INSTALLATION AND OPERATING INSTRUCTIONS

IBC Technologies

VFC 15-150 - VFC 45-225

MODULATING GAS BOILERS

(Natural Gas or Propane)

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.

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.

This Manual is also available in French - contact IBC or visit our web site www.ibcboiler.com

Intertek

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SAFETY CONSIDERATIONS

⚠ 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.

Installation, start-up and servicing of IBC boilers must be done with due care and attention, and should only be performed by competent, qualified, licensed and trained heating technicians.

Failure to read and comply with all instructions and applicable National and local codes may result in hazardous conditions that could result in property damage and injury to occupants which in extreme cases might result in death.

SPECIFICATIONS

SPECIFICATION	VFC 15-150	VFC 45-225
CSA Input (Natural Gas or Propane) - MBH	15 - 150	45 - 225
CSA Input (Natural Gas or Propane) - kW	4.4 - 44	13 - 66
CSA Output - MBH	14 - 139	41 - 206
CSA Output - kW	4.1 - 41	12 - 60
A.F.U.E.	96.1%	96.1%
Minimum gas supply pressure (Natural Gas or Propane) - inch w.c.	3 3	3 3
Maximum gas supply pressure (Natural Gas or Propane) - inch w.c.	14 14	14 14
Power use (120Vac/60Hz) @ full fire - Watts (excluding pumps)	57	158
Weight (shipping) - lbs/Kg	165 / 75	168 / 76
Pressure vessel water content - USG/Litres	2.4 / 9	2.4 / 9
Maximum boiler flow rate - USgpm	16	25
Minimum boiler flow rate - USgpm	4	8
Maximum operating water pressure* - psig	80	80
Minimum water pressure - psig	8	8
Normal flue temperature @ 100°F boiler return water temperature - high fire	100 to 105 °F 37.8 to 40.5°C	100 to 105 °F 37.8 to 40.5°C
Normal flue temperature @ 160°F boiler return water temperature - high fire	160 to 165 °F 71.1 to 73.9°C	160 to 165 °F 71.1 to 73.9°C
Approved installation altitude - ASL	0 - 8,000'	0 - 8000'
Ambient temperature - Low (°F-°C) Ambient temperature - High (°F-°C)	32°F / 0°C 122°F / 50°C	32°F / 0°C 122°F / 50°C
Max. relative humidity (non-condensing)	90%	90%
Minimum water temp.	34°F / 1.1°C	34°F / 1.1°C
Maximum water temp. (electronic hi-limit)	190°F / 87.8°C	190°F / 87.8°C
Maximum water temp. (mechanical hi-limit)	200°F / 93.3°C	200°F / 93.3°C
Max. ΔT - supply/return (electronic fence)	35°F	35°F
Maximum equivalent vent length - 2" Each side (Vent & Air Intake)) - 2 1/2" (Natural Gas or Propane) - 3" Air intake options: either direct vent or indoor supply	50' 70' 120'	N/A N/A 240'

* boilers are shipped with 30 psig pressure relief valve - up to 75 psig relief valve can be ordered

HAZARDS & PRECAUTIONS

⚠ DANGER

Points out an <u>immediately</u> hazardous situation which must be avoided in order to prevent serious injury or death.

⚠ WARNING

Points out a <u>potentially</u> hazardous situation which must be avoided to prevent serious injury or death.

⚠ CAUTION

Points out a <u>potentially</u> hazardous situation which must be avoided to prevent possible moderate injury and/or property damage

⚠ NOTE

Points out installation, maintenance and operation details that will result in enhanced efficiency, longevity and proper operation of your boiler.

Supplied with the boiler - The IBC boiler is shipped with an accessory parts kit consisting of the following items:

- 1 x Vent connection kit
- 1 x Condensate trap kit
- 1 x 30 psig pressure relief valve (higher pressure 75 psig - by special order).
- 1 x Outdoor temperature sensor

CONTENTS

The Installer must carefully read this manual to ensure that all installation details can be adhered to. Special attention is to be paid to clearances and access, vent travel and termination, gas supply, condensate removal and combustion air supply.

The Installer should do a pre-installation check the to ensure that the following precautions can be observed:

- The boiler should be installed in areas where the combustion air source is not subject to chemical fouling or agricultural vapours. 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 chlorides such as those released with the use of laundry detergents are also to be avoided. For this reason, the indoor air venting option using air surrounding the boiler should not be used in a laundry room. Similarly, ensure any direct vent air source is not adjacent to a clothes dryer exhaust terminal. Avoid agricultural applications where the boiler and/or the intake air source are affected by ammonia and/or dust.
- The boiler should be located 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.
- At a new construction site, or during renovations, action must be taken to protect the boiler from drywall dust or other construction related contaminants; 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 when firing - allow for air circulation and ventilation in the immediate area.
- When the boiler is in operation, the impact of the steam plume normally experienced at the exhaust terminal of a condensing boiler should be assessed. Generally, intake and exhaust pipes should terminate at a rooftop or sterile wall location. Boiler condensate is corrosive. Protective measures must be taken to prevent corrosion damage to metal roofs or other metal building components in contact with the condensate. Keep exhaust plumes well away from all building air intakes including those of neighbouring properties.
- The exhaust outlet should be placed so as to reach 24” minimum above the down-turned intake - to avoid exhaust re-ingestion.
- For sidewall venting options: Both the inlet and exhaust terminations should normally be located on the same plane (side) of the building. The elevation of both pipes can be raised in “periscope style” after passing through the wall to gain required clearance above grade and snow level.
- If the indoor combustion air option is used, ensure combustion air openings to the boiler room remain unblocked and free of obstructions.
- Examine the condensate outlet to ensure proper disposal of condensate will occur during operation. If condensate will be discharged into copper or ferrous metal drains, ensure acid neutralization is employed.
- Ensure that the pressure relief valve will be installed with no valves or other means of isolation between its inlet and the boiler. Make sure the relief valve outlet will be piped with unobstructed piping (minimum 3/4” diameter) to a safe discharge location.

⚠ DANGER

Should overheating occur or the gas supply fails 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

⚠ WARNING

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.

⚠ CAUTION

Care must be taken to properly size the boiler for its intended use. Prolonged full fire run time, over-sizing or under-sizing, and incorrect flow rates through the boiler can lead to increased maintenance costs, equipment stress and premature failure.

1.0 INSTALLATION

1.1 GENERAL

VFC gas-fired modulating boilers are low pressure, fully condensing units having variable input ranges (a) 15 MBH (15,000 Btu/hr) to 150 MBH (15-150 model, 0 to 8,000') and (b) 45 MBH to 225 MBH (45-225 model, 0 to 8,000'). The boilers are approved as "Category IV" vented appliances using either Direct Vent (sealed combustion) or indoor combustion air, providing a great degree of installation flexibility.

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**.

	DESCRIPTION	SIZE
A	Water Outlet	1-1/4" NPT-M
B	Water Inlet	1-1/4" NPT-M
C	Gas Inlet	1/2" NPT-F
D	Knock-outs (6)	1/2"
E	LCD Display	3/4"
F	Exhaust Vent	4.0" Hole
G	Combustion Air	4.0" Hole

Table 1: Connections

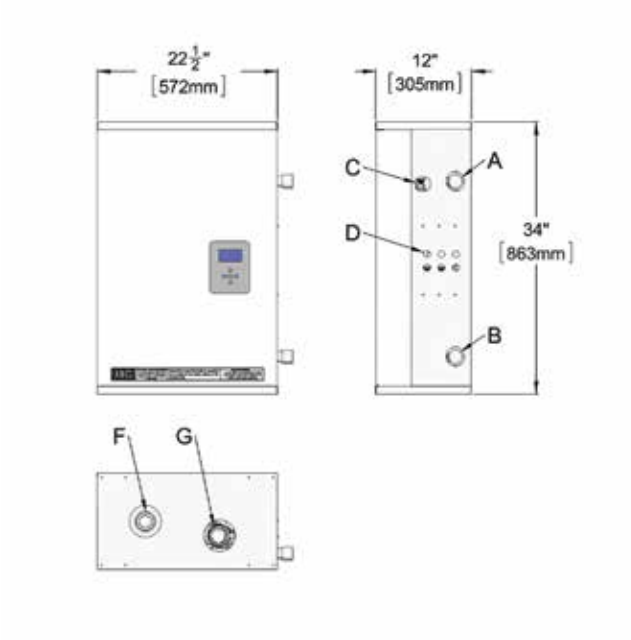


Figure 1a: Dimensions / Connections for VFC 15-150

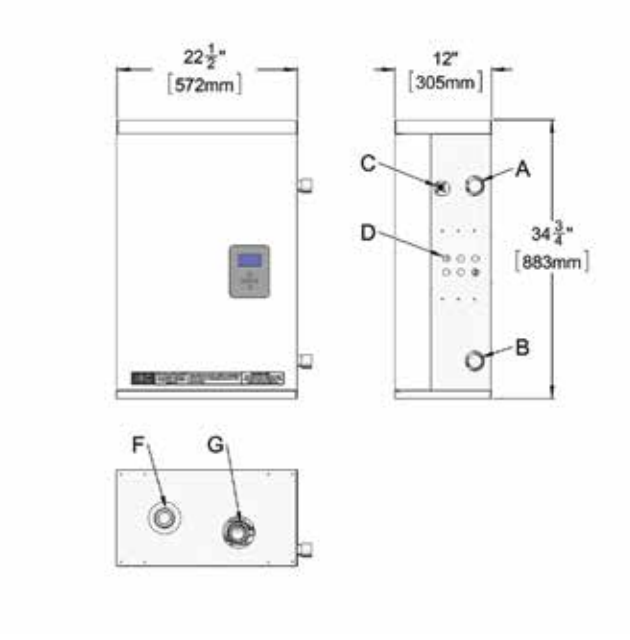


Figure 1b: Dimensions / Connections for VFC 45-225

1.2 CODE REQUIREMENTS

The VFC 15-150 model was tested to and certified under CSA 4.9-2000 / ANSI Z21.13-2000. The larger VFC 45-225 unit was approved under CSA 4.9a-2005 / ANZI Z21.13a-2005.

Installation must conform to local codes, or in the absence of these, with the latest editions of CAN/CGA B149 and the Canadian Electrical Code Part 1 CSA C22.2 No. 1.

In the US, installations must conform to the current 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, then the more stringent requirement will apply.

1.3 LOCATION

⚠ WARNING

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

⚠ WARNING

Combustion air must not be drawn from areas containing corrosive air from swimming pools or spas, including air directly next to outdoor pools and spas

⚠ WARNING

The boiler shall not be exposed to water leaks from piping or components located overhead. This includes condensation dropping from un-insulated cold water lines overhead.

VFC-series boilers are designed and approved for indoor installation (wall or rack mounting), with significant flexibility of location provided with the available venting options. The boiler can be placed in an alcove, basement, closet or utility room. Surrounding ambient conditions shall be 0°C to 50°C *and less than 90% relative humidity.*

Install the boiler in areas where the combustion air source is not subject to chemical fouling or agricultural vapours. 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 chlorides such as those released with the use of laundry detergents are also to be avoided. For this reason, the indoor air venting option using air surrounding the boiler should not be used in a laundry room. Similarly, ensure any direct vent air source is not adjacent to a clothes dryer exhaust terminal. **Avoid agricultural applications where the boiler and/or the intake air source are affected by ammonia and/or dust.**

Locate the boiler 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.

Boiler weight: 150 lbs / 68 kg without water. Use - *as a minimum* - 4 x #12 size 2" lag screws or 1/4" bolts (with metal mounting systems). Fasteners are to be attached to solid material capable of supporting the combined weight of the boiler and piping assembly components.

Other factors affecting potential mounting sites:

- Ensure minimum clearance requirements for combustible materials *(see Table 2)* are satisfied.
- Minimum 24" clearance at the front and 10” above is recommended for adequate servicing. Check local codes for additional access and service clearance requirements.
- **At a new construction site, or during renovations, action must be taken to protect the boiler from drywall dust or other construction related**

contaminants; 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 when firing - allow for air circulation and ventilation in the immediate area.

SURFACE	DISTANCE FROM COMBUSTIBLE SURFACES	RECOMMENDED DISTANCE FOR SERVICE
Front	2"	24"
Rear	0"	0"
Left Side	0"	8" (for vent run)
Right Side	2"	18"
Top	6"	10"

Table 2 - Clearance from boiler cabinet

Distance below the boiler of up to 15" (15-150 model) and up to 24" (45-225 model) is required to provide clearance for the inlet and exhaust venting together with the required condensation trap. See page 1-15.

1.4 EXHAUST VENTING AND AIR INTAKE

⚠ DANGER

Do not common vent the VFC modulating series boilers with any other existing or new appliance.

⚠ WARNING

Venting, condensate drainage, and combustion air systems for all IBC boilers must be installed in compliance with all applicable codes and the instructions of their respective Installation Manuals.

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 comply will result in severe personal injury or death.

It is important to carefully plan the installation to ensure the appropriate vent materials, travel and termination decisions are incorporated. Specific attention is warranted to manage the impact of the steam plume normally experienced at the exhaust terminal of a condensing boiler. Generally, intake and exhaust pipes should terminate at a rooftop or sterile wall location, to maximize customer satisfaction. Keep exhaust plumes well away from all building air intakes including those of neighbouring properties.

All venting must be installed in accordance with the requirements of the jurisdiction having authority: in Canada, Part 8, *Venting Systems* of the B149.1-10 Code and any other local building codes are to be followed. In the USA the National Fuel Gas Code, ANSI 223.1, latest edition, 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.

When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in the National Fuel Gas Code, ANSI Z223.1 - latest edition. In Canada, use the B149.1-10 Installation Code.

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.

- Seal any unused opening in the common venting system.
- 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.
- 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.
- Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.
- 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.
- 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 - B149.1-10 Installation Code and/or local codes.

1.4.1 Applications

All VFC-series boilers are approved with alternative venting options: either 2-pipe Direct Vent or single pipe /Indoor Air 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 *(see Section 1.4 for air intake piping requirements).* Using the indoor air alternative, air for combustion is drawn from the indoor air surrounding the boiler.

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.

1.4.2 Exhaust Vent Material

EXHAUST VENT MATERIAL – CANADA

Use Polypropylene (PPs) or CPVC vent systems approved under ULC-S636 Standard for Type BH Gas Venting Systems, or stainless steel Type BH venting systems. Permitted PPs materials comprise Single Wall Rigid pipe and fittings and Flexible.

- ULC-S636 CPVC: 90°C (194°F)
- ULC-S636 PPs: 110°C (230°F)

In the standard configuration, VFC series boilers can supply water temperatures up to 190°F, leaving stack temperatures above the 65°C (149°F) limit for ULC-S636 approved PVC.

⚠ WARNING

Do not mix PPs venting materials from different Manufacturers.

These venting materials are designed to be installed as part of a complete system.

Failure to comply may result in severe personal injury or death.

For long vent runs with higher initial exhaust temperature, some jurisdictions may allow the use of mixed materials for economy: ULC-S636 approved CPVC for the initial run followed by ULC-S636 approved PVC to the termination *(It is the responsibility of the Installer to confirm that local codes will allow this option).* Ensure appropriate transition glue is used. The installer is responsible to ensure that sufficient temperature loss is allowed for in the CPVC section to fall below the limit for PVC, taking into account the highest possible ambient temperature in the area of vent travel (e.g. boiler room, attic and/or chase).

EXHAUST VENT MATERIAL – USA

IBC strongly recommends only PPs or CPVC vent component systems approved under *ULC-S636 Standard for Type BH Gas Venting Systems*, or stainless steel Type BH venting systems* are to be used - BUT - many local jurisdictions in the USA still allow the use of PVC (ULC-S636 or Sch. 40 ASTM D1785 or D2665 and fittings) or CPVC (ULC-S636 or Sch. 40/ASTM F441 with Sch. 80 fittings); or CSA approved 3" stainless vent systems. If PVC is to be used, you shall use a minimum of 10 lineal feet of CPVC, and then transition to PVC using approved transition glue. The installer shall ensure that vent temperatures in the PVC section cannot exceed 140°F.

Do not use ABS or any cellular core pipe for exhaust venting.

The boiler offers 2" venting connections. Fittings are to be used to adapt to the appropriate diameter – see Vent Travel below. Exhaust venting is to be connected directly to the 2" NPT male threaded stainless steel fitting on the bottom of the pressure vessel using:

- For CPVC (and in the USA only, PVC) systems a 2" CPVC (USA: 2” PVC allowed) threaded adaptor or 90° elbow adaptor. A condensate trap formed using the supplied fittings shall be considered part of the exhaust and installed near the base of the boiler (see Figure 2).
- for PPs, use IBC’s VFC PPs transition kit as appropriate for the chosen PPs system:

CENTROTHERM INNOFLUE™	M&G DURAVENT POLYPRO™
KIT# P-166A	KIT# P-167A
2” Stainless Coupler (190-044)	2” Stainless Coupler (190-044)
PPs Transition (180-037)	PPs Transition (180-040)
Retainer Clip (180-050)	Retainer Clip (180-051)

Combustion air piping is connected at the base of the boiler using a standard 2" PVC (ABS) coupler or elbow (see Section 1.4.7). For PPs intake piping, use standard PPs : 2”Sch 40 adaptor parts from the respective PPs manufacturers.

Venting shall be supported in accordance with applicable code.

***Manufacturers of stainless steel Type BH venting systems must submit their approved transition fitting to IBC for evaluation and written approval.**

⚠ DANGER

Failure to install PPs adaptor with retainer clip could cause release of harmful exhaust gases into the heated space, potentially leading to injury or death.

Figure 1c: PP Vent Adaptor Assembly

1.4.3 Vent Travel

3" PPs (rigid single wall) or CPVC ULC-S636 approved piping is the standard venting option; with this, the VFC 15-150 boiler can be sited up to 120 equivalent feet from the vent termination (for the VFC 45-225, up to 240' equivalent). The actual vent travel allowance is reduced for fittings in accordance with *Table 3*. – e.g. for a VFC 15-150 using 4 x 90º CPVC elbows, the maximum lineal measure of pipe allowed is 88 feet (120'–(4 x 8'= 32) = 88'). For the 15-150 model, vent installations requiring only short travel can be satisfied using 2' or 2-1/2" pipe.

Flexible PPs can be used, but the allowances change as follows:

- Up to 60 lineal feet of 3” venting is allowed in nominally vertical orientation (>45°).
- Further travel is permitted using rigid single wall PPs (VFC 15-150 up to 30’ equivalent; VFC 45-225 up to 60’ equivalent).

EXHAUST PIPE SIZE	MAXIMUM EQUIVALENT LENGTH
Sched.40; Rigid PPs	
2" (15-150 only)	50' (each side)
2-1/2" (15-150 only)	70'
3" (15-150)	120'
3" (45-225)	240'
90° vent elbow	allow 8' equivalent
45° elbow	allow 3’ equivalent
PPs 87-90° elbow	use 8’ equivalent
Flexible PPs	
2” Flexible	60’ (see Note 1)
3” Flexible	60’ (see Note 1)

Table 3: Maximum exhaust venting length

NOTE 1: Plus up to 30’ (15-150) or 60’ (45-225) equivalent in rigid PPs can be used.

NOTE 2: Unused intake travel cannot be added to the exhaust. Unequal intake and exhaust piping is allowed - see Section 1.4.8.

VFC 15-150: when using the 3” venting option a 3" x 2" reducer must be placed *in a vertical section of the flue gas vent (within 3' of the boiler), to avoid pooling of condensate.* Similar comments apply to the 15-150’s 2-1/2" venting option – see below. The VFC 45-225 transitions to 3” using the 3” x 2” reducing tee supplied in its vent kit.

Certain installations of the 15-150 model can employ the 2" vent options. This would typically involve a 15 lineal foot run up to the ceiling joists and outside, using perhaps 3 x 90° elbows on each of the exhaust and intake. *We do not recommend horizontal runs using 2" pipe except near the base of the boiler, upstream of the condensate drain.* See **Section 1.5 Condensate Removal**. Reason: air friction from the fast moving exhaust at high-fire in a 2" pipe overcomes gravity on 1/4" / foot vent slope – leaving a pool of condensate at the next upturned elbow. Pooling can impair the achievement of full high-fire rating plate performance.

Again for the 15-150 model only, there is a further 2-1/2" vent option that offers some middle ground – it can be applied to runs of up to 70' equivalent length for each side, without the limitation on horizontal runs as the for 2" option.

If the site requires a horizontal exit immediately below the boiler – bush out to 2-1/2" or 3" pipe in the downward vertical run immediately below the 2" threaded adaptor, and elbow to horizontal before splicing in a field sourced 2-1/2" or 3" reducing tee for mounting of the condensate trap; this will slow the exhaust velocity sufficiently for good drainage and reduce “spitting” at the vent termination. In this case, the 3" x 3/4" (or 2-1/2" x 3/4") reducing tee would replace the 2" tee and 2" x 3/4" bushing supplied with the VFC 15-150 boiler.

Exhaust venting must slope down to the trap/drain with a pitch of at least 1/4" per foot (PPs vent: follow PPs manufacturer requirements for slope) so condensate runs towards the trap. Support should be provided for intake and vent piping, particularly so for horizontal runs (follow local code). Insulate exhaust piping where it passes through unheated spaces or underground, with appropriate pipe insulation to prevent freezing of condensates.

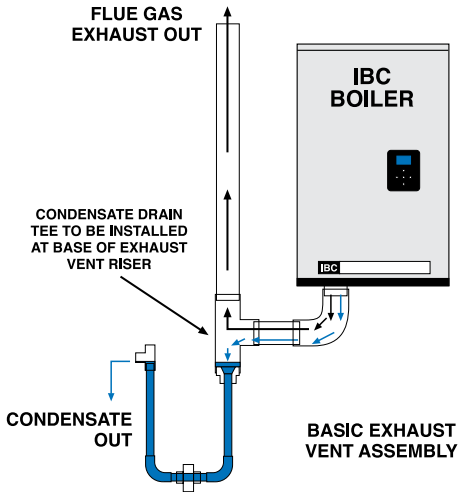


Figure 2: Basic exhaust vent assembly

⚠ WARNING

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.

Fan control harness plug

Unplugging fan control harness plug will drive the fan into manual high speed operation for vent leak test

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

All joints must be secured. For CPVC in Canada, use ULC-S636 approved CPVC solvent cement, in accordance with its manufacturer instructions. Follow the cement manufacturer’s instructions closely when joining various components.For PPs, connections shall be secured using approved retainer clips supplied by the respective PPs manufacturer.

All vent connections must be liquid and pressure tight. Prior to firing the boiler, and before any of the venting run is concealed by the building construction, the installer must test the exhaust joints under fan pressure with the vent blocked, using a soap/water solution. Installer must fill condensate trap prior to test.

Remove the fan control harness plug as illustrated in the photos, and then block the vent outlet so that the vent run will be under maximum fan pressure. Paint all joints with an approved leak test solution just as you would joints in a gas line, and make sure there are no leaks. Good practice would suggest that the installer attach a tag on the vent line near the condensate drain tee indicating the type of test, the date and the installer’s name.

1.4.4 Venting Passage Through Ceiling and Floor

- Confirm material meets local codes including fire stopping requirements.
- Pipe clearances - no IBC requirements; follow local codes.
- All piping must be liquid and pressure tight.

1.4.5 Rooftop Vent Termination

Rooftop vents must terminate as follows:

- The exhaust pipe can terminate in an open vertical orientation without concern about rain infiltration; this will drain away through a properly configured condensate trap.
- If used, the intake air pipe is not typically drained, so it must be terminated with a down-turned elbow (see **Figure 3**). The intake pipe does not need to penetrate the roof at the same elevation as the exhaust (as shown); lower down roof is OK.
- To promote the projection of exhaust away from the building and from the intake pipe, reduction of 3" pipe to 2" is permitted for a maximum lineal travel of 3' (e.g. the final 3') including 2 x 90° elbows on each side.
- Optional bird screen may be placed in a termination fitting. Leave unglued, and hold in place with a short nipple. This permits easy access for cleaning.
- For roof top venting of multiple boiler sets, group all intake terminals together for a common penetration through a custom cap. Alternatively, place in the closest proximity achievable using commonly available pipe flashing. Similarly group the exhaust pipes and place the 2 separate groups of pipes at least 3' apart (the closest intake and exhaust pipes shall be 36" - or more - apart). Use the same 24" (minimum) vertical separation for all termination options. For alternate group terminations, contact the IBC Factory for written guidance.
- **DO NOT exhaust vent into a common venting system.**

⚠ WARNING

Condensate can cause corrosion of metal roofing components and other roofing materials. Check with the builder or roofing contractor to ensure that materials will be resistant to acidic condensate. pH levels can be as low as 3.0

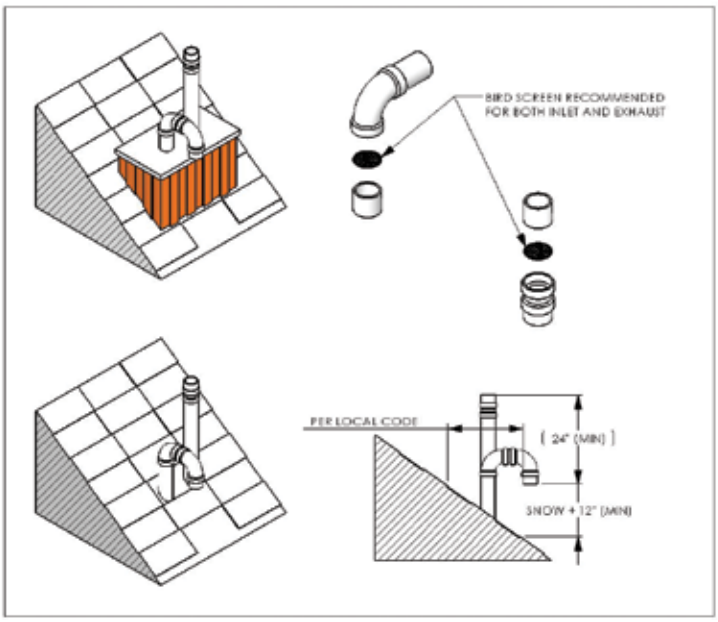


Figure 3: Rooftop vent terminal configurations

1.4.6 Sidewall Vent Termination

Sidewall direct vent applications shall be vented as follows:

- Both the inlet and exhaust terminations should normally be located on the same plane (side) of the building.
- The exhaust outlet is to be placed so as to reach 24" minimum above the down-turned intake - to avoid exhaust re-ingestion.
- The elevation of both pipes can be raised in “periscope style” after passing through the wall, then configured as in *Figure 4*, to gain required clearance.

- Use a 45° elbow on the exhaust termination to launch the plume up and off the sidewall, for protection of wall.
- Bird screen of 1/4" stainless steel or plastic mesh is useful to guard against foreign objects.

⚠ WARNING

It is extremely important to maintain at least the minimum separation of exhaust vent termination from boiler intake air as illustrated in Figures 3, 4 and 5. Failure to do so can result in a dangerous situation where exhaust gasses are re-ingested with combustion air. Damage to the boiler can result from a failure to maintain these separations. Third party vent termination kits and concentric wall penetration kits that do not maintain these minimum separations shall NOT be used. Improper installation will void the warranty. Do not use proprietary *InnoFlue* or *PolyPro* PPs sidewall terminals without specific written approval from IBC.

