IBC

IBC Technologies Inc.
Vancouver, Canada

VFC Modulating Gas Boilers

- ***Model VFC 35-90 (natural gas)***
- ***Model VFC 50-130 (natural gas)***
- ***Model VFC 35-100LP (propane)***
- ***Model VFC 45-130LP (propane)***

INSTALLATION AND OPERATING INSTRUCTIONS

WARNING: If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury, or loss of life.

Do not store or use gasoline or other flammable vapours and liquids or other combustible materials in the vicinity of this or any other appliance.

Should overheating occur or the gas supply fail to shut off, do not turn off or disconnect the electrical supply to the pump. Instead shut off the gas supply at a location external to the appliance

WHAT TO DO IF YOU SMELL GAS:

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a nearby phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.
- Installation and service must be performed by a qualified installer, service agency or the gas supplier.

TABLE OF CONTENTS

1. INSTALLATION

1.1 GENERAL

VFC modulating boilers are low pressure, fully condensing units having a variable inputs ranging from 35 MBH (35,000 Btu/hr) to 130 MBH. The boilers are approved for either Direct Vent (sealed combustion) or Category IV (indoor air) applications, providing a great degree of installation flexibility.

The installer must clearly indicate the vent category for the installation on the rating plate using an indelible marker. See section 1.4 - Venting.

Figure 1. shows outer case dimensions and piping and electrical holes. Use this diagram to find a suitable location for the boiler. (see also Section 1.3 - Location.)

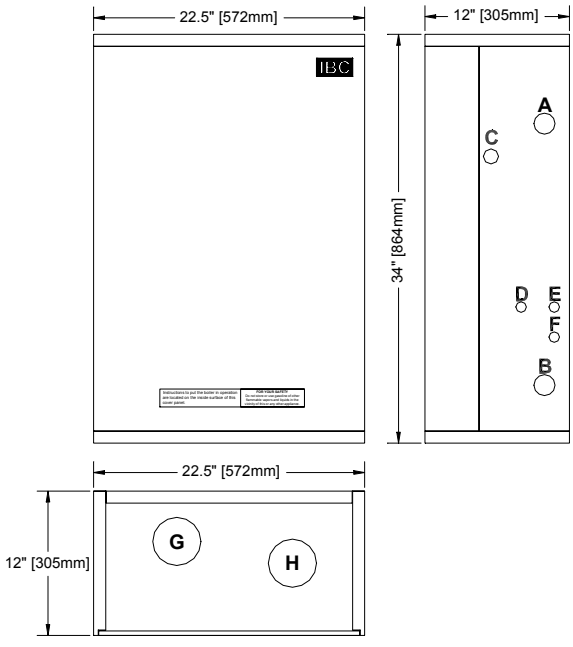


Figure 1. Dimensions/Connections

Table 1 - Connections		
	Description	**Size**
A	water outlet	1" NPT
B	water inlet	1" NPT
C	gas	½" NPT
D	electrical power	3/4"
E	thermostat	3/4"
F	pump	3/4"
G	combustion air	4.0"
H	exhaust vent	4.0"

1.2 CODE REQUIREMENTS

Gas manifold and controls met safe lighting and other performance criteria when boiler underwent tests specified in ANSI Z21.13-2000 / CSA 4.9-2000.

Installation must conform to **local codes**, or in the absence of these, with the latest editions of **the National Fuel Gas Code ANSI Z223.1** and the **National Electrical Code ANSI/NFPA 70**.

Where required by jurisdiction, installation must conform to the Standard for Controls and Safety Devices for Automatically Fired Boilers, **ANSI/ASME CSD-1**. If there is any conflict in the above requirements, then the more stringent requirement will apply.

In Canada, installations must conform to the current **CAN/CGA B149** and the **Canadian Electrical Code Part 1 CSA C22.2 No. 1.**

1.3 Location

Keep boiler area free and clear of combustible materials, gasoline, and other flammable vapours and liquids.

VFC-series boilers are designed and approved for wall or floor installation (on combustible flooring), with significant flexibility of location provided with the available venting options. The boiler can be placed in an alcove, basement, closet or utility room.

Care must be taken not install the boiler in areas where the combustion air source is subject to chemical fouling. Experience has shown that exposure to corrosive chemical fumes such as chlorinated and/or fluorinated hydrocarbons can reduce the life of a boiler. Cleaners, bleaches, air fresheners, refrigerants, aerosol propellants, dry-cleaning fluids, de-greasers and paint-removers all contain vapours which can form corrosive acid compounds when burned in a gas flame. Airborne chorides such as those released with the use of laundry detergents are also to be avoided. For this reason, the Category IV (indoor air) venting option using air surrounding the boiler should not be used in a laundry room installation.

It is recommended that the boiler be located in an area where water leakage will not result in damage to the area. If a location such as this cannot be found, a suitable drain pan, should be installed under the appliance. The boiler is not to be installed above carpeting.

In addition to the foregoing, other factors determining potential mounting sites:

- ensure minimum clearance requirements for combustible materials(see **Table 2**) are satisfied
- 36” clearance at the front is recommended for adequate servicing
- gas ignition system components should be protected from water (dripping, spraying, rain, etc.)
- boiler should not be exposed to water leaks from piping or components located overhead
- in a new construction installation, particular action must be taken to protect the boiler from dust; combustion air should be drawn from a CLEAN source (e.g. outdoors) and the boiler should be isolated from interior dust sources. Do not seal boiler case openings directly - allow for air circulation and ventilation in the immediate area.

Table 2 - Clearance from Boiler Cabinet

Surface	Distance from Combustible Surfaces	Recommended Distance for Service
Front	2”	24”
Rear	0”	0”
L. Side	0”	12”
R. Side	2”	18”
Top	10”	10”

Below the boiler, 12” is required to provide clearance for the inlet and exhaust venting together with the required condensation trap. Legs are available as an accessory for floor-mounting of the boiler; the 14” legs provide the necessary clearance.

1.4 Venting

All venting must be installed in accordance with the requirements of the

jurisdiction having authority: in the USA Part 7, *Venting of Equipment* of the National Fuel Gas Code, ANSI 223.1, latest edition, and any other local building codes are to be followed. In Canada, Part 7 - *Venting Systems* of the B149 Code prevails. Where there is a discrepancy between the installation instructions below, and the code requirements, the more stringent shall apply.

IMPORTANT

When an existing boiler is removed from a common venting system, the common venting system is likely to be too large for proper venting of the appliances remaining connected to it.

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 opening 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 and other deficiencies which could cause an unsafe condition.

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

f. Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1 - latest edition. In Canada, all installations must conform with the current CAN/CGA - B149 Installation Code and/or local codes.

When resizing any portion fo the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in the National Fuel Gas Code, ANSI Z223.1 - latest edition. In Canada, use the CAN/CGA - B149 Installation Code.

1.4.1 Applications

All VFC-series boilers are approved with alternative venting options: either Direct Vent or Category IV venting can be used offering flexibility to meet the specific requirements of the installation. With the Direct Vent case, combustion air is piped directly to the boiler's air

intake from outdoors. Using the Category IV alternative, air for combustion is drawn from the indoor air surrounding the boiler or drawn from ventilated attic or crawl spaces.

The standard VFC boiler is shipped with a high water temperature limit switch set for 200°F.

Provided the maximum overall vent length limit is not exceeded, the installer may choose to vent the boiler through the wall, directly through the roof or upward using an existing - but otherwise unused - chimney *as a vent raceway* (see below).

All boilers are shipped with connectors permitting attachment of 2" intake piping.

It is a code requirement that the rating plate reflect the nature of the boiler vent configuration as installed. To facilitate such venting installation flexibility, VFC boilers are shipped with the rating plate unmarked. The installer shall indelibly mark the appropriate box on the rating plate to recognize the venting alternative chosen.

1.4.1.1 Intake/Exhaust Vent Material

The approved materials of construction:
For the **exhaust** vent-
• 2" CPVC Sch. 40 or 80 pipe (per ASTM F441) and Sch. 40 or 80 fittings for the initial 10 lineal feet of travel
• 2", 2½" or 3" Sch 40 CPVC or PVC(ASTM D1785 or D2665); alternatively: 2" or 3" ABS (Sch. 40/ASTM D2661 or F628) and fittings thereafter;

For the **inlet** air - 2", 2½" or 3" PVC or 2" and 3" ABS are permitted.

Exhaust venting is to be connected directly to the 2" NPT male threaded stainless steel fitting on the bottom of the pressure vessel using a 2" CPVC NPT x Socket fitting (female threaded adaptor or 90° elbow). A condensate trap of CPVC and PVC shall be spliced into the CPVC exhaust pipe at or near the base of the boiler (see Figure 2).

Combustion air piping is connected at the base of the boiler using a standard 2" PVC coupler or elbow. Screen material shall be placed at the inlet as appropriate for the environment (e.g. insects, dust).

1.4.1.2 Vent Travel

Using the standard 2" piping, the boiler can be sited up to 60 equivalent feet from the vent termination. The actual vent travel is reduced for fittings in accordance with **Table 3**. - for example, using 5 x 90º ABS long-sweep* elbows, the maximum lineal measure is 35 feet. Direct vent installations requiring longer travel can be satisfied using 2½" or 3" intake and vent piping (the latter subject to an initial 10' of 2" CPVC - which is *included* in the limit for 2½" or 3" pipe).

Table 3 - Max. Venting Length

Pipe Size	Max. Equiv.Length
2"	60'
2½" or 3"	90'
90° elbow(CPVC/PVC)	allow 8' equiv.
45° elbow(CPVC/PVC)	allow 4' equiv.
90° elbow*(ABS)	allow 5' equiv.
45° elbow*(ABS)	allow 2.5' equiv.

If the 2½" or 3" piping alternative is selected, a 3"x2" (or 2½" x 2" as appropriate) bushing is to be used in the inlet piping within 3 feet of the combustion air line clearance hole at the base of the boiler. Such 3' interval (which is part of the 90' max. travel

distance) is allowed to provide space for splicing in the optional 2" compatible air filter unit. On the exhaust side, a 3" x 2" (or 2½"- 2") reducer must be placed in a vertical section of the flue gas vent, to avoid pooling of condensate.

