must be:

- made of material serviceable for temperatures of 250°F [121°C] or greater
- directed so that hot water flows away from all persons
- directed to a suitable place for disposal
- installed so as to allow complete draining of the T&P relief valve and discharge line

T&P relief valve discharge piping **MUST NOT** be:

- excessively long, using more than 2 elbows or 15 feet [4.5 m] of piping can reduce discharge capacity
- directly connected to a drain, terminate discharge piping within 6" [152 mm] from drain, refer to local codes

- plugged, reduced or restricted
- subject to freezing



#### WARNING

Do not install any valve between T&P relief valve and the storage tank or SMART connection or on T&P relief valve discharge piping. Do not plug T&P relief valve or discharge piping. Improper placement and piping of T&P relief valve can cause severe personal injury, death or substantial property damage.



#### WARNING

Isolation valves are only intended for servicing the domestic coil. During any domestic service the appliance should be turned off and the domestic coil drained to prevent over pressurization of the appliance's domestic coil.

### Drain Valves

Drain valves and fittings are field supplied.

### Thermal Expansion

If a backflow preventer, check valve or pressure reducing valve is installed on the cold water supply piping of the domestic water heater, install an expansion tank on the cold water supply line to prevent normal thermal expansion from repeatedly forcing open the relief valve.



#### CAUTION

Relief valve is not intended for constant duty, such as relief of pressure due to repeated normal system water expansion. Correct this condition by installing a properly sized expansion tank in domestic water system. Refer to expansion tank manufacturer's installation instructions for proper sizing.

## Domestic Piping

The domestic water volume of the CHALLENGER is approximately 0.26 gallons [ 1 l]. Remember to include this volume when sizing the expansion tank.

### Water Hammer

Dishwashers, clothes washers and fast-closing positive shut-off valves incorporated in the system all contribute to creating water shock. Install a water hammer arrester to prevent damage to pipes and appliances. See device manufacturer's instructions for application and installation.

### Vacuum Breaker - Storage Tank or SMART Installations

Installing a vacuum breaker on the inlet of the storage tank will prevent damage to the tank if a negative pressure is developed in the domestic supply line. See manufacturer's instructions for application and installation of the vacuum breaker.

### General Piping Requirements

- For domestic water piping diagrams, see Figs 11 and 12, pages 26 and 27.

#### BEST PRACTICE

**It is recommended to install flush valves as outlined in Fig. 11 and 12, pages 26 and 27 for servicing the domestic coil.**

#### BEST PRACTICE

**It is recommended to install a strainer on the domestic cold water inlet to prevent any nuisance issues with domestic flow switch. An optional lead free, 60 mesh y-strainer is available through ACV-Triangle Tube part number CCSTRA01.**

- All plumbing must meet or exceed all local, state and national plumbing codes.

- Use pipe joint compound or tape suitable for potable water systems.
- Size all piping no smaller than the appliance's DHW connections.
- Use isolation valves to isolate the DHW connections and system components.
- Use dielectric unions or couplings to protect hot and cold water fittings from corrosion when connecting dissimilar materials such as copper and galvanized iron pipe.
- If copper pipe is used for domestic water connections, first solder pipe to a threaded adapter and then screw adapter onto the domestic cold water inlet of the appliance. The domestic cold water inlet contains an internal plastic flow switch which can be damaged by heat from soldering.

#### NOTICE

**Do not apply heat to the domestic cold water inlet when making solder connections to water heater. Solder tubing to adapter before fitting adapter to cold water inlet of heater. It is imperative that no heat be applied to the cold water inlet, as it contains a non metallic flow switch.**

### Thermostatic Mixing Valve

The CHALLENGER is factory supplied with a thermostatic mixing valve with built-in check valves on the hot and cold inlets. The mixing valve must be installed as shown in Figs. 9, 11 and 12.

The mixing water temperature range of the thermostatic mixing valve is 85°F [30°C] to 140°F [60°C].

The thermostatic mixing valve is preset to its minimum mixed water temperature, 85°F [30°C].

## Domestic Piping

### BEST PRACTICE

**Additional thermostatic/anti-scald valves should be installed at each hot water faucet, bath and shower outlet.**

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 [5°C] 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.**

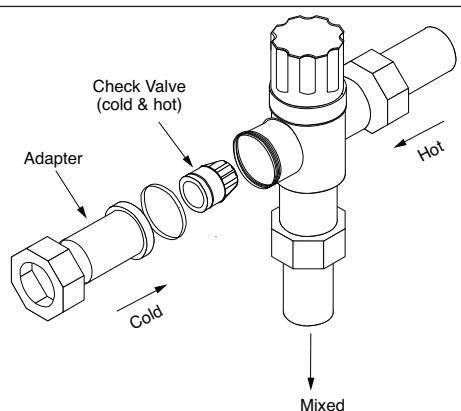


Fig. 9: Mixing Valve Assembly

### Recirculation Piping

- Recirculation return piping if applicable, must be installed in the cold water inlet as shown Figs 11 and 12, page 26 and 27.
- A stainless steel or bronze circulator is recommended and must be controlled by a aquastat.

### Storage Tank Installations

For applications requiring high domestic hot water flow rates for a short period of time (dump load), the installer may install a storage type tank (see Fig. 12 page 27) in the domestic piping.

The installer must:

1. Relocate the thermostatic mixing valve from the CHALLENGER to the outlet of the storage tank.
2. Remove domestic restrictor at the inlet of the domestic flow switch.
3. Provide recirculation from the storage tank back to the CHALLENGER using a bronze or stainless steel type circulator.

### Setting the Thermostatic Mixing Valve

### NOTICE

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

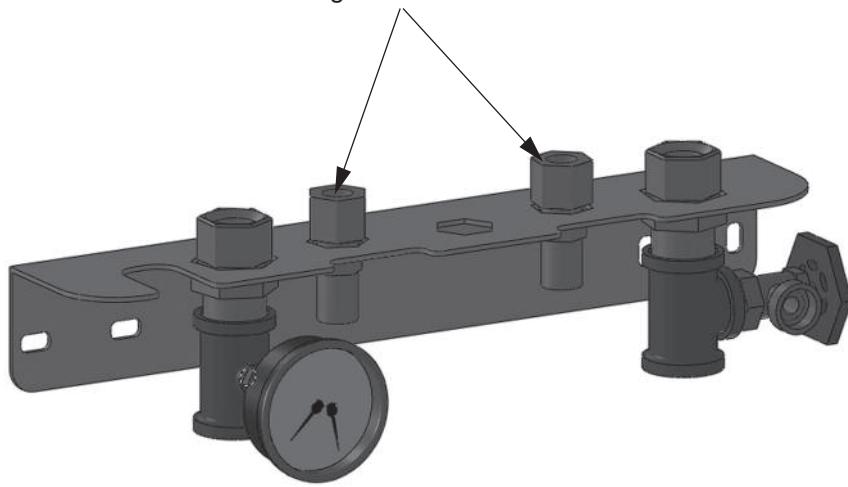
### WARNING

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

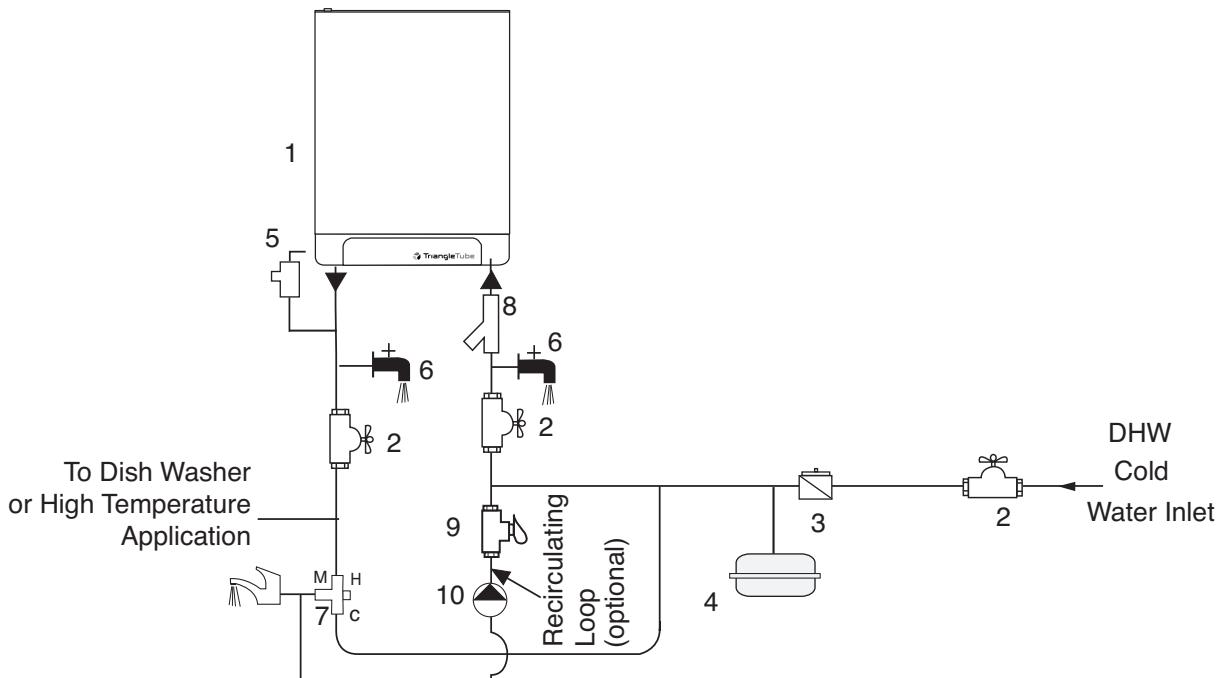
If any adjustment needs to be made to the valve's temperature setpoint refer to the manufacturer's instructions included with the valve.

## Domestic Piping

1/2" compression x 3/4" NPT Adapter  
Fittings for DHW



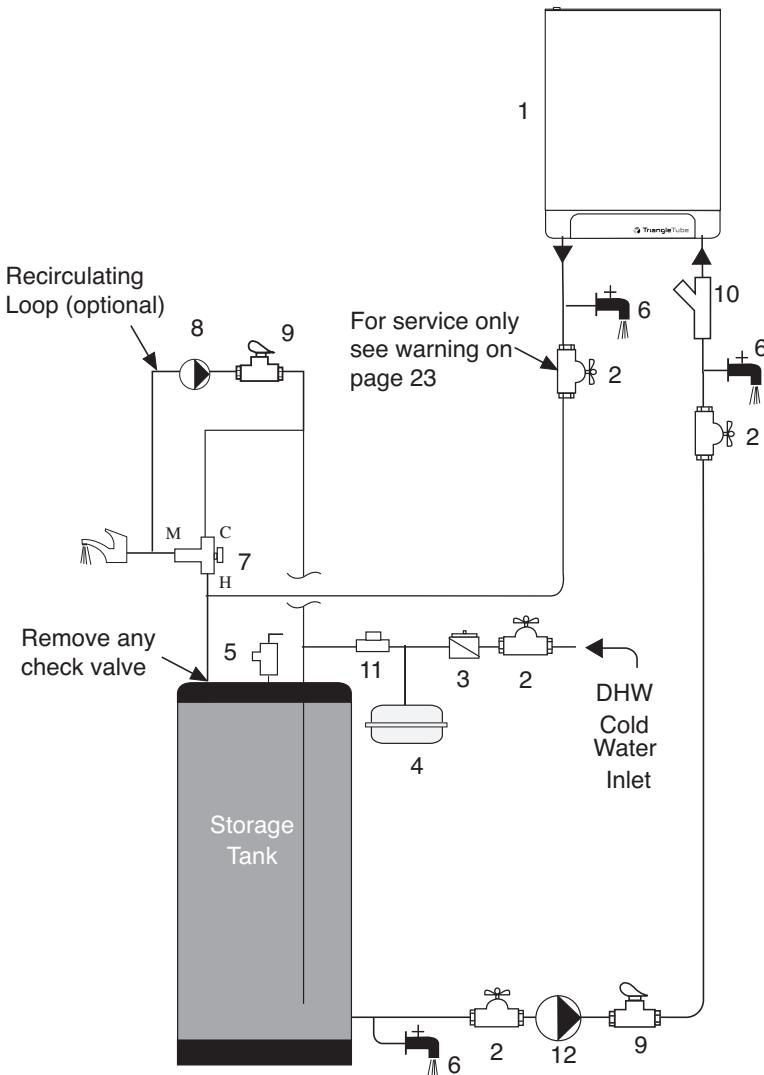
**Fig. 10 : Installation of Domestic Compression Adapter Assemblies**



**Fig. 11 : Domestic Piping - Standard Installations**

- |  |  |
|--|--|
| 1. CHALLENGER  | 7. Mixing valve with check valve                                 |
| 2. Isolation valve                                   | 8. Strainer (*)  |
| 3. Backflow preventer or pressure reducing valve (*) | 9. Flow check valve (*)  |
| 4. Thermal expansion tank (potable) (*)              | 10. Circulator (potable , must be controlled by a aquastat ) (*) |
| 5. Domestic pressure relief valve - 150 psi max.     | (*) Optional device may be required by local codes               |
| 6. Drain/flush valve                                 |  |

## Domestic Piping



**Note:**

Domestic cold water inlet through a storage tank will yield a lower domestic pressure drop in addition to greater domestic performance. Domestic set point temperature should be set to 149°F [65°C] see page 52. DHW function button (  ) should be set to ON (  ) at the display panel, see page 49. Remove domestic restrictor at inlet of the domestic flow switch.

**Fig. 12 : Domestic Piping - Storage Tank Installations**

- |   |  |
|---|--|
| 1. CHALLENGER   | 10. Strainer (*)   |
| 2. Isolation valve  | 11. Vacuum breaker (*)   |
| 3. Backflow preventer or pressure reducing valve (*)          | 12. Domestic circulator (potable Grundfos UP26-99BF or Taco 009-SF5 or equivalent sized for 2.5 gpm [9.5 lpm] at 32 feet [9.7 m], must be controlled by a aquastat mounted on the storage tank with a maximum set point of 130°F [55°C]. |
| 4. Thermal expansion tank (potable) (*)                       | (*) Optional device maybe required by local codes  |
| 5. Temperature/Pressure relief valve                          |  |
| 6. Drain/flush valve  |  |
| 7. Mixing valve with check valve                              |  |
| 8. Circulator (potable, must be controlled by a aquastat) (*) |  |
| 9. Flow check valve   |  |

## Installation Vent/Combustion Air & Condensate Drain

### SECTION VI - Installing Vent / Combustion Air & Condensate Drain

#### Installing Vent and Combustion Air



##### DANGER

The CHALLENGER must be vented and supplied with combustion air as shown in the CHALLENGER PVC, CPVC, PP and SS Vent Supplement 2013-38, included in the installation envelope. Refer to instructions for parts list and method of installation. Once installation is completed, inspect the vent and combustion air system thoroughly to ensure systems are airtight and comply with the instructions given in the venting supplement and are within all requirements of applicable codes. Failure to comply with the installation requirements on the venting and combustion air piping will cause severe personal injury or death.

##### NOTICE

Contact ACV-Triangle Tube for other venting options including PVC Concentric Vent/Air Termination Supplement 2008-04 or CHALLENGER Concentric Vent/Air System Supplement 2011-60. Refer to these instructions for parts list and method of installation.

#### Installing Condensate Drain Assembly

1. Locate the condensate trap assembly and cut top with hacksaw or knife and install as shown in Fig. 13 page 29.

##### NOTICE

The installer must fill the condensate trap with water prior to assembling on the appliance. Do not operate appliance without factory supplied condensate trap installed on appliance.

2. Remove front door and install trap. Ensure the trap is completely seated and secure on the appliance.
3. Connect 13/16" ID tubing to the drain barbed fitting of the trap assembly.

##### NOTICE

The drain line materials must be an approved material by the authority having jurisdiction. In absence of such authority, PVC and CPVC piping must comply with ASTM D1785 or D2845. The cement and primer used on the piping must comply with ASME D2564 or F493. For installations in Canada, use ULC certified PVC or CPVC pipe, fittings and cement/primer.

4. Continue the tubing from the trap assembly to a floor drain or condensate pump.

##### NOTICE

When selecting and installing a condensate pump, ensure the pump is approved for use with condensing appliances. The pump should be equipped with an overflow switch to prevent property damage from potential condensate spillage.

5. The CHALLENGER will typically produce a condensate that is considered slightly acidic with a pH content below 4.0. Install a neutralizing filter if required.



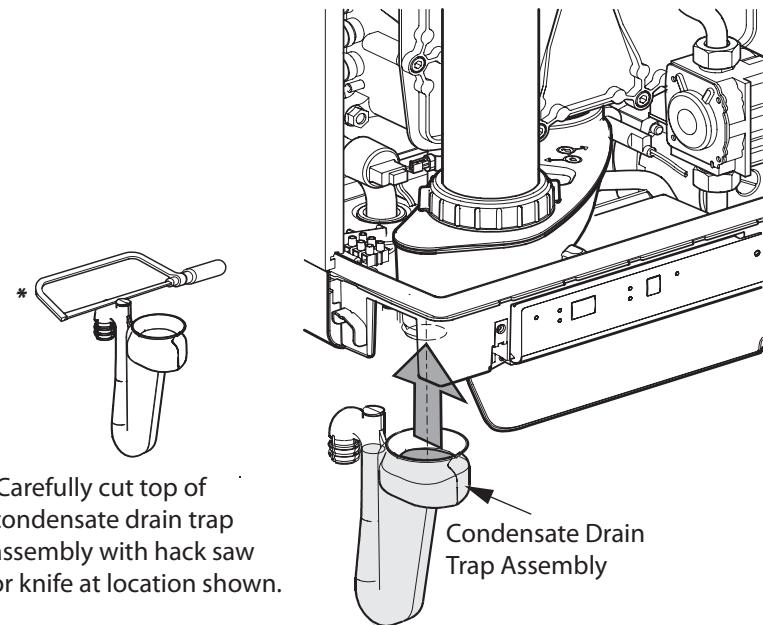
##### CAUTION

The condensate drain must remain filled, unobstructed and allow unrestricted flow of condensate. The condensate should not be subject to conditions where freezing could occur. If the condensate is subjected to freezing or becomes obstructed, it can leak, resulting in potential water damage to the appliance and surrounding area.

---

## Installation Vent/Combustion Air & Condensate Drain

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**Fig. 13: Condensate Drain Trap Assembly**

## Gas Piping

### SECTION VII - 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. Install a 1/2" NPT pipe union at the factory supplied gas piping nipple, for ease of service.
2. Install the factory supplied manual shutoff valve in the gas supply piping as shown in Fig. 14. For installations in Canada the installer must tag and identify the main shutoff valve.
3. Install a sediment trap (drip leg) on the gas supply line prior to connecting to the CHALLENGER gas train as shown in Fig. 14.
4. Support the gas piping using hangers. Do not support the piping by the appliance or its components.
5. Purge all air from the gas supply piping.
6. Before placing the CHALLENGER into operation, check and test all piping connections for leaks.
  - Close the manual shutoff valve during any pressure test with less than 13" w.c. [32 mbar].

- Disconnect the CHALLENGER and its gas valve from the gas supply piping during any pressure test greater than 13" w.c. [32 mbar].

