WEIL-McLAIN

Ultra

Gas-fired water boiler

Boiler Manual

- Installation
- Start-Up
- Maintenance
- Parts

Ultra with PhD Precision Hydronic Data technology

CERTIFIED

DESIGN CERTIFIED

WARNING This manual must only be used by a qualified heating installer/service technician. Read all instructions, including this manual and the Ultra Vent Supplement, before installing. Perform steps in the order given. Failure to comply could result in severe personal injury, death or substantial property damage.

Part number 550-100-009/0703

THE *Ultra* BOILER, WITH PhD TECHNOLOGY – HOW IT WORKS . . .

PhD technology

PhD Technology, Precision hydronic Data, is an intelligent system that delivers Precision hydronic heating and hot water needs while maximizing efficiency by measuring the Data parameters of your heating system.

1. Cast aluminum heat exchanger

2. Heat exchanger access cover

3. Blower

The advanced blower design and air inlet silencer (5a) on Ultra boilers result in very quiet operation.

80 & 105 — Air enters the boiler enclosure through the air intake adapter (18), flows through the enclosure, enters the the air inlet silencer (5a), then enters the blower. The blower pulls air through the silencer and pushes it into the venturi (5), where it mixes with gas before entering the burner.

155 & 230 — Air enters the boiler enclosure through the air intake adapter (18), flows through the enclosure, enters the the air inlet silencer (5a), then enters the venturi (5). The blower pulls air and gas through the venturi and pushes the mixture into the burner.

4. Gas valve

The gas valve senses the vacuum in the venturi caused by flowing air, and allows gas to flow when power is applied. The manual gas valve (4a) allows shutting off the gas supply for servicing or shutdown. Models 80 and 105 use a sensing line (4b) from the gas valve to the blower outlet so the gas valve references the same pressure as the venturi inlet.

5. Venturi

When air flows through the venturi, it creates a vacuum. This vacuum pulls gas from the gas valve. So gas will only flow if air is flowing. On 80 and 105 models, the gas air mixture enters the burner after the venturi. On 155 and 230 models, the gas/air mixture enters the blower before passing on to the burner.

6. Flue gas sensor

This sensor monitors the flue gas exit temperature. The control module will shut down the boiler if flue gas temperature gets too hot. This protects the flue pipe and the heat exchanger from overheating.

7. Outlet water temperature sensor

This sensor monitors boiler outlet water temperature (system supply). The control module adjusts boiler firing rate so the outlet temperature is correct.

8. Return water temperature sensor

This sensor monitors return water temperature (system return). The control module reduces or increases boiler input, depending on how close the return water temperature is to the outlet water temperature.

9. Temperature and pressure gauge

10. Electronic display & buttons

The 4-digit electronic display is used to:

- Set space heating temperature.
- Show outlet water temperature (normal) or other operating conditions (in Information mode).
- Show boiler status and shutdown or lockout codes for easy troubleshooting.

The buttons allow changing display mode and reset after lockout. The on/off Power switch (10a) turns power to the boiler controls on or off.

11. Flue pipe adapter

12. Burner

Made with high-grade stainless steel construction, the burner uses pre-mixed air and gas and provides a wide range of firing rates.

13. Water outlet pipe (system supply)

14. Water return pipe (system return)

15. Gas connection pipe

16. *Ultra* Control Module

The *Ultra* Control Module responds to signals from the room thermostat, supply water sensor, return water sensor, flue gas sensor and (if used): domestic hot water aquastat, outdoor temperature sensor, and summer/winter switch. The control module automatically adjusts blower speed (and gas flow rate) to match boiler output to space heating and/or DHW heating demand. The control module is accessed by removing top front cover (16a).

17. Transformer

The transformer reduces line voltage from 120 vac to 24 vac, providing 24 vac to the control module for the gas valve and blower signal .

18. Air intake adapter

19. Electrical entrance cover plate

Remove the electrical cover plate to access the line voltage terminal strip (19b) and the low voltage terminal strip (19a). Attach line voltage conduits to the three holes at the left of the line voltage terminal strip for power, CH pump and DHW pump. Route low voltage wires through the opening to the right of the low voltage terminal strip.

20. Boiler drain valve

21. Line voltage receptacle

Use this connection to plug in line voltage meters or tools while working on boiler. Do not exceed 10-amp load.

22. P/T gauge temperature sensor well

The remote sensor for the panel-mounted pressure/temperature gauge inserts into the outlet water pipe here.

23. Flue gas condensate drain connection

Connect condensate drain line to ½" PVC tee here. The condensate trap (23a) and PVC fittings are field-installed.

24. Front door

The front door is sealed to the boiler assembly around its entire perimeter. Two knurled-head screws (24a) secure the door in place.

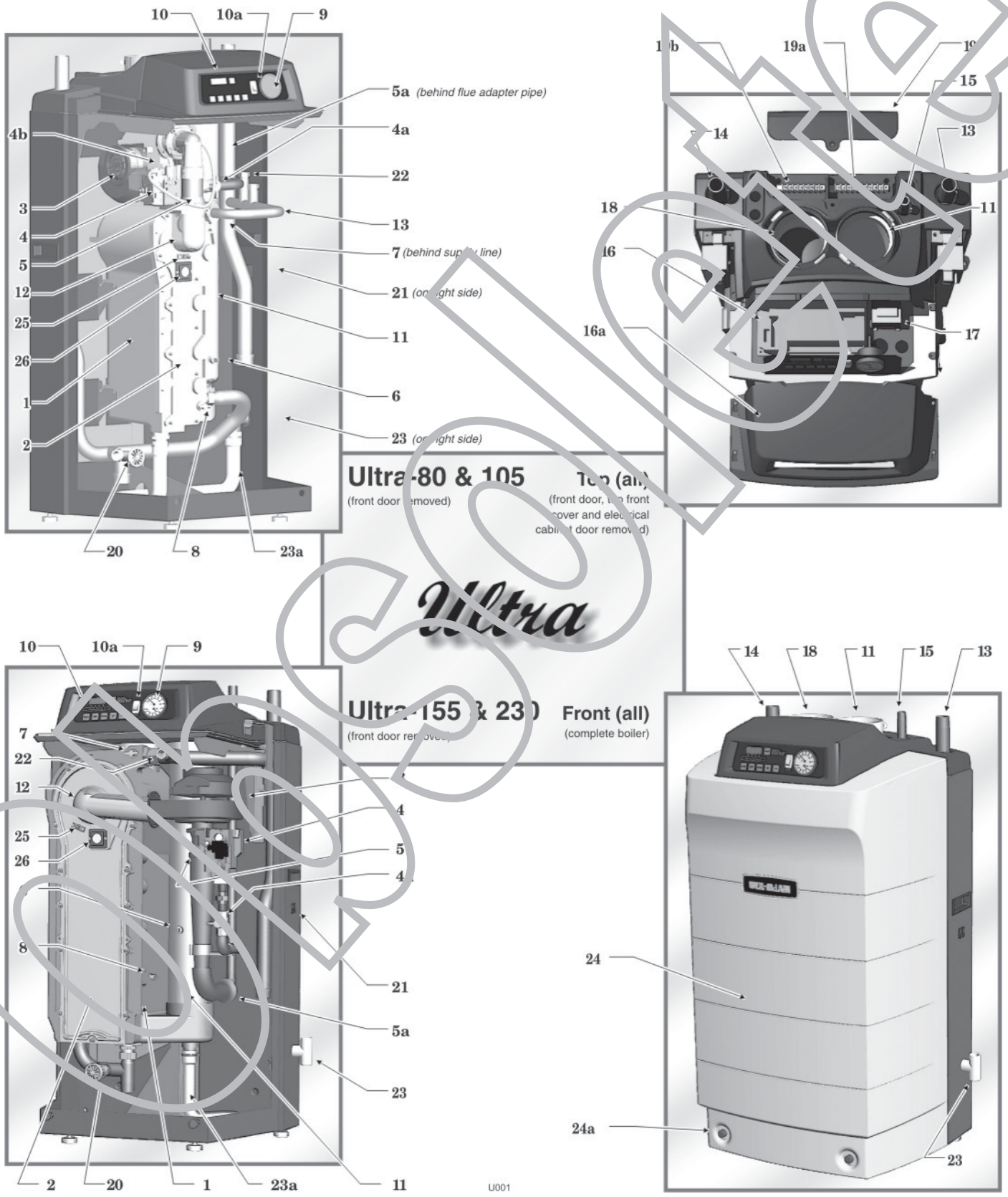
25. Ignition electrode

The burner flame is ignited by applying a high voltage to the ignition electrode. This causes a spark (from electrode to ground).

26. Flame inspection window

The quartz glass window provides a view of the burner surface and flame.

THE *Ultra* GAS-FIRED WATER BOILER, WITH PhD TECHNOLOGY



Contents

Hazard definitions

The following defined terms are used throughout this manual to bring attention to the presence of hazards of various risk levels or to important information concerning the life of the product.

DANGER Indicates presence of hazards that will cause severe personal injury, death or substantial property damage.

WARNING Indicates presence of hazards that can cause severe personal injury, death or substantial property damage.

CAUTION Indicates presence of hazards that will or can cause minor personal injury or property damage.

NOTICE Indicates special instructions on installation, operation or maintenance that are important but not related to personal injury or property damage.

Please read before proceeding

WARNING

Installer— Read all instructions, including this manual and the Ultra Vent Supplement, before installing. Perform steps in the order given.

User — This manual is for use only by a qualified heating installer/service technician. Refer to User's Information Manual for your reference.

User — Have this boiler serviced/inspected by a qualified service technician, at least annually.

Failure to comply with the above could result in severe personal injury, death or substantial property damage.

WARNING

The boiler contains ceramic fiber materials. Use care when handling these materials per instructions on page 55 of this manual. Failure to comply could result in severe personal injury.

NOTICE

When calling or writing about the boiler—Please have the boiler model number from the boiler rating label and the CP number from the boiler jacket. You may list the CP number in the space provided on the Installation and service certificate located on page 31.

Consider piping and installation when determining boiler location.

Any claims for damage or shortage in shipment must be filed immediately against the transportation company by the consignee.

Commonwealth of Massachusetts

When the boiler is installed within the Commonwealth of Massachusetts:

- This product must be installed by a licensed plumber or gas fitter.
- If antifreeze is used, a reduced pressure back-flow preventer device shall be used.

WARNING

Failure to adhere to the guidelines on this page can result in severe personal injury, death or substantial property damage.

When servicing boiler —

- To avoid electric shock, disconnect electrical supply before performing maintenance.
- To avoid severe burns, allow boiler to cool before performing maintenance.

Boiler operation —

- Do not block flow of combustion or ventilation air to boiler.
- Should overheating occur or gas supply fail to shut off, do not turn off or disconnect electrical supply to circulator. Instead, shut off the gas supply at a location external to the appliance.
- Do not use this boiler if any part has been under water. Immediately call a qualified service technician to inspect the boiler and to replace any part of the control system and any gas control that has been under water.

Boiler water —

- The Ultra heat exchanger is made of aluminum, and requires that system pH always be between 7.0 and 8.5 and water chemistry be checked. Chemical treatment may be necessary. See page 24 for details.
- Thoroughly flush the system (without boiler connected) to remove sediment. The high-efficiency heat exchanger can be damaged by build-up or corrosion due to sediment.
- Do not use petroleum-based cleaning or sealing compounds in boiler system. Gaskets and seals in the system may be damaged. This can result in substantial property damage.
- Do not use "homemade cures" or "boiler patent medicines." Serious damage to boiler, personnel and/or property may result.
- Continual fresh make-up water will reduce boiler life. Mineral buildup in heat exchanger reduces heat transfer, overheats the aluminum heat exchanger, and causes failure. Addition of oxygen carried in by make-up water can cause internal corrosion. Leaks in boiler or piping must be repaired at once to prevent make-up water.
- Do not add cold water to hot boiler. Thermal shock can cause heat exchanger to crack.

Freeze protection fluids —

NEVER use automotive or standard glycol antifreeze, even glycol made for hydronic systems. Use only freeze-protection fluids recommended in the Ultra Boiler Freeze Protection Supplement.

Follow all guidelines in the Ultra Boiler Freeze Protection Supplement. Thoroughly clean and flush any replacement boiler system that has used glycol before installing the new Ultra boiler.

1 Prepare boiler location

Installations must comply with:

- Local, state, provincial, and national codes, laws, regulations and ordinances.
- National Fuel Gas Code, ANSI Z223.1 – latest edition.
- Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1, when required.
- National Electrical Code.
- For Canada only: B149.1 or B149.2 Installation Code, CSA C22.1 Canadian Electrical Code Part 1 and any local codes.

NOTICE The Ultra boiler gas manifold and controls met safe lighting and other performance criteria when boiler underwent tests specified in ANSI Z21.13 — latest edition.

Before locating the boiler, check:

1. Check for nearby connection to:
   - System water piping
   - Venting connections
   - Gas supply piping
   - Electrical power
2. Check area around boiler. Remove any combustible materials, gasoline and other flammable liquids.

WARNING Failure to keep boiler area clear and free of combustible materials, gasoline and other flammable liquids and vapors can result in severe personal injury, death or substantial property damage.

3. The Ultra boiler must be installed so that gas control system components are protected from dripping or spraying water or rain during operation or service.
4. If new boiler will replace existing boiler, check for and correct system problems, such as:
   - System leaks causing oxygen corrosion or heat exchanger cracks from hard water deposits.
   - Incorrectly-sized expansion tank.
   - Lack of freeze protection in boiler water causing system and boiler to freeze and leak.

Provide clearances:

Clearances from combustible materials

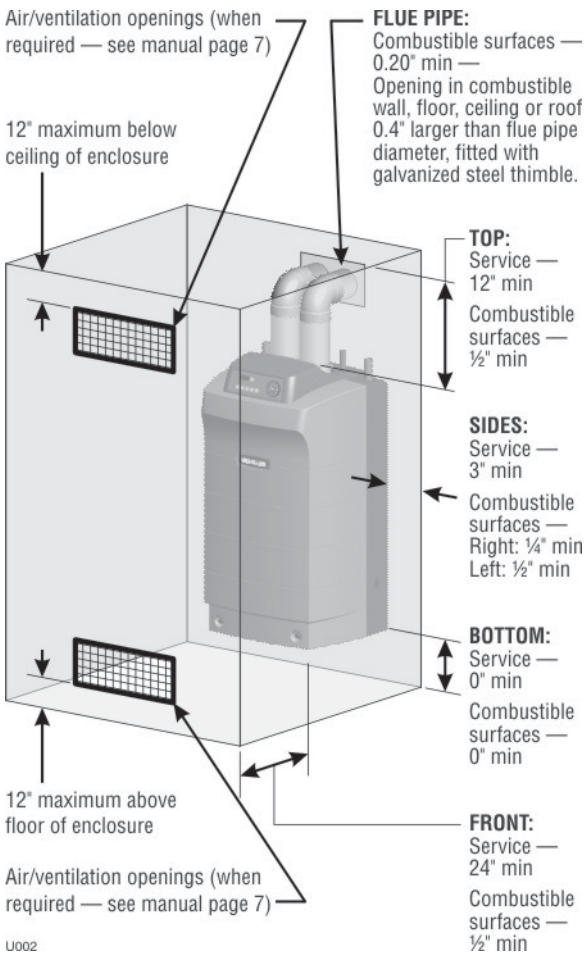
1. Hot water pipes — at least ½" from combustible materials.
2. Vent pipe — at least 0.20" from combustible materials.
3. See Figure 1 for other clearance minimums.

Clearances for service access

1. See Figure 1 for recommended service clearances. If you do not provide minimum clearances shown, it might not be possible to service the boiler without removing it from the space.

NOTICE The Ultra boiler may be wall mounted (using special wall mount kit) or floor mounted. No clearance is required at the rear of the unit, either for service or for clearance to combustible surfaces.

Figure 1 Clearances required



1 Prepare boiler location *(continued)*

Provide air openings to room:

Ultra boiler alone in boiler room

1. No air ventilation openings into boiler room are needed when clearances around Ultra boiler are at least equal to the SERVICE clearances shown in Figure 1. For spaces that do NOT supply this clearance, provide two openings as shown in Figure 1. Each opening must provide 1 square inch free area per 1,000 Btuh of boiler input.

Ultra boiler in same space with other gas or oil-fired appliances

1. Follow the National Fuel Gas Code (U. S.) or CSA B149.1 and B149.2 (Canada) to size/verify size of the combustion/ventilation air openings into the space.

WARNING The space must be provided with combustion/ventilation air openings correctly sized for all other appliances located in the same space as the Ultra boiler.

Replace boiler jacket front door after servicing. The boiler front door must be securely fastened to the boiler to prevent boiler from drawing air from inside the boiler room. This is particularly important if the boiler is located in the same room as other appliances.

Failure to comply with the above warnings could result in severe personal injury, death or substantial property damage.

2. Size openings only on the basis of the other appliances in the space. No additional air opening free area is needed for the Ultra boiler because it takes its combustion air from outside (direct vent installation).

Flooring and foundation

Flooring

The Ultra boiler is approved for installation on combustible flooring, but must never be installed on carpeting.

WARNING Do not install boiler on carpeting even if foundation is used. Fire can result, causing severe personal injury, death or substantial property damage.

Foundation

Provide a solid foundation pad, at least 2 inches above the floor, if any of the following is true:

- floor can become flooded.
- the floor is dirt, sand, gravel or other loose material.
- the boiler mounting area is severely uneven or sloped.

The minimum foundation size is 24 inches x 20 inches. Foundation may be of wood, brick or concrete (minimum 2 inches thick) construction.

If flooding is possible, elevate boiler sufficiently to prevent water from reaching boiler.

Residential garage installation

Precautions

Take the following special precautions when installing the boiler in a residential garage. If the boiler is located in a residential garage, per ANSI Z223.1, paragraph 5.1.9:

- Mount the boiler with a minimum of 18 inches above the floor of the garage to the bottom of the boiler to ensure the burner and ignition devices will be no less than 18 inches above the floor.
- Locate or protect the boiler so it cannot be damaged by a moving vehicle.

Vent and air piping

The Ultra boiler requires a special vent system, designed for pressurized venting. Ultra boilers are rated ANSI Z21.13 Category IV (pressurized vent, likely to condense in the vent).

You must also install air piping from outside to the boiler air intake adapter. The resultant installation is categorized as direct vent (sealed combustion). Note prevention of combustion air contamination on page 8 when considering vent/air termination.

Vent and air must terminate near one another and may be vented vertically through the roof or out a side wall. You may use any of the vent/air piping methods covered in the Ultra Boiler Vent Supplement, included in the envelope assembly. Do not attempt to install the Ultra boiler using any other means.

Be sure to locate the boiler such that the vent and air piping can be routed through the building and properly terminated. The vent/air piping lengths, routing and termination method must all comply with the methods and limits given in the Ultra Boiler Vent Supplement.

1 Prepare boiler location *(continued)*

Prevent combustion air contamination

Install air inlet piping for the Ultra boiler as described in the Ultra Boiler Vent Supplement. Do not terminate vent/air in locations that can allow contamination of combustion air. Refer to Table 1 for products and areas which may cause contaminated combustion air.

WARNING You must pipe combustion air to the boiler air intake. Ensure that the combustion air will not contain any of the contaminants below. Contaminated combustion air will damage the boiler, resulting in possible severe personal injury, death or substantial property damage. Do not pipe combustion air near a swimming pool, for example. Also avoid areas subject to exhaust fumes from laundry facilities. These areas will always contain contaminants.

Table 1 Corrosive contaminants and sources

Products to avoid
Spray cans containing chloro/fluorocarbons
Permanent wave solutions
Chlorinated waxes/cleaners
Chlorine-based swimming pool chemicals
Calcium chloride used for thawing
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 have contaminants
Dry cleaning/laundry areas and establishments
Swimming pools
Metal fabrication plants
Beauty shops
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

When removing a boiler from existing common vent system:

DANGER Do not install the Ultra boiler into a common vent with any other appliance. This will cause flue gas spillage or appliance malfunction, resulting in possible severe personal injury, death or substantial property damage.

WARNING Failure to follow all instructions can result in flue gas spillage and carbon monoxide emissions, causing severe personal injury or death.

At the time of removal of an existing boiler, 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.

a. Seal any unused openings in the common venting system.

b. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion or other deficiencies which could cause an unsafe condition.

c. Test vent system — 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.

d. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.

e. Test for spillage at 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.

f. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined herein, return doors, windows, exhaust fans, fireplace dampers, and any other gas-burning appliance to their previous conditions of use.

Any improper operation of common venting system should be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1 — latest edition. Correct by resizing to approach the minimum size as determined using the appropriate tables in Part 11 of that code. Canadian installations must comply with B149.1 or B149.2 Installation Code.

2 Prepare boiler

Remove boiler from crate

CAUTION Cold weather handling — If boiler has been stored in a very cold location (below 0°F) before installation, handle with care until the plastic components come to room temperature.

1. The Ultra boiler is generally easier to handle and maneuver after removing from crate.
2. After removing outer shipping carton from boiler, REMOVE jacket front door by loosening two knurled-head screws at lower front. Removing the door will prevent possible damage to the door during handling.
3. To remove boiler from pallet (after removing jacket front door):
   a. Remove the four lag screws securing shipping brackets.
   b. Unscrew the two rear boiler legs and remove the shipping brackets.
   c. Replace legs.
   d. Discard the cardboard protector insert on the rear of the boiler.

NOTICE Do not drop boiler or bump jacket on floor or pallet. Damage to boiler can result.

Prepare for propane if operating on propane:

WARNING **Ultra-80: DO NOT** apply the following instructions to conversion of Ultra-80 boilers. Follow the instructions provided with the optional propane conversion kit. The propane conversion kit is NOT included as standard equipment for the Ultra-80.

Do not apply the following to conversion of a boiler already installed and connected to gas supply. For a boiler already installed, you must turn off gas supply, turn off power and allow boiler to cool before proceeding. You must also completely test the boiler after conversion to verify performance as described under "Startup," Section 7 of this manual. See separate natural to propane conversion instructions for conversion of an existing boiler.

You must install the propane orifice to fire the Ultra boiler on propane. Verify when installing that the orifice size marking matches boiler size (105, 155 or 230). Failure to comply could result in severe personal injury, death or substantial property damage.

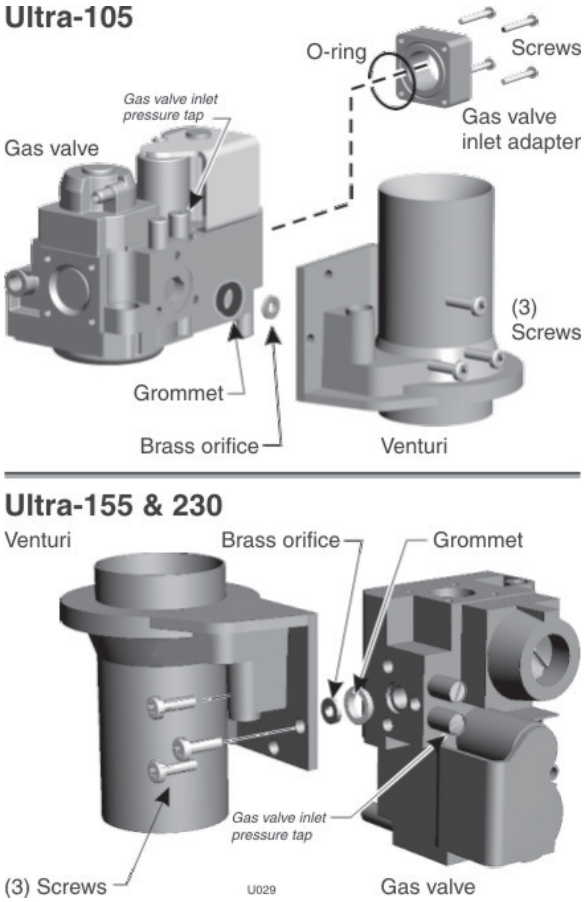
1. With boiler on its back, remove jacket front door by removing two knurled head screws at lower front. Then lift door away from boiler.
2. Disconnect the gas valve electrical plug.
3. Ultra-105: Remove the 4 screws securing gas valve inlet adapter to valve. Ultra-155 & 230: Disconnect the gas line union below the gas valve.
4. Remove (3) TORX screws securing gas valve to venturi (Figure 2).
5. Locate propane orifice disc from conversion kit bag. Verify that the stamping on the orifice disk matches the boiler size (105, 155 or 230). Place orifice in the black rubber grommet in the side of the gas valve and secure in valve (Figure 2).
6. Reposition gas valve against venturi and replace (3) TORX screws securing valve to venturi. Secure gas valve inlet adapter to gas valve with 4 screws (Ultra-105) or reconnect gas line union (Ultra-155 & 230). On Ultra-105 boilers, make sure the plastic hose is connected from gas valve to inlet elbow.