Exhaust venting must slope down to the trap/drain with a pitch of at least ¼" per foot so condensate runs towards the trap. Support should be provided every 2 to 3 feet for each of the intake and vent piping. Insulate exhaust piping where it passes through unheated space with appropriate pipe insulation to prevent freezing of condensates.

Ensure all venting components are clean of burrs/debris prior to assembly. Care is to be taken to avoid ingestion into the fan of CPVC/ABS/ PVC debris left in the combustion air piping.

All joints must be secured using CPVC, PVC, or ABS/PVC solvent cement to bond the respective pipe material. Use solvent cement on the connector located at the CPVC/ABS or PVC junction (e.g. 10' along the exhaust piping). Follow the cement manufacturer's instructions closely when joining various components.

All vent connections must be liquid and pressure tight. Test exhaust venting connections, under fan pressure with vent blocked, using a soap/water solution prior to firing.

1.4.1.3 Condensate Trap

A condensate trap must be installed at the base of the boiler (or within 12" of the first 90° exhaust line elbow), as shown in Figures 2. (e.g. spliced into the 2" PVC exhaust vent using a straight 2" tee or a 2" x ½" x 2" reducing tee). The trap itself is formed using ½" PVC pipe for the drop leg, with ½" PVC pipe, elbows and threaded union fittings. The trap must be installed as follows:

- Must be 5"min in height (see **Fig. 2**.)
- Must be piped to within 3" of a drain or be connected to a condensate pump (using ½" PVC)
- Drainage line must slope down to the drain at a pitch of ¼" per foot so condensate runs towards the trap
- **IMPORTANT! Fill trap with water before boiler is first fired to prevent exhaust fumes from entering room. Never operate the boiler unless the trap is filled with water.**
- Trap should be checked every 6 months. Clean and refill as necessary.

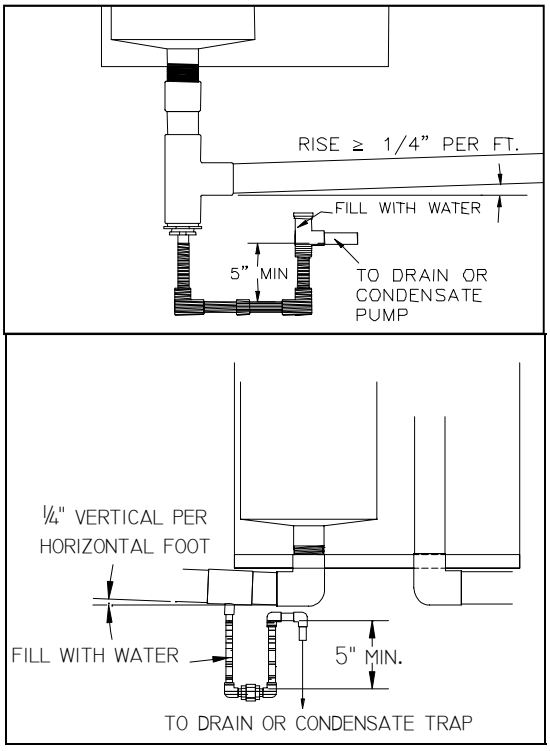


Figure 2. Condensate Trap Alternatives

1.4.1.4 Venting Passage Through Ceiling and Floor

The following instructions apply to 2", 2½" and 3" piping:

- pipe clearances - no specific requirements; follow local codes
- piping must be supported in the flooring
- all piping must be liquid and pressure tight.

1.4.1.5 Rooftop Vent Termination

Vents must terminate as follows:

- 12" above grade and normal snow line to vent terminal bottom
- DO NOT exhaust vent into a common venting system

(See **Figures 3 & 4** for rooftop vent terminations)

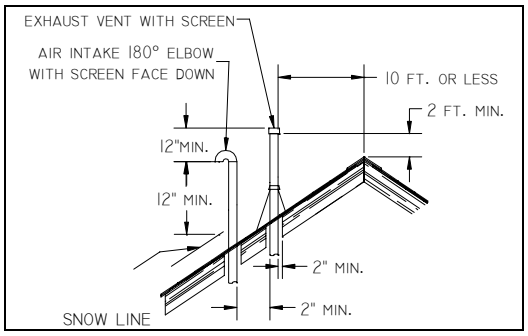


Figure 3. Vent Terminations through a Pitched Roof

1.4.1.6 Sidewall Vent Termination

Vents must terminate as follows: minimum 12" from any building opening

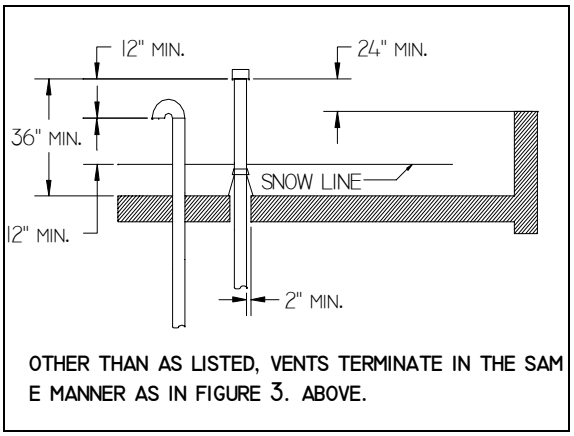


Figure 4. Vent Terminations Through a Flat Roof

- minimum 3' above any forced air intake located within 10'
- minimum 4' horizontally from (and in no case above or below) unless 4' horizontal distance is maintained, from electric or gas meters, regulators and relief equipment
- not to be located over public walkway, in a confined space, or under any overhang or deck
- vents must be installed such that flue gas does not discharge towards neighbor's windows, or where personal injury or property damage can occur.
- for Direct Vent installations employing sidewall vent terminations, both the inlet and exhaust terminations shall be located on the same plane (side) of the building, with the exhaust outlet placed above the inlet to avoid re-ingestion.

(See **Figures 5,6, & 7** for side wall vent terminations)

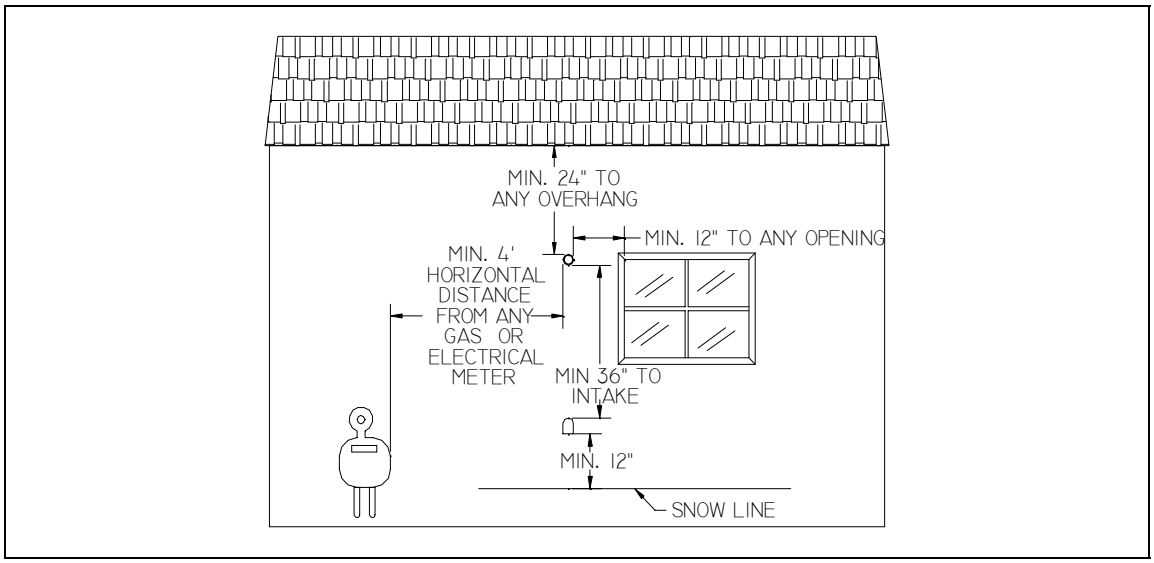


Figure 5. Side Wall Venting

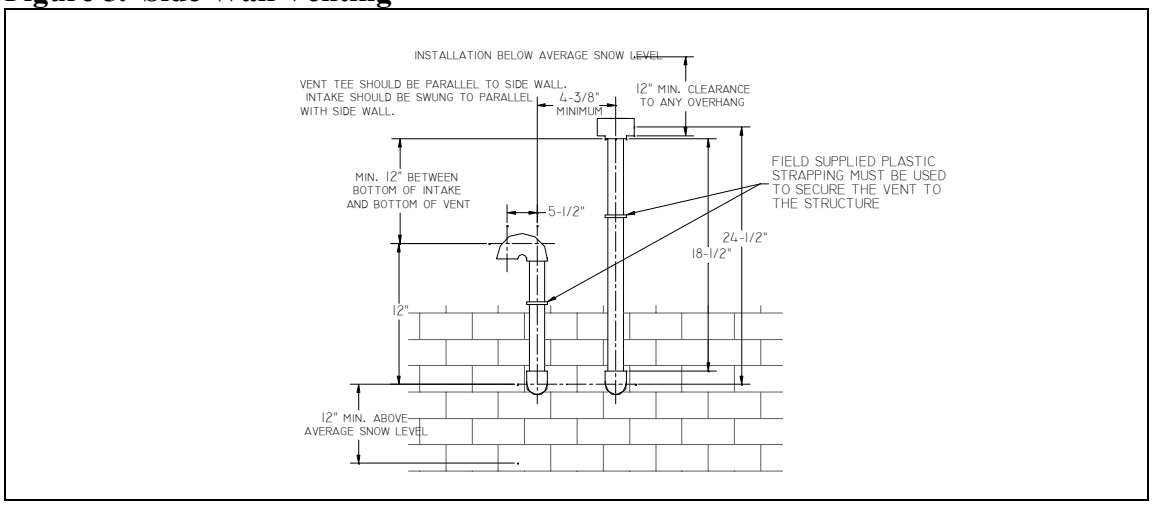


Figure 6. Side Wall Vent Terminations (Configuration 1)