##### **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.**

7. Use pipe joint compound 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**

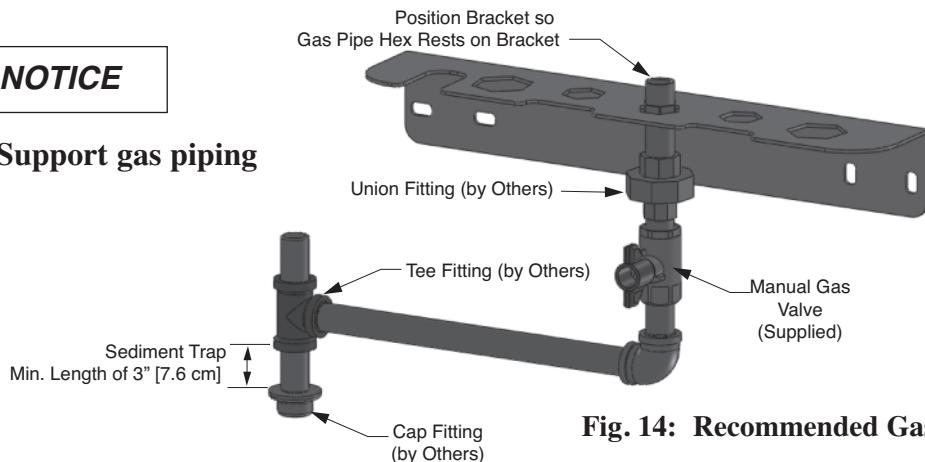
**Failure to apply pipe joint compound as detailed above can result in severe personal injury, death or substantial property damage.**

##### **WARNING**

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

##### **NOTICE**

#### Support gas piping



**Fig. 14: Recommended Gas Supply Piping**

## Gas Piping

### NATURAL GAS

#### Pipe Sizing - Natural Gas

Refer to Table 1 for schedule 40 metallic pipe length and diameter requirements for natural gas, based on rated CHALLENGER 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. [0.75 mbar].
- For additional gas piping sizing information, refer to ANSI Z223.1. For Canadian installations refer to B149.1.

#### Natural Gas Supply Pressure Requirements

1. Pressure required at the gas valve inlet supply pressure port:
  - Maximum 13" w.c. [32 mbar] at flow or no flow conditions to the burner.
  - Minimum 5" w.c. [13 mbar] during flow conditions to the burner. Must be verified during start up and with all other gas appliances operating within the gas piping service.
  - Maximum gas inlet pressure must not be exceeded and minimum gas inlet pressure is for the purpose of input adjustment.

2. Install 100% lockup gas pressure regulator in the gas supply line if inlet pressure can exceed 13" w.c. [32 mbar] at any time. Adjust the lockup pressure regulator for 13" w.c. [32 mbar] 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 and propane gas 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.**

**Table 2: Natural Gas Orifice Requirements**

| CHALLENGER MODEL | Natural Orifice Size | Orifice Marking |
|------------------|----------------------|-----------------|
| CC85             | 0.256" [6.50 mm]     | 650             |
| CC105            | 0.256" [6.50 mm]     | 650             |
| CC125            | 0.285" [7.25 mm]     | 725             |

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

| Length of Pipe in Feet | Capacity of Schedule 40 Metallic Pipe in Cubic Feet of Natural 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" | 1-1/2" |
| 10                     | 132  | 278  | 520 | 1050   | 1600   |
| 20                     | 92   | 190  | 350 | 730    | 1100   |
| 30                     | 73   | 152  | 285 | 590    | 890    |
| 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    |

## Gas Piping

### PROPANE GAS

#### Pipe Sizing - Propane Gas

#### **⚠ WARNING**

The unit was shipped with a propane conversion kit which is located on the top of the unit in the instructions packet. This kit includes all the necessary parts and instruction to perform the conversion from natural to propane gas. If this conversion kit is missing, please contact ACV-Triangle Tube Technical Support before installing unit for missing kit.

#### **⚠ 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 the propane orifice, see Fig. 15, failure to ensure proper burner setup could result in severe personal injury, death or substantial property damage.

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

#### Propane Gas Supply Pressure Requirements

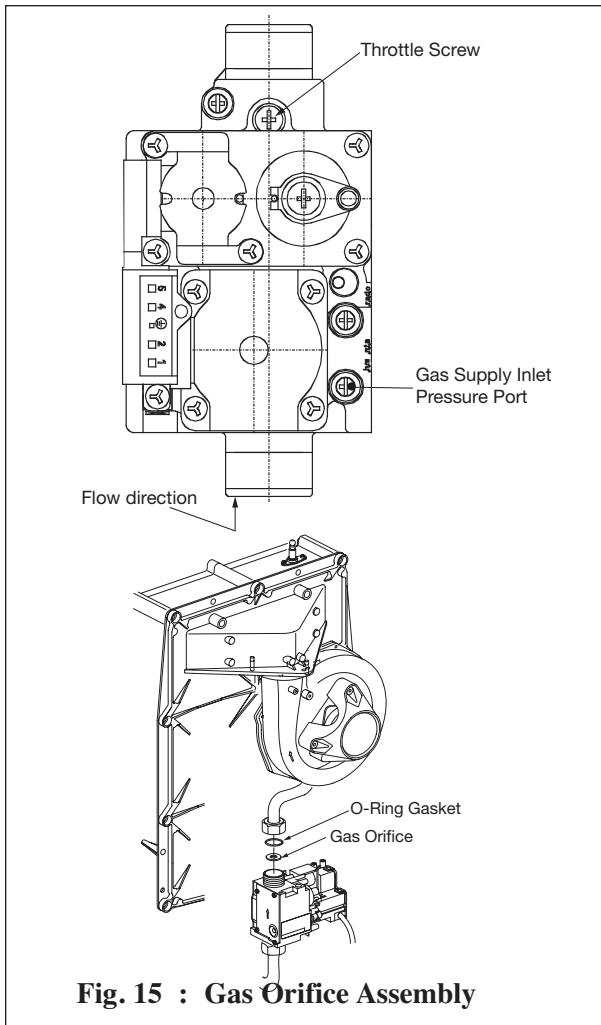
1. Adjust the propane supply regulator provided by the gas supplier for 13" w.c. [32 mbar] maximum pressure
2. Pressure required at the gas valve inlet supply pressure port:
  - Maximum 13" w.c. [32 mbar] at flow or no flow conditions to the burner
  - Minimum 5" w.c. [13 mbar] during flow conditions to the burner. Must be verified during start up and with all other gas appliances operating within the gas piping service.
  - Maximum gas inlet pressure must not be exceeded and minimum gas inlet pressure is for the purpose of input adjustment.

#### **⚠ 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.

Table 3: Propane Gas, Orifice Requirements:

| CHALLENGER MODEL | Propane Orifice Size | Orifice Marking |
|------------------|----------------------|-----------------|
| CC85             | 0.199" [5.05 mm]     | 505             |
| CC105            | 0.199" [5.05 mm]     | 505             |
| CC125            | 0.220" [5.60 mm]     | - 580 -         |



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## Internal Wiring

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### SECTION VIII - 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.

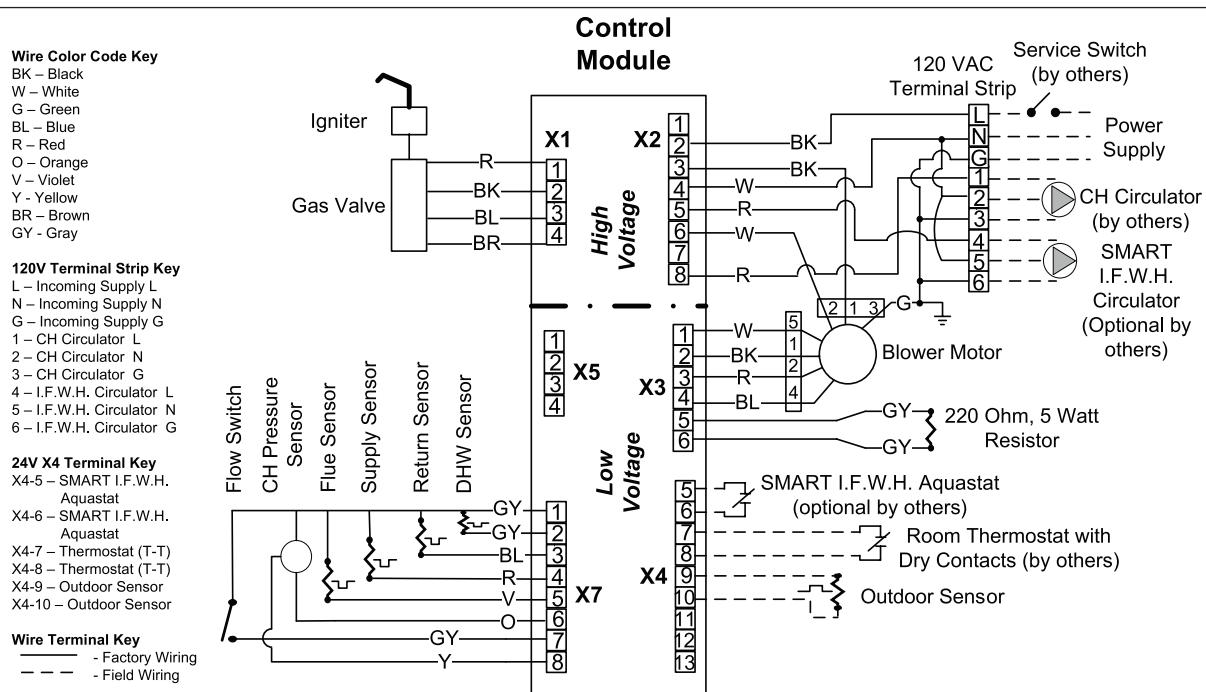
 **CAUTION**

Prior to servicing, label all wires before disconnecting. Wiring errors can cause improper and dangerous operation. Verify proper wiring and operation after servicing.

#### General Requirements

- Wiring must be N.E.C Class 1.
- If original wiring as supplied with the appliance must be replaced, use only Type T 194F [90°C] wire or equivalent as a minimum.
- The CHALLENGER must be electrically grounded as required by National Electrical Code ANSI/NFPA 70 - latest edition and / or the Canadian Electrical Code Part 1, CSA C22.1, Electrical Code.

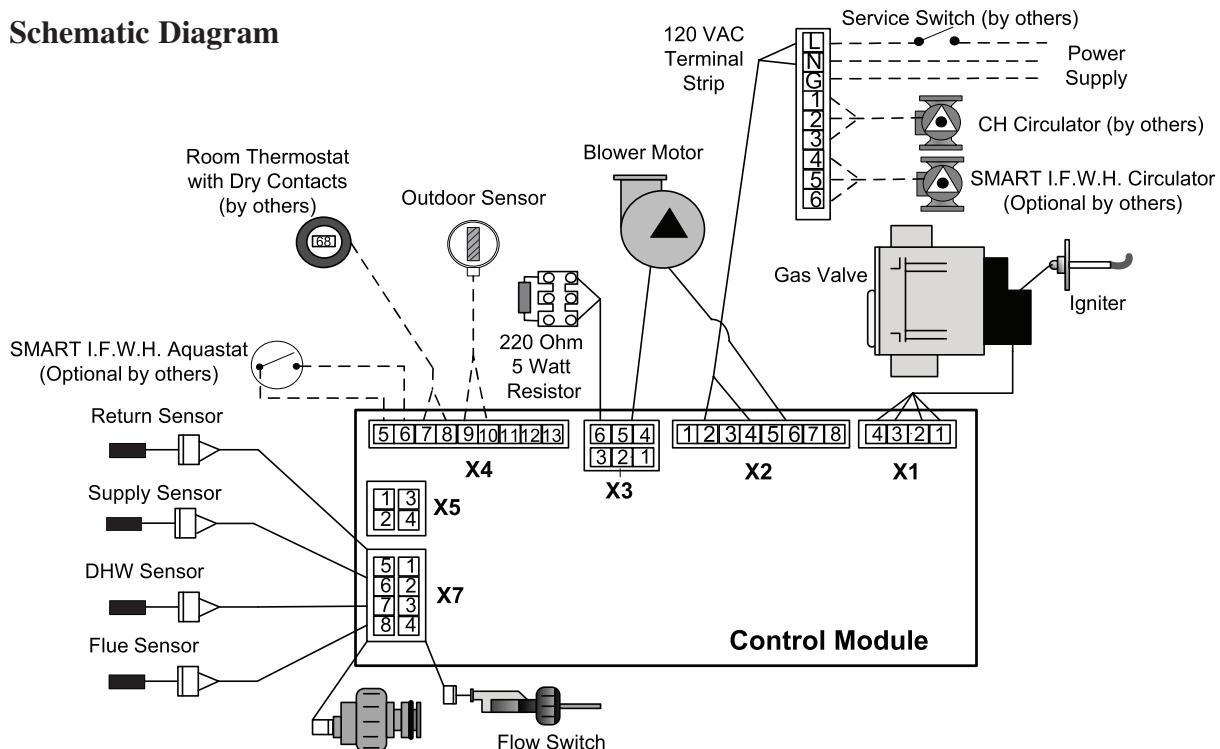
## Internal Wiring



**Ladder Diagram**

- Note**
- The wiring for 120V field connections to the appliance shall have a minimum size of 14 AWG and a temperature rating of at least 194°F (90°).
  - If any of the original wire as supplied with the appliance must be replaced with T wire or it's equivalent.

## Schematic Diagram



**Fig. 16: CHALLENGER Factory Wiring Diagrams**

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## External Wiring

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### SECTION IX- 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**

The ON/OFF switch of the CHALLENGER only disables the function of the appliance. Electrical power remains at the control module. To avoid a shock hazard, disconnect power at the external service switch when servicing the appliance.

#### Control Module Circulator AMP Ratings

- AMP draw of the CH circulator must not exceed 2.3 amps.

 **WARNING**

**ELECTRICAL SHOCK HAZARD.** Before making any electrical connections to the CHALLENGER, disconnect electrical power supply at the service panel. Failure to comply can cause severe personal injury or death.

#### Line Voltage Connections

1. Connect a 120 VAC/15A service to the 120V terminals L, N and G inside the CHALLENGER as shown in Fig. 16, page 34.
2. Route the incoming 120 VAC power wire through the provided openings in the bottom right side jacket panel.
3. The appliance must be provided with an external service switch, check local code requirements for compliance.

**NOTICE**

**The installer must provide and install a fused disconnect or 15 amp (minimum) service switch. Check local electrical code requirements for compliance.**

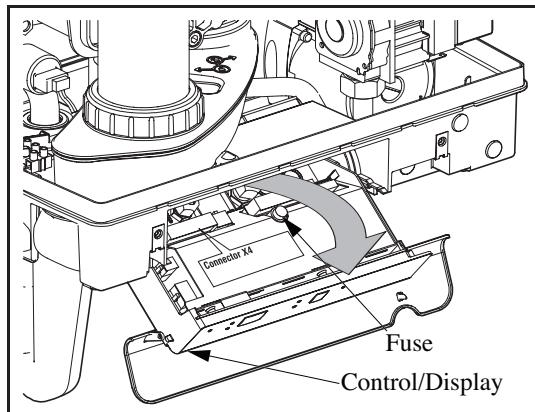
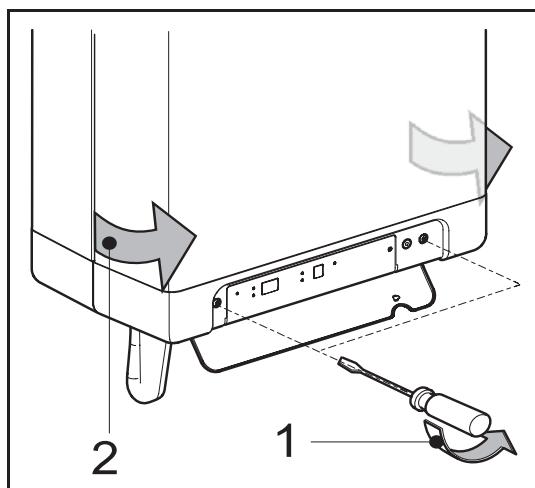
## External Wiring

### Low Voltage Connections

1. Open the display cover and unscrew both screws to remove the front cover
2. Pull the control/display forward until it tips downward to provide access.
3. Ensure field installed low voltage wiring is not run parallel or next to telephone or power cable.
4. Consult Table 4 for making low voltage connections.

**Table 4: Low Voltage Electrical**

| Temperature control                  | Connector X4 | Notes        |
|--------------------------------------|--------------|--------------|
| Room thermostat                      | 7 – 8        | Voltage free |
| Outside temperature sensor           | 9 – 10       | -            |
| SMART I.F.W.H<br>Aquastat (Optional) | 5 – 6        | Voltage free |



**Fig. 17: Accessing Low Voltage X4 Connections**

### Thermostat Wiring

#### NOTICE

**Isolate 120V wiring from low voltage wiring to prevent any potential electrical “noise”.**

1. Connect room thermostat or the end switch (isolated contact only) to the low voltage terminal strip on the drop down control panel, as shown in Fig. 16, page 34 and Fig. 17.
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 0.1 amps when wired directly to the CHALLENGER.
  - 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.

#### NOTICE

**When making low voltage connections to the CHALLENGER, ensure no external voltage is present in the thermostat circuits. If external voltage is present, provide an isolated contact to prevent damage to the appliance control.**

## External Wiring

# CH Circulator

1. Connect the CH primary circulator to the CHALLENGER 120 V terminals 1,2 and 3 located inside the appliance as shown in Fig. 16, page 34.
  2. Maximum CH circulator continuous current draw is 2.3 A.

## DHW Circulator for Optional Smart IFWH

1. Connect the DHW circulator using the CHALLENGER 120V, terminals 4, 5 and 6 located inside the appliance as shown in Fig. 16, page 34.
  2. Remove one of the gray plastic strain reliefs on the bottom of the boiler and install a field supplied duplex connector and two washers in its place. Place one washer on the inside and the other outside of the boiler before installing the duplex connector. The duplex connector will allow the wiring from the domestic circulator to enter the boiler.

3. Maximum DHW circulator continuous current draw is 2.3 A.

## **System Circulator - Zone Valve Application**

To energize the system circulator shown as item 12 in Fig. 8 page 20 reference Fig. 18. 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.

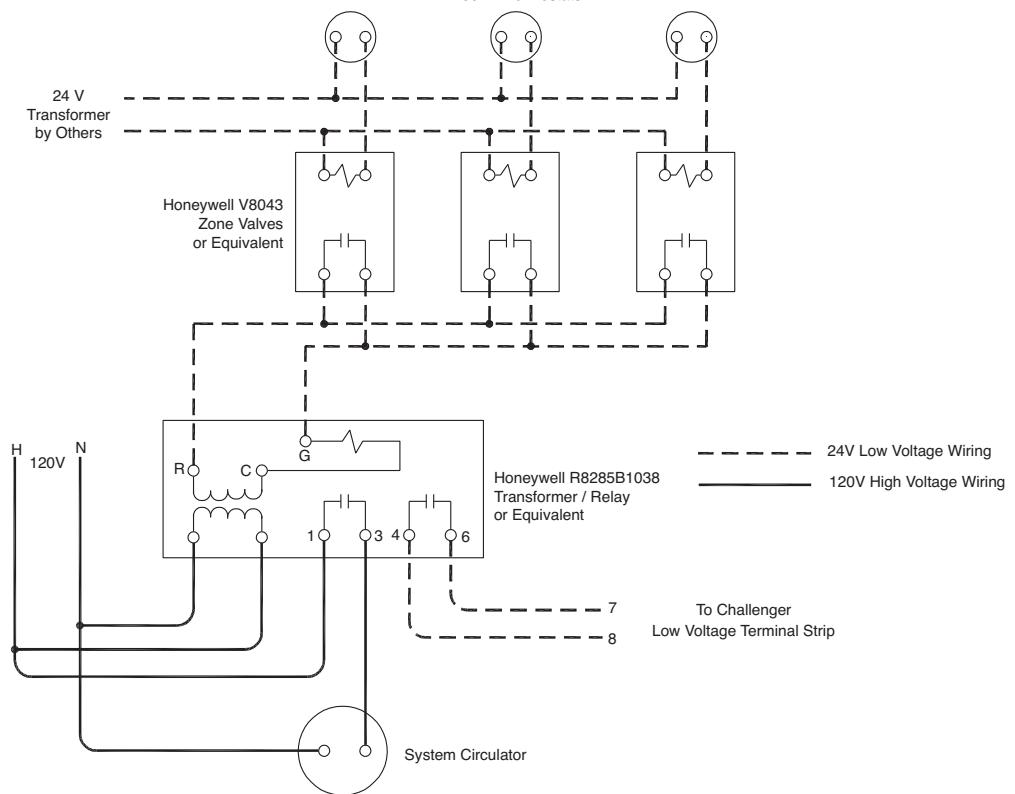
## Outdoor Reset Control

The CHALLENGER may operate with a variable appliance operating temperature using the ACV-Triangle Tube outdoor sensor, see pages 55 through 57 for installation and set-up.