DANGER **Ultra-105**: Inspect the O-ring between the gas valve and gas valve inlet adapter block whenever they are disassembled. The O-ring must be in good condition and must be installed. Failure to comply will cause a gas leak, resulting in severe personal injury or death.

7. DO NOT attempt to adjust gas valve outlet pressure.
8. Connect gas valve electrical plug to valve terminals.
9. After installation is complete, attach the propane conversion label (in conversion kit bag) next to the boiler rating plate.
10. Replace jacket front panel.

NOTICE **Ultra-80-LP** boilers are factory-equipped to operate on propane gas.

Figure 2 Installing propane orifice



Placing floor-mounted boilers

1. Set boiler in place and check level.
   a. Adjust legs, if necessary to level boiler.

Placing wall-mounted boilers

1. Ultra boilers can be wall mounted. Use only the separately available Ultra boiler wall mounting kit and instructions. See WARNING below.

WARNING The wall must be vertically plumb and capable of carrying the weight of the boiler. The operating weights are: Ultra-80: 139 pounds / Ultra-105: 145 pounds / Ultra-155: 181 pounds / Ultra-230: 192 pounds.

Wall mount Ultra boilers only using Weil-McLain Ultra boiler wall-mounting kit and accompanying instructions. This kit is not supplied as standard equipment with the boiler, and must be purchased separately.

Failure to comply with above could result in severe personal injury, death or substantial property damage.

2 Prepare boiler *(continued)*

Perform hydrostatic pressure test

Pressure test boiler before permanently attaching water or gas piping or electrical supply.

Prepare boiler for test

1. See Figure 3 for reference in following steps.
2. Remove 1" x 1" x ¾" tee and ¾" street elbow from accessory bag. Pipe to boiler supply connection as shown. (Use pipe dope sparingly.)
3. Temporarily plug the ¾" relief valve tapping in the street elbow with a ¾" NPT pipe plug.
4. Connect a hose to boiler drain valve, the other end connected to a fresh water supply. Make sure hose can also be used to drain boiler after test.
5. Connect a nipple and shutoff valve to system supply connection on the 1" x 1" x ¾" tee. This valve will be used to bleed air during the fill. (Valve and nipple are not included with boiler.)
6. Connect a shutoff valve to system return connection. (Valve is not included with boiler.)
7. To avoid getting water on boiler, you may want to pipe street elbows on top of shutoff valves and attach catch-buckets beneath.
8. If convenient, install the boiler circulator and any other piping compatible with Figure 3 that would still allow bleeding air from shutoff valves. Follow guidelines in this manual for piping components, locations and sizing.

Fill and pressure test

1. Open the shutoff valves you installed on supply and return connections.
2. Slowly open boiler drain valve and fresh water supply to fill boiler with water. The boiler will fill quickly because the water content is less than 2 gallons.
3. When water reaches shutoff valves, close boiler drain valve.
4. Close shutoff valves.
5. Slowly reopen boiler drain valve until test pressure on the pressure/temperature gauge reaches at least 45 psig, but no higher than 55 psig.
6. Hold at test pressure for 10 minutes.

WARNING Do not leave boiler unattended. A cold water fill could expand and cause excessive pressure, resulting in severe personal injury, death or substantial property damage.

7. Make sure constant gauge pressure has been maintained throughout test. Check for leaks. Repair if found.

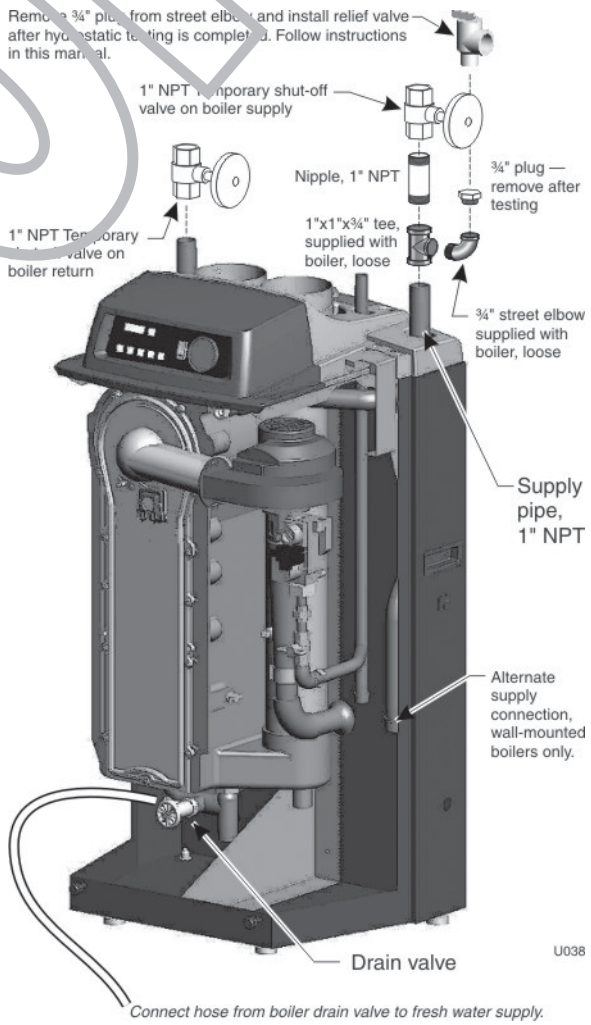
WARNING Leaks must be repaired at once. Failure to do so can damage boiler, resulting in substantial property damage.

WARNING Do not use petroleum-based cleaning or sealing compounds in boiler system. Gaskets and seals in the system may be damaged. This can result in substantial property damage.

Drain and remove fittings

1. Disconnect fill water hose from water source.
2. Drain boiler through drain valve. Remove hose after draining.
3. Remove nipples and valves unless they will remain for use in the system piping.
4. Remove plug from relief valve street elbow. See section 3 (page 11) to install relief valve.

Figure 3 Hydrostatic test piping connections



Connect hose from boiler drain valve to fresh water supply.

3 Install water piping

Install relief valve

1. Install relief valve in ¾" street elbow piped from boiler supply piping tee (Figure 3). Pipe the relief valve only as shown, in the location shown.
2. Connect discharge piping to safe disposal location, following guidelines in the WARNING below.

WARNING To avoid water damage or scalding due to relief valve operation:

- Discharge line must be connected to relief valve outlet and run to a safe place of disposal. Terminate the discharge line in a manner that will prevent possibility of severe burns or property damage should the valve discharge.
- Discharge line must be as short as possible and be the same size as the valve discharge connection throughout its entire length.
- Discharge line must pitch downward from the valve and terminate at least 6" above the floor drain where any discharge will be clearly visible.
- The discharge line shall terminate plain, not threaded, with a material serviceable for temperatures of 375 °F or greater.
- Do not pipe the discharge to any place where freezing could occur.
- No shutoff valve shall be installed between the relief valve and boiler, or in the discharge line. Do not plug or place any obstruction in the discharge line.
- Test the operation of the valve after filling and pressurizing system by lifting the lever. Make sure the valve discharges freely. If the valve fails to operate correctly, replace it with a new relief valve.
- Failure to comply with the above guidelines could result in failure of the relief valve to operate, resulting in possibility of severe personal injury, death or substantial property damage.

WARNING Use two wrenches when tightening water piping at boiler, using one wrench to prevent the boiler return line or supply line from turning. Failure to support the boiler piping connections to prevent them from turning could cause damage to boiler components.

General piping information

Additional controls, when required

NOTICE The Ultra control module uses temperature sensors to provide both high limit protection and modulating temperature control. The control module also provides low water protection by sensing the temperature of the heat exchanger. Some codes/jurisdictions may require additional external controls for high limit and/or low water cutoff protection.

Additional limit control:

Following standard industry practices, if installation is to comply with ASME or Canadian requirements, an additional high temperature limit is needed. Consult local requirements for other codes/standards to determine if needed.

1. Install additional high temperature limit constructed to prevent a temperature setting above 200°F in system supply piping between boiler and isolation valve. (Note that the Ultra control module operating limit function shuts the boiler down at 190°F or Parameter 4, whichever is lower.)
2. See section 9, pages 34 and 35 for wiring.
   a. If limit control is to cause a boiler hard lockout (requiring manual reset of Ultra control module), connect isolated contact to field control wiring terminals 6 and 8 as shown in wiring diagram.
   b. Otherwise, connect isolated contact between terminals 6 and 7 for a soft lockout (automatic reset).
   c. If using a manual reset limit control or wiring in the manual reset circuit, Parameter 4 (see page 39) should be no closer than 20°F to the limit control setting (i.e., no higher than 180°F for a 200°F limit setting, for example).

Separate low water cutoff:

A low water cutoff device is required when boiler is installed above piping level or by certain state or local codes or insurance companies. Consult local requirements to determine.

1. If required, use a low water cutoff designed for water installations. Electrode probe-type is recommended.
2. Purchase low water cutoff and install in tee in supply piping above boiler.
3. See section 9, pages 34 and 35 for wiring.
   a. If limit control is to cause a boiler hard lockout (requiring manual reset of Ultra control module), connect isolated contact to field control wiring terminals 6 and 8 as shown in wiring diagram.
   b. Otherwise, connect isolated contact between terminals 6 and 7 for a soft lockout (automatic reset).

Backflow preventer:

Use backflow check valve in cold water supply as required by local codes.

3 Install water piping *(continued)*

System water piping methods

NOTICE

All piping methods shown in this manual use primary/secondary connection to the boiler loop. These designs ensure proper flow through the Ultra boiler, for the most efficient and reliable operation of the boiler and the heating system. For other piping methods, consult your local Weil-McLain representative or refer to separate Ultra boiler piping guides.

Wall-mounted boilers — Piping can exit bottom of boiler enclosure. See separate wall-mounting instructions for details.

Expansion tank and make-up water

1. Ensure expansion tank size will handle boiler and system water volume and temperature. Allow 3 gallons for boiler and its piping.

CAUTION

Undersized expansion tanks cause system water to be lost from relief valve and make-up water to be added through fill valve. Eventual boiler failure can result due to excessive make-up water addition.

2. Tank must be located as shown in this manual, or following recognized design methods. See tank manufacturer's instructions for details.
3. Connect the expansion tank to the air separator only if the separator is on the suction side of the circulator. Always install the system fill connection at the same point as the expansion tank connection to the system.
4. Most piping drawings in this manual show diaphragm expansion tanks. See Figure 4 for piping from air separator to expansion tank and make-up water line using a closed-type expansion tank.
5. Most chilled water systems are piped using a closed-type tank, as shown in Figure 8, page 15.

Diaphragm (or bladder) expansion tank

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

Closed-type expansion tank

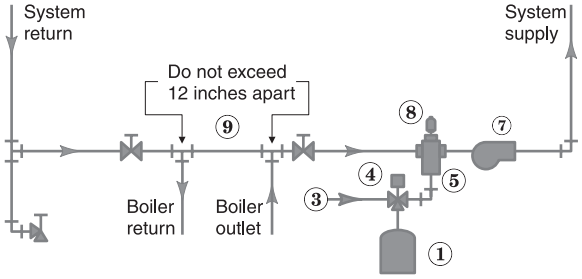
1. See Figure 4 for piping connections when using a closed-type expansion tank.
2. Pitch any horizontal piping up towards tank 1 inch per 5 feet of piping. Connect to tank with at least ¾" piping to allow room for air to rise.

CAUTION

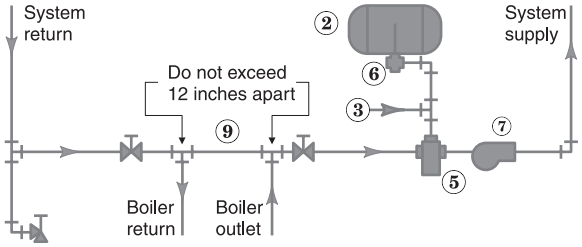
DO NOT install automatic air vents on closed-type expansion tank systems. Air must remain in the system and return to the tank to provide its air cushion. An automatic air vent would cause air to leave system, resulting in water-logging the expansion tank.

Figure 4 Expansion tank piping

Piping to diaphragm (or bladder) expansion tank



Alternate — Piping to closed-type expansion tank



1. Diaphragm-type expansion tank
2. Closed-type expansion tank
3. Make-up water supply
4. Fill valve, typical
5. Air separator
6. Tank fitting
7. System circulator
8. Automatic air vent
9. Primary/secondary connection

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Circulators

The boiler circulator (Taco 007 for Ultra-80/105 or 0011 for Ultra-155/230) is shipped loose. Locate it either in the return or supply piping, as shown in the appropriate piping diagram in this manual.

WARNING

DO NOT use the boiler circulator in any location other than the ones shown in this manual. The boiler circulator is selected to ensure adequate flow through the Ultra boiler. Failure to comply could result in unreliable performance and nuisance shutdowns from insufficient flow.

Sizing space heat system piping

1. See Figures 7 through 10, pages 14 – 17, for recommended piping. In all diagrams, the space heating system is isolated from the boiler loop by the primary/secondary connection.
2. Size the piping and components in the space heating system using recognized design methods.

3 Install water piping *(continued)*

Sizing DHW system piping

NOTICE When using the boiler for dedicated DHW applications, use the circulator supplied with the boiler (007 for Ultra-80/105; 0011 for Ultra-155/230) to circulate to the water heater except where higher flow rates may be required for the heater used. Use the following method to select a circulator for the water heater on combined space heating/DHW systems.

1. Figure 5 shows recommended DHW piping, as shown in Figures 7 through 10, pages 14 – 17. All show direct connection of the DHW piping to the boiler because the boiler circulator shuts down during DHW operation.
2. Figure 6 shows the pump curves for suggested DHW circulators (Taco 007, 0011, 0012, 0014 or equivalent). Use these curves along with boiler pressure drop data from Table 2 to size the DHW piping and circulator. Or you can use Table 2 for a quick-selection method.
3. Table 2 uses the available head from Taco circulators to help you select the right circulator.
   a. See Figure 5.
   b. H1 is the head loss across the boiler.
   c. H2 is the head loss across the DHW piping.
   d. H3: Table 2 subtracts H1 and H2 from the available head of the circulator. This gives the maximum value for H3, head loss across the water heater.
4. To select a circulator using Table 2:

   Step 1: From the water heater manufacturer's data, find:
   a. Required boiler water flow rate, GPM, at 180°F.
   b. Pressure drop (feet water column) across the water heater at this flow rate.

   Step 2: Find your boiler model in Table 2, and find a flow rate that is just larger than the required flow rate from step 1a.

   Step 3: Read across to column H3, containing maxium values for H3 when using the circulator listed. The value in column H3 must be larger than the water heater pressure drop from step 1b.

Figure 5 DHW piping (see Table 2 for approximate head losses)

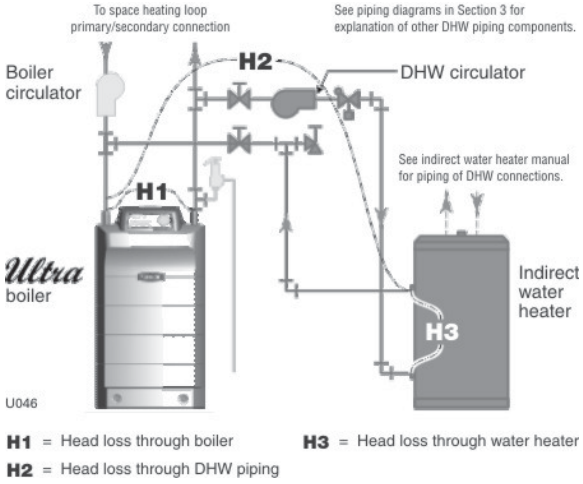


Figure 6 Pump curves for typical circulators suggested for DHW circulator

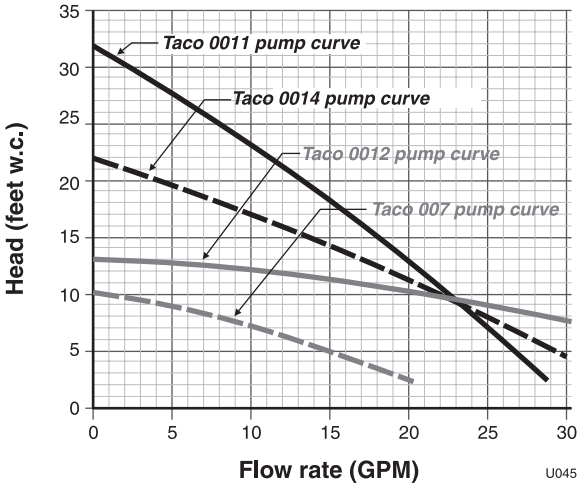


Table 2 Pipe sizing and head losses for DHW applications *(H1=boiler head loss; H2=piping head loss; H3=maximum allowable head loss through water heater based on available head of circulator chosen; i.e., Taco 007, 0011, 0012 or 0014 circulator)*

Flow rate	Temp rise	Pipe size	H1	H2	H3 (0010, 0014 or 0011 circulator)		
					007	0012	0011
GPM	°F	Inches	Feet w.c.	Feet w.c.	Feet w.c.	Feet w.c.	Feet w.c.
Ultra-80							
3.5 (min)	41	1	1.4	0.8	7.9	11.4	25.9
6.7	21	1¼	6.0	1.2	2.0	6.2	18.6
10 (max)	14	1¼	14.6	2.5	Not rec.	Not rec.	5.5
Ultra-105							
4.5 (min)	42	1	3.1	1.2	5.6	9.3	23.1
8.2	23	1¼	9.4	1.8	Not rec.	2.0	13.2
11 (max)	17	1¼	16.2	2.9	Not rec.	Not rec.	2.5

Flow rate	Temp rise	Pipe size	H1	H2	H3 (0010, 0014 or 0011 circulator)		
					0012	0014	0011
GPM	°F	Inches	Feet w.c.	Feet w.c.	Feet w.c.	Feet w.c.	Feet w.c.
Ultra-155							
7.0 (min)	40	1	3.6	2.7	7.0	12.2	19.1
10.0	28	1¼	7.7	2.5	2.0	6.8	13.2
13 (max)	21	1¼	13.3	3.9	Not rec.	Not rec.	2.2
Ultra-230							
10 (min)	41	1	5.9	5.0	2.0	6.1	11.7
11.5	36	1¼	7.5	3.2	2.0	5.6	10.4
14 (max)	30	1¼	10.8	4.5	Not rec.	Not rec.	3.0

3 Install water piping *(continued)*

Zoning with zone valves

1. Connect boiler to system as shown in Figure 7 when zone valve zoning. The primary/secondary piping shown ensures the boiler loop will have sufficient flow. It also avoids applying the high head of the boiler circulator to the zone valves.
2. When using a closed-type expansion tank, connect the expansion tank and make-up water piping as shown in Figure 4, page 12.
3. Connect DHW (domestic hot water) piping to indirect storage water heater as shown.

NOTICE The *Ultra* PhD Control Module turns off space heating during DHW heating. The boiler circulator will turn off, preventing hot water from circulating to the system. The flow/check valve shown on the boiler outlet piping prevents gravity circulation in the boiler loop during DHW heating.

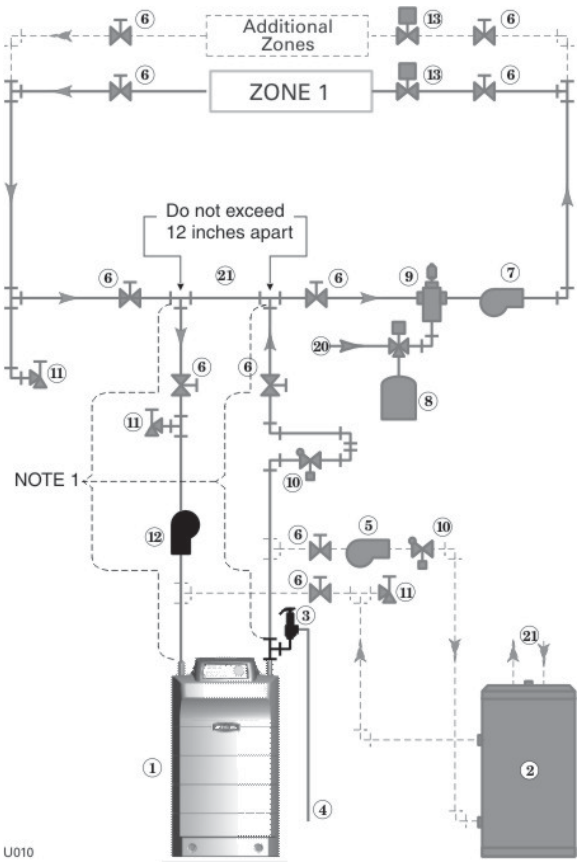
4. Controlling the system circulator
   a. To cycle the system circulator from the Ultra PhD control module, add a circulator relay wired to the boiler circulator terminals as shown on page 21.

NOTE 1: To ensure adequate flow rate through the boiler, use the following pipe size on all boiler loop piping (connecting boiler to and from the primary/secondary connection, item 21):

Ultra-80 or Ultra-105 – 1" or larger.

Ultra-155 or Ultra-230 – 1¼" or larger.

Figure 7 Zone valve zoning plus optional DHW piping



Legend Figure 7

1 Ultra boiler
2 Indirect water heater (DHW), if used
3 Boiler relief valve (see page 11 for piping details)
4 Relief valve discharge piping (see page 11 for details)
5 DHW circulator (see page 13 for suggested sizing)
6 Isolation valves
7 System circulator
8 Diaphragm (or bladder) type expansion tank (see page 12 for piping of closed-type expansion tank, if used)
9 Air separator [with automatic air vent only on systems using diaphragm (or bladder) type expansion tank]
10 Flow/check valves (with weighted seats to prevent gravity circulation)
11 Purge/drain valves
12 Boiler circulator
13 Zone valves, typical
20 Make-up water supply
21 Primary/secondary connection

— Supplied with boiler
— By others (not included with boiler)

3 Install water piping *(continued)*

Zoning with circulators

1. Connect boiler to system as shown in Figure 8 when circulator zoning. The boiler circulator cannot be used for a zone. It must supply only the boiler loop.
2. Install a separate circulator for each zone.
3. When using a closed-type expansion tank, connect the expansion tank and make-up water piping as shown in Figure 4, page 12.
4. Connect DHW (domestic hot water) piping to indirect storage water heater as shown.

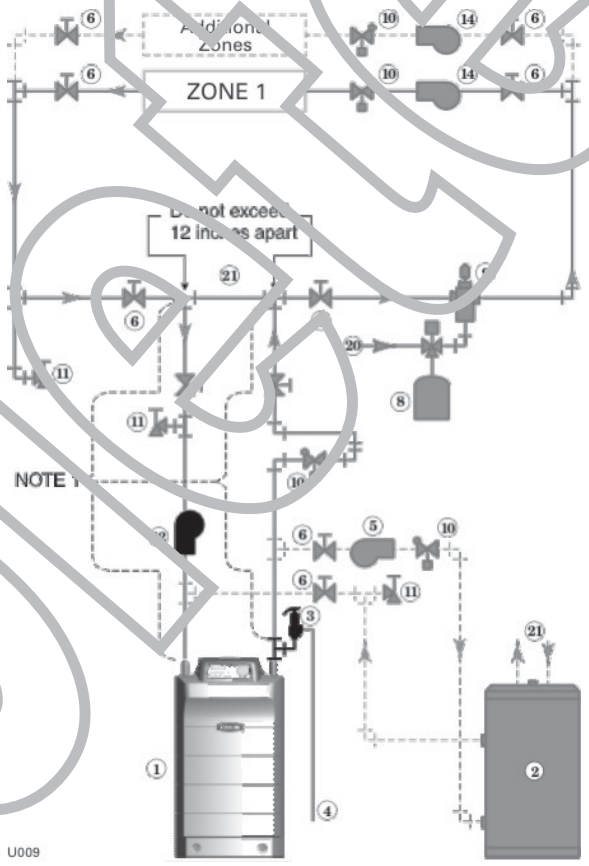
NOTICE The *Ultra* PhD Control Module turns off space heating during DHW heating. The boiler circulator will turn off, preventing hot water from circulating to the system. The flow/check valve shown on the boiler outlet piping prevents gravity circulation in the boiler loop during DHW heating.