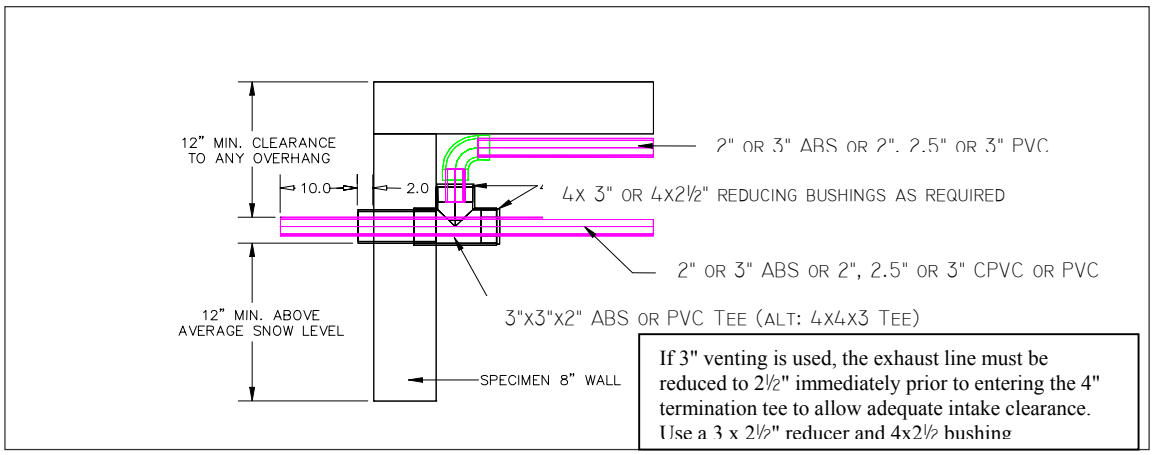


Figure 7. Side Wall Vent Terminations (Configuration 2)

1.4.2 Category IV Venting

A category IV venting system is one in which air for combustion is take from the ambient air around the boiler. Vent piping is run horizontally or vertically to the outdoors.

1.4.2.1 Ventilation and Air Supply

To support combustion, an ample air supply is required. This may require direct openings in the boiler room to the outside. If the boiler is not in a room adjacent to an outside wall, air may be ducted from outside wall openings. Provisions for combustion and ventilation air must be made as follows: in the USA, in accordance with Section 5.3 *Air for Combustion and Ventilation of the National Fuel Gas Code*, ANSI Z223.1 (latest edition), or applicable provisions of the local building codes; in Canada, in compliance with CAN 1.4.3.

The following lists are recommendations for buildings of energy-saving construction, fully caulked and weather-stripped:

- an opening to the outside, within 18" of the floor, but no less than 6" off the floor, should be provided in the room. Each opening should be covered in a grill, and have an area of 1" per 1,000 BTUh for ALL APPLIANCES in the area.
- Openings must not be closed or reduced. Doors and windows used for air supply must be locked open.
- Mechanical draft exhaust or supply fans are not to be used in or near the boiler area
- Boiler combustion and ventilation airflow must not be obstructed

Indoor combustion air must not expose the boiler to contamination - see **Section 1.3 - Location**, above. In other respects, Category IV venting is installed in the same manner as for the exhaust side of Direct Vent installations, except that there is no 2½" extended travel vent option in the Category IV configuration.

1.4.3 Closet Installations

For installations in a confined space (such as a closet), ventilation openings must be provided through a door or wall to prevent excessive heat from building up inside the space.

Minimum requirements:

- one opening within 12" of the ceiling (100 sq. in. opening)
- one opening within 12" of the floor (100 sq. in. opening)

1.5 Water Piping

Follow applicable Codes and good piping practice. Any uninsulated hot water pipes must be installed with a minimum 1" clearance from combustible materials.

System piping is connected to the boiler using the 1" NPT female threaded fittings provided at the locations shown on page 10. Typical piping systems are shown in **Figures 8, 9, &10**.

A 30 psi pressure relief valve (¾" NPT) is supplied for field installation in the flow supply line, in the manner shown in **Figures 8, 9, & 10**. Relief valve discharge piping must terminate 6" above a drain using plain un-threaded end, or per local Code.

To avoid water damage, system piping and components are not to be located overhead the boiler.

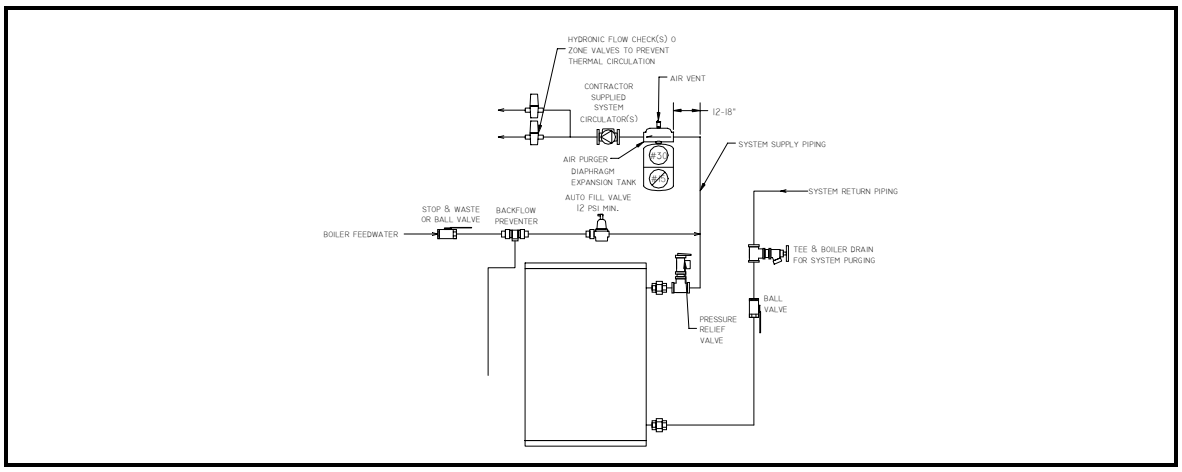


Figure 8. Sample Piping Schematic (1)

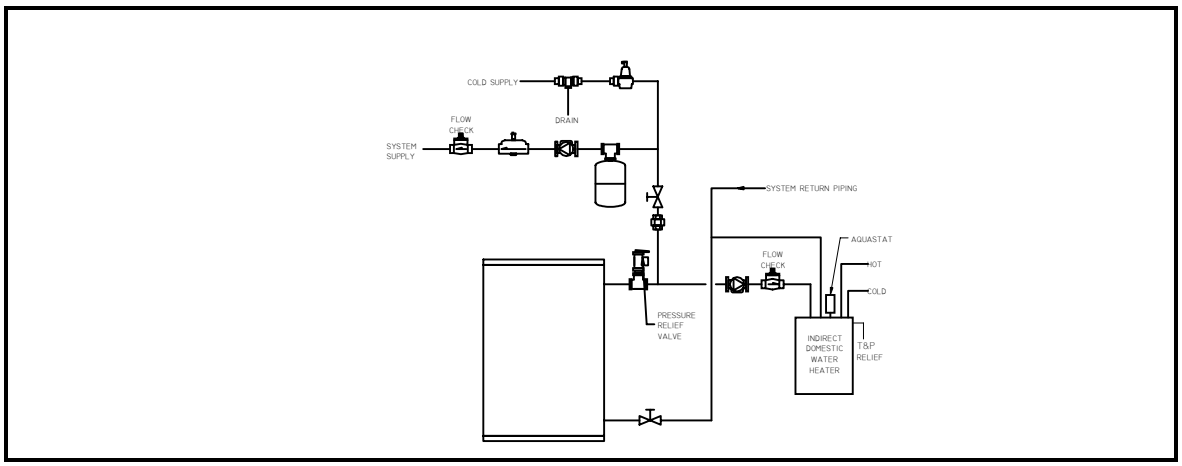


Figure 9. Sample Piping Schematic (2)

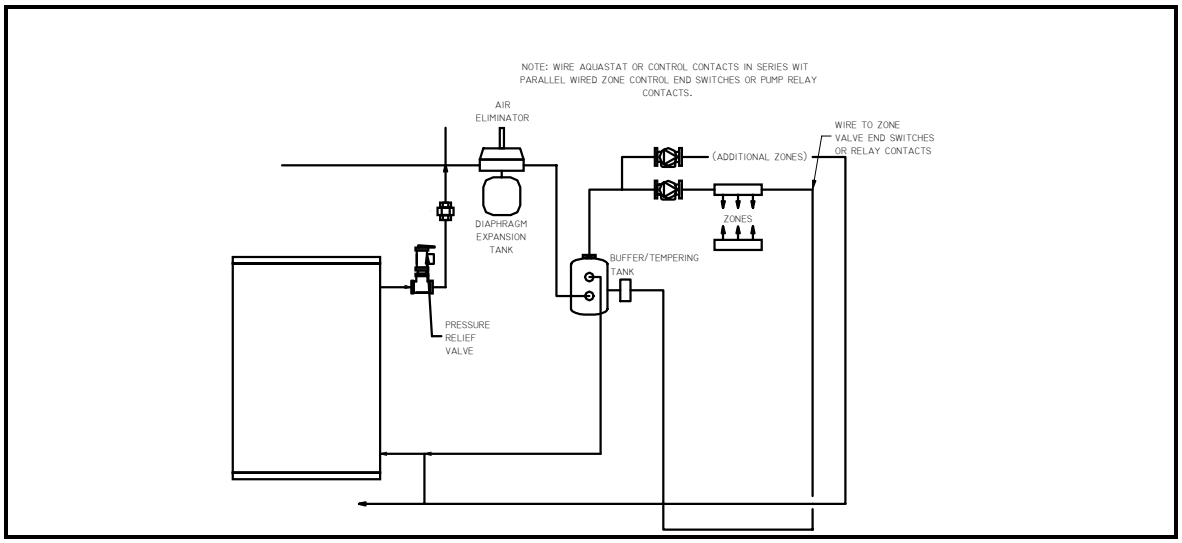


Figure 10. Sample Piping Schematic (3)

The VFC boiler is designed for supply water temperatures within the range 80°F to 180°F, with a 20°F rise. Water flow rates and pressure drop (head in ft. w.c.) associated with a 20°F maximum rise (Δ°T) for the respective VFC models are as follows:

Table 4 - Flow Rate

Model	Flow (USgpm)	Approx. Head (ft. wc)
VFC 35-90	9.0	5
VFC 50-130	13.0	10
VFC 35-100LP	10.0	6.5
VFC 45-130LP	13.0	10

Water flow rates must not be allowed to fall below 6 gpm (35-90 & 35-100LP series: 5 gpm) in any possible operating condition (eg. single zone in use).