## **NOTICE**

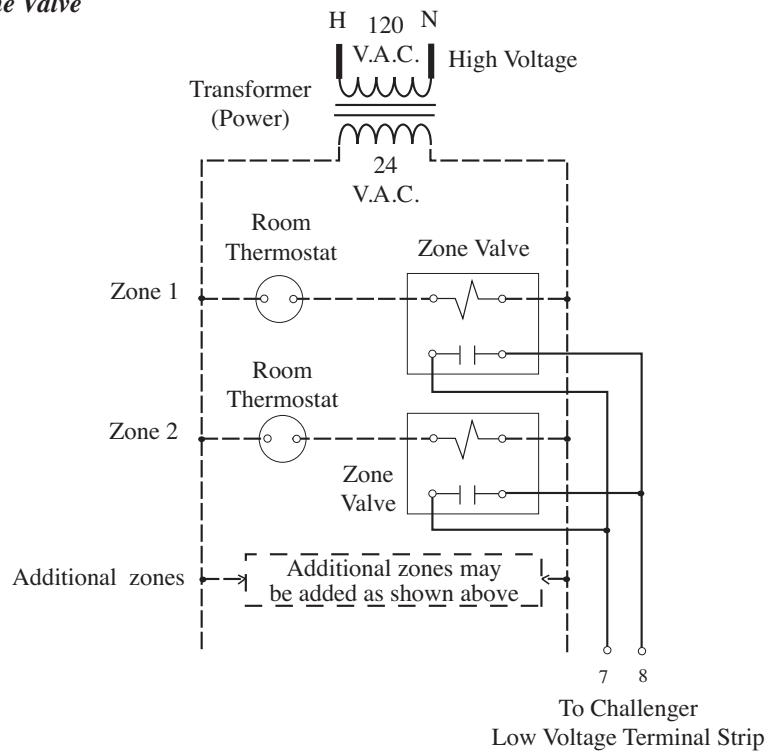
If the installer opts for a fixed operating temperature for the boiler system, the outdoor sensor is not required and should not be installed.

**Fig. 18: Secondary System Circulator Wiring**

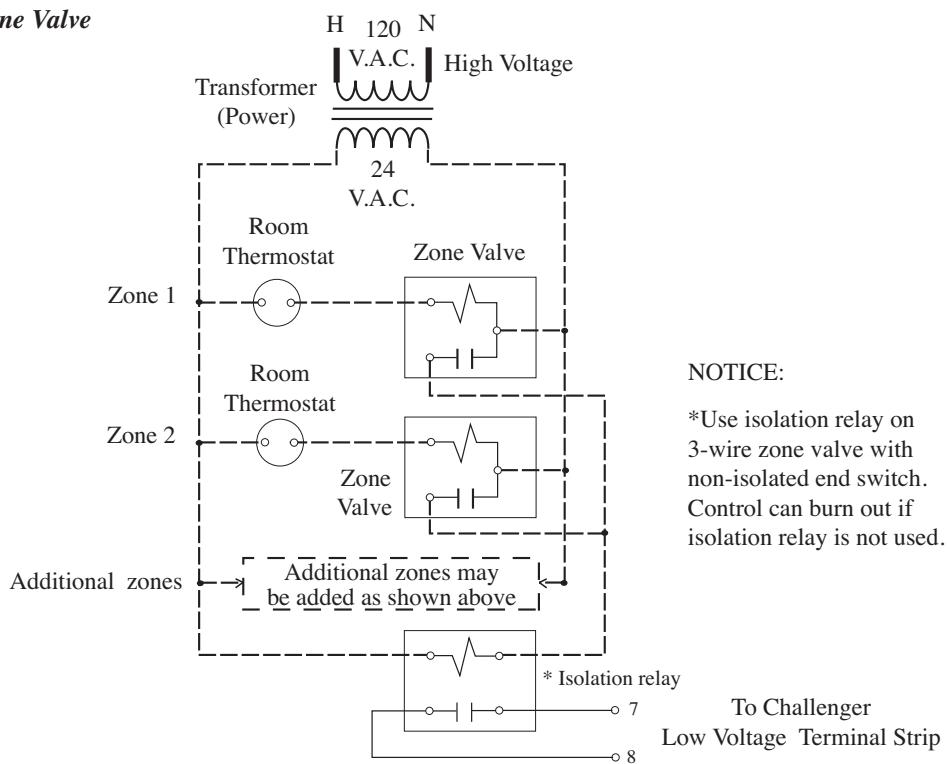


## External Wiring

### 4 Wire Zone Valve



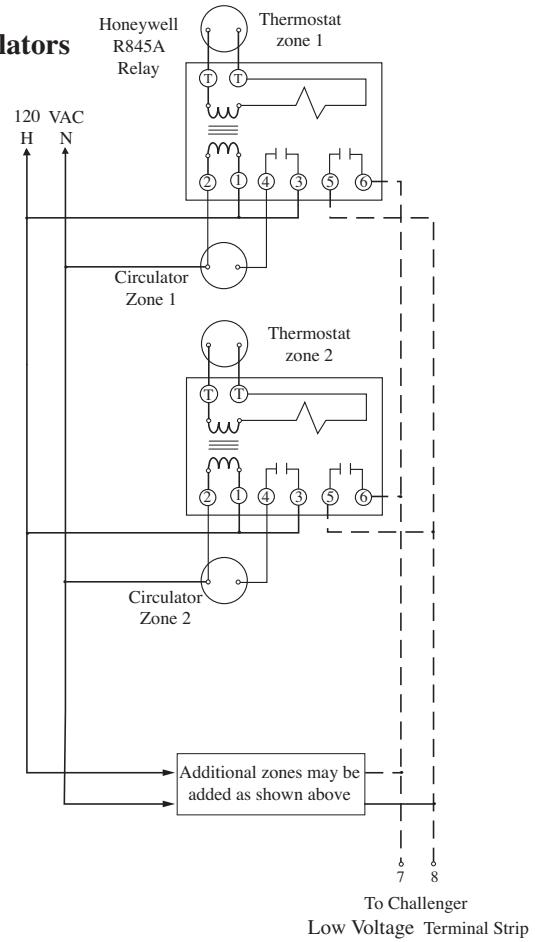
### 3 Wire Zone Valve



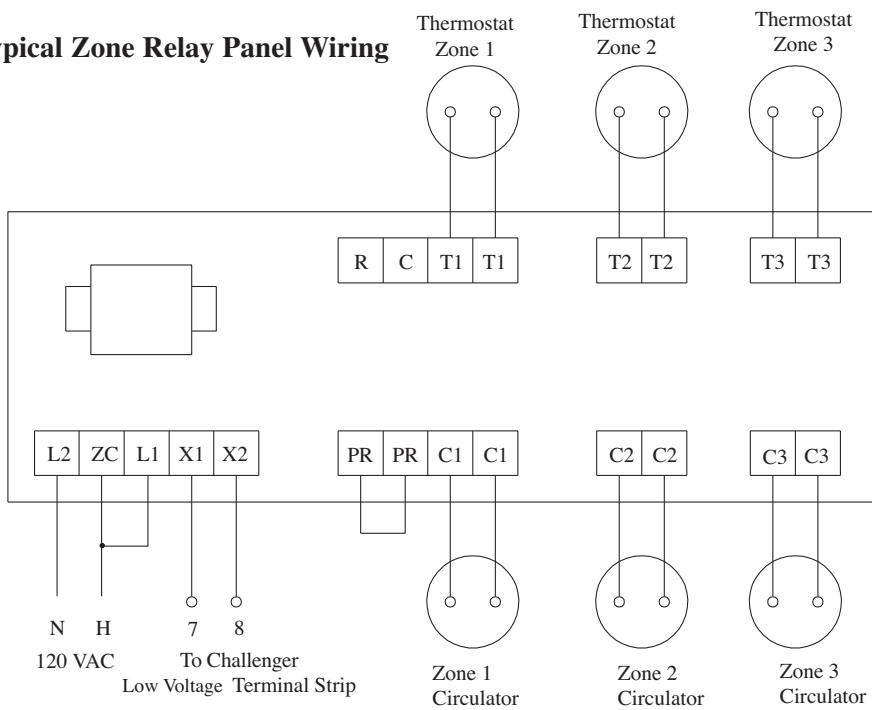
**Fig. 19: Multiple Zone Field Wiring Using Zone Valves**

## External Wiring

**Fig. 20: Field Wiring with Zone Circulators**



**Fig. 21: Typical Zone Relay Panel Wiring**



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## Start-Up Preparation

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### SECTION X - Start-Up Preparation

#### Check Boiler System Water Chemistry

 **WARNING**

**Do not use petroleum-base cleaning or sealing compounds in the boiler 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 6.5 to 8.5

Maintain the boiler water pH between 6.5 and 8.5. 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 CHALLENGER or leave the appliance filled, until the condition is corrected.

#### Water Total Hardness Less Than 7 Grains/Gallon

For areas with unusually hard water (total hardness above 7 grains/gallon or 120ppm or mg/l) consult a water treatment company.

#### Chlorinated Water

Do not use the CHALLENGER to heat a swimming pool or spa directly.

Maintain the chlorine level of the water at levels considered safe for drinking.

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

The installer must flush the boiler system to remove any sediment to allow proper operation of the CHALLENGER .

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

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

#### Check and Test Antifreeze

For boiler 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 or Class of 1, as listed in Clinical Toxicology of Commercial Products.**

## Start-Up Preparation

### Use of Antifreeze in the Boiler System

#### **WARNING**

**NEVER use automotive or ethylene glycol antifreeze or undiluted antifreeze in the boiler 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 boiler water volume of the CHALLENGER CC 85 is 0.37 gallons [1.4 l], CC 105 is 0.42 gallons [1.6 l] and CC 125 is 0.50 gallons [1.9 l]. Remember to include this volume in sizing of the expansion tank.

Check with local codes requirements for the installation of backflow preventers or actual disconnection from the boiler's cold water fill or make up water supply line.

#### **NOTICE**

**Massachusetts Code requires the installation of a backflow preventer if antifreeze is used.**

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 or Class of 1, as listed in Clinical Toxicology of Commercial Products.**

### Filling the Boiler System

1. Close the boiler drain valve located on the bottom of the appliance and any manual or automatic air vent in the system.
2. Open all system isolation valves.
3. Fill the boiler system to correct system pressure. Correct pressure will vary with each application.

#### **NOTICE**

**Typical residential system fill pressure is 12 psi [0.8 bar]. System pressure will increase when system temperature increases. Operating pressure of the system should never exceed 25 psi [1.7 bar].**

4. Purge air and sediment from each zone of the hydronic system through the purge valves. Open air vents to allow air to be vented from the zones.
5. Once the system is completely filled and purged of all air and sediment, check the system pressure and check/repair any leaks.

#### **WARNING**

**Unrepaired system leaks will cause continual makeup water to be added to the appliance. Continual makeup water could cause mineral buildup within the heat exchanger, reducing the heat transfer, causing possible heat buildup and eventual heat exchanger failure.**

### Check Low Water Cut Off/CH Pressure Sensor

- The CHALLENGER is provided with a factory installed LWCO that senses boiler CH system pressure of more than 7 psig [0.5 bar].
- Compare CH system pressure gauge reading to CHALLENGER's control pressure display reading, which can only be viewed when control is ON and no CH or DHW call is present. Adjust pressure accordingly.

## Start-Up Preparation

### 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**

**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 the control terminal strip, located on the drop down panel.
- Connect a voltmeter across the wire ends of the external thermostat wiring.
- Energize each thermostat, zone valve and relay in the external circuit, individually 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 CHALLENGER control panel.

- Reconnect the external thermostat wires to the control terminal strip.

### Inspection of Condensate Drain Assembly

1. Inspect and ensure the Condensate Drain Assembly is properly installed as described on page 28 and shown in Fig. 13 on page 29.
2. Remove the Condensate Drain Assembly and fill with fresh water.

#### **NOTICE**

The condensate drain assembly must be installed on the appliance and filled with water when the CHALLENGER is in operation. The condensate drain assembly prevents flue gas emissions from entering the condensate line. Failure to ensure trap is filled with water could result in severe personal injury or death.

3. Re-Install the condensate drain assembly.

## Start-Up Procedures

### SECTION XI - Start-Up Procedures

#### Final Checks Before Start-Up

- Read page 46 through 57 regarding the operation of the CHALLENGER control.
- Verify the CHALLENGER and the boiler system are full of water and all system components are correctly set for operation, including the minimum flow rate through the boiler, see pages 79-81.
- Verify Start-up Preparation items outlined on pages 40 thru 42 have been completed.
- Verify all electrical connections are correct and securely fastened.
- Inspect vent and combustion air piping for signs of deterioration from corrosion, physical damage or sagging. Verify combustion air and vent piping are intact and correctly installed and supported. Reference the proper CHALLENGER vent supplement.
- Verify burner configuration - gas orifice size.
  - Check for proper labeling on the gas valve (propane only) and the rating label for proper gas configuration.
  - If there is doubt on the burner configuration, remove the gas valve and check for proper gas orifice size. See pages 31 and 32 for orifice sizes.
- Ensure the vent Condensate Drain Assembly is filled with water.

#### CHALLENGER Start-Up

1. Turn ON the electrical supply/service to the appliance. Press the ON-OFF button “①” located on the front control panel to the OFF position.
2. Read and follow the Operating Instructions outlined on page 45.

#### If CHALLENGER Does Not Start Correctly

1. Verify DHW and CH systems are turned ON (parameter 1) is set to “0”. Read setting the appliance parameters section of the

manual starting on page 52 for more information.

2. Check for loose electrical connections, blown fuse (external or internal at the appliance control) or open service switch.
3. Is the external limit control (if applicable) open? Ensure the external limit is reset to the closed position.
4. Is the gas supply valve(s) open at the appliance and meter?
5. Is incoming gas supply pressure at the appliance more than 5”w.c. [13 mbar] and less than 13” w.c. [32 mbar] for natural or propane with all gas appliances ON or OFF.
6. Are the heating thermostats set above room temperature?

If none of these conditions correct the problem, contact ACV-Triangle Tube Tech Service.

#### Check the CHALLENGER and System

##### Check Piping.

Check 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 piping.

#### **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.

## Start-Up Procedures

### Check Gas Piping

Check around the appliance for gas odor following the procedure outlined in this manual on Page 42.

#### **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 on the left side of the heat exchanger. The flame should be blue and stable and should be the length of the burner.

#### **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 rate. To manually place the appliance into high or low fire mode, reference page 50. The combustion reading should be within the range listed in Table 5. **The CO level should not exceed 100 ppm when combustion is correct.**

#### **WARNING**

**The combustion levels should be measured at high and low firing rate, refer to page 50 of the CHALLENGER control section on how to set the firing rate. If the combustion levels are not within the range given in Table 5 for the firing rate, shut the appliance down and contact**

**ACV-Triangle Tube Technical Support. Failure to comply with this requirement could result in severe personal injury, death or substantial property damage.**

**Table 5: Recommended Combustion Levels**

|   | Natural Gas   | Propane Gas  |
|---|---|--|
| High Fire<br>(h or H)   | 9% to 10.1% CO <sub>2</sub>   | 10.5% to 11.1% CO <sub>2</sub>   |
| (  and +)<br>DOOR OFF*       | 5% to 3.2% O <sub>2</sub>   | 5% to 4.1% O <sub>2</sub>  |
| Low Fire<br>(L)<br>(  and -) | 0 to 0.4 lower CO <sub>2</sub> than high fire<br>9.0 % min. CO <sub>2</sub> | 0 to 0.4 lower CO <sub>2</sub> than high fire<br>10.5 % min. CO <sub>2</sub> |
| CO Max.   | 100 ppm   | 100 ppm  |

\* Door open can raise the maximum allowable CO<sub>2</sub> by 0.4 or lower the minimum allowable O<sub>2</sub> by 0.6.

### 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 50.
2. Operate the appliance for approximately 10 minutes.
3. Turn off all gas appliances on the gas service, except the CHALLENGER.
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:  
$$3600 \times 1000 / \text{number of seconds recorded for one cubic foot of gas} = \text{BTU/H}$$
6. The BTU/H calculated should approximate the input rating listed on the appliance.

## Start-Up Procedures

### FOR YOUR SAFETY READ BEFORE LIGHTING



**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 “OFF” all electrical power to the appliance.
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 “ON” all electric power to the appliance. Push ON/OFF button on the CHALLENGER control panel display until LED above button is lit.
8. Set room thermostat(s) to desired setting(s).
9. The CHALLENGER control panel display will show a sequence of numbers (1,2,3,4) as the right digit. Sequence digit 3 or 4 indicates the appliance is firing. A blank display 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“OFF” all electric power to the appliance if service is to be performed.
3. Turn the external manual gas valve handle clockwise  to “CLOSE”, (valve handle shall be perpendicular to gas piping).

## Start-Up Procedures

### Appliance ON/OFF

1. The appliance operation is started using the ① ON/OFF button.
2. When appliance is in operation, the green LED above the ① ON/OFF will be lit.
3. When the appliance is not in operation, the green LED above the ① ON/OFF will not be lit. The main display will show "OFF" and the operating display will show - .

### Set Boiler Maximum Central Heating (CH) Set Point Temperature

1. Press the CH/DHW/Parameter button "I" at the display panel for approximately 2 to 3 seconds until the radiator symbol "III" (CH) LED, lights up and the main display begins to flash.
2. Press the + or - buttons to set the desired maximum temperature setting on the main display.
3. Press the ↩ reset button to close the setting menu and store the changes.

#### NOTICE

If the ↩ reset button is not pressed within 30 seconds, the settings menu is automatically closed and the changes are stored.

If the ① ON/OFF button is pressed prior to the ↩ reset button, the settings menu is closed and the changes are NOT stored.

### Operation Verification - Space Heating

#### NOTICE

Digits and characters shown in brackets [ ], in the following outline, represent the control module operating display.

1. Set the room thermostat to the lowest setting.

2. Turn off power to the appliance, wait a few seconds and turn on power to the appliance.

3. The following operating displays should occur:

[A] Self check on power up

[ ] No call for heat

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

[1] This is the prepurge cycle. The burner blower and the boiler circulator become energized. The blower has a 5 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, the burner will begin to modulate.

- If the burner flame is not established the control module will repeat the ignition sequence after approximately 15 seconds. If the flame is not established after four attempts the control will lockout. The main display will show [4] and the fault LED above the ↩ reset button will flash and [E] will flash in the operating display.

- To verify flame failure safety 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 Central Heating (CH) operation cycle. The control module will begin to modulate the burner firing rate based on actual appliance outlet temperature and the set point temperature. The CH water temperature is displayed on the main display.