NOTE 1: To ensure adequate flow rate through the boiler, use the following pipe size on all boiler loop piping (connecting boiler to and from the primary/secondary connection, item 21):

Ultra-85 or Ultra-105 – 1" or larger.

Ultra-155 or Ultra-230 – 1¼" or larger.

Figure 8 Circulator zoning plus optional DHW piping



Legend Figure 8

1 Ultra boiler
2 Indirect water heater (DHW), if used
3 Boiler relief valve (see page 11 for piping details)
4 Relief valve discharge piping (see page 11 for details)
5 DHW circulator (see page 13 for suggested sizing)
6 Isolation valves
7 System circulator
8 Diaphragm (or bladder) type expansion tank (see page 12 for piping of closed-type expansion tank, if used)
9 Air separator [with automatic air vent only on systems using diaphragm (or bladder) type expansion tank]
10 Flow/check valves (with weighted seats to prevent gravity circulation)
11 Purge/drain valves
12 Boiler circulator
14 Zone circulators, typical
20 Make-up water supply
21 Primary/secondary connection

— Supplied with boiler

— By others (not included with boiler)

3 Install water piping *(continued)*

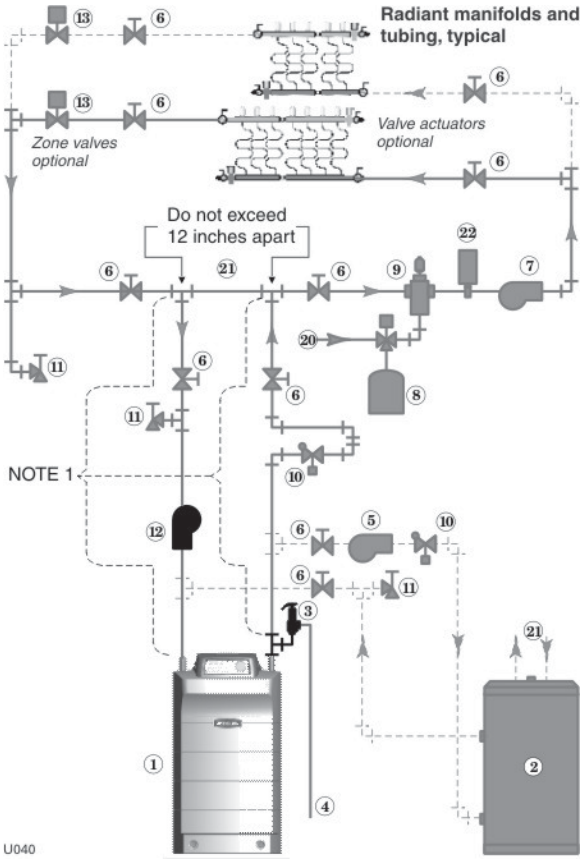
Radiant heating applications

1. The Ultra boiler is ideal for use in radiant heating. The Ultra boiler's unique heat exchanger design allows it to work well even in condensing mode. So there is no need to regulate boiler return water temperature in radiant heating applications.
2. Connect boiler to system as shown in Figure 9 for typical radiant heating applications. The primary/secondary piping shown ensures the boiler loop will have sufficient flow. Size the system piping and circulator to provide the flow and pressure drop needed for the radiant system.
3. Add the high limit control (Figure 9, item 22) to ensure supply water temperature will not exceed the maximum allowable for the radiant system. Wire this limit control between low voltage terminal strip terminals 6 and 7.
4. When using a closed-type expansion tank, connect the expansion tank and make-up water piping as shown in Figure 4, page 12.
5. Connect DHW (domestic hot water) piping to indirect storage water heater as shown.

NOTICE The *Ultra* PhD Control Module turns off space heating during DHW heating. The boiler circulator will turn off, preventing hot water from circulating to the system. The flow/check valve shown on the boiler outlet piping prevents gravity circulation in the boiler loop during DHW heating.

6. Controlling the system circulator
   a. To cycle the system circulator from the Ultra PhD control module, add a circulator relay wired to the boiler circulator terminals as shown on page 21.
7. Setting boiler outlet water target temperature.
   a. Follow procedure on page 28 to set space heating target temperature to the desired supply temperature for the system. For outdoor reset operation, install and connect the outdoor temperature sensor supplied with the boiler.

Figure 9 Typical radiant heating system piping plus optional DHW



NOTE 1: To ensure adequate flow rate through the boiler, use the following pipe size on all boiler loop piping (connecting boiler to and from the primary/secondary connection, item 21):
Ultra-80 or Ultra-105 – 1" or larger.
Ultra-155 or Ultra-230 – 1¼" or larger.

Legend Figure 9

1 Ultra boiler
2 Indirect water heater (DHW), if used
3 Boiler relief valve (see page 11 for piping details)
4 Relief valve discharge piping (see page 11 for details)
5 DHW circulator (see page 13 for suggested sizing)
6 Isolation valves
7 System circulator
8 Diaphragm (or bladder) type expansion tank (see page 12 for piping of closed-type expansion tank, if used)
9 Air separator [with automatic air vent only on systems using diaphragm (or bladder) type expansion tank]
10 Flow/check valves (with weighted seats to prevent gravity circulation)
11 Purge/drain valves
12 Boiler circulator
13 Zone valves, when used (zoning may also be done using manifold-mounted valve actuators)
20 Make-up water supply
21 Primary/secondary connection
22 High limit temperature control, set to protect radiant tubing

— Supplied with boiler
— By others (not included with boiler)

3 Install water piping *(continued)*

Chilled water systems

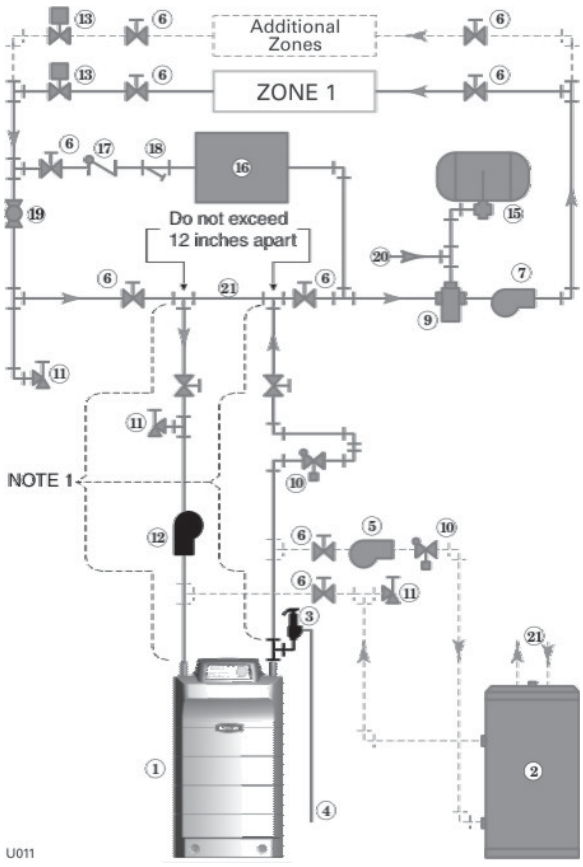
1. Install boiler so that chilled medium is piped in parallel with the heating boiler. Use appropriate valves to prevent chilled medium from entering boiler. See Figure 8 for typical installation of balancing valve and check valve.
3. The space heating system may be zoned with circulators if a separate circulator is supplied for the chilled water loop.
3. If boiler is connected to heating coils located in air handling units where they can be exposed to refrigerated air, use flow control valves or other automatic means to prevent gravity circulation during cooling cycle.

CAUTION Follow these piping guidelines below to ensure chilled water does not enter the boiler loop. Cold return water can shut down the boiler, with the potential for freeze-ups in the building from loss of heat.

WARNING Chilled medium, if used, is piped in parallel with heating boiler as shown in Figure 8. Use appropriate valves to prevent chilled medium from entering boiler.

If boiler is connected to heating coils located in air handling units where they can be exposed to refrigerated air, use flow control valves or other automatic means to prevent gravity circulation during cooling cycle. Circulation of cold water through the boiler could result in erratic operation, causing possible substantial property damage due to shutdown of the heating system and resultant freeze-ups.

Figure 10 Chilled water system plus optional DHW piping



NOTE 1: To ensure adequate flow rate through the boiler, use the following pipe size on all boiler loop piping (connecting boiler to and from the primary/secondary connection, item 21):
Ultra-80 or Ultra-105 – 1" or larger Ultra-155 or Ultra-230 – 1¼" or larger.

Legend Figure 10

1 Ultra boiler
2 Indirect water heater (DHW), if used
3 Boiler relief valve (see page 11 for piping details)
4 Relief valve discharge piping (see page 11 for details)
5 DHW circulator (see page 13 for suggested sizing)
6 Isolation valves
7 System circulator
9 Air separator (DO NOT use automatic air vents on systems fitted with closed-type tanks)
10 Flow/check valves (with weighted seats to prevent gravity circulation)
11 Purge/drain valves
12 Boiler circulator
13 Zone valves, typical
15 Closed-type expansion tank
16 Water chiller
17 Check valve
18 Strainer
19 Balancing valve
20 Make-up water supply
21 Primary/secondary connection

— Supplied with boiler
— By others (not included with boiler)

4 Venting, combustion air & condensate line

Install vent and combustion air piping

DANGER

Ultra Boiler must be vented and supplied with combustion and ventilation air as described in Weil-McLain Ultra Boiler Vent Supplement (included in envelope assembly). Ensure the vent and air piping and the combustion air supply comply with these instructions regarding vent system, air system and combustion air quality. See also Section 1 of this manual.

Inspect finished vent and air piping thoroughly to ensure all are airtight and comply with the instructions provided and with all requirements of applicable codes.

Failure to provide a properly-installed vent and air system will cause severe personal injury or death.

Prepare condensate fittings

1. Remove PVC fittings and gasket from the accessories bag.
2. Deburr and chamfer outside and inside of ½" x 1¼" PVC nipple to ensure even cement distribution when joining.
3. Clean nipple ends and all fittings. Dry thoroughly.
4. For each joint in the condensate line, apply the following. Assemble parts ONLY in the order given.
   a. Apply primer liberally to both joint surfaces — pipe end and fitting socket.
   b. While primer is still damp, lightly apply approved cement to both surfaces in a uniform coating.
   c. Apply a second coat of cement to both surfaces. Avoid using too much cement on sockets to prevent cement buildup inside.
   d. With cement still wet, insert pipe into fitting, twisting ¼ turn. Make sure pipe is fully inserted.
   e. Wipe excess cement from joint. Check joint to be sure a smooth bead of cement shows around the entire joint.
5. See Figure 11.
6. Assemble the ½" PVC nipple to the PVC reducing elbow as shown in step 1.
7. Allow joint to dry completely. Then slide gasket over nipple as shown in step 2.
8. Slide nipple through jacket condensate line hole to position as shown in Figure 11, bottom.
9. Cement the ½" tee to the protruding ½" nipple. Be sure both nipple and reducing elbow finish upright. IMPORTANT: Firmly press the reducing elbow and the tee together while the cement sets to ensure the gasket is securely compressed. The gasket ensures the jacket enclosure is airtight at this location.

Connect condensate drain

1. Remove condensate trap line from bag. Install as shown in Figure 11.
2. Slide trap line onto flue outlet condensate connection and PVC reducing elbow as shown. Secure with hose clamps.
3. Connect condensate drain tubing to the ½" PVC tee and run to floor drain or condensate pump. Use ½" PVC or CPVC pipe; or 5/8" I.D. tubing.

NOTICE

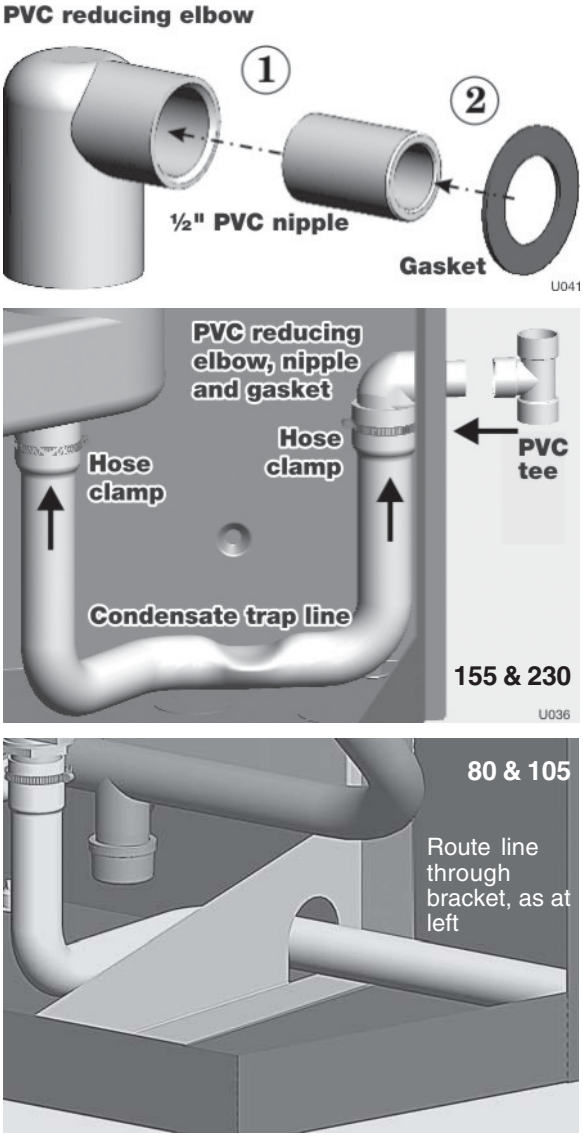
Use materials approved by the authority having jurisdiction. In the absence of other authority, PVC and CPVC pipe must comply with ASTM D1785, F441 or D2665. Cement and primer must comply with ASTM D2564 or F493. For Canada, use CSA or ULC certified PVC or CPVC pipe, fittings and cement.

4. Leave the top of the ½" tee OPEN. This is needed as a vacuum break.
5. When installing a condensate pump, select one approved for use with condensing boilers and furnaces. The pump should have an overflow switch to prevent property damage from condensate spillage.
6. Condensate from the Ultra boiler will be slightly acidic (typically with a pH from 3.2 to 4.5). Install a neutralizing filter if required by local codes.

CAUTION

The condensate line must remain unobstructed, allowing free flow of condensate. If condensate is allowed to freeze in the line or if the line is obstructed in any other manor, condensate can exit from the boiler tee, resulting in potential water damage to property.

Figure 11 Condensate trap assembly

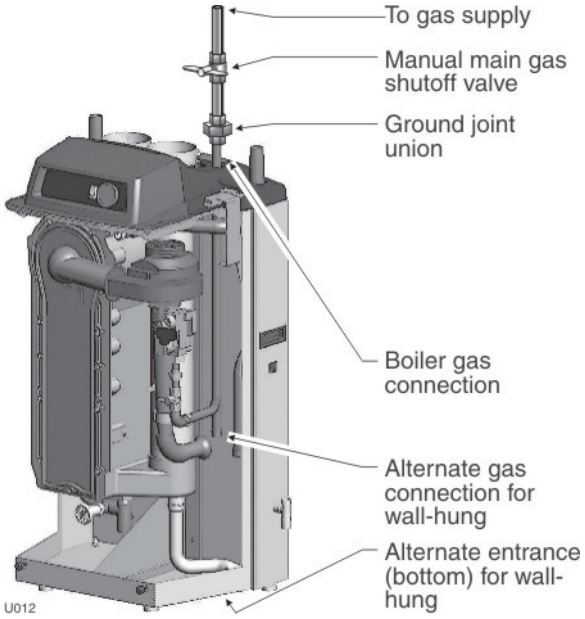


5 Gas piping

Connecting gas supply piping

1. Remove jacket front panel and refer to Figure 12 to pipe gas to boiler.
   a. Install ground joint union for servicing, when required.
   b. Install manual shutoff valve in gas supply piping outside boiler jacket when required by local codes or utility requirements.
   c. In Canada — When using manual main shutoff valve, it must be identified by the installer.
2. Wall-mounted boilers
   a. Refer to separate Ultra Boiler Wall-mounting instructions.
   b. Gas connection may enter from the bottom of boiler as explained in the Wall-mounting instructions.

Figure 12 Connect gas supply piping



3. Support piping with hangers, not by boiler or its accessories.
4. Purge all air from gas supply piping.
5. Before placing boiler in operation, check boiler and its gas connection for leaks.
   a. Close manual main shutoff valve during any pressure testing at less than 13" w.c.
   b. Disconnect boiler and gas valve from gas supply piping during any pressure testing greater than 13" w.c.

WARNING Do not check for gas leaks with an open flame — use bubble test. Failure to use bubble test or check for gas leaks can cause severe personal injury, death or substantial property damage.

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

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

WARNING 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, requiring no field adjustment. Attempting to alter or measure the gas valve outlet pressure could result in damage to the valve, causing potential severe personal injury, death or substantial property damage.

WARNING Ultra boilers are shipped ready to fire natural gas ONLY. You must install the propane orifice if the boiler will be connected to propane. See page 9. Failure to comply could result in severe personal injury, death or substantial property damage.

WARNING Use two wrenches when tightening gas piping at boiler, using one wrench to prevent the boiler gas line connection from turning. Failure to support the boiler gas connection pipe to prevent it from turning could damage gas line components.

5 Gas piping *(continued)*

Natural Gas:

Pipe sizing for natural gas

1. Refer to Table 4 for pipe length and diameter. Base on rated boiler input (divide by 1,000 to obtain cubic feet per hour).
   a. Table 4 is only for natural gas with specific gravity 0.60, with a pressure drop through the gas piping of 0.30" w.c.
   b. For additional gas pipe sizing information, refer to ANSI Z223.1 (or B149.1 or B149.2 for Canadian installations).

Natural gas supply pressure requirements

1. Pressure required at gas valve inlet pressure port:
   - Maximum: 13" w.c. with no flow (lockup) or with boiler on
   - Minimum: 4" w.c. with gas flowing (verify during boiler startup, while boiler is at high fire)
2. Install 100% lockup gas pressure regulator in supply line if inlet pressure can exceed 13" w.c. at any time. Adjust lockup regulator for 13" w.c. maximum.

Propane Gas:

WARNING Ultra boilers are shipped ready to fire natural gas ONLY (exception: Ultra-80-LP is propane-ready). You must install the propane orifice if the boiler will be connected to propane. See page 9. Failure to comply could result in severe personal injury, death or substantial property damage.

Pipe sizing for natural gas

1. Contact gas supplier to size piping, tanks and 100% lockup gas pressure regulator.

Propane supply pressure requirements

1. Adjust propane supply regulator provided by gas supplier for 13" w.c. maximum pressure.
2. Pressure required at gas valve inlet pressure port:
   - Maximum: 13" w.c. with no flow (lockup) or with boiler on
   - Minimum: 4" w.c. with gas flowing (verify during boiler startup, while boiler is at high fire)

Table 4 Pipe capacity for 0.60 specific gravity natural gas

Gas pipe length (feet)	Capacity of pipe for pipe size of: (Capacity in cubic feet gas per hour)				
	½"	¾"	1"	1¼"	1½"
10	132	278	520	1050	1600
20	92	190	350	730	1100
30	73	152	285	590	860
40	63	130	245	500	760
50	56	115	215	440	670
75	45	93	175	360	545
100	38	79	150	305	460
150	31	64	120	250	380

6 Field wiring

WARNING ELECTRICAL SHOCK HAZARD — For your safety, turn off electrical power supply at service entrance panel before making any electrical connections to avoid possible electric shock hazard. Failure to do so can cause severe personal injury or death.

NOTICE Wiring must be N.E.C. Class 1.

If original wiring as supplied with boiler must be replaced, use only type 105 °C wire or equivalent.

Boiler must be electrically grounded as required by National Electrical Code ANSI/ NFPA 70 – latest edition.

Installation must comply with:

1. National Electrical Code and any other national, state, provincial or local codes or regulations.
2. In Canada, CSA C22.1 Canadian Electrical Code Part 1, and any local codes.

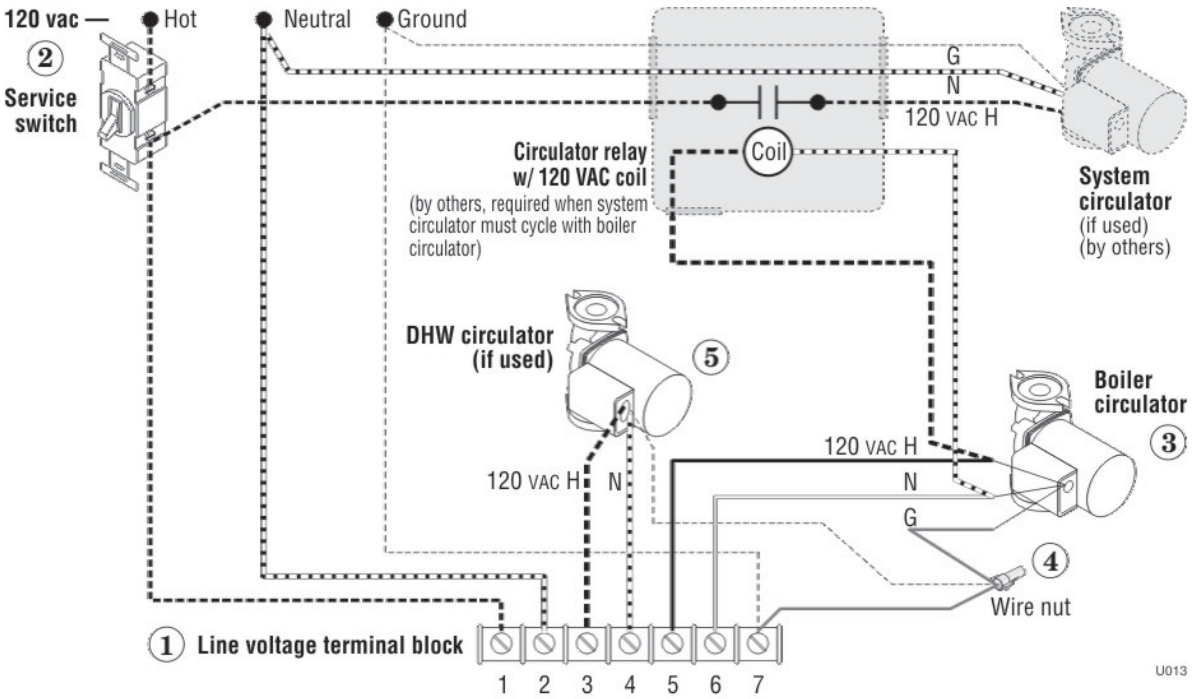
Line voltage connections

1. Connect 120 VAC power wiring to line voltage terminal strip in left compartment of electrical entrance, as shown in Figure 13, item 1.
2. Provide and install a fused disconnect or service switch (15 amp. recommended) as required by the code. (See Figure 13, item 2)
3. Boiler circulator is shipped loose. Wire Boiler circulator as shown for Figure 13, item 3.
4. When connecting a DHW circulator, connect wiring to line voltage terminal strip as shown for Figure 13, item 5.
5. Route all wires and conduits to the jacket openings specified in Figure 14, page 22.

Wiring a system circulator

1. To activate a system circulator when the Boiler circulator operates, wire as shown at bottom of Figure 13.
2. You must install a relay as shown. DO NOT wire in parallel with the Boiler circulator. See CAUTION in Figure 13.

Figure 13 Line voltage field wiring connections (service switch provided by installer)



CAUTION Do not connect another circulator directly to the same wires as the Boiler circulator or the DHW circulator. The control module will encounter fuse failures, causing the boiler to shut down. Use separate relay as shown when wiring a System circulator to operate with Boiler circulator. Connect all system circulator wires in external junction boxes (by others), not to boiler terminal block.