To achieve system flow rates and temperatures within such limits, care must be taken to select the appropriate pump. Evaluate pressure drop across the system, including the above head values for the boiler itself. Ensure pump is rated for the design circulating water temperatures; some pumps have a minimum water temperature rating above the low temperature potential of the boiler. Following installation, confirm actual performance by measuring Δ°T (under high and low flow conditions) after establishing the correct firing rate (see **Section 2.2 – Check Boiler Input**).

VFC-series boilers are supplied with a integral low-water flow switch, which allows installation of the boiler above radiation level. The flow switch is calibrated to close with at 4.5 US gpm and open at 4.0 US gpm.

When installed in a low mass heating system such as an in-floor radiant application, the VFC-series boilers may benefit through use of a buffer tank to ensure a controlled supply temperature, and to prevent short cycling. It is highly recommended that a buffer tank be included in any heating system in which any single zone has radiative loading lower than 1/3rd of the minimum input of the boiler (i.e. at 35,000 BTU/hr, the boiler should be buffered if any single zone attached is below 12,000 Btu/hr).

Propylene glycol solution is commonly used in a water heating loop where freeze protection is required. Its density is lower than that of water, resulting in lower thermal performance at a given flow and pressure. As a rule of thumb, a 50%:50% solution of propylene glycol and water will require an increased system circulation rate (gpm up 10%), and system head (up 20%) to provide performance equivalent to straight water.

Whether required by local Codes or otherwise, it is recommended that piping systems include a suitable check valve, gate valve and feedwater regulator set at 12 psig. in the make-up water link with the city main. Use of unions and gate or ball valves at the boilers supply and return water connections is recommended to simplify servicing.

1.6 Gas Piping

The boiler requires an inlet gas pressure of at least 4.0” w.c. for natural gas and 10.5" w.c. for propane. For either fuel, the inlet pressure shall be no greater than 14.0” w.c. Confirm this pressure range is available with your local gas supplier.

The inlet gas connection of the boiler's gas valve is 1/2" NPT (female).

Adequate gas supply piping shall be provided with no smaller than 1/2" Iron Pipe Size (IPS), in accordance with the following chart:

Table 5 - Max. Pipe Length (ft)

Model	1/2" IPS	3/4" IPS	1" IPS
VFC 35-90	20	100	350
VFC 50-130	10	50	175
VFC 35-100LP	50	200	600
VFC 45-130LP	30	125	400

Gas piping must have a sediment trap ahead of the boiler's gas valve (see **Figure 11**.). A manual shutoff valve must be located outside the boiler, in accordance with local codes/standards. All threaded joints in gas piping should be made with a piping compound resistant to the action of natural gas - do not use Teflon tape. Use proper hangers to support gas supply piping.

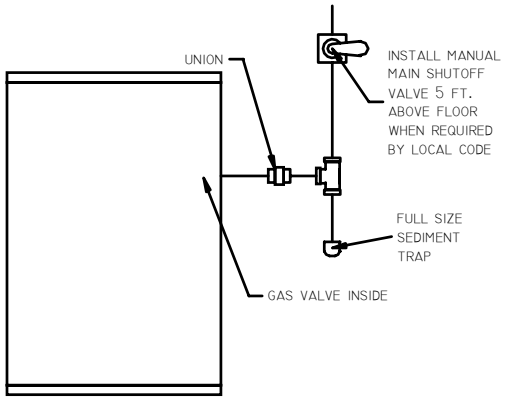


Figure 11. Typical Gas Piping

The boiler must be disconnected or otherwise isolated from the gas supply during any pressure testing of the system at test pressures in excess of 1/2 psig. Dissipate test pressure prior to reconnecting.

The boiler and its gas piping shall be leak tested before being placed into operation.

The gas valve is provided with pressure taps to measure gas pressure upstream (supply pressure) and downstream (manifold pressure) of the gas valve. Note that manifold pressures vary in accordance with firing rate with the modulating series boilers.

Table 6 - Manifold Pressures

Model / Fuel Type	Range
Natural Gas Units	0.5" - 3.5" w.c.
Propane Units	1.2" - 10.0" w.c.

1.7 Electrical Connections

All Electrical wiring to the boiler (including grounding) must conform to local electrical codes and/or National Electrical Code, ANS/NFPA No. 70 – latest edition, or The Canadian Electrical Code, C22.1 - Part 1.

1.7.1 Mains Hook-up

Line-voltage wiring is done within the field-wiring box. Referring to **Wiring Diagram** on page 32, connect the boiler to the mains power using a separate, fused circuit and a disconnect means within sight of the boiler. Use 14-gauge conductors in BX cable or conduit appropriately anchored to the boiler case for both mains supply and pump circuits. The transformer primary (black wire) is connected to the neutral and line (hot) wires. The red conductors for the pump contacts should be wired into the ungrounded leg of the pump circuit.

Note: The combined current of all pumps connected through the on-board pump relay (red conductors) should not exceed 10 amps.

1.7.2 Thermostat wiring

The Thermostat terminal block is located on the control module. The thermostat terminals should NOT be connected to any other power source and should only be connected to a room thermostat, isolated, zone valve end switches or circulator end switches. When using 3-wire zone valves (non-isolated) the zone valve end contacts must be isolated from the thermostat terminals using an appropriate relay.

1.7.3 Thermostat Heat Anticipator

When installed in a non-zoned system, the heat anticipator setting is dependant on the gas valve installed in the boiler:

Gas Valve	Anticipator Current Setting
White-Rodgers 36E27	0.5A

For zoned systems, each room thermostat's heat anticipator should be adjusted to the current draw of its associated zone valve.

2. Boiler Systems and Operation

2.1 ELECTRONIC CONTROL MODULE

The electronic control module governs ignition and flame safeguards, throttle management, and mixture and temperature control. Additionally, it provides a user interface, and performs data and error logging functions.

Data may be downloaded at any time from the controller by connecting the optional IBC communications cable between the optical link and a microcomputer. Data includes the following:

- Ignition counter
- Average water temperature
- Average output
- Gas usage meter
- Error log

Further information about the communications interface can be found in the user manual for that product.

2.1.1 Logged Data

All data is permanently logged in the controller, and cannot be altered except on replacement of the controller.

Ignition Counter
The control module tracks the number of successful ignitions in its lifetime.

Average Water Temperature
The control module tracks the water temperature averaged over the lifetime of the boiler.

Average Output
The control module tracks boiler output averaged over the lifetime of the boiler.

Gas Usage Meter
The control module tracks the amount of gas used in its lifetime.

Error Log

The error log contains the last 3 errors detected by the controller.

2.1.2 Glossary of Terms

This glossary briefly defines some terms used in the control module functions.

Call for Heat
The thermostat indicates that room temperature is below the thermostat setting. A **Call for Heat** AND a **Heat Required** signal are needed to start the boiler, and are defined as **Heating Enabled**.

Heat Required
Temperature sensors on the boiler indicate that water temperature is below the water temperature setpoint. A **Call for Heat** AND a **Heat Required** signal are needed to start the boiler, and are defined as **Heating Enabled**.

Heating Enabled
The boiler is powered and there is a **Call for Heat** and **Heat** is **Required**. (If the boiler is in an error mode, the boiler will not start.)

2.2 SEQUENCE OF OPERATION

The control module has 5 cycles during normal operation, as well as an error mode for problem detection:

1. Standby cycle
2. Purging
3. Ignition cycle
4. Heating cycle
5. Circulating cycle
6. Error mode

Each state is explained below. A flow chart for the sequence of operation can be found in the back of the manual.

2.2.1 Standby

Waiting for a boiler operating signal. The boiler is off during this time.

2.2.2 Purging

Prepurge

On a boiler operating signal, the boiler automatically enters a prepurge cycle.

The fan starts and automatically adjusts to a level suitable for ignition. Twenty seconds later, the pump starts. After a total of 30 seconds, the ignition cycle begins.

Interpurge

The boiler enters an interpurge cycle if ignition is unsuccessful. The fan and pump continue to run, and ignition is delayed by an additional 25 seconds.

Postpurge

The fan remains on for 10 seconds and then reduces airflow to an ultra low flow mode for 90 minutes unless pre-empted.

The pump remains on for 5 minutes after the **heating** cycle ends.

If the **heating** cycle ends as a result of water temperature exceeding setpoint by 8°F, the **postpurge** will continue as normal, but the boiler will enter the **circulating** mode.

If there is a boiler operating signal any time during this cycle, the postpurge ends, and a prepurge begins, otherwise the boiler will enter standby mode.

2.2.3 Ignition

After the prepurge, the gas valve opens for 5.5 seconds.

For the first 3 seconds a spark is delivered to the burner. For the remaining 2.5 seconds, the probe is in a flame sensing mode, and the gas valve is kept open.

If no flame is detected at the end of the trial, the **interpurge** cycle is repeated. If ignition fails 3 times successively, the boiler locks out and must be reset by shutting the main power switch off and back on. A qualified technician should be consulted to establish and remedy.

If ignition is successful, the output of the boiler decreases immediately to minimum, and the heating cycle begins.

2.2.4 Heating

The heating cycle lasts until the boiler operating signal ends, or until water temperature exceeds the setpoint temperature by 8°F at minimum output. At the end of the heating cycle, the boiler enters a **postpurge**.

During the heating cycle, boiler output changes to meet heating demands. Water temperature is regulated about the setpoint to ±3°F.

2.2.5 - Circulating

This cycle operates when water temperature exceeds setpoint by 8°F at minimum output, and call for heat is still present. After entering a **postpurge**, the pump remains on until water temperature is 8°F below setpoint temperature or the boiler operating light is off has ended.

2.2.6 - Error Mode

The controller continually checks sensors to see that they are operating within normal parameters. If sensors indicate the boiler is operating outside it limits, it will declare an error condition.