5. Allow the appliance to operate and the boiler outlet temperature to reach the set point temperature.

## Start-Up Procedures

- [1] The setpoint temperature has been reached. Combustion will cease and the post purge cycle of the blower begins. The control module will de-energize the gas valve and the blower will continue with the 10 second post purge cycle, before shutting down. The CH circulator will continue to run until the room thermostat is satisfied.
6. 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.
- [7] The CH circulator will continue to run for a 1 minute post pump cycle.

### NOTICE

The CH circulator automatically runs for 10 seconds once every 24 hours to prevent seizing. Timing for this automatic switching starts after the last call for heat.

- [ ] The appliance is in Standby MODE waiting for a call for heat.
7. Verify the operation of the appliance by repeating the operational sequence several times.
8. Return the room thermostat to a desired setting.

## Set DHW Set Point Temperature

1. Press the CH/DHW/parameter button “” at the display panel for approximately 2 to 3 seconds until the faucet “” (DHW) LED lights up and the main display begins to flash.
2. Press the + or - buttons to set the desired domestic water temperature on the main display. Minimum setting is 104°F [40°C], Maximum setting is 149°F [65°C], factory default is 120°F [49°C].

3. Press the  reset button to close the setting menu and store the changes.

### NOTICE

If the  reset button is not pressed within 30 seconds, the settings menu is automatically closed and the changes are stored.

If the ① ON/OFF button is pressed prior to the  reset button, the settings menu is closed and the changes are NOT stored.

## Operation Verification - Domestic Hot Water (if applicable)

### NOTICE

Digits and characters shown in brackets [ ], in the following outline, represent the control module operating display.

1. Set the room thermostat to the lowest setting.
2. Turn off power to the appliance, wait a few seconds and turn on power to the appliance.
3. The following operating displays should occur:
  - [A] Self check on power up
  - [ ] No call for heat
4. Turn on a domestic hot water faucet to initiate a domestic call. The display should show
  - [1] This is the prepurge cycle. The burner blower become energized. The blower has a 5 second prepurge cycle. The CH (central heating) circulator will remain off, to provide DHW priority.
  - [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, the burner will begin to modulate.

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## Start-Up Procedures

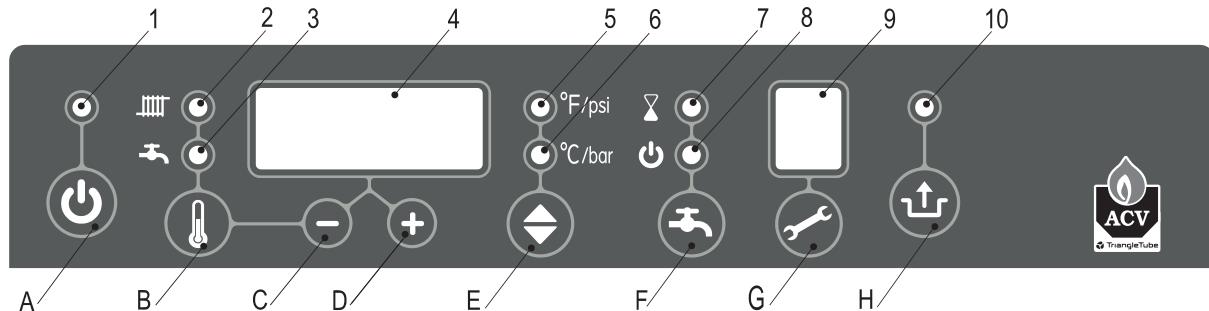
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- If the burner flame is not established the control module will repeat the ignition sequence after approximately 15 seconds . If the flame is not established after four attempts the control will lockout and the main display will show [4] and the fault LED above the  reset button will flash and [E] will flash in the operating display.
  - To verify flame failure safety 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.
- [4] This is the normal DHW operation cycle. The control module will begin to modulate the burner firing rate based on actual DHW set point temperature. The DHW water temperature is displayed in the main display.
5. Turn off the domestic hot water faucet to end the call for heat.

[1] This begins a post purge cycle. The control module closes the gas valve and the blower continues to operate for approximately 10 seconds.
  6. Verify the DHW operation by repeating the outlined operation sequence several times.

## Start-Up Procedures

### Control Display



#### Read-Out

1. On/Off (Lit when on)
2. CH operation or setting maximum CH temperature
3. DHW operation or setting DHW temperature
4. Main display with temperature of CH or DHW or CH water pressure or fault code
5. Temperature °F or pressure psi
6. Temperature °C or pressure bar
7. DHW function eco (learned)
8. DHW function on (minimum block temp)
9. Operating display
10. Flashes to indicate fault

#### Operation

- A. On/Off button
- B. CH / DHW/parameter button
- C. - button
- D. + button
- E. Units U.S. customary or metric
- F. DHW function off/eco/on
- G. Service button
- H. Reset/store button

### Appliance ON/OFF

1. The appliance operation is started using the ① ON/OFF button.
2. When appliance is in operation, the green LED above the ① ON/OFF will be lit.
3. When the appliance is not in operation, the green LED above the ① ON/OFF will not be lit. The main display will show "OFF" and the operating display will show - .

### Additional DHW Functions

Additional DHW setting can be activated by pressing the DHW button.

- ON (① LED lit above the DHW button) - The appliance DHW function is activated continuously. The appliance will maintain a minimum heat exchanger temperature to assure instant delivery of hot water.
- ECO ( LED lit above the DHW button) - The DHW function is self-learning. The appliance will maintain a minimum heat exchanger temperature during times with typical domestic demands, learned over the past 3 days of use.
- OFF (no LED lit) - The appliance will not maintain a minimum heat exchanger temperature. This will affect the delivery and performance of the initial DHW temperature.

#### NOTICE

**Units cannot be changed if the main display (Parameter Mode) or operating display (Error Mode) is flashing.**

#### BEST PRACTICE

**In application in which the DHW is not utilized or the DHW demand is minimal, set the DHW function to OFF.**

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## Start-Up Procedures

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### Test Mode Function

**TO TEMPORARILY PLACE THE BURNER INTO HIGH FIRE TEST MODE:** press and hold both the “” and “+” button simultaneously once until operating display shows “h” for CH high fire or twice until the operating display shows “H” for DHW high fire.

While in the test mode:

- high limit will function
- appliance 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 and hold both the “” and “-” button simultaneously until operating display shows “L”.

### Flame Current

While in high fire or low fire test modes the flame current ( $\mu\text{A}$ ) can be checked at the control by pressing and holding the “” DHW button.

**TO DEACTIVATE THE HIGH OR LOW FIRE TEST MODE:** press and hold both the “+” and “-” button simultaneously.

### Control Software Version

To view the control software version cycle the incoming power off then on to the CHALLENGER at the wall switch.

## Start-Up Procedures

| Main Display | Operating Display | Function  |
|--------------|-------------------|---|
| OFF          | —                 | Press ① button to turn appliance ON<br>LED lite above ① button will be lit when appliance is ON |
| XXP          |                   | No demand for heat  |
| XXP          | A                 | Control self-test   |
| XXX          | 1                 | Fan pre purge or post purge cycle   |
| XXX          | 2                 | Ignition sequence   |
| XXX          | 3                 | Burner ON for space heating (CH)  |
| XXX          | 4                 | Burner ON for domestic hot water (DHW)  |
| XXX          | 6                 | Burner OFF due to reaching temperature setpoint   |
|              | 7                 | Space Heating (CH) post pump cycle  |
|              | 8                 | Burner ON for DHW pre-heating   |
|              | 9                 | Burner ON for freeze protection   |
| LOP*         |                   | Raise CH pressure above 7 psig [0.5 bar]  |
| ODS**        |                   | Outdoor sensor not installed  |
| POLE         |                   | Incoming line and neutral are reversed  |

The  LED will be lit for CH (central heating call)

The  LED will be lit for DHW (domestic call)

### NOTICE

**“X” represents temperature or pressure readings. When temperature is displayed it will be followed by “°F” or “°C” in the main display and the appropriate LED will be lit. When pressure is displayed it will be followed by a “P” in the main display. Pressure can only be read when the operating display is blank or shows a “A”.**

\* If factory installed CH Low Water Cut Off (LWCO) is below 7 psig [0.5 bar] the main display will flash a soft lockout of LOP (burner and CH primary pump is blocked) followed by the pressure reading. Once CH system pressure is increased above 7 psig [0.5 bar] normal boiler operation will be restored. Check LWCO wiring if LOP flashes to 90\_P (PSI) or 6.0\_P (bar).

\*\* If the outdoor sensor is not installed the main display will display ODS when the boiler is in standby without a CH or DHW call for heat or any errors. The lack of the outdoor sensor will not prevent the unit from operating on a CH or DHW call for heat, but is recommended to increase system efficiency

## Start-Up Procedures

### Setting the Appliance Parameters

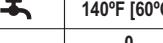
1. Press the “” button at the display panel for approximately 2 to 3 seconds until main display begins to flash.
2. Press the “” button repeatedly to scroll through the list of parameters. The operating display will show the parameter number and main display will show the parameter setting.
3. To modify a parameter press the + or - buttons.
4. Press the “” button to scroll to the next parameter to be changed.

5. After all parameters have been changed, press the  reset button to close the setting menu and store the changes. The main display will go blank and a P will be displayed in the operating display to let you know the control was programmed.

#### **NOTICE**

If the  reset button is not pressed within 30 seconds, the settings menu is automatically closed and the changes are stored.

If the ① ON/OFF button is pressed prior to the  reset button, the settings menu is closed and the changes are NOT stored.

| Main Display  |                  | Operating Display     | Description  | Adjustments  |
|---|------------------|-----------------------|--|--|
| LED (Flashing)  | Factory Settings | Parameters (Flashing) |  |  |
|    | 186°F [86°C]     |                       | Boiler set point temperature                                     | Adjustment range 86°F to 194°F [30°C to 90°C]  |
|  | 140°F [60°C]     |                       | DHW (domestic) setpoint temperature                              | Adjustment range 104°F to 149°F [40°C to 65°C]   |
|   | 0                | 1                     | Installation type  | 0=Combi (Heat and DHW)<br>1=Heating + SMART I.F.W.H. ③<br>2=DHW only (no heating system required)<br>3=Heating only  |
|   | 0                | 2                     | CH pump continuous   | 0=Intermittent pump on for heat and post purge<br>1=Pump continuously active except during DHW call or if outside temperature is above parameter 7 with the outdoor sensor installed - Warm Weather Shut Down. |
|   | 86°F [30°C]      | 5                     | Min. supply temperature of the heat curve                        | Adjustment range 60°F to 140°F [16°C to 60°C]  |
|   | 0°F [-18°C]      | 6                     | Min. outside temperature of the heat curve                       | Adjustment range -22°F to 50°F [-30°C to 10°C]   |
|   | 64°F [18°C]      | 7                     | Max. outside temperature of the heat curve                       | Adjustment range 60°F to 78°F [16°C to 26°C]   |
|   | 1                | 8                     | CH pump post purge period  | Adjustment range 0 to 15 minutes   |
|   | 1                | 9                     | DHW post pump ④  | Adjustment range 0 to 15 minutes   |
|   | 0                | 0                     | Waiting time after a DHW demand before a CH demand is answered ① | Adjustment range 0 to 15 minutes   |
|   | 0                | P                     | Anti-cycling period during CH operation ②                        | Minimal switch-off time in CH operation<br>Adjustable from 0 to 15 minutes   |

#### Note:

- ① The waiting time starts at the end of the DHW call (no DHW flow - DHW flow switch contacts are open) and blocks the burner and CH circulator. If DHW function is turned ON (① LED is lit above the  DHW button) or ECO is ON ( LED is lit above  DHW button) than the burner will continue to fire for DHW until a minimum heat exchanger temperature is achieved. Burner and CH circulator will continue to be blocked until the remaining waiting time ends. This feature only applies if parameter 1 is set to 0.
- ② The anti-cycling time starts when burner shuts down during a CH call due to boiler water reaching the boiler set point temperature plus a 6°F [3°C] differential. The CH circulator will continue to operate while the burner is blocked.
- ③ For installations with a ACV-Triangle Tube SMART Indirect Fired Water Heater (I.F.W.H.) piped off the primary loop, similar to figures 7 and 8 on page 20, parameter 1 should be set to 1. The SMART's aquastat should be wired to CHALLENGER'S X4-5 and X4-6 electrical connectors, see Figure 16, page 34. The domestic I.F.W.H. circulator should be wired using the CHALLENGER's 120 V terminals 4 (line) 5 (neutral) and 6 (ground). During a domestic call for heat on terminals X4-5 and X4-6, only the domestic I.F.W.H. circulator will operate and the boiler's target supply water temperature will shift to 186°F [86°C].
- ④ The DHW post pump function only applies when parameter 1 is set to a setting of 1 Heating & Smart I.F.W.H. and only occurs if no CH call for heat is present

## Start-Up Procedures

### Fluctuating Water Temperature

Domestic water temperatures can fluctuate with factory control settings when the domestic hot water flow is less than 0.7 gpm. The fluctuation is due to the interaction between the domestic water flow switch minimum setting and the domestic hot water mixing valve. As the domestic hot water leaving the appliance approaches the domestic hot water mixing valve setting, the mixing valve reduces the amount of hot water through the appliance below the domestic flow switch minimum setting. The appliance cycles off until the mixing valve opens calling for more domestic water. To improve the domestic hot water performance at low flows it is recommended to reduce the domestic hot water temperature set-point on the control down from 140°F (60°C) to 125°F (52°C), see page 52 and or to turn the domestic function on the control to ON or ECO, see page 49. Additionally, ensure the minimum domestic water pressure is 40 psi (2.8 bar), see page 21. A lower domestic hot water temperature setpoint will reduce the domestic hot water temperature at higher domestic flows.

### Error (Hard Lockout) Mode

If a system fault occurs, the system enters a hard lockout condition which requires a manual reset by pressing the RESET button . A hard lock is indicated by a flashing [E] on the operating display as well as a flashing LED light above the reset  button. The error code is located on the main display. The error must be corrected before the control will reset.



### CAUTION

**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.**

| Temperature (°F) | Temperature (°C) | NTC (kOhm) |
|------------------|------------------|------------|
| -22              | -30              | 171.70     |
| -4               | -20              | 98.82      |
| 14               | -10              | 58.82      |
| 32               | 0                | 36.10      |
| 50               | 10               | 22.79      |
| 68               | 20               | 14.77      |
| 78               | 25               | 12.00      |
| 86               | 30               | 9.81       |
| 104              | 40               | 6.65       |
| 122              | 50               | 4.61       |
| 140              | 60               | 3.25       |
| 158              | 70               | 2.34       |
| 176              | 80               | 1.71       |
| 194              | 90               | 1.27       |
| 212              | 100              | 0.95       |

**Table 6: 12 K Ohm NTC Sensor Resistance**



**The appliance freeze protection feature is disabled during a Hard Lockout, however the CH circulator will operate.**

## Start-Up Procedures

### Error (Hard Lockout) Codes\*

| Main Display          | Operating Display (Flashing) | Error Description  | Possible Solution   |
|-----------------------|------------------------------|--|---|
| 10, 11, 12,<br>13, 14 | E                            | - CH supply sensor fault S1                                | <ul style="list-style-type: none"> <li>• Check wiring for break</li> <li>• Check for proper flow direction</li> <li>• Replace S1</li> <li>• E10 Open sensor</li> <li>• E11 Flow switch sticking or miss installed</li> <li>• E11 Shorted sensor</li> <li>• E12 Decreased too quickly</li> <li>• E13 Increased too quickly</li> <li>• E14 Stuck</li> </ul> |
| 20, 21, 22,<br>23, 24 | E                            | - CH return sensor fault S2                                | <ul style="list-style-type: none"> <li>• Check wiring for break</li> <li>• Check for proper flow direction</li> <li>• Replace S2</li> <li>• E 20 Open sensor</li> <li>• E 21 Shorted sensor</li> <li>• E22 Decreased too quickly</li> <li>• E23 Increased too quickly</li> <li>• E24 Stuck</li> </ul>   |
| 0                     | E                            | - Sensor fault after self check                            | <ul style="list-style-type: none"> <li>• Replace S1 and/or S2</li> </ul>  |
| 1, 28                 | E                            | - Temperature too high                                     | <ul style="list-style-type: none"> <li>• Air in installation</li> <li>• Pump not running</li> <li>• Insufficient flow in installation, shut off valves closed, pump setting too low</li> <li>• Flow switch sticking or miss-installed</li> <li>• Check for wiring</li> </ul>  |
| 2                     | E                            | - CH supply sensor S1 and CH return sensor S2 interchanged | <ul style="list-style-type: none"> <li>• Check for proper flow direction</li> <li>• Replace S1 or S2</li> </ul>   |
| 4                     | E                            | - No flame signal  | <ul style="list-style-type: none"> <li>• Manual gas shut off valve closed</li> <li>• Remove air from gas pipe</li> <li>• Gas supply pressure too low or failing</li> <li>• Gas valve or ignition unit not powered</li> <li>• Incorrect ignition gap</li> <li>• Check adjustment of gas valve</li> </ul>   |
| 5                     | E                            | - Poor flame signal  | <ul style="list-style-type: none"> <li>• Condensate drain blocked</li> <li>• Check adjustment of gas valve</li> </ul>   |
| 6                     | E                            | - Flame detection fault                                    | <ul style="list-style-type: none"> <li>• Replace ignition cable + spark plug cap</li> <li>• Replace ignition unit at gas valve</li> <li>• Replace boiler controller</li> </ul>  |
| 8                     | E                            | - Incorrect fan speed                                      | <ul style="list-style-type: none"> <li>• Fan catching on casing</li> <li>• Wiring between fan and casing</li> <li>• Check wiring for poor wire contact</li> <li>• Replace fan</li> </ul>  |
| 29,30                 | E                            | - Gas valve relay fault                                    | <ul style="list-style-type: none"> <li>• Replace boiler controller</li> </ul>   |
| 18, 19                | E                            | - Flue sensor fault  | <ul style="list-style-type: none"> <li>• E18 open sensor</li> <li>• E19 Shorted sensor</li> <li>• Check/Replace sensor</li> </ul>   |
| 7,16, 17              | E                            | - DHW sensor fault   | <ul style="list-style-type: none"> <li>• E16 Shorted sensor</li> <li>• E17 Open sensor</li> <li>• Check/replace sensor</li> <li>• E7 Excessive temperature</li> <li>• Check gas orifice</li> <li>• Check combustion settings</li> </ul>   |
| 50F                   |                              | - Improper frequency                                       | <ul style="list-style-type: none"> <li>• Verify ground</li> <li>• Frequency should be between 45 and 65 Hz</li> </ul>   |

\* Red LED above  button will flash, correct condition, and press  button.

**NOTICE** If outdoor sensor is shorted the boiler will not enter into a hard lockout but will maintain the minimum supply temperature of the heat curve.

## Outdoor Reset Control

### SECTION XII - Outdoor Reset Control

An outdoor reset function is included in the CHALLENGER control. The use of the outdoor reset function is required to optimize boiler efficiency, see notice on page 56. If the outdoor sensor is not installed before turning on the boiler, an Outdoor Sensor Open ODS will be displayed. This display will not prevent the appliance from operating. The ODS display will automatically reset once the outdoor sensor is installed.