6 Field wiring *(continued)*

Low voltage connections (Fig. 15)

1. Connect low voltage wiring to low voltage terminal strip (Figure 15, item 1) as shown in Figure 15 and the boiler wiring diagram.
2. Route all low voltage wires through grommeted jacket opening to right of low voltage terminal strip, as shown in Figure 14.

Thermostat

1. Connect Figure 15, item 2, room thermostat or end switch (isolated contact only) between terminals 5 and 6.
2. Install thermostat on inside wall away from influences of drafts, hot or cold water pipes, lighting fixtures, television, sunrays, or fireplaces.
3. Thermostat anticipator (if applicable):
   a. If connected directly to boiler, set for 0.1 amps.
   b. If connected to relays or other devices, set to match total electrical power requirements of connected devices. See device manufacturers' specifications and thermostat instructions for details.

Outdoor temperature sensor

1. Connect outdoor temperature sensor (Figure 15, item 6) between terminals 1 and 2 to enable outdoor reset operation of the Ultra boiler. If fixed-temperature operation is required, do not install outdoor sensor.
2. Mount sensor on exterior wall, shielded from direct sunlight or flow of heat or cooling from other sources.
3. If desired, install a summer/winter switch (Figure 15, item 7) across terminals 1 and 2 to force fixed-temperature operation during summer months. When the switch is closed, the boiler (space heating) circulator is disabled.
4. Route sensor wires through the grommeted hole at right of the electrical entrance (see Figure 14).

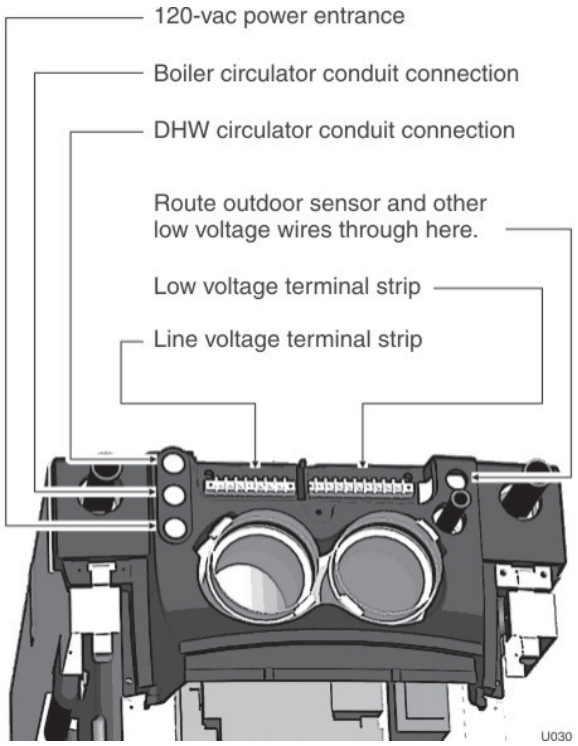
DHW aquastat

1. Connect storage indirect water heater (DHW) aquastat (Figure 15, item 3) between terminals 3 and 4.

Additional limits

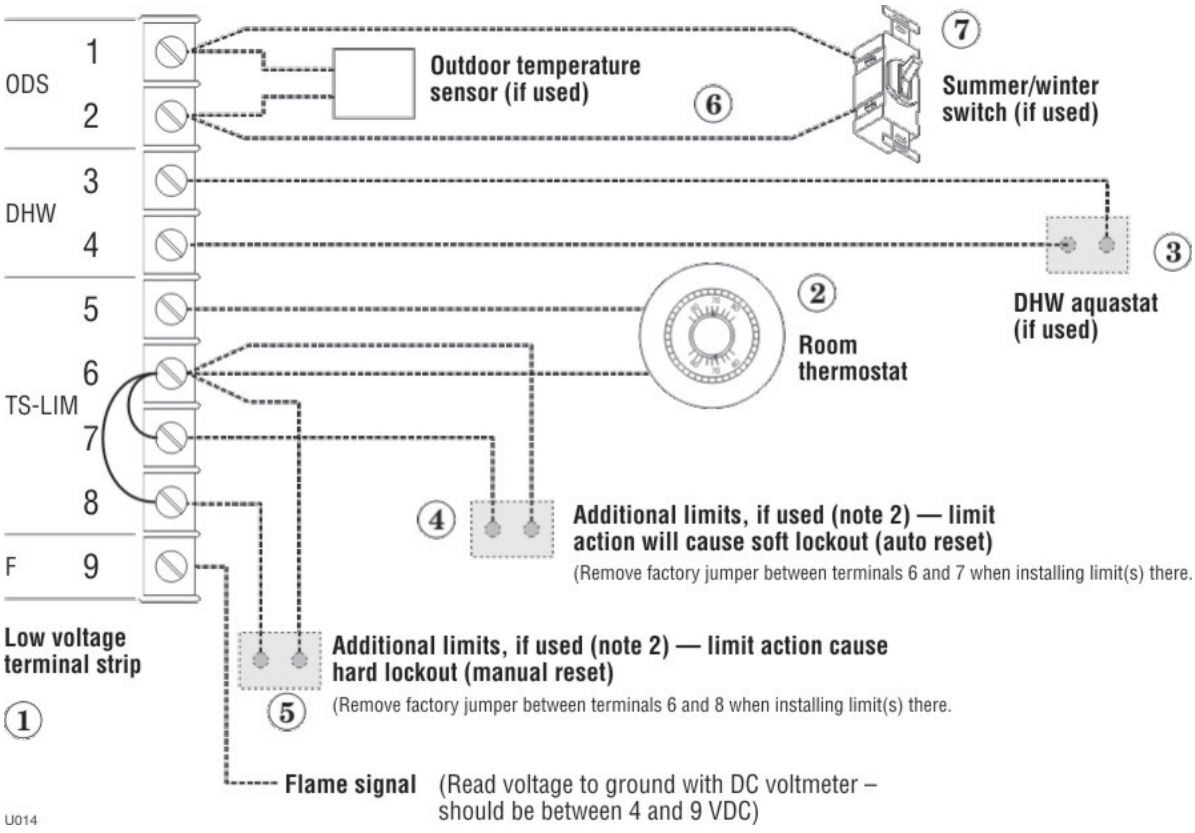
1. Connect additional limit controls and interlocks between the terminals shown in Figure 15.
2. Controls connected between terminals 6 and 7 (see Figure 15, item 4) will cause a soft lockout (automatic reset). When limit(s) closes, boiler will resume normal operation.
3. Controls connected between terminals 6 and 8 (see Figure 15, item 5) will cause a hard lockout (manual reset). The boiler will only restart after the Ultra display panel RESET switch is pressed.

Figure 14 Routing field wiring



6 Field wiring *(continued)*

Figure 15 Low voltage field wiring connections



7 Start-up

Check/control water chemistry

WARNING Do not use petroleum-based cleaning or sealing compounds in boiler system. Damage to elastomer seals and gaskets in system could occur, resulting in substantial property damage.

WARNING Before filling the boiler and system with water, verify the following. Failure to comply could result in boiler failure or unreliable operation.

Water pH between 7.0 and 8.5

1. Maintain boiler water pH between 7.0 and 8.5. Check with litmus paper or have chemically analyzed by water treatment company.
2. If pH differs from above, consult local water treatment company for treatment needed.

Hardness less than 7 grains

1. Consult local water treatment companies for unusually hard water areas (above 7 grains hardness).

Chlorine concentration less than 200 ppm

1. Filling with chlorinated fresh water should be acceptable since drinking water chlorine levels are typically less than 5 ppm.
2. Do not use the boiler to directly heat swimming pool or spa water.
3. Do not fill boiler or operate with water containing chlorine in excess of 200 ppm.

Clean system to remove sediment

1. You must thoroughly flush the system (without boiler connected) to remove sediment. The high-efficiency heat exchanger can be damaged by buildup or corrosion due to sediment.
2. For zoned systems, flush each zone separately through a purge valve. (If purge valves and isolation valves are not already installed, install them to properly clean the system.)
3. Flush system until water runs clean and you are sure piping is free of sediment.

Test/replace freeze protection fluid

1. For systems using freeze protection fluids, follow guidelines in Ultra Boiler Freeze Protection Supplement.

Freeze protection (when used)

WARNING NEVER use automotive or standard glycol antifreeze, even glycol made for hydronic systems. Use only freeze-protection fluids recommended in the Ultra Boiler Freeze Protection Supplement. Follow all guidelines in the Freeze Protection Supplement, and thoroughly clean and flush any replacement boiler system that has used glycol before installing the new Ultra boiler.

1. Determine freeze protection fluid quantity using total system water content, following fluid manufacturers's instructions. Boiler water content is listed on page 63. Remember to include expansion tank water content.
2. Local codes may require back flow preventer or actual disconnect from city water supply.
3. When using freeze protection fluid with automatic fill, install a water meter to monitor water make-up. Freeze protection fluid may leak before the water begins to leak, causing concentration to drop, reducing the freeze protection level.

Fill and test water system

1. Fill system only after ensuring the water meets the requirements of this manual.
2. Close manual and automatic air vents and boiler drain valve.
3. Fill to correct system pressure. Correct pressure will vary with each application.
   a. Typical cold water fill pressure for a residential system is 12 psi.
   b. Pressure will rise when boiler is turned on and system water temperature increases. Operating pressure must never exceed 25 psig.
4. At initial fill and during boiler startup and testing, check system thoroughly for any leaks. Repair all leaks before proceeding further.

WARNING Eliminate all system leaks. Continual fresh make-up water will reduce boiler life. Minerals can build up in sections, reducing heat transfer, overheating heat exchanger, and causing heat exchanger failure.

5. The system may have residual substances that could affect water chemistry. After the system has been filled and leak tested, verify water pH and chlorine concentrations are acceptable.

7 Start-up *(continued)*

Purge air from water system

1. Purge air from system:
   a. Connect a hose to the purge valve (see purge/drain valves, item 11, in piping diagrams on pages 14 through 17. Route hose to an area where water can drain and be seen.
   b. Close the boiler or system isolation valve between the purge valve and fill connection to the system.
   c. Close zone isolation valves.
   d. Open quick-fill valve on cold water make-up line.
   e. Open purge valve.
   f. One zone at a time, open the isolation valves. Allow water to run through the zone, pushing out the air. Run until no noticeable air flow is present. Close the zone isolation valves and proceed with the next zone. Follow this procedure until all zones are purged.
   g. Close the quick-fill water valve and purge valve and remove the hose. Open all isolation valves. Watch that system pressure rises to correct cold-fill pressure.
   h. After the system has operated for a while, eliminate any residual air by using the manual air vents located throughout the system.
   i. If purge valves are not installed in system, open manual air vents in system one at a time, beginning with lowest floor. Close vent when water squirts out. Repeat with remaining vents.
2. Open automatic air vent (diaphragm-type or bladder-type expansion tank systems only) one turn.
3. Open other vents.
   a. Starting on the lowest floor, open air vents one at a time until water squirts out.
   b. Repeat with remaining vents.
4. Refill to correct pressure.

Check for gas leaks

WARNING Before starting the boiler, and during initial operation, smell near the floor and around the boiler for gas odorant or any unusual odor. Remove boiler front door and smell interior of boiler enclosure. Do not proceed with start-up if there is any indication of a gas leak. Repair any leak at once.

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, requiring no field adjustment. Attempting to alter or measure the gas valve outlet pressure could result in damage to the valve, causing potential severe personal injury, death or substantial property damage.

WARNING Propane boilers only – Your propane supplier mixes an odorant with the propane to make its presence detectable. In some instances, the odorant can fade, and the gas may no longer have an odor. Before start-up (and periodically thereafter), have the propane supplier verify the correct odorant level in the gas.

Check thermostat circuit(s)

1. Disconnect the two external wires connected to the boiler thermostat terminals (low voltage terminal strip terminals 5 and 6).
2. Connect a voltmeter across these two incoming wires. Close each thermostat, zone valve and relay in the external circuit one at a time and check the voltmeter reading across the incoming wires.
3. There should NEVER be a voltage reading.
4. If a voltage does occur under any condition, check and correct the external wiring. (This is a common problem when using 3-wire zone valves.)
5. Once the external thermostat circuit wiring is checked and corrected if necessary, reconnect the external thermostat circuit wires to boiler low voltage terminal strip terminals 5 and 6. Allow the boiler to cycle.

Inspect/fill condensate system

Inspect/check condensate lines and fittings

1. Inspect the condensate drain line, condensate PVC fittings and condensate trap. (See Figure 11, page 18 for component locations.)
2. Pour water into the top of the boiler's ½" PVC condensate tee and check for any leaks in the condensate drain line or fittings. Repair any leaks.

Fill condensate trap with water

1. Loosen the hose clamp securing the right end of the condensate trap to the PVC reducing elbow (see Figure 11, page 18).
2. Slide the trap hose end off of the elbow.
3. Fill the trap with fresh water to within a inch of the end of the hose.
4. Replace trap hose on PVC reducing elbow and tighten the hose clamp.

WARNING The condensate trap (page 3, item 23a) must be filled with water during all times of boiler operation to avoid flue gas emission from the condensate drain line. Failure to fill the trap could result in severe personal injury or death.

7 Start-up *(continued)*

Final checks before starting boiler

- ❑ Read manual section 9 to familiarize yourself with Ultra PhD control module operation. Read Operating Instructions (page 27) for proper steps to start boiler.
- ❑ Verify the boiler and system are full of water and all system components are correctly set for operation.
- ❑ Verify the preparation procedures of section 7, pages 24 and 25 have been completed.
- ❑ Fill vent condensate trap with water (by removing hose clamp and hose at PVC reducing elbow). Replace hose on PVC reducing elbow and tighten clamp.
- ❑ Verify electrical connections are correct and securely attached.
- ❑ Inspect vent piping and air piping for signs of deterioration from corrosion, physical damage or sagging. Verify air piping and vent piping are intact and correctly installed per Ultra Boiler Vent Supplement.

Start the boiler

1. Turn OFF Power switch on Ultra display panel. Turn on power to boiler.
2. Read and follow the Operating instructions of Figure 16, page 27.

If boiler does not start correctly

1. Check for loose connections, blown fuse or service switch off?
2. Is external limit control (if used) open? Is boiler water temperature above 200 °F?
3. Is thermostat set below room temperature?
4. Is gas turned on at meter or boiler?
5. Is incoming gas pressure less than 4" w.c.?
6. Are parameters 2 and 3 set to "1" as explained on page 28?

If none of the above corrects the problem, refer to Troubleshooting, section 11, page 48 of this manual.

❑ Check system and boiler

❑ Check water piping

1. Check system piping for leaks. If found, shut down boiler and repair immediately. (See WARNINGS on pages 24 and 25 regarding failure to repair leaks.)
2. Vent any remaining air from system using manual vents. Air in the system will interfere with circulation and cause heat distribution problems and noise.

❑ Check vent piping and air piping

1. Check for gas-tight seal at every connection and seam of air piping and vent piping.

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

❑ Check gas piping

1. Check around the boiler for gas odor following the procedure of page 19 of this manual.

WARNING If you discover evidence of any gas leak, shut down the boiler at once. Find the leak source with bubble test and repair immediately. Do not start boiler again until corrected. Failure to comply could result in severe personal injury, death or substantial property damage.

❑ Propane boilers — verify conversion

1. Verify propane orifice has been installed per Propane Conversion instructions.

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, requiring no field adjustment. Attempting to alter or measure the gas valve outlet pressure could result in damage to the valve, causing potential severe personal injury, death or substantial property damage.

WARNING Ultra boilers are shipped ready to fire natural gas ONLY. You must install the propane orifice if the boiler will be connected to propane. See page 9. Failure to comply could result in severe personal injury, death or substantial property damage.

❑ Check flame & combustion

1. Press and hold both the Ultra control panel "Mode" and "+" buttons simultaneuously until "H" appears.
2. The "H" in the first digit of the display means the boiler will operate at high fire when the blower speed reaches maximum.
3. Look at the flame through the flame inspection window. The high fire flame should be blue and should be stable. The burner surface should be covered with orange dots.
4. Remove the flue temperature sensor from the flue pipe and insert a combustion test probe.

Continued on page 28 . . .

7 Start-up *(continued)*

Figure 16 Operating instructions

FOR YOUR SAFETY READ BEFORE OPERATING

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

A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.

B. Before OPERATING, smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor. See below.

C. Use only your hand to turn the gas control knob. Never use tools. If the knob 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.

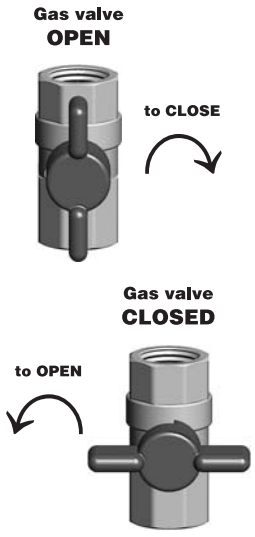
D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control, which has been under water.

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.

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. Verify external manual gas valve is open (valve handle parallel to gas piping).
3. Turn OFF POWER switch on the Ultra control panel.
4. Rotate two thumb screws at bottom of access door counterclockwise to release door.
5. Remove boiler access door.
6. Turn boiler manual gas valve knob counterclockwise to open gas supply.
7. Smell for gas in the boiler enclosure. If you smell gas, STOP! Follow "B" in the safety information above. If you don't smell gas, go to the next step.
8. Turn ON POWER switch on the Ultra control panel.
9. Set thermostat(s) to desired setting.
10. The Ultra control panel display left digit will show a sequence of numbers (0, 1, 2, etc.) that indicate boiler control sequence. Digit 3 or 4 indicates boiler is firing. Digit 0 means there is no call for heat (all room thermostats and domestic water heater satisfied).
11. If the appliance will not operate when there is a call for heat and piping is not hot, follow the instructions "To Turn Off Gas To Appliance" below and call your service technician or gas supplier.
12. Replace jacket front panel. Make sure panel is seated firmly in place and all joints are visually sealed. Then tighten the two thumb screws at bottom of access door firmly.



Boiler manual gas valve

TO TURN OFF GAS TO THE APPLIANCE

1. Set room thermostats to lowest setting.
2. Turn off all electric power to the boiler if service is to be performed. Turn OFF POWER switch on the Ultra control panel.
3. Close external manual gas cock (valve handle perpendicular to gas piping). Remove boiler access door. Turn boiler manual gas valve knob clockwise to close gas supply.
4. Replace boiler access door.

7 Start-up *(continued)*

❑ Check flame & combustion (continued)

5. Testing is suggested for either CO_2 or O_2 and for CO. The values should be in the range listed in the table below. The CO should not exceed 100 ppm when combustion is correct.

WARNING If combustion at either high or low fire is outside the range given below, shut down the boiler and contact your local Weil-McLain representative. Failure to comply could result in severe personal injury, death or substantial property damage.

Natural gas				Propane			
CO_2 min.	CO_2 max.	O_2 min.	O_2 max.	CO_2 min.	CO_2 max.	O_2 min.	O_2 max.
8.0%	10.0%	3.5%	7.0%	9.5%	11.5%	3.1%	5.9%

6. Measure natural gas input:
   a. Operate boiler 10 minutes.
   b. Turn off other appliances.
   c. At natural gas meter, measure time (in seconds) required to use one cubic foot of gas.
   d. Calculate gas input:

$$\frac{3600 \times 1000}{\text{number of seconds from step } \mathbf{c}} = \text{Btuh}$$

   e. Btuh calculated should approximate input rating on boiler rating label.
7. Press and hold the Ultra control panel "Mode" and "-" buttons simultaneously until the display shows "L".
8. The "L" in the first digit means the boiler will operate at low fire when the blower speed reaches minimum.
9. Look at the flame through the flame inspection window. The low fire flame should be stable and evenly distributed over burner surface with a uniform orange color.
10. Repeat the combustion test of steps 4 and 5 above.
11. Press and hold the "+" and "-" buttons to return boiler to automatic firing.
12. Replace flue gas temperature sensor.

WARNING You must replace the flue gas temperature sensor to prevent flue gas spillage into the boiler enclosure. Failure to comply could result in severe personal injury, death or substantial property damage.

Set space heating operation

Verify space heating mode

1. Press the "Mode" button until the display shows "Para." This is the parameter mode.
2. Press the "Step" button until the display first digit shows "3."
3. The last digit must show "1." If any other number displays, press the "+" button until "1" shows in the right-hand digit. Press the "Store" button to save this setting.

Set space heating target temperature

1. Press the Ultra control panel "Step" button until the display first digit shows "4." The right 3 digits show the outlet water temperature setting.
2. Press the "+" or "-" button to change the setting to the desired outlet water temperature. (The factory default setting is 190 °F.)
   a. Outdoor sensor installed — Setting is the target temperature for outdoor temperature at or below 32 °F. At higher outside temperatures, the Ultra PhD control module calculates the target temperature. (See page 32 and 33 for detailed discussion of outdoor reset.)
      When a summer/winter switch is used, closing the switch will disable the boiler (space heating) circulator during summer operation.
   b. Outdoor sensor not installed — Setting is the target temperature at all times.
3. Press the "Store" button to save the setting.

Check DHW operation setup

1. Go to step 2 if the control is in Parameter mode already. Press the "Mode" button until the display shows "Para" (parameter mode).
2. Press the "Step" button until the display first digit shows "2."
3. The last digit must show "1." If any other number displays, press the "+" button until "1" shows in the right-hand digit. Press the "Store" button to save this setting.
4. The Ultra PhD control module turns on the DHW circulator when the indirect water heater operating control closes. The control module shuts off the boiler circulator (stops space heating) during calls for DHW heating.

Verify operation — space heating

NOTE: "[_ _ _ _]" in the following indicates the characters that should show on the Ultra display panel. "180" in the right 3 places means the display shows the measured boiler water temperature. The number shown will not necessarily be 180.

1. Turn down DHW aquastat on DHW tank (if used). If necessary, turn off power and remove one of the DHW aquastat wires to ensure boiler will not receive a DHW heat call.
2. Turn off power to boiler at service switch.
3. Wait a few seconds, then turn on power to boiler.
   [A:180] (*self-check* on power-up, for a few seconds)
   [0:180] (*no call for heat*)
4. Raise room thermostat to call for heat.
   [5:180] (*blower/circulator on*) The blower and boiler circulator energize and the control checks for air flow.
   [1:180] (*prepurge*) Blower speed will increase to ignition speed. The blower will run in prepurge for 10 seconds.

7 Start-up *(continued)*

[2!80] (*ignition*) After prepurge, the control module opens the gas valve and starts ignition spark.

a. If burner flame proves within 4.5 seconds, burner continues to fire. Burner will fire at start-up rate — 50% of maximum input — for about 10 seconds to allow flame to stabilize.

b. If burner flame does not prove within 4.5 seconds, control module attempts ignition sequence again. Flame must prove within 5 attempts or control will lockout (display will show [E 02]).

c. Verify flame failure operation by closing boiler manual gas cock to prevent gas flow. Open manual gas valve after testing.

[3!80] (*burner on, space heating*) Once flame is proven and stable, the burner turns down to low fire for approximately 2 minutes.

- After this low fire period, the burner is allowed to modulate. Firing rate depends on actual outlet water temperature versus target temperature.

5. Allow boiler to bring water temperature to target temperature.
   [6!80] (*target temperature reached*) The burner will shut down. The blower will run in postpurge (see below), then turn off. The boiler circulator continues to run as long as there is a call for heat.
6. Lower room thermostat to stop call for heat.
   [1!80] (*postpurge*) When the room thermostat is satisfied (call for heat ended), the burner turns off. The blower will continue for a 15-second postpurge, then turn off. (If another call for heat occurs, the boiler will remain off for one minute before starting again, and the display will show [6!80].)
   [0!80] (*no call for heat*) Boiler is now in standby mode (waiting for heat call).
7. Repeat above steps several times to verify operation.
8. Return the room thermostat to normal setting.