2 types of error conditions can occur:

Soft Errors result when an abnormal condition exists which does not present an immediate safety hazard. The boiler enters an extended interpurge and a 5 minute error cycle. Following the interpurge, the fan and pump are stopped until the end of the error cycle. Normal operation then resumes.

Hard Errors result when a condition exists that may be a safety hazard. The boiler enters an extended prepurge then the fan and pump are stopped. The boiler is in a lockout, and must be checked and restarted by a service technician.

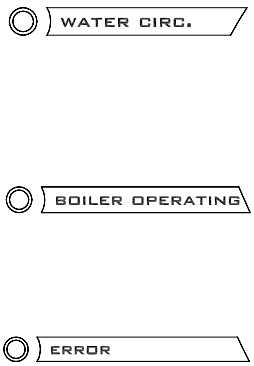
A **soft error** can be identified when the **error light** and the **boiler operating light** are on at the same time.

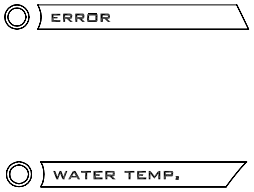
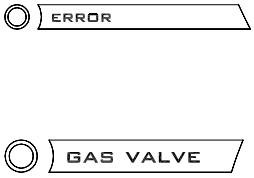
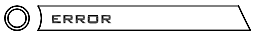
If the **boiler operating light** is not on while the **error light** is on, the boiler is in a **hard error**.

Table 7 lists the hard and soft errors and their causes. Note that other problems such as disconnected wires or defective sensors may be the cause of the error. Always check connections and wiring first.

Section 3.6.3 - Troubleshooting With the Control Module provides a detailed troubleshooting list for each error condition.

Table 7 - Soft and Hard Errors

Soft Errors	Description
Temp.Probe Error 	• measured temp exceeds max. input temp. or less than min. input temp. • temp. sensor defective or disconnected
Low Air 	• airflow is below blocked vent threshold. • Defective or disconnected mass flow sensor • Defective or disconnected fan
Low Flow 	• low water flow and vent limit not exceeded

Hard Errors	Description
Hi Limit 	• water temp. has exceeded limit of water temp. switch.
Max. Ignition Trials 	• boiler has failed 3 successive ignition trials
Vent Hi-Limit 	• vent temperature has exceeded limit of vent temp. switch.

2.3 USER INTERFACE

2.3.1 Keypad Functions

The keypad allows the user to change the setpoint or operating mode of the boiler.

The boiler defaults to its normal operating mode during power-up.

To change the setpoint temperature, press and hold the key in the desired direction until the setpoint is reached. The most recent setpoint is retained in the controller even if power is interrupted.

2.3.2 Indicator Lights

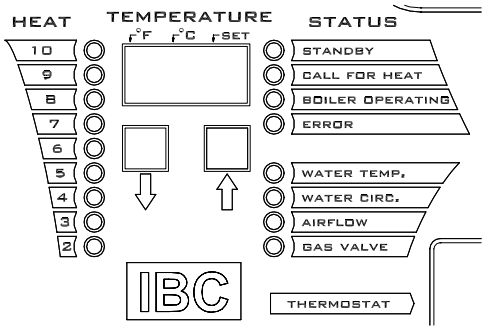


Figure 12. Display

The numeric display labeled TEMPERATURE indicates the current water temperature in °F or °C(toggle between units by pressing and holding both keys simultaneously). Pressing either button individually displays the setpoint temperature.

The left-hand column labeled HEAT provides an illuminated display of the output level of the boiler. The indicators light up sequentially from bottom to top as output increases.

The 8 indicators in the right-hand column labeled STATUS display various conditions of the boiler. These indicators are described in **Table 8 - Status Indicators**.

Table 8 - Status Indicators

STANDBY	**Flashing:** Boiler is waiting for a call for heat. **Off:** Boiler is firing or preparing to fire.*
CALL FOR HEAT	**On:** Thermostat indicates more heat is needed. **Off:** Call for heat has ended.
BOILER OPERATING	**On:** Boiler is in any mode except standby, or a **soft error** exists. **Off:** Boiler is in standby or lockout.
ERROR	**On:** The error indicator lights when a **hard or soft error** exists (See section **2.2.6 Errors**) In most cases, one of the 4 indicators below will also be flashing when an error exists.
WATER TEMP.	**On:** Boiler is on and temp. sensors are functioning normally.
WATER CIRC.	**On:** Pump is running. **Flashing:** pump is on but no water flow detected
AIRFLOW	**On:** Fan is on. **Flashing:** fan is moving less air than normal
GAS VALVE	**On:** Boiler heating. **Flashing:** gas valve is open but no flame detected

*Provided there is power to the unit.

3. STARTUP

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.

WHAT TO DO IF YOU SMELL GAS

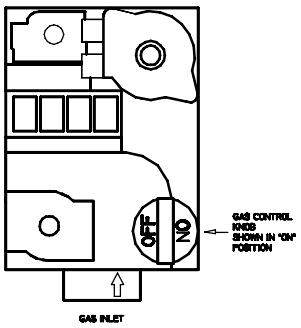
- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas suppliers instructions.
- If you cannot reach your gas supplier, call the fire department.

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.

OPERATING INSTRUCTIONS

1. **STOP!** Read the safety information above on this label.
2. Set the thermostat to lowest setting.
3. Turn off all electric power to the appliance by selecting main power switch to Off.
4. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.



5. Remove front cover from appliance.
6. Turn gas control knob clockwise ↱ to Off.
7. Wait five (5) minutes to clear out any gas. Then smell for gas, including near the floor. If you smell gas, **STOP!** Follow B in the safety information above on this label. If you don't smell gas, go to the next step.
8. Turn gas control knob counterclockwise ↰ to On.
9. Replace front cover on appliance.
10. Turn on electric power to appliance by selecting main power switch to On.
11. Set thermostat to desired setting.
12. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.

TO TURN OFF GAS TO APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn of all electric power to the appliance by selecting main power switch to Off.
3. Remove front cover from appliance.
4. Turn gas control knob clockwise ↱ to Off.
5. Replace front cover on appliance

Also ensure items under the following caption 3.1 Prior to Start-up have been addressed.

3.1 PRIOR TO START-UP

Ensure venting system is complete and seal tested. Confirm any common venting system at the installation site is isolated and independent of the VFC boiler and that any holes left from removal of a previous boiler have been sealed. Fill condensation trap to full 5" (min) neck height. Check water piping system is fully charged, and that all air has been discharged through loosened bleed caps. Use a minimum water pressure of 12 psig. Perform a final check of electrical wiring.

3.1.1 Test Ignition System Safety Shutoff Device

With the boiler in operation, test the ignition system safety shutoff device by shutting the manual gas valve immediately outside the boiler case. Ensure boiler has shut off and error and gas valve lights are flashing. To restart boiler, reset power.

3.2 ADJUSTMENT FOR ALTITUDE

VFC Modulating Boilers are factory assembled to operate with natural gas at sea level. As altitude increases, the orifice plate between the gas valve elbow and the mixing tube (see Figure 13. Gas Assembly) must be changed as described in Table 9 - Orifice Plate Sizing.

To ensure the correct orifice is in place, adjust the thermostat to maximum setting, and water temperature setpoint to its minimum setting. Allow the boiler to reach a steady state, then check the boiler input using the following formula:

Boiler Input Formula

$$\frac{3600}{\text{time}} \times \text{HV(BTU/ft.)} = \text{INPUT}$$

time = seconds for 1 cu. ft. of gas through meter

HV = heating value of gas as provided by gas supplier

INPUT= gas input(in BTU/hr)

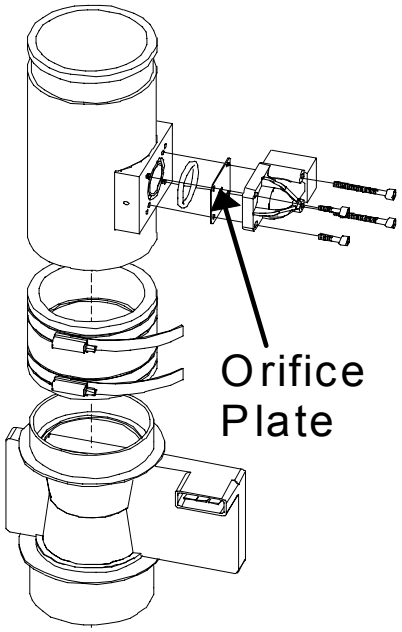


Figure 13. Gas Assembly

Table 9 - Orifice Plate Identification / Sizing (in 0.001" following "D")

Model / Altitude	0 - 1,500'	1,501 - 3,000'	3,001 - 4,500'
VFC 35-90	M-A005-090SL-D208	M-A005-090A1-D212	M-A005-090A2-D215
VFC 50-130	M-A006-130SL-D250	M-A006-130A1-D255	M-A006-130A2-D259
VFC 35-100LP	M-A009-100SL-D139	M-A009-100A1-D142	M-A009-100A2-D144
VFC 45-130LP	M-A008-130SL-D159	M-A008-130A1-D162	M-A008-130A2-D164

4. MAINTENANCE AND TROUBLESHOOTING

4.1 BOILER MAINTENANCE

The owner is responsible for general care of the boiler. Improper maintenance of the boiler may result in a hazardous condition.

4.1.1 General Care

Keep combustible materials and flammable liquids and vapours away from the boiler. Keep vent terminals clear of obstructions (snow, dirt, etc.).

For a list of suppliers for all components, contact IBC Technologies or visit our website at *www.ibcboiler.com.*

CAUTION: Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation.

4.1.2 Inspection

Inspection of the boiler to be performed annually by a qualified service technician.

Venting

Check vent terminals for and remove any obstructions.

Check for holes or leaks in venting. Replace venting as needed.

Examine for any signs of moisture caused by sweating intake air pipes; insulate as required.

Air Filter

Replace or clean air filter annually.

Condensate Traps

Check condensate traps every 6 months for water seal and blockages. If a blockage exists, trap must be cleared and refilled.

Burner

Visually inspect burner through sight glass. Ensure flame is stable and without excessive fluttering. Normal flame pattern is evenly distributed over the burner surface.

Annual inspection of the burner is not necessary. If operating improperly, remove burner and clean or replace.