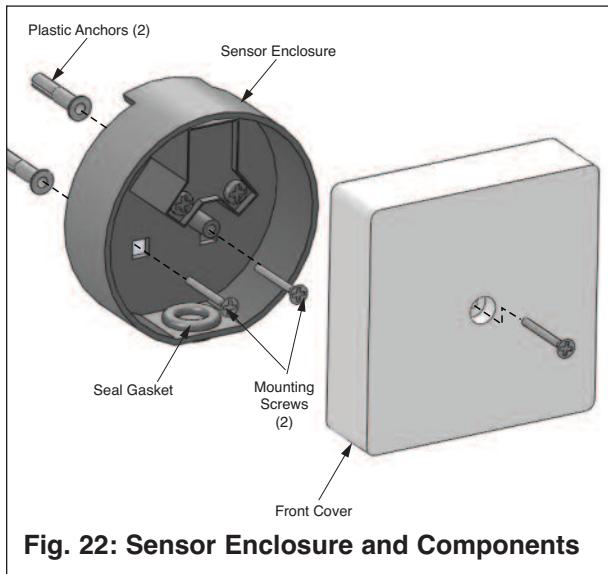


Fig. 22: Sensor Enclosure and Components

#### Mounting the Outdoor Sensor

1. Remove the front cover and mounting screws / anchors from the sensor enclosure.
2. When mounting the enclosure, the exterior wall selected should represent the coldest outdoor temperature. Typically a northern or northeastern wall will suit most buildings. A southern facing wall may suit buildings that have large glass walls or windows on the southern face.
3. Ensure the sensor enclosure is shielded from direct sunlight or the effects of heat or cold from other sources (exhaust fans, appliance vents...) to prevent false temperature sensing.

4. Mount the sensor enclosure at an elevation on the exterior wall to prevent accidental damage or tampering.
5. Avoid mounting the enclosure in areas subjected to excessive moisture.
6. Once an area on the exterior wall has been determined, to affix the enclosure use the enclosure as a template to mark the location of the mounting screws.
7. Using a 3/16" [5 mm] drill bit, drill 2 pilot holes on the marked locations.
8. Tap the enclosed plastic anchors into the pilot holes. Use care not to damage the anchors.
9. Mount the sensor enclosure using the screws provided.

#### Wiring the Sensor

1. Route two 18 gauge wires through the seal gasket. Connect the wires to the sensor terminals 1 and 2.
2. Route the sensor wire back to the CHALLENGER, ensuring the wires are not run parallel to telephone or power cables.

#### NOTICE

If the sensor wires are located in an area with sources of potential electromagnetic interference (close to 120 V wiring) the sensor wires should be shielded or the wires should be routed in a grounded metal conduit. If using shielded cable, the shielding should be connected to the common ground of the appliance.

3. Connect the sensor wires to the outdoor sensor terminals 9 and 10 on the low voltage X4 connector terminal strip located at the control on the swing out panel (see appliance wiring diagram, Fig. 16 page 34).

## Outdoor Reset Control

### NOTICE

In accordance with Section 325 (f) (3) of the Energy Policy and Conservation Act, this boiler is equipped with a feature that saves energy by reducing the boiler water temperature as the heating load decreases. This feature is equipped with an override which is provided primarily to permit the use of an external energy management system that serves the same function.

#### THIS OVERRIDE MUST NOT BE USED UNLESS AT LEAST ONE OF THE FOLLOWING CONDITIONS IS TRUE.

- An external energy management system is installed that reduces the boiler water temperature as the heating load decreases.
- This boiler is not used for any space heating
- This boiler is part of a modular or multiple boiler system having a total input of 300,000 BTU/hr or greater.
- This boiler is equipped with a tankless coil.

### Adjusting Outdoor Reset Curve

The appliance CH set point along with Parameters 5, 6 & 7 define the settings of the outdoor reset curve. See Graph 1 and Table 7, page 57 for an example of modifying the outdoor reset curve.

#### CH Maximum Boiler Operating Temperature

| Factory Setting | Minimum Setting | Maximum Setting |
|-----------------|-----------------|-----------------|
| 186°F<br>[86°C] | 86°F<br>[30°C]  | 194°F<br>[90°C] |

If an outdoor temperature sensor is not connected to the appliance, the appliance setpoint for a heating call will be set to the CH Maximum Boiler Operating Temperature Setpoint. If an outdoor temperature sensor is connected, the CH Maximum Boiler

Operating Temperature Setpoint becomes the appliance setpoint on the CH Reset Curve Coldest Day.

#### CH Minimum Boiler Operating Temperature Setpoint (Parameter 5)

| Factory Setting | Minimum Setting | Maximum Setting |
|-----------------|-----------------|-----------------|
| 64°F<br>[18°C]  | 59°F<br>[16°C]  | 77°F<br>[26°C]  |

This parameter is not applicable if an outdoor sensor is not connected to the appliance. When an outdoor temperature sensor is connected, the CH Minimum Boiler Operating Temperature Setpoint becomes the appliance setpoint on the CH Reset Curve Warmest Day.

#### CH Reset Curve Coldest Day (Parameter 6)

| Factory Setting | Minimum Setting | Maximum Setting |
|-----------------|-----------------|-----------------|
| 86°F<br>[30°C]  | 59°F<br>[16°C]  | 140°F<br>[60°C] |

This parameter is not applicable if an outdoor sensor is not connected to the appliance. When an outdoor temperature sensor is connected, the CH Reset Curve Coldest Day is the coldest design temperature of the heating system.

#### CH Reset Curve Warmest Day (Parameter 7)

| Factory Setting | Minimum Setting  | Maximum Setting |
|-----------------|------------------|-----------------|
| 00°F<br>[-18°C] | -22°F<br>[-30°C] | 50°F<br>[10°C]  |

This parameter is not applicable if an outdoor sensor is not connected to the appliance. When an outdoor temperature sensor is connected, the CH Reset Curve Warmest Day is the warmest design temperature of the heating system.

## Outdoor Reset Control

### Changing Outdoor Reset Parameters

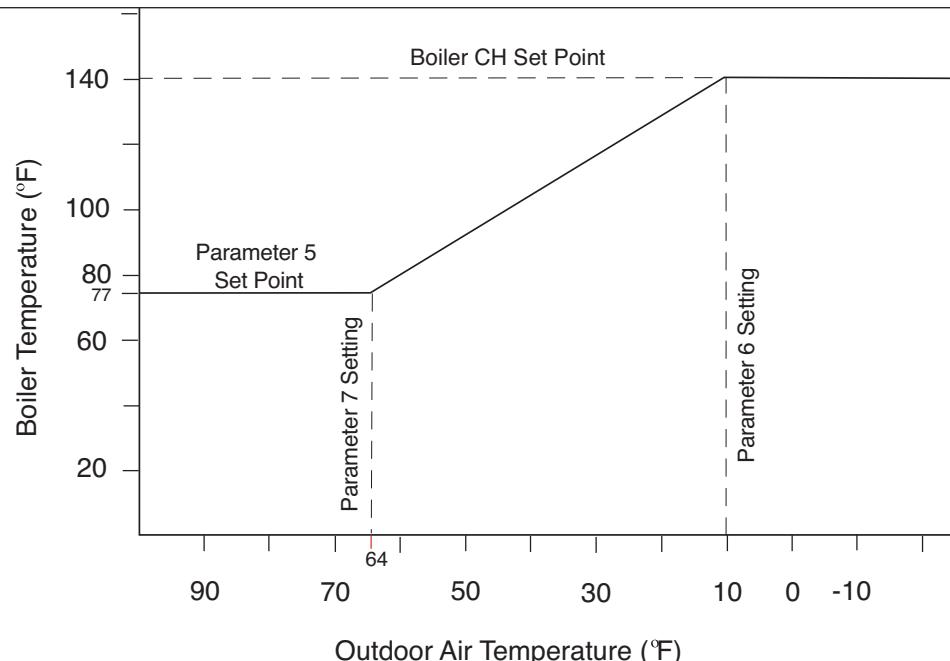
1. Press the “” button at the display panel for approximately 2 to 3 seconds until main display begins to flash.
2. Press the “” button repeatedly to scroll through the list of parameters. The operating display will show the parameter number and main display will show the parameter setting.
3. To modify a parameter press the + or - buttons.

4. Press the  button to close the setting menu and store the changes.

The appliance control module has now been reprogrammed with the desired parameter values.

#### NOTICE

**Pressing the ① ON/OFF button will exit the parameter setting mode without storing the parameter changes.**



**Graph 1: Outdoor Air Temperature Reset Curve (Example)**

**Table 7: Outdoor Air Temperature Reset (Example)**

| Outdoor Temperature | Appliance target Temp.<br>Based on Outdoor Temp. |
|---------------------|--|
| 10°F or Lower       | 140°F  |
| 30°F                | 117°F  |
| 50°F                | 93°F   |
| 64°F or Higher      | 77°F   |

Graph 1 illustrates Appliance CH Setpoint adjusted to 140°F target temperature at 10°F outdoor air temperature

Note: Factory setting of CH set point is 186°F

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## Check-Out Procedures

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### SECTION XIII- 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 59.**

#### Check-Out Procedures

- Boiler system water chemistry checked and verified as outlined on page 40.
- Any automatic air vents caps placed within the system are open one full turn.
- Air is purged from the heating zones and appliance system piping.
- Confirm the appliance has proper gas orifice as noted on pages 31 and 32.
- Thermostat circuit wiring checked and verified that no voltage is present to the low voltage terminals as outlined on page 42.
- Operating Instructions on page 45 were followed during start-up.
- Combustion levels and flame pattern verified as outlined on page 44.
- Measured the rate of input on Natural Gas as outlined on page 44.
- Checked the incoming gas pressure to the CHALLENGER to ensure a minimum pressure of 5”w.c [13 mbar] during flow conditions to all gas appliances and a maximum pressure of 13”w.c [32 mbar] during non-flow conditions for Natural and Propane gas.
- Adjusted balancing valves and system limit controls to provide design temperatures to the primary space heating system.
- In multiple zone applications, adjusted for correct flow of appliance water to each zone.
- Checked and verified room thermostat(s) function properly and the thermostat(s) heat anticipator (if used) was properly set.
- Observed several operating cycles for proper operation of the CHALLENGER and the system.
- Set the room thermostat(s) to the desired room temperature.
- Reviewed all instructions shipped with the CHALLENGER with the homeowner or maintenance personnel.
- Completed the Installation Record on page 59.
- Ensure all manuals and other documents are returned to the Installation envelope and given to the owner for safekeeping.

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## **Installation Record**

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### **SECTION XIV - Installation Record**

CHALLENGER 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 personnel.

Installer Information

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

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

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

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

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## Maintenance Schedule

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### SECTION XV - 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 appliance jacket area; clean and vacuum if necessary.
- Clean the condensate drain assembly 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, sealed tight and properly supported.
- Check appliance water pressure, piping and expansion tank.
- Check control settings.
- Check ignition electrode (sand off any white oxide; clean and reposition).
- Check ignition wiring and ground wiring.
- Check all control wiring and connections.
- Check burner flame pattern (stable and uniform).

Additional items if combustion or performance is poor:

- Clean heat exchanger and flue ways.
- Remove burner assembly and clean inside of burner head using compressed air only.

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

#### Owner Maintenance

Periodic:

- Check the area around the appliance.
- Check and remove any blockage from the combustion air inlet and ventilation openings.
- Check the temperature and pressure gauges.

Monthly:

- Check vent piping.
- Check combustion air inlet piping.
- Check the pressure relief valve.
- Check the condensate drain assembly.

Every 6 months:

- Check appliance piping and gas supply piping for corrosion or potential signs of leakage.
- Operate the 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 CHALLENGER or in system components, resulting in severe personal injury, death or substantial property damage.

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## Maintenance Procedures

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### SECTION XVI - Maintenance Procedures

#### Annual Maintenance Procedures



**The CHALLENGER 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 60 and further explained on pages 61 through 68 should be performed to assure maximum efficiency and reliability of the appliance. Failure to service and maintain the CHALLENGER 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 outlined in the maintenance schedule on page 60. In addition to this maintenance, the CHALLENGER 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 CHALLENGER is free of combustible / flammable materials or flammable vapors or liquids. Remove immediately if found.

Verify that combustion air inlet area is free of any contaminates. Refer to the materials listed on page 7 of this manual. If any of these products are in the area 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 appliance front jacket panel.

Vacuum any dirt or debris from the blower component.

Re-install front jacket panel when completed.



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

#### Check System Piping

Inspect all piping (water and gas) for leaks and verify that the piping is leak free and properly supported.

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



**Eliminate all boiler leaks. Continual fresh make-up water will reduce the heat exchanger life causing appliance failure. Leaking water may also cause severe property damage to the surrounding area. Inspect the gas supply piping using the procedure outlined on Page 42.**

## Maintenance Procedures

### Clean Condensate Drain Assembly

1. Remove the condensate assembly from the appliance.
2. Empty any water from the trap and drain assembly. Flush with fresh water as necessary to clean.
3. Check the drain piping from the condensate drain assembly to the drain. Flush to clean as necessary.
4. Fill the condensate drain assembly with water.
5. Reassemble the condensate drain assembly onto the appliance.

#### **WARNING**

**When re-assembling the condensate drain assembly ensure all gaskets are in place and correctly installed. Ensure all associated internal joints are complete, tight and secure. Failure to comply can result in flue gas leakage resulting in severe personal injury, death or substantial property damage.**

### Check Ventilation Air Openings

Verify that all 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 and Combustion Air Piping

Visually inspect the venting system and combustion air piping for blockage, deterioration or leakage. Repair any deficiencies.

Verify that the combustion air inlet piping is connected, sealed and properly supported.

#### **WARNING**

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

### Check Boiler System

Verify all system components are correctly installed and operating properly.

Check the cold fill pressure for the system, typical cold water fill pressure is 12 psig [0.8 bar].

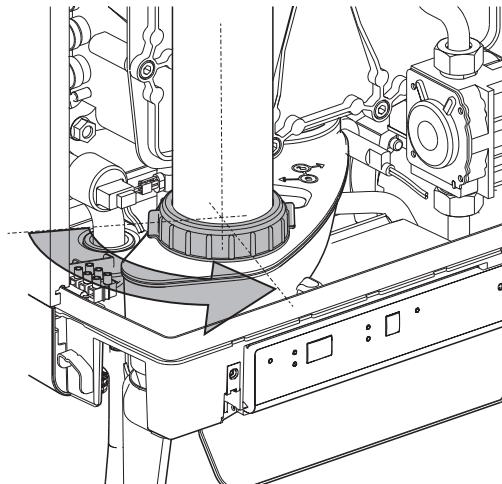
Verify the system pressure, as the appliance operates at high temperature, to ensure the pressure does not exceed 25 psig [1.7 bar]. Excessive pressure reading may indicate expansion tank sizing is incorrect or system performance problems.

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

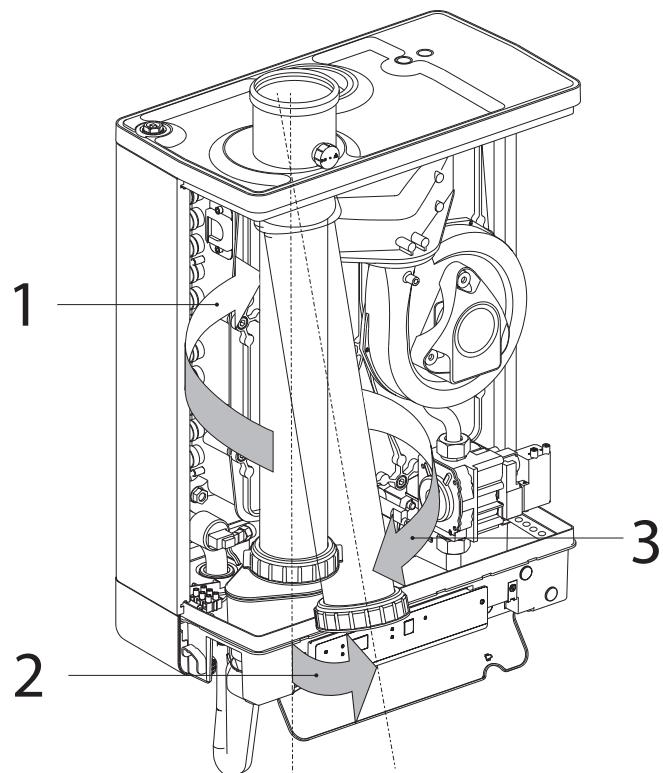
### Removing Internal Flue and Condensate Pan For Inspection

1. Loosen the flue pipe retaining ring as shown in Fig. 23, page 63.
2. Pull up on the flue pipe to disengage from the condensate pan as shown in Fig. 24.
3. Pull the flue pipe down and out to disengage from the vent adapter as shown in Fig. 24, page 63.
4. Lift up the condensate pan to disengage from trap.
5. Once the condensate pan is clear of the bottom jacket, rotate it towards the front of the appliance and push down on the rear to disengage from the heat exchanger as shown in Fig. 25, page 63.
  - Inspect the flue pipe and condensate pan for cracks, damage or distortion. Check all gaskets for tears, discoloration or other damage, replace as necessary.
  - Once inspection is completed re-assemble the condensate pan and flue pipe in reverse order.

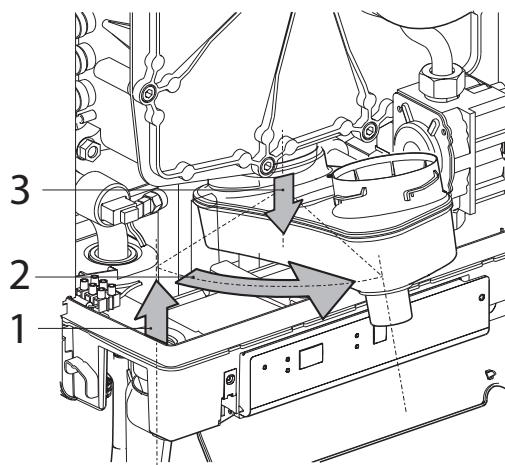
## Maintenance Procedures



**Fig. 23: Loosening of Flue Pipe Retaining Ring**



**Fig. 24: Removal of Flue Pipe**



**Fig. 25: Removal of Condensate Pan**

## Maintenance Procedures

### **WARNING**

When re-assembling the condensate pan and flue pipe ensure all gaskets are in place and correctly installed. Ensure all associated joints are complete, tight and secure. Failure to comply can result in flue gas leakage resulting in severe personal injury, death or substantial property damage.

### **Check Expansion Tank**

Refer to Section IV - Boiler Piping for recommended location of the expansion tank and air eliminators.

#### Closed -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. Recommended 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 [0.8 bar]. If tank does not hold a charge pressure, then the membrane is damaged and the tank should be replaced.

### **Check Relief Valve(s)**

Inspect the relief valve(s) 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 relief valve(s), 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.

### **Inspection of Ignition Electrode**

Remove the ignition electrode using a 3 mm or T-15 hex key inserted through the two top panel holes located above the igniter. If necessary separate the top panel from the right side by inserting a straight screw driver in two slots on right side of top panel and bending metal tab in slots away from the side. Lift top panel .

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 igniter to Fig. 26, page 65.