Verify operation — DHW

1. Reconnect DHW aquastat wiring to boiler if necessary.
2. Turn off power to boiler at service switch.
3. Wait a few seconds, then turn on power to boiler.
   [A!80] (*self-check* on power-up, for a few seconds)
   [0!80] (*no call for heat*)
4. Raise DHW aquastat above tank temperature, to call for heat.
   [5!80] (*blower/circulator on*) The blower and DHW circulator energize and the control checks for air flow.
   [1!80] (*prepurge*) Blower speed will increase to ignition speed. The blower will run in prepurge for 10 seconds.
   [2!80] (*ignition*) After prepurge, the control module opens the gas valve and starts ignition spark.

a. If burner flame proves within 4.5 seconds, burner continues to fire. Burner will fire at start-up rate — 50% of maximum input — for about 10 seconds to allow flame to stabilize.

b. If burner flame does not prove within 4.5 seconds, control module attempts ignition sequence again. Flame must prove within 5 attempts or control will lockout (display will show [E 02]).

c. Verify flame failure operation by closing boiler manual gas valve to prevent gas flow. Open gas cock after testing.

[4!80] (*burner on, DHW*) Once flame is proven and stable, the burner is allowed to modulate. Firing rate depends on actual outlet water temperature versus target temperature.

5. Allow boiler to bring water temperature to target temperature.
   [6!80] (*target temperature reached*) The burner will shut down. The blower will run in postpurge (see below), then turn off. The DHW circulator continues to run as long as there is a call for DHW heating.
6. Lower DHW aquastat to stop call for heat.
   [1!80] (*postpurge*) When the room thermostat is satisfied (call for heat ended), the burner turns off. The blower will continue for a 15-second postpurge, then turn off. (If another DHW call for heat occurs, the boiler will begin the heating cycle immediately.)
   [8!80] (*DHW circulator run-on*) The DHW circulator continues to run for 30 seconds.
   [0!80] (*no call for heat*) Boiler is now in standby mode (waiting for heat call).
7. Repeat above steps several times to verify operation.
8. Return the DHW aquastat to normal setting.

Operating information

1. To check operating conditions (actual and target temperatures, for example), see page 40 for an explanation of the Ultra control module Information mode.
2. During normal operation (no shutdown or lockout), the right 3 display digits show actual boiler outlet water temperature.

Perform Check-out procedures

1. Perform and check off the steps on page 30.
2. Complete the Installation and service certificate on page 31 to complete boiler start-up.

Replace boiler jacket front door

WARNING Replace boiler jacket front door after servicing. The boiler front door must be securely fastened to the boiler to prevent boiler from drawing air from inside the boiler room. This is particularly important if the boiler is located in the same room as other appliances. Failure to keep the door securely fastened could result in severe personal injury or death.

8 Check-out/start-up verification

- ❑ Boiler and heat distribution units filled with water?
- ❑ Water chemistry verified per page 24?
- ❑ Automatic air vents, if used, open one full turn?
- ❑ Air purged from system?
- ❑ Air purged from gas piping? Piping checked for leaks?
- ❑ Propane orifice installed for propane firing and propane conversion label affixed to jacket?

WARNING Ultra boilers are shipped ready to fire natural gas ONLY. You must install the propane orifice if the boiler will be connected to propane. See page 9. Failure to comply could result in severe personal injury, death or substantial property damage.

- ❑ Thermostat circuit wiring checked to ensure there are no stray voltages per "Check thermostat circuits," page 25?
- ❑ Followed Operating instructions, page 27 of this manual and on boiler for proper start-up?
- ❑ Burner flame and combustion verified per pages 26 and 28?
- ❑ Verified control operation for space heating and DHW (if used) per pages 28 and 29?
- ❑ Tested additional field-installed controls — If boiler has a low water cutoff, additional high limit or other controls tested for operation as outlined by manufacturer? (Boiler should be operating and should go off when controls are tested. Verify controls cause soft lockout or hard lockout as desired.)
- ❑ Set additional field-installed limit control(s) to system temperature requirements? Adjusted balancing valves and controls to provide design temperature to system?
- ❑ For multiple zones, adjusted for correct flow in each zone?
- ❑ Verified thermostat heat anticipator (if available) set properly? Refer to page 22, under "Thermostats."
- ❑ Cycled boiler with thermostat (and with DHW aquastat, if installed) — Raised to highest setting and verified boiler goes through normal start-up cycle? Lowered to lowest setting and verified boiler goes off?
- ❑ Measured natural gas input? (per page 28)
- ❑ Checked incoming gas pressure by connecting manometer to gas valve ahead of boiler? (Gas pressure for natural gas or propane gas must be at least 4 inches w.c. with boiler operating at high fire and no more than 13 inches w.c. with boiler operating or boiler off.)
- ❑ Observed several operating cycles for proper operation.
- ❑ Set room thermostat to desired room temperature (and DHW aquastat, if installed, to desired DHW storage temperature)?
- ❑ Reviewed all instructions shipped with this boiler with owner or maintenance person?
- ❑ Fill in Installation and service certificate on page 31.
- ❑ Return instructions to envelope and give to owner or place inside boiler housing.

8 Check-out/start-up verification

Installation certificate

Boiler model _____

CP number _____

Date installed _____

Measured Btuh input _____ Fuel: ❑ Natural Gas ❑ Propane

- ❑ Installation instructions have been followed.
- ❑ Check out sequence has been performed.
- ❑ Above information is certified to be correct.
- ❑ Information received and left with owner/maintenance person

Comments:

_____

_____

_____

_____

_____

_____

Installer _____(company) _____(phone)

_____(address)

_____(address)

_____

(installer's signature)

9 Operating information

Ultra PhD Control Module

The Ultra boiler is controlled by a microprocessor electronic control — the Ultra PhD Control Module. The module senses outlet water temperature, return water temperature, flue temperature and outdoor temperature (when outdoor sensor is installed). It uses this information (plus input from external limit and operating controls) to regulate boiler on/off operation and can modulate boiler firing rate to more closely match output to demand.

Electrical specifications

Ultra boilers require 120 VAC/60 HZ power supply and are not polarity sensitive.

Control module specifications

• Supply voltage	120 vac / 60 hz
• Electrical demand	10 va
• Prepurge timing	10 seconds
• Postpurge timing	15 seconds
• Min. off time, space heating	1 minute
• Pump run on after space htg.	10 seconds
• Min. off time, DHW	0 seconds
• Pump run on after DHW	30 seconds
• Line voltage fuse, F1	5 amp fast-blow
• Low voltage fuse, F3	4 amp slow-blow

Boiler temperature regulation

Operating temperature (target)

The Ultra control module senses outlet water temperature and regulates boiler firing rate to achieve a target temperature, set by installer, by setting Parameter 4. Temperature can be set between 70°F and 190°F. See page 38 for procedure.

- Space heating — Target temperature is fixed (equal to Parameter 4) when outdoor reset is not installed.
- Space heating — Target temperature is calculated as described under "Outdoor reset operation" when outdoor sensor is connected. Exception: See explanation of "Supply temperature boost."
- DHW heating — Target temperature is 190°F.

High limit operation

If outlet water temperature exceeds target temperature (or 190°F, whichever is lower), high limit action occurs. The control module shuts the burner off.

DHW operation (if used)

The boiler is factory set to immediately change target outlet water temperature to 190°F on a call for heat from the DHW aquastat.

Additional Thermal Overrun Protection

High limit operation shuts down the burner when the outlet water temperature exceeds the target temperature. However, adverse conditions could cause the water temperature to rise too quickly, overshooting this temperature. The Ultra control module's PhD technology provides advanced protection in the event of thermal overrun. Using its electronics, the Ultra control module provides two additional levels of overrun protection:

Level 1 Indication would occur if supply or return water temperature reached 203°F. The Ultra control module would display a soft lockout code ("b" followed by "18" if on the supply, or "19" if on the return). The module would not operate the burner again until the water temperature dropped 9°F below target temperature.

Level 2 Lockout would occur if supply or return water temperature reached 210°F. The Ultra module would enter hard lockout and display an error code ("E" followed by "18" if on the supply or "19" if on the return). NOTE: Hard lockout requires manually pressing the Ultra display panel reset button to restart operation. Service technician must troubleshoot the cause of the problem and correct it before placing the boiler back in operation.

Low water protection

1. The control module uses temperatures sensed at both supply and return areas of the heat exchanger. If the flow rate is too low (temperature difference too high) or either temperature is too high, the control module shuts the boiler down. This ensures boiler shutdown in the event of low water or low flow conditions.
2. Some codes and jurisdiction may accept these integral features of the control in lieu of requiring an additional limit control or low water cutoff. Consult local jurisdiction to determine.

Outdoor reset operation, if used

Target temperature with outdoor reset

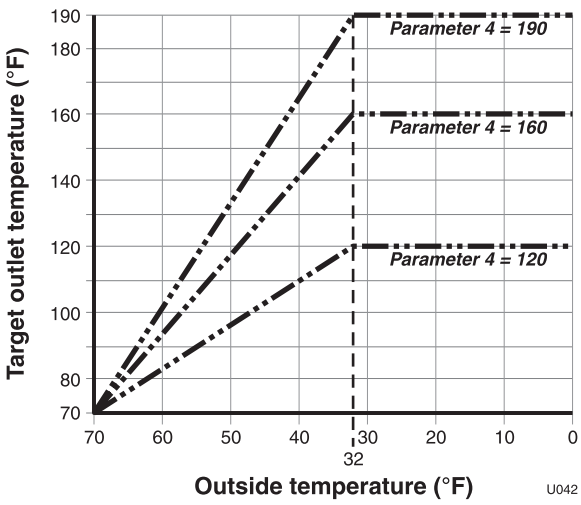
All Ultra boilers are shipped with an outdoor temperature sensor. When this sensor is installed (low voltage terminal strip terminals 1 and 2), the control module regulates target outlet water temperature based on outside temperature.

Set the temperature curve by setting Parameter 4 to:

- ODT in the following is the outdoor design temperature for the area.
- For ODT of 32°F or lower:
  - Set Parameter 4 to the desired supply temperature at the ODT.
- For ODT above 32°F:
  - Set Parameter 4 to the desired system temperature when outdoor temperature is 32°F.

9 Operating information *(continued)*

Figure 17 Outdoor reset target temperature



Reset curve

Figure 17 shows how the Ultra control module calculates target temperature.

- For outdoor temperature at or below 32°F, the target temperature equals Parameter 4 and never higher.
- For outdoor temperature above 32°F, the target temperature is reduced on a curve that would result in 70°F supply temperature at 70°F outdoor temperature.

Summer/winter switch option

Install a summer/winter switch, if desired, to disable the boiler (space heating) circulator during non-heating months. Connect switch across the outdoor sensor terminals. When switch closes, the boiler circulator is disabled and the boiler operates only on call for DHW heating.

Supply temperature boost

In outdoor reset operation (outdoor sensor connected), the Ultra control module automatically increases the target outlet water temperature if a call for heat exceeds 10 minutes. At each 10 minutes of a continuous call for heat, the control module increases the target temperature by 18°F. The module will continue increasing target temperature until it reaches the value set in parameter 4.

When the call for heat ends while target temperature is "boosted," the target temperature drops about 2°F for each minute the thermostat is open.

Purpose of boost — If the target temperature happens to be too low, the control "boosts" the target temperature until the supply water meets the system's needs.

DHW operation, if used

The *Ultra* PhD Control Module allows connection of a DHW aquastat to low voltage terminal strip terminals 3 and 4. When the DHW aquastat calls for heat, the module shuts down the boiler circulator, activates the DHW circulator and immediately sets target outlet water temperature to 190°F. This provides automatic priority heat allocation to the indirect water heater for maximum response and recovery. The DHW circulator continues for 30 seconds after the heating cycle to deliver the most possible heat.

Boiler circulator

Each Ultra boiler is shipped with a circulator. The circulator has sufficient head to handle boiler pressure drop plus reasonable pressure drop in the connecting piping. See pages 12 through 17 for piping and flow rate information. The control module internal relay contact is suitable for handling only the boiler circulator provided. Do not wire additional pumps in parallel with the boiler circulator. To operate a system circulator when the boiler circulator operates, see page 21.

Freeze protection

DO NOT install the boiler in a room likely to freeze.

The following integral feature of the Ultra control module provides some protection for the boiler only — not for the system.

- The Ultra control module provides freeze-up protection as follows when the boiler water temperature drops below 45 °F:
  - Below 45 °F, the boiler circulator operates constantly.
  - Below 37 °F, the boiler turns on at low fire.
  - Boiler and circulator turn off if boiler water temperature rises above 50 °F.

CAUTION This feature of the Ultra control module does not eliminate the possibility of freezing. The installation must still use recognized design, installation and maintenance practice to prevent freeze potential for the boiler and system.

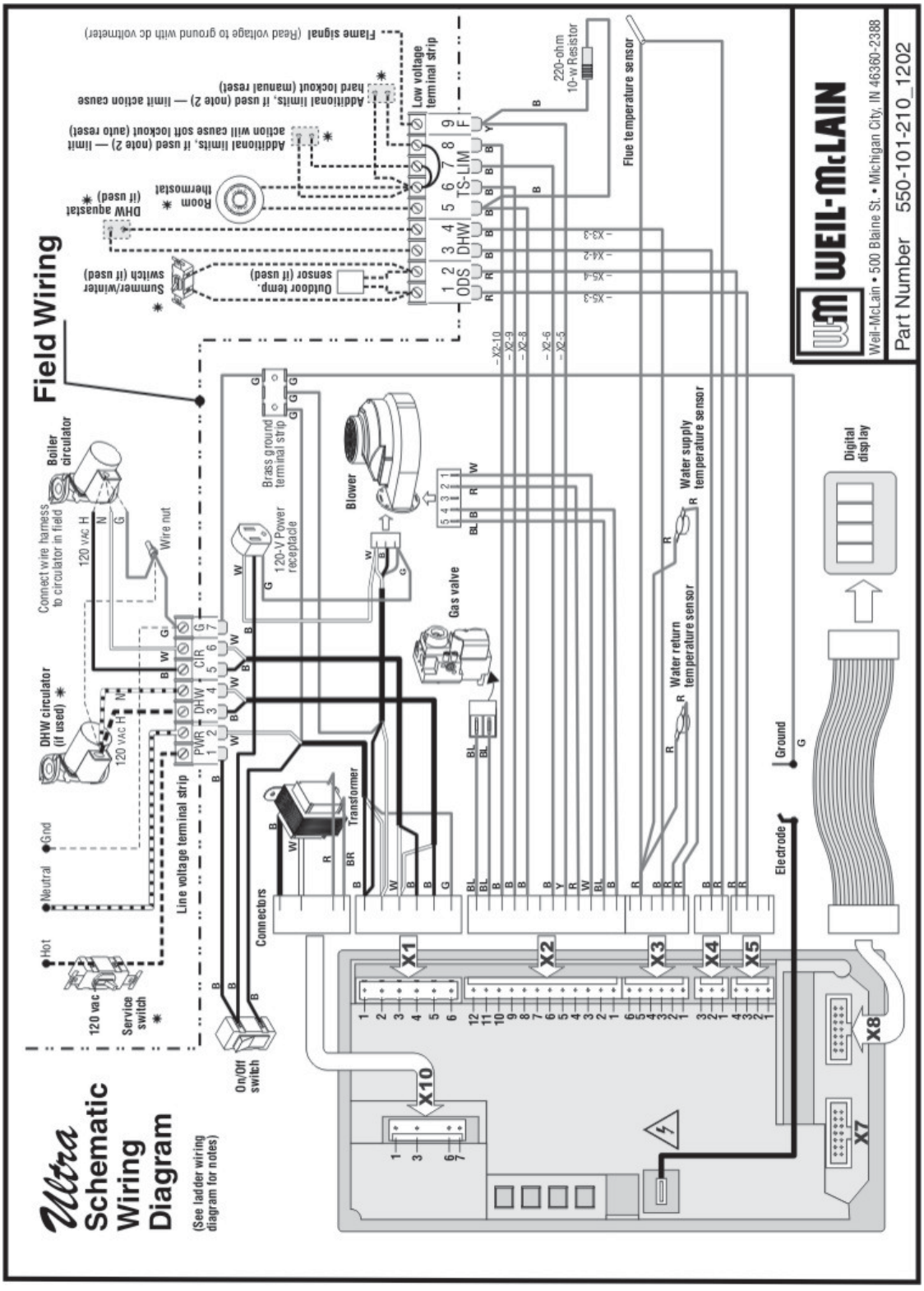
External controls (interlocks) (if used)

External limit controls wired between low voltage terminal strip terminals 6 and 7 will cause the boiler to shut down in soft lockout when they open. Remove the factory jumper between these terminals when using.

External limit control wired between low voltage terminal strip terminals 6 and 8 will cause the boiler to hard lockout (requiring manual reset of the electronic display RESET button). Remove the factory jumper between these terminals when using.

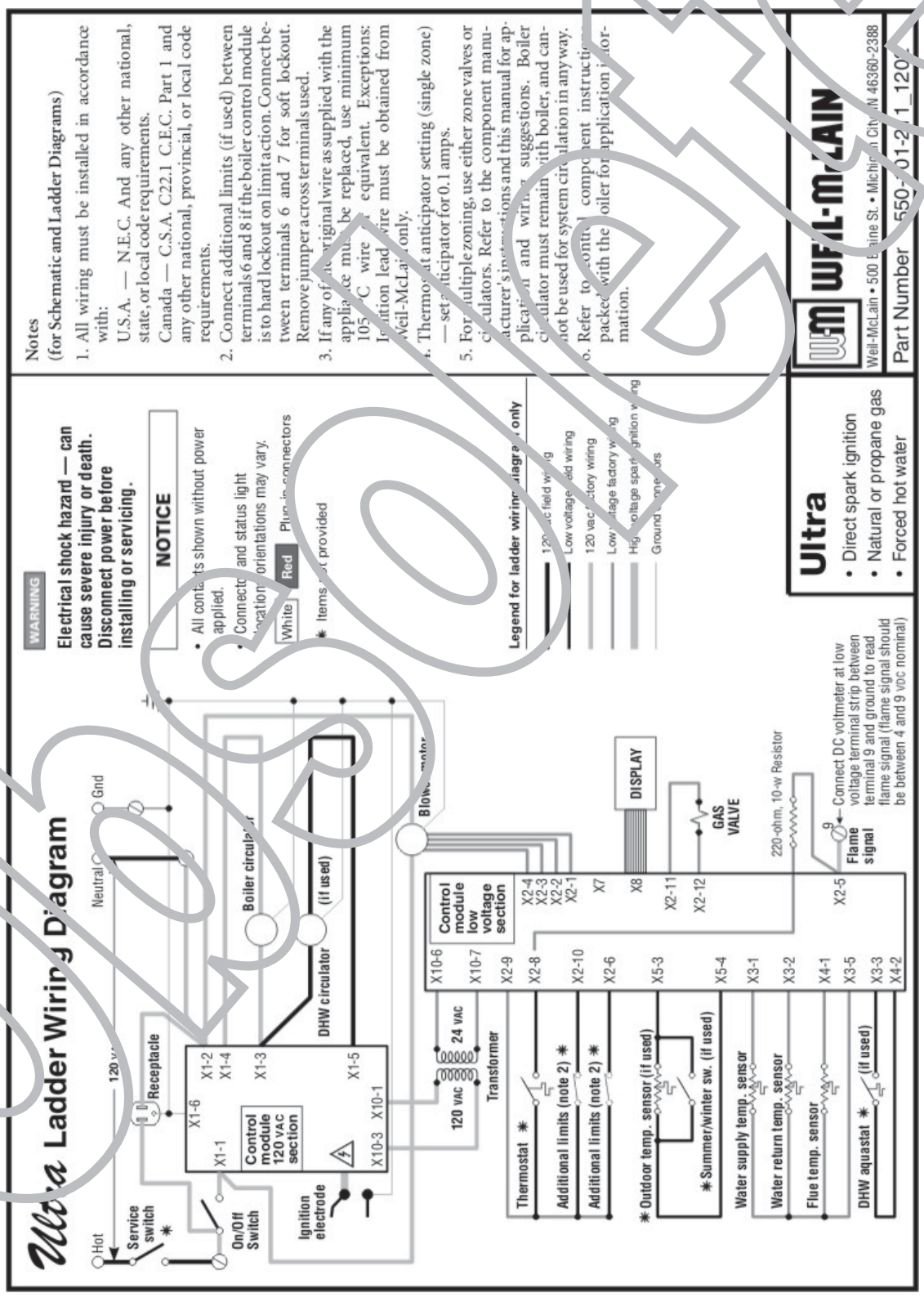
9 Operating information

Figure 18 Schematic wiring diagram



9 Operating information *(continued)*

Figure 19 Ladder wiring diagram

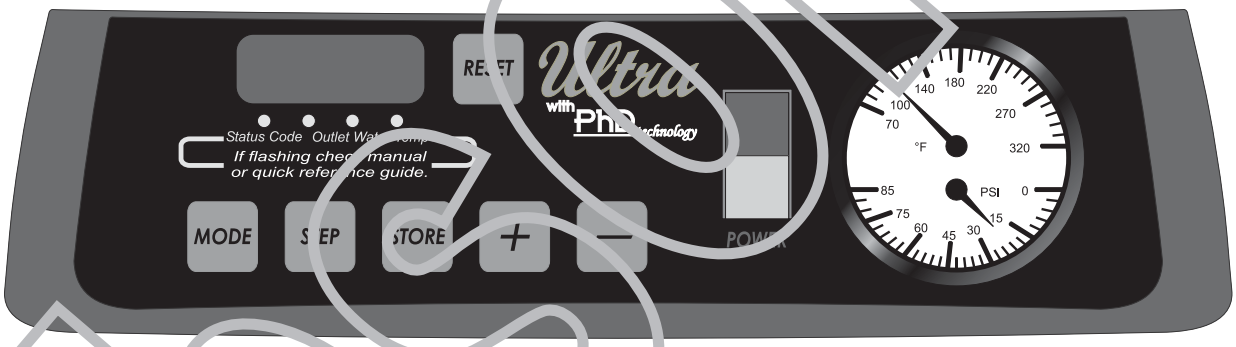


9 Operating information

WEIL-MCLAIN *Ultra* PHD CONTROL MODULE QUICK-REFERENCE

Ultra digital display operation

Use digital display keys to set temperatures and operating conditions and monitor boiler operation.



Mode button

Default:	Standby mode
Press 1 time:	Parameter mode
Press 2 times:	Information mode
Press 3 times:	Standby mode

Standby mode:	Normal operation / boiler status indication / soft lockout
Parameter mode	Check or change space heating & DHW settings
Information mode:	Check operating temperatures and rates of change
Hard lockout mode:	Use error code to troubleshoot failures

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9 Operating information *(continued)*

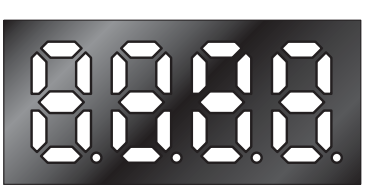
NOTICE Where two keys are shown pressed at the same time, you must press the keys together. A slight delay in pressing one of the keys may cause a different result.

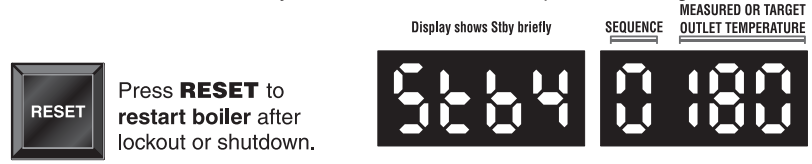
WEIL-MCLAIN *Ultra* PHD CONTROL MODULE QUICK-REFERENCE

Standby Mode *(Operating mode)*

Key functions & display

When boiler is powered on, the display will always show "**A**" followed by measured outlet water temperature during its self-test.





RESET — Press **RESET** to **restart boiler** after lockout or shutdown.

Press	Result	Display shows:
Short	**Outlet water target temp.** (display shows "**c**" and outlet water target temperature**)	c 190
Long	Turn **space heating OFF/ON** (display shows "**c**" and outlet water target temp. or OFF)	c 190
Short	Shows factory setting for DHW. (Make sure to adjust desired water temperature for DHW on the DHW tank aquastat.)	d 140
Long	Turn **DHW OFF/ON** (display shows "**d**" and DHW factory setting or OFF)	d 140
Long	Set burner to **high fire** (display shows **H** and measured outlet water temperature)	H 180
Long	Set burner to **low fire** (display shows **L** and measured outlet water temperature)	L 180
Long	**Deactivate forced hi/lo firing** (display shows sequence and measured outlet water temp.)	0 180
Short	Change to **next mode** (Para)	Para

Press the key combinations above to obtain results shown

** Outlet water "**target temperature**" means:
Outdoor sensor not connected: Target is fixed setpoint temperature control attempts to maintain for boiler outlet water.
Outdoor sensor connected: Target is temperature calculated by PhD control module, based on outside air temperature.