Use a CO_2 analyzer to determine proper combustion. CO_2 level should be 9.2% (for natural gas) or 10.4% (propane) .

Pump

Check that the pump is on in normal operation.

Gas Piping

Check for damage or leaks and repair as needed.

Control Module

Check that boiler operation is consistent with the steps in **section 2.2 - Sequence of Operation**.

Check that water temperature setpoint is satisfactory.

If a problem exists with the control module, consult troubleshooting guide.

Water

Check water pressure and temperature. There should be no noticeable change if boiler is functioning normally. Check for any noise in the system.
Check water piping for damage or leaks and repair as needed.

Freeze Protection

WARNING: Do not use Ethylene Glycol, automotive-type antifreeze, or undiluted antifreeze. This may result in severe boiler damage.

Use only antifreeze made specifically for hydronic systems. Inhibited propylene glycol is recommended. Antifreeze volume must not exceed 50% of the total volume of water in the system.

Verify proper operation after servicing.

COMPONENT DESCRIPTION

A diagram of components and their placement can be found at the end of this manual.

For a list of supplier for all components, contact IBC Technologies or visit our website at *www.ibcboiler.com.*

The following list provides a summary description of major components:

4.2.1 Fan/Blower

Part#/Type: #VFCX-P005 / RG130-0800 24 VDC blower

Function: Moves combustion air and flue gas products through the boiler and venting.

Installation: The fan must be removed at the flange and step washers.

4.2.2 Gas Valve

Type: White-Rodgers 36E27-201B (nat. gas) or 36E27-202B (propane) Modulating Electronic Governor (MEG) Valve.

Function: regulates and supplies gas for gas/air mixing based on a signal from the control module.
Installation: see Section 3.1 Gas Valve Adjustment.

4.2.3 Mass Airflow Sensor

Part#/Type: #VFCM-P009

Function: Measures combustion airflow

Installation: The mass airflow sensor fits between the intake pipe and the mixing tube, connected with 2 flexible couples.

4.2.4 Oxygen Sensor

Part#/Type: #VFCM-P008 / Potentiometric Oxygen Sensor

Function: Senses combustion quality and signals controller for fine tuning of fan/gas valve.

Installation: Replace every 5 years. Remove with 3/8" wrench. Apply gas tape to threaded joint.

4.2.5 Flow Switch

Part#/Type: #VFCX-P002/ ½" NPT paddle-type brass spst reed switch

Function: for confirmation of adequate circulating water flow; shuts boiler off when flowrate drops below US 4.0 gpm.

Installation: Ensure that arrow points towards the pressure vessel; shift bar to "NO" position.

4.2.6 Hi-Limit

Part#/Type: #VFCX-HL200 / Therm-O-Disc 37T_21, calibrated for 200°F, 15°F differential.
Function: Shuts boiler off when water temperature exceeds safety limit.

Installation: Mount with Honeywell *Tradeline* #107408 Heat Conductive Compound between the base of the hi-limit switch and the mounting surface.

4.2.7 Transformer

Part#/Type: #VFCX-P006/ Hammond DG2G control transformer; Alternate: Rex Manufacturing CS100AW/X Primary- 120 VAC; Sec.- 24 VAC; 100VA

Function: Provides 24 VAC for (1) the control circuit and (2) AC to DC power converter, to drive the brushless DC fan.

Installation: See wiring & ladder diagrams.

4.2.8 Temperature Sensors

Part#/Type: #VFCM-P007 (2 used)

Function: Senses water temperature. Signals controller to adjust output according to water temperature.

Installation: use 3/8" wrench to remove and tighten.

4.2.9 Control Module

Part#/Type: #VFCM-M001

Function: See **Section 2** for an explanation of controller function.

Installation: The 4 screws on the front panel corners secure the cover. To remove the unit from the mounting brackets, ensure all wires are removed from the control module. Remove the controller from the brackets by removing the thumbscrews on the left and the screws on the right.

4.3 TROUBLESHOOTING GUIDE

The troubleshooting section is divided into 2 sections:

- Preliminary checks
- Detailed systems review

Often, a problem can be identified and solved through simple checks of the basics: confirming the electrical power supply, gas flow and resetting the thermostat control. To extend the cover of such preliminary checks, the boiler's control module offers a clear visual display of the status of the various control circuit components.

Should a problem remain unsolved after applying the preliminary checks, proceed to the detailed system review, using the Troubleshooting Guide. The Guide covers potential error conditions as grouped into the following categories:

- Ignition
- Cycling
- Temperature

Below each section is a list of Symptoms, Diagnoses, and Remedies.

Also provided with this manual are 4 diagrams for use with troubleshooting including

- electrical wiring diagram
- sequence of operations flowchart
- boiler component layout diagram
- troubleshooting flowchart

4.3.1 Preliminary Checks

The first step in troubleshooting this system should be to observe the control module display. The right hand column of indicators display error conditions and sources of error as described in **Section 2.2.6 - Error Mode**.

In addition to checking the display, the following list is a guideline for troubleshooting:

1. Confirm power to the boiler: check that control module display is on.
2. Check that boiler is not in a safety lockout. Check that control module display is illuminated.

3. Ensure wiring is clean and secure.
4. Check that manual gas valve and boiler gas valve are open.
5. Confirm water systems is properly charged to 12 psig and pump is serviceable.

4.3.2 Troubleshooting Electronic Components

This section details the method for troubleshooting the non-standard electronic components on the boiler including the mass airflow sensor and the temperature sensors.

4.3.2.1 Mass Airflow Sensor

If the mass airflow sensor is suspected of defect, remove the sensor and connector and send both to IBC for testing.

4.3.2.2 Temperature Sensor

The resistance of the temperature sensors varies inversely with temperature. Connect an Ohmmeter to the sensors as shown in **Figure 14**. Resistance should be between 3.5kΩ and 5.3 kΩ. Resistance should decrease with an increase in temperature.

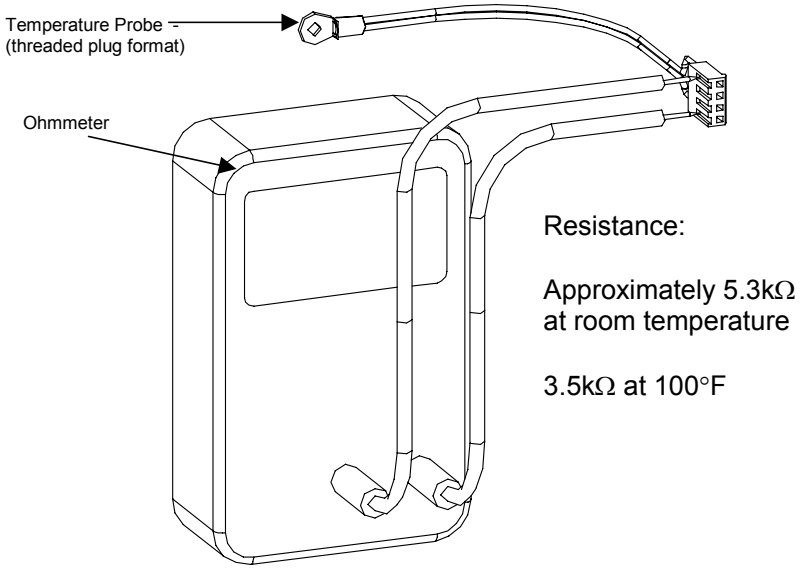


Figure 14. Ohmmeter Check of Temperature Sensors

4.3.2.3 Fan/Blower

Fan speed is adjusted using a signal from the control module. Four leads are attached between the fan and the controller. The red and blue leads supply power to the fan, and the fan will not operate if these connections are lost. The black lead carries the signal from the controller to the fan. If this connection is lost, the fan will operate at maximum speed. The white lead is unused. This connection will not alter the operation of the fan.

Table 10 - Fan Operation		
Lead Color	**Function**	**Troubleshooting**
Red	28Vdc. Positive power terminal	Fan will not function if disconnected.
Blue	28Vdc. Negative power terminal	Fan will not function if disconnected.
Black	Signal from controller	Fan will only operate at max. speed if disconnected.
White	Not used	No effect on fan operation.

4.3.2.4 Flow Switch

Check resistance between flow switch leads. If resistance is very low, there should be water flow. If resistance is very high, flow rate should be 4.0 USGPM.

4.3.2.5 Hi-Limit Switch

Check resistance between leads. If resistance is very low, temperature should be acceptable. If resistance is very high, temperature should be out of bounds.

4.3.3 Troubleshooting With the Control Module

Note: Never attempt to repair the control module. If the control module is defective, replace it immediately.

Airflow Error	
Water circ. lamp flashing Error and Boiler Operating lamps on	*Low Airflow*
Boiler unable to ignite. Partially blocked vent.	• Check venting for obstructions and remove.
Water noise in vent. Excess condensate in venting.	• Check condensate trap for obstructions. Remove obstructions and refill condensate trap with water. • Check vent length and size. Compare with **Table 3 - Maximum Venting Length**.

Mass Flow Error	
Airflow flashing Error and boiler Operating lamps on	*Signal from mass airflow sensor is not being detected or is giving an abnormal reading*
Defective or disconnected mass airflow sensor.	• Check wiring to mass airflow sensor and control module. • Check mass airflow sensor as explained in **Section 3.6.2 - Troubleshooting Electrical Components**.
Fan speed input to fan disconnected or fan is defective.	• Check all wiring between fan and control module. Replace leads if necessary. If leads are intact, replace fan or control module as necessary. • Check fan as explained in **Section 4.3.2.3 - Troubleshooting Electrical Components**.
Temperature Sensor Error	
Temperature lamp flashing Error and Boiler Operating lamps on	*Water temperature exceeds operating temperature.*
Current outlet temperature exceeds operating limit.	• Check water flow
Defective or disconnected temperature sensor.	• Check wiring to temperature sensor and control module. • Check temperature sensor as explained in **Section 4.3.2.2 - Troubleshooting Electrical Components**.
Waterflow Error	
Water circ flashing Error and boiler operating lamps on	*Low water flow, vent limit not exceeded.*
Defective or disconnected flow switch.	• Check wiring to flow switch and control module. • Check flow switch as explained in **Section 4.3.2.4 - Troubleshooting Electrical Components**.
Improper piping.	• Refer to **Section 1.4 - Water Piping** for recommended piping installation.
Undersized pump.	• Check manufacturer's rating charts. • Check temperature differential across heat exchanger.
Restriction in water pipe.	• Check temperature differential across zone/heat exchanger.