### **Check Ignition Wiring and Ground Wiring**

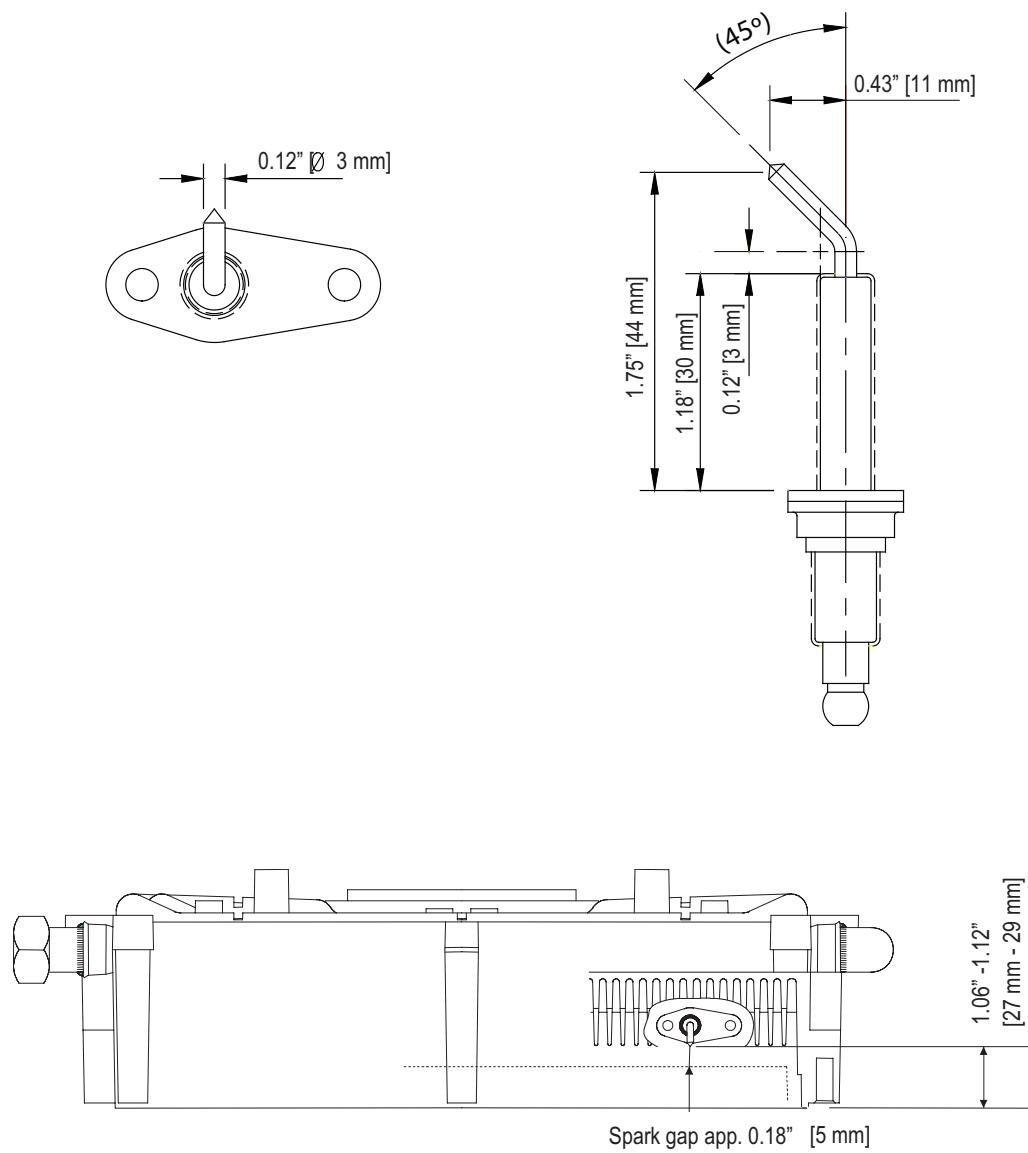
Inspect the ignition wiring from the burner control module to the ground at heat exchanger.

Ensure wiring is in good condition and securely connected.

Check ground continuity of the wiring to the appliance heat exchanger or piping using a continuity meter.

Replace and correct ground wire if ground continuity is not completed and satisfactory.

## Maintenance Procedures



**Fig. 26: Igniter Dimensions**

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## Maintenance Procedures

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### Check Control Wiring

Inspect all control wiring. Ensure wiring is in good condition and properly connected.

Disconnect the wiring harness connectors from the blower.

### Check Control Settings

1. Check the control CH/DHW/parameter settings by pressing the thermometer button “” on control display. When the LED is lit for “” this is the CH setting. When the LED is lit for “” this is the DHW setting. Adjust settings with “+” or “-” buttons as necessary.
2. Press the  reset button to close the setting menu and store the changes.
3. Check any external limit control settings (if used). Adjust settings as necessary.

Remove the mounting bolts and washers securing the front of the heat exchanger and set bolts and washers aside.

Carefully remove the front plate of the heat exchanger. Ensure combustion chamber insulation is not damaged during removal. See WARNING on page 68.

Remove the burner head mounting screws and remove the burner head. Inspect the burner head for deterioration. Use compressed air or a vacuum to clean the burner head. Replace burner head if necessary. Replace burner head gasket.

Re-assemble the burner head and burner head gasket. Ensure mounting screws are tight.

Remove the blower.

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

Re-assemble the blower and venturi onto front plate of the heat exchanger . Ensure all gaskets are in good condition, and positioned correctly. Replace gaskets if necessary.

Re-assemble the front plate of the heat exchanger with bolts and washers onto the heat exchanger. Ensure the gasket and combustion chamber insulation is in place and not damaged, replace gasket and insulation if necessary. See WARNING on page 68. Ensure all screws and bolts are tight.

Reconnect the wiring harness connectors to the blower.

Re-assemble the gas supply connections and electrical connector to gas valve inside the appliance. Open the external manual gas valve. Check gas piping for any leaks as outlined on page 42 and repair if necessary. Place the appliance back into service.

### 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 boiler is within normal operating range.

Complete the checkout procedures as referenced in this manual.

### Check Burner Flame

Inspect the burner flame through the observation port on left side off the heat exchanger.

Verify flame pattern is blue and covers the entire burner surface during high fire. Ensure combustion at both high and lowfire meet the requirements listed in Table 5, page 44. If combustion is OK and flame pattern is not fully blue & covers the entire burner surface during highfire, shut the appliance down and allow it to cool thoroughly before disassembly.

Close the external manual gas valve on the gas supply line and disconnect the gas piping and electrical connector to the gas valve inside the appliance.

## Maintenance Procedures

### Check Combustion Levels

Refer to page 44 of this manual for measuring combustion levels and burner adjustments.

### Clean Boiler Heat Exchanger

1. Shut down the appliance:
  - Follow the instructions on Page 45 "To Turn Off Gas to Appliance"
  - Do not drain the appliance unless it will be subject to freezing conditions.
  - Do not drain the appliance if freeze protection fluid is used in the system.
2. Allow the appliance to cool down to room temperature before servicing.
3. Disconnect the gas piping and electrical connector to the gas valve.
4. Disconnect the wiring harness connectors from the blower.
5. Remove the mounting bolts and washers securing the front of the heat exchanger and set aside.
6. Carefully remove the front plate of the heat exchanger. Ensure combustion chamber insulation is not damaged during removal. See **WARNING** on page 68.
7. Use a vacuum cleaner, compressed air or water to remove any accumulation from the heat exchanger flue ways. Do not use any solvent.
8. Re-assemble the front plate of the heat exchanger onto the heat exchanger. Ensure the gasket and combustion chamber insulation is in place and not damaged, replace gasket and insulation if necessary. See **WARNING** on page 68.
9. Re-assemble the blower the wiring harness.
10. Reconnect the gas piping and electrical connector to gas valve. Check for leaks, repair if necessary.
11. Close isolation valves at the appliance boiler piping to isolate the appliance from the heating system.
12. Attach a hose to the boiler drain valve and flush the boiler thoroughly with fresh water by using the purge valves to allow water to enter through the make-up water line to the boiler.
13. Once the boiler has been completely flushed, return the boiler and system piping back to operation.
14. Perform the required startup and checkout procedures as outlined on pages 40 to 58.

### Clean Domestic Heat Exchanger

#### **NOTICE**

**Before cleaning the domestic heat exchanger it is recommended to remove the domestic flow restrictor at the inlet of the domestic flow switch and to reinstall the switch to hasten cleaning. Reinstall the domestic flow restrictor when cleaning is complete.**

1. Shut down the appliance:
  - Follow the instruction on Page 45 "To Turn Off Gas to Appliance"
2. Shut off all electrical power feed to the appliance.
3. Allow the appliance to cool down to room temperature before servicing.
4. Close the field installed isolation (shut off) valves on both the domestic cold and hot water lines to the appliance as shown in figure 11 & 12 on pages 26 & 27.
5. Submerge one end of hose halfway into cleaning fluid in a clean bucket with 4 gallons of new undiluted, food grade, white vinegar.
6. Attach other end of hose to a potable (bronze or stainless steel) circulating pump with a 2.5 gallon per minute [9.5 liters per minute] flow rate with 32 feet [9.7 meters] of head equivalent to Grundfos UP 26-99BF or Taco 009-SF5, use another hose to connect from the pump to the field installed domestic hot water outlet drain/flush valve.

## Maintenance Procedures

7. Attach separate hose to the field installed domestic cold water inlet drain/flush valve.
8. Submerge the other end of this hose halfway in fluid in the same bucket.
9. Open both drain/flush valves on the domestic cold and hot water lines.
14. Relocate the remaining hose still connected to the domestic cold water inlet drain/flush valve to the domestic hot water outlet drain/flush valve and the other end of this hose from the bucket to a suitable drain.
15. Rinse the domestic heat exchanger for 5 minutes by opening both the domestic hot water outlet drain/flush valve and the isolation (shut) off valve on the domestic cold water inlet.
16. Close drain/flush valve on the domestic hot water outlet.
17. Remove hose from the drain/flush valve on the domestic hot water outlet.
18. Open the field installed isolation (shut off) valve on the domestic hot water outlet.
19. Turn on all electric to the appliance.
20. Perform the required startup and checkout procedures as outlined on pages 40 to 58.

### **WARNING**

**To avoid risk of electrocution ensure all power is off to the appliance before servicing. Use G.F.C.I. protected power supply to pump. Additionally before powering up the circulating pump ensure all hose connections and fittings are leak free and no water is on the floor.**

10. Carefully power up the pump allowing the vinegar to circulate through the domestic heat exchanger for 1 hour.
11. Turn pump off and carefully remove all power to the pump.
12. Close both drain/flush valves on the domestic cold and hot water lines.
13. Remove hose from bucket and pump connected to the drain/flush valve on the domestic hot water outlet.

### **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 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:

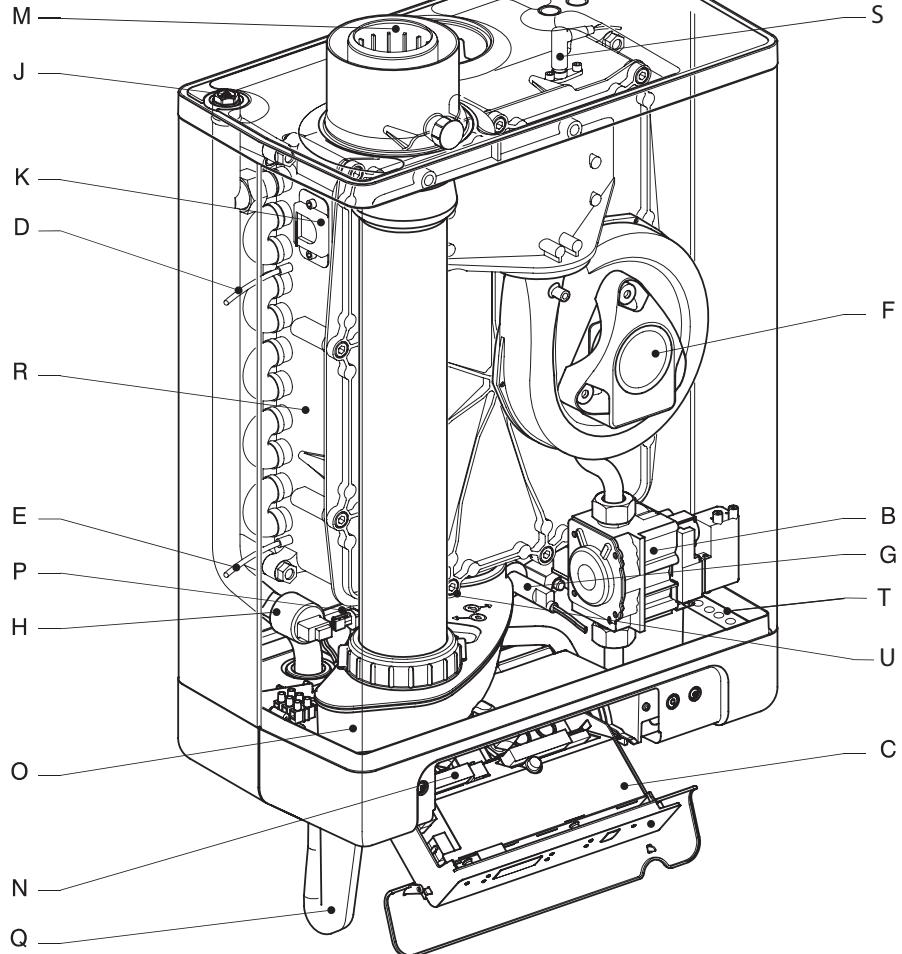
1. Use a NIOSH approved respirator which meets OSHA requirements for cristobalite dust, similar to N95. Contact NIOSH at 1-800-356-4676 or on the web at [www.cdc.gov/niosh](http://www.cdc.gov/niosh) for latest recommendations.

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

## Replacement Parts



- |                                 |   |                                   |
|---------------------------------|---|-----------------------------------|
| B. Gas valve                    | J. Pressure relief and air vent assembly  | P. DHW sensor S3                  |
| C. Control/Display              | K. Sight glass  | Q. Condensate drain trap assembly |
| D. CH supply sensor S1          | M. Vent/Air adapter (80/125 concentric optional shown or 3" standard not shown) | R. Heat exchanger                 |
| E. CH Return sensor S2          | N. Low voltage/terminal strip X4  | S. Ignition electrode             |
| F. Blower                       | O. Condensate pan   | T. High voltage terminal strip    |
| G. DHW flow switch & Restrictor |   | U. Flue Sensor                    |
| H. LWCO/CH pressure sensor      |   |                                   |

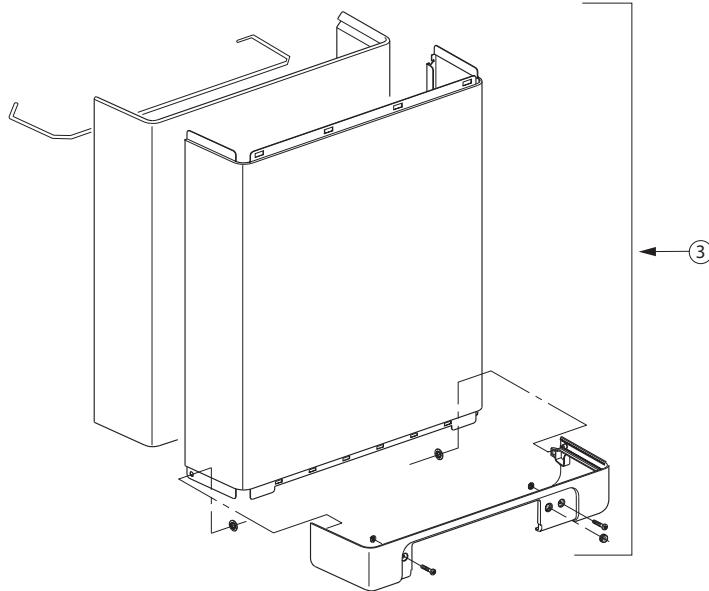
**Fig. 27: CHALLENGER Internal Components**

### **WARNING**

Replacement parts must be purchased through a local ACV-Triangle Tube distributor. When ordering part please provide the model number and description and/or part number of replacement part.

Use only genuine ACV-Triangle Tube replacement parts to ensure warranty coverage and to avoid damage to appliance and improper operation of appliance. Contact ACV-Triangle Tube at 856-228-8881 or [www.triangletube.com](http://www.triangletube.com) for list of distributors nearest you.

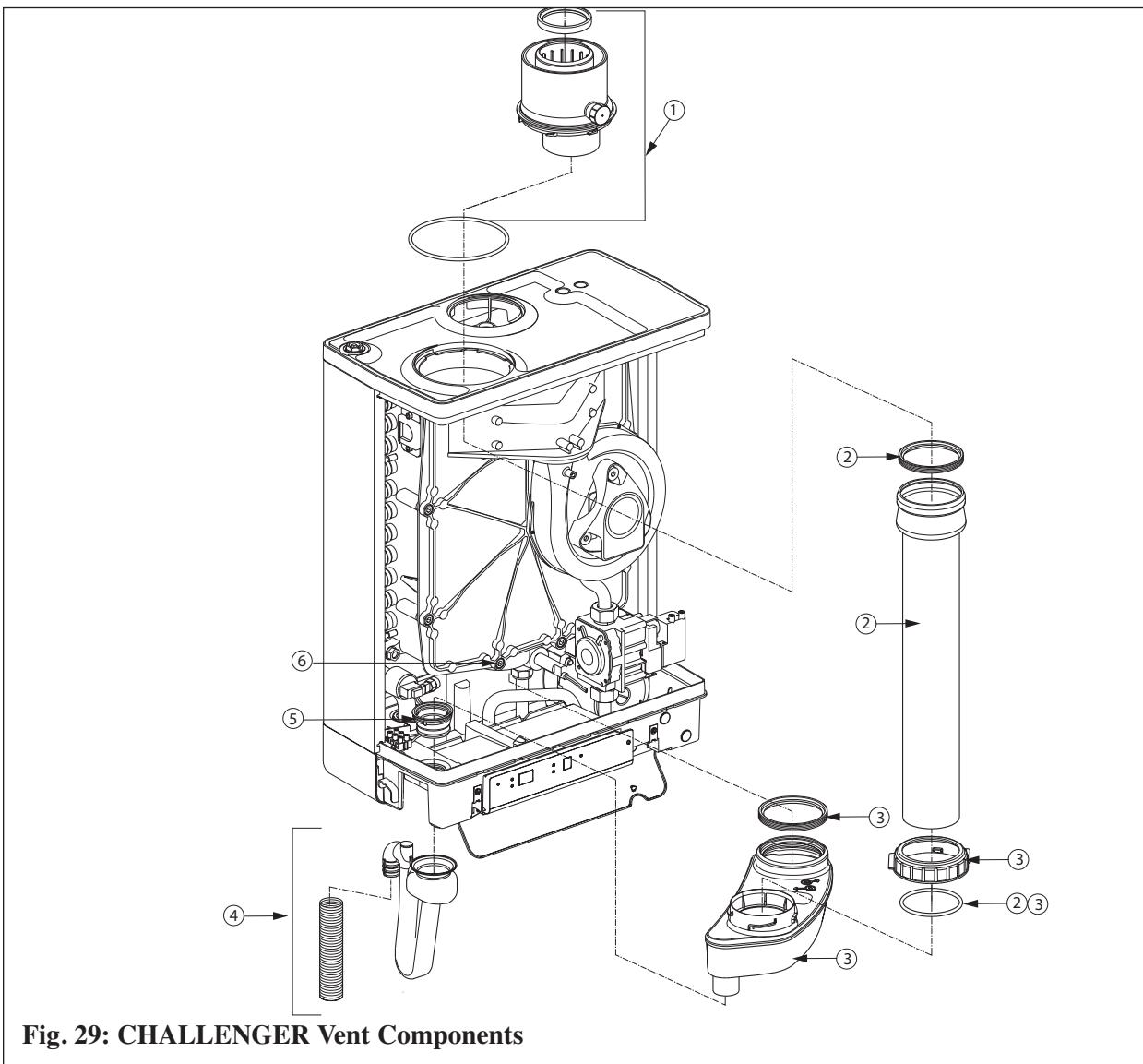
## Replacement Parts



**Fig. 28 : CHALLENGER Front Door**

| Item | Part Number<br>CC85 | Part Number<br>CC105 | Part Number<br>CC125 | Description                                     |
|------|---------------------|----------------------|----------------------|---|
| 1    | CCRKIT04            |                      |                      | Wall Bracket Assembly (Not Shown)               |
| 2    | CCRKIT05            |                      |                      | Pipe Connectors & Brackets Assembly (Not Shown) |
| 2A   | CCFTG01             |                      |                      | Connector Pipe CH (Not Shown) - 1/Kit           |
| 2B   | CCFTG02             |                      |                      | Connector Pipe DHW (Not Shown) - 1/Kit          |
| 3    | CCRKIT06            | CCRKIT07             | CCRKIT08             | Front Door Assembly                             |