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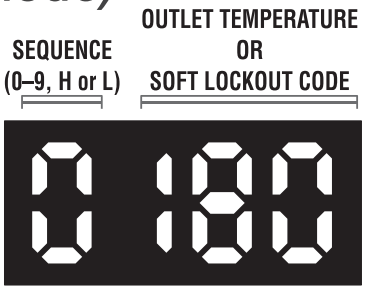
9 Operating information

WEIL-MCLAIN *Ultra* PHD CONTROL MODULE QUICK-REFERENCE

Standby Mode *(Operating mode)*

Boiler sequence display



After display shows "Stby" for a brief period, the first character shows boiler status, followed by boiler outlet water temperature. If the burner is being held off due to a soft lockout, the display alternates between showing **9** followed by boiler outlet water temperature and **b** followed by the two-digit codes below. Soft lockout means the boiler will start again automatically if the condition is corrected or timed out.

Press RESET button to restart boiler without waiting for timeouts below

First digit	Other digits	Boiler status	First digit	Code #	Boiler is in soft lockout when 9/b shows. Reason for boiler soft lockout is:
0	Actual (measured) outlet water temperature	Standby — no call for heat	9 alternating with b	_18	Outlet temperature too high (over 203°F) — Burner off until outlet water temp drops 9°F below target temperature
1		Pre-purge (10 seconds) or Post-purge (15 seconds)		_19	Return temperature too high (over 203°F) — Burner off until both outlet and return water temperatures drop 9°F below target temperature
2		Ignition		_24	Return temp higher than supply temp — Burner off waiting for correction
3		Burner on for space heating		_25	Outlet water temp rose too quickly — Burner off for 10 minute wait (burner recycles, increasing wait 1 minute each attempt, to max. of 15 minutes)
4		Burner on for DHW heating			
5		Checking airflow before prepurge		_26	External limit open on limit wired in soft lockout (auto reset) circuit — Burner off for 150 seconds
6		Burner off because temperature setting has been reached		_29	Blower signal not zero when it should be — Burner off until signal condition terminates
7		Pump on after space heating cycle for run-on of 10 seconds		_30	Temperature rise across boiler more than 58°F — Burner off for 150 second wait (plus 1 additional minute for each failed attempt, up to max. of 22 minutes each time)
8		Pump on after DHW heating cycle for run-on of 30 seconds		_35	Short circuit across flue temperature sensor terminals — Burner off until corrected
H		Burner on, running in high fire mode (manually set for test)		_40	Open circuit across flue temperature sensor terminals — Burner off until corrected
L		Burner on, running in low fire mode (manually set for test)		_52	Flue temperature exceeded 216°F, but did not exceed 225°F (hard lockout occurs above 225°F) — Burner off for 150 second wait
				_65	Waiting for blower to start

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9 Operating information *(continued)*

WEIL-MCLAIN *Ultra* PHD CONTROL MODULE QUICK-REFERENCE

Parameter Mode *(Change settings)*

(Press **Mode** button 1 time from Standby mode)

RESET

Press **RESET** to restart boiler after lockout or shutdown.

Display shows **Para** until a key is pressed.

Press	Result	Display shows:
Short	Step to **next parameter** *(continue tapping **Step** to change to 1, 2, 3 or 4)*	1 140 **DHW setting** (See details below)
Short	**Increase** setting	2 01 **DHW setup** (See details below)
Hold	**FAST increase** setting	3 01 **Space heating setup** (See details below)
Short	**Decrease** setting	4 190 **Outlet temperature** (See details below)
Hold	**FAST decrease** setting	
Short	**Store** current setting *** *(tap this key after setting the parameter as desired)*	
Short	**Next mode** (Info)	InFo

1 DHW setting
Left digit shows **1**
Right three digits show 140. **DO NOT** change this setting. Performance could be unreliable. Set DHW tank temp. on DHW aquastat.

2 DHW setup
Left digit shows **2**
Right digit should show **1**
DO NOT change this setting. DHW performance could be unreliable or unsafe.

3 Space heating (SH) setup
Left digit shows **3**
Right digit should show **1**
DO NOT change this setting as it might affect boiler performance.

4 SH temperature
Left digit shows **4**
Right three digits show target outlet water temperature (outlet temperature at 32°F outside if outdoor sensor is installed). Adjust to desired setting with + and - keys.

*** After the Store button is pressed, the set value will flash twice to confirm the change. Change will take effect after you leave the Parameter mode.

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9 Operating information

WEIL-MCLAIN *Ultra* PHD CONTROL MODULE QUICK-REFERENCE

Information Mode *(Check settings)*

(Press **Mode** button 2 times from Standby mode)

Press **RESET** to restart boiler after lockout or shutdown.

Measured outlet water temperature
(First digit shows **1** & dot flashes)
(Others show measured outlet temp.)

Outside temperature
(First digit shows **4** & dot flashes)
(Others show outside temperature)

Outlet water temperature change
(First digit shows **7** & dot flashes)
(Right two show rate of change, °F/sec)

Return water temperature
(First digit shows **2** & dot flashes)
(Others show measured outlet temp.)

Flue temperature
(First digit shows **5** & dot flashes)
(Others show measured flue temp.)

Return water temperature change
(First digit shows **8** & dot flashes)
(Right two show rate of change, °F/sec)

This function not used
(First digit shows **3** & dot flashes)
(Others show -18)

Target outlet water temperature
(First digit shows **6** & dot flashes)
(Others show target outlet temp.)

This function not used
(First digit shows **9** & dot flashes)
(Right digits show -32)

NOTE Display will show **A–32** if **STEP** is pressed after **9** appears.

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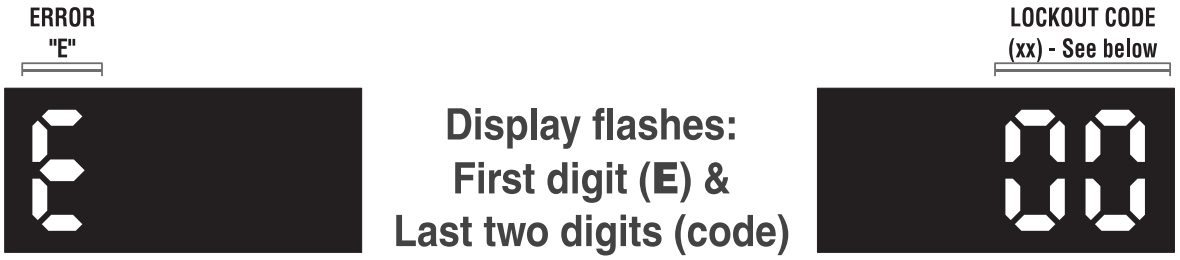
9 Operating information *(continued)*

WEIL-MCLAIN *Ultra* PHD CONTROL MODULE QUICK-REFERENCE

HARD LOCKOUT Mode

Boiler in hard lockout (requires manual **RESET**)
Display flashes First digit and Last two digits:



Code	Reason for hard lockout	Code	Reason for hard lockout
See Boiler manual for suggested troubleshooting procedures			
00	Flame detected on start-up	18	Outlet water temperature was higher than 210°F
02	Igntion failed after 5 retries	19	Return water temperature was higher than 210°F
03	Internal control failure	25	Outlet temperature increased too fast
04	Power lost after lockout	28	No signal from blower
05	Internal control failure	29	Blower signal not zero when it should be
06	Internal control failure	31	Outlet temperature sensor short circuit
07	Internal control failure	32	Return temperature sensor short circuit
11	Internal control error	36	Outlet temperature sensor open circuit
12	External limit open (limit wired in hard lockout circuit)	37	Return temperature sensor open circuit
13	Internal control failure	44	Internal control failure
14	Internal control failure	52	Flue temperature was higher than 225°F
15	Internal control failure	60	Internal error reading parameters
16	Internal control failure	61	Air flow circuit failure
17	Internal control failure	65	Not enough blower driving force

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10 Maintenance and annual startup

Table 5 Service and maintenance schedules

	Service technician (see following pages for instructions)	Owner maintenance (see Ultra User's Information Manual for instructions)	
ANNUAL START-UP	**General:** • Reported problems • Inspect interior; clean and vacuum if necessary; WARNING — no solvents • Clean condensate trap and fill with fresh water • Check for leaks (water, gas, flue, condensate) • Verify flue and air lines in good condition and sealed tight • Check system water pressure/system piping/expansion tank • Check control settings • Ignition electrode (sand off any white oxide; clean and reposition) • Ignition and ground wiring • Wiring and connections • Perform start-up checkout and performance verification per pages 24 through 29 • Flame inspection (stable, uniform) • Flame signal (at least 4 VDC) • Clean heat exchanger if flue temp more than 54°F above return water temp **Additional if combustion or performance indicate need:** • Clean heat exchanger • Remove and clean burner using compressed air only • Vacuum the blower **Review:** • Review with owner	**Daily**	• Check boiler area • Check air openings • Check pressure/temperature gauge • Verify boiler front door is securely in place
		Monthly	• Check vent piping • Check air piping • Check relief valve • Check condensate drain system • Check automatic air vents (if used)
		Periodically	• Test low water cutoff (if used)
		Every 6 months	• Check boiler piping (gas and water) • Operate relief valve
		End of season	• Shut boiler down (unless boiler used for domestic water)

WARNING Follow the Service and maintenance procedures given throughout this manual and in component literature shipped with the boiler. Failure to perform the service and maintenance could result in damage to the boiler or system. Failure to follow the directions in this manual and component literature could result in severe personal injury, death or substantial property damage.

10 Maintenance and annual startup *(continued)*

WARNING The boiler should be inspected and started annually, at the beginning of the heating season, only by a qualified service technician. In addition, the maintenance and care of the boiler designated in Table 5 and explained on the following pages must be performed to assure maximum boiler efficiency and reliability. Failure to service and maintain the boiler and system could result in equipment failure.

WARNING Electrical shock hazard — Turn off power to the boiler before any service operation on the boiler except as noted otherwise in this instruction manual. Failure to turn off electrical power could result in electrical shock, causing severe personal injury or death.

Address reported problems

1. Inspect any problems reported by owner and correct before proceeding.

Inspect boiler area

1. Verify that boiler area is free of any combustible materials, gasoline and other flammable vapors and liquids.
2. Verify that air intake area is free of any of the contaminants listed on page 8 of this manual. If any of these are present in the boiler intake air vicinity, they must be removed. If they cannot be removed, reinstall the air and vent lines per this manual and the Ultra Boiler Vent Supplement.

Inspect boiler interior

1. Remove jacket front door and inspect interior of boiler.
2. Remove the venturi air inlet silencer and clean if necessary. Replace silencer.
3. Vacuum any sediment from the inside of the boiler and components. Remove any obstructions.

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

Clean condensate trap

1. Loosen condensate trap line hose clamps and remove trap line.
2. Empty water from trap line and inspect. Flush out if needed with fresh water.
3. Check condensate elbow and tee and condensate line to drain. Flush if necessary to clean.
4. Replace condensate trap line and tighten hose clamps.
5. Fill trap with fresh water by pouring into upturned end of PVC condensate tee.

Check all piping for leaks

WARNING Eliminate all system or boiler leaks. Continual fresh make-up water will reduce boiler life. Minerals can build up in sections, reducing heat transfer, overheating heat exchanger, and causing heat exchanger failure. Leaking water may also cause severe property damage.

1. Inspect all water and gas piping and verify to be leak free.
2. Look for signs of leaking lines and correct any problems found.
3. Check gas line using procedure on page 20.

Check air openings

1. Verify that combustion and ventilation air openings to the boiler room and/or building are open and unobstructed. Check operation and wiring of automatic combustion air dampers, if used.
2. Verify that boiler vent discharge and air intake are clean and free of obstructions.

Flue vent system and air piping

1. Visually inspect entire flue gas venting system (and air piping, if installed) for blockage, deterioration or leakage. Repair any joints that show signs of leakage in accordance with vent manufacturer's instructions. When air is ducted to boiler, verify that air inlet hose is connected and properly sealed.

WARNING Failure to inspect for the above conditions and have them repaired can result in severe personal injury or death.

10 Maintenance and annual startup

Check water system

1. Verify all system components are correctly installed and operational.
2. Check the cold fill pressure for the system. Verify it is correct (usually around 12 psig).
3. Watch the system pressure as the boiler heats up (during testing) to ensure pressure doesn't rise too high. Excessive pressure rise indicates expansion tank sizing or performance problem.
4. Inspect automatic air vents and air separators. Remove air vent caps and briefly press push valve to flush vent. Replace caps. Make sure vents do not leak. Replace any leaking vents.

Check expansion tank

1. Expansion tanks provide space for water to move in and out as the heating system water expands due to temperature increase or contracts as the water cools. Tanks may be open, closed or diaphragm or bladder type. See section 3 of this manual for suggested best location of expansion tanks and air eliminators.

   Open-type — located above highest radiator or baseboard unit, usually in the attic or closet. Has a gauge glass and overflow pipe to a drain.

   Closed-type — welded gas tight and located above boiler. Tank is partially filled with water, leaving an air cushion for expansion.

   - Make sure this type of tank is fitted with a tank fitting, such as the B & G Tank-Trol or Taco Taco-Trol. This fitting reduces gravity circulation of air-saturated tank water back to the system and prevents the air from bubbling up through the water as it returns from the system.
   - Do not use automatic air vents in systems with closed-type tanks. The air will escape from the system instead of returning to the tank. Eventually, the tank will waterlog and no longer control pressurization. The boiler relief valve will weep frequently.

   Diaphragm- or bladder-type — welded gas tight with a rubber membrane to separate the tank pressurizing air and the water. May be located at any point in the system, but most often found near the boiler.

   - Systems with this type of expansion tank require at least one automatic air vent, preferably located on top of an air eliminator, as shown in examples in manual section 3.

2. If relief valve has tended to weep frequently, the expansion tank may be waterlogged or undersized.

   Closed-type tank — tank is most likely waterlogged. Install a tank fitting if not already installed. Then check fill level per fitting manufacturer's instructions. If fill level is correct, check tank size against manufacturer's instructions. Replace with a larger tank if necessary.

   Diaphragm- or bladder-type — first, check tank size to be sure it is large enough for the system. If size is too small, add additional tank(s) as necessary to provide sufficient expansion. If tank size is large enough, remove tank from system and check charge pressure (usually 12 psig for residential applications). If tank won't hold pressure, membrane has been damaged. Replace tank.

Check boiler relief valve

1. Inspect the relief valve and lift the lever to verify flow as in the following warnings, excerpted from a relief valve manufacturer's warning label. Before operating any relief valve, ensure that it is piped with its discharge in a safe area to avoid severe scald potential. Read manual section 3, page 11 before proceeding further.

WARNING Safety relief valves should be reinspected AT LEAST ONCE EVERY THREE YEARS, by a licensed plumbing contractor or authorized inspection agency, to ensure that the product has not been affected by corrosive water conditions and to ensure that the valve and discharge line have not been altered or tampered with illegally. Certain naturally occurring conditions may corrode the valve or its components over time, rendering the valve inoperative. Such conditions are not detectable unless the valve and its components are physically removed and inspected. This inspection must only be conducted by a plumbing contractor or authorized inspection agency — not by the owner. Failure to reinspect the boiler relief valve as directed could result in unsafe pressure buildup, which can result in severe personal injury, death or substantial property damage.

10 Maintenance and annual startup *(continued)*

Check boiler relief valve *(continued)*

WARNING Following installation, the valve lever must be operated AT LEAST ONCE A YEAR to ensure that waterways are clear. Certain naturally occurring mineral deposits may adhere to the valve, rendering it inoperative. When manually operating the lever, water will discharge and precautions must be taken to avoid contact with hot water and to avoid water damage. Before operating lever, check to see that a discharge line is connected to this valve directing the flow of hot water from the valve to a proper place of disposal. Otherwise severe personal injury may result. If no water flows, valve is inoperative. Shut down boiler until a new relief valve has been installed.

2. After following the above warning directions, if the relief valve weeps or will not seat properly, replace the relief valve. Ensure that the reason for relief valve weeping is the valve and not over-pressurization of the system due to expansion tank waterlogging or undersizing.

Inspect ignition electrode

1. Remove the ignition electrode from the boiler heat exchanger access cover.
2. Remove any white oxides accumulated on the ignition electrode using sandpaper. If the ignition electrode cannot be cleaned satisfactorily, replace igniter with a new one.
3. Replace ignition electrode, making sure gasket is in good condition and correctly positioned.

Check ignition ground wiring

1. Inspect boiler ground wire from heat exchanger access cover to ground terminal strip.
2. Verify all wiring is in good condition and securely attached.
3. Check ground continuity of wiring using continuity meter.
4. Replace ground wires if ground continuity is not satisfactory.

Check all boiler wiring

1. Inspect all boiler wiring, making sure wires are in good condition and securely attached.

Check control settings

1. Set the control module display to Parameter mode and check all settings. See page 39. Adjust settings if necessary. See page 28 for adjustment procedures.
2. Check settings of external limit controls (if any) and adjust if necessary.

Perform start-up and checks

1. Start boiler and perform checks and tests specified on pages 26 through 29.
2. Verify cold fill pressure is correct and that operating pressure does not go too high.
3. Complete the check-out procedure on page 30.

10 Maintenance and annual startup

Check burner flame

WARNING The boiler contains ceramic fiber materials. Use care when handling these materials per instructions on page 55 of this manual. Failure to comply could result in severe personal injury.

1. Inspect flame through observation window using the procedure on page 26.
2. If flame is unsatisfactory at either high fire or low fire, turn off boiler and allow boiler to cool down. Then remove burner and clean it thoroughly using a vacuum cleaner or compressed air. Do not use compressed air to clean burner if performed inside a building.
3. To access burner, remove the heat exchanger cover plate following the procedure on page 47.
4. When replacing burner, ensure gasket is in good condition and correctly positioned. After tightening the three retainer screws, bend up the retainer tabs as shown in Figure 20 to prevent screw rotation.
5. After servicing, replace boiler components. Retest boiler.

Check flame signal

1. Flame signal (DC volts from low voltage terminal strip terminal 9 to ground) should be at least 4 VDC.
2. A lower flame signal may indicate a fouled ignitor or damaged ignitor insulation. If cleaning the ignitor does not improve, ground wiring is in good condition, and ground continuity is satisfactory, replace the ignitor.
3. See Troubleshooting in this manual for other procedures to deal with low flame signal.

Check flue gas temperature

1. Place the control display in Information mode while the boiler is operating at high fire. See page 40 for details.
2. The flue gas temperature (display first digit shows "5") must not be more than 60°F higher than the return water temperature (display first digit shows "2").
3. If the flue temperature is higher than this, shut down the boiler, allow to cool, and follow the procedure on page 47 to clean the heat exchanger.

General maintenance

1. Oil motor in system requiring regular oiling.
2. See Oil bearing circulators for motor oiling procedures.

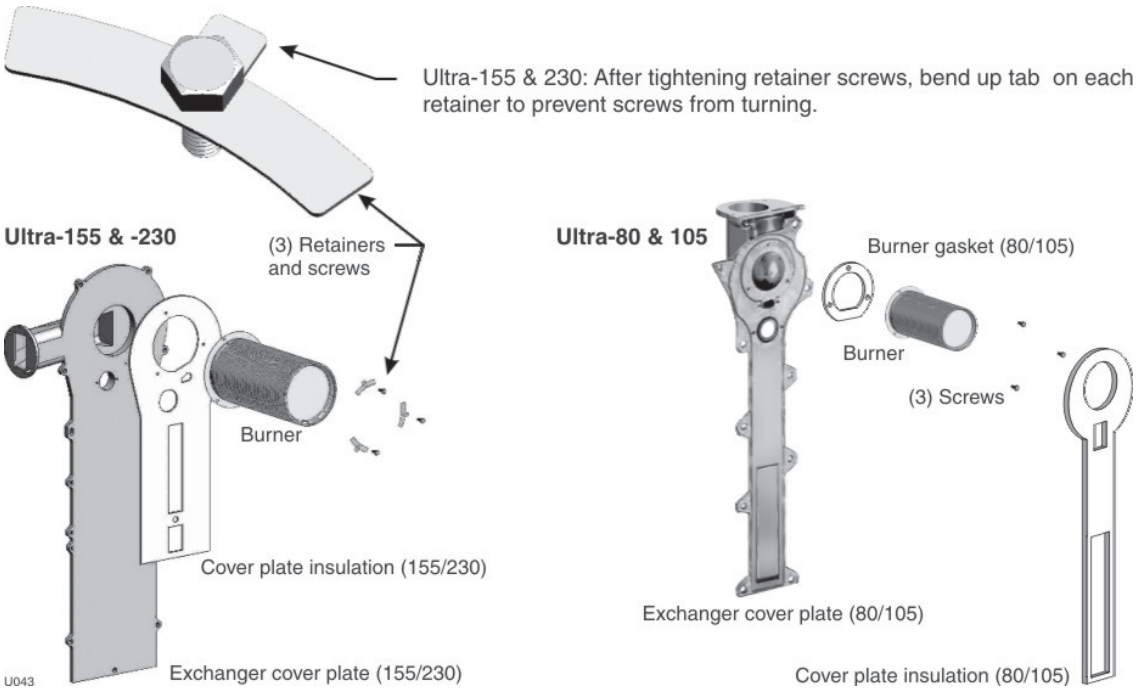
Oiled bearing circulators

1. The circulator shipped with the Ultra boiler is water-lubricated. No oiling is required.
2. Check other circulators in the system. Oil any circulators requiring oil, following circulator manufacturer's instructions. Over-oiling will damage the circulator.

Review with owner

1. Review the User's Information Manual with the owner.
2. Emphasize the need to perform the maintenance schedule specified in the User's Information Manual (and in this manual as well).
3. Remind the owner of the need to call a licensed contractor should the boiler or system exhibit any unusual behavior.
4. Remind the owner to follow the proper shutdown procedure and to schedule an annual start-up at the beginning of the next heating season.

Figure 20 Burner assembly



10 Maintenance and annual startup *(continued)*

Replace boiler jacket front door after start-up or servicing

WARNING Replace boiler jacket front door after start or servicing. The boiler front door must be securely fastened to the boiler to prevent boiler from drawing air from inside the boiler room. This is particularly important if the boiler is located in the same room as other appliances. Failure to keep the door securely fastened could result in severe personal injury or death.

Cleaning boiler heat exchanger

WARNING The boiler contains ceramic fiber materials. Use care when handling these materials per instructions on page 55 of this manual. Failure to comply could result in severe personal injury.

1. Shut down boiler:
   a. Follow "To Turn Off Gas to Appliance" instructions on boiler and Lighting instructions.
   b. Do not drain boiler unless it will be exposed to freezing temperatures. If using freeze prevention fluid in system, do not drain.
2. Allow time for boiler to cool to room temperature if it has been firing.
3. Remove jacket front door by removing two knurled head screws at lower front. Lift door away from boiler to remove.
4. Follow procedure below to access the heat exchanger interior.

Access exchanger: Ultra-80 and Ultra-105 Only

1. Remove (4) Phillips-head screws securing gas valve inlet adapter to gas valve. This will disconnect the gas valve from the gas line.
2. Remove the air silencer by separating it from the air adapter on the blower inlet.
3. Disconnect the gas valve plug, blower power supply plug and blower control connector.
4. Release the exchanger cover plate by removing the nuts securing it to the exchanger.
5. Pull the entire blower/venturi/gas valve/cover plate assembly out of the boiler. (See page 61 for component identification and locations.)
6. Use a vacuum cleaner to remove any accumulation on the heating surfaces. Do not use any solvent.
7. If the vacuum cleaner is unable to clean completely, wash the heating surfaces with clean, warm water. If necessary, use a piece of 20-gauge or lighter sheet metal ¾" wide by about 18 inches long to loosen deposits.
8. Inspect the heat exchanger cover plate insulation. Replace if insulation is damaged. Read the ceramic fiber WARNING above before handling or disposing of ceramic fiber materials.
9. Re-install the blower/venturi/gas valve/cover plate assembly and secure the cover plate with nuts.
10. Connect gas valve electrical plug and blower power and control connectors.

DANGER Inspect the O-ring that should still be in the gas valve inlet adapter block. The O-ring must be in good condition and must be installed when gas valve is reconnected. Failure to comply will cause a gas leak, resulting in severe personal injury or death.

11. Secure gas valve inlet adapter to gas valve with (4) Phillips-head screws.
12. Re-install the air silencer by pressing onto the air inlet adapter.
13. Install access cover gasket, chamber insulation assembly and cover. Secure cover with nuts.

Access exchanger: Ultra-155 and Ultra-230 Only

1. Remove gas valve electrical plug from gas valve. Also remove two electrical molex plugs from blower assembly.
2. Disconnect gas line union with pipe wrench or Channel Lock Pliers.
3. Remove air silencer by lifting plastic clamp off gas line and then gently sliding air silencer down and off valve.
4. Remove two 5/32" Allen head screws securing blower assembly to heat exchanger front cover.
5. Remove blower and gas valve assembly.
6. Remove hex head nuts (10mm box end wrench) from burner cover plate and remove burner cover plate from heat exchanger.
7. Remove three M4 hex head screws (7mm box end wrench) and burner clips securing burner to cover plate. Remove cover plate.
8. Use a vacuum cleaner to remove any accumulation on the heating surfaces. Do not use any solvent.
9. If the vacuum cleaner is unable to clean completely, wash the heating surfaces with clean, warm water. If necessary, use a piece of 20-gauge or lighter sheet metal ¾" wide by about 18 inches long to loosen deposits.
10. Inspect the heat exchanger cover plate insulation and gasket. Replace if damaged. Read the ceramic fiber WARNING above, left, before handling or disposing of ceramic fiber materials.
11. Place cover plate gasket in groove of heat exchanger cover plate. Replace cover plate.
12. Re-install hex head nuts (10mm box end wrench) on cover plate mounting studs and tighten in a staggering pattern until cover plate is uniformly tightened.
13. Re-install blower insuring new gasket, provided in this kit, is in proper alignment between blower and heat exchanger front cover.
14. Re-install air silencer by sliding on gas valve venturi and securing clamp to gas line.
15. Connect the two blower electrical molex plugs.
16. Re-connect gas valve union and gas valve electrical plug.

All models (procedure continued)

1. Close isolation valves on piping to isolate boiler from system. Attach a hose to boiler drain valve and flush boiler thoroughly with clean water by using purging valves to allow water to flow through water make-up line to boiler.
2. When boiler has been flushed, restore boiler to operation.
3. Perform start-up and checkout procedures of pages 45 and 46.
4. Turn on gas supply and check for gas leaks.

WARNING Failure to properly check for gas leaks can cause severe personal injury, death, or substantial property damage.

5. Turn on boiler electrical supply and test boiler for proper operation as stated in the Ultra Boiler Manual.
6. Replace boiler jacket front door when servicing is completed. See Warning at top of this page.

11 Troubleshooting

WARNING Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Always disconnect power to boiler before servicing. Failure to comply could result in severe personal injury, death or substantial property damage.

WARNING Never jumper (bypass) any device except for momentary testing as outlined in Troubleshooting Charts. Severe personal injury, death or substantial property damage can result.

Before troubleshooting:

1. Have the following items:
   a. Voltmeter that can check 120 VAC , 24 VAC and 12 VDC.
   b. Continuity checker.
   c. Contact thermometer.
2. Check for 120 VAC (minimum 102 VAC to maximum 132 VAC) to boiler.
3. Make sure thermostat is calling for heat and contacts (including appropriate zone controls) are closed. Check for 24 VAC between thermostat wire nuts and ground.
4. Make sure all external limit controls are either installed (and closed) or temporarily jumpered for testing.

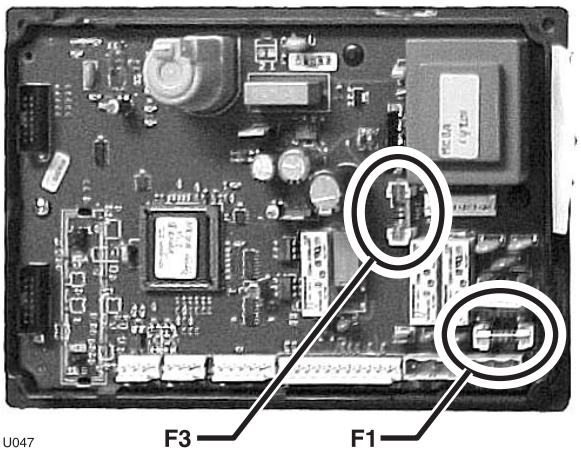
Check the following:

1. Wire connectors to control module are securely plugged in at module and originating control.
2. Gas pressures:
   - Maximum: 13" w.c. with no flow (lockup) or with boiler on
   - Minimum: 4" w.c. with gas flowing (verify during boiler startup with boiler at high fire)

Always check control module fuses

NOTICE ALWAYS check control module fuses before replacing control module or any major components (blower, etc.). If one of these fuses is blown, it can prevent control module or other components from operating.

1. Turn OFF power to boiler at external line switch.
2. Remove jacket top front panel (item 8, page 59).
3. Remove control module cover.
4. Inspect fuses F1 and F3 (located as shown in photo below).



5. The boiler is shipped with two spare fuses attached to the control module cover.
6. If necessary, replace open fuse (F1 is 5-amp fast-blow; F3 is 4-amp slow-blow).

WARNING Do not jumper fuse or replace with any fuse except as specified. Failure to comply could result in severe personal injury, death or substantial property damage.

7. Install control module cover and jacket top front cover after fuse inspection.
8. Restore power to boiler at external line switch and verify boiler operation (pages 26 through 30) after completing boiler service.

Replace boiler jacket front door

WARNING Replace boiler jacket front door after servicing. The boiler front door must be securely fastened to the boiler to prevent boiler from drawing air from inside the boiler room. This is particularly important if the boiler is located in the same room as other appliances. Failure to keep the door securely fastened could result in severe personal injury or death.

VERIFY PROPER OPERATION AFTER SERVICING.
(see pages 26 through 30)

11 Troubleshooting *(continued)*

Boiler not firing and:	Check for:		Corrective actions:
Control display blank.	120 vac at terminals 1 and 2 of line voltage terminal strip?	1	NO — Check external line switch and fuse or breaker.
	120 vac on both sides of fuse F1? (Turn OFF external power to boiler before removing cover.)	1	NO — Turn off power to boiler and replace fuse if necessary. Inspect boiler interior wiring to determine cause of fuse opening.
	Wiring correct, in good condition and securely attached?	1	Correct if needed. Replace any damaged wiring or components. Replace control module if problem persists.
Display first digit shows 0; last digits show 2 or 3-digit number (boiler outlet water temperature).	Room thermostat and DHW aquastat satisfied?	1	YES — Boiler off, no call for heat. Turn up thermostat or aquastat. Boiler should start.
	Thermostat or aquastat calling for heat, but boiler not firing?	1	Check voltage on both sides of low voltage fuse, F3. (Turn OFF external power before removing cover.) If necessary, replace fuse. Determine reason for fuse failure if possible.
		2	See page 39 to check/set boiler parameters 2 and 3. Make sure space heat or DHW is turned on. Turn on if necessary.
		3	Turn off power to boiler. Temporarily jumper low voltage terminal strip terminals 5 and 6 (space heat) or 3 and 4 (DHW). Retry. If boiler operates, check thermostat or aquastat and wiring. Replace if necessary. Remove temporary jumper(s).
		4	Turn off power to boiler. Check wiring against wiring diagram; verify all wiring in good condition and secure.
		5	Replace wire harnesses and retry.
		6	Replace control module.
Display first digit shows a number from 1 to 8; last digits show 2 or 3-digit number (boiler outlet water temperature).		1	Boiler in normal operating mode. See page 38 for explanation and status.
Display flashes 9, then b. Last two digits show code number.		1	See page 38 for brief explanation of soft lockoutcode. See pages 49 and 50 for troubleshooting soft lockouts.

Checking temperature sensors

1. The boiler temperature sensors (flue, outdoor, return water and supply water) are all resistance-type devices.
2. The table at right shows the correct value for the sensor at various temperatures.
3. Use the resistance values at 32°F, 60°F, 70°F and 212°F to measure the sensor resistance at known temperatures (ice point, room temperature and sea level boiling point). For ice point and boiling point, insert the sensor in water at that temperature. Use an ohmmeter to read resistance value.
4. To check whether the control module is correctly sensing temperature, you can use a resistance decade box. Connect the decade box temporarily in place of a sensor and use the control module **Information** mode (see page 40 for details) to read the temperature. The temperature should be close to the value corresponding to the input resistance.

Sensor resistance values

Temp (°F)	Sensor ohms		Temp (°F)	Sensor ohms	
	Min	Max		Min	Max
32	34265	37871	130	3698	4088
40	27834	30764	140	3043	3364
50	21630	23907	150	2517	2782
60	16944	18727	160	2091	2311
70	13372	14780	170	1744	1928
80	10629	11747	180	1461	1615
90	8504	9399	190	1229	1359
100	6847	7568	200	1038	1147
110	5545	6129	210	880	972
120	4517	4992	212	851	941

11 Troubleshooting *(continued)*

SOFT LOCKOUT *[Display flashes 9, then b in first position; last two digits on steady (code)]*			
Code	*Reason for soft lockout* *(also see page 38)*	**Corrective actions** *(pressing RESET should restart boiler immediately)* **WARNING: Electrical shock hazard. Turn off power to boiler when working with wiring or replacing any boiler component.**	
18	High limit operation — burner off until outlet water temp drops 9°F below the target temperature.	*1*	Check system for: • Verify boiler and system are full of water. • Make sure system does not have trapped air. • Inspect and verify system piping and components. • Verify piping agrees with Boiler manual recommendations.
		2	Use a contact thermometer to check outlet water temperature. Compare to temperature shown with display in Info mode (“1” in first digit; see page 39). (Also see page 49.) Replace supply termperature sensor if results are not close. Replace control module if sensor replacement doesn’t solve problem.
19	High limit operation — burner off until both the supply and return temperatures drop 9°F below the target temperature.	*1*	Check system for: • Verify boiler and system are full of water. • Make sure system does not have trapped air. • Inspect and verify system piping and components. • Make sure water flow is not reversed or pipes crossed.
		2	Use a contact thermometer to check return water temperature. Compare to temperature shown with display in Info mode (“2” in first digit; see page 39). (Also see page 49.) Replace return termperature sensor if results are not close. Replace control module if sensor replacement doesn’t solve problem.
24	High limit operation — return temp is higher than supply temp.	*1*	Check system for: • Verify boiler and system are full of water. • Make sure system does not have trapped air. • Inspect and verify system piping and components. • Make sure water flow is not reversed or pipes crossed.
		2	Use a contact thermometer to check return water temperature. Compare to temperature shown with display in Info mode (“2” in first digit; see page 39). (Also see page 49.) Replace return termperature sensor if results are not close. Replace control module if sensor replacement doesn’t resolve.
25	High limit operation — outlet water temp increased too quickly.	*1*	This usually indicates flow rate too low. Check system for: • Verify boiler and system are full of water. • Make sure system does not have trapped air. • Inspect and verify system piping and components. • Verify piping agrees with Boiler manual recommendations.
		2	Verify operation of boiler circulator. • Check voltage at circulator junction box to ensure 120 vac when boiler operates. If no voltage, check wiring and wiring connections. • High voltage terminal strip terminals 5 and 6 should show 120 vac for space heating; terminals 3 and 4 should show 120 vac for DHW. Replace circulator if powered but not operating. • Replace line voltage wire harness if necessary. Replace control module if wire replacement doesn’t resolve.
26	External limit (if used) opened (limit wired between low voltage terminal strip terminals 6 and 7).	1	Determine reason for limit action and correct.
		2	If limits are closed, check wiring and connections. Apply a temporary jumper across terminals 6 and 7 and check operation. If problem persists, check boiler internal wiring. Replace low voltage harness if necessary. Replace control module if harness replacement doesn’t resolve.

11 Troubleshooting *(continued)*

SOFT LOCKOUT *[Display flashes 9, then b in first position; last two digits on steady (code)]*			
Code	*Reason for soft lockout* *(also see page 38)*	**Corrective actions** *(pressing RESET should restart boiler immediately)* **WARNING: Electrical shock hazard. Turn off power to boiler when working with wiring or replacing any boiler component.**	
29	Blower turning when it should be off.	1	Check boiler wiring against wiring diagram. Replace line voltage and low voltage wiring harnesses if necessary. Replace control module if wire replacement doesn't resolve.
30	High limit operation — temperature rise across boiler too high.	*1*	This usually indicates flow rate too low. Verify boiler and system are full of water. Inspect and verify system piping and components. Verify piping agrees with Boiler manual recommendations. Make sure system pressure drop is not too high.
		2	Verify operation of boiler circulator. Check voltage at circulator junction box to ensure 120 vac when boiler operates. If no voltage, check wiring and wiring connections. High voltage terminal strip terminals 5 and 6 should show 120 vac for space heating; terminals 3 and 4 should show 120 vac for DHW. Replace circulator if powered but not operating. Replace line voltage wire harness is necessary. Replace control if wire replacement doesn't resolve.
35	Flue temperature sensor short circuit.	1	Inspect flue temperature sensor and wiring. Replace sensor if wiring correct and in good condition. Replace low voltage wiring harness if problem persists. Replace control module if harness replacement doesn't resolve.
40	Flue temperature sensor open circuit.	1	Inspect flue temperature sensor and wiring. Replace sensor if wiring correct and in good condition. Replace low voltage wiring harness if problem persists. Replace control module if harness replacement doesn't resolve.
52	Flue temperature limit operation.	1	This usually indicates heat exchanger needs to be cleaned. Follow instructions on page 47 to clean flue side of heat exchanger.
		2	Use a flue thermometer to measure flue temperature. Compare to temperature shown by control in Information mode ("5" in first digit of display; see page 40). (Also see page 49.) Replace flue temperature sensor if results are not similar. Replace control module if sensor replacement doesn't resolve.
		3	Isolate boiler from system and drain through drain valve. Use system purge valves to allow water to flush through boiler out drain valve. Check water discharge for signs of scale or sediment.
65	Blower not operating when turned on.	1	Turn off power to boiler. Remove line voltage connector at blower. Restart boiler and check voltage across blower plug terminals. If 120 vac is **NOT** present, inspect wiring and tightness of connections. Replace line voltage wire harness if necessary. Replace control module if wire harness replacement doesn't resolve.
		2	If 120 vac is present on blower wire harness, replace harness and retry. If problem persists, replace blower motor.

11 Troubleshooting *(continued)*

HARD LOCKOUT condition *[Display flashes first digit, "E" and last two digits (code)]*			
Code	Reason for hard lockout (also see page 41)	**Corrective actions** *(pressing RESET should restart boiler immediately)* **WARNING: Electrical shock hazard. Turn off power to boiler when working with wiring or replacing any boiler component.**	
00	Flame detected on startup	1	Burner may be operating too hot due to incorrect combustion. Inspect flame during operation following the procedure on pages 26 and 28. If flame is acceptable at both high and low fire, go to step 2. If flame is not acceptable: For propane boilers, verify propane orifice is correct and properly installed. See page 12 for procedure. Obtain and install propane orifice if necessary. For correctly-orificed propane boiler or natural gas boiler, replace gas valve if burner glows excessively.
		2	Look into the burner inspection window after the boiler shuts down. If flame is still present, gas valve may be leaking. Replace gas valve. BEFORE replacing valve, check gas line pressure coming to boiler. Pressure must not exceed 13 inches w.c. or valve damage could occur.
02	Ignition failed through 5 attempts	1	If no ignition spark occurs: • check ignition electrode cable, electrode connector and connections. • inspect ignition electrode cable and electrode for insulation damage. • check ground lead from ground terminal strip to heat exchanger access cover.
02 (cont.)	Ignition failed through 5 attempts (continued)	2	If spark occurs, but no flame: • Verify manual gas valve in boiler is open. • Verify plastic line from gas valve to air inlet elbow is connected to gas valve and elbow, and line is unobstructed, with no kinks • Check incoming gas pressure per page 21. • Verify gas lines are free of obstruction. • Purge gas lines of air if necessary. • Verify flue gas vent and air supply piping are correctly installed, in good condition and there are no obstructions. • Check voltage to gas valve. It should be 24 vac during ignition attempt. • Check gas meter to verify gas flows when gas valve is activated. • Remove and inspect/clean ignition electrode per page 45. Clean white oxides if necessary. Replace ignition electrode if in poor condition or cannot be cleaned. • See page 9 for procedure to disconnect gas valve from venturi. Inspect venturi gas line to verify there are not obstructions. Replace gas valve. • Check for possible flue gas recirculation at vent/air terminations or inside boiler housing. • If gas valve is powered, gas flows when activated, and above have been verified, replace gas valve and retry.

11 Troubleshooting *(continued)*

HARD LOCKOUT condition *[Display flashes first digit, "E" and last two digits (code)]*			
Code	Reason for hard lockout (also see page 41)	**Corrective actions** *(pressing RESET should restart boiler immediately)* **WARNING: Electrical shock hazard. Turn off power to boiler when working with wiring or replacing any boiler component.**	
02 (cont.)	Ignition failed through 5 attempts (continued)	3	Flame occurs, but flame signal too low (less than 4 vdc between low voltage terminal strip terminal 9 and ground): • Inspect flame per pages 26 and 28, at both low and high fire rates. Inspect and clean burner if necessary. Replace burner if not in good condition. • Check gas flow rate at gas meter with boiler at high fire (see page 36 to force boiler to high fire). If input is not within about 10% of boiler rating, replace gas valve. (Length of the vent/air piping will affect boiler firing rate, with longer piping causing lower inputs.) • Check ground wire and connections from ground terminal strip to heat exchanger access cover and from ground terminal strip to X1-6 terminal on the wiring harness. Use ground continuity meter to verify good ground path. • Follow procedure on page 45 to inspect and clean ignition electrode. Replace ignition electrode if necessary. • If above does not correct problem, replace control module.
04	Voltage lost after lockout occurred.	1	Control module will only restart with manual reset, even after power loss. But the error code information is lost.
03 05 06 07 08 09 11	Internal control failure	1	Reset control and retry. If problem persists, replace control module.
12	External limit opened.	1	An external limit control opened the circuit between low voltage terminal strip terminals 6 and 8. Determine reason for limit action and correct.
		2	If limits are closed, check wiring and connections. Apply a temporary jumper across terminals 6 and 8 and check operation. If problem persists, check boiler internal wiring. Replace low voltage harness if necessary. Replace control module if harness replacement doesn't resolve.
13 14 15 16 17	Internal control failure	1	Reset control and retry. If problem persists, replace control module.
18	Thermal overrun condition — Oultet water temperature above 210°F	*1*	Check system for: • Verify boiler and system are full of water. • Make sure system does not have trapped air. • Inspect and verify system piping and components. • Make sure water flow is not reversed or pipes crossed.
		2	Use a contact thermometer to check outlet water temperature. Compare to temperature shown with display in Info mode ("1" in first digit; see page 39). (Also see page 49.) Replace return termperature sensor if results are not close. Replace control module if sensor replacement doesn't solve problem.

11 Troubleshooting *(continued)*

HARD LOCKOUT condition *[Display flashes first digit, "E" and last two digits (code)]*			
Code	Reason for hard lockout (also see page 41)	**Corrective actions** *(pressing RESET should restart boiler immediately)* **WARNING: Electrical shock hazard. Turn off power to boiler when working with wiring or replacing any boiler component.**	
19	Thermal overrun condition — Return water temperature above 210°F	*1*	Check system for: • Verify boiler and system are full of water. • Make sure system does not have trapped air. • Inspect and verify system piping and components. • Make sure water flow is not reversed or pipes crossed.
		2	Use a contact thermometer to check return water temperature. Compare to temperature shown with display in Info mode ("2" in first digit; see page 39). (Also see page 49.) Replace return termperature sensor if results are not close. Replace control module if sensor replacement doesn't solve problem.
28	Blower not running	1	Turn off power to boiler. Remove line voltage connector at blower. Restart boiler and check voltage across blower plug terminals. If 120 vac is **NOT** present, inspect wiring and tightness of connections. Replace line voltage wire harness if necessary. Replace control module if wire harness replacement doesn't resolve.
		2	If 120 vac is present on blower wire harness, replace harness and retry. If problem persists, replace blower motor.
29	Blower signal not zero when it should be	1	Inspect wiring and connections. If wiring is correct, replace blower assembly. If blower assembly replacement is unsuccessful, replace control module.
31	Outlet water temperature sensor short circuit.	1	Inspect outlet water temperature sensor and wiring. Replace sensor if wiring correct and in good condition. Replace low voltage wiring harness if problem persists. Replace control module if harness replacement doesn't resolve.
32	Return water temperature sensor short circuit.	1	Inspect return water temperature sensor and wiring. Replace sensor if wiring correct and in good condition. Replace low voltage wiring harness if problem persists. Replace control module if harness replacement doesn't resolve.
36	Outlet water temperature sensor open circuit.	1	Inspect outlet water temperature sensor and wiring. Replace sensor if wiring correct and in good condition. Replace low voltage wiring harness if problem persists. Replace control module if harness replacement doesn't resolve.
37	Return water temperature sensor open circuit.	1	Inspect return water temperature sensor and wiring. Replace sensor if wiring correct and in good condition. Replace low voltage wiring harness if problem persists. Replace control module if harness replacement doesn't resolve.
44	Internal control failure	1	Reset control and retry. If problem persists, replace control module.
52	Flue temperature limit operation (temperature exceeded 225°F).	1	This usually indicates heat exchanger needs to be cleaned. Follow instructions on page 47 to clean flue side of heat exchanger.
		2	Use a flue thermometer to measure flue temperature. Compare to temperature shown by control in Information mode ("5" in first digit of display; see page 39). (Also see page 49.) Replace flue temperature sensor if results are not similar. Replace control module if sensor replacement doesn't resolve.
		3	Isolate boiler from system and drain through drain valve. Use system purge valves to allow water to flush through boiler out drain valve. Check water discharge for signs of scale or sediment.
60	Internal control failure	1	Reset control and retry. If problem persists, replace control module.
61	Internal control failure	1	Reset control and retry. If problem persists, replace control module.
65	Blower signal too low (not enough driving force)	1	Inspect wiring and connections. If wiring is correct, replace blower assembly. If blower assembly replacement is unsuccessful, replace control module.

12 Replacement parts

WARNING Replacement parts must be purchased through a local Weil-McLain distributor. When ordering, specify boiler model and size and include description and part number of replacement part. Results from using modified or other manufactured parts will not be covered by warranty and may damage boiler or impair operation.

NOTICE Weil-McLain part numbers are found in Weil-McLain Boilers and Controls Repair Parts Lists.

WARNING The boiler contains ceramic fiber materials. Use care when handling these materials per instructions on this page. Failure to comply could result in severe personal injury.

Handling ceramic fiber materials

REMOVAL OF COMBUSTION CHAMBER LINING

WARNING The combustion chamber lining in this product contains ceramic fiber material. Ceramic fibers can be converted to cristobalite in very high temperature applications. The International Agency for Research on Cancer (IARC) has concluded, "Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1).":

- Avoid breathing dust and contact with skin and eyes.
  - Use NIOSH certified dust respirator (N95). This type of respirator is based on the OSHA requirements for cristobalite at the time this document was written. Other types of respirators may be needed depending on the job site conditions. Current NIOSH recommendations can be found on the NIOSH web site at http://www.cdc.gov/niosh/homepage.html. NIOSH approved respirators, manufacturers, and phone numbers are also listed on this web site.
  - Wear long-sleeved, loose fitting clothing, gloves, and eye protection.
- Apply enough water to the combustion chamber lining or base insulation to prevent airborne dust.
- Remove combustion chamber lining or base insulation from the boiler and place it in a plastic bag for disposal.
- Wash potentially contaminated clothes separately from other clothing. Rinse clothes washer thoroughly.

NIOSH stated First Aid.

- Eye: Irrigate immediately
- Breathing: Fresh air.

12 Replacement parts *(continued)*

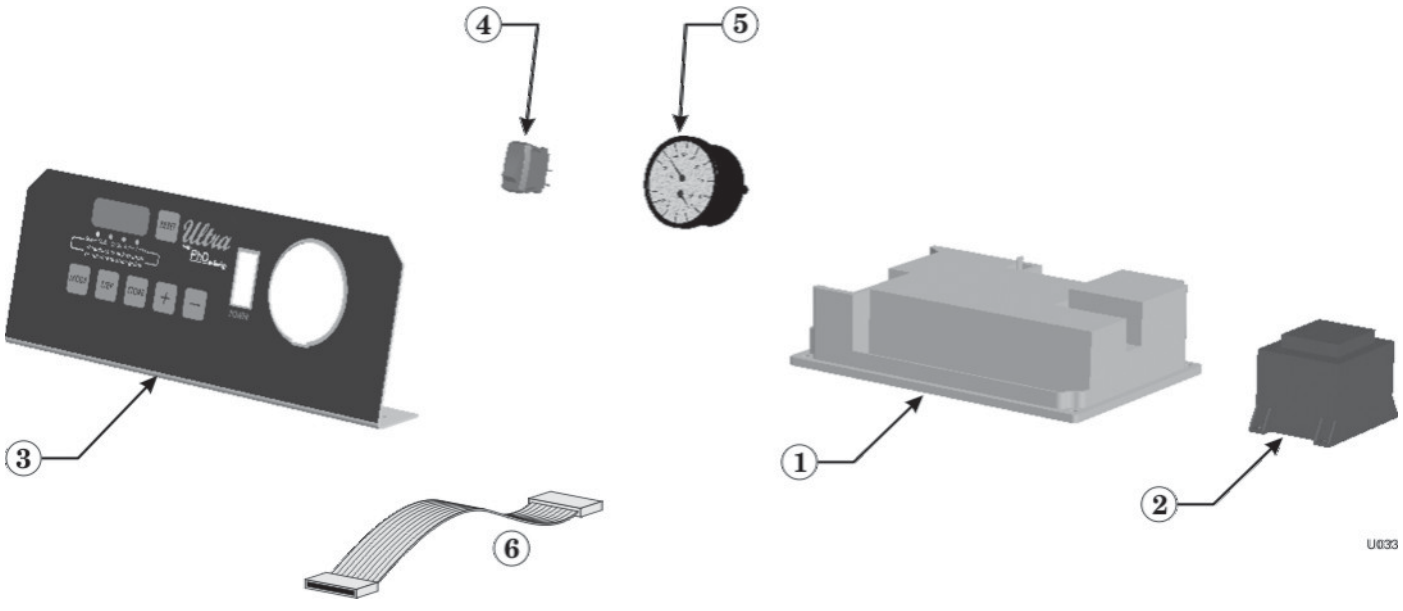
Miscellaneous parts and kits

Item	Description	Part Number
1	Pressure relief valve, ASME 30 PSI, ¾" npt male, (watts #330)	383-500-095
2	Boiler circulator, without flanges Ultra-80 & -105 . . . . . Taco Model 007 Ultra-155 & -230 . . . . . Taco Model 0011	511-405-113 511-405-124
3	Circulator hardware kit – inlet, 1" (Includes 1 flange, 2 nuts, 2 screws, and 1 gasket)	381-354-525
4	Circulator hardware kit – outlet, 1¼" (Includes 1 flange, 2 nuts, 2 screws, and 1 gasket)	381-354-526
5	Vent/air termination plate (2 required for each boiler)	383-500-100
6	Vent termination bird screen (2 required for Ultra-80, -105 & -155) 3" vent	383-500-105
7	Vent termination bird screen (2 required for Ultra-230 only) 4" vent	383-500-110
8	Natural to propane conversion kit for Ultra-80 Natural to propane conversion kit for Ultra-105 (orifice bag assembly)	383-501-020 540-100-001
9	Propane to natural conversion kit for Ultra-80	383-501-021
10	Natural to propane conversion kit for Ultra-155 (orifice bag assembly) Natural to propane conversion kit for Ultra-230 (orifice bag assembly)	383-500-115 383-500-120
11	Alarm control kit	383-500-080
12	Outdoor temperature sensor	383-500-125

12 Replacement parts *(continued)*

Control parts

Item	Description	Part Number
1	Ultra control module	383-500-190
2	Transformer, 120v/24v	383-500-195
3	Display board kit (Includes display, bracket, label, and off-set)	383-500-200
4	On/off power switch	383-500-205
5	Pressure/temperature gauge assy., (Includes temperature and pressure sensor)	383-500-210
6	Ribbon cable, control module to display board	383-500-215
7	Low voltage wire harness assembly for Ultra-80 & -105 (not shown) Low voltage wire harness assembly for Ultra-155 & -230 (not shown)	591-300-002 383-500-220
8	Line voltage wire harness assembly for Ultra-80 & -105 (not shown) Line voltage wire harness assembly for Ultra-155 & -230 (not shown)	591-300-001 383-500-230
9	Control module fuses (not shown) F1 — 5-amp, fast-blow (5 fuses package) F3 — 4-amp, slow-blow (5 fuses package)	383-500-235 383-500-240
10	120 volt, 3-wires receptacle (not shown)	383-500-245

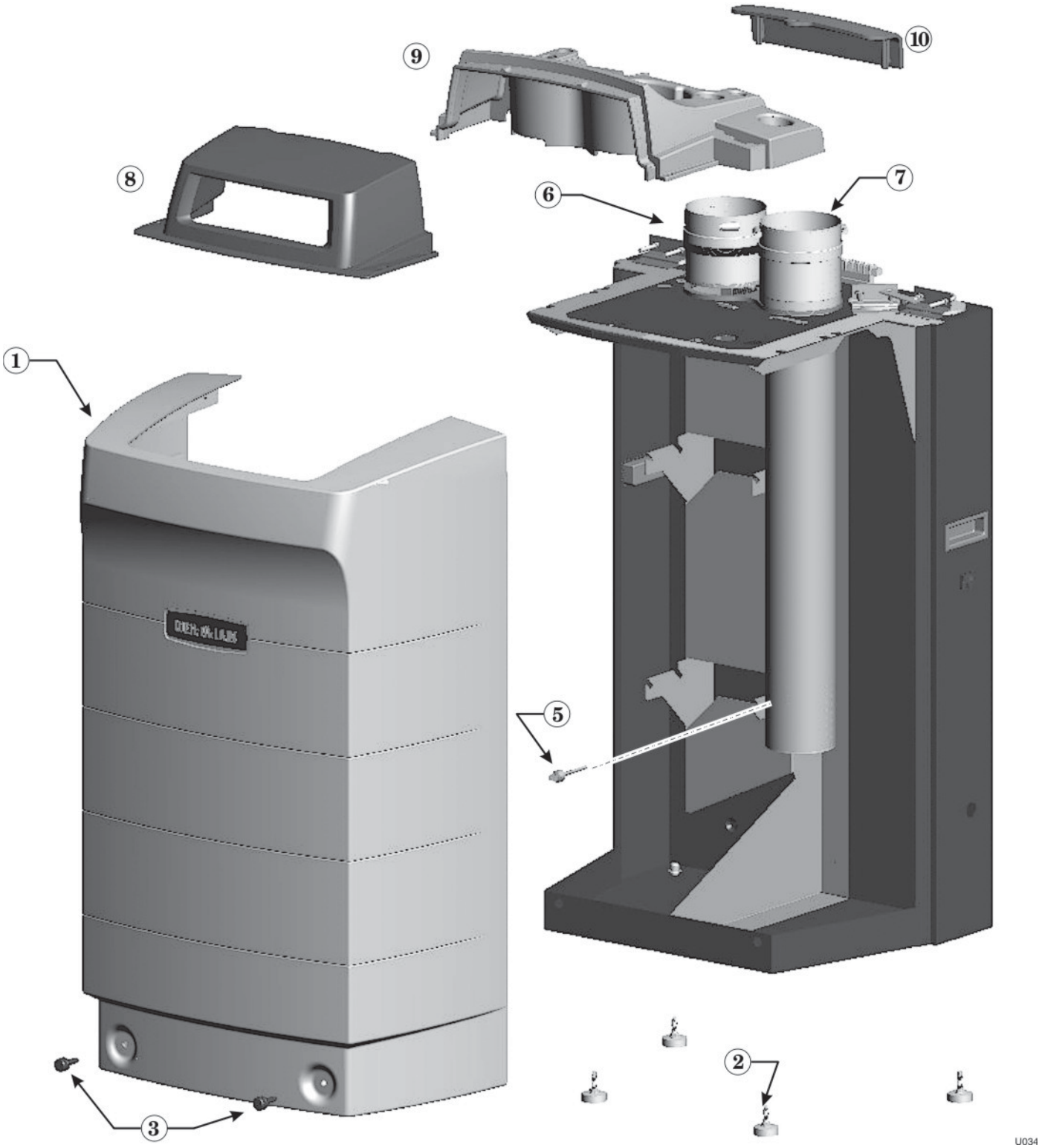


12 Replacement parts *(continued)*

Jacket parts *(page 59)*

Item	Description		Part Number
1	Jacket front door		383-500-135
2	Boiler leg kit	4 Required	383-500-065
3	Knurled head screw for jacket front door	2 Required	383-500-320
4	Knurled head screw clip-on receptacle (not shown)	2 Required	383-500-180
5	Flue temperature sensor replacement kit		383-500-055
6	Air adapter assembly (Includes adapter, gasket and mounting bracket)	Ultra-80 & -105 & -155, 3” Ultra-230, 4”	 383-500-145 383-500-150
7	Flue outlet pipe adapter	Ultra-80 & -105, 3” Ultra-155, 3” Ultra-230, 4”	560-900-001 383-500-155 383-500-160
8	Top cover, front		383-500-165
9	Top cover, rear		383-500-170
10	Electrical cabinet door		383-500-175

12 Replacement parts *(continued)*

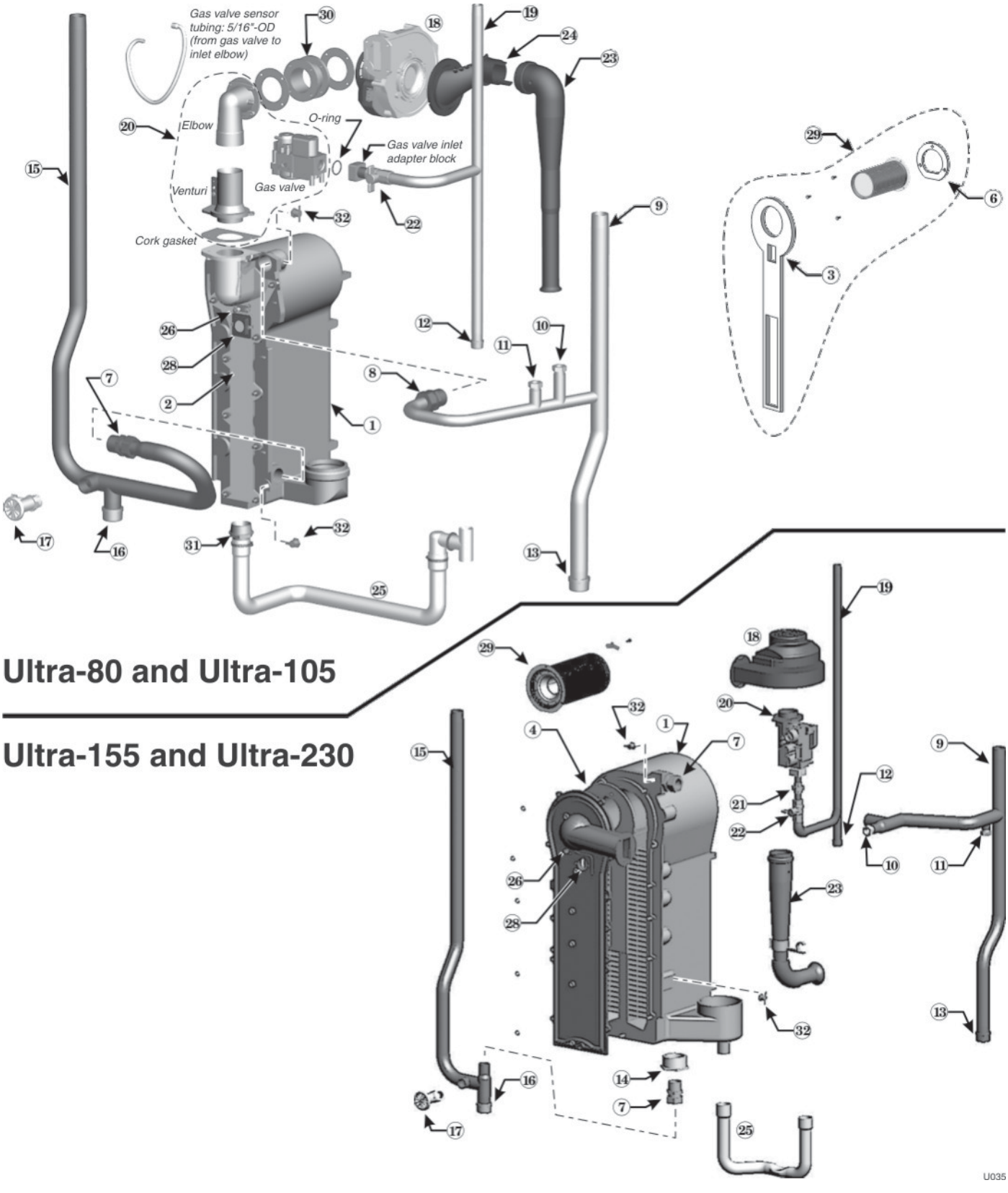


12 Replacement parts *(continued)*

Replacement parts — heat exchanger and piping *(page 61)*

Item	Description	Boiler Models	Part Number
1	Heat exchanger replacement kit — Heat exchanger, cover plate, burner, electrode, water sensors, compression fittings, condensate fitting, gaskets, and hardware	Ultra-80NG Ultra-80LP Ultra-105	383-501-023 383-501-024 383-501-035
	Heat exchanger replacement kit — Heat exchanger, cover plate, burner, electrode, water sensors, compression fittings, gaskets, and hardware	Ultra-155 Ultra-230	383-500-070 383-500-075
2	Cover plate replacement kit — Cover plate, cover plate gasket, burner gasket, and hardware	Ultra-80/-105	383-501-022
3	Cover plate gasket/insulation	Ultra-80/-105	591-200-000
4	Cover plate insulation	Ultra-155/-230	383-500-250
5	Cover plate gasket (not shown)	Ultra-155/-230	383-500-255
6	Burner gasket	Ultra-80/-105	590-300-000
7	Water compression fitting, 28 mm	Ultra-155/-230	383-500-260
8	Water compression fitting, 22 mm	Ultra-80/-105	564-100-002
9	Water supply piping assembly — Pipe, temperature well, check valve, cap (assembled) & compression fitting	Ultra-80/-105 Ultra-155/-230	383-501-036 383-500-265
10	½" NPT well for temperature gauge	All	383-500-270
11	Pressure/temperature gauge check valve	All	383-500-275
12	Pipe cap, ½" NPT (gas line – remove for bottom gas entrance and cap top of item 16)	All	Obtain locally
13	Pipe cap, 1" NPT (supply line – remove for bottom piping entrance and cap top of item 9)	All	Obtain locally
14	Return water bushing 1¼" BSP x 1" BSP	Ultra-155/-230	383-500-280
15	Return water pipe assembly — Pipe, drain valve, cap (assembled) & compression fitting	Ultra-80/-105 Ultra-155/-230	383-501-037 383-500-285
16	Pipe cap, 1" NPT (return line – remove for bottom piping entrance and cap top of item 15)	All	Obtain locally
17	Boiler drain valve, ¾" NPT	All	511-246-392
18	Blower assembly kit — Blower, gasket, and hardware	Ultra-80/-105	383-501-027
	Blower assembly kit — Blower, gasket, and hardware	Ultra-155	383-500-035
	Blower assembly kit — Blower, gasket, molex adapter, and hardware	Ultra-230	383-500-040
19	Gas pipe assembly — Gas pipe, shut-off valve, 1 1/2" nipple, adapter block, O-ring, and hardware	Ultra-80/-105	383-501-038
	Gas pipe assembly — Gas pipe and shut-off valve	Ultra-155/-230	383-500-290
20	Gas valve/venturi kit — Gas Valve, venturi, 90° elbow, gaskets, and hardware (assembled)	Ultra-80NG	383-501-029
	Gas valve/venturi kit — Gas Valve, venturi, 90° elbow, propane orifice, gaskets, and hardware (assembled)	Ultra-80LP	383-501-039
	Gas valve/venturi kit — Gas Valve, venturi, 90° elbow, gaskets, and hardware (assembled)	Ultra-105	383-501-030
	Gas valve/venturi kit — Gas Valve/venturi assembly, adapter block, O-ring and hardware	Ultra-155 Ultra-230	383-500-025 383-500-030
21	Ground joint union, ½" NPT	Ultra-155/-230	Obtain locally
22	Manual gas valve, ½" NPT	All	Obtain locally
23	Air silencer kit — Air silencer and gasket	Ultra-80/-105 Ultra-155/-230	383-501-026 383-500-295
24	Air silencer adapter kit — Air silencer adapter and hardware	Ultra-80/-105	383-501-025
25	Condensate trap kit — Condensate trap, hose clamps, pvc fittings, and gasket	Ultra-155 Ultra-230	383-501-031 383-500-060
26	Ignition electrode kit — Ignition electrode, suppressor, gasket, and hardware	All	383-500-045
27	Ignition cable kit (not shown) — Ignition cable, suppressor, and wire tie	All	383-500-050
28	Inspection glass kit — Bracket, glass, gasket, and hardware	All	383-500-020
29	Burner replacement kit — Burner, gaskets and hardware	Ultra-80NG Ultra-80LP Ultra-105 Ultra-155 Ultra-230	383-501-032 383-501-033 383-501-034 383-500-085 383-500-090
30	Aluminum spacer kit — Spacer, gaskets and hardware	Ultra-80/-105	383-501-028
31	Condensate fitting	Ultra-80/-105	561-200-000
32	Return/supply sensor kit — (1) sensor	All	383-500-300

12 Replacement parts *(continued)*



13 Dimensions

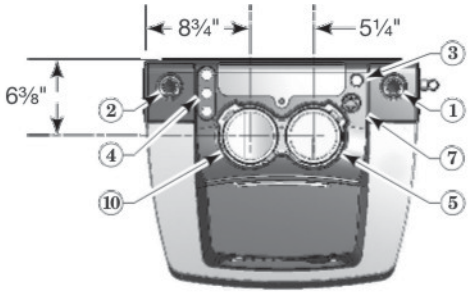
① Supply connection (*note 1*)

② Return connection (*note 1*)

③ Low voltage wire opening

④ Electrical entrance openings

⑤ Vent connection:
Ultra-80, -105, & -155 — 3"
Ultra-230 — 4"



TOP

⑥ Pressure/temperature gauge

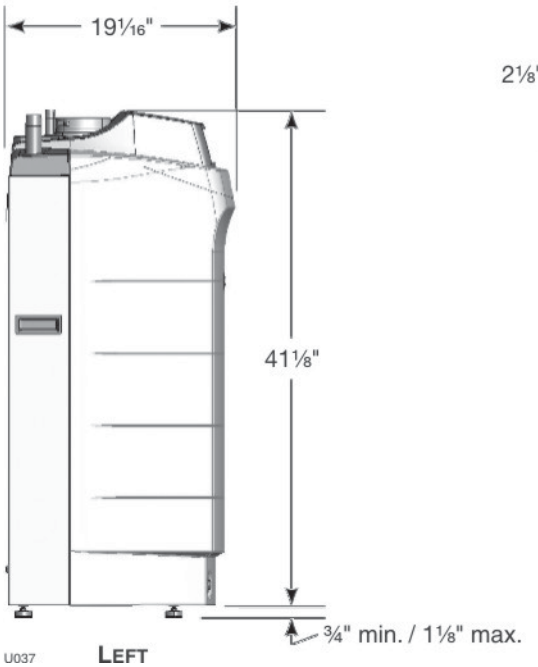
⑦ Gas connection (*note 1*)

⑧ Drain valve (inside enclosure)

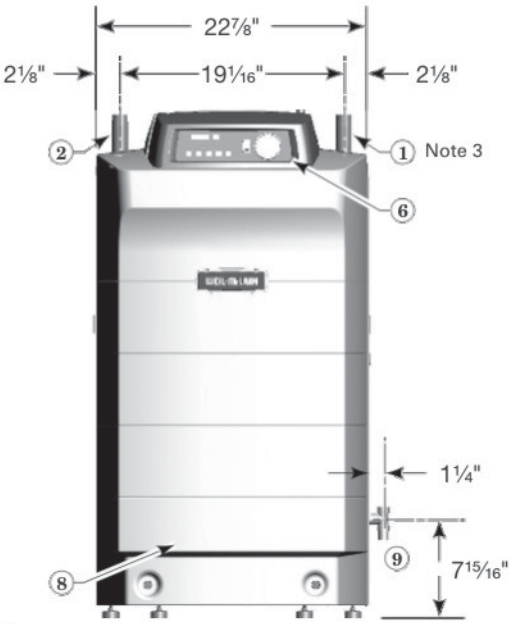
⑨ Condensate drain (½" PVC)

⑩ Air connection:
Ultra-80, -105, & -155 — 3"
Ultra-230 — 4"

ALL DIMENSIONS IN INCHES



U037 LEFT



FRONT

RIGHT

Notes

1. Boiler supply and return tappings are both 1" NPT. See pages 14 through 17 for recommended system supply and return piping sizes. Wall-hung boilers: water piping and gas pipe can be routed through bottom of enclosure using wall-mounting kit.
2. Boiler circulator is shipped loose. Circulator may be mounted on either boiler supply or return piping. Both 1" and 1¼" circulator flanges are shipped with boiler.
3. Relief valve is shipped loose. See page 11 for mounting details. Relief valve mounts on supply pipe off of 1 x 1 x ¾ tee and ¾" street elbow.

14 Ratings

Boiler Model Number	DOE Heating Capacity	CSA Input	CSA Output	Net I=B=R Ratings	Boiler Water Content	DOE Seasonal Efficiency	Weil-McLain Low temperature seasonal efficiency	Vent Size
	Btuh *(Note 2)*	Btuh *(Note 6)*	Btuh *(Note 6)*	Btuh *(Note 3)*	Gallons	AFUE, % *(Note 1)*	% *(Note 5)*	*(Note 4)*
Ultra-80	71,000	80,000	71,000	62,000	0.69	93.0	98.0	3"
Ultra-105	94,000	105,000	94,000	81,000	0.82	92.0	98.0	3"
Ultra-155	139,000	155,000	139,000	123,000	1.17	93.0	98.0	3"
Ultra-230	207,000	230,000	207,000	183,000	1.57	92.8	98.0	4"

1. As an Energy Star Partner, Weil-McLain has determined that Ultra boilers meet the Energy Star guidelines for energy efficiency.
2. Based on standard test procedures prescribed by the United States Department of Energy.
3. Net I=B=R ratings are based on net installed radiation of sufficient quantity for the requirements of the building and nothing need be added for normal piping and pickup. Ratings are based on a piping and pickup allowance of 1.15. An additional allowance should be made for unusual piping and pickup loads.
4. Ultra boilers require special venting, consistent with Category IV boiler. Use only the vent materials and methods specified in Ultra vent supplements. Ultra boilers must be direct-vented. Ultra-230 can be vented with either 3" or 4" vent pipe. Vent length limits for 3" vent are not as long as for 4" vent.
5. Weil-McLain Low temperature seasonal efficiency is based on ASHRAE 103 test method, using boiler return water temperature of 90°F, with boiler outlet water temperature of 110°F.
6. Ratings shown are for sea level applications only. For altitudes from sea level to 5,500 feet above sea level, the Ultra boiler requires no modifications and automatically derates itself by approximately 4% per 1000 feet above sea level. For elevations above 5,500 feet, contact your local Weil-McLain sales office for details.

WEIL-McLAIN

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Part number 550-100-009/0703