Hi Limit Error	
Temperature lamp flashing **Error lamp on**	*Water temperature exceeds hi-limit.* *Boiler in lockout.*
Defective or disconnected hi-limit switch.	• Check wiring to hi-limit switch and control module. • Check hi-limit switch as explained in **Section 4.3.2.5 - Troubleshooting Electrical Components**.
Low water flow not detected by the flow switch.	• Check flow switch and connections. Ensure flow switch connection on control module has not been bypassed. • Check for obstructions in water pipe.
Maximum Ignition Trials Error	
Gas valve lamp flashing **Error lamp on**	*Boiler has failed to ignite on 3 successive attempts.* *Boiler in lockout.*
No spark when igniting Igniter probe/flame sensor disconnected.	• Check that igniter lead is secure at the control module and at the probe.
Manual gas shutoff is closed.	• Open manual gas shutoff and reset boiler.
Gap between igniter probe and burner is too large.	• Adjust gap between igniter probe/flame sensor and burner to a distance of 3/16”
Boiler ignites, but shuts off at the end of the ignition trial Improperly grounded pressure vessel/burner.	• Ensure pressure vessel is grounded.
Loose or defective igniter cable	• Check ignition cable. Ensure lead ends are secured to the control module and the igniter probe. • Check the igniter probe/flame sensor is electrically isolated from the vessel, and its ceramic insulator is uncracked. Cracked ceramic will ground out the current. Ensure vessel is electrically grounded, to facilitate flame rectification.
Vent Hi-Limit Error	
Error lamp on	*Vent temperature has exceeded the vent limit switch.* *Boiler in lockout*
Low water flow and flow switch signal has not been detected.	• Check wiring to flow switch and control module. • Check that flow switch has not been bypassed or short circuited.

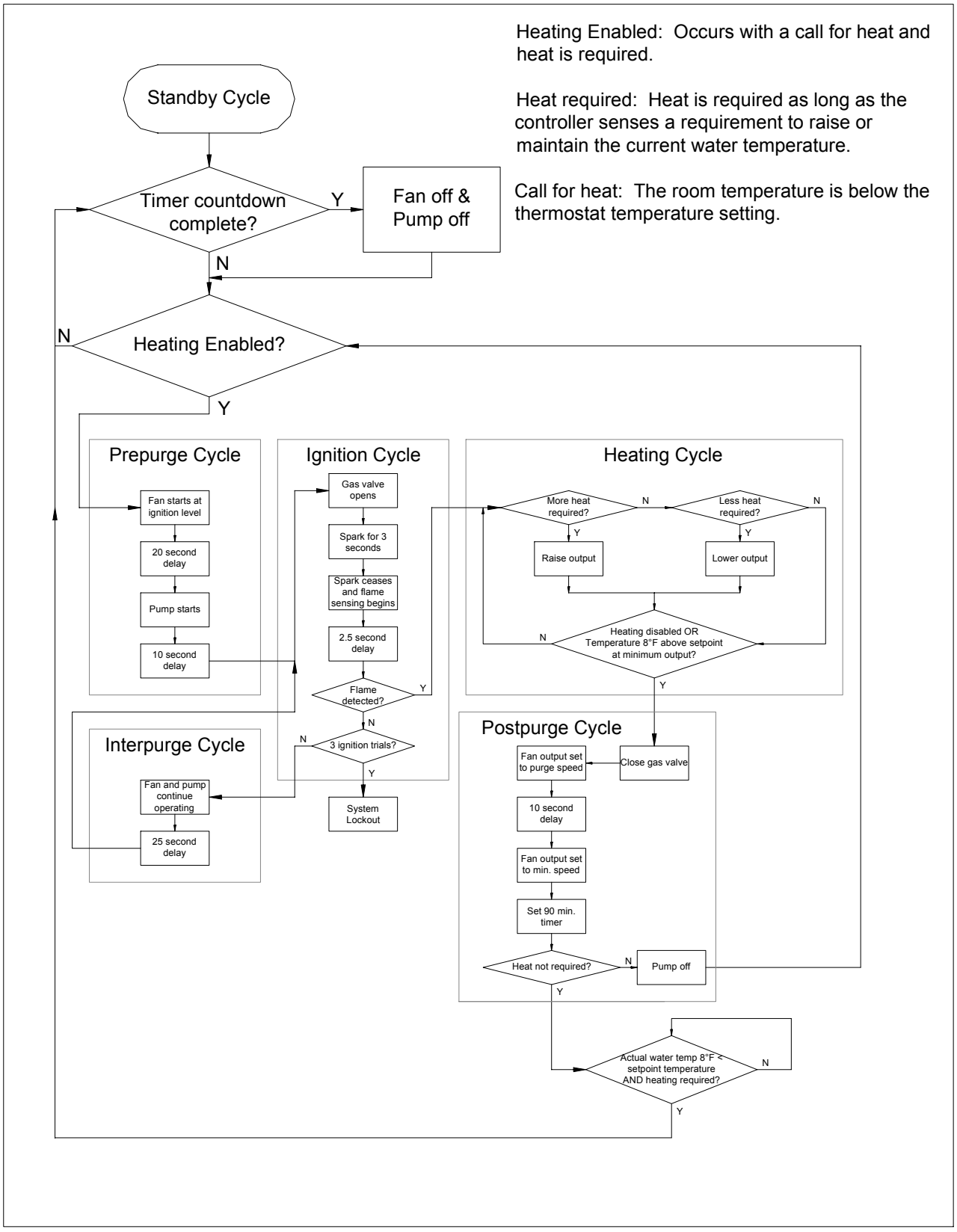
4.3.4 Detailed System Checks

Detailed Systems Troubleshooting		
Cycling Problems		
Symptom	**Diagnosis**	**Remedy**
Rapid Cycling		
i) Gas valve clicks on and off repeatedly when igniting.	Obstruction in Intake/ Exhaust venting.	Inspect vent terminals and tubing. Clear any obstructions.
ii) Water noise in exhaust venting	Excess Condensate in venting.	Check venting angles
	• *Obstruction in condensate trap.*	Inspect and clean condensate trap.
	• *Improper vent length.* • *Improper slope to vent.*	Check venting. Compare vent length and diameter to **Table 3-Maximum Venting**.
no other symptoms	Incorrect anticipator setting or defective thermostat.	Check operation. Refer to manufacturer's instructions. Check setting with ammeter.
	Air in system (check for flashing flowswitch lamp), of marginal water flow.	Bleed/purge system as required. Confirm adequate pump size and temp rise in HX
	Slow combustion air blower.	Check that CO_2 level is OK 9.2% nat. gas (10.4% for propane)
	Dirty burner/heat exchanger.	Check pressure drop.
	Insufficient water flow.	
	• *Improper piping.*	Refer to recommended piping in **Section 1.5**.
	• *Undersized pump.*	Check manufacturer's rating charts/check temperature differential across heat exchanger.
	• *Restriction in water pipe.*	Check temperature differential across zone/heat exchanger.
	Insufficient radiation.	Check actual amount of radiation per zone and refer to manufacturer's rating tables.
	Unit overfired.	Clock gas meter/check gas pressure with manometer/ check CO_2 level.
	Unit Oversized.	Refer to Load Calculation vs. Boiler Output
	Improperly set or defective operating/safety controls	Check operation with Ohmmeter/Voltmeter

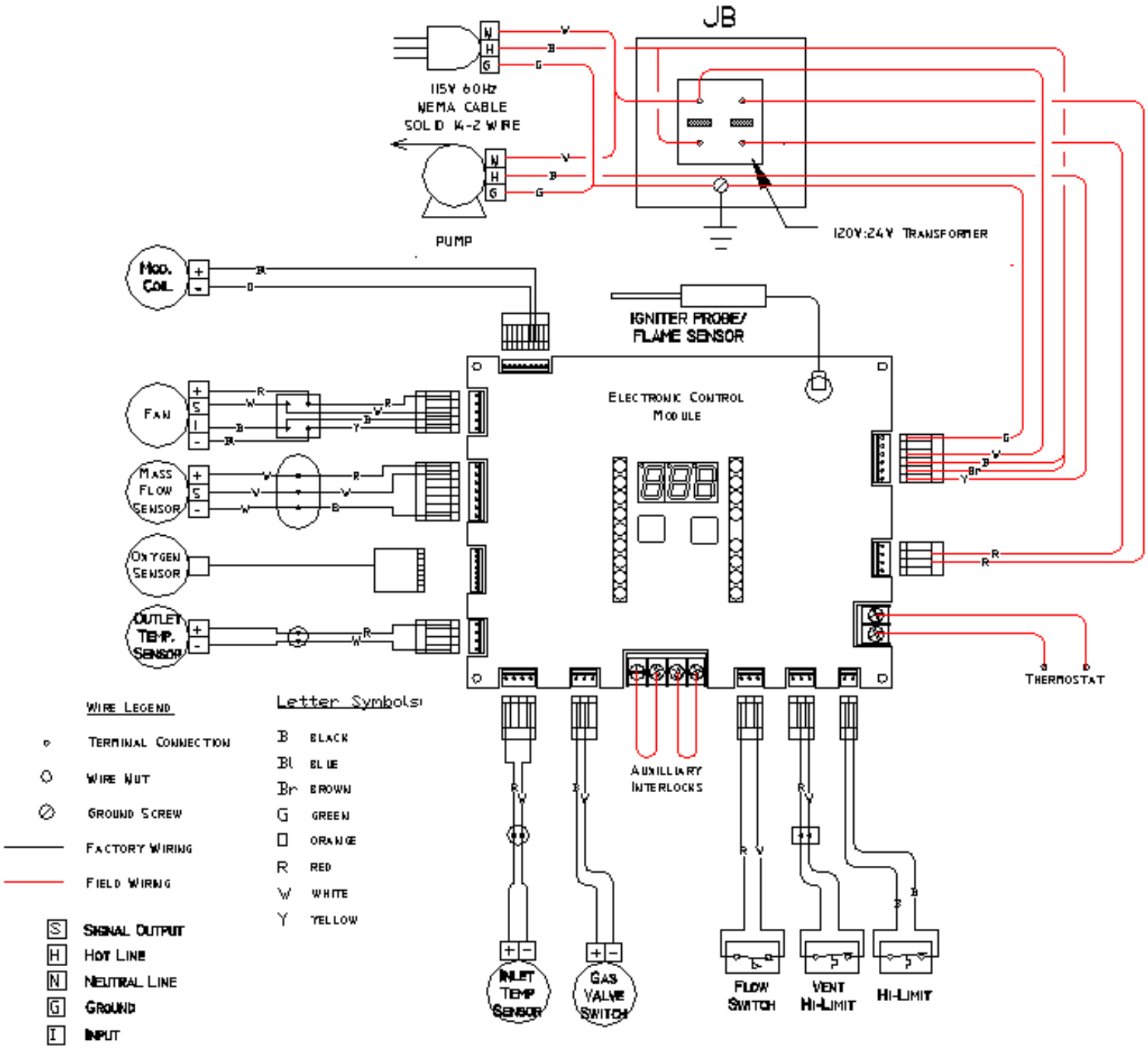
Ignition Problems		
Symptom	**Diagnosis**	**Remedy**
Noisy spark when igniting.	Ignition lead is not firmly connected.	Reconnect ignition lead
	Contaminants/moisture on igniter probe/flame sensor.	Ensure probe is dry by re-running post-purge; otherwise, clean or replace igniter probe.
Boiler rumbles when igniting.	Poor gas/air mixture.	Check CO_2 in exhaust. Check mass airflow sensor.
	Fluctuating gas pressure/ gas pressure too high/too low.	Check pressure with manometer during ignition. Check mass airflow sensor.
Boiler will not attempt to ignite.		
i) Fan and pump are operating normally.	No power to ignition control module.	Check system wiring. Check airswitch & air tubing.
	Igniter probe/flame sensor disconnected.	Reconnect probe.
	Blown fuse in ignition module.	Check fuse. If blown, replace.
	Defective Control Module.	Check ignition output from control module.
ii) Fan and pump are off		
No lights on display	No power to boiler	Check line voltage
	Defective transformer.	Check transformer. Reconnect or replace as needed.
iii) Fan off and pump on		
Boiler ignites but shuts off within seconds	Bad electrical grounding of vessel defeats flame rectification	Confirm continuity between pressure vessel and ground terminal on Control Module.
	Loose or bad igniter cable	Check and replace as required