## Replacement Parts

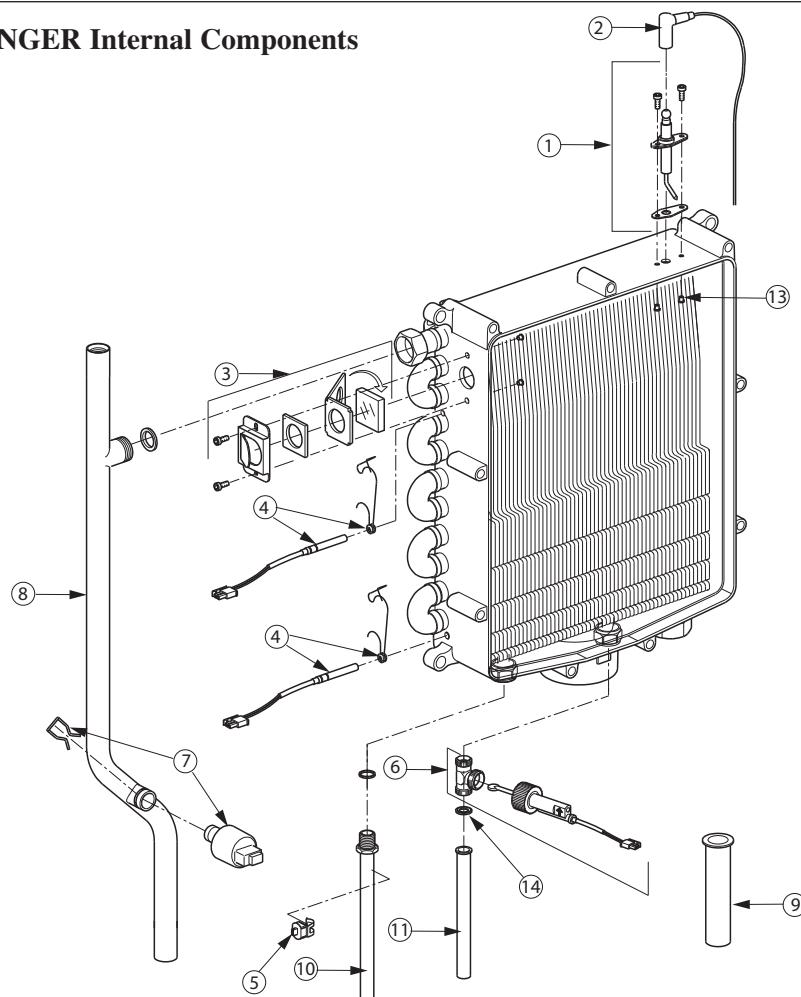


**Fig. 29: CHALLENGER Vent Components**

| Item | Part Number<br>CC85 | Part Number<br>CC105 | Part Number<br>CC125 | Description   |
|------|---------------------|----------------------|----------------------|---|
| 1    | CCRKIT09            |                      |                      | 80/125 Concentric Vent /Air Adapter Assembly (optional - shown) |
|      | CCRKIT35            |                      |                      | 3" Vent/Air Adaptor Assembly ( standard -not shown)             |
| 2    | CCRKIT10            | CCRKIT11             | CCRKIT12             | Vent Assembly   |
| 3    | CCRKIT13            |                      |                      | Condensate Collector Assembly                                   |
| 4    | CCRKIT14            |                      |                      | Condensate Drain Trap Assembly                                  |
| 5    | CCRKIT41            |                      |                      | Condensate Collector/Trap Gasket                                |
| 6    | CCRKIT36            |                      |                      | Flue Sensor   |

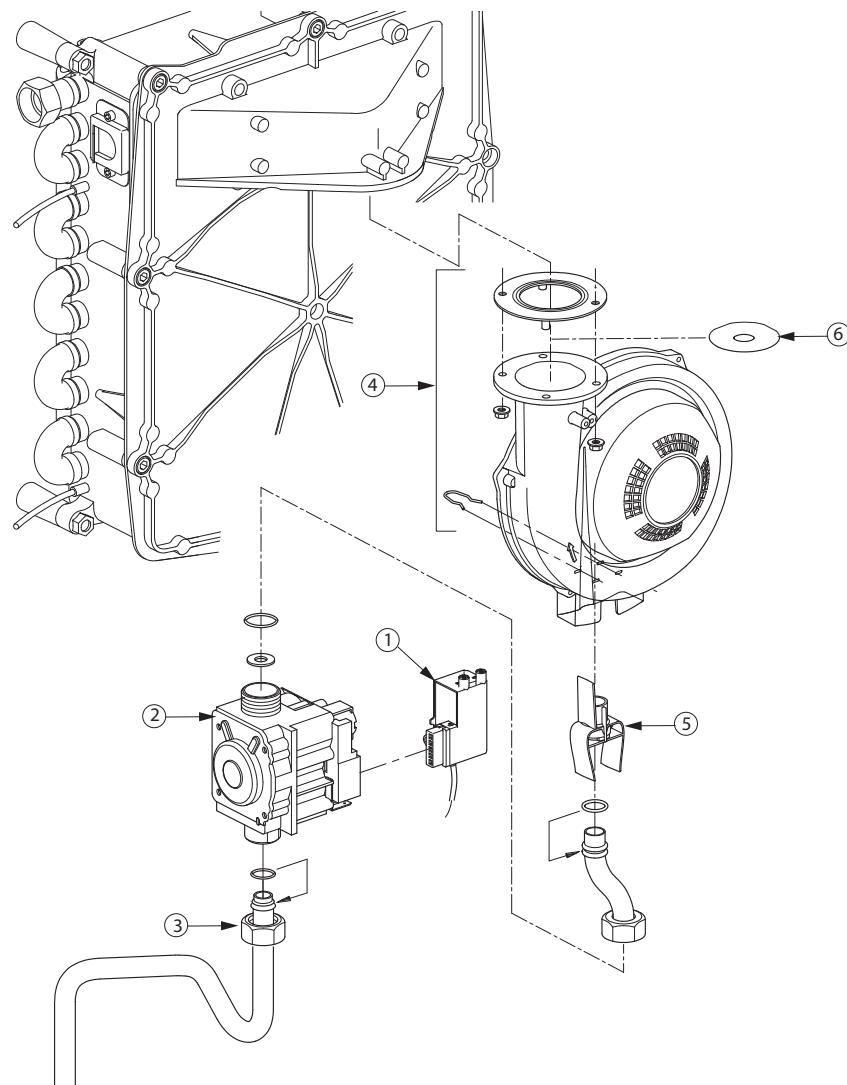
## Replacement Parts

**Fig. 30 : CHALLENGER Internal Components**



| Item | Part Number<br>CC85 | Part Number<br>CC105 | Part Number<br>CC125 | Description                      |
|------|---------------------|----------------------|----------------------|----------------------------------|
| 1    |                     | CCRKIT15             |                      | Igniter Assembly                 |
| 2    |                     | CCCLB01              |                      | Ignition Cable                   |
| 3    |                     | CCRKIT16             |                      | Sight Glass Assembly             |
| 4    |                     | CCRKIT17             |                      | CH Sensor Assembly - 1/Kit       |
| 5    |                     | CCSENS02             |                      | DHW Sensor                       |
| 6    |                     | CCRKIT18             |                      | DHW Flow Switch Assembly         |
| 7    |                     | CCRKIT19             |                      | LWCO/CH Pressure Sensor Assembly |
| 8    | CCRKIT20            | CCRKIT21             | CCRKIT22             | CH Supply pipe Assembly          |
| 9    |                     | CCRKIT23             |                      | CH Return Pipe Assembly          |
| 10   |                     | CCRKIT26             |                      | DHW Supply Pipe Assembly         |
| 11   |                     | CCRKIT27             |                      | DHW Return Pipe Assembly         |
| 12   |                     | CCRKIT42             |                      | LWCO Wiring Harness (not shown)  |
| 13   |                     | CCRKIT40             |                      | Ignitor Bushings -2/kit          |
| 14   | CCRKIT49            | N/A                  |                      | DHW Flow Restrictor 2 gpm White  |
|      | N/A                 | CCRKIT50             | N/A                  | DHW Flow Restrictor 2.5 gpm Blue |
|      | N/A                 |                      | CCRKIT51             | DHW Flow Restrictor 3 gpm Red    |

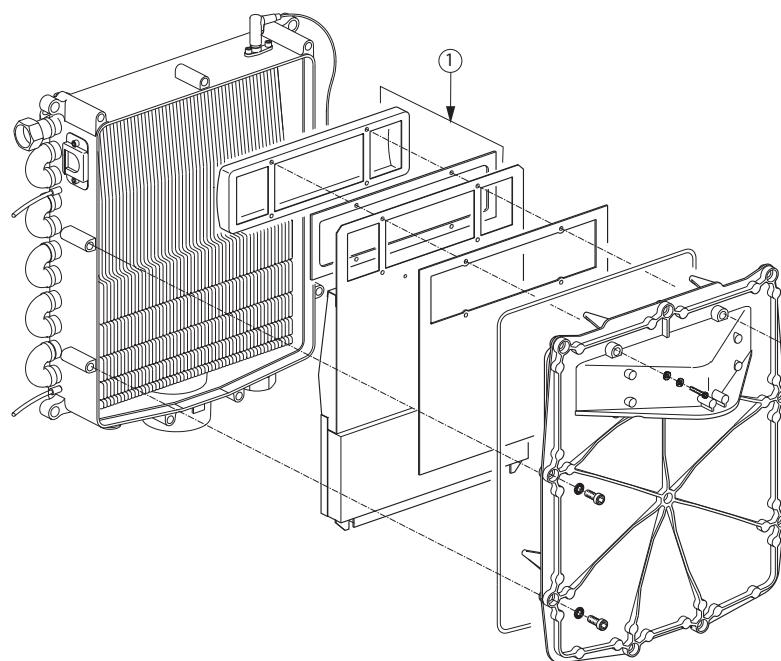
## Replacement Parts



**Fig. 31 : CHALLENGER Blower & Gas Valve Components**

| Item           | Part Number<br>CC85 | Part Number<br>CC105 | Part Number<br>CC125 | Description                           |
|----------------|---------------------|----------------------|----------------------|---------------------------------------|
| 1              | CCRKIT28            |                      |                      | Ignition Transformer Assembly         |
| 2              | CCRKIT29            |                      |                      | Gas Valve Assembly                    |
| 3              | CCRKIT30            | CCRKIT31             |                      | Gas Pipe Assembly                     |
| 4              | CCRKIT32            |                      |                      | Blower Assembly                       |
| 5              | CCRKIT45            |                      | N/A                  | Venturi 406                           |
|                | N/A                 |                      | CCRKIT46             | Venturi 362                           |
| 6              | CCRKIT47            | N/A                  |                      | Blower Outlet Orifice 1" (25 mm)      |
|                | N/A                 | CCRKIT48             | N/A                  | Blower Outlet Orifice 1-7/16" (37 mm) |
| Not Applicable |                     |                      |                      |                                       |

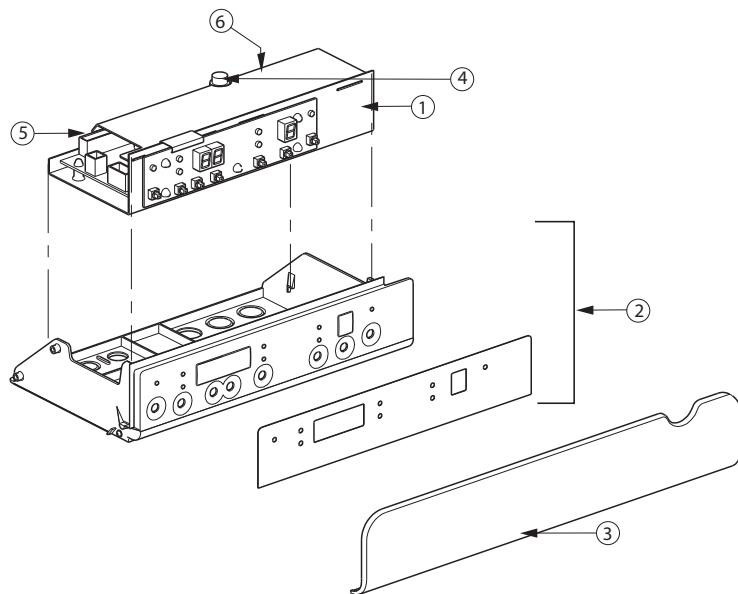
## Replacement Parts



**Fig. 32 : CHALLENGER Burner Components**

| Item | Part Number<br>CC85 | Part Number<br>CC105 | Part Number<br>CC125 | Description     |
|------|---------------------|----------------------|----------------------|-----------------|
| 1    |                     | CCRKIT33             |                      | Burner Assembly |

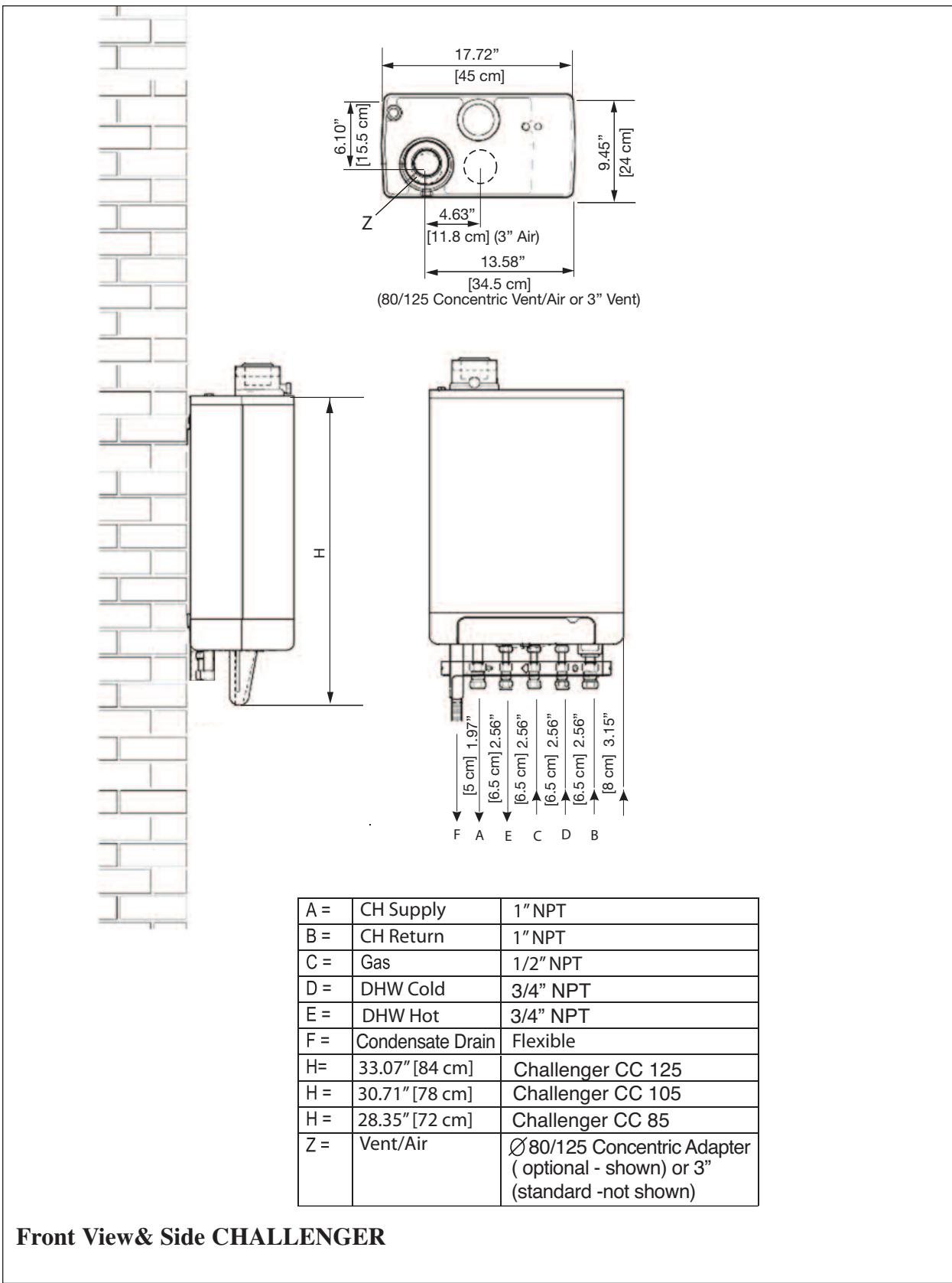
## Replacement Parts



**Fig. 33 : CHALLENGER Control Components**

| Item | Part Number<br>CC85 | Part Number<br>CC105 | Part Number<br>CC125 | Description                             |
|------|---------------------|----------------------|----------------------|---|
| 1    |                     | CCCON01              |                      | Control/Display                         |
| 2    |                     | CCCS01               |                      | Housing Plastic Control                 |
| 3    |                     | CCRKIT34             |                      | Flip Panel                              |
| 4    |                     | CCFUSE01             |                      | Fuse - 1/Kit                            |
| 5    |                     | CCRKIT43             |                      | Connector - X4, 24V, 9 Pin (Not shown)  |
| 6    |                     | CCRKIT44             |                      | Connector - X2, 120V, 8 Pin (Not shown) |

## Specifications



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## Specifications - Water Heater

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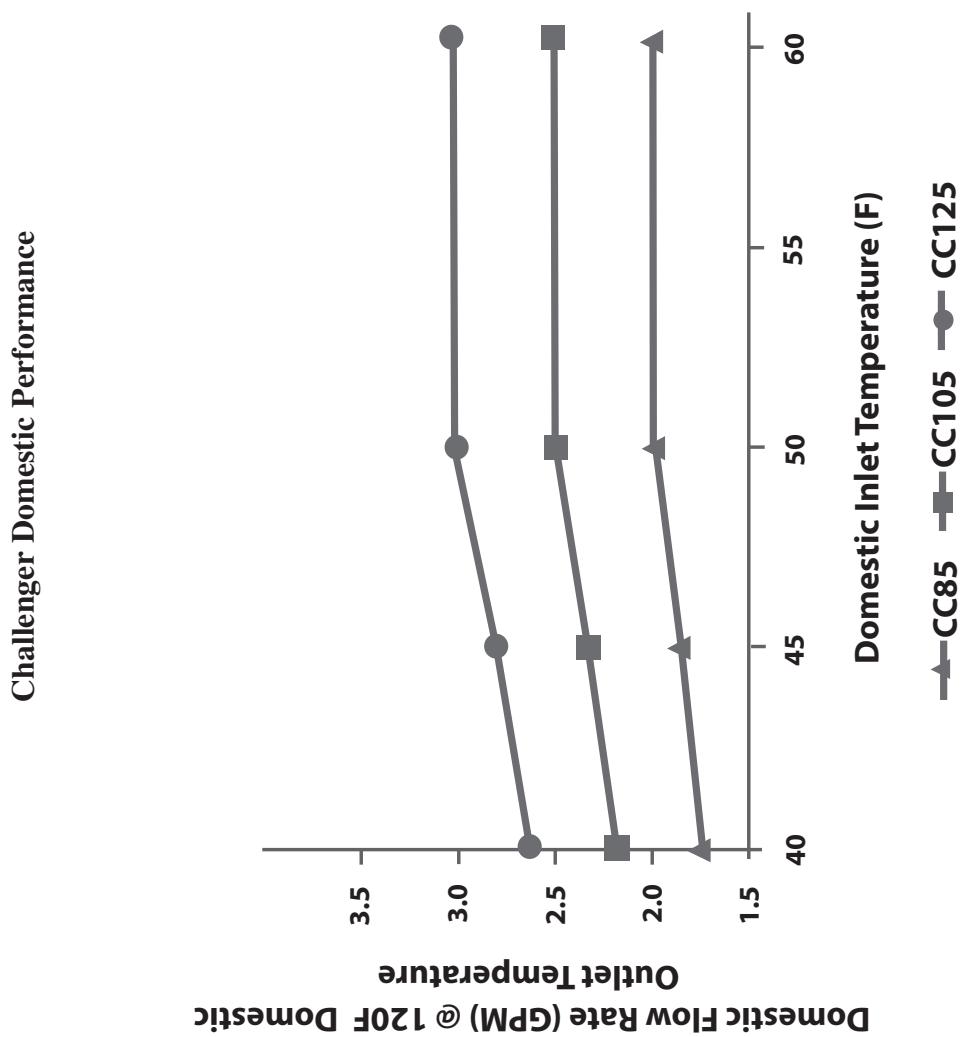
**NOTICE**

The following efficiency performance is achieved when the CHALLENGER is operated as a Water Heater according to DOE 10CFR, Part 430, subpart B, Appendix E, test procedure.

| Model  | Fuel               | Modulation Input<br>BTUH [KW]  | Continuous Domestic Flow<br>77°F Rise | Water Heater Energy Factor | Shipping Weight Lbs [Kg] |
|--------|--------------------|--------------------------------|---------------------------------------|----------------------------|--------------------------|
| CC 85  | Natural or Propane | 23,000 [6.7] to 84,000 [24.6]  | 1.8 gpm [6.8 lpm]                     | .87                        | 66 [30]                  |
| CC 105 | Natural or Propane | 29,000 [8.5] to 106,000 [31]   | 2.3 gpm [8.7 lpm]                     | .86                        | 73 [33]                  |
| CC 125 | Natural or Propane | 33,000 [9.7] to 124,000 [36.3] | 2.7 gpm [10.41 lpm]                   | .85                        | 80 [36]                  |



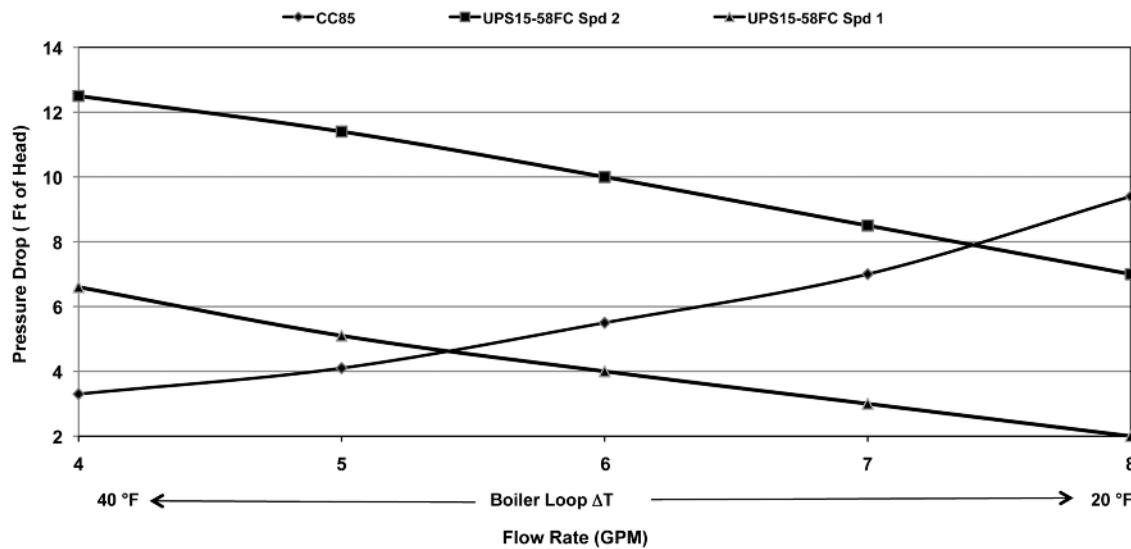
## Specifications - Water Heater



Graph 2 : Domestic Flow Rate at 120°F Domestic Outlet and Varying Domestic Inlet Temperature

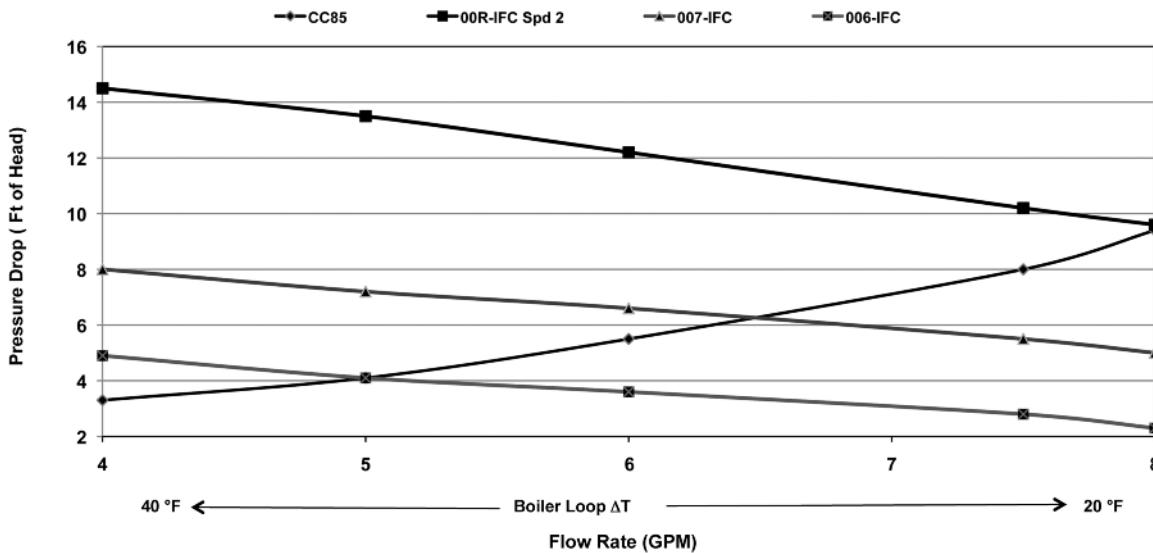
## Specifications - Boiler

**CC85 Primary Loop Pumps - Grundfos**



**Graph 5 : Pressure Loss Through Boiler - Grundfos Circulators**

**CC85 Primary Loop Pumps - Taco**



**Graph 6 : Pressure Loss Through Boiler - Taco Circulators**

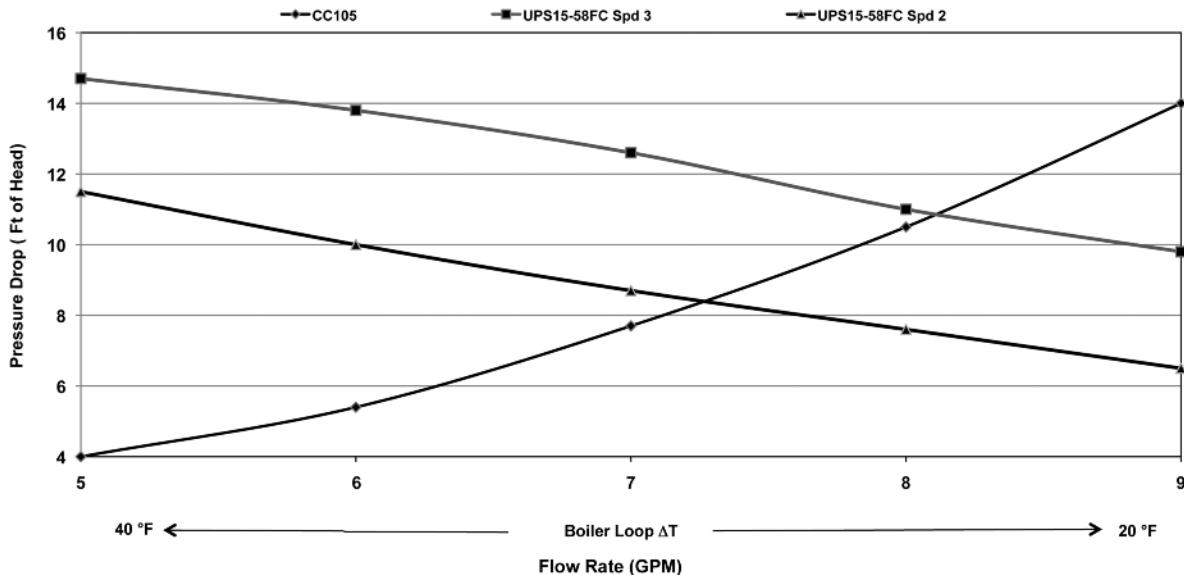
### NOTICE

Minimum allowable boiler flow rate at full input: 4 gpm [15 lpm] CHALLENGER CC85

Pump curves and system curves do NOT include any allowance for near boiler piping.

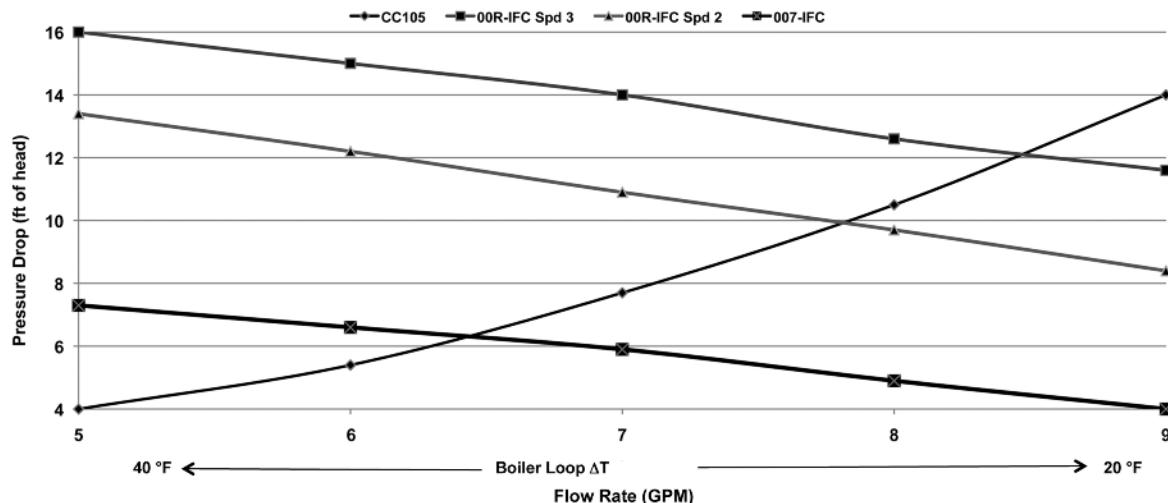
## Specifications - Boiler

**CC105 Primary Loop Circulators - Grundfos**



**Graph 7 : Pressure Loss Through Boiler - Grundfos Circulators**

**CC105 Primary Loop Circulators - Taco**



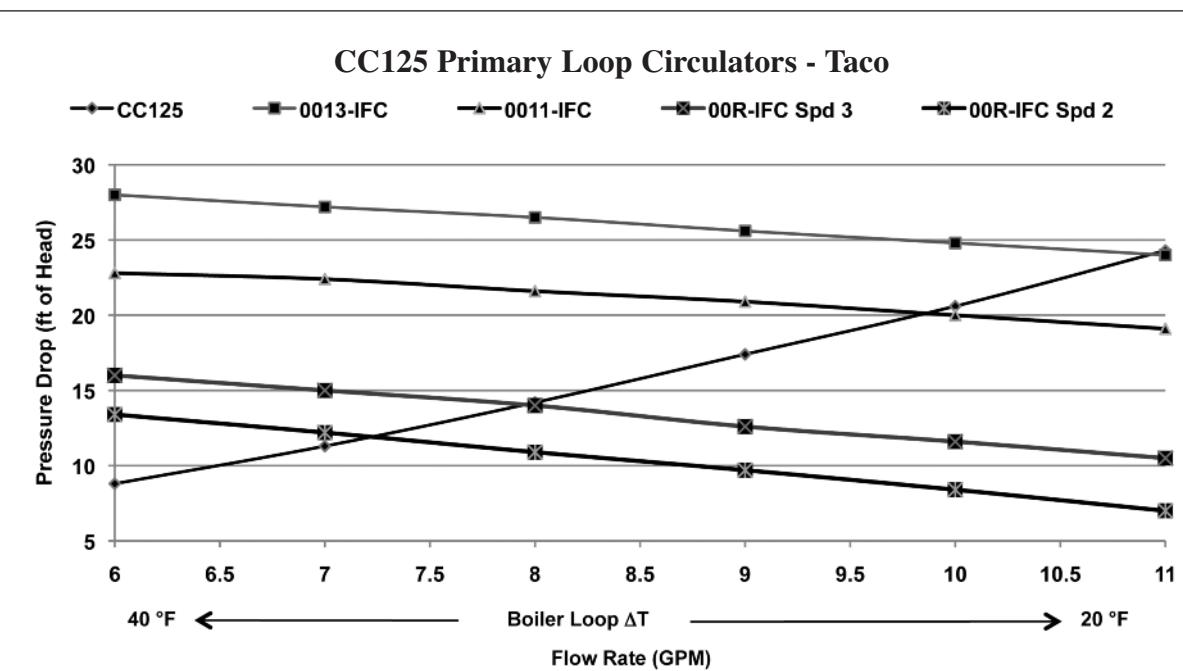
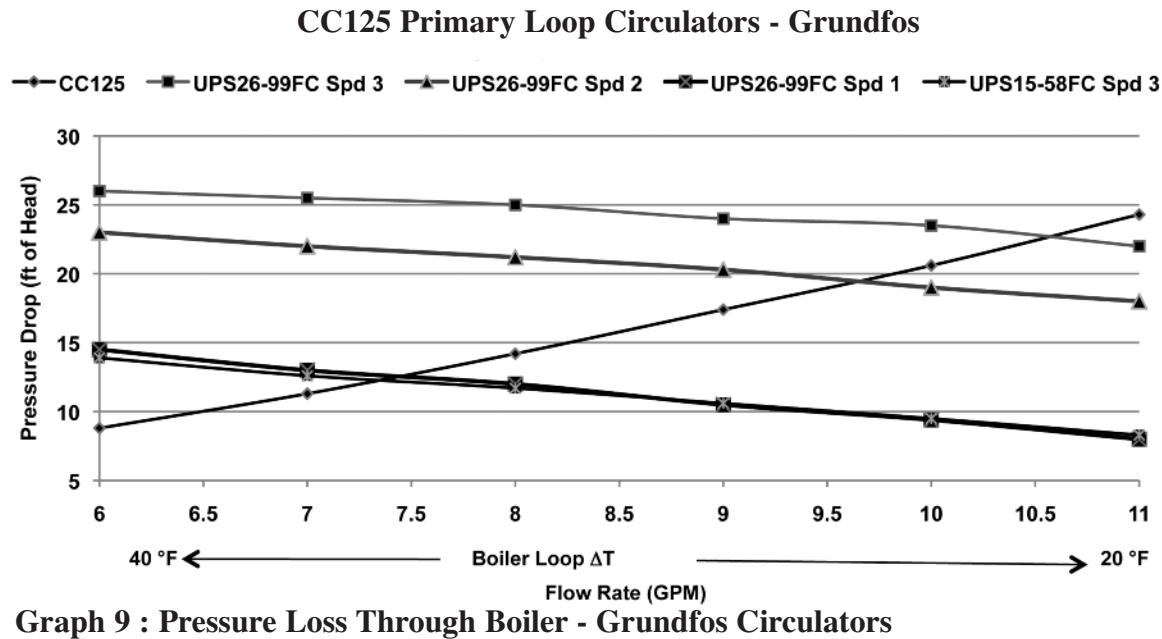
**Graph 8 : Pressure Loss Through Boiler - Taco Circulators**

### NOTICE

Minimum allowable boiler flow rate at full input: 5 gpm [19 lpm] CHALLENGER CC105

Pump curves and system curves do NOT include any allowance for near boiler piping.

## Specifications - Boiler



**NOTICE**

Minimum allowable boiler flow rate at full input: 6 gpm [23 lpm] CHALLENGER CC125

Pump curves and system curves do NOT include any allowance for near boiler piping.

## Specifications - Boiler

### NOTICE

The following efficiency performance is achieved when the CHALLENGER is operated as a Boiler according to ASHRAE 103 test procedure

| Model  | Fuel                     | Modulation Input<br>BtU/H (kW)<br>Note 4 | DOE Heating Capacity<br>Btu/h (kW)<br>Note 1 & 4 | Net Boiler<br>IBR Rating<br>BTUh (kW)<br>Note 2 | DOE<br>Seasonal<br>Efficiency AFUE<br>Note 3 | Shipping<br>Weight<br>Lbs (Kg) |
|--------|--------------------------|--|--|---|--|--------------------------------|
| CC 85  | Natural<br>or<br>Propane | 23 000 (6,7)<br>to<br>84 000 (24,6)      | 75 000<br>(22,3)                                 | 65 000<br>(19,3)                                | 94%  | 66 (30)                        |
| CC 105 | Natural<br>or<br>Propane | 29 000 (8,5)<br>to<br>106 000 (31)       | 94 000<br>(27,8)                                 | 82 000<br>(24,3)                                | 94%  | 73 (33)                        |
| CC 125 | Natural<br>or<br>Propane | 33 000 (9,7)<br>to<br>124 000 (36,3)     | 110 000<br>(32,8)                                | 96 000<br>(28,4)                                | 94%  | 80 (36)                        |

**Note 1:** The heating capacity of the CHALLENGER CC 85/105/125 is based on the test requirements of the U.S. Department of Energy.

**Note 2:** 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 3:** Based on the given AFUE the CHALLENGER CC 85/105/125 meets the energy efficiency guidelines established by Energy Star.

**Note 4:** Input and output ratings are shown for sea level applications. The CHALLENGER automatically derates the input at approximately 2% for every 1,000 Ft. of altitude. No alterations to the appliance or burner system are required.



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## Notes

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## Notes

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## Notes

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## **Additional quality water heating equipment available from ACV-Triangle Tube**

### **Maxi-Flo and Spa Heat Exchangers**



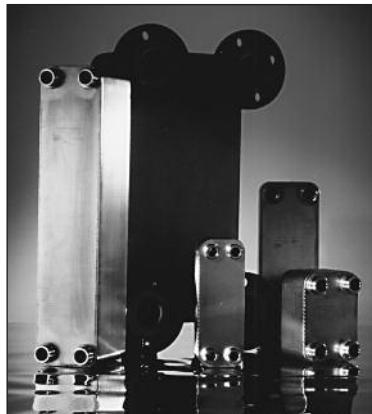
- Construction of high quality corrosion resistant stainless steel (AISI 316) or titanium
- Specially designed built-in flow restrictor to assure maximum heat exchange
- Compact and light weight
- Available in 8 sizes that can accommodate any size pool or spa

### **SMART Indirect Fired Water Heaters**



- Exclusive Tank-in-Tank design
- Stainless steel construction
- Available in 7 sizes
- Limited LIFETIME residential warranty
- 6 year limited commercial warranty
- Self cleaning/self descaling design

### **TTP Brazed Plate Heat Exchangers**



- For domestic water, snow melting, radiant floor, refrigeration
- Plates made of stainless steel, with a 99.9 % copper and brazed, ensuring a high resistance to corrosion
- Self cleaning and self descaling
- Computerized sizing available from ACV-Triangle Tube
- Available in capacities from 25,000 BTU/hr to 5,000,000 BTU/hr



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