To promote the projection of exhaust away from the building and from the intake pipe, reduction of 3" pipe to 2" is permitted for a maximum lineal travel of 3' including 2 x 90° elbows on each side. This allows for smaller wall penetrations, with sufficient travel allowance to achieve the minimum exterior configuration as shown above.

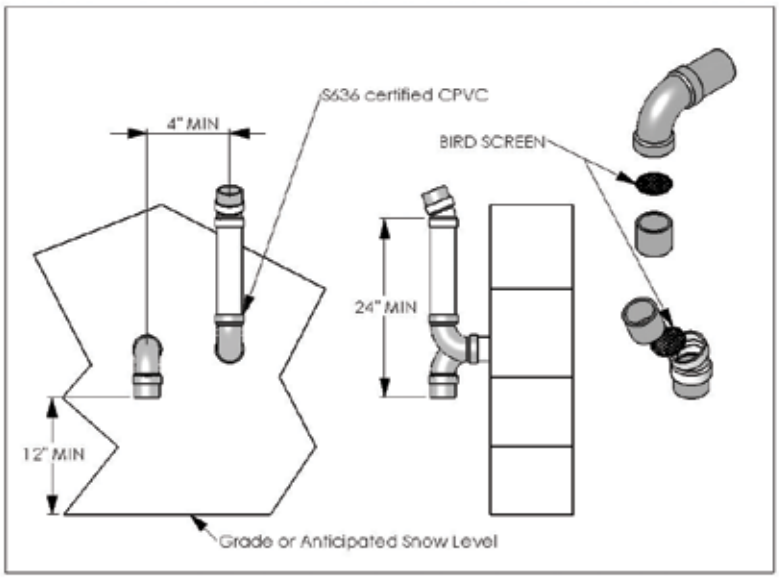


Figure 4: Sidewall vent termination - piping configuration

For side venting of multiple boiler sets, group all intake terminals together with 4" to 8" lateral spacing, and similarly group the exhaust pipes. Place the 2 groups on the same plane of the building (e.g. north facing wall). Place the 2 groups of pipes at least 3' apart (the closest intake and exhaust pipes shall be 36" - or more – apart. Use same 24" (minimum) vertical separation as displayed above. Alternately, as long as the boilers are identical models - intake and exhaust terminals can maintain a minimum of 12" of separation horizontally from any exhaust or inlet termination of an adjacent boiler. For alternate group terminations, contact the IBC Factory for written guidance.

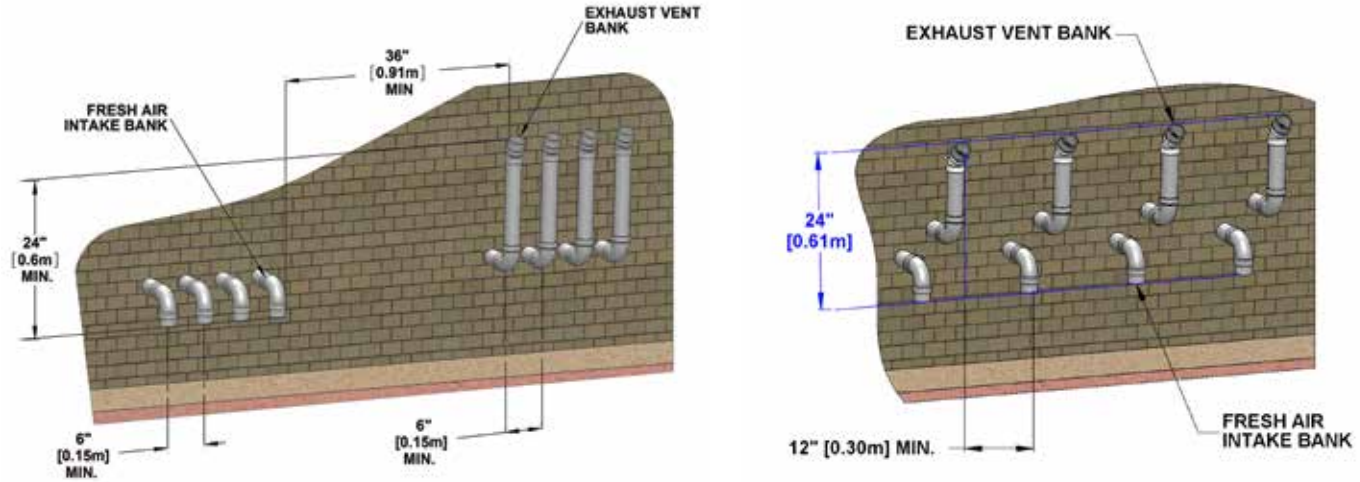


Figure 5: Sidewall vent termination - multiple vent piping configuration

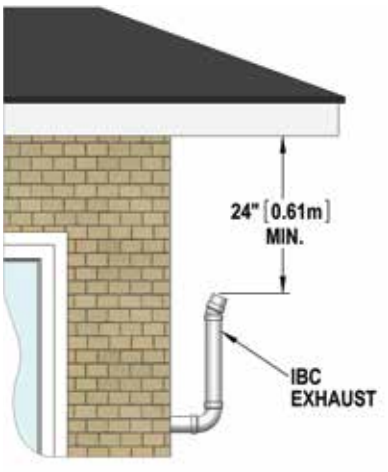


Figure 6: Vent terminal clearances

Figure 7: Prohibited installation

⚠ WARNING

In areas of high snowfall, Users must be advised to check side wall vent and air intake terminations on a regular basis to ensure blockage does not occur.

Vent terminal clearance minimums are as follows:

- Clearance above grade, veranda, porch, deck or balcony – 12" (0.3m), but check local code also (anticipated snow levels may supersede).
- Clearance to openable window or door – 36" (0.91m) (USA – 12")
- Vertical clearance to ventilated sofit located above the terminal within a horizontal distance of 2' (0.61m) from the centreline of the terminal.
- Clearance to each side of centreline extended above meter/regulator assembly: - 3' (0.91m) within a height of 15' (4.6m) above the meter/regulator.
- Clearance to service regulator vent outlet: - 3' (0.91m)
- Clearance to non-mechanical air supply inlet to building or the combustion air intake to any other appliance: - 3' (0.91m) (USA – 12" (0.3m))
- Clearance to a mechanical air supply inlet: - 6' (1.82m) (USA - 3' (0.91m) above if within 10' (3.1m) horizontally)
- Clearance above paved sidewalk or paved driveway located on public property: - 7' (2.2m) *Note: Cannot terminate directly above a paved sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings*
- Clearance under veranda, porch, deck or balcony: - 12" (0.3m). *Note: Prohibited unless fully open on a minimum of two sides below the floor.*
- Vents must be installed such that flue gas does not discharge towards neighbor's windows, or where personal injury or property damage can occur.
- It is important to ensure proper condensate management from vent terminations. Condensate shall not be discharged in a manner that will cause damage to external building finishes or components, or infiltrate the building envelope.

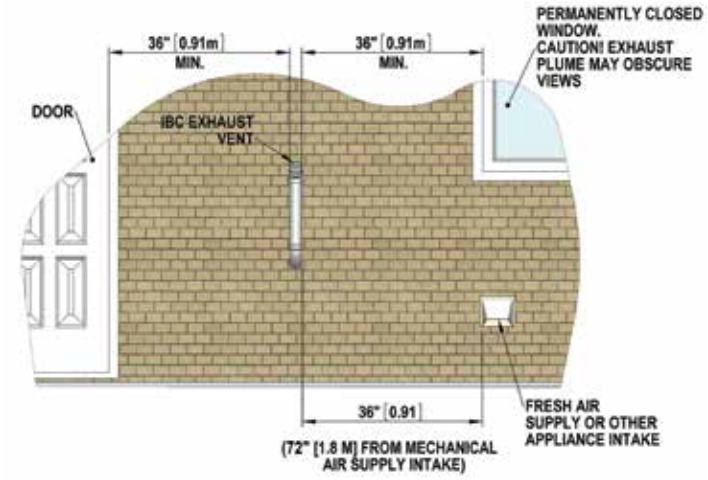


Figure 8: Vent terminal clearances

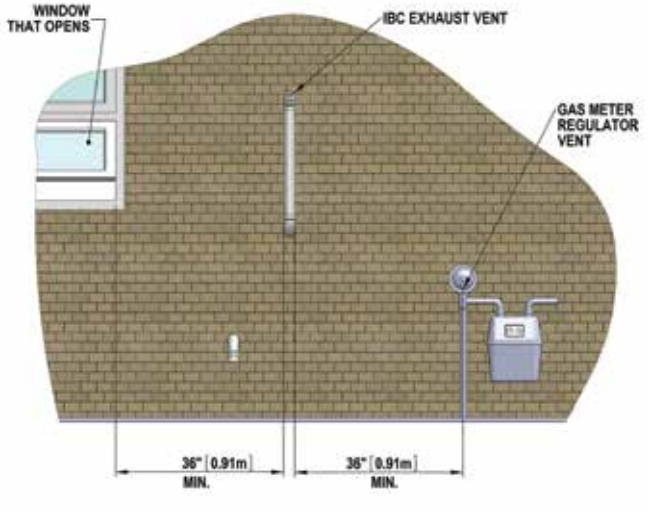


Figure 9: Vent terminal clearances

1.4.7 “Direct Vent” Combustion Air Intake Piping

There are two basic methods of supplying combustion air to an IBC boiler.

The direct vent option uses piping from the outside to supply combustion air directly to the boiler’s combustion air connection.

⚠ WARNING

In addition to preventing ingestion of chemical contaminants, care must be taken to ensure air intake terminals are not installed in locations where contamination might occur due to ingestion of particulate foreign material (dust, dirt and debris).

⚠ WARNING

Intake air openings must be configured such that rain or other forms of moisture cannot enter the air intake piping system. Otherwise serious damage to the boiler may result.

⚠ NOTE

Care must be taken when installing air intake piping to ensure that a “trap” is not formed in the piping so as to allow a build-up of water, and blockage of intake air.

Such blockage will result in a boiler safety shut-down.

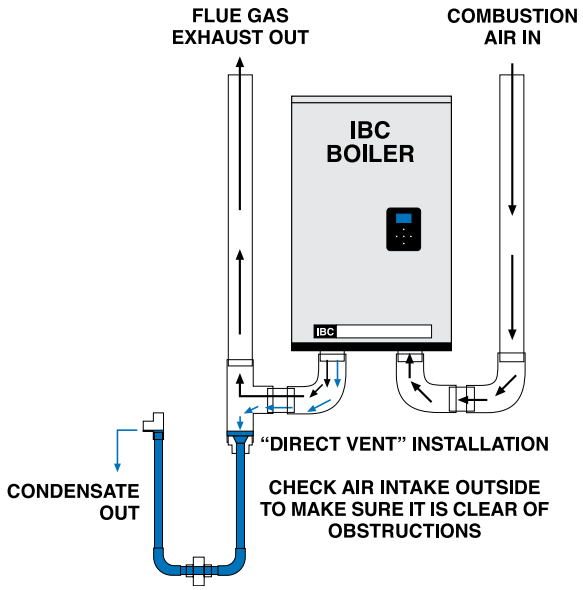


Figure 10: Direct vent - intake, exhaust and condensate removal system

INTAKE PIPE SIZE	MAXIMUM EQUIVALENT LENGTH
Sched.40; Rigid PPs	
2" (15-150 only)	50' (each side)
2-1/2" (15-150 only)	70'
3" (15-150)	120'
3" (45-225)	240'
90° vent elbow	allow 8' equivalent
45° elbow	allow 3’ equivalent
PPs 87-90° elbow	use 8’ equivalent
Air Intake Filter (Part #103)	allow 8' equivalent
Flexible PPs	
2” Flexible	N/A
3” Flexible	60’ maximum (see Note 1)

Table 4: Maximum intake piping length

NOTE 1: Further vent allowance is available for 3” Rigid Single Wall PPs as follows: VFC 15-150: up to 30’ equivalent; VFC 45-225: up to 60’ equivalent.

For the **inlet** air – Schedule 40 PVC, ABS, or PPs piping of any type is permitted. Use same diameter as Vent pipe, allowing for up to 6 ft actual run of 2” before any required transition.

NOTE: It is not permitted to add to the exhaust length by transfer of unused intake allowance.

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

For 3" piping, a 3"x 2" 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 of 2" pipe can be treated as 3" pipe without reference to its smaller diameter in calculation of the maximum allowable vent travel distance. All elbows and tees at the base of the boiler and at the termination must be included in the calculation.

Care must be taken to ensure adequate separation is maintained between the air intake inlet and the vent terminal. Refer to the vent terminal configuration drawings in the Vent Termination section above.

Support should be provided for intake piping, particularly so for horizontal runs (follow local code).

⚠ WARNING

When using Indoor Air options, adequate combustion air must be supplied to the boiler room according to the requirements of all applicable codes.

1.4.8 "Indoor Air" Combustion Air Intake Piping

An "Indoor Combustion Air installation", as described herein, is one in which air for combustion is taken from the ambient air around the boiler.

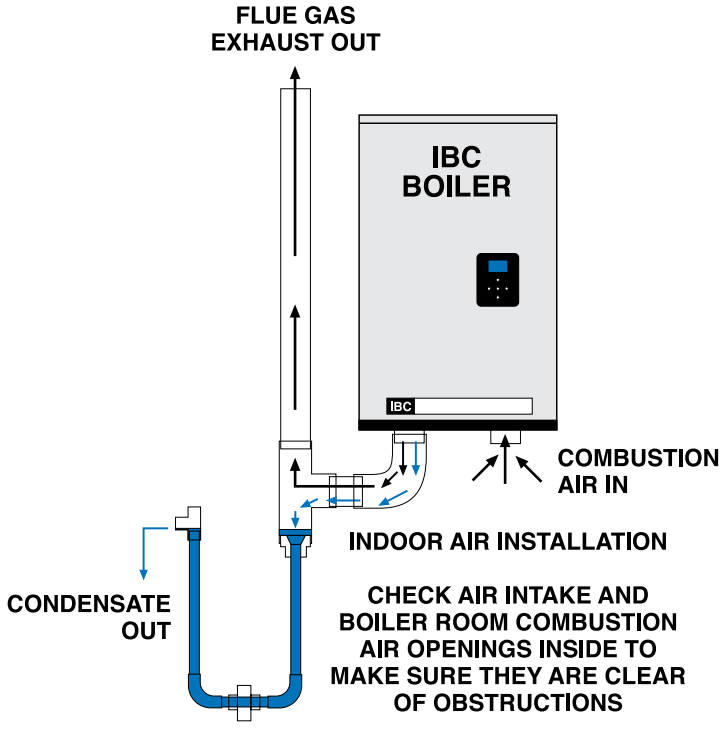


Figure 11: Indoor air - intake, exhaust and condensate removal system

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 the National Fuel Gas Code, ANSI Z223.1 (latest edition), or applicable provisions of the local building codes**
- **in Canada, in compliance with B149-10.**

1.4.9 Combustion Air Filtration

If combustion air contamination from ingested particulate matter may be a concern in any installation, an optional air intake filter may be installed. IBC supplied air intake filters have a known pressure drop and fouling factor and should be used as a component of the combustion air system according to the allowable intake length in *Table 4.*

⚠ NOTE

Combustion fan blockages can occur when environmental particulate and foreign matter contaminants (leaves, dust, dandelion & cottonwood fluff, etc) are drawn into the air intake. In areas where this problem is suspected to be an issue, our optional air intake filter should be installed.

Filters should be checked and cleaned or replaced on a regular schedule based on the severity of the problem.

Figure 12: Optional air intake filter IBC Part #103 - Filter element alone is IBC Part #104

Air intake filter IBC Part # 103

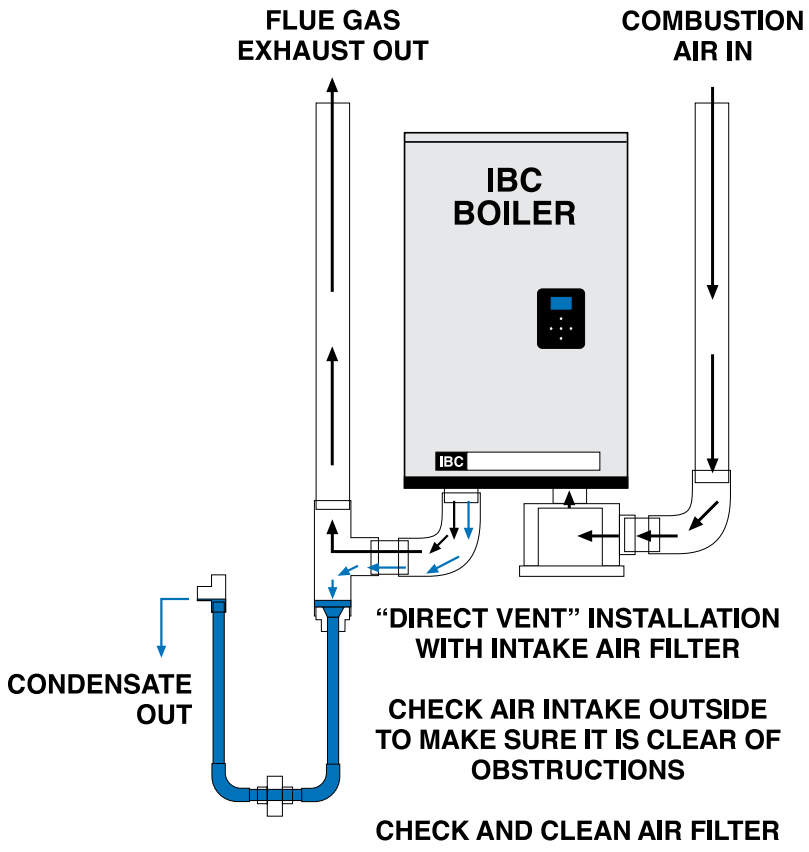


Figure 13: Direct vent - intake, exhaust and condensate removal system with optional air intake filter (filtration may also be used on indoor air applications as required)

1.4.10 Closet Installations

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

The boiler shall not be exposed to ambient conditions above 122°F (50°C) or below 32°F (0°C).

1.5 CONDENSATE REMOVAL

IBC's specified vent configuration promotes the safe drainage of moisture from the boiler and exhaust venting without flowing liquids back through the heat exchanger (as done by other condensing boilers). Reliable system operation requires (1) proper design and installation of exhaust venting to allow condensate to run back to the drain/trap; (2) proper trap depth to handle maximum potential pressure within the vent, and (3) acid neutralization as appropriate. To achieve these:

1. Allow for a 1/4" per foot slope back to the trap connection, with appropriate hangers to maintain that gradient; do not use 2" pipe on horizontal runs - air friction from the fast moving exhaust at high fire in a 2" pipe can overcome gravity even with the specified slope, leaving a pool of condensate at the next upturned elbow; do not transition between pipe diameters on horizontal vent runs – always place any reducing couplers in the vertical run)
2. Ensure a trap is established as described below.
3. When required, add (and maintain in good condition) a neutralization tank.

⚠ WARNING

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.

Failure to comply will result in severe personal injury or death.

⚠ WARNING

If condensates are to be discharged into building drain piping materials that are subject to corrosion, a neutralization package must be used.

⚠ CAUTION

When a condensate neutralization package is installed, the pH of the condensate discharge must be measured on a regular schedule to ensure the neutralizing agent is active and effective.

1.5.1 Condensate Trap

When installling the condensate trap, please take into account the following:

- Must be piped to within 1" of a drain or be connected to a condensate pump.
- Drainage line must slope down to the drain at a pitch of 1/4" per foot so condensate runs towards the trap
- If necessary, the drain connection tee can be laid so the main axis is horizontal; ensure the drain tee is as close as possible to the vent riser to avoid water bypass and pooling.
- Most installers prefer to run the combustion air intake pipe alongside the vent, both to the left side of the boiler to keep the area right of the unit clear for system water piping.
- Use the supplied PVC unions for easy access for cleaning. Locate on the vertical legs as per *Figures 15 and 16.* Earlier installations may have a single union at base of the trap *(as shown in Figure 14).*
- Condensate traps should be checked every 2 months, and cleaned and refilled as necessary.

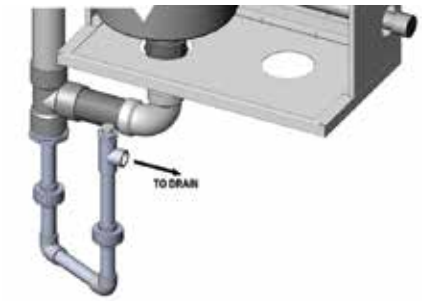


Figure 15: Condensate trap configuration (double union option shown)

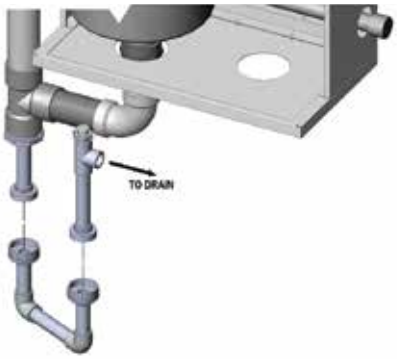


Figure 16: Condensate trap disassembly for cleaning

1.5.1.1 WITH SCHEDULE 40 PLASTIC VENTING SYSTEMS (E.G. ULC-S636 CPVC)

A condensate trap must be installed near the base of the boiler as shown in *Figures 14 or 15.* The trap is formed using PVC pipe, elbows and threaded union fittings.

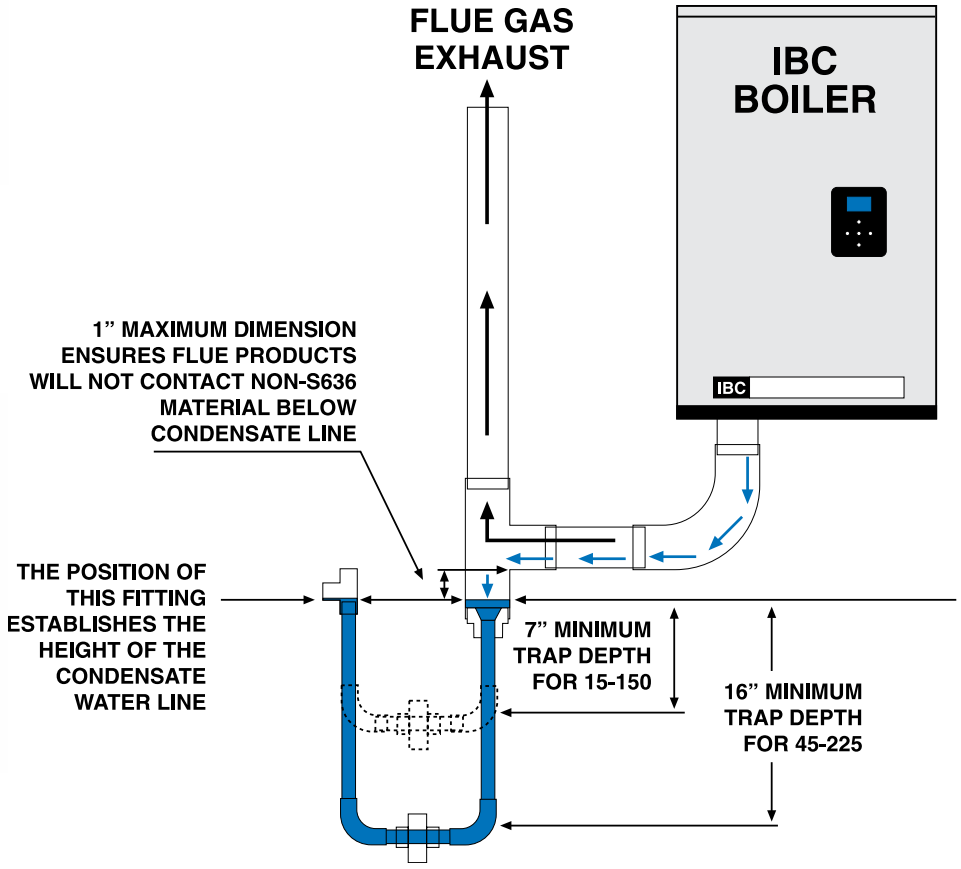


Figure 14: Condensate trap configuration (single union option shown)

NOTE: for CPVC vent systems, the connecting tee and bushing should be formed using CPVC, transitioning to PVC in the wetted section of the trap, where non-ULC-S636 materials are allowed as this section is not in contact with flue products. The trap must be installed as follows:

- For the 15-150 model, must be 7" min in height *(see Figure 14);* with the conventional vent kit parts supplied with the boiler, approximately 15" clearance below the boiler is required. For the 45-225 model, the trap shall have an effective minimum depth of 16" (up to 24" below may be required; this can be achieved using a conventional drop as shown below or a ball trap assembly of similar properties).
- Use the supplied vent kit parts to establish the trap in the location shown below. *Do not place the drain connection tee directly at the base of the boiler.*

Figure 17: Condensate trap installation

⚠ WARNING

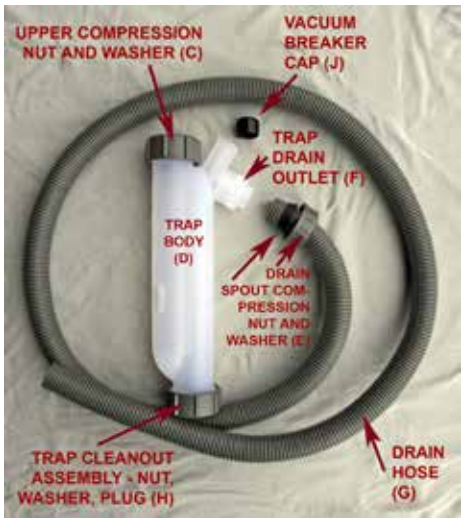
The Trap Hook must be installed as instructed and all trap fittings must be tightened as instructed to prevent leakage of flue gasses.

Failure to comply may result in severe personal injury or death.

1.5.1.2 WITH PPS VENTING SYSTEMS

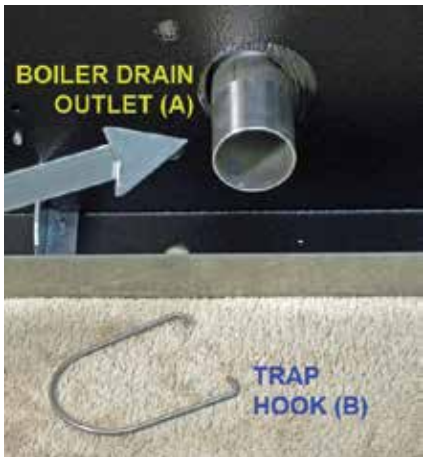
A condensate trap must be installed on the drain connection at the base of the boiler as shown in *Figure 17.* Please follow the installation instructions below:

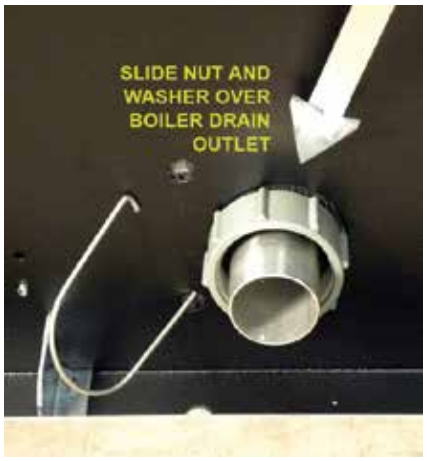
1. Undo Drain Spout Compression Nut (E), remove Drain Hose (G) from Trap Drain Outlet (F). Place Vacuum breaker cap (J) over the Vacuum breaker opening and push firmly home. Remove Upper Compression Nut and Washer (C) and slide over Boiler Drain Outlet (A). Insert one Trap Hook barb into the back mounting hole.
2. ***Fill Trap with water,*** and slide Trap Body (D) over Boiler Drain Outlet (A). Swing Trap Hook (B) around the Drain Outlet (F) connection threads. Insert remaining Trap Hook barb into the front hole. Pull the trap slightly downward to seat it against the hook and tighten Upper Compression nut (C).
3. Attach Drain Hose (G) and tighten Drain Spout Compression Nut (E).

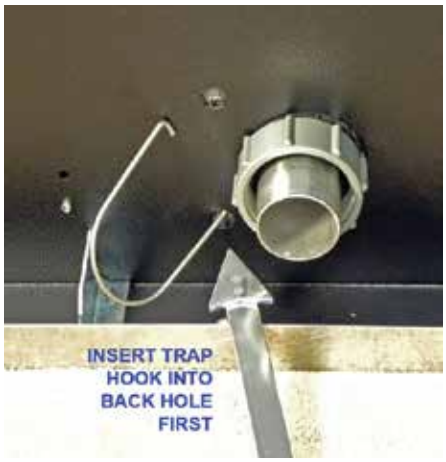


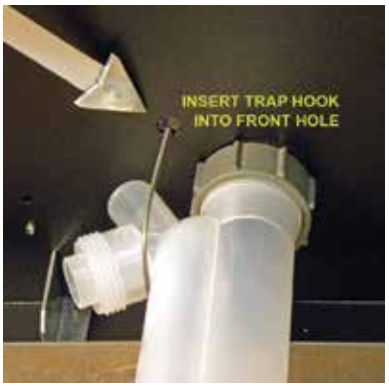
Condensate Trap as shipped

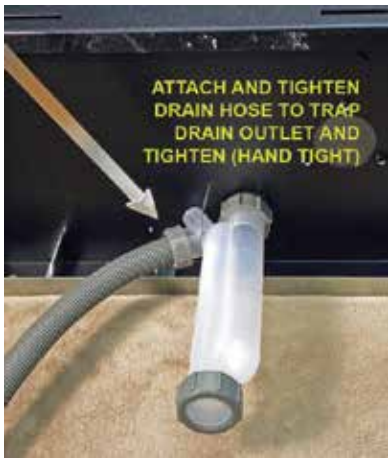
Condensate Trap, disassembled











1.5.3 Condensate Trap Assembly - cleaning procedure

1. Turn off the power to the boiler and allow it to cool down.
2. Remove the trap from the boiler (reverse the installation procedure above).
3. Remove the Trap Cleanout Assembly (H), from the Trap Body and clean and flush the debris out.
4. Re-assemble trap components, re-fill trap, and replace on boiler as described in the installation instructions above.

⚠ NOTE

It is the responsibility of the installing and/or service Contractor to advise and instruct the end User in how to perform the Trap cleaning procedure, and to advise that the Trap be checked at least every two months and cleaned as required.

1.5.4 Further installation details

- Condensate drain must be piped to within 1” of a drain or be connected to a condensate pump.
- Drainage line must slope down to the drain at a pitch of 1/4” per foot so condensate runs towards the drain.
- Condensate traps should be checked every 2 months, and cleaned and refilled as necessary.

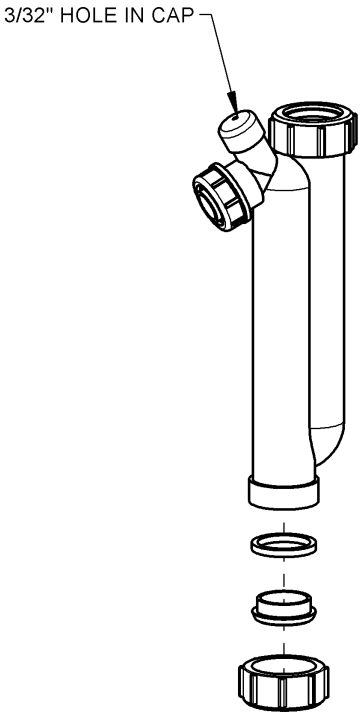


Figure 18: Condensate trap disassembly for cleaning

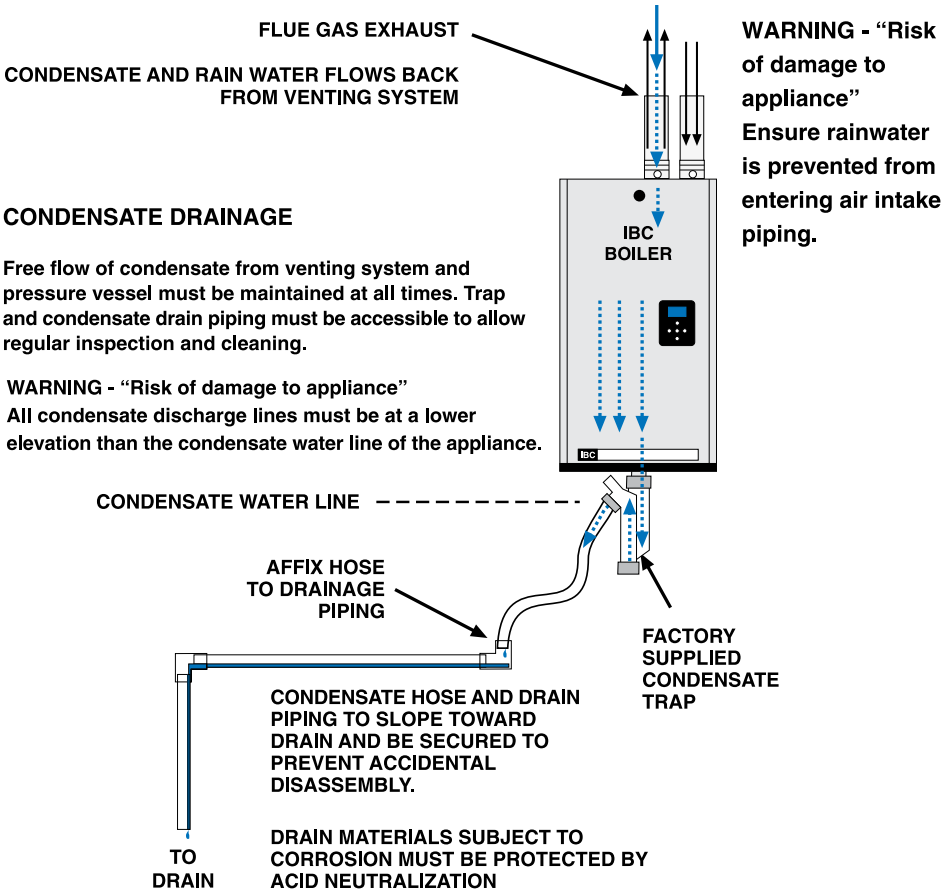


Figure 19: Condensate trap drainage

⚠ WARNING

If condensates are to be discharged into building drain piping materials that are subject to corrosion, a neutralization package must be used.

⚠ CAUTION

When a condensate neutralization package is installed, the pH of the condensate discharge must be measured on a regular schedule to ensure the neutralizing agent is active and effective.

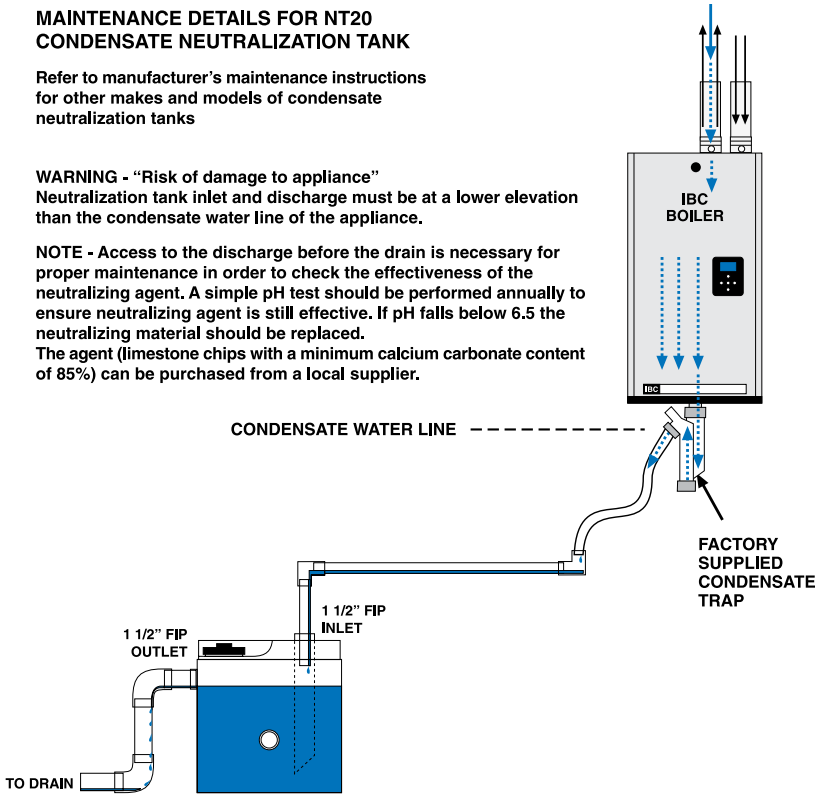


Figure 20: Condensate neutralization tank

1.6 WATER PIPING

⚠ WARNING

During operation, the relief valve may discharge large amounts of steam and/or hot water. Therefore, to reduce the potential for bodily injury and property damage, a discharge line MUST be installed that it:

1. is connected from the valve outlet with no intervening valve and directed downward to a safe point of discharge.
2. allows complete drainage of both the valve and the discharge line.
3. is independently supported and securely anchored so as to avoid applied stress on the valve.
4. is as short and straight as possible
5. terminates freely to atmosphere where any discharge will be clearly visible and is at no risk of freezing.
6. terminates with a plain end which is not threaded.
7. is constructed of a material suitable for exposure to temperatures of 375°F or greater.
8. is, over its entire length, of a pipe size equal to or greater than that of the valve outlet.

DO NOT CAP, PLUG OR OTHERWISE OBSTRUCT THE DISCHARGE PIPE OUTLET!

⚠ CAUTION

Installers should inquire of local water purveyors as to the suitability of their supply for use in hydronic heating systems.

If water quality is questionable, a local water treatment expert must be consulted for testing, assessment and, if required, treatment.

Alternatively, water or hydronic fluid of known quality can be brought to the site.

1.6.1 General Piping Issues

The VFC modulating series boilers are designed for use within a closed loop, forced circulation, low pressure system. A 30 psi pressure relief valve (3/4" NPT) is supplied for field installation in the flow supply line – see below. An optional 75 Psig relief valve can be used where required on closed loop systems within multi-level buildings. Relief valve discharge piping must terminate between 6" (15cm) and 12” (30cm) above the floor using plain un-threaded end, or per local Code.

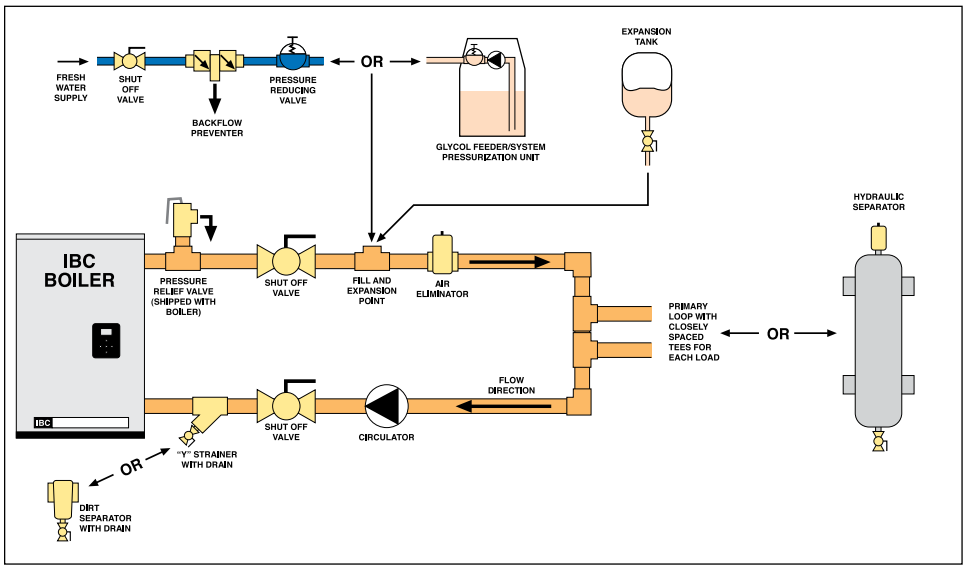


Figure 21: Boiler trim options

System piping is connected to the boiler using the 1-1/4" NPT-M threaded fittings. Unions and gate or ball valves at the boilers supply and return water connections are recommended to simplify servicing. Un-insulated hot water pipes must be installed with a minimum 1" clearance from combustible materials.

Fluid fill is most often accomplished by using a boiler regulator & fill valve set at 12 psig or more, with appropriate backflow prevention device as required by local code. This is acceptable in areas where municipal water or well water has been treated and filtered to remove excessive minerals and sediment, and water chemistry is known to be suitable for closed loop hydronic systems. In areas where water quality is in question, or when chemical treatment or glycol is required, other options should be considered. Follow applicable Codes and good piping practice.

There are a number of boiler feed and pressurization devices on the market today that may be a better choice than a raw water fill from the mains. When regular maintenance requires relief valve blow-off, the discharge may be directed back into the pressurization unit for recycling of boiler fluid and chemicals back into the system. In buildings that may be unoccupied for long periods of time, pressurization units are useful to prevent flood damage should leakage occur from any component in the system. An additional benefit is that backflow prevention devices are not required when using these devices.

Do not place any water connections overhead the boiler; leaks can damage the fan & controls. If needed, create a shield over the louvered top of the cover, but allow clearance for airflow and service access.

For best results, use a *Primary: Secondary* piping system, with a pumped boiler loop using 1-1/4" piping for the 15-150 and 1 1/2" for the 45-225. Heat exchanger head for both models is approx. 7' at 14 gpm, and 12' at 22 gpm so an inexpensive fractional horsepower pump is normally adequate. Primary/ Secondary piping ensures adequate flow and de-couples Δ°T issues (boiler vs. distribution). Aim for a 20° to 30° F Δ°T across the heat exchanger at high fire (there is a boiler protection throttle fence limiting the Δ°T to 35°F).

Table 5 - pump sizing - deleted; consult IBC Shop drawing information

⚠ WARNING

Close fill valve after any addition of water to the system, to reduce risk of water escapement.

⚠ NOTE

Full sized application drawings can be downloaded from our web site.

www.ibcboiler.com

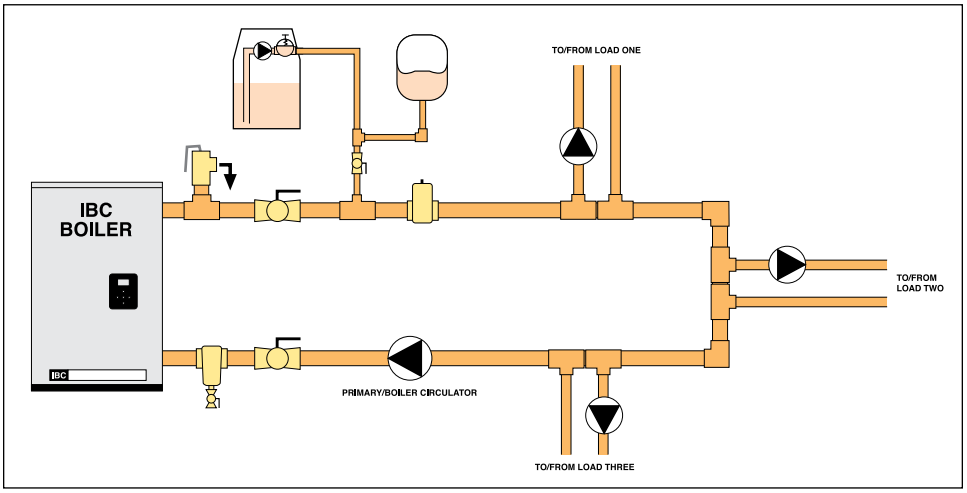


Figure 22: Basic Primary/Secondary piping concept

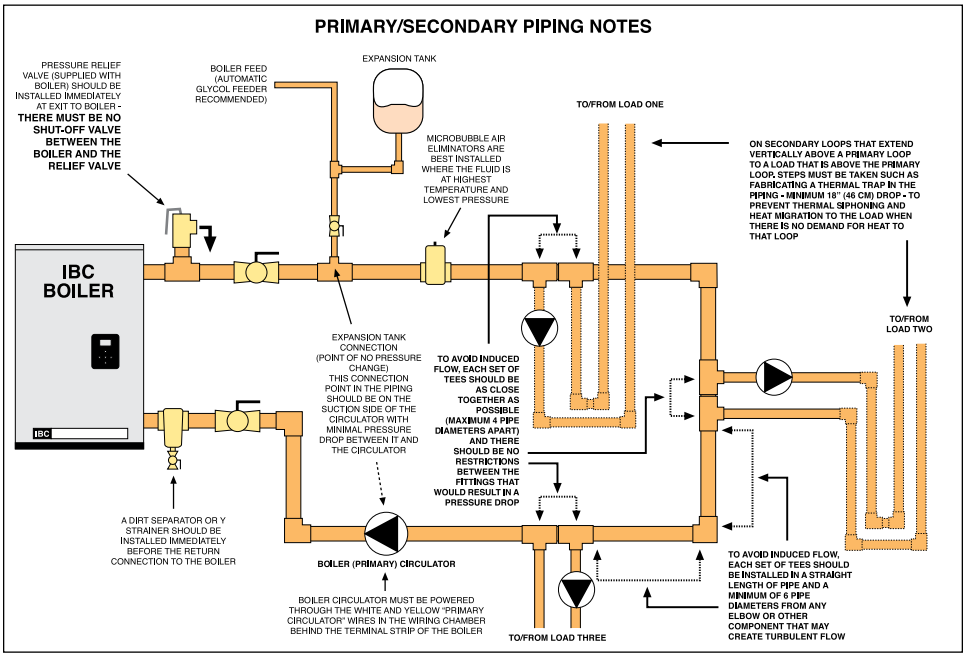


Figure 23: Important Primary/Secondary piping details

The VFC modulating series boilers are designed to supply three different heating loads with temperatures within the range 34°F to 185°F - to meet three separately piped loads. Use closely spaced tees to connect each pumped “load” (e.g. DHW, baseboards or radiant floor) to the primary loop, or employ the use of a hydraulic separator to isolate the boiler loop from the system and pipe the system from the secondary side of the separator.

A variety of application drawings showing basic design options are available from the IBC web site at: www.ibcboiler.com

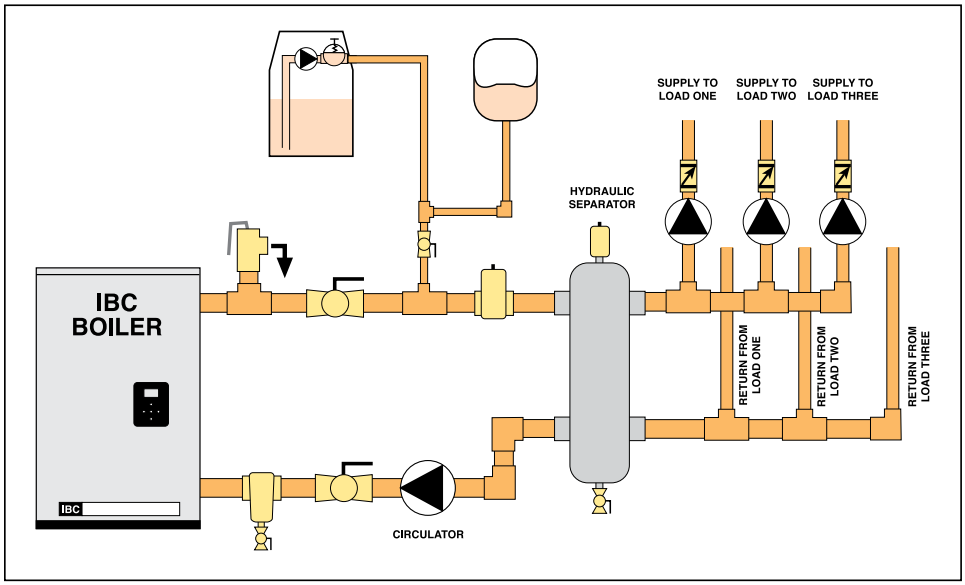


Figure 24: Primary/Secondary piping concept with hydraulic separator

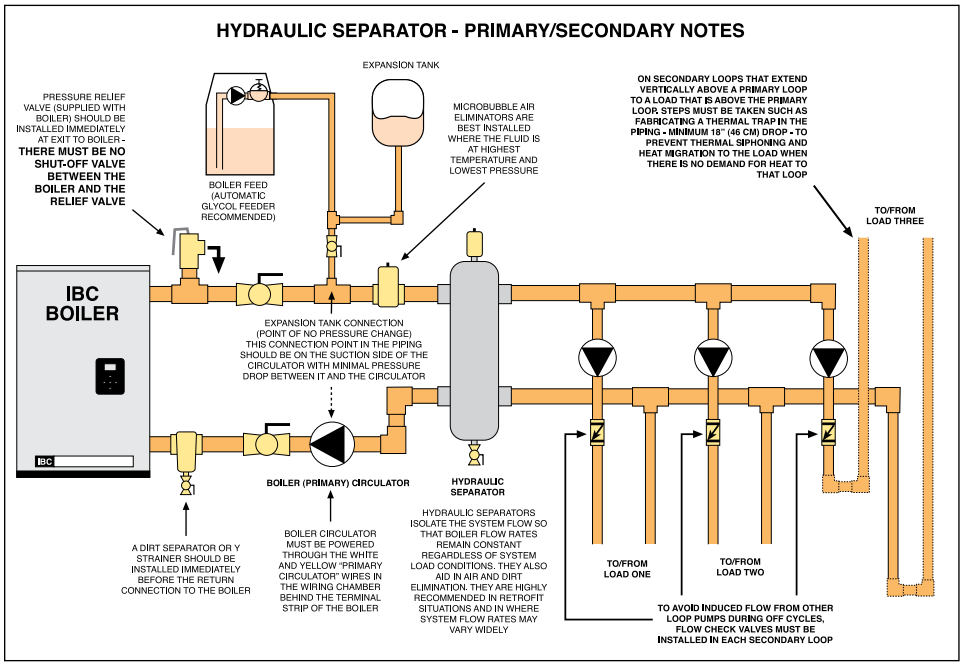


Figure 25: Important Primary/Secondary piping details with hydraulic separator

Always ensure that loads sensitive to high temperatures are protected using means such as an aquastat (wired to the boiler’s auxiliary interlocks) or mixing valve set for maximum limit (say 140°F) to protect radiant floors.

PRESSURE VESSEL HEAD					
Flow rate (gpm)	4	8	12	16	20
Head @ flow (ft wc)	0.7	2.5	5.0	8.3	12.3

Table 6: Pressure Vessel Head

⚠ NOTE

The Primary (boiler) pump must be under the control of the boiler and wired to the correct yellow and white wires labelled "Primary" in the wiring box.

Failure to do so will result in a no heat condition as the boiler will interrupt start-up with a "No Water Flow" error.

Ensure the 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.

We require waterflow after burner shutdown to utilize legacy heat – this is significant due to the mass of the heat exchanger (40 Kg) plus its 9L internal water volume. Default software values will run the boiler's primary pump for up to 5 minutes (300 seconds) after burner shutdown. Secondary pumps can be set to run up to 5 minutes after burner shutdown (for the last calling load). As shipped, the default software will run the Load 3 / DHW pump for 5 minutes to place the legacy heat where it is useful – e.g. in the DHW tank. Any secondary pump can be set to run for 0 – 300 seconds in the heat purge mode. Guard against deadheading pumps when all zone valves are closed *(see Section 2.7 Set Up & Load Definition)*.

The primary pump must be under the control of the boiler, to allow the boiler's flow proving routine to run. The boiler control looks for flow/no flow during a pump on / off check on each start up. Ensure that temporarily wired primary or secondary pumps (e.g. wired externally during the system fill/purge phase) are returned to the boiler's control terminals. A *"No Water Flow"* error message will otherwise be experienced on start-up.

⚠ WARNING

Do not use automotive-type ethylene or other types of automotive glycol antifreeze, or undiluted antifreeze of any kind. This may result in severe boiler damage. It is the responsibility of the Installer to ensure that glycol solutions are formulated to inhibit corrosion in hydronic heating systems of mixed materials. Improper mixtures and chemical additives may cause damage to ferrous and non-ferrous components as well as non-metallic, wetted components, normally found in hydronic systems. Ethylene glycol is toxic, and may be prohibited for use by codes applicable to your installation location. For environmental and toxicity reasons, IBC recommends only using non-toxic propylene glycol.

There are two water pressure sensors, located on the boiler's supply and return water piping. These act to provide both low water pressure and low water level cut-off protection and water flow measurement. Schematics for several piping layouts are provided, and additional drawings are available at www.ibcboiler.com. Installers shall conform the piping design to one of the provided configurations to simplify the control application, promote good loads-and- flows management.

The VFC modulating series boilers offer unparalleled matching of heat generation to radiation. The low minimum firing is better suited to low thermal loads presented in a typical multi-zoned radiation system. However, where individual zones in a heating system have loads under 5,000 Btu/hr, the system will still benefit through use of a buffer tank to ensure a controlled supply temperature, and to prevent short cycling. Buffering should be added on the secondary piping of the relevant load, to avoid bulking up the thermal mass of the primary piping circuit (and potentially lengthen the duration of the transition from hot to cool loads).

Propylene glycol solution is commonly used in a closed 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.

VFC modulating series boilers can be connected directly to a floor of non-oxygen barrier polybutylene material (PB tubing). For maintenance of warranty on such systems, we require evidence of a thorough flushing of all loops, plus installation of a dirt separator or side stream filter. A separator/filter maintenance routine

shall be carried out after the retrofit, with filter clearing after the 1st day, 1st week, month and annually thereafter. Care is to be taken to avoid use of ferrous fittings and pumps on PB tube systems.

⚠ NOTE

This piping drawings in this manual are simple schematic guides to a successful installation. There are many necessary components not shown, and details such as thermal traps are left out so the drawings have greater clarity. We require that our boilers be installed by licensed and experienced trades people who are familiar with the applicable local and national codes. System design is to be completed by an experienced hydronic designer or Engineer. It is necessary to carefully read and follow these installation instructions along with the application drawing that fits your system.

1.6.2 Installation Rules

NOTE: The Boiler Trim element – common to each of the following systems - includes the pressure relief, fill, expansion tank and air bleed elements. The primary pump can be located on either the Supply or Return piping sections.

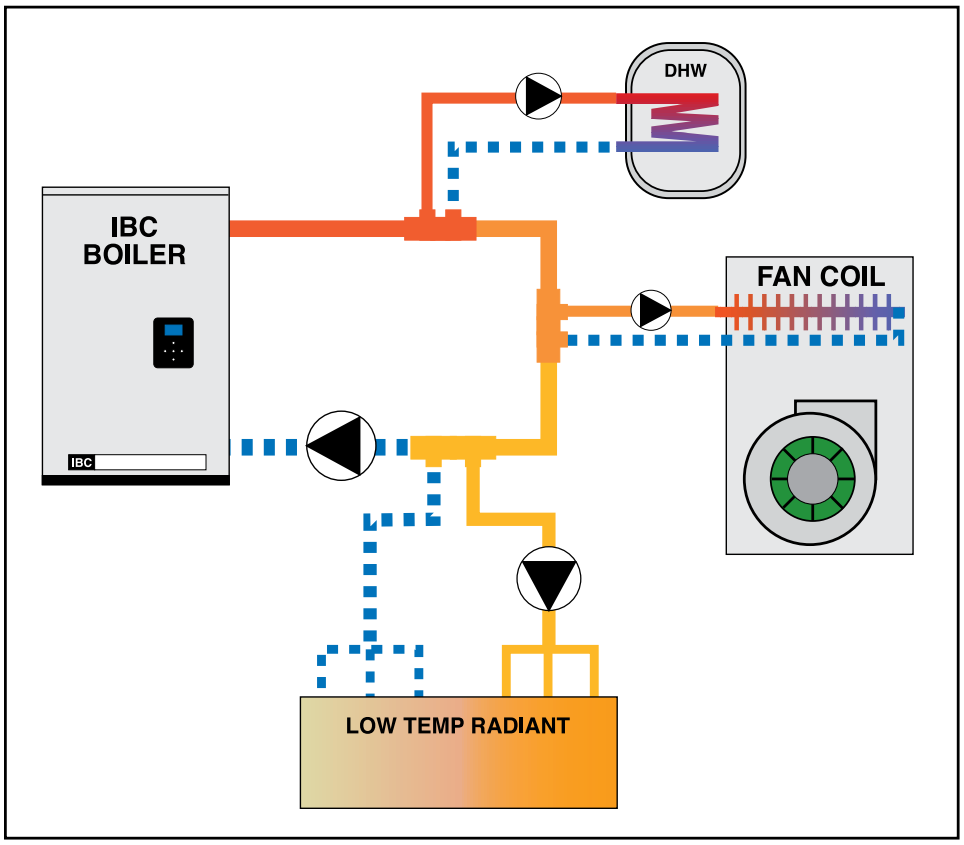


Figure 26: Basic Primary/Secondary, 3 load piping concept

Features of the preferred Primary / Secondary piping system:

1. Good circulating water flow through the boiler irrespective of load or radiation system head
2. Allows flexible ΔT° control in secondary loops
3. Adds to the system's thermal buffering, to assist in handling small loads and temperature transition.

This piping configuration requires an extra pump. The VFC modulating series boilers' controller hosts wiring terminals and integral relays to simplify installation and operation of this preferred layout, offsetting such costs.

For optimal performance, place pumps on the supply side of secondary loops to facilitate air evacuation. Use pumps with internal check valves to avoid ghost flows and thermal siphoning.

The primary loop temperature may need to transition from a 180°F domestic water heating load to a 100°F radiant floor requirement. The secondary pumps will swap off/on simultaneously, *provided the pre-set maximum allowable temperature of the*

new load is not exceeded. In the case of the typical maximum limit for a radiant floor (most would enter 140°F); the floor pump would remain off, the boiler shut down, leaving primary circulation on until the primary loop temperature drops into the acceptable range for the floor. Temperature sensing is done using thermistors at the boiler supply and return – no further sensors need to be installed.

The use of the multi-temperature modulating system is optimized when the need to shutdown the boiler is reduced or eliminated during the transitional period. System design enhancements: (a) keep a relatively low thermal mass in the primary loop, and (b) incorporate a 3-way mixing valve on the "cool" load piping.

If the installation involves small loads, as in typical zoned baseboard heating applications, use of a buffer tank is recommended. To aid in temperature transition from hot to cool loads, a 3-way mixing valve can be placed at the entrance to the cool load (this will also provide floor protection). This will permit immediate circulation of mixed flow into the cool loop. See separate publication *Application Notes* for more detail *(available at www.ibcboiler.com or from your IBC Representative).*

Always ensure that loads sensitive to high temperatures (e.g. radiant floor) are protected using appropriate means such as a manual mixing valve, or an aquastat (set to130°F, for example) wired to the boiler's auxiliary interlocks.

⚠ NOTE

When using the sequential load feature of the IBC boiler, attention must be paid to the operation of system components in order to ensure they are compatible.

Many air handlers (fan coils) for instance have a thermostat connection that will energize an internal relay to operate the air handler circulator and its fan on a call for heat. This may result in operation of these components when other loads are running at a higher priority, resulting in cold air blowing, or robbing heat from another load.

Some wiring alteration may be required to divorce both of these functions from thermostat control in favour of more effective control from the IBC boiler.

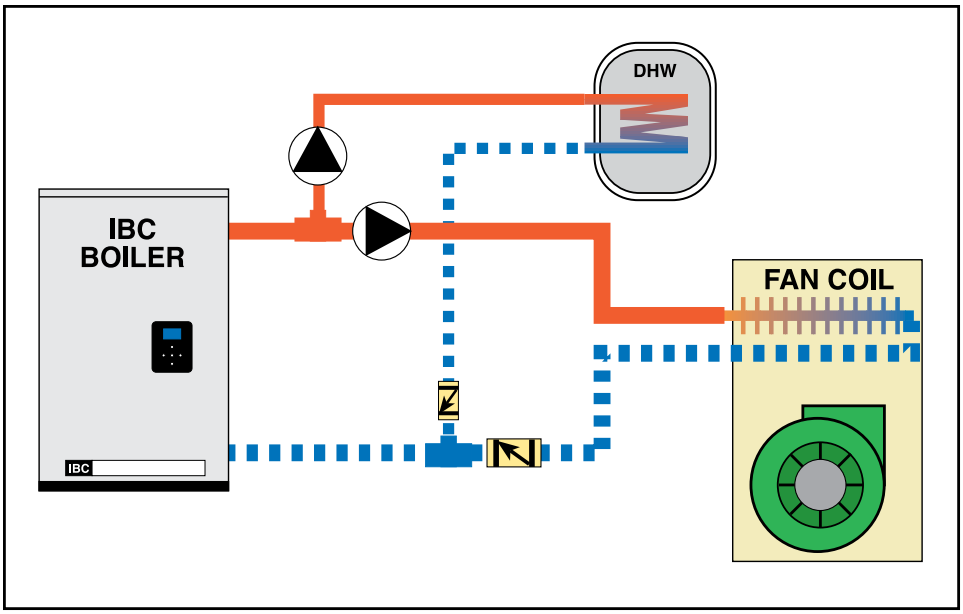


Figure 27: Two pump, two load - parallel piping concept

⚠ NOTE

For information and details regarding Multiple Boiler application, consult our *Technical Notes - Multiple Boiler Systems.* These notes provide necessary detail on specific single and multiple boiler applications "Piping", "Wiring" and "Settings". (available at www.ibcboiler.com or from your IBC Representative).

Compared with the Primary/Secondary approach, the above design saves one pump. Lost is the simplicity of constant head and flow at the boiler, with reduced flexibility in the handling of large temperature differentials. Wiring: loop the yellow & white "Primary Pump" pair up to connect to the lowest pair of contacts on the green Pump/Valve terminal block. Then connect the two load pumps to the chosen Load 1-2-3 contacts on the same green terminal block.

Check valves or thermal traps should be used to isolate both the supply and return piping for each load - to avoid thermal siphoning and reverse flow.

To ensure adequate water flow through the boiler under high-head / single zone space heating conditions, a pressure activated bypass or other means of bypass must be used on any load where the flow rate might drop below minimum requirements (4 gpm for the 15-150, 8 gpm for the 45-225).

For further information and details, consult our *Application Notes* – which provide detail on specific single and multiple boiler applications *"Piping", "Wiring"* and *"Settings". (available at www.ibcboiler.com or from your IBC Representative).*

1.7 GAS PIPING

The boiler requires an inlet gas pressure of at least 3.0" w.c. for natural gas or 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:

MODEL	1/2" IPS	3/4" IPS	1" IPS
VFC 15-150 (Natural Gas)	10	40	130
VFC 15-150 (Propane)	50	180	620
VFC 45-225 (Natural Gas)	5	20	60
VFC 45-225 (Propane)	25	90	290

Table 7: Maximum Pipe Length (ft)

⚠ NOTE

Due to the precision of modern modulating boilers it is important to pay special attention to gas pressure regulation.

It is essential to check gas supply pressure to each boiler with a manometer or other high-quality precision measuring device. Pressure should be monitored before firing the boiler, when the regulator is in a "lock-up" condition and during operation, throughout the boiler's full modulation range.

Pay special attention to retrofit situations where existing regulators may have an over-sized orifice and/or worn seats, causing pressure "creep" and high lock up pressures.

A high quality regulator will maintain constant pressure above the boiler's minimum specification at all firing rates, and will not exceed the boiler's maximum pressure rating when locked-up with no load.

Gas piping must have a sediment trap ahead of the boiler's gas valve *(see Figure 28)*. 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 an approved piping compound resistant to the action of natural gas/propane. Use proper hangers to support gas supply piping as per applicable codes.

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 *(see Figure 31).* Note that manifold pressure varies slightly in accordance with firing rates with the modulating series boilers, but will always be close to 0" w.c.

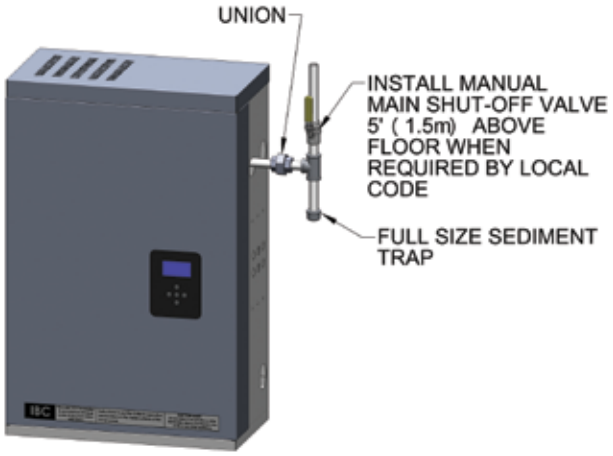


Figure 28: Typical gas piping

1.8 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.

Removing wiring box cover

Line voltage leads for power supply, primary pump and variable speed output

Line voltage load pump terminal strip

⚠ CAUTION

The internal pump relays in the IBC control have a maximum rating of 5 Amps or 1/3 H.P. each, with a maximum total allowable draw of 10 amps.

Isolation contactors MUST be used if electrical loads exceed these maximums.

1.8.1 120VAC Line Voltage Hook-up

Line-voltage wiring is done within the field-wiring box. *(Refer to Section 6.2.Wiring Diagram on page 6-4).* Connect the boiler to the grid power using a separate, fused circuit and on/off switch within sight of the boiler. Use 14-gauge wire in BX cable or conduit properly anchored to the boiler case for mains supply and pump circuits.

Connect a 120 VAC / 15 amp supply to the *"AC IN"* tagged leads in the wiring box. The max. actual draw (with 4 typical residential size pumps) is less than 4 amps.

If primary / secondary piping is used, with pumps to manage multiple loads, add a 12" pigtail to bring 120v to the bottom pair of contacts on the Pump/ Zone Valve Terminal Block located on the upper right-hand edge of the controller. The upper 3 pairs of contacts on this green connector strip are then powered to manage up to 3 load pumps – the top pair for Load 1, the second pair for #2 etc. Once the controller is programmed for the respective loads, the boiler will manage all the loads without need of further relays (OK for loads up to 1/3 HP; for more – use a protective relay). *The green Pump/Valve terminal strip is not pre-wired because some installations will use it to manage 24 v zone valves.*

The primary pump is connected to the White/Yellow pair labeled *Primary Pump.* This lead is factory wired to the controller (and its 120 VAC supply) at the upper right backside of the controller board – do not attempt to connect the primary pump to the Pump/Zone Valve Terminal Block along the controller's right edge - this is for the secondary pumps and/or zone valves only. Connect the pump's Black wire to the Yellow of this pair (switched Hot). The White/ Yellow pair should be individually capped if the primary pump does not obtain its power from this pair (e.g. if a variable speed primary pump is connected to the mains power).

If a parallel pump piping configuration is used rather than primary/secondary, loop the White/Yellow *Primary Pump* pair up to connect this to the lowest pair of contacts on the green Pump/Valve terminal strip, then connect the two load pumps in the normal way – this will bring power to the pump control block.

Pumps can be switched on/off using the keypad, so there is no need for temporary pump wiring during system filling / air purging. If pumps are hard-wired to the panel during the system fill/purge phase, re-wire the boiler pump to the Primary Pump leads inside the wiring box, to enable the water flow proving routine to run.

In a new construction application- **use a construction thermostat – or jumper with in-line on/off switch – for on/off management of the boiler. Do not just pull power from the unit, or its moisture management routine will be interrupted** (fan turns at ultra low rpm for 90 minutes after burner shutdown). Treat it like a computer, where you do not just pull the plug when done. If an "Insufficient airflow / check vent" error signal shows, check for (and remove) any water in the clear vinyl air reference tubes. This has been seen occasionally at construction sites where the boiler has been repeatedly de-powered wet.

The combined current of all pumps connected through the on-board pump relays should not exceed 10 amps.

⚠ NOTE

The IBC boiler (like any modern appliance that contains electronic equipment), must have a "clean" power supply, and is susceptible to power surges and spikes, lightning strikes and other forms of severe electrical "noise". Power conditioning equipment (surge protectors, APC or UPS devices) may be required in areas where power quality is suspect.

1.8.2 Power Quality and Electrical Protection

The control board (for all models) is protected using in-line field replaceable fuses of 5 amp (slow-blow). The control circuit board is further protected using on-board factory repairable fusing.

The principal exposures to electrical damage:- (a) when wiring of pumps to the boiler's pump terminals, avoid screwdriver contact with the metal control cover; (b) avoid water or solder spray onto fan motor circuitry.

1.8.3 Zone Valve Hook-up

If zone valves rather than pumps are used to manage multiple heating loads, then 24VAC for the zone valves should be provided to the power contacts on the Pump/ Zone Valve Terminal Block. Use a separate transformer – the 40VA unit inside the wiring box is for internal systems only. The individual load/zone valves are then to be wired to their associated contacts on the secondary pump/zone valve connector. Do not confuse such "load/zone valves" with similar valves used to segregate a single load type (e.g. those used on a zoned radiant floor) – see next section.

Terminal Strip for:
- *Thermostat/switch Inputs*
- *Sensor inputs*
- *Auxiliary Interlocks*
- *Network Wiring*
- *External Control Signal*

1.8.4 Thermostat / Sensor Wiring

Dry contacts for thermostats for each of 3 loads are provided as marked on the lower / orange connector strip (e.g. "Therm 1"). Gang lines from a multiple-zoned load (e.g. off the end-switches for each radiant floor zone) to present a common thermostat signal to the controller. Ensure there are no disturbing influences on the call-for-heat lines - e.g. no coils to switch an air handler motor. Where these zone valves are of a non-isolated 3-wire configuration, the zone valve end contacts must be isolated from the load's controller thermostat terminal using an appropriate relay. Required input for enabling the IBC boiler is a dry / mechanical contact; ensure that triac or other parasitically-powered units are not used.

⚠ DANGER

Do not connect thermistor sensors to "Therm" terminals. An overheating hazard can result in serious personal injury and/or property damage.

⚠ NOTE

The IBC control only recognizes a true dry contact closure as a call for heat on terminals "Therm. 1, Therm. 2 or Term. 3. Thermostats and other devices that use a "Triac" output cannot be used as a call for heat without the installation of an intervening relay with dry contacts to connect to the IBC terminal strip.

1.8.5 Other Wiring

Other optional low voltage connections to the control board include:

- Two auxiliary interlocks - for external safety devices as may be required by some jurisdictions, such as a low water cut-off or a low gas pressure cut-out (for off-grid propane). A floor-protecting aquastat can use one of these, to cause a full boiler shutdown in the case of excess floor temperature.
- Contacts for indoor and outdoor temperatures sensors associated with Reset Heating. A 10K ohm thermister for outdoor reset sensing is supplied with the boiler, to encourage use of this temperature compensating space heating technique for improved comfort and combustion efficiency.
- One pair for a DHW tank sensor. Connect to "DHW S" (not the respective Therm. 1,2,3 location) and the boiler will automatically notice and go to a smart DHW routine
- One pair of contacts for remote secondary loop temperature control.
- One pair (marked BoilerNet) for network connection – this is used for connecting multiple VFC modulating units for autonomous staging. See separate **Technical Memo** for guidance.
- A final pair of contacts, to receive a 0-10VDC (default) or 4-20 mA signal from an external boiler controller- for direct throttle control. The boiler's own sensors act as high limits only. User must enter maximum and minimum boiler supply temperatures.

NOTE: Sensors connected to any sensor input contacts must be of NTC Thermister - type with a resistance of 10,000 ohms at 25°C and β = 3892. We do not recommend using 3rd party supplied sensors. Compatible water temperature sensors and outdoor sensors can be supplied by your IBC distributor.

1.8.6 Thermostat Heat Anticipator

IBC "Therm." contacts draw no power, so an anticipator setting for the thermostat is not applicable with the VFC modulating series boilers. In the case of a single temperature / heat load where zone valves are used to manage individual thermostatically controlled zones, each room thermostat's heat anticipator should be adjusted to the current draw of its associated zone valve.

A 2.5 mm Slot screwdriver is required for the bottom terminal strip. Broader or narrower blades may damage the terminal screws.

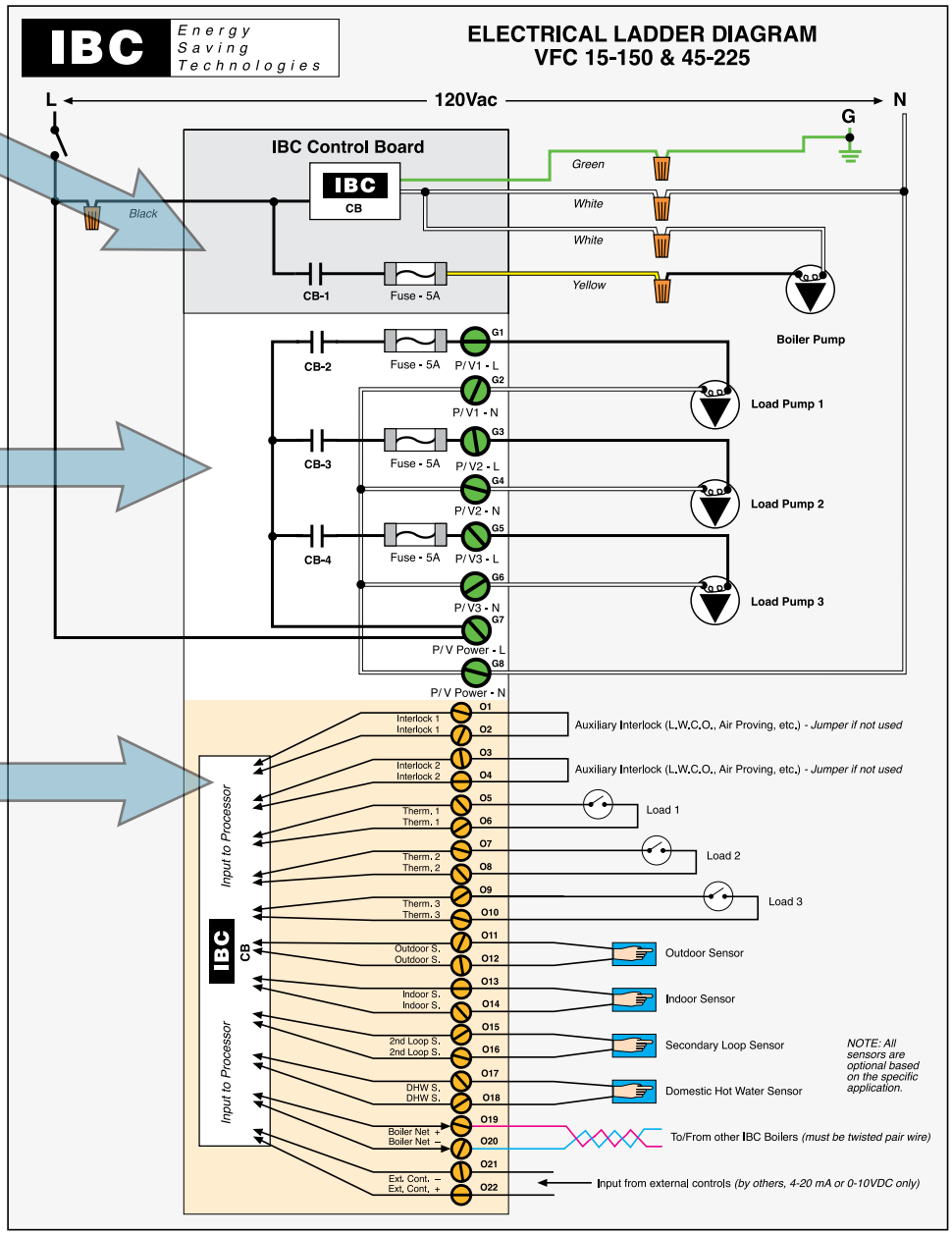


Figure 29: Electrical Wiring Connections (full page ladder diagram at back of this manual)

2.0 BOILER SYSTEMS AND OPERATION

2.1 GENERAL

⚠ WARNING

If the boiler can become exposed to fluid temperatures below 34°F (1°C), a method of protection to prevent freezing of condensate should be employed. Contact the factory for further information.

VFC modulating series boilers are designed to service three separate, directly piped heating loads using different pre-selected water temperatures and heat regulation routines. External controls can extend applications.

The control is outfitted to provide for outdoor reset, set point regulation and DHW. The design objective is DHW plus radiant floor and baseboard space heating, each operable at a unique temperature.

While the three load “channels” are shipped pre-programmed with default values, they can each be programmed with DHW, set-point control or outdoor reset parameters *(see Section 2.7 Set Up and Load Definition).* The strategy is to deliver high temperature water, as required by most indirect DHW tanks on the market, and by finned tube baseboards, but default to the lowest possible boiler supply temperature to maximize efficiency. The VFC modulating series boilers can handle supply temperatures within the range 34°F to 185°F.

2.2 CONTROL

The control unit provides overall management of boiler operations, including:

1. Power-up / set-up / boiler state machine (standby / heat call management etc).
2. Burner, pumps (primary + external) and/or zone valve management.
3. Temperature and throttle operation.
4. Maintenance of a service log with diagnostics.
5. 2 way communications.

Operating and historical data may be accessed at any time, using the Log and Advanced Settings fields, available using the permanently lit LCD screen. See below. Data includes the following:

- Ignition counter
- Time records, including burn time by load and the throttle duty cycle
- Error log

2.3 USER INTERFACE

2.3.1 Keypad Functions

A five button keypad is provided for intuitive navigation around the screen. The four outer keys are used to move the cursor up or down, and side to side. The centre button is used to make selections and confirm inputs. The left hand key is also used to back-step to the previous screen; multiple key stokes are used to withdraw back to the operating status screen.

2.3.2 LCD Display

Upon power-up, the LCD screen initially flashes a software release number then switches to a *Standby-* display mode, showing real time data plus key temperature target settings.

When there is a call for heat from any load, that load is identified at the Status line *(e.g. Heating – RFL (for radiant floor) in place of Standby)*. The Target temperature for the relevant load is conspicuously displayed while that load is being handled.

NOTE: The Status line displays those loads that are heating or calling for heat. In this instance *("Heating 3DHW")*, Load 3 has been set up as DHW and is actively heating, with no other loads calling for heat. If you saw *("Heating 3DHW C:1RFL")*, it would indicate Load 3 DHW is actively heating, while Load 1 (Radiant Floor heating with Reset) is shown as requiring heat but awaiting its turn. If a third load has been implemented and is also calling, the Status line display would expand to show the relevant details.

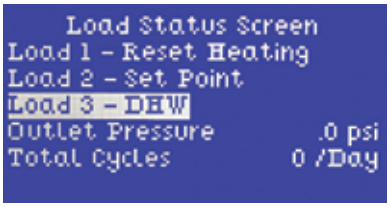
LEGEND:

- **RFI:** Radiant Floor with Reset
- **CIR:** Cast Iron Radiators w/ Reset
- **BBd:** Baseboards w/ Reset
- **AIR:** Air Handler w/ Reset
- **StP:** Set Point
- **DHW:** Domestic Hot Water

Other information is accessible using a menu based system – described in the following sections.

2.4 ACCESS LEVELS

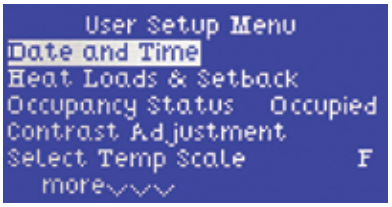
The controller provides for the display of further information (via the *Load Status Screen*) plus three levels of access for the adjustment of control settings. This is done to simplify the control interface for the user while retaining field access to the full functionality of the system for the appropriately trained heating professional. The split access feature offers a layer of security against adventurous "finger trouble", including accidental adjustment to settings that could lead to inefficient operation (e.g. excessive cycling) or dangerous conditions.



To access the *Main Menu*, touch any key. Move the cursor up or down using the top and bottom keys.

The *Load Status Screen* offers a comprehensive summary of all settings and actual readings for each heating load, eliminating a need to jump between screens while doing an extended watch of boiler operation.

NOTE: where the word "more" is displayed at the bottom or top of a screen, it is possible to see more lines by moving the cursor in that direction.



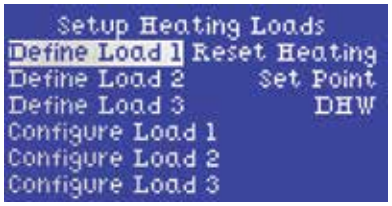
2.4.1 User setup

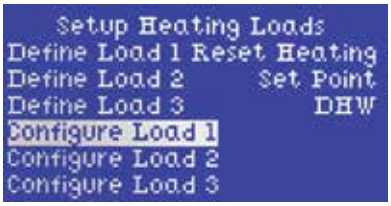
The occupant has access to a number of practical settings. The most meaningful include adjustment of the indoor temperature target plus the temperature setback and occupied / unoccupied modes. The User Menu also provides access to the time & date fields, provides the means to toggle between C° / F° plus allows adjustment of the screen image itself *("Contrast Adjustment").*

2.4.2 Installer Setup

The installer has access to all *"User"* adjustable fields plus a much wider selection of inputs. Loads can be declared and configured, with temperature settings appropriate to the characteristics of the heating system.

Key issues here are selection of appropriate boiler supply temperature criteria for the type of emitter, and the establishment of practical temperature differentials (e.g. DHW tank target vs. boiler supply). A record of the service history is also available for onscreen access.





2.4.3 Advanced Diagnostics

Not an access level, this field allows a view into detailed sensor readings and operating parameters such as fan rpm. This screen is useful for advanced troubleshooting of pressure sensors, etc.

2.4.4 Advanced Setup

This access level is set for the sole use of factory representatives and is permanently password protected.

2.4.5 Passwords

A Password access feature is loaded on the controller, for use in situations where there is exposure to unauthorized and / or uneducated adjustment. The installer is encouraged to consult with the user to determine the need for ongoing access to settings. In risk situations, the password feature can be invoked by selecting *"Password On/Off"* and toggling to *"On"* in either or both of the User and Installer menus.

Pre-set passwords are used:

- For the User the code is "11111" followed by "enter"
- A common "installer" code is also used, to ensure continuing access even with a change in service personnel. Contact IBC for access to this password.

2.5 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

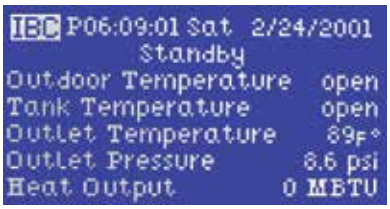
Each state is explained below. A flow chart for the sequence of operation can be found in the back of the manual.

GLOSSARY OF TERMS

This glossary briefly defines some terms used in the Sequence discussion.

- **Call for Heat:** The thermostat indicates that room temperature is below the thermostat setting.
- **Heat Required:** Temperature sensors on the boiler indicate that water temperature is below the water temperature target or setpoint.
- **Heating Enabled:** The boiler is powered and there is a **Call for Heat**, **Heat** is **Required**. The boiler will start and enter the Heating Cycle unless it is in an error mode.

2.5.1 Standby



Waiting for a *Heating Enabled* signal. The burner and boiler pump are off during this time.

2.5.2 Purging

PREPURGE

On a *Heating Enabled* signal, the boiler automatically enters a prepurge cycle.

The fan starts and automatically adjusts to a level suitable for ignition. Ten seconds later, the pump starts. After a total of 15 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 15 seconds.

POSTPURGE

The fan remains on for 20 seconds and then reduces airflow to an ultra low flow mode for 90 minutes unless preempted.

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

If the **heating** cycle ends as a result of water temperature exceeding the load specific band limit, the **postpurge** will continue as normal, but the boiler will enter the **circulating** mode.

The cut off temperature levels are specific for each load; they are determined using the preset target plus ½ of the supply differential entered. Default values for such differentials are 22°F (+/- 11°F) for space heating with outdoor reset and 40°F (+/- 20°F) for DHW and other set point loads,

If there is a *Heating Enabled* signal any time during this cycle, the postpurge ends, and a prepurge begins, otherwise the boiler will enter Standby mode.

2.5.3 Ignition

After the prepurge, the gas valve opens for 4.0 seconds.

If no flame is detected at the end of the trial, the **interpurge** cycle is entered. If ignition fails 3 times successively, the boiler locks out for a 1 hour long interval, after which the ignition cycle is refreshed (e.g. for 3 further attempts). Alternately, the boiler can be powered down and restarted to accelerate the re-try sequence. The homeowner should follow up persistent recurrence of the 1 hour reset routine by contacting a qualified service technician, to evaluate the cause of such ignition irregularity.

With a successful ignition, the output of the boiler decreases immediately to a low level, and the heating cycle begins.

2.5.4 Heating

The heating cycle lasts until the *Heating Enabled* state ends (for all loads), or until water temperature exceeds the target temperature by ½ of the supply differential for the last served load and the throttle has fallen to the minimum output. At the end of the heating cycle, the boiler enters a **postpurge.**

During the heating cycle, the boiler addresses the multiple defined loads in accordance with its Prioritization algorithm. See **Section 2.6.1**. Boiler output changes to meet heating demands as indicated by the temperature characteristics of the boiler supply and return water. Boiler supply water temperature targets vary according to the set up parameters entered, and are subject to further variation for loads where Outdoor Reset has been selected. Where thermal loads are within the boiler's 15 to 150 MBH throttle range, the control algorithm seeks to regulate the boiler supply temperature within ±3°F of the target temperature. On/Off differentials apply to loads below the 15 MBH minimum input rating. The following default differentials are automatically applied upon initial load characterization: DHW and other SetPoint loads (±20°F); space heating with Outdoor Reset invoked (±11°F). These default differentials can be adjusted in the password protected *Installer* access area.

2.5.5 Circulating

This cycle operates when water temperature exceeds target by 1/2 of the supply differential for that load at minimum output, and call for heat is still present. After entering a **postpurge**, the system pump remains on until water temperature is 1/2 of the supply differential below setpoint temperature.

The boiler can also enter the Circulating mode during transition from a high

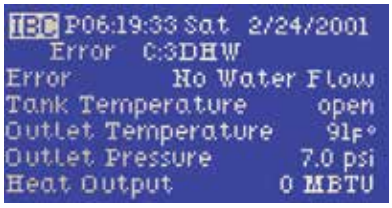
⚠ WARNING

This boiler is equipped with an automatic blocked vent shutoff system. In the case of an *"Insufficient Airflow Error"* event, a licensed and qualified service technician shall follow the steps set out at Section 5.3.1 *Airflow.*

temperature load (e.g. DHW at 180°F) to a cool target (e.g. radiant floor on Outdoor Reset, at perhaps 90°F). In the case in which the temperature is outside the applicable differentials, the burner will shut off while the pump remains on until water temperature is 11°F below the new load (radiant floor) target temperature. Thermal shock avoidance routine is employed to avoid undesirable effects of large temperature swings: the hot load pump remains on until the boiler's return water sensor detects temperature stability - to sink excess heat. For example, upon satisfaction of a DHW call the DHW zone pump will remain running until the boiler return water temperature falls to the DHW tank target temperature. This deposits legacy heat from the primary loop into the water tank before activation of a radiant floor load pump.

Always ensure that loads sensitive to high temperatures are protected using appropriate means - e.g. a three way mixing valve set to restrict entering water temperature to 130°F, or at minimum, an aquastat (set to130°F, for example) to be wired to the boiler's auxiliary interlocks to protect a radiant floor.

2.5.6 - 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.

Two 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 purge, followed by the error cycle of 5 minutes for all conditions other than Maximum Ignition Trials (a modified Hard Error which locks out for 1 hour after 3 unsuccessful ignition attempts). Following the purge, 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 purge then the fan and pump are stopped. The boiler is in a lockout, and must be checked and restarted by a service technician.

With software versions 3.10.0 and higher, the boiler offers an error status signal feature. *Please see IBC Technical Note: Boiler Status – Analog Output.*

See **Section 5.3.1 Control Panel** for a list of hard and soft errors and their likely 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.

2.6 OTHER OPERATING FEATURES

2.6.1 Prioritization

The control module hosts a scheduling routine to manage the boiler's operation when more than one load has been defined. Typically, loads declared as DHW receive significant - but not absolute - priority. A time vs. differential system will allocate heat amongst each of up to 3 loads over time.

Multiple heating loads - with varying temperature targets - are run *sequentially* as opposed to *simultaneously* (with a mixing valve). The objective is to serve each load at the minimum possible temperature, as opposed to running hot then mixing down – with hardware, saving the related hardware and fuel cost.

The approach optimizes the low temperature combustion benefits of direct cool running of a radiant floor. The large throttle turndown range coupled with outdoor reset means that several loads can receive heat in-turn, with less on/off duty cycling than would occur with other heat sources.

The boiler is shipped with default values for each type of declarable load (e.g. DHW, radiant floor). The preset variables for DHW (a value of 80 on a 20-90 scale) give it substantial priority, which declines over time if another load is calling. Spacing heating loads (with Outdoor Reset) are given a default value of 35, while other SetPoint loads start with 50 points. Over time, such points are transferred between the loads in accordance with the system rules. The boiler will automatically shift between loads once the points totals reach an upset value. Upon a load transfer, the burner will modulate down to its base level and will then throttle up as required for the new load. If competing loads have not been satisfied at the load switch stage, the control will register the firing rate and will return rapidly to such rate on the next rotation.

Heat-apportioning can be altered using the keypad in the password protected *Installer* input section. For instance if Baseboards (set up with Outdoor Reset as Load 3) are not providing the desired heat, the on-time of the baseboards can be increased by increasing the Prioritization value relative to the other declared channels (e.g. moving the Load 3 preset value from 50 to 60 or reducing another load's value). Temperature targets for the underserved load could also be raised in this example. For absolute priority, move the Load setting above 90. This will eliminate Load switching. Do not set each load to the top value, and it is generally better to avoid equal ratings. Note: the priority scale values do not need to add up to 100 – they are relative only to each other.

⚠ NOTE

US law effective Sept 2012 requires residential heating boilers under 300,000 btu/hr to be equipped with *Automatic Means* of boiler water temperature adjustment in relation to heat demand. This boiler offers such control but also a means to override it. See the inside back cover of this Manual for a message in respect of the use of such override.

2.6.2 Load Pairing

With software versions 3.10.0 and higher, the controller allows two loads of compatible temperature settings to be run together. See IBC Technical Note: Load Pairing for further details.

2.6.3 Reset Heating

The boiler offers Outdoor Reset control as standard equipment; this coordinates the control of boiler supply water temperature for space heating with the outdoor temperature. Outdoor Reset offers enhanced home comfort and efficiency by using variable water temperatures to compensate for the differing rates of heat loss that a building faces as outdoor temperature changes. At any outdoor temperature *above the coldest day expected*, it automatically uses lower heating temperatures than would otherwise be used. This saves energy without sacrificing comfort.

When applied within a condensing boiler, outdoor reset offers direct and significant combustion efficiency benefits by allowing generally lower circulating water temperature. This provides cooler return water to the boiler, promoting more condensation (= energy capture).

Contacts are provided for connection of an outdoor sensor (a *tekmar 070* or similar sensor is shipped with each boiler) to be placed in an appropriate outdoor position. The temperature management algorithm flexes the boiler supply temperature according to characterized heating curves that are automatically called up through the load declaration process. Curves are provided for each of the radiation terminal types offered - e.g. high or low mass radiant floor, air handler, finned tube baseboards etc.

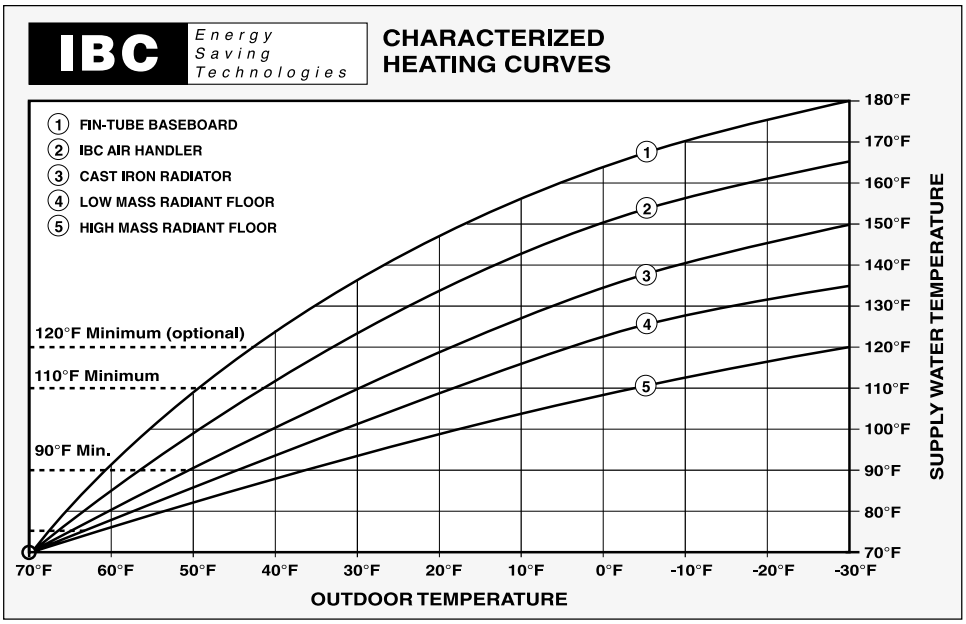


Figure 30: Outdoor reset curves

In an “open loop” reset system, a room or zone thermostat is used to send a call for heat over a 24VAC lead; this opens the respective zone valve, and signals the boiler to fire using onward leads to the boiler’s dry contacts (use one of the pairs marked “Therm 1, 2 or 3” on the orange connector terminal located on the right edge of the controller). Gang such leads in parallel from multiple zone valves for single connection to the boiler. Note that typical room thermostats simply provide a call for heat, they do not control the circulating water temperature from the boiler in an open loop reset system. Adjustment of a room thermostat from 23°C to 30°C will make no further difference to the delivered temperature if the floor slab has stabilized at the boiler temperature served up by the reset curve.

Where Outdoor Reset is applied without the indoor sensor feedback option, some manual adjustment may be required to achieve the desired comfort level. Fine adjustment can be made at the keypad using the *Indoor Setpoint Temperature* variable, located as Line 1 in the User screen. To increase heat (e.g. from 72°F to 73°) - move the Indoor value upward (warmer) from the level otherwise chosen. This shifts the position of the reset curve, will amend the boiler water temperature by a similar amount. Do not adjust the *Design Indoor Temp.* value - a movement upward in concert with Line 1 adjustment will have the effect of neutralizing the intended effect.

An optional indoor temperature feedback routine can be activated (with field installation of an indoor sensor, connected to the contacts located on the controller) to automate adjustment of the Outdoor Reset routine.

The key inputs on initial set up are (1) *Design Outdoor Temperature* – the coldest expected weather typically experienced at the installation site; (2) the *Design Supply Temperature* – the desired boiler operating level to occur at that coldest day; and (3) the *Design Indoor Temp.* - this is the value that anchors the reset curve. The *Indoor Set Point Temp.* variable is the primary means for the user to “bias” the outdoor reset routine to add or reduce heat.

If outdoor reset is selected and there is no signal received from the sensor, the controller assigns a provisional 0°C value and will adopt the appropriate temperature target from the relevant reset curve.

See **Section 2.7 Set Up & Load Definition** for activation procedure.

2.6.4 Variable Speed Pumping

This section reserved.

2.6.5 Temperature Setback

For heating loads declared as Space Heating (e.g. with *Outdoor Reset*) and/or *DHW (where a thermistor probe is used),* there are provisions for entering temperature setback intervals. During the setback period, the boiler supply water temperature target is adjusted from the pre-set fixed or floating (with *Outdoor Reset*) levels. There is a simultaneous movement in the *Indoor Setpoint Temperature* or *DHW Tank Setpoint,* to yield a consistent spread and avoid undesirable cycling. Normally users would apply this feature to achieve fuel savings during night-or-away hours. It is also possible to use the feature to set forward (up) the temperature; this may be of use for certain commercial applications where short-term high temperature DHW service is desired.

Up to 56 events / week can be programmed for each eligible load – for example, DHW can be set back twice and returned (twice) each day. The routine can be applied by specific day (Mon-Sun).

The automated setback feature cannot be applied to setpoint loads, including DHW with simple aquastat control. This is due to the lack of linkage with the thermostat; setback without linkage could lead to unacceptable cycling.

Access is via the *User Setup* screen.

2.6.6 Unoccupied Mode

Users can further reduce energy consumption by switching the boiler to the unoccupied mode during holidays or other away periods.

While in the Unoccupied mode, the DHW load is turned off, while Space Heating loads for which Outdoor Reset is activated will drop both the circulating water and the indoor setpoint temperature parameters to 50°F. Set Point controlled loads are not adjusted through this process, to avoid the potential for boiler cycling as there is no linkage with the relevant thermostat.

On the main *User Setup* Menu, select *"Occupancy Status"*, then toggle between *Occupied* (top button) and *Unoccupied* (lower button) as desired.

2.6.7 Summer Shutdown

During the Installer set up process, a cut-off level for outdoor temperature can be selected - to curtail any further space heating. This is typically used to turn off an

Outdoor Reset enabled load once the outdoor temperature reaches a threshold level e.g. 60°F. The load will be automatically reactivated once the weather returns to levels below the selected threshold. Use of this feature with a value 5° - 10°F below the *Indoor Setpoint Temperature* is strongly recommended to avoid short cycling of the boiler during very marginal heating conditions.

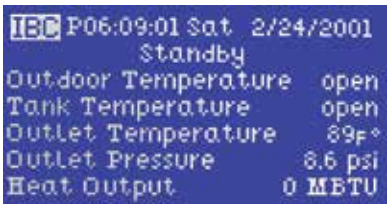
From the main Installer Setup Menu, select *"Heat Load Configuration"*, then *"Configure Load (use the load number tagged as Space Heating)"*, and drop down to "Summer Shutdown". Press Enter to select, then use the keys to move the threshold temperature to the desired level, and press the centre key again to record. The controller must receive a valid signal from the *tekmar 070* outdoor sensor, supplied with the boiler, to operate.

2.6.8 Remote / Slave Mode

Installers have the option of placing the control of the boiler under an external electronic controller (such as a *tekmar 265*). Connections are provided to receive a 0-10vDC or 4-20 mA signal for throttle management. The default configuration is 0-10V; to switch over to 4-20mA, remove the electrical box corner cover to provide access to the slotted clearance hole on the lower right corner of the control module; use needle-nose pliers to move the plastic jumper tab from the right two terminals to the left two terminals accessible through the slotted clearance hole. Where the IBC controller senses a signal on the remote connections, it automatically subordinates its internal throttle logic, and adopts the external signal. In such slave mode, temperature management is also surrendered to the external controller's sensors. The installer only enters Maximum Boiler Supply and On/Off Differential temperatures; the boiler will respond to these as high limit switches.

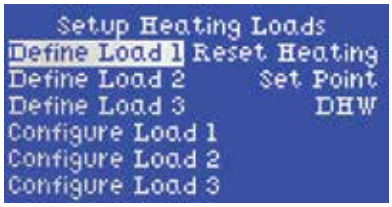
From the main Installer Setup Menu, select *"Define Load (with desired #)"*, then locate and enter *"External Control"*. Next, configure the load with the Maximum and Differential temperature values.

2.7 SET UP & LOAD DEFINITION

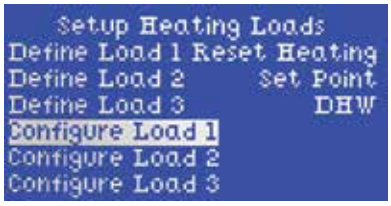


After the boiler is powered up, the installer can use the keypad and display to characterize the application, as follows:

1. In the *Standby* mode, start by pressing any key to call up the *Main Menu.*
2. Using the directional keys, move the cursor to *Installer Setup,* then depress the centre *(Enter)* key. See **Section 2.4.5. Passwords** if these are in use or desired.
3. Select *Date & Time* (and Enter), then move the cursor about to adjust time (on a 24:00 hour basis), date and invoke Daylight Savings if appropriate. Use the upper key to increase a value (e.g. date, time, temperature), the bottom key to reduce. Note that it is often possible to move in steps of 10 or 100 by moving the cursor right or left once a field has been selected for adjustment. Hit the *Enter* key to record the desired / amended information after each value has been selected.
4. Use the left-most key to step back to the *Installer Setup* screen, and select *Heat Load Configuration* for input of the load characteristics.



5. Each of the boiler's 3 Load positions can be configured for any type of heating. VFC boilers are factory shipped with default settings as follows: Load 1 set as *Space Heating* or *Reset Heating,* with H*igh Mass Radiant Floor* set as the terminal type; Load 2 as Set Point; and Load 3 as DHW. The factory defaults can be changed using the *Define Load 1-2-3* lines to reverse the order, turn off a Load or do whatever the installer desires.



6. Once the appropriate *Loads* are set, use the left-hand key to move back to the *Setup Heating Loads* screen, then move down to *Configure Load 1* (and hit enter).

7. The screen will display the input fields appropriate to the nature of the load selected, e.g. *Design Outdoor Temp.* for a *Space Heating* (or *Reset Heating*) load. Note: these fields are pre-loaded with default values that are to be altered to reflect the desired parameters.

8. For reset loads, the initial selection to be made addresses the "emitter" type – choices include H(high) Mass Radiant, L(ow) Mass Radiant, Baseboard, Air Handler etc. An appropriate reset curve is called up through this procedure. Reset loads carry a default value for *Design Outdoor Temp.* of -10°F (-23°C). Raise or lower this as appropriate – e.g. for Vancouver, use 19° to 25°F, while for Edmonton -35°F would be appropriate. Note: - for some users, this adjustment may seem counter-intuitive. Moving the setting toward a colder design value will have the effect of *reducing* the boiler's target temperature for any given weather, because a given current condition is relatively warmer than the designated "coldest" day.

Moving down the screen, set the *Design Supply Temperature* – the targeted temp. for circulating water on the coldest day. For an in-slab radiant floor this would typically be 125°F (50°C). For finned tube baseboards typically driven at 180°F, try 160°F max. instead, to promote combustion efficiency. For air handlers, try running 20°F lower than typically used. Of course, the appropriate setting will depend on the characteristics of the emitter and the building but in general the VFC modulating boiler's large throttle turndown will allow better *average* temp. control, permitting lower *maximums.*

9. For Reset Loads, move down the screen again to display more lines;

Use the *Summer Shutdown* field to enter a threshold temperature for the avoidance of heating during warmer times. This is typically set at 60° to 65°F so as to eliminate excessive boiler cycling in marginal heating conditions.

Use the *Minimum Temp.* field to optimize boiler run times on low mass loads. Finned tube baseboards sink very little heat when operated below 100°F; application of a "full reset curve" (e.g. 160°F right down to a 70°F room target) would cause boiler cycling in light-to-moderate heating conditions. Set baseboard minimums at 100-120°F and aim for 4 or less cycles/hr. A minimum setting can also be used to enhance home comfort with single or excessive speed air handlers to avoid the cool blast effect. Set the lowest possible level for combustion efficiency. IBC's high efficiency fully modulating air handlers (AH60 or CAF60) can use a minimum as low as 100°F to achieve up to 95% efficiency when combined with the VFC modulating boiler's wide throttle turndown.

10. For all loads, select and enter a *Maximum* allowable temperature and on/off *Supply Differential Temp.* Note these values must be input; they are not automatically assigned as done within some boiler controls. Ensure the Maximum takes account of the construction and safety requirements of each application – e.g., 140°F max. for typical in-slab radiant floor, for avoidance of thermal stress. The Differential shall be set to offer a reasonable temperature control range (suggested values: 22°F for high mass radiant // 40°F for low mass baseboards // 30°F for DHW). Ensure that the spread between the *Target* and *Maximum* temps is greater than one half of the *Differential* (e.g. for a radiant floor *Design Supply Temperature* of 125°F and a *Maximum* of 140°F, a differential of 22°F (half of which is 11°F) fits nicely.

11. Avoid situations where the *Maximum* is close or below the potential Target, or the boiler will cycle off its (software) water high limit.

12. Priority:- where more than one load is present, it is critical that a value be entered to allow reasonable load scheduling *(see Section 2.6.1).*

13. At the lower end of the Load 1-2-3 setup screen, there are 4 lines available for "mapping" of sensor inputs.. For example, *"Indoor Temp. from …..Indoor"* indicates that the boiler will look for a signal from an indoor sensor on the Indoor Sensor wiring contacts. Failing a valid signal, the screen will display *"Indoor Temp. …..Open"*, and there will be no effective indoor trim of the reset curve. These lines do not require amendment at most installation sites. The mapping feature allows reassignment of the sensor contacts to support non-standard functions. For example, re-allocation of the Water Temp. signal from "(boiler) *Outlet*" to *"Secondary Loop"* will allow the throttle management routine to manage a secondary loop temperature rather than the boiler's own direct supply temperature. Use this when injecting into a commercial heating: cooling loop. Another possibility: two separate reset channels – each with its own indoor trim. Sensor ports open for such re-assignment are DHW, Indoor, Outdoor and Secondary Loop.

14. The final 3 lines are for the motorized mixing valve option. See separate documentation for this.

15. To compensate for altitude at the installation site, use the *Altitude* adjustment feature, found in the front *Installer Setup* menu (several lines below *"Heat Load Configuration"*. Key in the altitude – in hundreds of feet above sea level. For example, an installation at 2,860 feet should be entered as "29" (as rounded to the nearest hundred).

16. Two lines below *Altitude* adjustment is the field for amendment of the primary pump heat purge time. To shorten the 5 minute post-firing period, reduce the 300 second interval to as low as 60 sec. Similar adjustment of secondary pump run time can be made in the *Heat Load Configuration / Configure Load 1,2,3* fields (down to zero sec.= off).

17. With software versions 3.10.0 and higher, the controller allows two loads of compatible temperature settings to be run together. *See IBC Technical Note: Load Pairing for further details.*

18. Upon completion of the input of load parameters, use the left button to step back through the menu system to return to the Operating Status screen.

19. To enact the control arrangements as input, it is necessary that the piping structure and system wiring are configured appropriately *(refer to Section 1.6.2 Installation Rules, page 1-20 for piping layouts and the Wiring Schematics on pages 6-7 and 6-8).* Ensure that DHW aquastat or thermistor probe leads, thermostat and pump (or zone valve) leads are connected at their respective contact points on the terminal block.

20. Forced shutdown: – use the *Heat Load Configuration* screen to switch off load(s) to remove a call for heat, if no other means are readily available. **Simple removal of power to boiler is to be avoided – this interrupts the moisture management routine.** Treat the unit as you would treat a computer, allowing an orderly shutdown.

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3.0 STARTUP AND COMMISSIONING

3.1 LIGHTING AND SHUTTING DOWN THE BOILER

FOR YOUR SAFETY READ BEFORE OPERATING

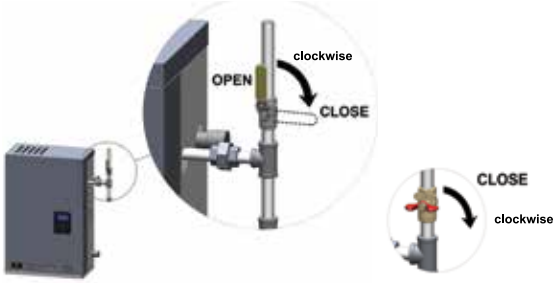
WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life

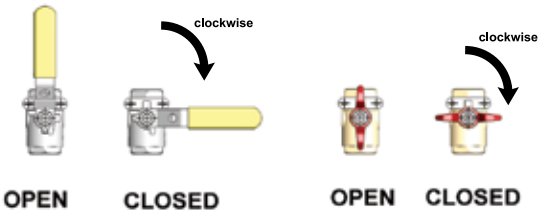
A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will 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 supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

C. Use only your hand to turn the gas control valve. Never force using tools. If the valve will not turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.
D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

OPERATING INSTRUCTIONS

1. STOP! Read the safety information above on this label before doing anything.
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. Locate manual gas shut-off valve (see pictures below) and turn clockwise to "CLOSE".
6. Wait five (5) minutes to clear out any gas. Then smell for gas, including near the floor. If you smell gas, STOP! Follow step "B" in the safety information above on this label. If you don't smell gas, go to the next step.
7. Turn gas control valve to OPEN.
8. Turn on electric power to appliance by selecting main power switch to ON.
9. Set thermostat to desired setting.
10. If the appliance will not operate, follow the instructions "TO TURN OFF GAS APPLIANCE" and call your service technician or gas supplier.





TO TURN OFF GAS APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn off all electric power to the appliance by selecting main power switch to OFF.
3. Turn gas control valve to CLOSE.

3.2 PRIOR TO START-UP

Inlet gas supply pressure test port

⚠ WARNING

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.

Failure to comply will result in severe personal injury or death.

3.2.1 Pre-Ignition Checks

1. 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, that any holes left from removal of a previous boiler have been sealed, and that any resizing of the old flue has been done. Fill condensation trap to full neck height.
2. Check water piping system is fully flushed and charged, and that all air has been discharged through loosened bleed caps. Note it is possible to switch all pumps on/off from the keypad – without a call for heat. This greatly simplifies system filling and air bleeding (go to *Installer Setup*, drop down to *Pump Purge* and toggle to *On*. When complete, return to *Off*, or this will automatically occur with a call for heat). Use a minimum water pressure of 12 psig. And confirm pressure relief valve is installed and safely drained.
3. Perform a final check of electrical wiring.
4. Using a manometer, check to see that adequate gas pressure is present at the inlet gas supply test port. Requirements are minimum 3” w.c and maximum 14” w.c.

3.2.2 Test Ignition Safety Shutoff

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 the appropriate Error information is displayed on the LCD screen. To restart boiler, reset power.

3.3 COMMISSIONING

Manifold pressure test port

⚠ DANGER

Making adjustments to the IBC gas valve without a properly calibrated gas combustion analyzer and by persons who are not trained and experienced in its use is forbidden. Failure to use an analyzer can result in an immediate hazard.

The VFC modulating boilers are factory calibrated to operate with natural gas (or propane if so ordered) at sea level. The relevant valve adjustment screws have been factory sealed using Loctite thread-lock compound, which can be broken where required. However, **no mixture adjustment shall be performed unless done by a qualified technician using properly functioning combustion analyzing equipment.**

Upon initial set up, the installer can enter the site elevation to compensate for altitude. Without such intervention, the gas valve will automatically de-rate the maximum input in accordance with the density altitude, at approximately 2% per 1,000’ above sea level. The gas valve’s zero governor will ensure that the gas:air mixture is not affected at altitude.

To verify the proper operation of the gas valve in the field, the following procedure can be carried out by a qualified technician *(see Figure 31).*

1. with a small (1/8" or 3 mm) flat screwdriver, open the manifold pressure test port by turning its centre- screw 1 full turn counterclockwise. Attach a manometer between the manifold pressure test port and the reference line.
2. Allow the boiler to ignite / run against a large load, to maintain high fire
3. With the boiler at maximum output, use a 2 mm hex key to adjust the zero-offset *(see Figure 31, “A”)* as required to achieve 0” wc. This adjustment is only necessary if this screw has been tampered with.

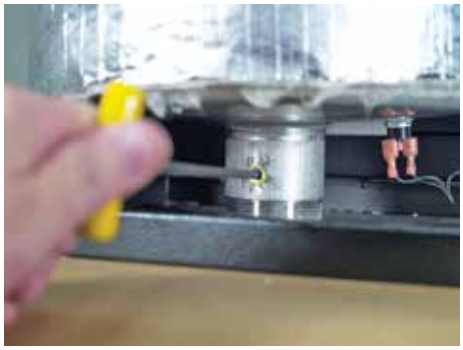
Zero-offset adjustment screw

Gas:Air ratio adjustment screw

⚠ NOTE

Upon installation of this boiler, you must use an indelible marker on the rating plate to mark an X in the box associated with the fuel used.

4. With a combustion analyzer probe in the flue gas test port, turn the Gas:Air Ratio Adjustment screw *(see Figure 31, "B")* to achieve 28% excess air (corresponding CO2 values are 9.2% for natural gas and 10.4% for propane). This screw offers very fine adjustment, and may require several turns. **NOTE:** This screw has significant backlash. When changing direction of turn, it may take up to a full turn before any change is indicated on the analyzer reading. Clock the gas meter to confirm full maximum rating plate input.
5. To confirm or adjust the minimum fire level settings, Re-define the load as "Manual Control". Use Heat Output in "Configure Load x" to control the output as needed.
6. At the minimum firing rate, adjust the zero-offset screw *(see Figure 31, "A")* to obtain 28% excess air. It may be necessary to reduce the output in stages if this adjustment has been tampered with.
7. Turn boiler off by removing the call for heat (use the Heat Load Configuration screen to turn load to off if no other ready means available), then remove the manometer connections, and turn the centre-screw in the manifold pressure test port 1 full turn clockwise. Ensure fully closed, but not over-tightened.



Removal of flue gas test port plug

Insertion of flue gas analyzer probe

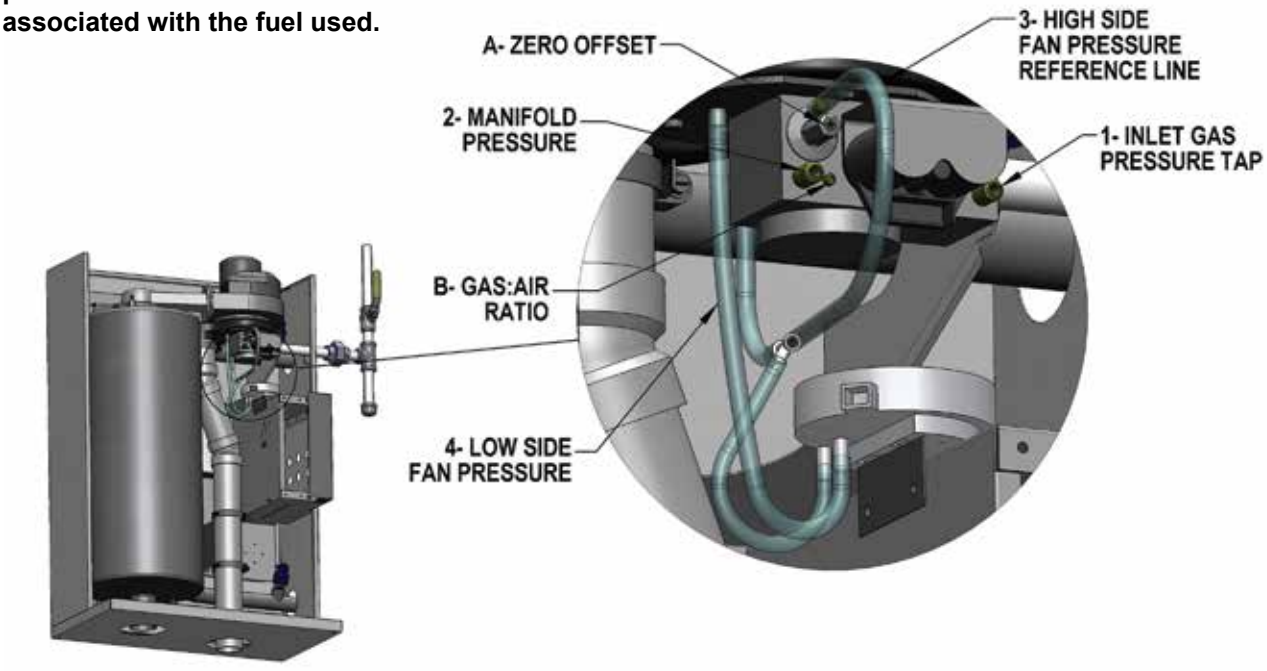


Figure 31: Gas Valve and Pressure Reference System

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4.0 MAINTENANCE

4.1 BOILER MAINTENANCE

⚠ CAUTION

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.).

4.1.2 Inspection

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

⚠ CAUTION

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

4.1.3 Venting

- Check vent terminals for and remove any obstructions (e.g. leaves, dust, other debris).
- Check, and clean or replace intake air filters or screens as required.
- 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.
- Ensure proper resealing or reinstallation of venting on each servicing.

⚠ WARNING

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.

Failure to comply will result in severe personal injury or death.

4.1.4 Condensate Traps

- Open PVC union to drain, watching for mud / debris. Flush and refill.
- If condensate neutralization is used, check pH level of condensate discharge.

4.1.5 Burner

- Remove burner to inspect for extent of fouling. Blow clear using compressed air. Evaluate the magnitude of clearing required, and establish a reasonable burner inspection schedule. Some boiler / locations may call for annual service, others showing clean burners will only need attention every 2 – 5 years. Consider adding air filtration if burner requires cleaning every year. In alternate years, visually inspect burner through sight glass. Ensure flame is stable and without excessive fluttering. Normal flame pattern is evenly distributed over the burner surface.
- If burner is operating improperly, remove and clean or replace. Use a CO2 analyzer to determine proper combustion. CO2 level should be 9.0% (for natural gas) or 10.2% (propane).
- When re-installing burner, ensure it is inserted so that the seam (that runs along the length of the metal-fibre surface) is placed as far away from the ignitor as possible (180° rotation arc away). Also confirm spark gap is 1/8". Confirm visually by removing viewport, turning gas supply OFF, and allowing the boiler to run through an ignition cycle. Compare the spark length with the spark rod diameter, which is the same 1/8" (e.g. use the rod as a reference).

⚠ WARNING

Whenever the burner is removed for inspection or boiler servicing, the sealing gaskets must be examined and replaced if damaged. Upon re-assembly, an approved leak test solution must be applied around the burner flange sealing area to ensure there is no leakage of combustible gas/air premix.

⚠ CAUTION

The IBC heat exchanger has a small amount of combustion chamber insulation (refractory), which contains ceramic fibers.

When exposed to extremely high temperatures, the ceramic fibers, which contain crystalline silica, can be converted into cristobalite - which is classified as a possible human carcinogen.

Care should be taken to avoid disturbing or damaging the refractory. If damage occurs, contact the factory for directions.

Avoid breathing and contact with skin and eyes and follow these precautions:

1. For conditions of frequent use or heavy exposure, respirator protection is required. Refer to the "NIOSH Guide to the Selection and Use of Particulate Respirators Certified under 42 CFR 84" for selection and use of respirators certified by NIOSH. For the most current information, NIOSH can be contacted at 1-800-356-4676 or on the web at www.cdc.gov/niosh.

2. Wear long sleeved, loose fitting clothing, gloves and eyes protection.

3. Assure adequate ventilation.

4. Wash with soap and water after contact.

5. Wash potentially contaminated clothes separately from other laundry and rinse washing machine thoroughly.

6. Discard used insulation in an air tight plastic bag.

NIOSH stated first aid:
Eye contact - Irrigate and wash immediately.
Breathing - Provide fresh air.

4.1.6 Heat Exchanger

During burner inspection (with the burner removed), examine the heat exchanger tubes adjacent to the burner's normal position. In areas of poor gas quality, there may be a buildup of black plaque (typically sulfur). Other fouling agents: airborne dust, debris and volatiles.

The VFC heat exchanger has a larger surface area and significantly larger flue-paths than other condensing boilers; consequently it has more resilience to fouling. Clean when the gaps between the tubes become blocked with plaque, in accordance with Technical Notes "HEAT EXCHANGER CLEANING Version 1.2". Anticipate action every 2 – 5 years for typical residential use, or annually for boilers in commercial applications. Hard working boilers may need more frequent inspection and cleaning. Newer models are equipped with an internal "hours of use" timer, which will alert users when cleaning is required.

4.1.7 Pump

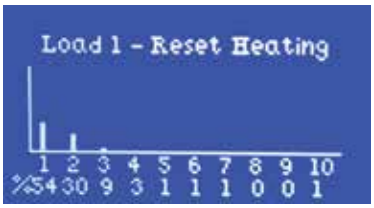
Check that the pump is on in normal operation and that the water Δ°T is reasonable for a given firing rate (e.g. 10°F between supply and return when firing at 75,000 Btu/hr. for a VFC 15-150 unit).

4.1.8 Gas Piping

Check for damage or leaks and repair as needed.

4.1.9 Control Module

- Check that boiler operation is consistent with the steps in **Section 2.5 Sequence of Operation**.
- Check that water temperature targets and setpoint is satisfactory and have not been adversely amended.
- Check the operating history using the screen: - use *Installer Setup // Logs*, to scan for hours of service, cycles per hour, and any logged errors. One method is to use the graphical presentation of the duty cycle by load – go to Logs, move the cursor to a load and push "Enter" to access. This gives a profile of the boiler's duty cycle by throttle level – see below.
- The first screen (below) shows that this boiler (a 15-150) has operated for 54% of total Load 1 on-time at the bottom 10% of the throttle range (e.g. between 15,000 to 27,500 Btu/hr.).



- Where a load is heavily weighted to the lowest firing rate and the cycles/day count is in excess of 96/day, there may be insufficient loading of the boiler. Consider increasing the temperature target for such load and/or the respective Minimum Temperature setting.
- If a problem exists with the control, consult troubleshooting guide.

⚠ WARNING

For service replacement of the fan on the VFC 45-225 boiler, *use the NRG-137*; DO NOT ATTEMPT TO PLACE A RG-148 FAN (as used on previous versions of the VFC 45-225 boiler) ON A BOILER HAVING A CONDENSATE TRAP DEPTH OF LESS THAN 28" – an RG 148 fan can blow a clear a shorter trap, allowing noxious fumes to enter living space.

⚠ WARNING

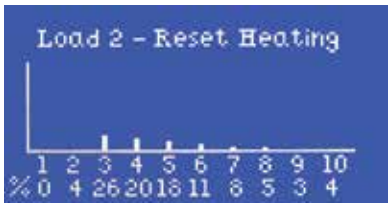
Do not use automotive-type ethylene or other types of automotive glycol antifreeze, or undiluted antifreeze of any kind. This may result in severe boiler damage. It is the responsibility of the Installer to ensure that glycol solutions are formulated to inhibit corrosion in hydronic heating systems of mixed materials. Improper mixtures and chemical additives may cause damage to ferrous and non-ferrous components as well as non-metallic, wetted components, normally found in hydronic systems. Ethylene glycol is toxic, and may be prohibited for use by codes applicable to your installation location. For environmental and toxicity reasons, IBC recommends only using non-toxic propylene glycol.

⚠ CAUTION

Installers should inquire of local water purveyors as to the suitability of their supply for use in hydronic heating systems. If water quality is questionable, a local water treatment expert must be consulted for testing, assessment and, if required, treatment. Alternatively, water or hydronic fluid of known quality can be brought to the site.

- The second screen (below) shows another boiler (a 45-225) has operated for 26% of the total Load 2 on-time at the bottom 30% of the throttle range and virtually no time below that.

  Interpretation of this type of operation must be done carefully, by observing the system as it runs. This could either be a classic case of over-sizing to a load that cannot sink heat fast enough, resulting in short cycling - OR - it may be normal and healthy operation for some loads, such as air handlers or heat exchangers that can always sink heat above the lower firing rates.



4.1.10 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.

4.1.11 Freeze Protection

Check freeze protection. 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.

4.1.12 Boiler Treatment

- Check consistency of any boiler treatment used (e.g. Furnox™), for appropriate mixture. Chemical inhibitors are consumed over time, lowering their density.
- Verify proper operation after servicing.

4.1.13 Relief Valve - Maintenance and Testing

The relief valve manufacturer requires that under normal operating conditions a "try lever test" must be performed every two months. Under severe service conditions, or if corrosion and/or deposits are noticed within the valve body, testing must be performed more often. A "try lever test" must also be performed at the end of any non-service period.

Test at or near maximum operating pressure by holding the test lever fully open for at least 5 seconds to flush the valve seat free of sediment and debris. Then release the lever and permit the valve to snap shut.

⚠ CAUTION

Before testing the relief valve, make certain the discharge pipe is properly connected to the valve outlet and arranged to contain and safely dispose of equipment discharge.

4.2 COMPONENT DESCRIPTION

A diagram of components and their placement can be found at the end of this manual. To obtain service parts, contact your installer, telephone IBC Technologies or visit our website at *www.ibcboiler.com*. The following list provides a summary description of major components:

Fan/Blowers: 15-150(L), 45-225(R)

4.2.1 Fan/Blower

PART#/TYPE: RG130 – IBC # 240-040 (VFC 15-150)
RG137 – IBC # 240-048 (VFC 45-225)

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

INSTALLATION: Fan removal is done at the flange (4 x #10-32 x 7/8" hex head) and the gas valve (3 x M4 x 30mm Phillips head self tapping screws accessible for the underside of the gas valve; for improved access – remove vinyl air reference tubes and black air pressure sensor.

4.2.2 Gas Valve

TYPE: IBC # 180-022

FUNCTION: zero governor gas valve provides strict gas/air mixture control over the range — 15 - 150 MBH for VFC 15-150 or 45 – 225 MBH for VFC 45-225.

INSTALLATION: *see Section 3.3 - Commissioning, for gas valve adjustments*

4.2.3 Direct Spark Ignition Module

TYPE: Fenwal 240-004B (alternate Capable Controls 240-049)

FUNCTION: microprocessor based spark generator and flame proving control with 15 sec. pre-purge; 3 try before an auto re-setting 1 hour lockout.

INSTALLATION: *(see Diagram 6.1-1 for correct position).* Use IBC # 180-011 suppression cable as the ignition lead.

Air pressure sensor removal showing reference line connections

4.2.4 Differential Pressure Sensor

TYPE: Air Prove Switch (IBC # 240-003)

FUNCTION: precise measurement of combustion airflow for operating control.

INSTALLATION: *(see Figure 31 for correct connection of air reference lines).*

Main combustion components (clockwise from left) Burner, with ignitor and V clamp - Fan coupler - Fan/Blower - Mixing plates & housing - Gas valve

Combustion group assembly

Control Module removal

Disconnecting Control Module plugs

4.2.5 Water Pressure Sensor

TYPE: Water Pressure (IBC # 240-006)

FUNCTION: water pressure and flow sensing.

INSTALLATION: *(see Diagram 6.1-1, and Diagram 6.1-2, 31 for correct position).*

4.2.6 High Limit

PART#/TYPE: IBC # 240-032 High Limit calibrated for 200°F, 15°F differential.

FUNCTION: Shuts boiler off when water temperature exceeds safety limit.

INSTALLATION: *(see Diagram 6.1-1 for correct position).* 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: IBC # 240-008 Primary- 120 VAC; Sec.- 24 V AC; 40VA control transformer.

FUNCTION: Provides 24 VAC for the control board, for (1) the control / safety circuit, (2) relays for pump and zone valve control, plus (3) input to DC power converters for 5 V and 12 V circuits (NB not for use to power external zone valves).

INSTALLATION: *(see Diagram 6.1-1 for correct position).*

4.2.8 Temperature Sensors

PART#/TYPE: IBC # 240-006 Thermistor; 10,000Ω with Beta = 3892

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

INSTALLATION: *(see Diagram 6.1-1 for correct position).* Use 1/4" nutdriver to loosen ring clamp. Install with back curve toward pipe using Honeywell Tradeline #107408 Heat Conductive Compound and re-tighten ring clamp. Warning! - Do not over-tighten clamp as this will damage sensor.

4.2.9 Control Module

PART#/TYPE: IBC # 500-001 Universal Control Board

FUNCTION: *(see Section 2.0 Boiler Systems And Operation for an explanation of controller function).*

INSTALLATION: *(see Diagram 6.1-1 for correct position).* 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 connectors on the edge and back of the control module. Place fingers on the board edge only when handling.

There is a 3V lithium battery (IBC # 240-024) for powering the permanent memory if AC power is not connected.

On-board field replaceable fuses (IBC # 240-023) are 5A, slow blow, 5mm x 20mm, and must be replaced using these same specs.

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5.0 TROUBLESHOOTING

The troubleshooting section is divided into 3 sections:

5.1 Preliminary Checks

5.2 Electronic Components

5.3 Troubleshooting Guide

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:

5.3.1 Using Control Module Errors Displayed

5.3.2 Ignition Problems

5.3.3 Cycling Problems

5.3.4 Temperature Problems

5.3.5 Miscellaneous

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

Also provided with this manual are a number of diagrams *(see Section 6.0)* for use with troubleshooting including:

- Electrical Wiring Diagrams
- Sequence of Operations Flowchart
- Boiler Component Layout Diagrams

5.1 PRELIMINARY CHECKS

The first step in troubleshooting this system should be a review of the Controller's LCD screen. There are a number of diagnostic features incorporated in the software that evaluate system integrity, display error conditions and provide initial suggested remedial actions *(see Section 2.5.6 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 (e.g. display is lit).
2. Check that boiler is not in a safety lockout.
3. Ensure wiring is clean and secure.
4. Check that gas is reaching the unit.
5. Confirm water system is properly charged to 12 psig and pump is serviceable.

5.2 ELECTRONIC COMPONENTS

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

5.2.1 Temperature Sensors

Return water temperature sensor

The resistance of the temperature sensors varies inversely with temperature. To test, measure the temperature of the sensed environment and compare with the value derived from the measurement of the resistance (obtained by connecting a good quality test meter capable of measuring up to 5,000 kΩ (5,000,000Ω) at the controller end of the sensor lead).

To obtain a resistance reading, remove power to the boiler. Locate the blue 2-wire leads coming from the thermistors, which are affixed to the boiler supply and return piping to the right of the heat exchanger. Disconnect the Molex connectors located approx. 6" from the sensors. Place multi-meter probes into Molex socket. Do not apply voltage to the sensor as damage may result.

Sensors are sensitive to excess binding force, which can distort the internal dielectric isolation. Use modest tension only when affixing sensor to pipe.

10KΩ sensors supplied with boiler

2 x Water temperature sensors - (L)
1 x Outdoor sensor - (R)
See table #8 for resistance values

TEMPERATURE		RESISTANCE	TEMPERATURE		RESISTANCE
°F	°C	Ω	°F	°C	Ω
0	-18	85,362	100	38	5,828
5	-15	72,918	105	41	5,210
10	-12	62,465	110	43	4,665
15	-9	53,658	115	46	4,184
20	-7	42,218	120	49	3,760
25	-4	39,913	125	52	3,383
30	-1	34,558	130	54	3,050
35	2	29,996	135	57	2,754
40	4	26,099	140	60	2,490
45	7	22,763	145	63	2,255
50	10	19,900	150	66	2,045
55	13	17,436	155	68	1,857
60	16	15,311	160	71	1,689
65	18	13,474	165	74	1,538
70	21	11,883	170	77	1,403
75	24	10,501	175	79	1,281
80	27	9,299	180	82	1,172
85	29	8,250	185	85	1,073
90	32	7,334	190	88	983
95	35	6,532	195	91	903

Table 8: Temperature Sensor resistance values

5.2.2 Fan/Blower

Control wire plug

Unplug to run fan full speed

Operating power is provided by means of a separate 120 VAC connector at the back of the fan (white/black/green). Control of the fan is provided via a four lead connector at the front of the fan. This connector feeds a PWM control signal (black wire) from the controller and provides a tachometer signal (white wire) back from the fan. Unplugging the connector will cause the fan to go to high speed and trigger a “Blocked Vent Error” within 6 seconds if the boiler is operating.

LEAD COLOR	FUNCTION	TROUBLESHOOTING
Red	35 VDC Positive power terminal	Fan will only operate at max. speed if disconnected.
Blue	35 VDC Negative power terminal	Fan will only operate at max. speed if disconnected.
Black	Signal from controller	Fan will only operate at max. speed if disconnected.
White	Fan tach.	2 pulses/rev (freq x 30=rpm)

Table 9: Fan Operation

5.2.3 Differential Air Pressure Sensor

Removing circuit board cover

Circuit board revealed

Go to the *Advanced Diagnostics* screen, and with the fan off (*“Fan Duty Cycle* = 0) look for a *Fan Pressure* reading of 102 +/-5. Next check with fan in operation, and look for an increased *Fan Pressure* value. In normal operation, the *Fan Pressure* reading should move toward the *Required Pressure* value. A backward movement in *Fan Pressure* indicates the clear vinyl reference lines have been reversed.

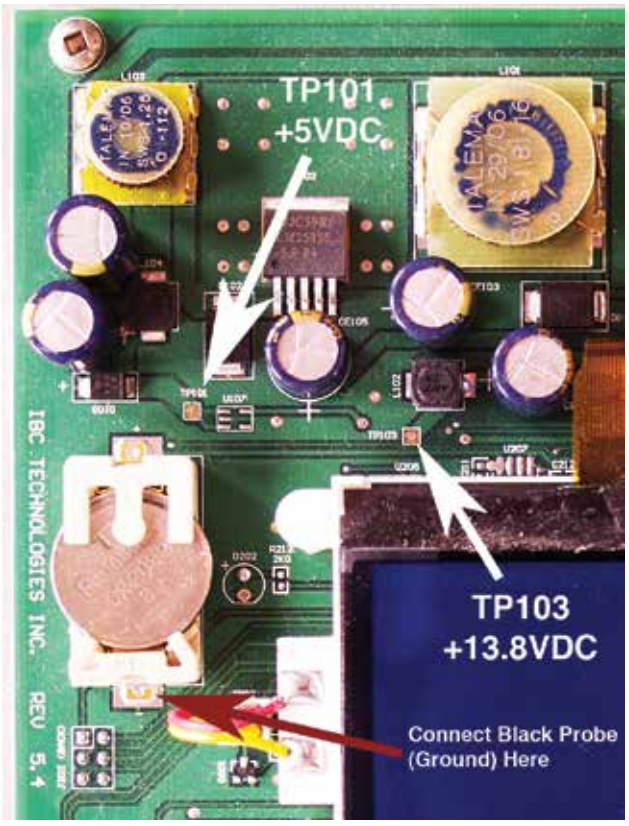

Figure 32 (right): Test points on circuit board for air pressure sensor voltage readings

Air pressure sensor mounting

Do not blow into sensor ports

Return water pressure sensor

Fenwal ignition module - Microamp (µA) test points are shown at top right corner of module (above red L.E.D.)

Next, confirm that the circuit is properly powered. The supply voltage to the sensor should be 13.8 VDC; to check, the simplest technique is to measure the circuit on the face of the controller circuit board (vs. an attempt to splice into the harness / connectors). See above for a presentation of the measurement points.

Finally, to measure the sensor output, connect a DC volt meter between points “J501-33” (located on the footprint of the 34 pin connector – immediately below the right leg of the LCD display - second pin from bottom right) and GND (see above). With the fan off, the measure should read 0.5VDC. With a Fan Pressure of approx. 300, the meter will read 1.5v (approx.). Note:- this component is a sensor, not a switch; do not over-pressurize by blowing into the air reference lines. Maximum pressure capacity is 40” w.c. @ 20 C but only 10” w.c. @ 5C.

5.2.4 Water Pressure Sensors

Go to the *Advanced Diagnostics* screen, and check the top 2 display lines — Inlet Pressure and Outlet Pressure. With the pumps at rest and system pressure of 12.5 psi, the *Inlet Pressure* and *Outlet Pressure* sensor values should read 235 +/- 5. Of the two, while at rest, the Inlet normally reads 1 – 2 points higher, reflecting the extra 2' of water column. The third displayed line Delta Pressure will normally indicate a value of approx. 20 with pump in operation. The location of the boiler pump will determine the movement of valid sensor values; in general, inlet pressure will increase while the outlet will decrease when the pump starts.

Check operation of both sensors by isolating the boiler from its system piping, closing the system fill valve then cracking the pressure relief valve; both signals should reflect declining pressure. If one or both remain “fixed”, drain boiler and replace sensor(s), or dislodge any blocking debris from sensor inlet channel and reinsert. To remove a red-coloured “502” sensor, it is necessary to release a stainless steel retaining clip at the base of the unit (see **Section 6.1 Parts Diagrams**, part #65). Before refilling system, ensure the 502 sensor retainer clips are properly re-installed. The black “505” sensors are threaded and do not use the retainer clip system.

5.2.5 Hi-Limit Switch (water and vent)

Check resistance between leads. If resistance is very low, temperature should be acceptable. If resistance is very high, temperature should be out of bounds. A simple means of checking whether a high limit switch is open is by measuring the AC voltage across the device. If the reading is 24 VAC the switch is open. If a 0VAC reading is shown, it is closed. NEVER connect an ohm-meter or continuity checker across a live circuit.

5.2.6 Ignition Module

There are two approved ignition modules - Fenwal (grey) and Capable Controls (white). Each have a red LED lamp providing the following signals: Fenwal – 1 rapid flash on 1st entering Pre-purge, 3 rapid flashes upon Failure to Ignite After 3 Attempts; the Capable Controls module provides a single flash at the start of each Purge and Interpurge cycle, continuous rapid flashes during the 4 second spark interval, solid illumination following successful ignition until burner shutdown, and a slow on/off cycle with a 3-try failure.

Flame current can be monitored on the Fenwal. Connect an electrical test meter - set to read Microamps (symbol µA) to the two test pins at the top right of the ignition module. Recycle the boiler so it enters another trial for ignition and monitor the flame current reading. When the burner ignites, a steady reading of

2-7 Microamps should be measured by your meter. The control will lock out if the reading drops below 0.7 Microamps. *(see Section 5.3.1 - "Control Module - Maximum ignition trials error", and Section 5.3.2 - "Ignition problems").* For conversion from Fenwal to the Capable Control, specify IBC part# 240-049 – that provides the module plus added wire lead and instructions.

5.3 TROUBLESHOOTING GUIDE

5.3.1 Using Control Module Errors Displayed

SYMPTOM	DIAGNOSIS	REMEDY
AIRFLOW ERROR **LCD Screen Message:** *Error – Insufficient Air Flow - Check Venting* *Insufficient combustion airflow; soft error; will retry in 5 minutes* **⚠ WARNING** **Never attempt to repair the control module (circuit board). If the control module is defective, replace it immediately.**	**Check fan operation**	• Check lead is attached at fan. • Cycle power off/on; listen for fan initialization. If no action, focus your attention on the fan itself.
	Check for fouled reference lines and air sensor	• Check clear vinyl air reference lines below gas valve for any sign of water. After disconnecting from black sensor, blow clear. Check for exhaust re-ingestion, or repeated power interruptions . • Ensure condensate trap is not blocked. • Go to Advanced Diagnostics and check differential air pressure sensor (at rest and with fan on). See **Section 5.2.3**.
	Check achieved fan power	In Advanced Diagnostics, during Pre-purge, Fan Pressure (FP) should move close to Required Pressure (RP); if FP only 120-150 vs. RP of 250 or 300, then check for actual vent system blockage: (a) disconnect intake within boiler case; (b) open burner then fan/gas valve looking for debris.
	Water noise in vent. Excess condensate in venting.	• Check condensate trap for obstructions. Remove obstructions and refill condensate trap with water. • Check vent length, size and configuration, particularly re: horizontal 2" piping.
WATERFLOW ERROR **LCD Screen Message:** *Error - No Water Flow* *Low water flow – soft error; will retry in 5 minutes*	**Check pressure sensors**	• Check wiring: water pressure sensors to controller. • Check pressure sensors. See **Section 5.2.4** – 2nd paragraph.
	Check for proper piping	Refer to **Section 1.6 Water Piping** for recommended piping installation.
	Check primary pump	If there is a valve on the primary loop, close it and listen for cavitation (evidence flow). If not, go to Installer Setup; select pump purge “on” to run pumps without a heat call - check for heat buildup at pump body (indicates no flow).
	Check for restriction in water pipe	Check temperature differential across heat exchanger at low –medium firing rate if possible. Examine air strainer components for scale.

SYMPTOM	DIAGNOSIS	REMEDY
MAXIMUM IGNITION TRIALS ERROR **LCD Screen Message**: *Error – Ignition Failure after 3 tries* *Boiler has failed to ignite on 3 successive attempts. Boiler in lockout for 1 hour, then repeats 3-try seq. Consult service technician if error recurs.*	**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 or gas line not fully purged.	Check for gas flow. Open manual gas shutoff and reset boiler.
	Gap between igniter probe and burner is too large or too small.	Adjust gap between igniter probe/flame sensor and burner to a distance of 3/16" (turn off gas supply and remove viewport for best visibility; use profile of 1/8" diameter ignitor rod to gauge distance)
	Spark, but no ignition.	Check spark module is sending power to gas valve – close gas supply, then disconnect (black) electric housing from face of gas valve, gently spread plastic tabs to open, and look for 24vac voltage between blue and brown wires during an ignition cycle. Replace module if no current detected
	Boiler ignites, but shuts off at the end of the ignition trial. Improperly grounded pressure vessel/burner or unserviceable ignition lead or spark module.	• Ensure pressure vessel is grounded. • Check the igniter probe/flame sensor is electrically isolated from the vessel, and its ceramic insulator is intact. • Replace ignition lead • Replace spark module
HI LIMIT ERROR **LCD Screen Message:** *Error – Water High-Limit Exceeded* *Water temperature exceeds hi-limit. Boiler in hard lockout. Will reset in 1 hour. Consult service technician.*	**Defective or disconnected hi-limit switch.**	• Check wiring to hi-limit switch and control module. • Check hi-limit switch. See **Section 5.2.5**.
VENT HI-LIMIT ERROR **LCD Screen Message:** *Error - Vent High-Limit Exceeded *** Call for service!* *Vent temperature has exceeded the vent limit switch. Boiler in lockout. Consult service technician.*		• Check wiring to ensure sensor is properly connected to control module. • Check for evidence of any damage to vent system. • Push manual reset button, maintain constant watch during boiler operation to evaluate vent temperature at maximum operating settings to ensure no unsafe condition exists, e.g. max flue temp. within allowable limits for exhaust pipe material used.

SYMPTOM	DIAGNOSIS	REMEDY
TEMPERATURE SENSOR ERROR **LCD Screen Message:** *Error - Max. In-Out Temp. Exceed. -> Check water flow Water temperature signal not within acceptable range. Potential flow or sensor failure. Consult service technician.*	**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. See **Section 5.2.1**.
MISCELLANEOUS **LCD Screen Message :** *Blank – screen dark, but fan running Indicative of power-surge damage to appliance*		• Check transformer; replace if damaged. • Check circuit board for visible damage.

5.3.2 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.	**Fluctuating gas pressure/ gas pressure too high/too low.**	Check CO2 level via analyzer.
	Check for proper piping.	Check pressure with manometer during ignition.
BOILER WILL NOT ATTEMPT TO IGNITE. FAN AND PUMP ARE OPERATING NORMALLY.	**No power to ignition control module.**	• Check system wiring. • Check air reference 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.
BOILER WILL NOT ATTEMPT TO IGNITE. FAN AND / OR PUMP ARE OFF DISPLAY NOT ILLUMINATED	**No power to boiler.**	Check line voltage .
	Defective transformer.	Check transformer. Reconnect or replace as needed.

5.3.3 Cycling Problems

SYMPTOM	DIAGNOSIS	REMEDY
RAPID CYCLING	**Improper values entered via keypad.**	Check load maximum temps are above target temps, by 1/2 of the selected boiler differential. Ensure boiler differential is OK (16-30°F is generally adequate)
	Excess Condensate in venting.	Check venting slopes on horizontal runs. Look for sags.
	Obstruction in condensate trap.	Inspect and clean condensate trap.
	Improper vent length or improper slope to vent.	Check venting. Compare vent length and diameter to **Table 3: Maximum Venting**.
	Incorrect settings or defective thermostat.	Check operation. Refer to manufacturer's instructions. Check setting with ammeter.
	Air in system or marginal water flow.	Bleed/purge system as required. Confirm adequate pump size and temp rise in HX
	Slow combustion air blower.	Check that CO2 level is OK 9.0% nat. gas (10.2% for propane).
	Dirty burner/heat exchanger.	Check pressure drop.
	Insufficient water flow due to improper piping.	Refer to recommended piping in **Section 1.6**
	Insufficient water flow due to undersized pump.	Check manufacturer's rating charts/check temperature differential across heat exchanger.
	Insufficient water flow due to restrictions 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 over-fired.	Clock gas meter/check gas pressure with manometer/ check CO2 level.
	Unit Oversized.	Check load calculation vs. min. boiler output.
	Improperly set or defective operating/ safety controls.	Check operation with ohmmeter/voltmeter.

5.3.4 Temperature Problems

SYMPTOM	DIAGNOSIS	REMEDY
INSUFFICIENT HEAT	**Operating temperature too low.**	increase temperature target. See **Section 2.7**
	Priority parameters or load configuration improperly set up.	Review load configuration parameters. See **Section 2.7**
	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 1.6**
	System pump undersized.	Check pump manufacturer's data/check temp differential across heat exchanger.
	Poor gas/air mixing.	Check CO2 level.
	Defective thermostat.	Refer to manufacturer's instructions.
	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.

5.3.5 Miscellaneous

SYMPTOM	DIAGNOSIS	REMEDY
FUMES AND HIGH HUMIDITY	**Improperly installed condensate trap**	Refer to installation/operation instructions
	Leak in vent piping	Inspect using soap solution
	Flue gas leak within boiler	Visually inspect all mechanical connections

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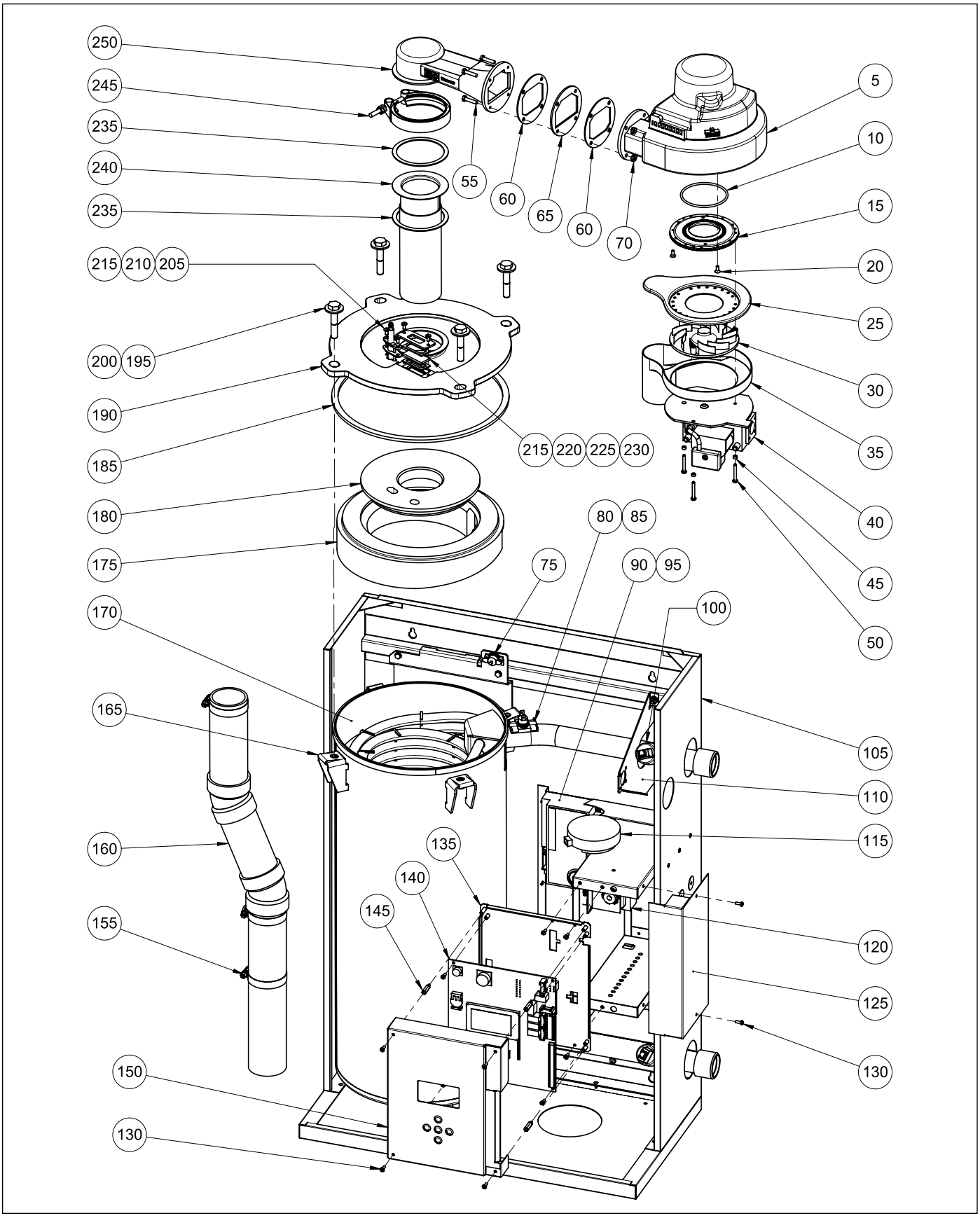
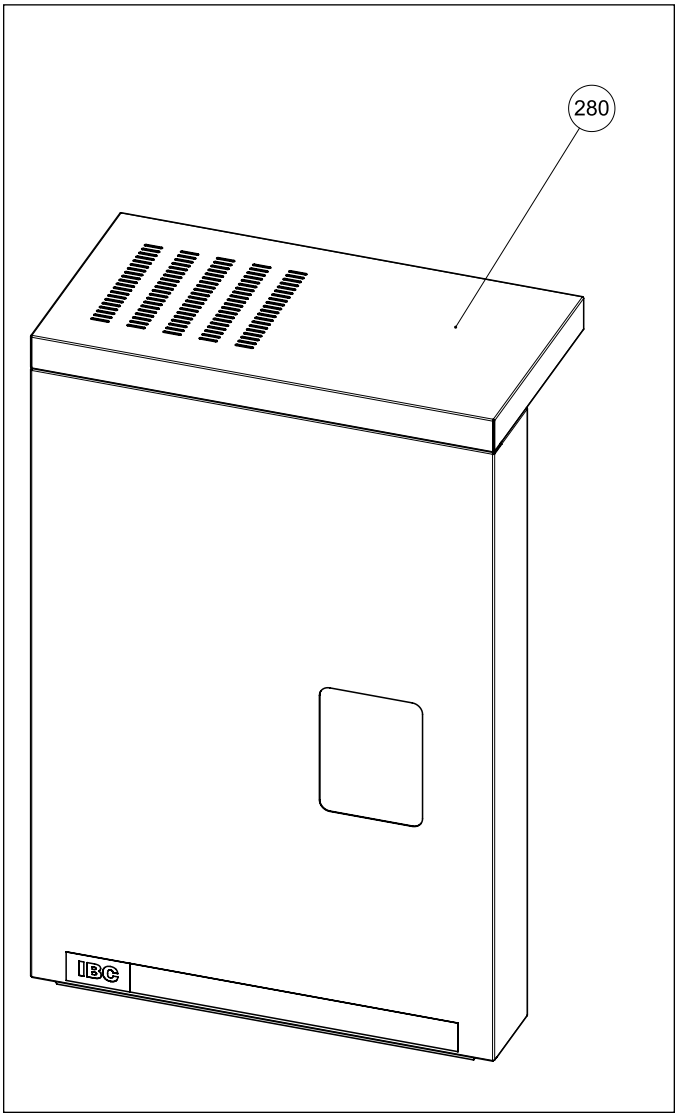
6.0 DIAGRAMS

6.1 VFC 45-225 PARTS DIAGRAM

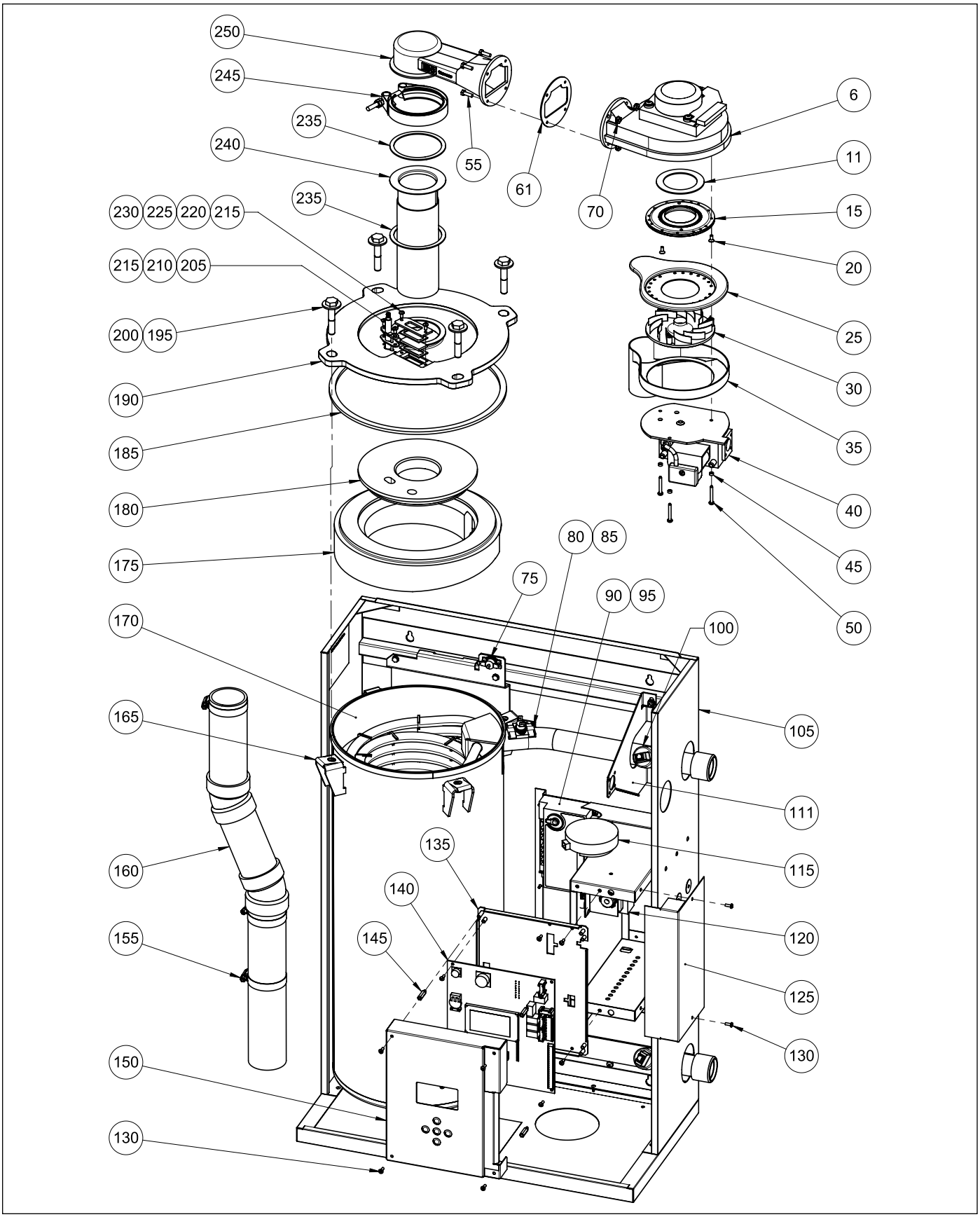


ITEM #	DESCRIPTION	PART #	QTY
5	Fan NRG 137	240-048	1
10	O-Ring	150-073	1
15	Fan Adapter Plate	180-023	1
20	Screw, M4x10 Tapping, Flat Head, Equipped w/Fan		3
25	Air Intake Base	180-017	1
30	Swirl Plate	180-020	1
35	Air Intake Cover	180-018	1
40	Gas Valve	180-022	1
45	Spacer, #8, 1/8" Thick, 1/4" OD	150-092	3
50	Screw, M4 x 30, Tapping, Equipped w/Gas Valve		3
55	Screw #10-32 x 7/8" Hex Head	150-110	4
60	Gasket, Fan - Fan Coupler	250-381	2
65	Fan Coupler Spacer	250-370	1
70	Nut, #10-32, With External Tooth Washer	150-111	4
75	Switch, Snap Disk, Manual Reset, 230F	240-030	1
80	Switch, Snap Disk, Auto-reset, 203F	240-032	1
85	Mounting Plate, Snap Disk	250-333	1
90	Ignition Module (alternate Capable Controls 240-049)	240-004B	1
95	Screw, Sheet Metal, #8 x 3/4"	150-102	2
100	Sensor, Water Pressure	240-006	2
105	Enclosure	250-312	1
110	Mounting Bracket, Gas Valve	250-316	1
115	Sensor, Air Pressure	240-003	1
120	Transformer	240-008	1
125	Side Cover, Controller	250-327	1
130	Screw, #6-32 x 3/8"	150-014	6
135	Chassis, Controller	250-107	1
140	PCB, Controller	230-001	1
145	Spacer, Male-Female, #6-32 x 3/4"	150-096	4
150	Front Cover, Controller	250-108	1
155	Pipe Clamp	150-039	3
160	2" ABS Intake Assembly		1
165	Clip Nut, M10, 19mm Center	150-105	4
170	Heat Exchanger	170-009	1
175	Refractory, Outer	250-287	1
180	Refractory, Inner	250-306	1
185	Gasket, Heat Exchanger Lid	250-328	1
190	Lid, Heat Exchanger	250-284	1
195	Screw, M10 x 55, Hex Head	150-106	4
200	Washer, Fender, M10	150-104	4
205	Ignitor	240-002	1
210	Gasket, Ignitor	250-050	1

ITEM #	DESCRIPTION	PART #	QTY
215	Screw, M4 x 8	150-091	4
220	Sight Glass Holder	250-309	1
225	Gasket, Sight Glass	250-060	2
230	Sight Glass	250-059	1
235	Gasket, Burner	250-308	2
240	Burner	180-021	1
245	V-Clamp	150-071	1
250	Fan Coupler	250-280	1
280	Front Cover, VFC 225	250-315	1

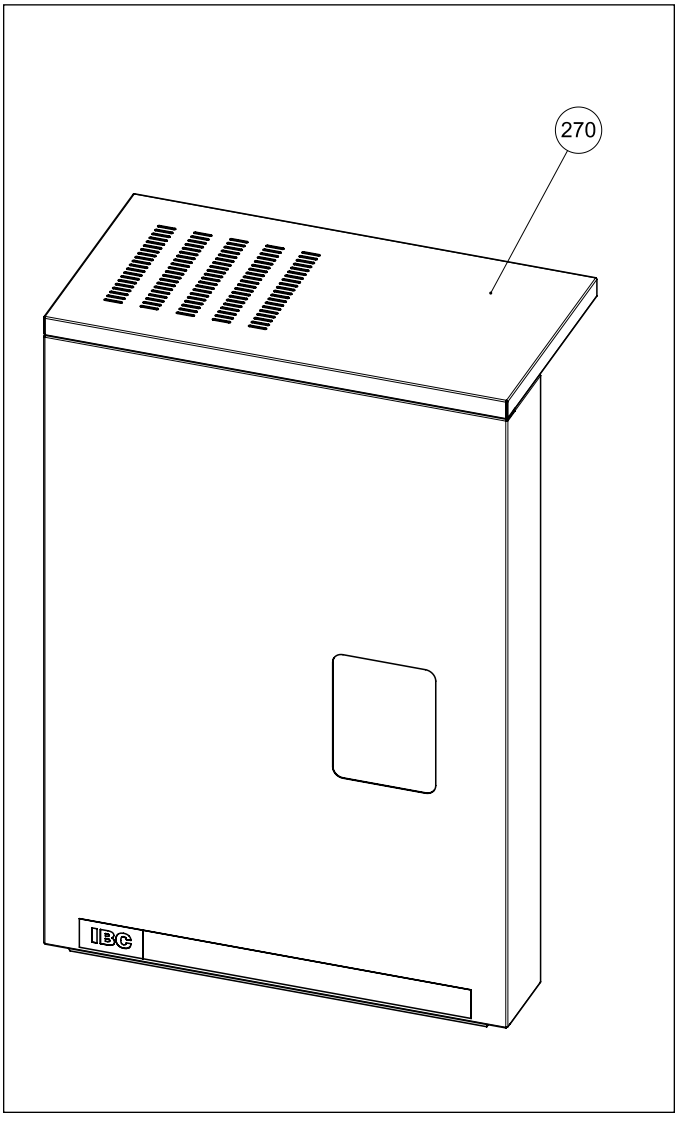


6.2 VFC 15-150 PARTS DIAGRAM



ITEM #	DESCRIPTION	PART #	QTY
6	Fan RG 130	240-040	1
11	Gasket Fan-Fan Adapter	250-310	1
15	Fan Adapter Plate	180-023	1
20	Screw, M4 x 10, Flat Head Equipped w/240-040		4
25	Air Intake, Base	180-017	1
30	Swirl Plate	180-020	1
35	Air Intake, Cover	180-018	1
40	Gas Valve	180-022	1
45	Spacer, #8, 1/8" Thick, 1/4" OD	150-092	3
50	Screw, M4 x 30, Tapping, Equipped w/180-022		3
55	Screw, #10-32 x 7/8", Hex Head	150-110	4
61	Gasket, Fan-Fan Coupler	250-311	1
70	Nut, 10-32, with External Tooth Washer	150-111	4
75	Switch, Snap Disk, Manual Reset, 230F	240-030	1
80	Switch, Snap Disk, Auto-reset, 203F	240-032	1
85	Mounting Plate, Snap Disk	250-333	1
90	Ignition Module (alternate Capable Controls 240-049)	240-004B	1
95	Screw, Sheet Metal, #8 x 3/4"	150-102	2
100	Sensor, Water Pressure	240-006	2
105	Enclosure	250-312	1
111	Gas Valve Mounting Bracket	250-314	1
115	Sensor, Air Pressure	240-003	1
120	Transformer	240-008	1
125	Side Cover, Controller	250-327	1
130	Screw, #6-32 x 3/8", Pan Head	150-014	6
135	Chassis, Controller	250-107	1
140	PCB, Controller	230-001	1
145	Spacer, Male-Female, #6-32 x 3/4"	150-096	4
150	Front Cover, Controller	250-108	1
155	Pipe Clamp	150-039	3
160	2" ABS Intake Assembly		1
165	Clip Nut, M10, 19mm Center	150-105	4
170	Heat Exchanger	170-009	1
175	Refractory, Outer	250-287	1
180	Refractory, Inner	250-306	1
185	Gasket, Heat Exchanger Lid	250-328	1
190	Lid, Heat Exchanger	250-284	1
195	Screw, M10 x 55, Hex Head	150-106	4
200	Washer, Fender, M10	150-104	4
205	Ignitor	240-002	1
210	Gasket, Ignitor	250-050	1
215	Screw, M4 x 8, Pan Head	150-091	1

ITEM #	DESCRIPTION	PART #	QTY
220	Sight Glass Holder	250-309	1
225	Gasket, Sight Glass	250-060	2
230	Sight Glass	250-059	1
235	Gasket, Burner	250-308	2
240	Burner	180-021	1
245	V-Clamp	150-071	1
250	Fan Coupler	250-280	1
270	Front Cover, VFC 150	250-313	1



6.3 ADDITIONAL PARTS DIAGRAMS

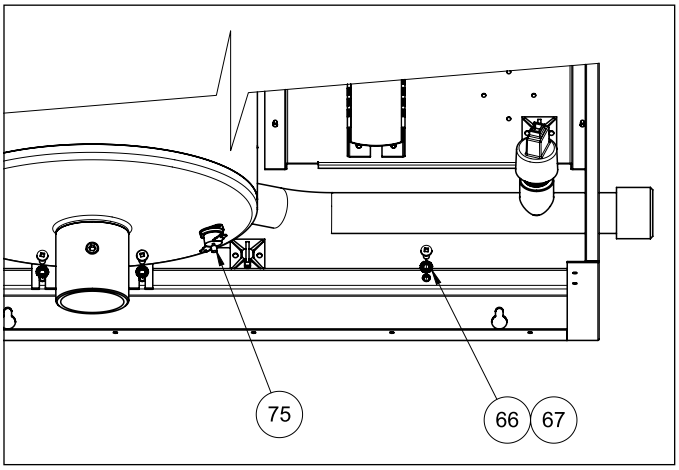


Diagram 6.1-3: Vent high limit

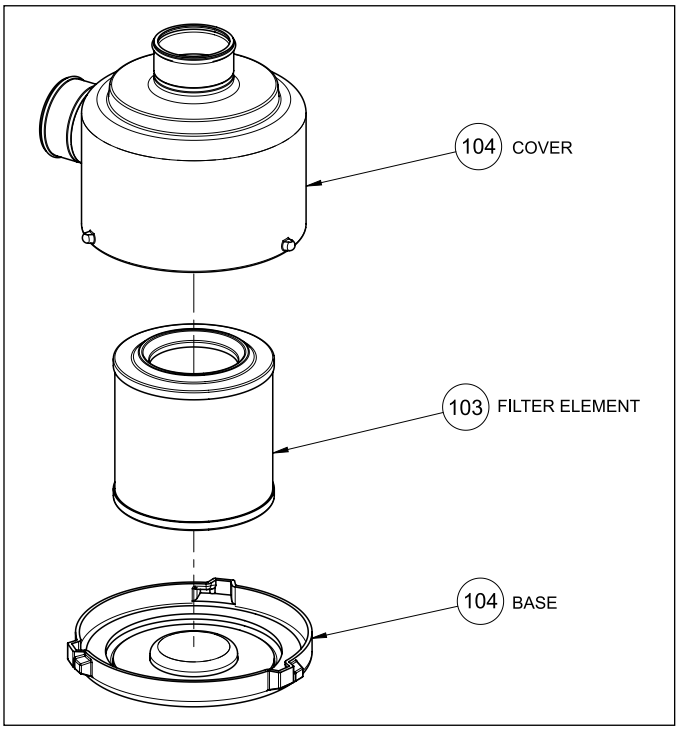


Diagram 6.1-5: Intake Air Filter (order separately)

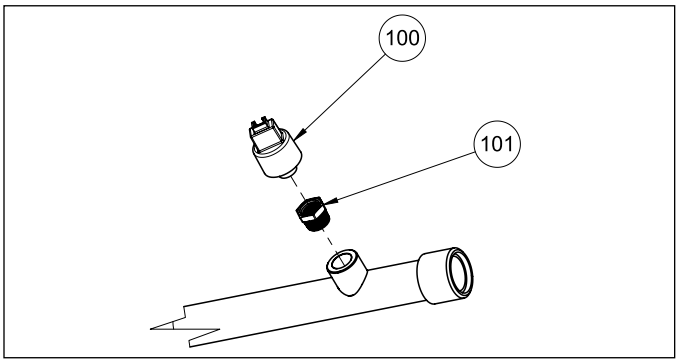


Diagram 6.1-2: Water pressure sensor group

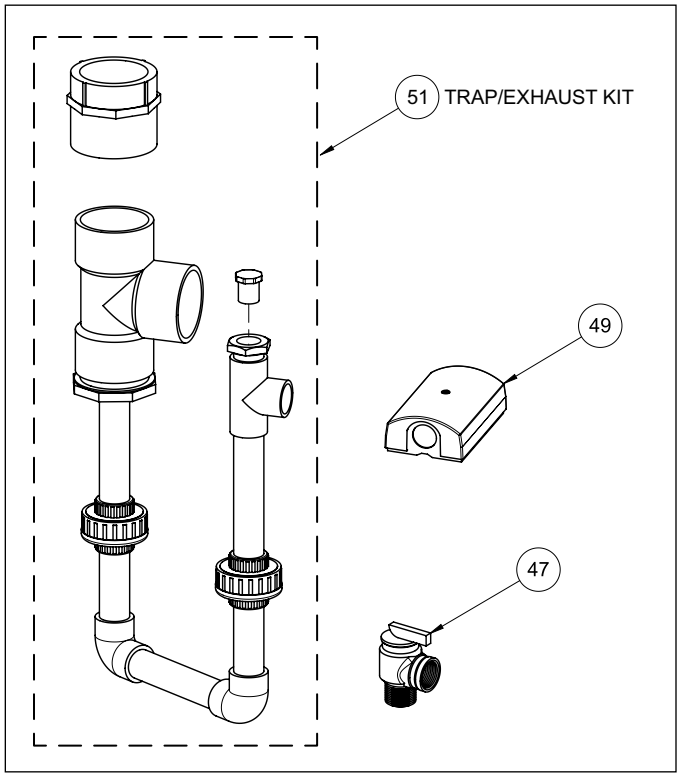


Diagram 6.1-4: Accessory parts kit (shipped with boiler)

ITEM #	DESCRIPTION	PART #
47	Pressure Relief Valve	180-005
49	Outdoor Temperature Sensor	240-025
51(a)	Trap/Exhaust Kit VFC15-150	P-150
51(b)	Trap/Exhaust Kit VFC45-225	P-151
66	Washer, #10, External Tooth	150-085
67	Screw, #10-32 x 1/2"	150-084
75	Switch, Snap disk, Manual Reset, 230F	240-030
100	Sensor, Water Pressure	240-006
101	Pressure Sensor Bushing	250-023
103	Intake Air Filter Element	180-103
104	Intake Air Filter Housing	180-104
	PARTS BELOW - NOT SHOWN	
68	Ignition Cable	210-001
69	Fuse Kit (10 pack)	P-114
71	8 Position Terminal Block - Green	240-019
72	22 Position Terminal Block - Orange	240-020
73	DC to AC Fan Harness Conversion Kit	71-ACDC
74	Acid Neutralization Tank	180-029
102	Ignitor Kit w/Gasket	P-142

6.4 WIRING DIAGRAMS

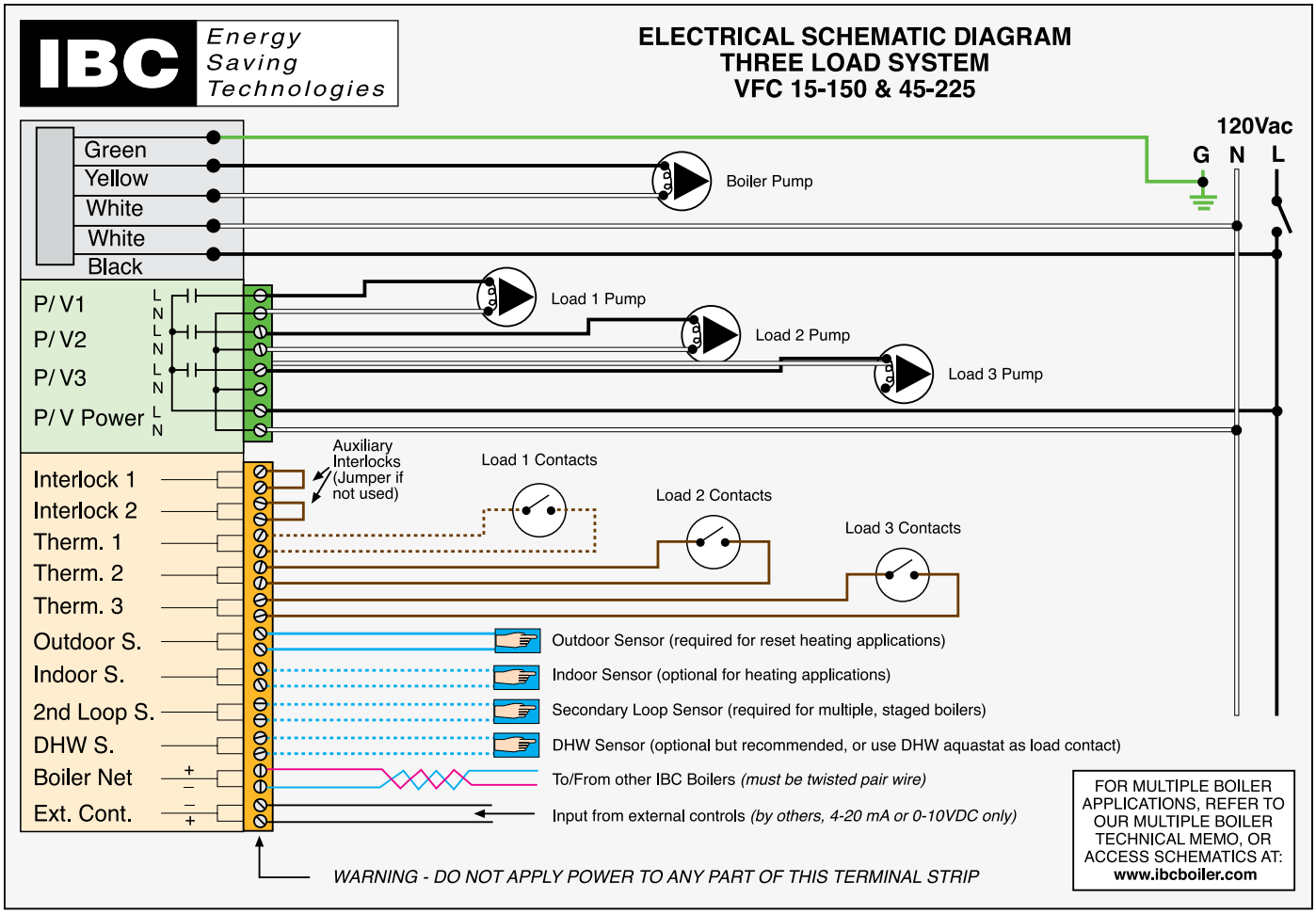


Diagram 6.2-1: Pictorial wiring diagram

ELECTRICAL NOTES AND SPECIFICATIONS

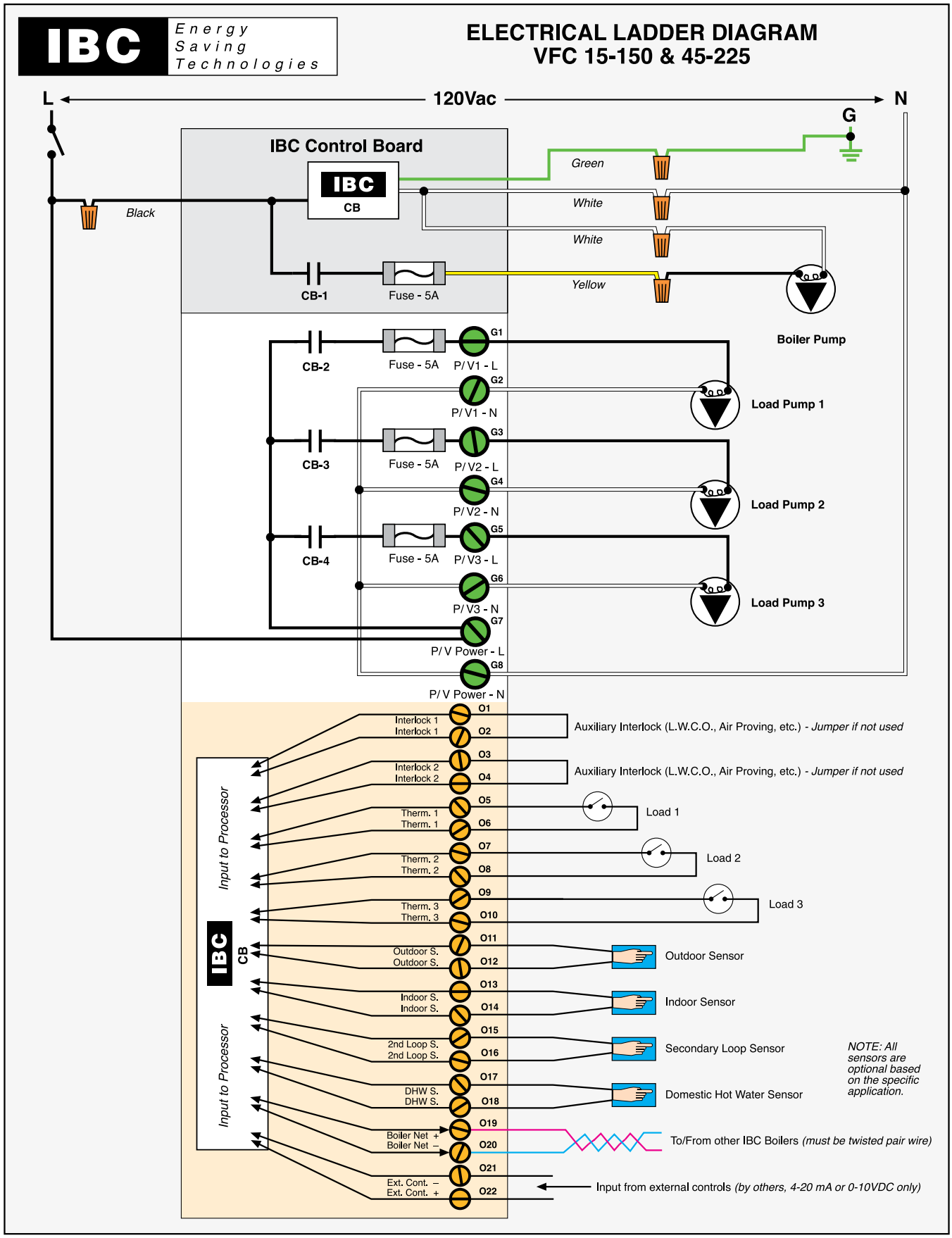


Diagram 6.2-2: Ladder wiring diagram

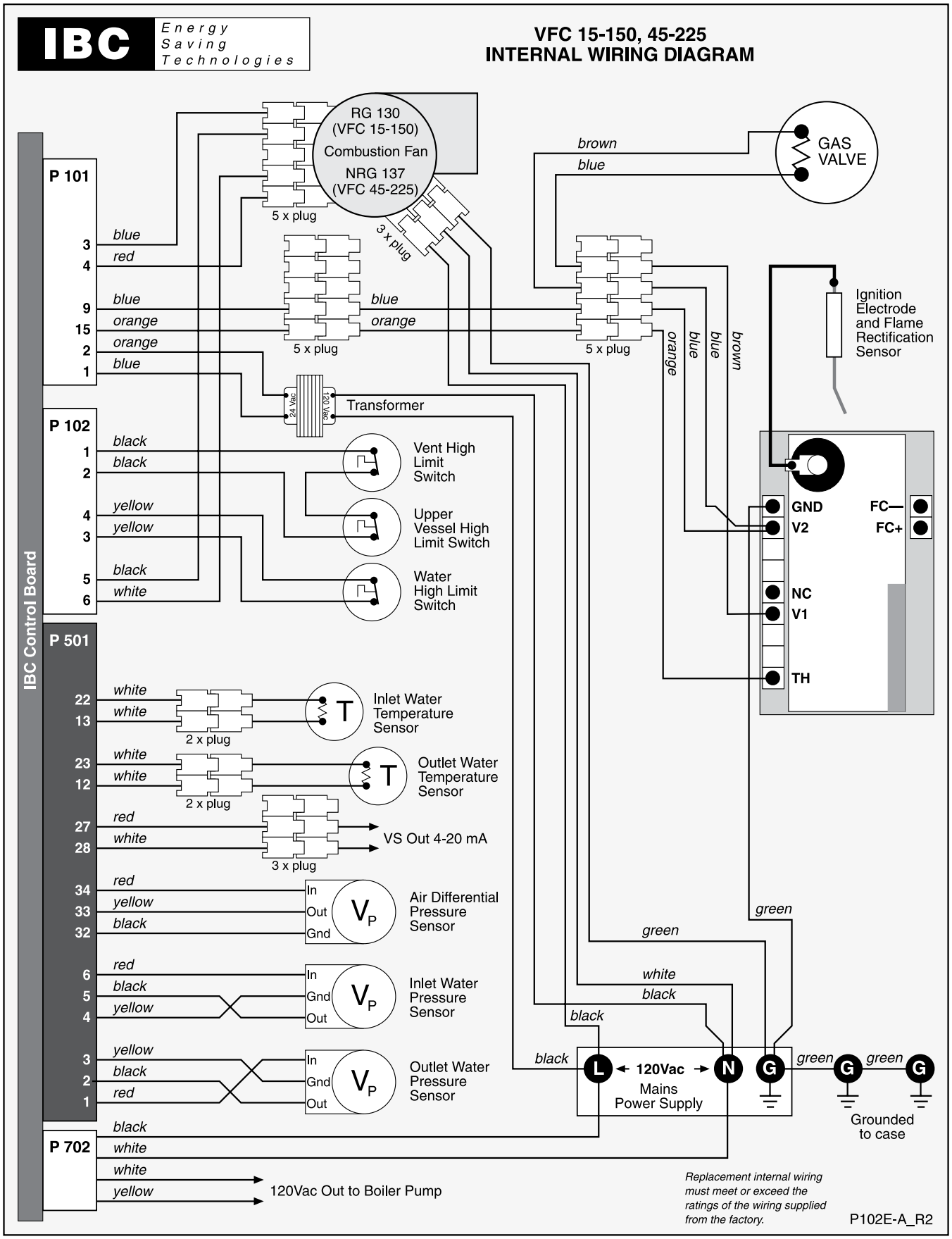


Diagram 6.2-3: Internal wiring diagram

6.5 SEQUENCE OF OPERATION

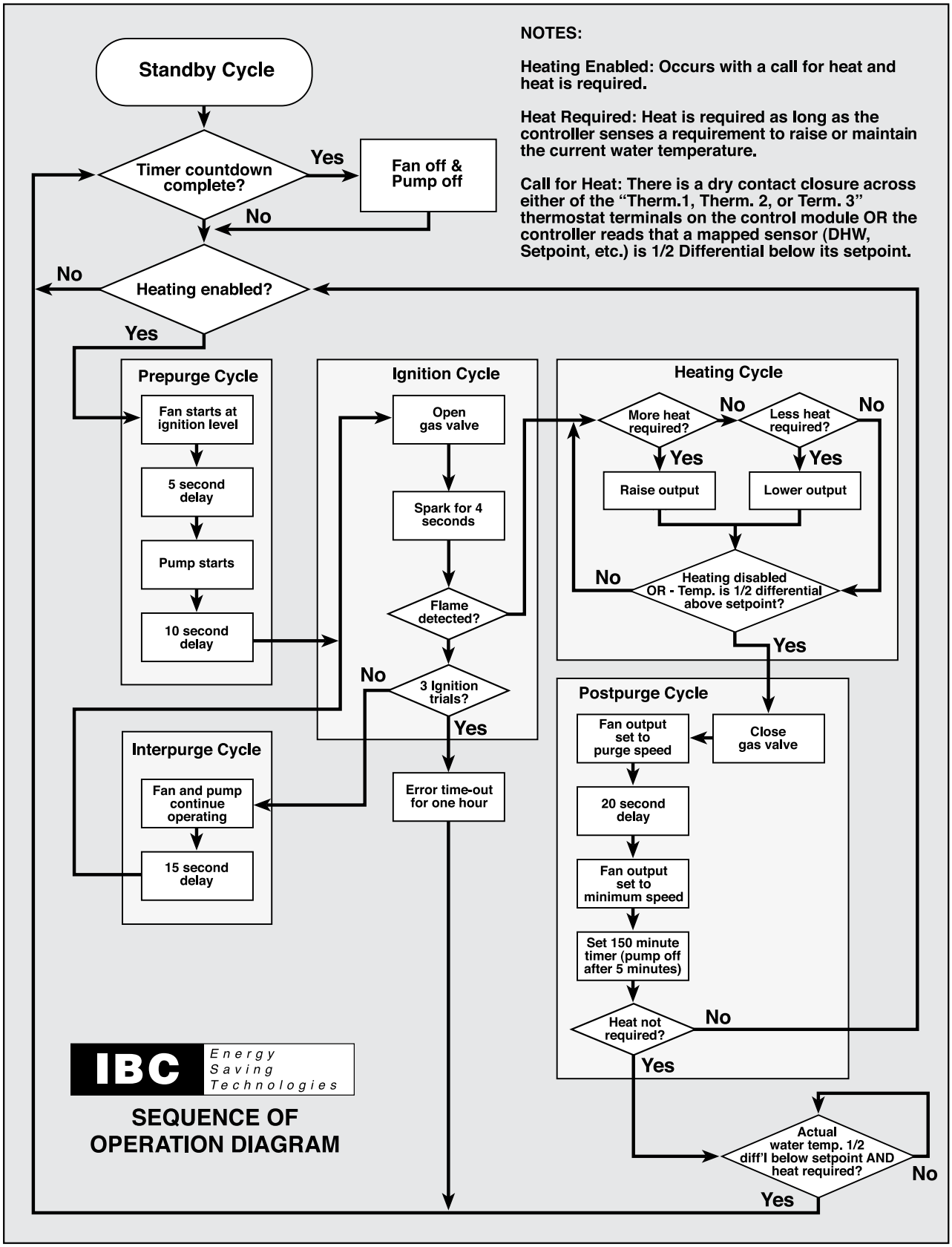


Diagram 6.3: Sequence of operation diagram

INSTALLATION & COMMISSIONING REPORT

Boiler Details:

Model Number _____ **Serial Number** _____

Date of Installation _____ **Address of installation** _____

_____

User contact information _____

Installer Information Company _____

Address _____

Phone/Fax/E mail _____

Fuel ☐ Natural Gas ☐ Propane

Gas Supply Pressure (high fire) _____ Inches w.c. **Measured Rate of Input (high fire)** _____ Btu/hr

☐ Installation instructions have been followed and completed (Section 1 of Installation and Operating Instructions).

☐ Check-out procedures have been followed and completed (Section 3 of Installation and Operating Instructions).

☐ Leak testing completed ☐ gas piping ☐ venting system ☐ Fan and combustion components

☐ System Cleaned and Flushed (type of cleaner used) _____

☐ System Filled (type/concentration of any glycol/chemicals used) _____

☐ Air purge completed (go to *Installer Setup - - Pump Purge - - On,* and operate pumps until air has been ejected)

☐ Relief Valve correctly installed and piped ☐ Relief valve "try lever" test performed

☐ Condensate trap filled ☐ Condensate drain clear and free flowing ☐ Condensate Neutralization? Yes/No

☐ Ignition Safety Shutoff test completed. Flame current reading - High fire _____ µA - Low fire _____ µA

☐ Standby readings from IBC display screen - (remove all heat calls) - Outdoor Temperature _____ Tank Temperature _____ Outlet Temperature _____ Outlet Pressure _____ Heat Output _____

☐ Load Status Screen readings - Load 1 _____ Load 2 _____ Load 3 _____

☐ From Installer Setup Menu (scroll down) - Altitude _____ Prim. Pump Purge Time _____

Multiboiler Config. _____ (go to *Installer Setup - - enter* - this setting should be "Off" ***except*** for Master Boiler)

☐ Advanced Diagnostic Menu readings - boiler in Standby - (remove all heat calls)

Outdoor Temperature _____ Inlet Pressure _____ Outlet Pressure _____ Delta Pressure _____

Flow Rate _____ Fan Speed _____ Required Pressure _____ Fan Pressure _____

☐ Owner advised and instructed in the safe operation and maintenance of the boiler and system.

☐ Information regarding the unit and installation received and left with owner

Combustion Readings - recommended, but optional (<u>required</u> for fuel conversion):

CO_2 _____ % O_2 _____ % CO _____ ppm

Flue temperature _____ Return water temperature (measure simultaneously with flue temp.) _____

Installers: send this completed sheet - Fax to 604 877 0295 - or - scan and Email to info@ibcboiler.com, and earn an extra year's Parts Warranty coverage (User to submit corresponding Installation Record from User Guide).

Commissioning has been completed as listed on this report - Installer Signature _____

INSTALLER SET-UP

Load Definition - Load #1 _____

Load Configuration - Load #1

_____

Load Definition - Load #2 _____

Load Configuration - Load #2

_____

Load Definition - Load #3 _____

Load Configuration - Load #3

_____

SERVICE RECORD

DATE	LICENSED CONTRACTOR	DESCRIPTION OF WORK DONE

NOTES

NOTES

As referenced on page 2-7 of this manual, the following message is relevant to users in the USA:

IMPORTANT

This Boiler is equipped with a feature that saves energy by reducing the boiler water temperature as the heating load decreases. This feature is equipped with an override which is provided primarily to permit the use of an external energy management system that serves the same function. THIS OVERRIDE MUST NOT BE USED UNLESS AT LEAST ONE OF THE FOLLOWING CONDITIONS IS TRUE:

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

US installers should contact IBC for any further information required.

REVISION HISTORY

R1 (SEPT 2005)	Initial release
R2 (JULY 2007)	Venting requirements (Canada) to ULC-S636; internal wiring diagram and warranty details added
R3 (MAR 2010)	VFC 45-225-SL variant added (with new NRG-137 fan); warranty removed to separate document
R4 (SEPT 2012)	Polypropylene venting, detachable lid heat exchanger and US Energy Act disclosures added; VFC 45-225-SL designation merged within base VFC 45-225 model

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