Miscellaneous		
Symptom	**Diagnosis**	**Remedy**
Fumes and High Humidity	Improperly installed condensate trap	Refer to installation/operation instructions
	Leak in CPVC/ABS/PVC vent piping	Visually inspect using soap solution
	Flue gas leak in heat exchanger	Visually inspect all mechanical connections

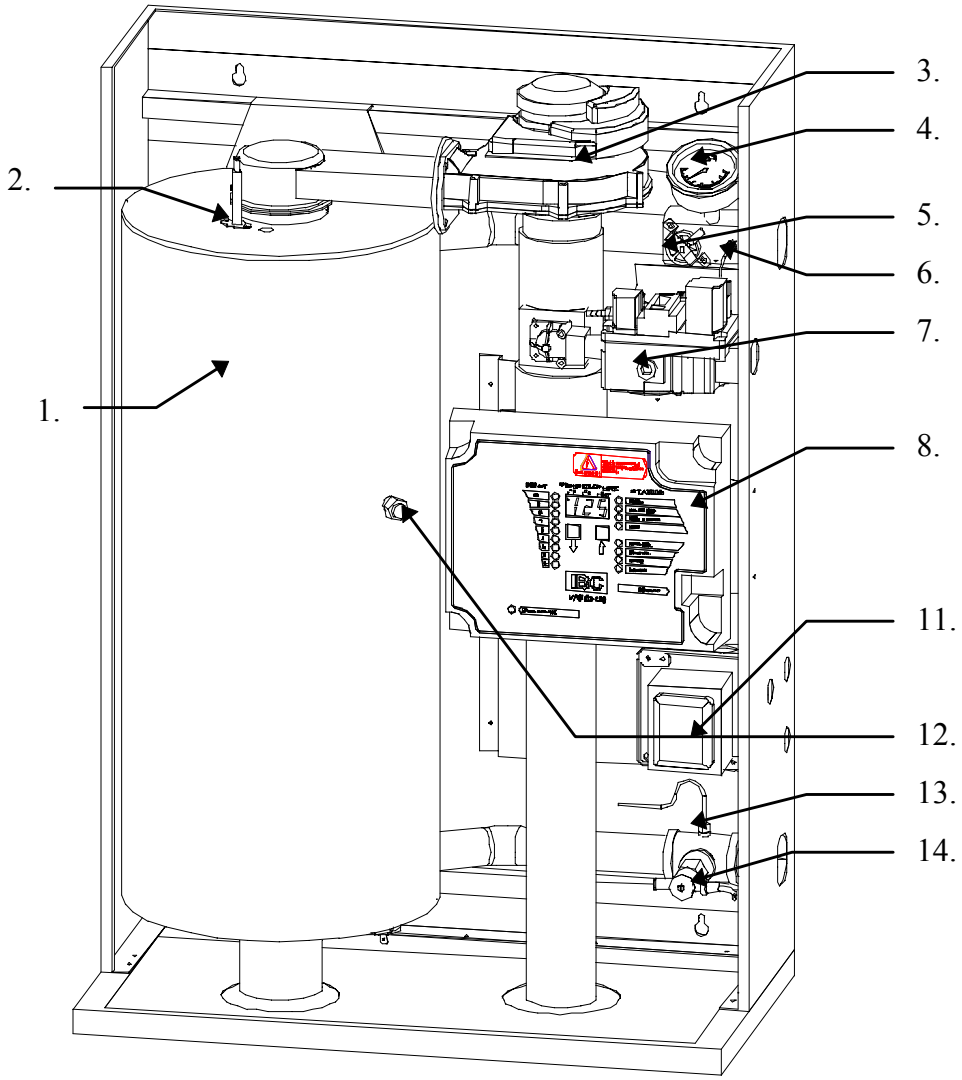
Temperature Problems		
Symptom	**Diagnosis**	**Remedy**
Insufficient heat.	Operating temp. too low	Boost setpoint per **Section 2.3.1** above
	Unit undersized	Refer to Load Calculation vs. Boiler Output
	Air trapped within system	Bleed system as required.
	Improper system piping	Refer to recommended piping in **Section 1.5**.
	System pump undersized	Check pump manufacturer's data/check temp differential across heat exchanger.
	Poor gas/air mixing	Check CO_2 level.
	Defective thermostat.	Refer to manufacturer's instructions.
	Incorrect gas/air orifices.	Refer to orifice sizing table
	Obstruction in condensate drain.	Inspect and clean condensate drain.
	Unit cycling on operating/ safety controls.	Check operation with Ohmmeter/Voltmeter.
	System radiation undersized	Check manufacturer's rating tables for capacity per foot.
Temperature exceeds thermostat setting	Incorrect anticipator setting	Check with Ammeter.
	Thermostat not level.	Check level.
One or more zones do not heat properly.	Air trapped within zone(s) piping	Vent system/zone as required.
	Insufficient radiation/ excessive heat loss.	Check actual length of pipe using radiation / heat loss calculation.
	Insufficient flow rate to zone(s).	Check temperature drop across zone.
	Defective zone valve/ zone circulator.	Check operation per manufacturer's instructions.
One or more zones do not heat properly.	Defective zone thermostat.	Check operation per manufacturer's instructions.
	Improper control wiring.	Check wiring per manufacturer's instructions.
	Improper/obstructed baseboard radiation.	Check baseboard manufacturer's instructions/ check at zone.
	Operating limit set improperly.	Check limit setting/operation.



Sequence of Operation Flowchart for VFC Modulating Series Boilers



Wiring Diagram for VFC Modulating Series Boilers



Component Layout Diagram

1. Pressure Vessel/Heat Exchanger
2. Igniter Probe/Flame Sensor
3. Fan/Blower
4. Tridicator
5. Hi-Limit Switch
6. Outlet Temperature Sensor
7. Modulating Gas Valve (MEG)
8. Modulating Boiler Control Module
9. (not shown, under controller) Mass Airflow Sensor
10. (not shown, under controller) Airflow Homogenizer
11. 120V:24V Transformer
12. Oxygen Sensor
13. Inlet Temperature Sensor
14. Water Flow Switch

Installation Checklist

Model#: _____ Dealer Name: _____	Serial#: _____	Water Tank #: _____ Installation Date: _____
Heat Loss: _____ BTUhr BTU/ft.: _____	ft. of Radiation: _____	# of Zones: _____ Total Radiation Output: _____ BTUhr

Electrical Information

Thermostat: _____ Anticipator Setting: _____ Amps
Supply Voltage: _____ Volts Combustion Air Blower Amp Draw: _____ Amps

Boiler Information

Type of Gas: _____ Operating Gas Inlet Pressure: _____ in. w.c.

CO_2 reading: _____ % Air Intake Orifice Size: _____
Air Pressure Differential Across Air Intake Orifice Plate: _____ in. w.c.

Vent/Intake Piping

	Pipe Size	Actual Length	# of 90 and 45 Elbows
Exhaust Vent Piping:	_____ in.	_____ ft.	_____
Air Intake Piping:	_____ in.	_____ ft.	_____

Water Pressure/Temperature

Temperature Rise Through Boiler
Space Heating: _____ °F
Domestic Hot Water: _____ °F

Operator Setting(A-E): _____
Flue Gas Temp.: _____ °F

Tridicator Gauge
Operating Pressure: _____ psig
Operating Temp.: _____ °F

Water Piping

Water Manifold Pipe Size
Supply: _____
Return: _____

Pipe Size to DHW Tank:
DHW Tank Aquastat Setting: _____ °F
Differential Setting: _____ °F

Valve Type to DHW Tank
Two-Way: _____
Three-Way: _____

System Pump Model #: _____ Additonal Pump Model #: _____

Expansion Tank Model #: _____ Expansion Tank Size: _____

Type of Air Elimination
Spirovent _____
Manual Air Bleed _____

System Bypass Type
Honeywell _____
Manual _____
None _____

Notes: