IBC®

# Installation and Operating Manual


## EX SERIES

### Commercial Boilers

EX 400
EX 500
EX 700
EX 850

**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 vapors and liquids or other combustible materials in the vicinity of this or any other appliance.

**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.

Intertek

ENERGY STAR

ASME H

AHRI CERTIFIED™

# Water quality

**Warning**

Water quality has a significant impact on the lifetime and performance of a boiler's heat exchanger.

Improperly prepared water in a heating circuit may cause damage to the heat exchanger through fouling or corrosion. Repeated or uncontrolled water fills will increase the potential for damage.

High levels of dissolved solids or minerals may precipitate out of the fluid onto the hottest part of the heat exchanger, impairing heat transfer and resulting in overheating and premature failure. The amount of solids that may form on the heat exchanger will depend on the degree of hardness and the total water volume in the system. A high water volume system with a low hardness count may cause as much damage as a system with less volume and higher hardness, so it is recommended to treat water so as to remove all dissolved solids. Other water chemistry allowable limits are as follows:

- Acidity pH is to be between 6.6 and 8.5
- Chloride is to be less than 125 mg/l
- Iron is to be less than 0.3 mg/l
- Cu less than 0.1 mg/l
- Conductivity is to be less than 400µS/cm (at 77°F [25°C])
- Hardness is to be 7 grains per gallon or less / 120 ppm or less

**Important**: Ensure that these limits are acceptable for the other water-side components in the system.

Shipped with the boiler:

- 4 x anchor brackets (installed on pallet)
- Condensate trap IBC # P-1221
- Tridicator IBC # P-1234
- Relief valve IBC # P-1205
- 2 x Inlet gas pressure test fittings, IBC part # 190-206
- 2 x spare air filters, IBC # P-381
- Outdoor sensor, IBC part 240-025

# Contents

# Safety information

## Manual safety markings

**Danger**

Points out an immediate hazardous situation that must be avoided to prevent serious injury or death.

**Warning**

Points out a potential hazardous situation that must be avoided to prevent serious injury or death.

**Caution**

Points out a potential hazardous situation that must be avoided to prevent possible moderate injury and/or property damage.

**Note**

Points out installation, maintenance and operational notes to enhance efficiency, longevity and proper operation of the boiler.

## Important safety instructions

Installation, start-up and servicing of IBC boilers must 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, and in extreme cases to death. Keep instructions near the air handling appliance for future reference.

**Danger**

Do not store or use gasoline or other flammable vapors or liquids in the vicinity of this or any other appliance. If you smell gas vapors, do not try to operate any appliance - do not touch any electrical switch or use any phone in the building. Immediately, call the gas supplier from a phone located remotely. Follow the gas supplier's instructions, or if the supplier is unavailable, contact the fire department.

**Warning**

Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury, or loss of life. Read and understand the entire manual before attempting installation, start-up, operation, or service. Installation and service must be performed only by an experienced, skilled installer or service agency.

Failure to follow all instructions in the proper order can cause personal injury or death. Read all instructions, including all those contained in component manufacturers' manuals before installing, starting up, operating, maintaining, or servicing the appliance.

**Warning**

Disconnect power supply before any wiring/service is performed. Failure to do so could result in damage to appliance and/or electric shock.

**Caution**

The boiler must be installed so that electrical components are not exposed to water during operation.

## Known contaminants

| Known Corrosive Contaminants to Avoid |
|---|
| Cements and glues |
| Paint or varnish removers |
| Adhesives used to fasten building products and other similar products |
| Chlorinated waxes or cleaners |
| Chlorine-based swimming pool chemicals |
| Calcium chloride used for snow and ice clearing |
| Sodium chloride or potassium chloride used for water softening |
| Refrigerant leaks from cracks in coils |
| Hydrochloric acid or muriatic acid used in household cleaning and stain removal |
| Chemicals in perming solutions |
| Chlorofluorocarbon chemicals found in spray cans |
| Chlorine-type bleaches, detergents, and cleaning solvents found in household laundry rooms |
| Antistatic dryer sheets in clothes dryers |

# Specifications

| Specifications | EX 400 | EX 500 | EX 700 | EX 850 |
|---|---|---|---|---|
| CSA Input (natural gas or propane) - MBH | 40-399 | 50-500 | 70 - 700 | 85 - 850 |
| CSA Input (natural gas or propane) - kW | 11.7 - 117 | 14.6 - 146.5 | 20.5 - 205 | 24.9 - 249 |
| CSA Output - MBH | 388 | 485 | 679 | 824.5 |
| CSA Output - kW | 114 | 142 | 199 | 241.6 |
| Thermal Efficiency | 97.9 | 97.5 | 97.0 | 97.0 |
| Minimum gas supply pressure (natural gas or propane) - inch w.c. | 4 | 4 | 4 | 4 |
| Maximum gas supply pressure (natural gas or propane) - inch w.c. | 14 | 14 | 14 | 14 |
| Ambient temperature:<br><br>Low °F / °C | 32 / 0 | 32 / 0 | 32 / 0 | 32 / 0 |
| High °F / °C | 122 / 50 | 122 / 50 | 122 / 50 | 122 / 50 |
| Max. relative humidity (non-condensing) | 90% | 90% | 90% | 90% |
| Minimum water temp. °F / °C | 34 / 1 | 34 / 1 | 34 / 1 | 34 / 1 |
| Maximum water temp. (electronic hi-limit) °F / °C | 190 / 88 | 190 / 88 | 190 / 88 | 190 / 88 |
| Max. ΔT - supply/return (electronic fence) °F / °C | 80 / 44 | 80 / 44 | 80 / 44 | 80 / 44 |
| Max. Water Temperature Lockout Limit °F / °C | 201 / 94 | 201 / 94 | 201 / 94 | 201 / 94 |
| Power use (120Vac/60Hz) @ full fire - Watts (less pumps) | 150 | 210 | 195 | 228 |
| Weight (empty) - lbs/Kg | Approx. 414 / 188 | Approx. 441 / 200 | Approx. 486 / 220 | Approx. 510 / 231 |
| Heating surface area - $ft^2$ / $m^2$ | 55.3 / 5.14 | 72.9 / 6.77 | 84.6 / 7.86 | 99.88 / 9.28 |
| Pressure vessel water content - USG/Liters | 13.5 / 51.1 | 12.4 / 46.9 | 17.5 / 66.3 | 16.4 / 62.0 |
| Maximum boiler flow rate - USgpm | 100 | 100 | 100 | 100 |
| Minimum boiler flow rate - USgpm | 10 | 12 | 18 | 21 |

| Specifications | EX 400 | EX 500 | EX 700 | EX 850 |
|---|---|---|---|---|
| Maximum operating water pressure* - psig | 160 | 160 | 160 | 160 |
| Minimum water pressure - psig | 8 | 8 | 8 | 8 |
| Relief valve pressure (supplied) - psig* | 50 | 50 | 50 | 50 |
| Approved installation altitude - ASL | 0 - 12,000' | 0-12,000' | 0 - 12,000' | 0-12,000' |
| Maximum equivalent vent length each side (vent & air intake) (natural gas or propane)<br><br>Air intake options: either direct vent or indoor supply | 170' | 170' | 120' | 120' |

*These alternative relief valves can be purchased: 30, 100, 125 and 150.

# Connection specifications

The following table displays the required connection specifications for each model.

| | EX 400, EX 500 | EX 700, EX 850 |
|---|---|---|
| Flue Outlet | 4" Schedule 40 | 6" Schedule 40 |
| Combustion Air Inlet | 4" Schedule 40 | 4" Schedule 40 |
| Water Outlet | 2" NPT-M | 2½" NPT-M |
| Water Inlet | 2" NPT-M | 2½" NPT-M |
| Knock-outs (8) | ½" | ½" |
| Gas Inlet | 1" NPT-F | 1" NPT-F |
| Condensate Outlet | ¾" Hose | ¾" Hose |

***Table 1*** *Connections*

# Cabinet dimensions

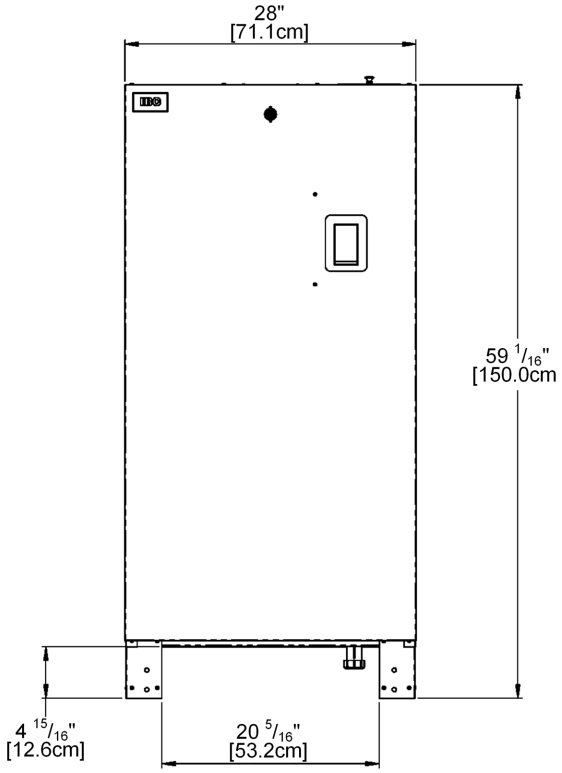



Figure 1 *Frontal view - EX 400, EX 500*

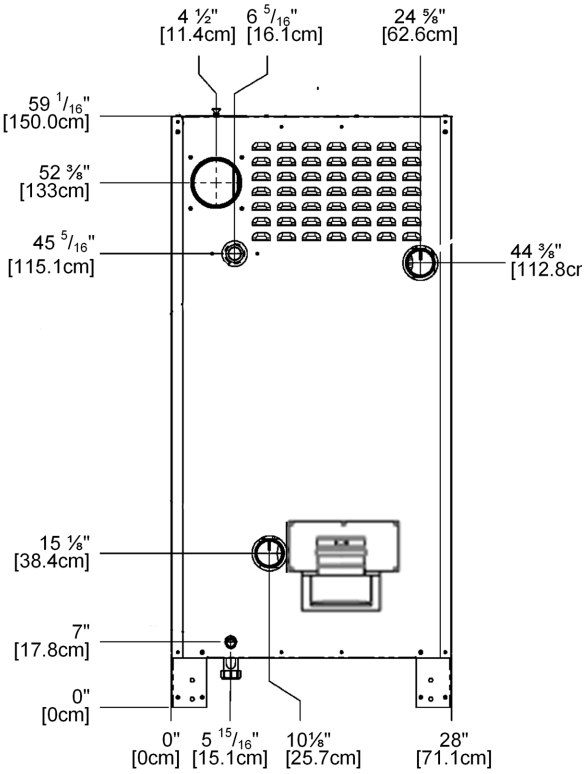



Figure 2 *Back view - EX 400, EX 500*

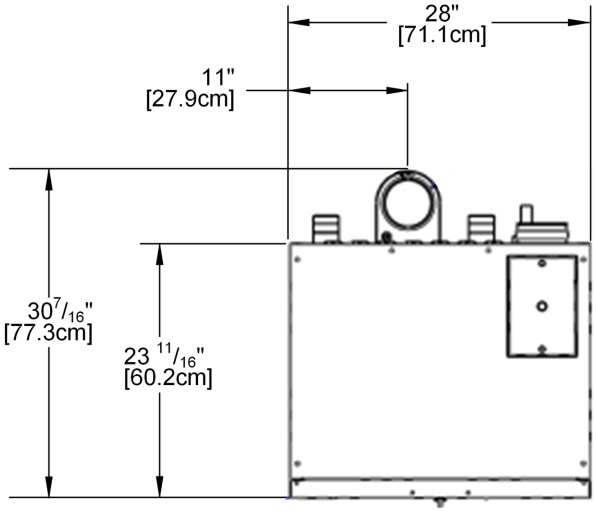



Figure 3 *Top view - EX 400, EX 500*

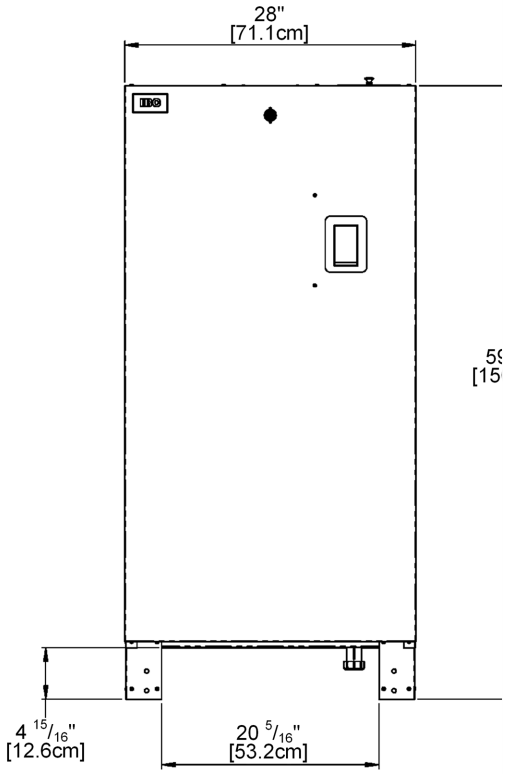



Figure 4 *Frontal view - EX 700, EX 850*

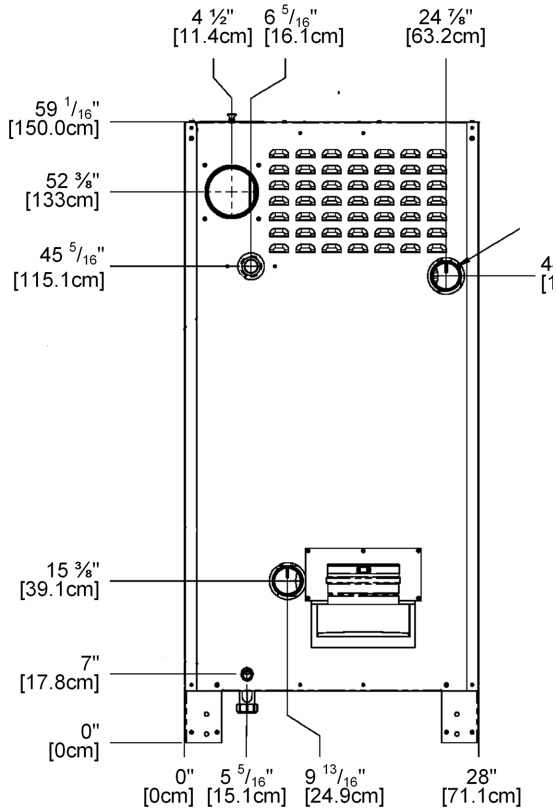



Figure 5 *Back view - EX 700, EX 850*

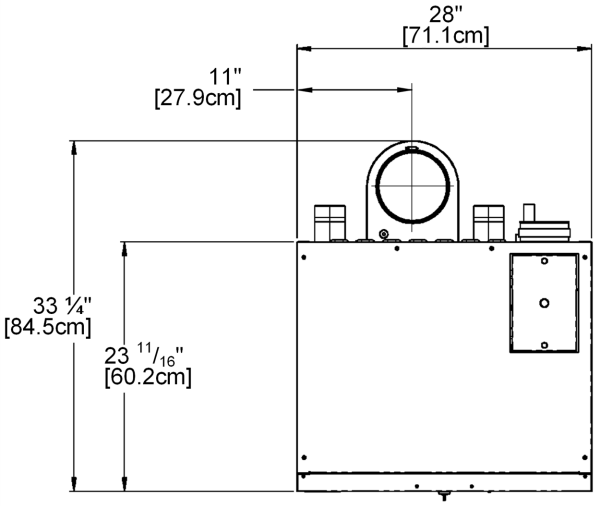



Figure 6 *Top view - EX 700, EX 850*

# 1.0 Introduction

IBC's range of large commercial boilers is the solution for large-scale projects such as apartment buildings, office buildings, big schools, hospitals, and hotels.

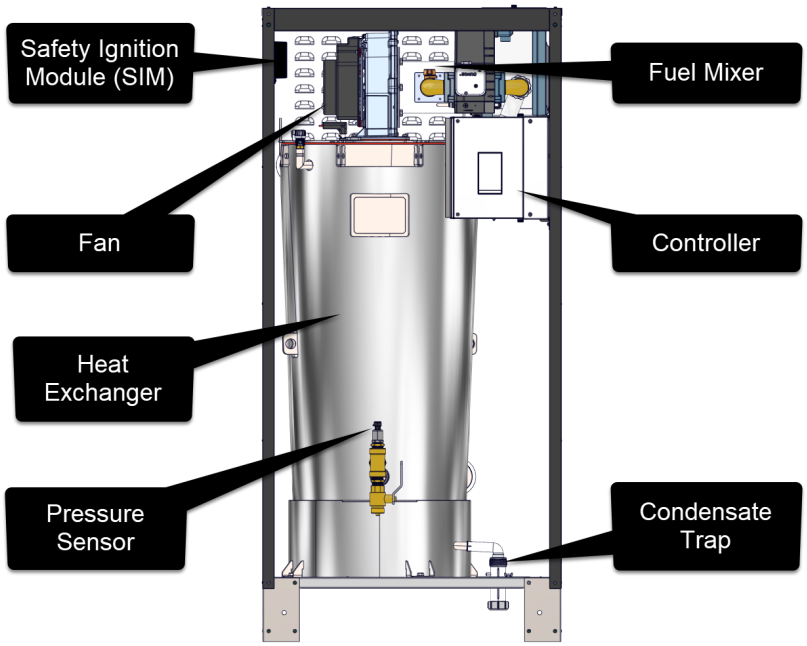



Figure 7 *Front internal view*

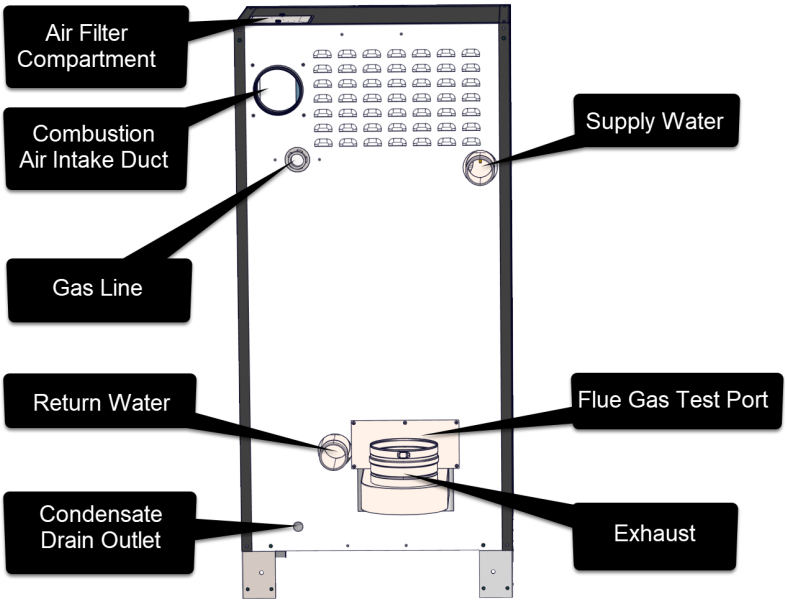



Figure 8 *Back view of boiler*

## 1.1 Standard features and benefits

- High thermal efficiency
- Built-in BACnet option
- Turn-down ratio 10 to 1
- Built-in 4-zone pump control
- Multiple boilers: Up to 24 boilers can be connected without external controls
- Maximum allowable ΔT=80 °F (44 °C)
- 50 psi relief valve (345 kPa)
- Boiler pump control up to ¾ H.P. 120V or 208/240V

## 1.2 Warranty

IBC offers a 10-year-limited warranty on the EX series heat exchanger and a 2-year warranty on all parts against defects in materials or workmanship and failures due to thermal shock.

For more information and to obtain the EX series warranty form, go to ibcboiler.com.

# 2.0 Before installation

Before installing the appliance, it is important to review and observe the following checklist of precautions:

| Precautions | Check |
|---|---|
| Care must be taken to properly size the boiler for its intended use.<br><br>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. | ☐ |
| Ensure you install the boiler where the combustion air source is not subject to chemical fouling or agricultural vapors.<br><br>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 vapors that 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. | ☐ |
| Locate the boiler where water leakage will not result in damage to the area.<br><br>If there is no suitable location, install a suitable drain pan under the boiler. Do not install above carpeting. | ☐ |
| At a new construction site, or during renovations, protect the boiler from drywall dust or other construction related contaminants.<br><br>Draw combustion air from a **clean** source (e.g., outdoors) and isolate the boiler from interior dust sources. Do not seal boiler case openings directly when firing - allow for air circulation and ventilation in the immediate area. | ☐ |
| Place the exhaust outlet 12" minimum above the down-turned intake to avoid exhaust re-ingestion. | ☐ |
| For sidewall venting options, place the inlet and exhaust terminations on the same side of the building.<br><br>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 using the indoor combustion air option, 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 condensates are to be discharged into building drain piping materials that are subject to corrosion, a neutralization package must be used. | ☐ |
| Ensure that the pressure relief valve is installed with no valves or other means of isolation between its inlet and the boiler. Make sure the relief valve outlet is piped with unobstructed piping (minimum 1" diameter) to a safe discharge location. | ☐ |

| Precautions | Check |
| --- | --- |
| If the boiler is likely to be 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. | ☐ |
| When the boiler is in operation, assess the impact of the steam plume normally at the exhaust terminal of a condensing boiler.<br><br>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 neighboring properties. | ☐ |

**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.

# 3.0 Installation

The gas-fired modulating boilers are low pressure, fully condensing appliances having a variable input range. Approved as “Category IV” vented appliances, the boilers use either Direct Vent (sealed combustion) or indoor combustion air, providing a great degree of installation flexibility.

## 3.1 Code requirements

The boilers are tested and certified under CSA 4.9-2017 / ANSI Z21.13-2017. Below are the code requirements for every installation.

| Canada | US |
|---|---|
| Conform to local codes, or in the absence of these, with the latest editions of CAN/CGA B149.1 and the Canadian Electrical Code Part 1 CSA C22.2 No. 1. | 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. | 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, follow the more stringent regulations. | If there is any conflict, follow the more stringent regulations. |

***Table 2*** *Code requirements by country*

## 3.2 Determining location of the appliance

The boilers are designed and approved for indoor installation in areas such as an alcove, basement, or utility room. These areas should have a surrounding temperature of 32 °F (0°C) to 122 °F (50 °C) and less than 90% relative humidity.

Even though EX models are approved for installation on combustible floors, do not install them on carpet.

**Warnings**

- Keep the area around a boiler clear of combustible materials, gasoline, and other flammable vapors and liquids.
- Ensure combustion air is not drawn from areas containing corrosive air such as swimming pools or spas, including air directly next to outdoor pools and spas.
- Ensure that a boiler is not exposed to water leaks from piping or components located overhead, including condensation from uninsulated cold water lines overhead.
- Protect the gas ignition system components from water (dripping, spraying, rain, etc.) during appliance operation and when servicing (pump replacement, condensate trap servicing, control replacement, etc.).
- Ensure that combustible materials do not make contact with exposed water piping and associated components (relief valves, circulators, etc.). Check local codes for required clearances and/or provide adequate insulation.

## 3.2.1 Factors to consider for best installation conditions

### Factors to consider for best installation conditions

- Install the boiler in areas where the combustion air source is not subject to chemical fouling or agricultural vapors. Exposure to corrosive chemical fumes such as chlorinated and/or fluorinated hydrocarbons can reduce the life of a boiler. See list of *Contaminants on page 1*. For this reason, do not use the indoor air venting option (using air surrounding the boiler) in a laundry room. Similarly, ensure any direct vent air source is not near a clothes dryer exhaust terminal. Avoid agricultural applications where the boiler and/or the intake air source are affected by ammonia and/or dust.
- Avoid installing a boiler where water leakage will cause damage; for example, above carpeting. If unavoidable, install a suitable drain pan under the appliance.

Other factors to consider:

- The minimum clearance requirements for combustible materials (see *Table 3* ).
- For adequate servicing, we recommend a minimum 30" clearance at the front and 12" above the boiler. Check local codes for additional access and service clearance requirements.
- At a new construction site, or during renovations:
  - Take action to protect the boiler from drywall dust or other construction related contaminants
  - Ensure combustion air is drawn from a **clean** source (e.g., outdoors)
  - Isolate the boiler from interior dust sources. Do not seal boiler case openings directly when firing - allow for air circulation and ventilation in the immediate area.

### 3.2.1.1 Anchoring the boiler

Boiler weight – without water and any effect of system piping and components – is approximately 500 lbs / 225 kg.

Use the brackets provided to secure the boiler to the floor.

## 3.3 Unpacking a boiler

The boiler is shipped bolted to a pallet with four (4) anchor brackets and 3/8" Hex head bolts. Once the anchor brackets are removed they can be used to secure the boiler to the floor.

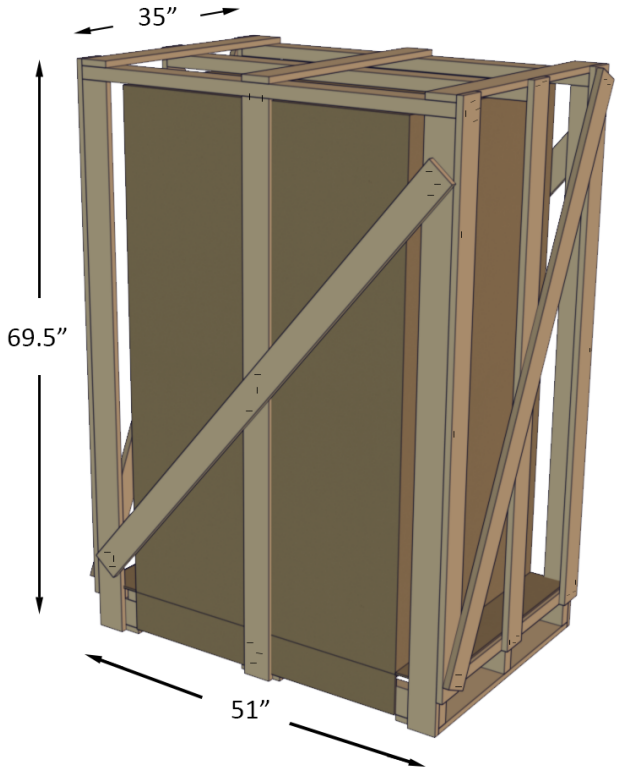



Figure 9 *Boiler packaging dimensions (inches)*

## 3.4 Installation clearances

**Warning**

Exposed water piping and associated components (relief valves, circulators, etc., should not be in contact with combustible materials. Check local codes for required clearances and / or provide adequate insulation.

| EX 400, EX 500, EX 700, EX 850 | | |
|---|---|---|
| **Surface** | **Minimum distance from combustible surfaces** | **Recommended clearance for installation and service** |
| Front | 2" | 30" |
| Rear flue connection | 2" | 24" |
| Left side | 1" | 2" |
| Right side | 1" | 4" |
| Top | 6" | 12"<br><br>(required for filter replacement) |
| Bottom | 0 | 0 |

*Table 3 Clearance distances for boiler mounting sites*

## 3.5 Exhaust venting and air intake venting

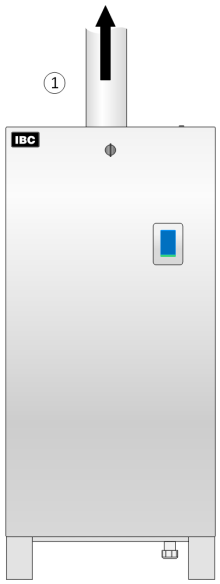
**Warning**

Venting, condensate drainage, and combustion air systems for all IBC boilers must be installed in compliance with all applicable codes and with instructions provided in the respective installation manuals.

Inspect finished vent and air piping thoroughly to ensure all are airtight, and comply with the instructions provided as well as with the requirements of applicable codes. Failure to comply will result in severe personal injury or death.

When planning a boiler's installation, consider the appropriate vent materials, travel and termination.

An important consideration is managing the impact of the steam plume normally 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 neighboring properties.




1 Flue gas exhaust to outdoors

Figure 10 *Flue gas venting*

**Danger**

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

## 3.5.1 Code

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 provided, and the code requirements, apply the more stringent.

Provisions for the combustion and air ventilation must be in accordance with the section “Air for Combustion and Ventilation” of the National Fuel Gas Code, ANSI Z223.1/NFPA 54, or Clause 8.2, 8.3 or 8.4 of the Natural Gas and Propane Installation Code, CAN/CSA B149.1, or applicable provisions of the local building codes.

### 3.5.1.1 Important considerations when removing an existing boiler

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 that remain connected to it. When resizing any portion of the common venting system, use the minimum size according to the appropriate tables in the National Fuel Gas Code, ANSI Z223.1 - latest edition. In Canada, use the B149.1 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. Determine that there is no blockage or restriction, leakage, corrosion and other deficiencies that could cause an unsafe condition.
- (Where practical) Close all building doors and windows such as doors adjacent to appliances remaining connected to the common venting system 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 the thermostat so that the appliance operates continuously.
- After determining that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-burning appliance to their previous condition.
- 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.

**Warning**

Covering non-metallic vent pipe and fittings with thermal insulation is prohibited.

## 3.5.2 Applications

All EX series boilers are approved with alternative venting options: either 2-pipe direct vent or vent pipe with indoor air. With the direct vent case, combustion air is piped directly to the boiler's air intake from outdoors (see *Vent termination clearance on page 30* 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 boiler may be vented through the wall, directly through the roof, or upward using an existing - but otherwise unused - chimney as a vent raceway.

## 3.5.3 Exhaust vent material

**Warning**

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

### Exhaust vent material – CANADA

Use PVC, CPVC, Polypropylene (PPs), or Stainless Steel (SS) vent component systems approved under ULC-S636 Standard for Type BH Gas Venting Systems, or stainless steel Type BH venting systems*. The vent temperature is limited by the boiler controller with the use of a flue temperature sensor to ensure the maximum temperature of the PVC venting material is not exceeded.

### Exhaust vent material – USA

PVC, CPVC, PPs, or SS venting materials are approved for use with these boilers in most of the USA. Check local codes to determine if any materials are prohibited. The vent temperature is limited with the use of the flue temperature sensor and software to ensure that the maximum temperature of the PVC venting material is not exceeded. PVC venting material shall be certified to Sch. 40 ASTM D1785 or D2665. CPVC material shall be certified to Sch. 40/ASTM F441.

### Exhaust vent material

Use of cellular core PVC (ASTM F891), cellular core CPVC, or Radel® (polyphenolsulfone) in venting systems is prohibited.

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

The exhaust fitting has a 6" PVC (schedule 40) connection. Use fittings to adapt to either PPs or SS venting material. Insert exhaust venting directly into the 6" female stainless steel fitting, and secure with the built-in clamp (see *Figure 11* ).

For PPs material, use the 6" transition / adaptor fitting (Sch 40 to PPs) offered by the respective PPs manufacturers Centrotherm / InnoflueTM (their part # ISAAL0606) or M&G Dura Vent / PolyProTM (# 6PPS-06PVCM-6PPF [10004281]), (# 4PPs-AD). For PPs material exposed to outdoor weather, follow the venting supplier's recommendations on UV protection.

For SS material, use the 6" transition / adaptor fitting offered by the SS manufacturers M&G Dura Vent (# FSA-6PVCM-6FNSF [300538]) or Heat Fab (Saf-T-Vent) 9601PVC.

**Warning**

Ensure that you lubricate the gasket with silicone grease before inserting the venting material. Fully insert the approved venting material into the boiler's exhaust outlet, and tighten clamp to ensure the venting connection is locked in place (as shown below).

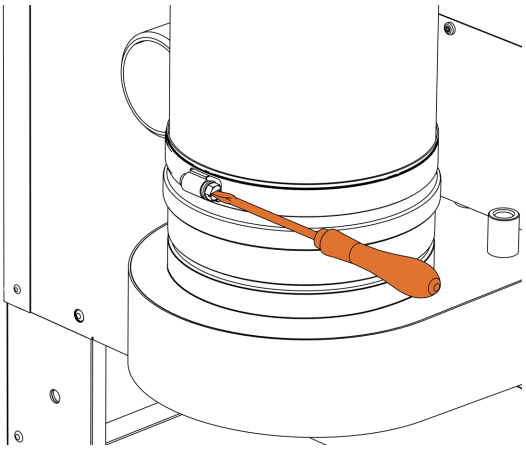


Figure 11 *Securing the vent connection*

Venting must be supported in accordance with the applicable code and instructions supplied by the manufacturers.

**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.

## 3.5.4 Vent travel

PVC/CPVC (Schedule 40), PPs (Rigid Single Wall), or SS approved piping are the standard venting options that can be sited up to 120 equivalent feet from the vent termination.

**Warning**

Follow all installation instructions supplied by the pipe and fitting manufacturer.

The actual vent travel allowance is reduced for fittings as shown in the following tables:

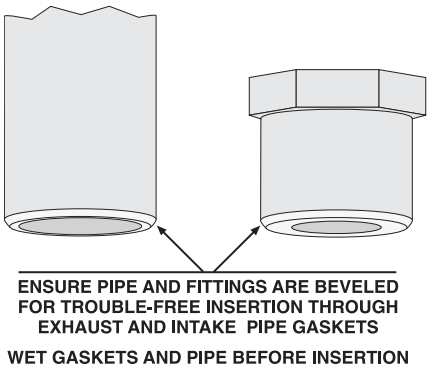
| Exhaust Pipe Size | EX 400, EX 500 | EX 700, EX 850 |
|---|---|---|
| **Sched.40; Rigid PPs** | | |
| 4" PVC/CPVC / Rigid PPs/SS | 170' (each side) | n/a |
| 6" PVC/CPVC / Rigid PPs/SS | n/a | 120' (each side) |
| 90° vent elbow | allow 5' equivalent | allow 5' equivalent |
| 45° elbow | allow 3' equivalent | allow 3' equivalent |
| PPs 87-90° elbows | use 5' equivalent | use 5' equivalent |

***Table 4*** *Maximum Exhaust Venting Length for EX 400, 500, 700, and 850 models*

For example, for an EX 850 using 6 x 90º CPVC vent elbows, the maximum lineal measure of pipe allowed is 90 feet (120' – (6 x 5' = 30) = 90').

**Note**

Unused intake travel cannot be added to the exhaust. Unequal intake and exhaust piping is allowed.




Exhaust venting must slope down towards the boiler with a pitch of at least 1/4" per foot (PP vent: follow PP manufacturer requirements for slope), so condensate runs back towards the trap. Support should be provided for intake and vent piping, particularly for horizontal runs (follow local code

Figure 12 *Pipe and fitting beveling*

- Check that material meets local codes including fire stopping requirements. Some local jurisdictions require a minimum initial length of pipe be exposed or accessible for inspection. Pipe clearances - no IBC requirements; follow local codes. All piping must be liquid and pressure tight.
- Ensure all venting components are clear of burrs/debris prior to assembly. Clear plastic debris left in the combustion air piping to avoid intake into the fan.
- Secure joints using appropriate solvent cement to bond the respective pipe material (Canada: CPVC cement approved under ULC-S636, in accordance with its manufacturer instructions; USA: PVC (ASTM D2564), or PVC/ABS (D2235) - Use transition glue anywhere that PVC and CPVC are joined. 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.
- Check that vent connections are 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 and water solution .the installer must fill the condensate trap prior to testing.

To drive the fan into manual high speed operation for vent leak testing, from the touchscreen controller Main Menu go to **Diagnostics**>**Test Operation**>Set **Vent Test** to **On**. 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. We suggest attaching a tag on the vent line near the condensate drain tee with the type of test, the date and the installer's name.

## 3.5.5 Venting passage through ceiling and floor

- Confirm material meets local codes including fire stopping requirements.
- Check the local jurisdiction on the minimum initial length of pipe that should be exposed or accessible for inspection.
- Follow the local codes for pipe clearances - no IBC requirements.
- Ensure that piping is liquid and pressure tight.

# 3.5.6 Rooftop vent termination

**Warning**

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

a. Rooftop vents must terminate as follows:

- The exhaust pipe can terminate in an open vertical orientation without concern about rain infiltration; rain will drain away through the condensate trap.
- 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.
- **Do not** exhaust vent into a common venting system.

b. For rooftop direct vent systems:

- Rooftop, two pipe, direct vent configurations, including typical clearance requirements are shown below in the following images.

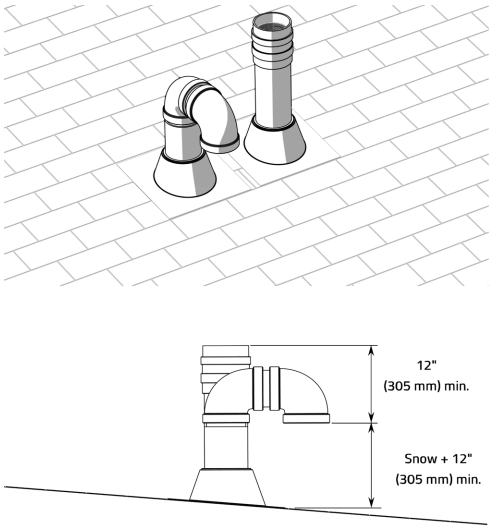



Figure 13 *Rooftop vent terminal configurations*

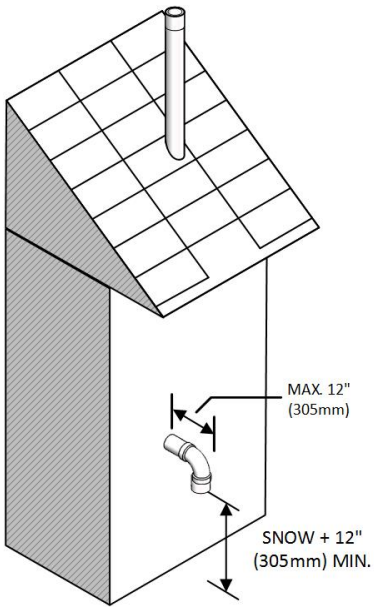
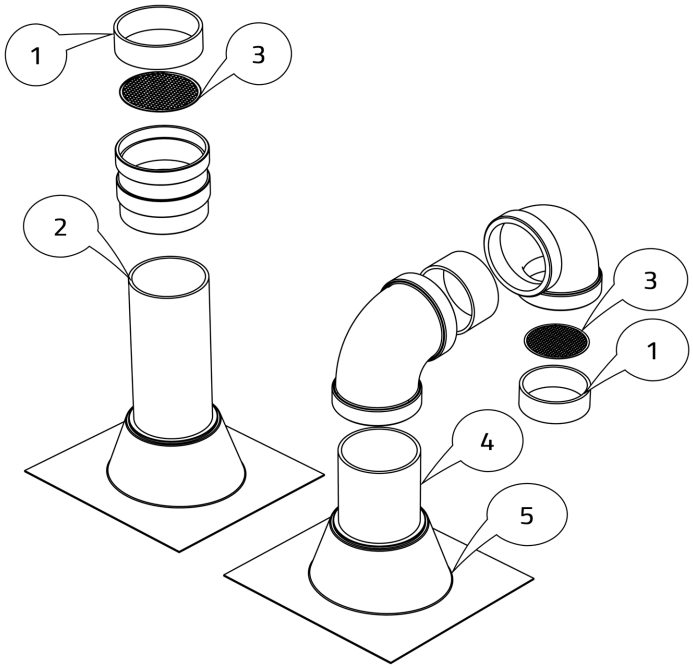



Figure 14 *Rooftop vent termination with sidewall combustion air*




| | |
|---|---|
| 1 | Vent screen retainer |
| 2 | Exhaust |
| 3 | Vent screen |
| 4 | Inlet |
| 5 | Flashing |

Figure 15 *Rooftop vent terminal vent screen and retainer*

» The intake air pipe is not typically drained, so it must be terminated with a down-turned elbow as shown.

» The intake pipe does not need to penetrate the roof at the same elevation as the exhaust (as shown); lower down on the roof is acceptable.

> **Best Practice**: To reduce the possibility of expansion noise, allow a ¼" gap around the exhaust and air intake piping.

- For roof top venting of multiple boiler sets, group all intake terminals together for a common penetration through a custom cap. Alternatively, place close together using commonly available pipe flashing. Similarly, group the exhaust pipes and place the two separate groups of pipes at least 3' apart (the closest intake and exhaust pipes shall be 36", or more, apart). Use the same 12" (minimum) vertical separation for all termination options. For alternate group terminations, contact the IBC Factory for written guidance.
- Roof top termination kits are approved for use with the boiler model. Installation of the vertical roof top termination must follow the installation instructions supplied with the venting material manufacturer. Care must be taken to install the termination kit a minimum horizontal distance of 10' (305 cm) away from any portion of the building and a minimum of 2' (61 cm) above the roof line plus the anticipated snow line.

## 3.5.7 Sidewall vent termination

**Caution**

Vent termination clearances in this section are code minimum, or IBC recommended minimum requirements, and may be inadequate for your installation. Building envelope details must be examined carefully. Take action to avoid moisture entering building structures. Serious structural damage may occur if adequate precautions and clearances are not allowed for. These precautions apply to neighboring structures as well as to the structure the boiler(s) are installed in.

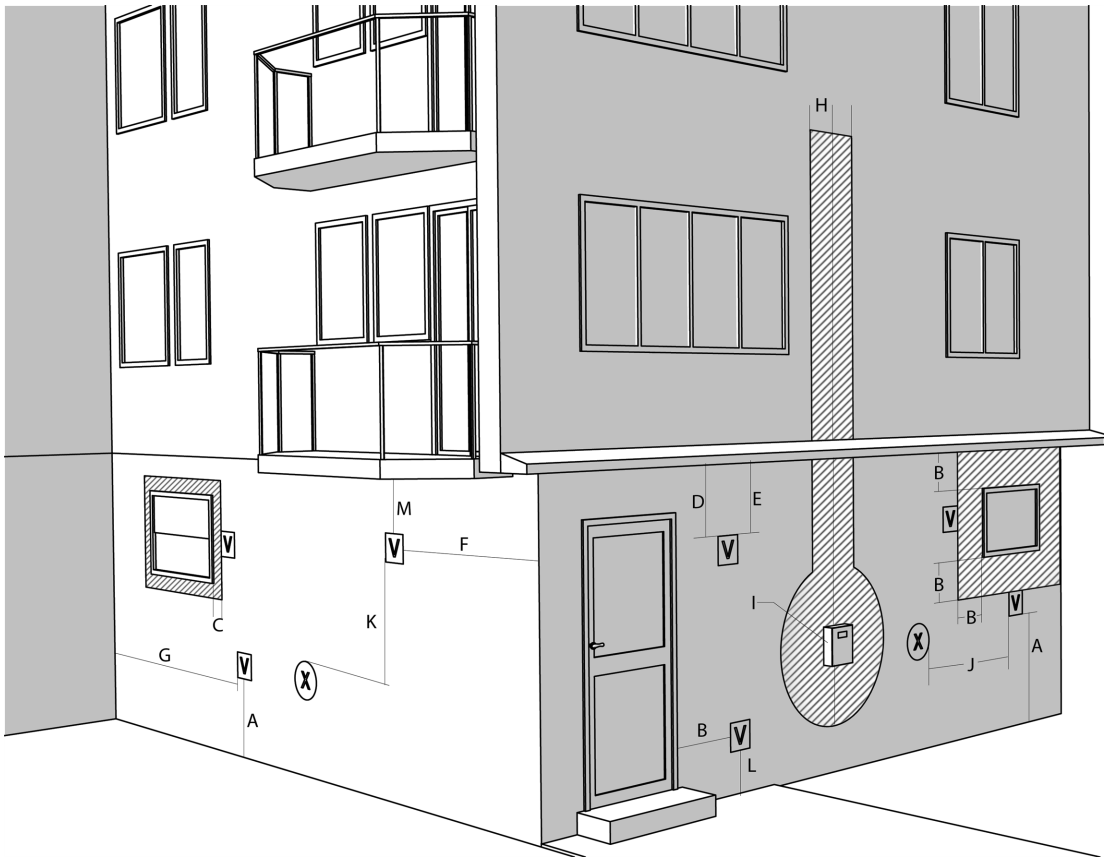



Figure 16 *Minimum clearances from vent/air inlet terminations (see legend on adjacent page)*

| | Description | US Installations[1] | Canadian Installations [2] |
|---|---|---|---|
| A | Clearance above grade, veranda, porch, deck, or balcony | 1' (30 cm) | 1' (30 cm) |
| B | Clearance to window or door that may be opened | 4' (1.2 m) below or to side of opening | 3' (91 cm) |
| C | Clearance to permanently closed window | * | * |

[1] In accordance with the current ANSI Z223.1/NFPA 54 National Fuel Gas Code.

[2] In accordance with the current CAN/CSA-B149 Installation Codes.

* Clearances in accordance with local installation codes and the requirements of the gas supplier.

| | Description | US Installations[1] | Canadian Installations [2] |
|---|---|---|---|
| D | Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2' (61 cm) from the center line of the terminal | 5' (1.5 m) | * |
| E | Clearance to unventilated soffit | * | * |
| F | Clearance to outside corner | 6' (1.83 m)* | 6' (1.83 m)* |
| G | Clearance to inside corner | 6' (1.83 m) | 6' (1.83 m)* |
| H | Clearance to each side of center line extended above meter/regulator assembly | * | 3' (91 cm) within a height 15' above the meter/ regulator assembly |
| I | Clearance to service regulator vent outlet | * | 6' (1.83 m) |
| J | Clearance to non-mechanical air supply inlet to building or the combustion air inlet to any other appliance | 4' (1.2 m) below or to side of opening; 1' (30 cm) above opening | 3' (91 cm) |
| K | Clearance to mechanical air supply inlet | * | 6' (1.83 m) |
| L | Do not terminate above paved sidewalk or paved driveway | Slip hazard due to frozen condensate | Slip hazard due to frozen condensate |
| M | Clearance under veranda, porch, deck or balcony | * | 12" (30 cm)[3] |

***Table 5*** *Vent/air inlet termination clearances*

**Warning**

**Important!:** Maintain at least the minimum separation of exhaust vent termination from boiler intake air as illustrated in *Figure 17* , *Figure 18* , *Figure 19* and *Figure 20* . Failure to do so can result in a dangerous situation where exhaust gases are re-ingested with combustion air. Damage to the boiler can result from a failure to maintain these separations. Do not use proprietary InnoFlue or PolyPro PPs terminals without specific approval from IBC.

[1] In accordance with the current ANSI Z223.1/NFPA 54 National Fuel Gas Code.

[2] In accordance with the current CAN/CSA-B149 Installation Codes.

[3] Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor and top of terminal, and underside of veranda, porch, deck or balcony is greater than 1' (30 cm).

Sidewall direct vent with separate vent and air pipes shall be terminated as follows:

- Locate the intake air and exhaust vent terminations on the same plane (side) of the building.
- Place the exhaust vent termination, so that it reaches 12" minimum above the down-turned intake to avoid exhaust re-ingestion.
- (Optionally) Raise the elevation of both terminations in “periscope style” after passing through the wall, then to gain the required clearance configure as shown in *Figure 17* , *Figure 18* , and *Figure 19* .
- Use a 45° elbow on the exhaust termination to launch the plume up and off the sidewall (for protection of wall). A short piece of venting cut at 45° gives a horizontal termination protected from wind loads (see *Figure 17* , *Figure 18* , and *Figure 19* ).
- Suggest use of a bird screen of ¼" stainless steel or plastic mesh (IPEX System 636 drain grate) to guard against foreign objects.

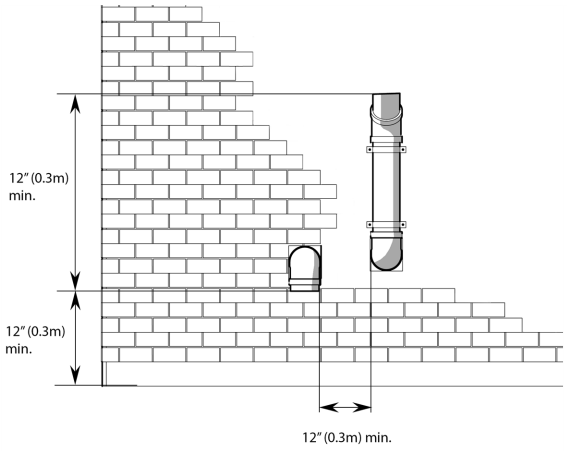



Figure 17 *Vent termination clearance*

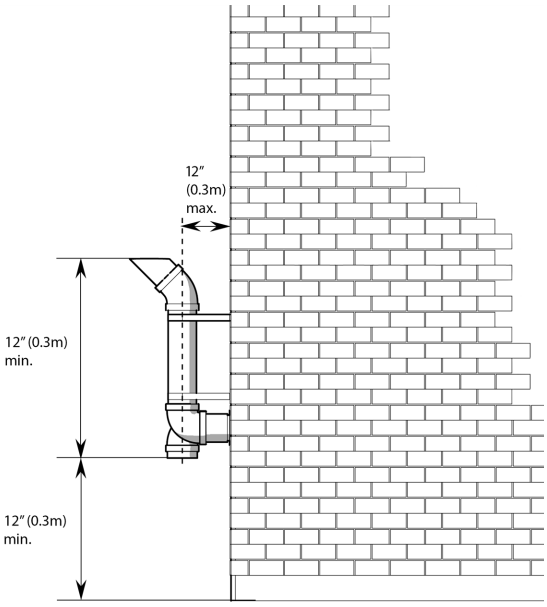



Figure 18 *Vent termination clearances*

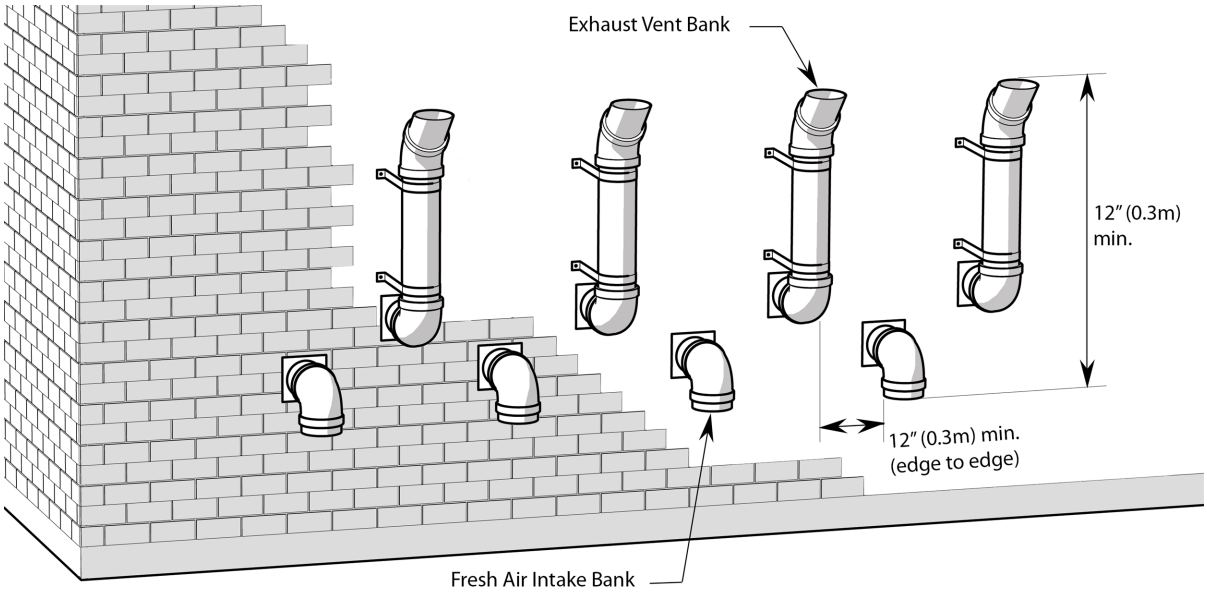



Figure 19 *Sidewall vent termination configuration option 1*

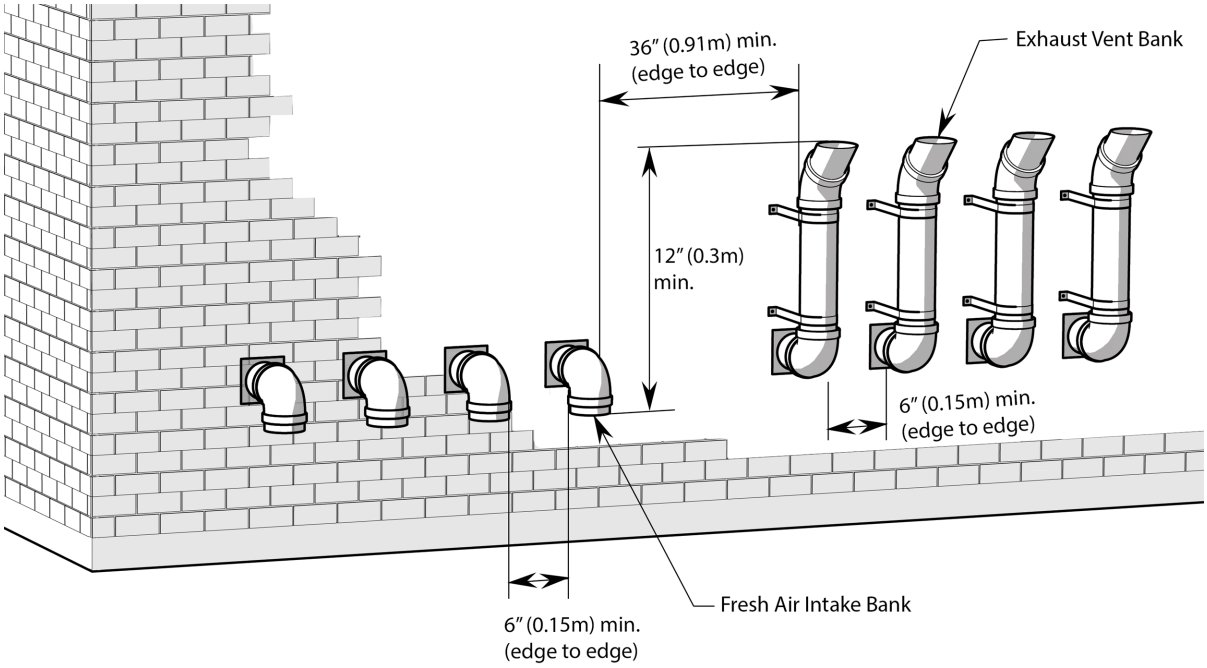



Figure 20 *Sidewall vent termination configuration option 2*

**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.

## 3.5.8 Direct vent combustion air intake piping

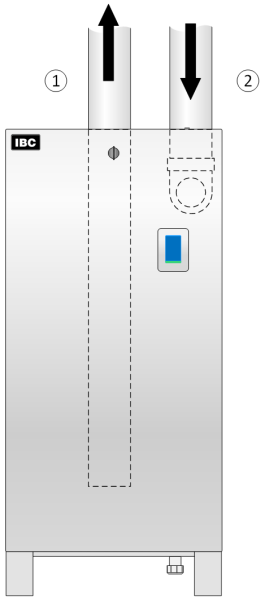
The direct vent option uses piping from the outside to supply combustion air directly to the boiler's combustion air connection. Combustion air piping - if used - is inserted directly into the 4" PVC-sized fitting, and increased immediately to 6".

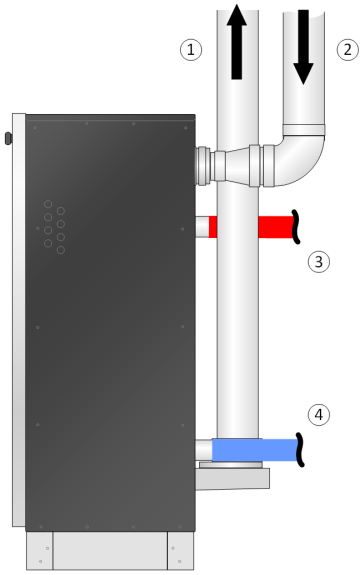
At a new construction site, or during renovations, action must be taken to protect the boiler from drywall dust or other construction related contaminants; combustion air should be drawn from a **clean** source (e.g. outdoors) and the boiler should be isolated from interior dust sources. Do not seal boiler case openings directly when firing - allow for air circulation and ventilation in the immediate area.

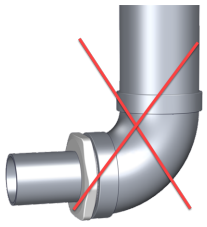
| Known Corrosive Contaminants to Avoid |
|---|
| Cements and glues |
| Paint or varnish removers |
| Adhesives used to fasten building products and other similar products |
| Chlorinated waxes or cleaners |
| Chlorine-based swimming pool chemicals |
| Calcium chloride used for snow and ice clearing |
| Sodium chloride or potassium chloride used for water softening |
| Refrigerant leaks from cracks in coils |
| Hydrochloric acid or muriatic acid used in household cleaning and stain removal |
| Chemicals in perming solutions |
| Chlorofluorocarbon chemicals found in spray cans |
| Chlorine-type bleaches, detergents, and cleaning solvents found in household laundry rooms |
| Antistatic dryer sheets in clothes dryers |

**Warnings**

- In addition to preventing ingestion of chemical contaminants, ensure air intake terminals are not installed in locations where contamination might occur due to ingestion of particulate foreign material (dust, dirt and debris).
- Configure intake air openings, so that rain or other forms of moisture cannot enter the air intake piping system. Otherwise serious damage to the boiler may result.



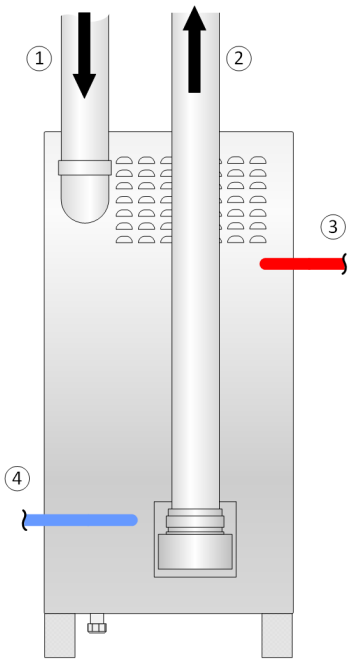



Do not use bushing on EX 700 and EX 850 models

| | | |
|---|---|---|
| 1 | Flue gas exhaust to outdoors (connection at rear of boiler) | Flue gas exhaust to outdoors |
| 2 | Combustion air from outdoors. "Direct Vent" installation: check air intake outside is clear of obstructions. | Combustion air from outdoors. Use reducing coupling to transition from 4" connection to 6" venting before first elbow. |
| 3 | | Boiler supply |
| 4 | | Boiler return |

Figure 21 *Direct vent combustion air intake*

Figure 22 *Combustion air intake - side view*




| | |
|---|---|
| 1 | Combustion air from outdoors |
| 2 | Flue gas exhaust to outdoors |
| 3 | Boiler supply connection at rear of boiler |
| 4 | Boiler return connection at rear of boiler |

Figure 23 *Rear view - combustion air intake*

**Notes**

- When installing air intake piping, ensure that a "trap" is not formed in the piping causing a build-up of water and blockage of intake air. Such blockages will cause a boiler safety shut-down.
- Filters require checking and cleaning or replacing on a regular schedule based on the severity of the problem.

| Intake Pipe Size | EX 400, EX 500 | EX 700, EX 850 |
|---|---|---|
| **Sched.40; Rigid PPs** | | |
| 4" PVC/CPVC / Rigid PPs/SS | 170' (each side) | n/a |
| 6" PVC/CPVC / Rigid PPs/SS | n/a | 120' (each side) |
| 90° vent elbow | n/a | 120' (each side) |
| 45° elbow | allow 5' equivalent | allow 5' equivalent |
| PPs 87-90° elbows | allow 3' equivalent | allow 3' equivalent |

*Table 6 Maximum intake pipe venting length for EX 400, 500, 700, and 850*

For the inlet air – Schedule 40 PVC, CPVC, ABS, PPs or SS piping of any type is permitted.

**Note**

Unused intake travel cannot be added to the exhaust. Unequal intake and exhaust piping is allowed.

Ensure that 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.

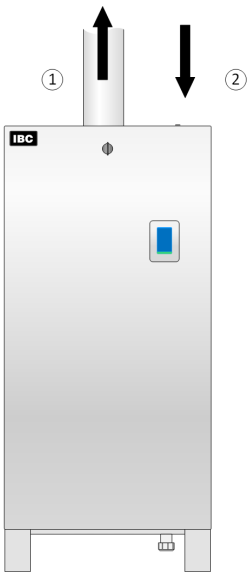
Use support for intake piping, particularly for horizontal runs (follow local codes).

## 3.5.9 Indoor air combustion air intake

An “Indoor Combustion Air installation” can be described as air for combustion that is taken from the air surrounding the boiler.

**Warning**

When using indoor air options, supply adequate combustion air to the boiler room according to the requirements of all applicable codes.




| | |
|---|---|
| 1 | Flue gas exhaust to outdoors |
| 2 | Combustion air from boiler room. For indoor air installation, check air intake and boiler room combustion air opening(s) to ensure they are clear of obstructions. |

Figure 24 *Indoor combustion air intake*

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 B149.1 (latest edition).

## 3.5.10 Combustion air filtration system

A built-in combustion air filter system is supplied with the boiler, and is located at the top of the appliance. The boilers use a 10" x 10" x 1" (MERV 8) filter.

End users will need to be instructed on how to maintain the filter in the boiler. For instructions on how to replace the filter, see *Replacing the air filter on page 98*.

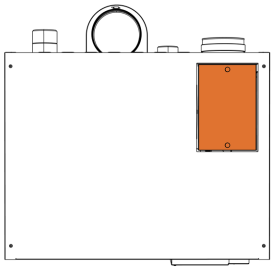


Figure 25 *Filter door - top view of boiler*

# 3.6 Installing a condensate trap

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 some other condensing boilers).

Reliable system operation requires:

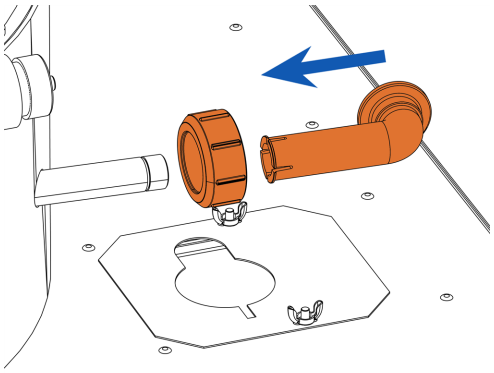
1. Proper design and installation of exhaust venting to allow condensate to run back to the drain/trap.
2. Acid neutralization as appropriate.

To achieve these:

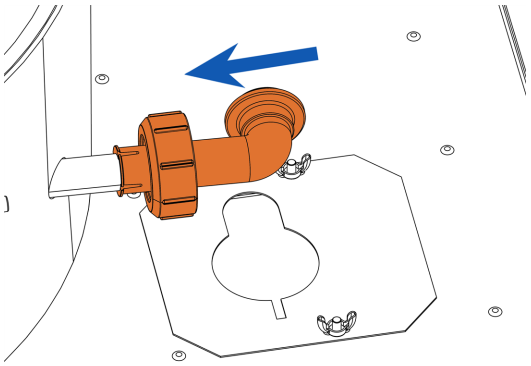
- Allow a minimum ¼" per foot slope back to the vent connection, with appropriate hangers to maintain that gradient. For PPs venting, follow the manufacturer's requirements. This will ensure proper drainage and prevent condensate from clogging.
- Ensure the supplied trap is correctly installed and filled with water.
- When required, add (and maintain in good condition) a neutralization tank. For information on installing a condensate neutralizer, see *Installing a condensate neutralizer on page 39*.

The condensate trap must be installed on the drain connection at the base of the boiler. The condensate drain must be piped to within 1" of a drain or connected to a condensate pump. The drainage line must slope down to the drain at a pitch of ¼" per foot so condensate runs towards the drain.

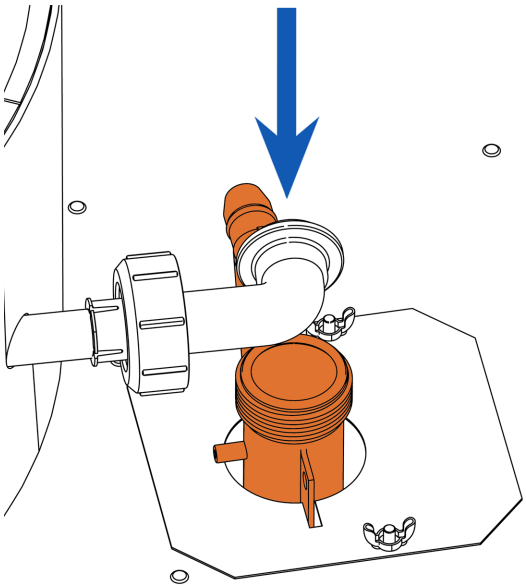
**1.** Slide the union nut onto the elbow. The union nut must include an embedded O-ring. Ensure that the O-ring seal is in place on the heat exchanger's stainless steel outlet tube.



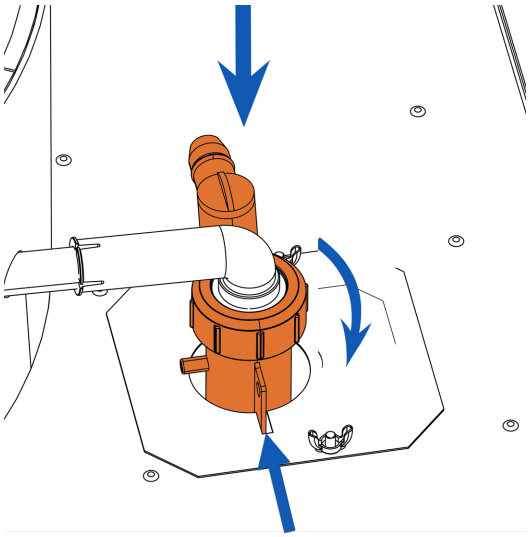
**2.** Attach the elbow and union nut firmly to the boiler's outlet tube, making sure that you rotate the elbow sideways.

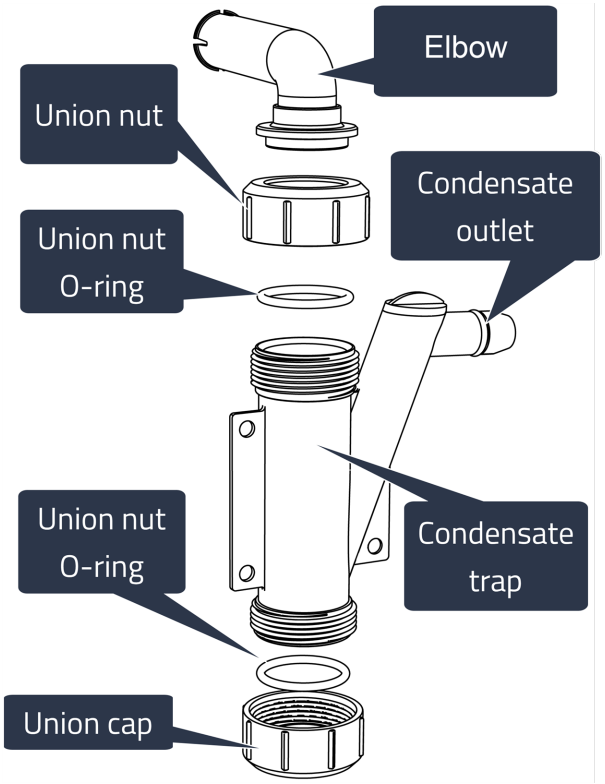


**3.** Fill the condensate trap with water and insert the trap into the hole of the metal plate.



**4.** Rotate the elbow, and tighten the union nut, so that the elbow and condensate trap are secured. Ensure the union nut O-ring is included. Check for leaks.






**Warning**

Fill the trap with water before initially firing the boiler to prevent exhaust fumes from entering the room. Never operate the boiler unless the trap is filled with water. Failure to comply will result in severe personal injury or death.

## 3.7 Installing a condensate neutralizer

If discharging condensate into building drain piping materials that are subject to corrosion, use a neutralization package.

**Warning**

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

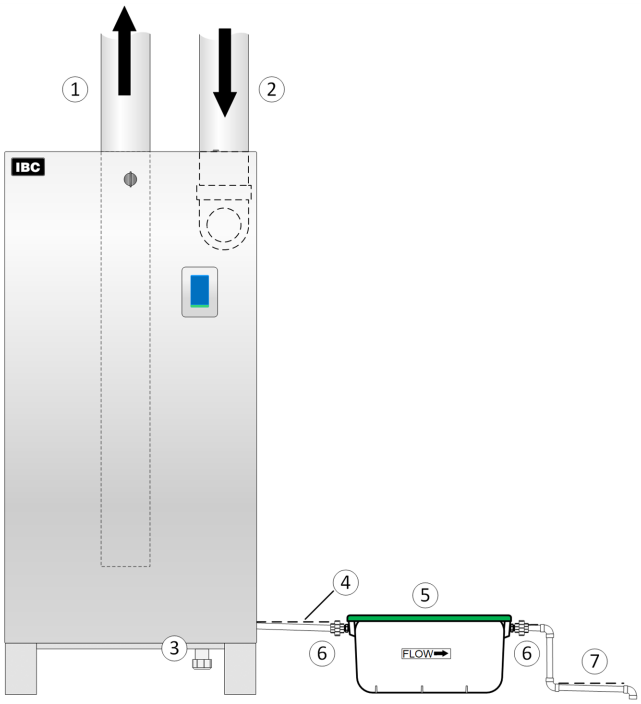



Figure 26 *Condensate neutralization tank*

| | |
|---|---|
| 1 | Flue gas exhaust (connection at rear of boiler): condensate, and potentially rain water, flow back from the venting system. |
| 2 | Air intake piping: **Warning** - Risk of damage to appliance. Ensure rain water is prevented from entering. |
| 3 | Free flow of condensate from venting systems and the pressure vessel must be maintained at all times. Trap and condensate drain piping must be accessible to allow regular inspection and cleaning. |
| 4 | Condensate water line: **Warning** - Risk of damage to appliance. All condensate discharge lines, including neutralization tank inlet, must be at a lower elevation than the condensate water line of the appliance. |
| 5 | Condensate neutralizer: Drain materials subject to corrosion must be protected by acid neutralization. **Warning** - Risk of injury. Tank fluid can be highly acidic. Do not use hands to stir material. Refer to the neutralization instructions of the manufacturer. Access to the discharge, before the drain, is necessary for proper maintenance in order to check the effectiveness of the neutralizing agent. A simple pH test should be performed annually to ensure neutralizing agent is still effective. If the pH falls below 6.5 the neutralizing material should be replaced. The agent (limestone chips with a minimum calcium carbonate content of 85%) can be purchased from a local supplier. |

6 1" FPT inlet and outlet. Unions for ease of maintenance (ships with shown model NT-25, IBC part 180-048).

7 To drain. Confirm slope. Slope the condensate hose and drain piping toward the drain and secure to prevent accidental dis-assembly.

**Danger**

The water in the condensate neutralizer can cause severe burns to the skin. Wear protective gloves and eye wear when servicing the condensate neutralizer.

## 3.8 Water Piping

**Warning**

Water quality has a significant impact on the lifetime and performance of a boiler's heat exchanger.

Improperly prepared water in a heating circuit may cause damage to the heat exchanger through fouling or corrosion. Repeated or uncontrolled water fills will increase the potential for damage.

High levels of dissolved solids or minerals may precipitate out of the fluid onto the hottest part of the heat exchanger, impairing heat transfer and resulting in overheating and premature failure. The amount of solids that may form on the heat exchanger will depend on the degree of hardness and the total water volume in the system. A high water volume system with a low hardness count may cause as much damage as a system with less volume and higher hardness, so it is recommended to treat water so as to remove all dissolved solids. Other water chemistry allowable limits are as follows:

- Acidity pH is to be between 6.6 and 8.5
- Chloride is to be less than 125 mg/l
- Iron is to be less than 0.3 mg/l
- Cu less than 0.1 mg/l
- Conductivity is to be less than 400µS/cm (at 77°F [25°C])
- Hardness is to be 7 grains per gallon or less / 120 ppm or less

**Important**: Ensure that these limits are acceptable for the other water-side components in the system.

| Boiler Head Loss - EX 400, EX 500 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Flow rate (gpm) | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| Head @ flow (ft) | 2.6 | 3.0 | 3.7 | 4.4 | 5.2 | 6.3 | 7.4 | 8.9 | 10.7 |

*Table 7 Boiler Head Loss - EX 400, EX*

| Boiler Head Loss - EX 700, EX 850 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Flow rate (gpm) | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| Head @ flow (ft) | 2.6 | 2.9 | 3.2 | 3.7 | 4.2 | 4.8 | 5.5 | 6.4 | 7.2 |

*Table 8 Boiler Head Loss - EX 700, EX 850*

Ensure that 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 the actual performance by measuring Δ°T (under high and low flow conditions) after establishing the correct firing rate.

To use legacy heat, we recommend water flow after burner shutdown. This is significant due to the mass of the heat exchanger plus its internal water volume. Default load settings 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 15 minutes after burner shutdown (for the last calling load). As shipped, the default settings will run the Load pump for 5 minutes to place the legacy heat where it is useful. Any secondary pump can be set to run for 0 – 900 seconds in the heat purge mode. Guard against deadheading pumps when all zone valves are closed by setting the load Pump Post Purge (sec) to '0'.

The primary pump must be under the control of the boiler to allow pump purge after burner shut-down.

Installers must conform to the piping design configurations provided to simplify the control application, promote good loads and flow management.

### Propylene glycol usage

**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. Installers must 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.

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. Generally, a 50%:50% solution of propylene glycol and water requires an increased system circulation rate (gpm up 10%), and system head (up 20%) to provide performance equivalent to straight water.

These boilers are designed for use within a closed loop, forced circulation, low pressure system. A 50 psi pressure relief valve (¾" NPT inlet, 1" NPT outlet) is supplied for field installation in the relief valve fitting on top of the boiler. An optional relief valve, with a rating of up to 150 psi, can be used where required on closed loop systems. Relief valve discharge piping must terminate between 6" (15 cm) and 12" (30 cm) above the floor or per local code.

**Warning**

During operation, the relief valve may discharge large amounts of steam and/or hot water. To reduce the potential for bodily injury and property damage, install a discharge line that:

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

**Do not cap, plug or obstruct the discharge pipe outlet.**

## 3.8.1 General piping best practices

Primary/secondary piping, or the use of a hydraulic separator (such as the Caleffi 549 SEP4™ 4-in-1 Magnetic Hydraulic Separators) is recommended for maximum flexibility in multi-load applications. Piping loads in parallel is also encouraged in systems that only have two loads, or when loads are operating simultaneously. The extremely low pressure drop through the heat exchanger of the EX series affords more flexible options unavailable in other designs.

**Caution**

Contact local water purveyors about the suitability of the supply for use in hydronic heating systems.

If unsure about water quality, request testing and assessment (and treatment, if required) from a local water treatment expert.

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

## 3.8.2 System piping

System piping is connected to the boiler using 2½" NPT-Male threaded fittings. To simplify servicing, we recommend using unions or flanged fittings, gate or ball valves at the boilers supply and return water connections. You must install un-insulated hot water pipes with a minimum ¼" clearance from combustible materials.

Fluid fill is most often accomplished by using a boiler regulator & fill valve set at 12 psig or more, with the 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 the applicable codes and good piping practice.

**Warning**

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

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 appliance for recycling of boiler fluid and chemicals back into the system. In buildings that may be unoccupied for long periods of time, pressurization appliances 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 above the boiler; leaks can damage the fan and controls. If needed, create a shield over the 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 2½" piping. Refer to *Table 7* or to *Table 8* for boiler head loss information.

Example: In these EX models, the minimum flow rate required through the heat exchanger is 18 or 21 gpm (depending on model) and a maximum of 100 gpm is allowed. 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 80°F).

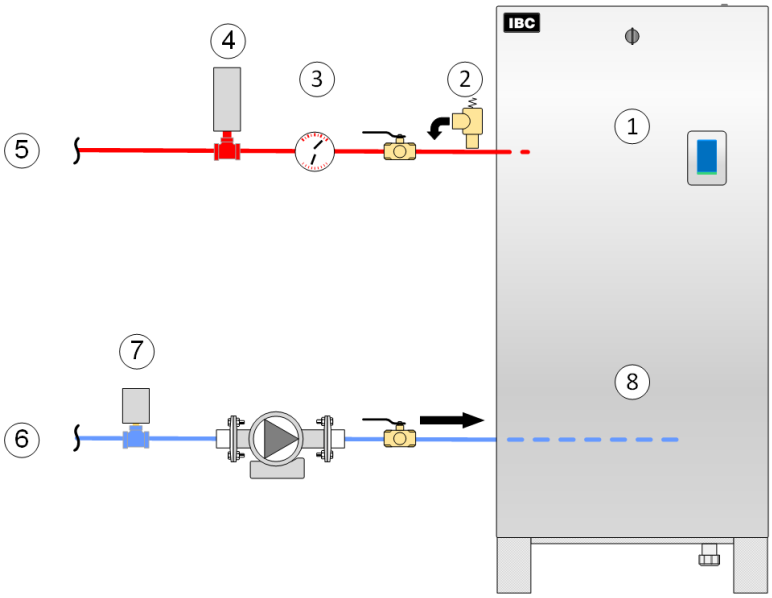
Check valves or thermal traps should be used to isolate both the supply and return piping for each load - to avoid thermal siphoning and reverse flow.

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 (18 or 21 gpm - depending on model).

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

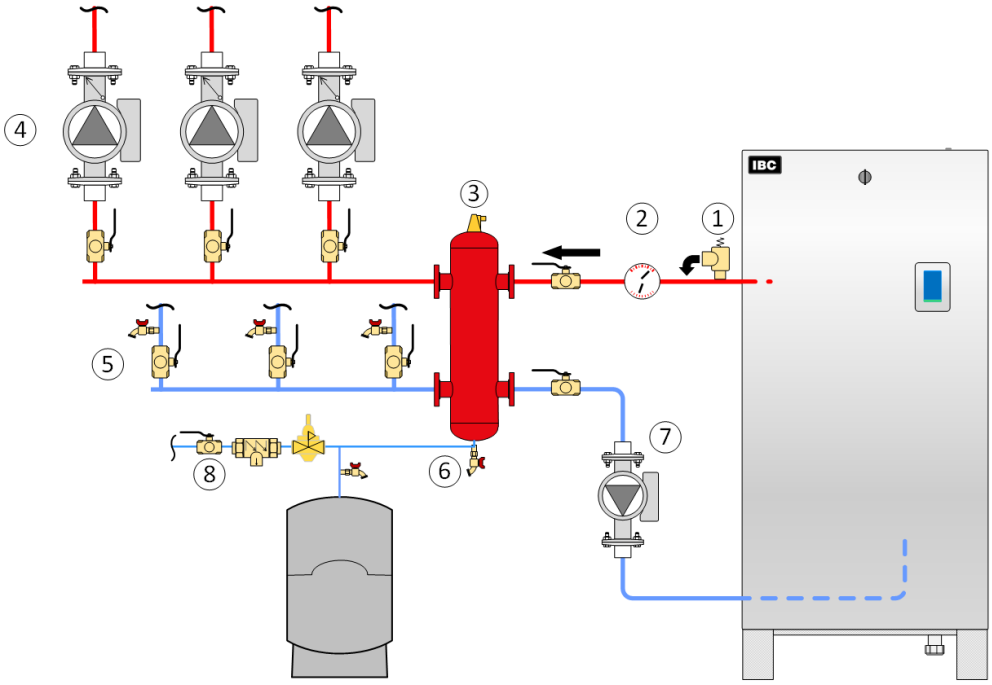
**Note**

The 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.



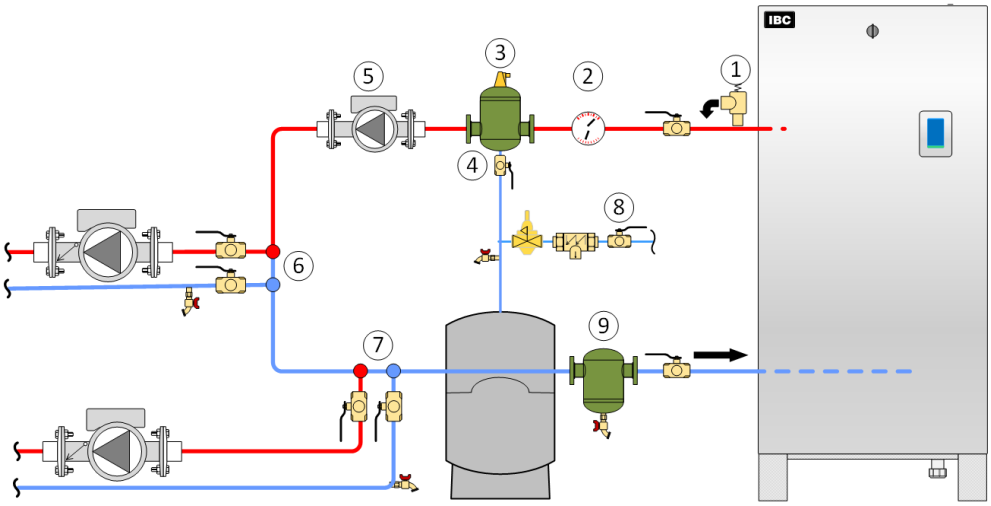

| | |
|---|---|
| 1 | Low water cut-off (LWCO): the IBC EX series comes factory-equipped with an internally mounted Certified Low Water Cut-Off. Sometimes an external device is required by local jurisdiction. These devices have specific installation requirements not illustrated here. Consult the IBC factory or the LWCO manufacturer for proper application of these devices. |
| 2 | Pressure relief valve (ships with boiler): no isolation valve permitted between boiler and relief valve. |
| 3 | Tridicator / external pressure and temperature gauge (ships with boiler). |
| 4 | Optional external water high limit (manual reset). The IBC EX series comes factory-equipped with an internally mounted manual reset mechanical water temperature high limit. It can be fitted with an external manual reset mechanical water temperature high limit if required by local jurisdiction. |
| 5 | To supply manifold |
| 6 | From return manifold |
| 7 | Optional flow switch: follow manufacturer's instructions. Typical requirements include installing on a horizontal run, with at least five (5) pipe diameters of straight piping both upstream and downstream of flow switch, and ensuring proper paddle engagement for the piping size. |
| 8 | Integrated boiler drain |

Figure 27 *Trim for multiple boiler installations*



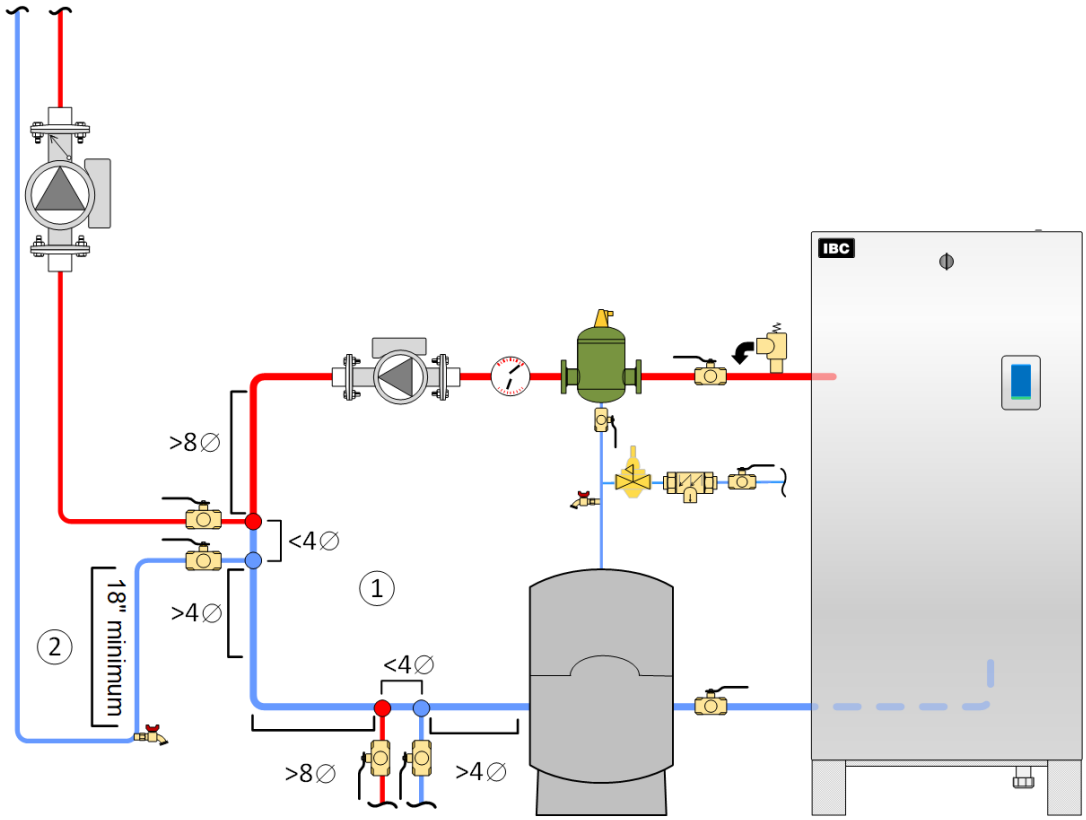

| | |
|---|---|
| 1 | Pressure relief valve (shipped with boiler): no isolation valve is permitted between the boiler and relief valve. |
| 2 | Tridicator or external pressure and temperature gauge (shipped with boiler). |
| 3 | Hydraulic separator (low-loss header) provides primary/secondary hydraulic separation, a microbubble air eliminator and a dirt separator. Air eliminator is installed at the most effective point, where the fluid is at the highest temperature and lowest pressure. |
| 4 | Secondary pumps to multiple loads or zones. All receive identical temperatures. Note integrated check valves. |
| 5 | Return lines from loads. |
| 6 | Expansion tank connection (point of no pressure change) should be on the suction side of the circulator. |
| 7 | Primary pump or boiler circulator into connection at rear of boiler. |
| 8 | Fill station with isolation valve closed, or fill tank. |

Figure 28 *Primary/Secondary piping concept with hydraulic separator*



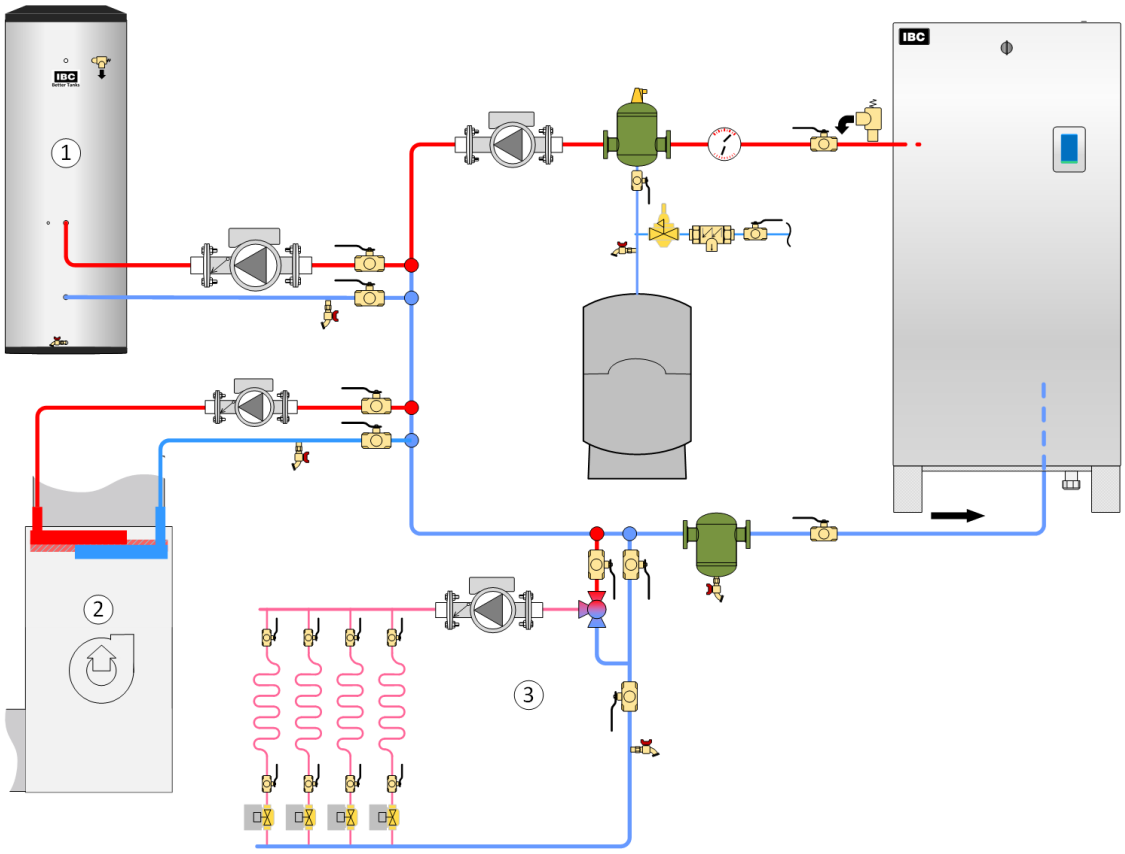

| | |
|---|---|
| 1 | Pressure relief valve (field-supplied): no isolation valve is permitted between the boiler and relief valve. |
| 2 | Tridicator or external pressure and temperature gauge (field-supplied). |
| 3 | Microbubble air eliminators are best installed where the fluid is at the highest temperature and lowest pressure. |
| 4 | Expansion tank connection (point of no pressure change) should be on the suction side of the circulator. |
| 5 | Primary pump or boiler circulator. |
| 6 | Closely-spaced tees to or from load 1. |
| 7 | Closely-spaced tees to or from load 2. |
| 8 | Fill station with isolation valve closed, or fill tank. |
| 9 | Dirt separator recommended. |

Figure 29 *Boiler trim options - single boiler*



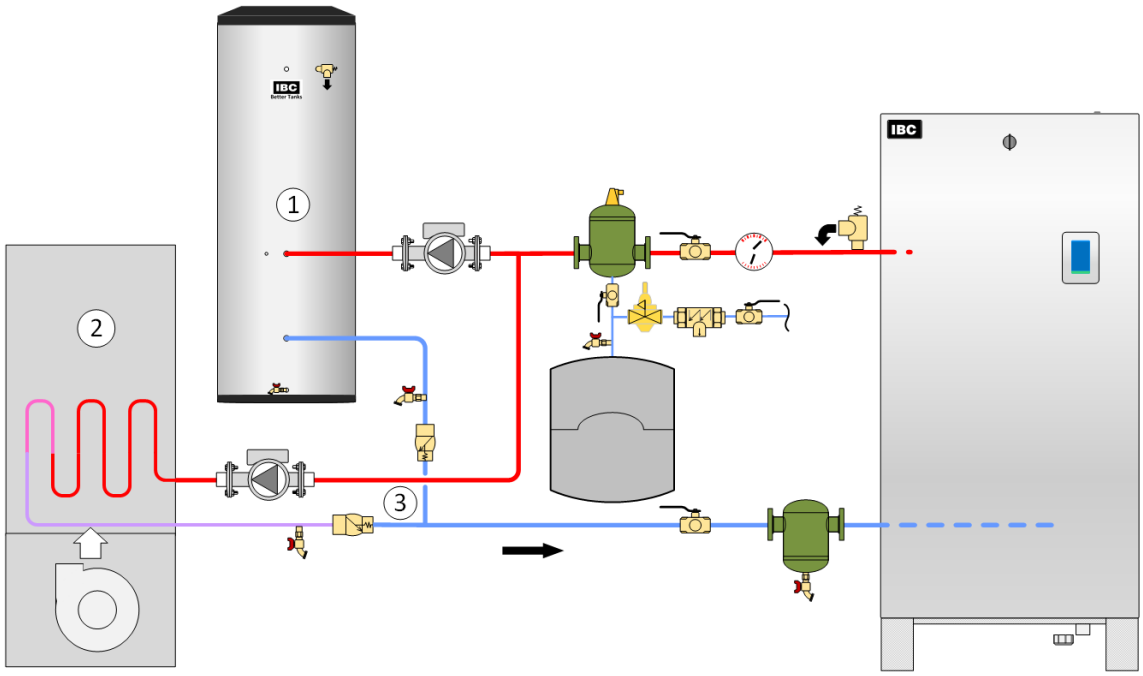

| | |
|---|---|
| 1 | Closely-spaced tees: To avoid induced flow, install each set of tees with straight piping a minimum of 8 pipe diameters upstream and 4 pipe diameters downstream. Avoid using elbow or other component that may create turbulent flow. Position tees as close together as possible (maximum 4 pipe diameters apart) and ensure that there are no restrictions between the fittings that would result in a pressure drop. |
| 2 | Heat migration: On secondary loops that extend vertically to a load that is above the primary loop, steps must be taken such as fabricating a thermal trap in the return piping - minimum 18" (46 cm) drop - to prevent thermal siphoning and heat migration to the load when there is no demand for heat to that loop. Alternatively, use check valves on both supply and return of secondary piping. |

Figure 30 *Important Primary/Secondary piping details with closely-spaced tees*




| | |
|---|---|
| 1 | DHW indirect tank |
| 2 | Air handler |
| 3 | Low temperature radiant protected by a mixing valve for simultaneous heating during higher temperature air handler operation. Boiler can return to lower supply temperature when radiant alone is operating. |

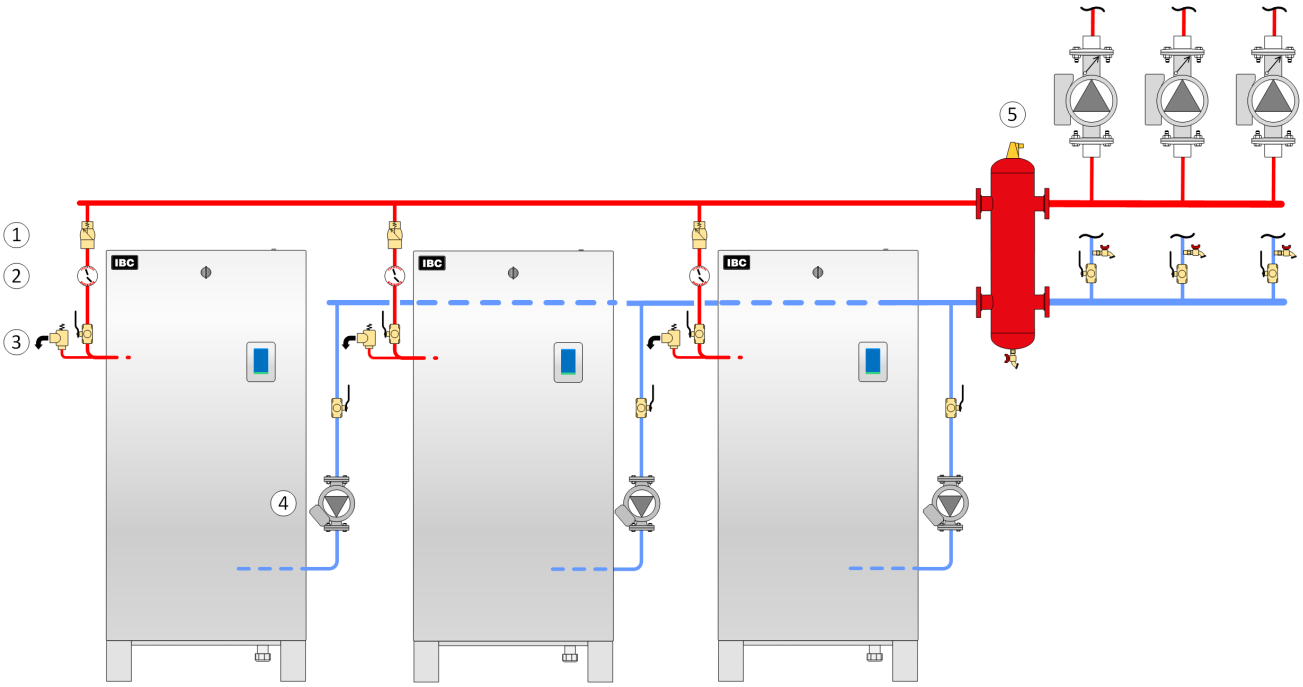
Figure 31 *Primary/Secondary piping concept with simultaneous heating calls*




| | |
|---|---|
| 1 | DHW indirect tank |
| 2 | Air handler |
| 3 | Check valves (may be integral to pumps - not shown) |

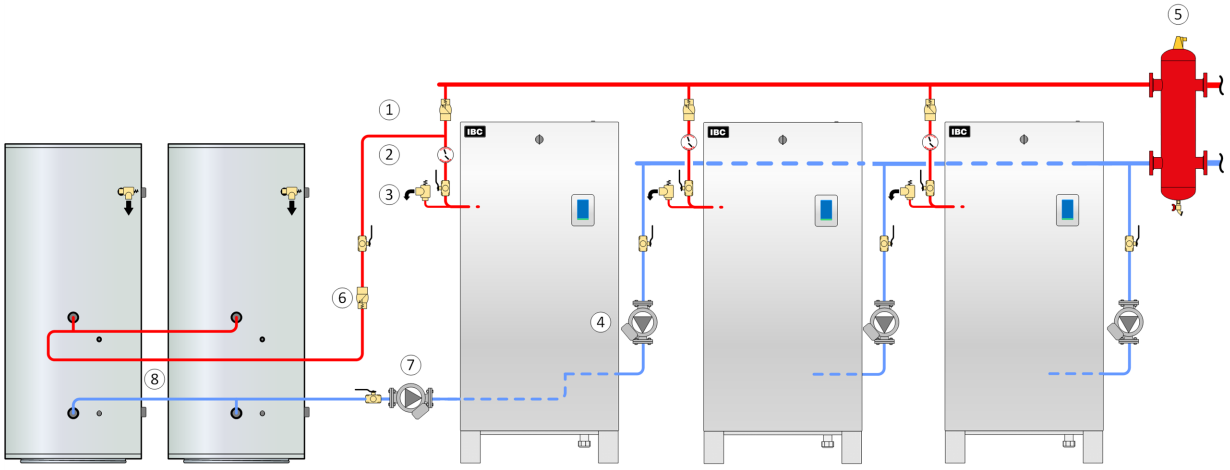
Figure 32 *Two pump, two load - parallel piping concept*

The boilers can supply multiple heating loads with compatible supply temperature requirements. Always ensure that loads sensitive to high temperatures are protected using means such as mixing valves.




| | |
|---|---|
| 1 | Check valve (typical of each boiler - may be integral to pump). |
| 2 | Tridicator (shipped with boiler) typical of each boiler. |
| 3 | Pressure relief valve (shipped with boiler) typical of each boiler. |
| 4 | Boiler pump into rear connection (typical of each boiler). |
| 5 | Low-loss header / hydraulic separator (shown) or closely-spaced tees 'bridge' to load piping. |

Figure 33 *Multiple boiler piping*




| | |
|---|---|
| 1 | Pressure relief valve (shipped with boiler) typical of each boiler. |
| 2 | Tridicator (shipped with boiler) typical of each boiler. |
| 3 | Check valve (typical of each boiler) |
| 4 | Boiler pump into rear connection (typical of each boiler) |
| 5 | Low-loss header / hydraulic separator (shown) or closely-spaced tees 'bridge' to load piping |
| 6 | Check valve for opt-out circuit. |
| 7 | Opt-out pump into rear side (opt-out boiler(s) only) |
| 8 | Opt-out load piping in reverse-return for balanced flows |

Figure 34 *Multiple boiler opt-out piping*

# 3.9 Gas piping

**Note**

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

**Important:** 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, during operation throughout the boiler's full modulation range, and after the call when the regulator is in a "lock-up" condition.

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.

## 3.9.1 Gas pressure

The boilers require a minimum inlet gas supply pressure of 4.0" w.c. for natural gas or propane during high fire operation. 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 to the boiler is 1" NPT (female).

The high gas pressure switch setpoint is set at 14" wc and the low gas pressure setpoint is set at 3.5" wc. To locate the switches on the boiler, see *Figure 43* or *Figure 44* .

Adequate gas supply piping must be installed with no smaller than 1¼" Schedule 40 (e.g. Iron Pipe Size (IPS) and using a 1" w.c. pressure drop, in accordance with the following chart.

| Maximum Gas Pipe Length (ft) | | | | |
|---|---|---|---|---|
| Model | 1¼" IPS | 1½" IPS | 2" IPS | 2½" IPS |
| EX 400 (Natural Gas) | 150' | 350' | 1000' | >2000' |
| EX 400 (Propane) | 400' | 900' | >2000' | >2000' |
| EX 500 (Natural Gas) | 100' | 200' | 700' | 1800' |
| EX 500 (Propane) | 250' | 600' | 2000' | >2000' |
| EX 700 (Natural Gas) | 50' | 100' | 350' | 800' |
| EX 700 (Propane) | 150' | 300' | 900' | 2000' |
| EX 850 (Natural Gas) | 40' | 80' | 250' | 600' |
| EX 850 (Propane) | 100' | 200' | 700' | 1600' |

***Table 9*** *Maximum Gas Pipe Length (ft)*

Gas piping must have a sediment trap ahead of the boiler's gas valve. A manual shutoff valve must be located outside the boiler, in accordance with local codes or standards. All threaded joints in gas piping should be made with an approved piping compound resistant to the action of natural gas or 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 ½ 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 43* or *Figure 44* ). Note that manifold pressure varies slightly in accordance with firing rates with the modulating series boilers, but will always be close to 0" wc. An adapter fitting is supplied with the boiler.

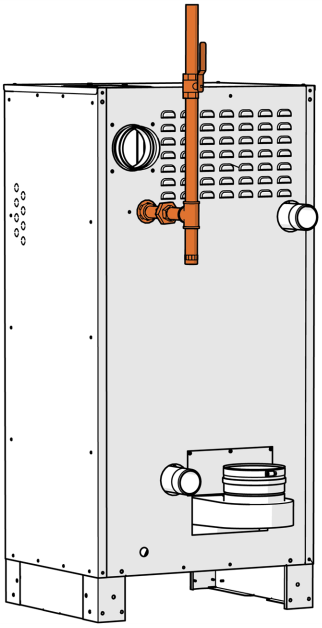


Figure 35 *Typical gas piping*

# 3.10 Electrical connections

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

## 3.10.1 Power quality and electrical protection

In areas of unreliable power, appropriate surge protectors and or power conditioning equipment should be installed in power supply wiring circuits.

**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.

## 3.10.2 120VAC line-voltage hook-up

Line-voltage wiring is done within the field-wiring box (see *Wiring diagrams on page 115*). 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.

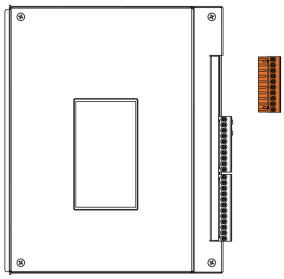


Figure 36 *Line voltage load pump terminals*

**Caution**

The on-board controller load pump relays are protected with 5 Amp fuses. The maximum recommended load on each fuse is 4 Amps (80% of rating). The maximum combined pump load is 10 Amps. Isolation relays or contactors **must** be used if the loads exceed these maximums.

Connect a 120VAC / 15 amp supply to the "AC IN" tagged leads in the wiring box.

### 3.10.2.1 Load pumps

The 120VAC power supply to the load pumps (P/V1, P/V2, P/V3, and P/V4) is factory installed and connected to P/V-L and P/V-N for your convenience. If you use the P/V relay connections for zone valves, you need to remove and cap off the 120VAC connections at P/V-L and P/V-N. The 24VAC can then be applied using an external transformer to supply power to zone valves. The upper 4 pairs of contacts on the connector strip are then powered to manage up to 4 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 manages all the loads without need of further relays (for loads up to ⅓ HP; for more – use a protective relay).

### 3.10.2.2 Boiler pump

The boiler (primary) pump is powered by the yellow wire from the pair labeled "Boiler Pump". Wire the pump's neutral to the white wire labeled "AC In". Do not attempt to connect the boiler pump to the pump/zone valve terminal block along the controller's right edge as this is reserved for the secondary pumps and/or zone valves only.

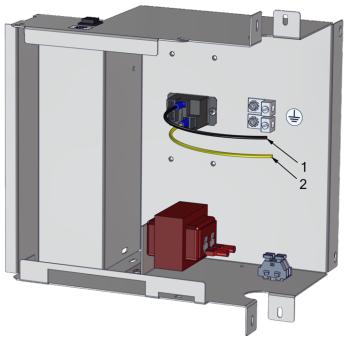



Figure 37 *Electrical box with boiler pump relay - black and yellow wires - EX 400, EX 500*

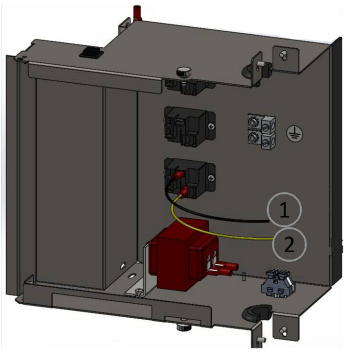



Figure 38 *Electrical box with boiler pump relay - black and yellow wires - EX 700, EX 850*

| | |
|---|---|
| 1 | Power in - black wire. |
| 2 | To boiler - yellow wire. |

If the total boiler amperage drawn is less than 12 amps and the boiler pump is 120V, you can connect the black wire from the relay to the line voltage mains supplied to the boiler. For 120 volt boiler pumps, the black wire can be connected to the line voltage mains and the yellow wire connected to boiler pump. For 208/240 volt boiler pumps, the black wire can be one leg of the 208/240 voltage mains and the yellow wire connected to the boiler pump.

The boiler pump relay may require connection to a second electrical circuit (amperage greater than 4 amps). The boiler pump relay is rated for a maximum amperage load of ¾ horsepower. A disconnect switch should be installed to isolate the boiler pump and the boiler pump relay power supply.

Pumps can be switched on/off using the touchscreen controller, 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 so the primary pump purge function is active.

In a new construction application, use a construction thermostat, or jumper with an in-line on/off switch – for on/off management of the boiler. Do not just turn off power from the appliance, 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 a "low 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 load pumps connected through the on-board pump relays should not exceed 10 amps. The control circuit board is protected using on-board field replaceable fuses. Each pump is fused with a separate 5 Amp fuse. The Alarm contact is fused with a 5 Amp fuse and the 24VAC boiler control circuit is protected with a 2 Amp fuse.

### 3.10.2.3 Variable speed boiler pumps

Variable speed boiler pumps are for connecting and managing speed in pumps that accept 0-10VDC on 4-20 mA input signal.

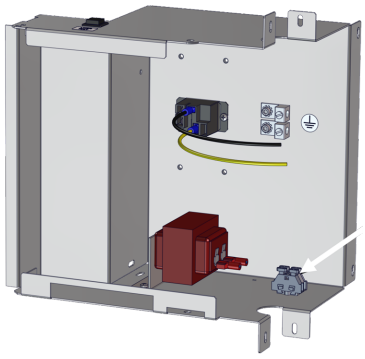


Figure 39 *Electrical box with new variable speed connection - EX 400, EX 500*

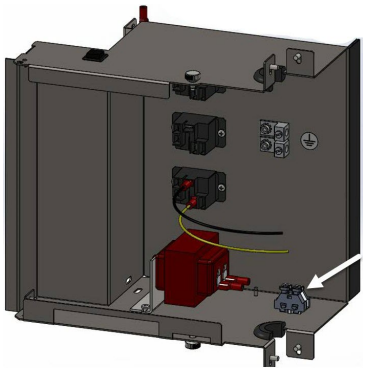


Figure 40 *Electrical box with new variable speed connection - EX 700, EX 850*

## 3.10.3 Other wiring

**Danger**

Do not connect sensors to “Therm” terminals. Overheating components can result in serious personal injury and/or property damage.

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 an external low-water cutoff.
- Contacts for indoor and outdoor temperatures sensors associated with reset heating. A 10K ohm thermister (resistor dependent on temperature) for outdoor reset sensing is supplied with the boiler for improved comfort and combustion efficiency.
- One pair for a DHW tank sensor. Connect to "DHW S" (not the respective Therm. 1,2,3,4 location) and the boiler automatically detects and calls 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 IBC modulating appliances for autonomous staging.
- The bottom pair of contacts (labeled 'External Control') receives 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. The user must enter maximum and minimum boiler supply temperatures.

**Note**

Sensors connected to any sensor input contacts must be of the NTC Thermister type with a resistance of 10,000 ohms at 77°F (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.

## 3.10.4 Thermostat / sensor wiring

Each of the four loads has dry contacts for thermostats as marked on the lower connector strip (e.g., "Therm 1"). Gang lines from a multiple-zoned load (e.g., off the end-switches for each radiant floor zone) present a common thermostat signal to the controller. Ensure that there are no disturbing influences on the call-for-heat lines - for example, that there are no coils to switch an air handler motor. Most power stealing thermostats can be connected directly to the Therm terminals. Consult the *Controller* manual for more detailed instructions.

## 3.10.5 Thermostat heat anticipator

IBC “Therm” contacts draw no power, so an anticipator setting for the thermostat is not applicable with the EX modulating series boilers. For a heat load where zone valves are used to manage thermostatically controlled zones, each room's thermostat heat anticipator should be adjusted to the current draw of its associated zone valve.

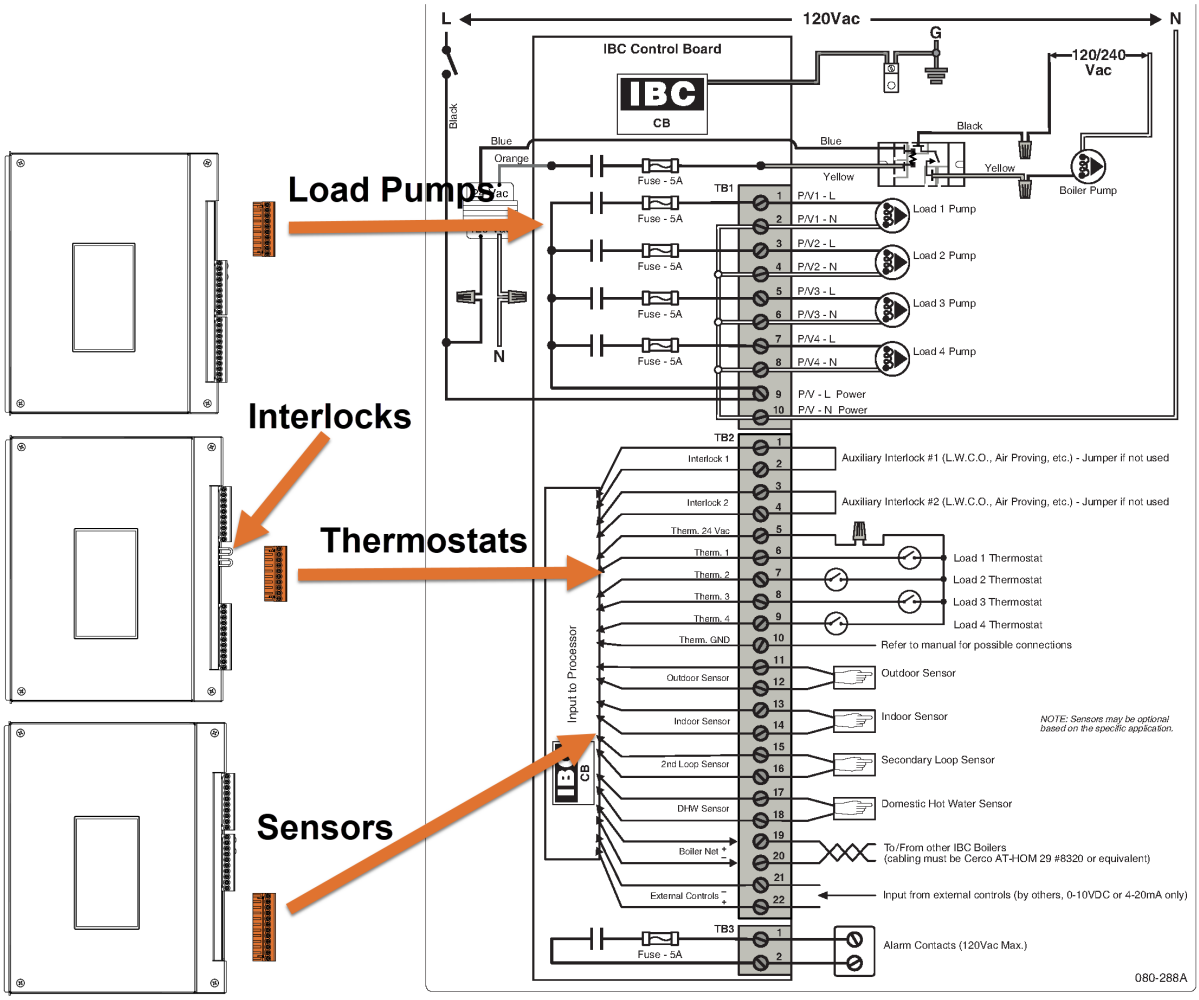



Figure 41 *Electric wiring connections*

# 4.0 About the boiler controller

This boiler is equipped with a touchscreen controller for programming the boiler. For detailed instructions on using the controller, see the *Touchscreen Controller* manual.

> **Note**
>
> Use only a stylus or a clean finger to interact with the touchscreen. Using sharp or metallic objects will cause damage.

The controller is equipped to provide:

- Control of up to 5 pumps – 1 boiler pump + 4 separate load pumps
- Outdoor Reset control
- Set Point temperature regulation
- Domestic Hot Water (DHW)
- External control via 0-10VDC or 4-20mA signaling
- Manual control of firing rate for gas valve calibration
- Alarm dry contacts
- Zoning - simultaneous operation of up to four pumps
- Load Combining – simultaneous operation of two similar water temperature loads
- Programmable setback / override schedule
- The control can manage or operate in a network of up to 24 IBC boilers without additional controller.
- Some of the new features available in the touchscreen control include:
  - Express Setup Menu for simple, quick programming
  - Portal connectivity for remote monitoring and programming
  - Superior warning messages while setting up the control
  - Advanced Error messages with visual display on the Home Screen
  - Internet/LAN connectivity
  - BACnet (with activation)

# 4.1 Controller

When the boiler is first energized, the controller will go through a power up sequence that will take approximately 90 seconds. During this time the controller is completing a self- diagnostic and loading all previous settings. In the event of a power interruption the boiler will automatically resume operation when power is restored with all the previously stored values.

The controller provides overall management of the boiler operations including:


- Power-up, self-diagnostics, easy Load parameter adjustments
- The boiler status bar indicates if the boiler is in a normal, warning or alarm state. When no warning or alarm state is present, the bar will be green and the time will be displayed inside the green area. The bar can also be yellow or red corresponding a warning or alarm state. Text inside the bar will indicate the specific warning or alarm present. If more than one alarm is present the text display will slowly change, rotating though whatever alarms that are present.
- Burner operation, safety management systems, Call for Heat management and Load Priority
- Real time boiler data
- Temperature and throttle operation
- Maintenance of operational and error service logs
- 2-way communication between other IBC boilers and controls
- Internet connection and communication

Operational and historical data may be accessed at any time using the System Status and Load Profiles sections of the control. Error logs are available in the Diagnostics section and the controller is capable of recording any or all errors since original power-up complete with the date and time of the error.

## 4.2 Controller interface

The control interface is provided through a 2¼ x 4 inch, color touchscreen display. The touchscreen responds to a light finger touch on the screen. You can also use a stylus, pencil, or similar device to operate the touch controls. Do not use a sharp or metallic object such as a screw driver to operate the control as it could damage the touchscreen.

The controller display is divided into two areas, the screen active area and the boiler status bar. All screens have an active area consisting of the screen title bar at the top and a border surrounding the active area. At the bottom of the display there is space reserved for the boiler status bar.

Prior to any interaction with the touchscreen, the display shows the Home screen details of the current boiler status. If the controller has been left on the Home screen long enough (user adjustable, 10 minutes by default) the display will be dimmed to save power.

The control will automatically return to the home screen if left unattended. The screens will step back one screen at a time in 10 minute increments if the touchscreen has not been touched. The pop-up windows will also step back automatically in 2 minute intervals.

# 5.0 Before operating the boiler

**Danger**

Do not store or use gasoline or other flammable vapors or liquids in the vicinity of this or any other appliance. If you smell gas vapors, do not try to operate any appliance - do not touch any electrical switch or use any phone in the building. Immediately, call the gas supplier from a phone located remotely. Follow the gas supplier's instructions, or if the supplier is unavailable, contact the fire department.

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.

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.

## 5.1 Important pre-ignition checks

Once installation of the appliance is completed, and before operating the appliance, it is important to review the following checklist of precautions:

### 5.1.1 Checklist for electrical conditions, ducting and water connections

| Checking electrical conditions | Check |
|---|---|
| Check all line voltage electrical connections to ensure all connections are correct and tight. | ☐ |
| Check thermostat connections. | ☐ |
| Thermostat in a suitable location. | ☐ |

| Checking piping connections | Check |
|---|---|
| Ensure venting system is complete and seal tested.<br><br>Confirm any common venting system at the installation site is isolated and independent of the EX boiler.<br><br>Also confirm that any holes left from the removal of a previous boiler have been sealed, and that any resizing of the old flue has been done. | ☐ |

| Checking piping connections | Check |
|---|---|
| Check that the water piping system is fully flushed and charged, and that all air has been discharged through loosened bleed caps.<br><br>Note it is possible to switch all pumps on/off from the touchscreen – without a call for heat. This simplifies system filling and air bleeding (go to Installer Setup, System Settings, Site Settings, change Manual Pump Purge 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 that the pressure relief valve is installed and safely drained. | ☐ |
| Check to see that adequate gas pressure is present at the inlet gas supply test port.<br><br>Open the test port by turning its center-screw one full turn counterclockwise, using a small (1/8" or 3 mm) flat screwdriver.<br><br>Connect a manometer and open the gas control valve. Requirements are minimum 4" w.c and maximum 14" w.c.<br><br>Check that there are no gas leaks. | ☐ |
| All connections are pressure tested and leak free. | ☐ |
| All piping flushed to ensure all air is removed. | ☐ |
| Check valve is installed and the external pump is flowing in the correct direction. | ☐ |

| Checking ducting connections | Check |
|---|---|
| All connections are pressure tested and leak free. | ☐ |
| All duct work is sized correctly and joints are sealed. | ☐ |
| Thermostat in a suitable location. | ☐ |

| Powering on the boiler | Check |
|---|---|
| Perform a final check of electrical wiring, and provide power to the boiler to initialize operation. | ☐ |

**Warning**

Fill the condensate trap with water before you first fire the boiler to prevent exhaust fumes from entering the room. Never operate the boiler unless the trap is filled with water. Failure to comply will result in severe personal injury or death.

# 6.0 Boiler operation

Before operating the appliance, there are some important pre-igntion checks that need to be performed. For more information, see *Before operating the boiler on page 63*. To understand the boiler start-up process, see *Sequence of Operation on page 118*.

## 6.1 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

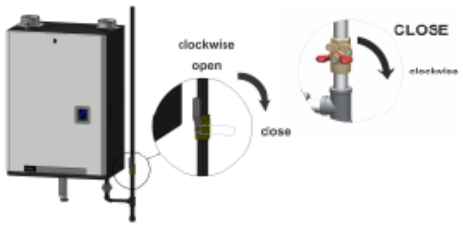
- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

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 APPLICANCE

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.

# 6.2 Testing the ignition safety shutoff

**To test the ignition system safety shutoff device:**

1. With the boiler in operation, shut off the gas control valve directly outside the boiler case.
2. Ensure that the boiler has purged, attempted to re-light three times, has shut off and the appropriate error information is displayed on the controller.


3. The error is displayed after testing the ignition safety shutoff.
4. To restart the boiler, reset the power or on the touchscreen controller's **Main Menu**, tap **Diagnostics**>**Advanced Diagnostics**>**Clear Errors**>**Yes**>**OK**.

# 6.3 Commissioning

The EX modulating boilers are factory calibrated to operate with natural gas (or propane if desired) at sea level. The gas-air ratio or zero-offset adjustment screw may need adjusting to attain optimum combustion results. Note that only qualified technicians using properly functioning and calibrated combustion analyzing equipment should perform a mixture adjustment.

## 6.3.1 Checking a boiler's fuel source

This boiler model can burn either natural gas or propane if equipped with the correct fuel-air metering device. Examine the rating plate of the boiler to ensure it is configured for the fuel you are using. If the boiler is configured for natural gas, but needs to be converted to propane, use the conversion kit (sold separately by IBC) to install the appropriate fitting(s) and adjust the gas valve accordingly. See *Table 11* for the required conversion kit.

The touchscreen controller will automatically detect the installation’s altitude and make the appropriate adjustments to operate the boiler up to 4,500 feet in elevation without de-ration. The boiler will automatically de-rate at altitudes above 4,500 feet.

## 6.3.2 Adjusting the gas valve (EX 400, EX 500)

**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.

To help with the following procedure, see *Figure 43* .

**Measuring the inlet gas pressure**

1. Before performing a combustion test and adjustment, turn off the boiler's external gas shut-off valve.
2. Attach a manometer to the inlet pressure test port (open by turning screw with a flat-head screwdriver), and turn on gas to appliance.
   - » When the boiler is at high fire, the static manometer reading should be ideally 7" w.c. for natural gas and 11" w.c. for propane.
   - » Minimum and maximum static pressure should be between 5" and 14" w.c. Monitor pressure throughout the commissioning (start-up) procedure. Pressure may drop up to 1" to 2" w.c. at high fire.
3. Ensure that you have a load configured (Reset Heating, Set Point, or DHW). This load should be large enough to allow the boiler to operate at high fire for over 10 minutes.

**Performing a combustion test**

1. Give the boiler a call for heat.
2. When the boiler reaches high fire, insert the combustion analyzer test probe into the flue gas test port. Then verify that the CO2 reading is within the combustion test targets at *Table 10* values.

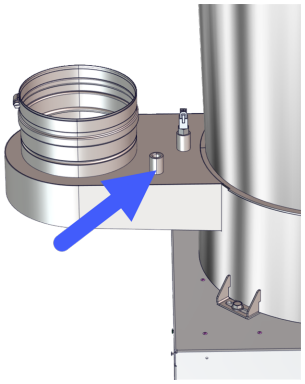


Figure 42 *Flue gas test port*

3. Set the heat-out value in manual mode to the minimum MBH for the boiler. To do this:
    a. Go to **Main Menu** > **Diagnostics** > **Test Operation**.
    b. Click inside the **Fan Test: Heat Output** box, and using the number pad, enter the minimum MBH.
    c. Select **OK**. The fan runs to the minimum MBH you have set. Select the Fan Test: Heat Output box to change the heat out value.
4. Low fire adjustment - adjust the low fire according to see *Table 10* using a Phillips head screwdriver. Turn clockwise to raise the $CO_2$% (to richen). Turn counter-clockwise to lower $CO_2$%. Start with ⅛ of a turn until you see the analyzer measure a change then only make 1/16 adjustments. If changing direction on this adjustment you may notice a significant backlash.
5. Check the results and confirm the correct settings when you return the boiler to high fire, and then to low fire.

> **Note**
> Clock the gas meter to confirm full maximum rating plate input.

6. To exit the **Test Operation** screen, select **Back**.
7. Remove call for heat.
8. Turn off the gas supply at the external gas shut-off valve.
9. Remove the analyzer probe, and install the test port plug.
10. Disconnect the manometer.
11. Tighten the inlet pressure port screw with a flat head screwdriver.
12. Turn on the gas supply shut off valve and test for gas leaks.

| Fuel | High fire | | Low fire | | CO max PPM |
|---|---|---|---|---|---|
| | Range % | Target % | Range % | Target % | |
| Natural Gas | 9.0 - 10.0 | 9.5 | 8.2 - 9.2 | 8.7 | <150 |
| Propane | 10.3 - 11.3 | 10.8 | 9.3 -10.3 | 9.8 | < 250 |

***Table 10*** *Combustion test target ranges - $CO_2$ / Maximum CO*

## 6.3.3 Adjusting the gas valve (EX 700, EX 850)

**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.

To help with the following procedure, see *Figure 44* .

**Measuring the inlet gas pressure**

1. Before performing a combustion test and adjustment, turn off the boiler's external gas shut-off valve.
2. Remove the inlet gas pressure test port plug with a 3 mm Allen key. Note the fitting has BSP threads.
3. Use the supplied fitting to transition from ⅛" BSP to barbed for connection to a manometer.
4. Attach a manometer to the inlet pressure test port, and turn on gas to appliance.
   - When the boiler is at high fire, the static manometer reading should be ideally 7" w.c. for Natural Gas and 11" w.c. for propane.
   - Minimum and maximum static pressure should be between 5" and 14" w.c. Monitor pressure throughout the commissioning (start-up) procedure. Pressure may drop up to 1" to 2" w.c. at high fire.
5. Ensure that you have a load configured (Reset Heating, Set Point, or DHW). This load should be large enough to allow the boiler to operate at high fire for over 10 minutes.

**Performing a combustion test**

1. After the boiler is lit and is at high fire, insert the combustion analyzer test probe into the flue gas test port (see *Figure 42* ). Then adjust the high fire (gas-air ratio) adjustment with a small slot screwdriver according to *Table 10* values. This adjustment screw is very sensitive and will only need very small adjustments to fine tune the gas valve. Turn counter-clockwise (in the direction of the '+' sign) to raise the CO2% (to richen). Turn clockwise to lower CO2%.
2. Set the heat-out value in manual mode to the minimum MBH for the boiler (see *Table 10* ). To do this:
   a. Go to **Diagnostics** > **Test Operation**.
   b. Click inside the **Fan Test: Heat Output** box, and using the number pad, enter the minimum MBH.
   c. Select OK The fan runs to the minimum MBH you have set. Select the Fan Test: Heat Output box to change the heat out value.

3. Low fire adjustment - adjust the low fire according to see *Table 10* . Use a 2.5 mm Allen key. Turn counter-clockwise (in the direction of the '+' sign) to raise to raise the $CO_2$% (to richen). Turn clockwise to lower $CO_2$%. Start with 1/8 of a turn until you see the analyzer measure a change then only make 1/16 adjustments. If changing direction on this adjustment you will notice a significant backlash.
4. Return the boiler to high fire, and check the results to confirm correct settings.

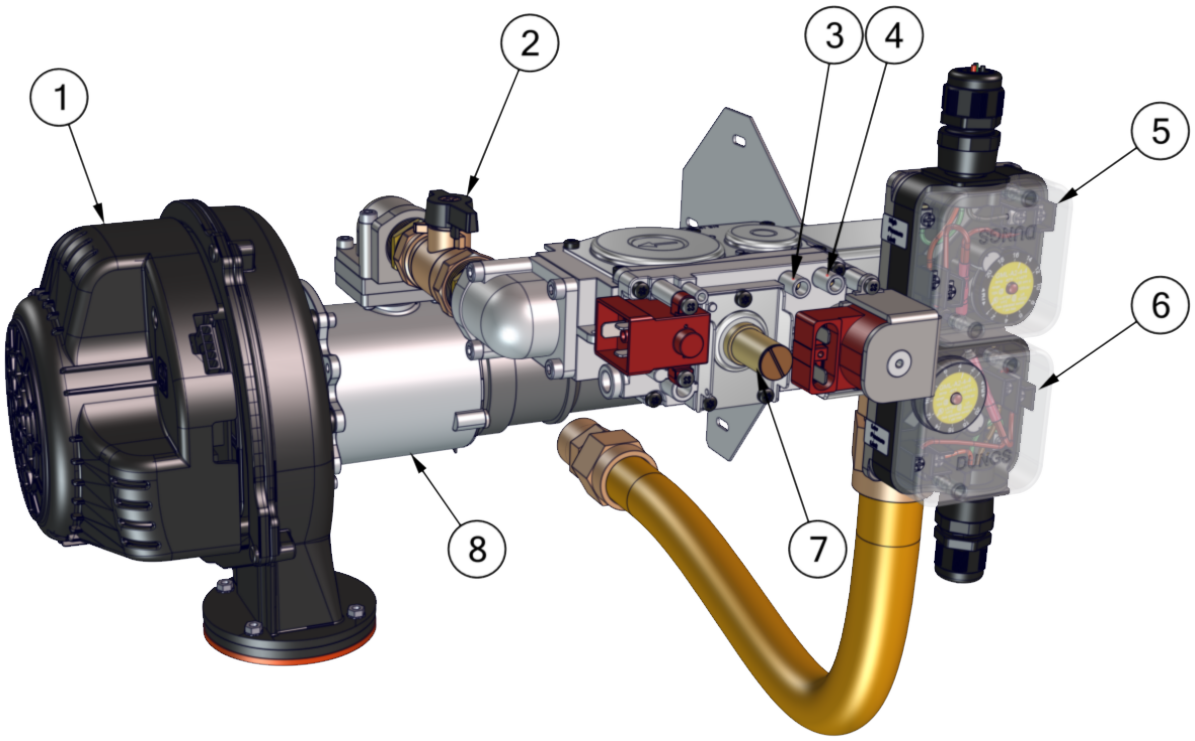
> **Note**
> Clock the gas meter to confirm full maximum rating plate input.

5. Return the boiler to low fire, and check the results to confirm correct settings.
6. To exit the **Test Operation** screen, select **Back**.
7. Turn off the gas supply at the external gas shut-off valve.
8. Remove the analyzer probe and install the test port plug.
9. Disconnect the manometer.
10. Remove the adapter fitting and reinstall the inlet test port plug, tightening with a 3mm Allen wrench. **Keep the fitting with the boiler for future use.**
11. Turn on the gas supply shut off valve and test for gas leaks.

## 6.3.4 Performing a fuel conversion

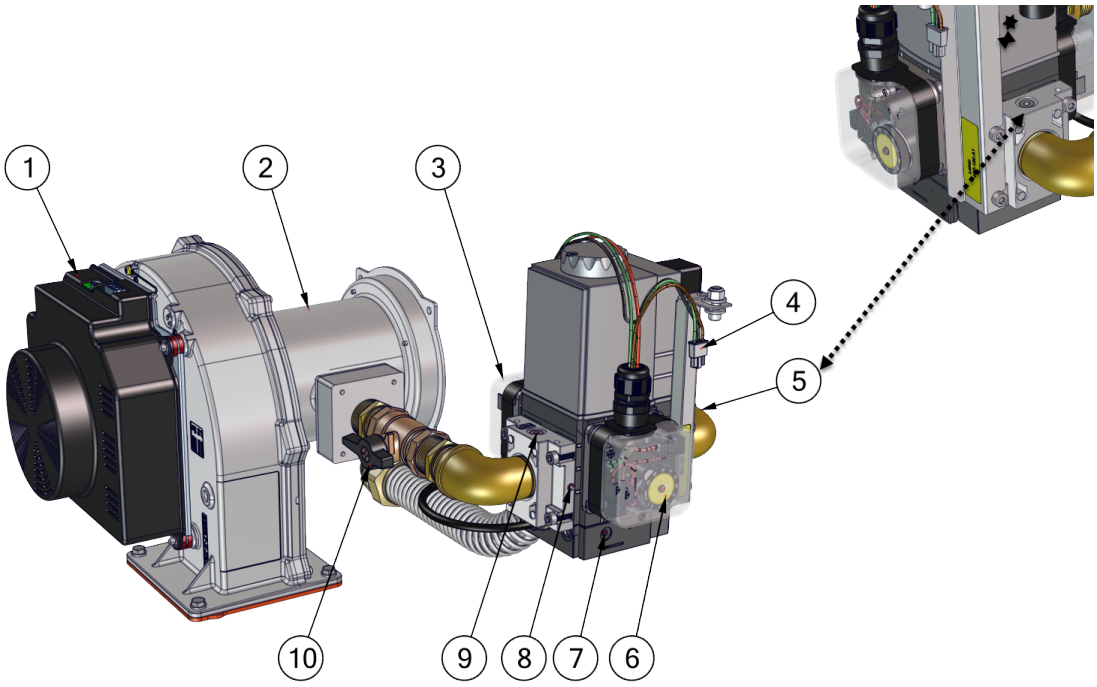
The EX boilers are factory fire-tested to operate with natural gas or propane as ordered. The rating plate will be marked to indicate which fuel the particular boiler has been set up with. Firing a boiler with a fuel other than what is listed on the rating plate is prohibited unless the conversion procedure is completed by a qualified technician.

> **Danger**
>
> Operating any IBC boiler using a fuel other than the fuel listed on its rating plate is prohibited. Failure to follow the instructions on converting to alternate fuels can result in a fire or explosion, which may cause property damage, personal injury, or loss of life.
>
> Check the rating plate of the boiler to ensure it is configured for the fuel you are using. If the fuel is incorrect for the appliance, a conversion kit must be ordered from IBC and the gas valve adjusted accordingly. Failure to perform the required fuel conversion can result in an immediate hazard.




| | |
|---|---|
| 1 | Fan |
| 2 | Shutoff valve |
| 3 | Manifold gas pressure test port |
| 4 | Inlet gas pressure test port |
| 5 | High pressure switch |
| 6 | Low pressure switch |
| 7 | Low fire adjustment |
| 8 | Mixing device |

Figure 43 *Gas valve and fan components - EX 400, 500*




| | |
|---|---|
| 1 | Fan |
| 2 | Mixing device |
| 3 | Gas high pressure switch |
| 4 | Three- (3) wire Molex plug |
| 5 | Inlet gas pressure test port (location of) |
| 6 | Gas low pressure switch |
| 7 | Low fire adjustment (zero-offset) |
| 8 | High fire adjustment (on the side) |
| 9 | Manifold gas pressure test port |
| 10 | Shutoff valve |

Figure 44 *Gas valve and fan components - EX 700, 850*

The High Fire (gas-air ratio) adjustment screw will have to be adjusted to attain optimum combustion results whenever fuel conversion is undertaken, however, no mixture adjustment shall be performed unless done by a qualified technician using properly functioning and calibrated combustion analyzing equipment.

Fuel conversions must be carried out by a qualified technician:

1. Ensure you are installing the correct fuel conversion kit for your boiler. Compare the boiler model number with the Kit # found in *Table 11* .
2. Read the fuel conversion instructions supplied with the fuel conversion kit.
3. Carefully follow the procedures of the fuel conversion instructions on:
    a. Fuel Conversion
    b. Combustion Testing and Adjustment
    c. Placing conversion labels associated with the new fuel onto the boiler.

### Fuel conversion kit part numbers

| Model Number | Natural Gas to Propane | Propane to Natural Gas |
|---|---|---|
| EX 400 | P-1236 | P-1235 |
| EX 500 | P-1238 | P-1237 |
| EX 700 | P-1201 | P-1200 |
| EX 850 | P-1203 | P-1202 |

***Table 11*** *Fuel Conversion Kits*

## 6.3.5 Measuring the inlet gas pressure

To locate the inlet gas pressure test port on the EX 400 and the EX 500 models, see *Figure 43* . To locate the inlet gas pressure test port on the EX 700 and the EX 850 models, see *Figure 44* .

### 6.3.5.1 Measuring the inlet gas pressure - EX 400 and EX 500

To perform a gas pressure test, you will need to use a flat head screwdriver and a digital manometer.

1. Shut off the gas supply. You will be measuring the inlet gas supply from the test port (see *Figure 45* ). Do not perform a test from the manifold gas pressure test port.
2. On the gas valve, loosen the inlet gas pressure test port screw counter-clockwise.

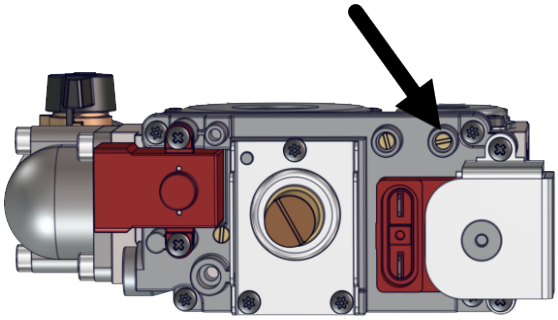


Figure 45 *Location of inlet gas pressure test port*

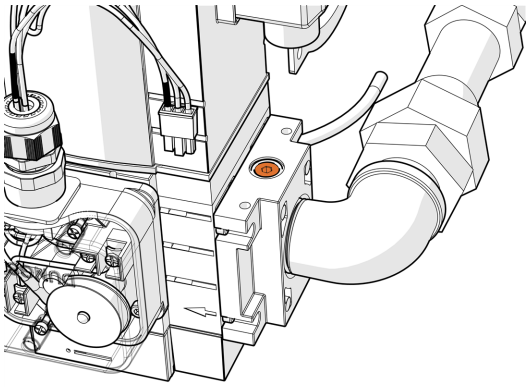
3. Attach the manometer to the inlet gas pressure test port.
4. Switch on the gas supply to measure the inlet gas pressure. The gas pressure for natural gas should be around 7" wc at high fire and 11" wc for propane. If the gas pressure dips below 3½" wc or exceeds 15" wc, the boiler will shut down. If this occurs, you will need to reset the gas high or low pressure switch. For instructions, see *Resetting the gas high / low pressure switches on page 76*.
5. After completing the inlet gas pressure test, switch off the gas supply.
6. Remove the manometer from the inlet gas pressure test port.
7. Tighten the bolt head using a flat head screwdriver.

### 6.3.5.2 Measuring the inlet gas pressure - EX 700 and EX 850

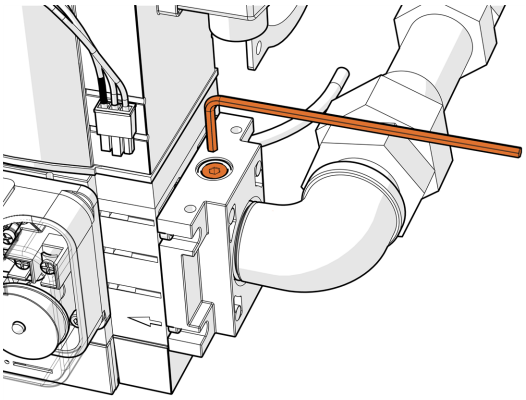
To perform a gas pressure test, you will need to use the inlet gas pressure test fitting (supplied with the boiler), a 3 mm Allen wrench, and a digital manometer.

You will be measuring the inlet gas supply from the test port located to the right of the gas valve (see ④ on *Figure 44* ). Do not perform a test from the manifold gas pressure test port.

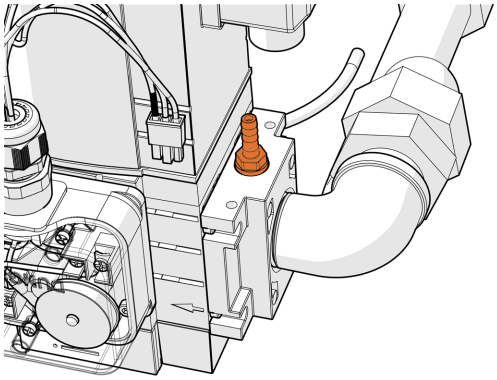
**1.** Shut off the gas supply.



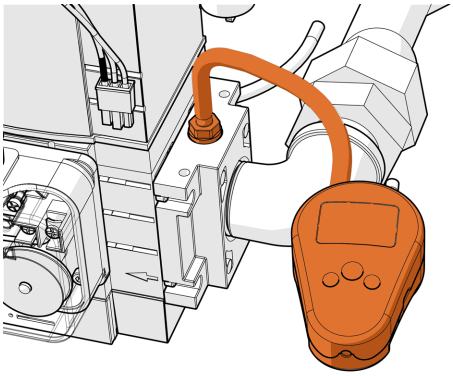
**2.** Remove the bolt head using a 3mm Allen wrench, and put aside.



**3.** Screw the inlet gas pressure test fitting into the inlet gas pressure test port.



**4.** Insert the tubing securely into the inlet gas pressure test fitting.

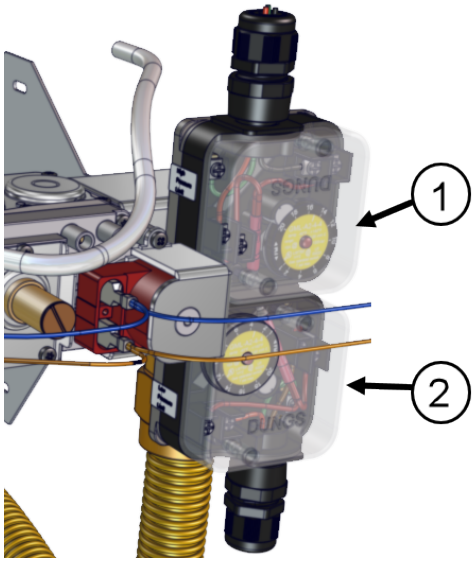


5. Switch on the gas supply to measure the inlet gas pressure. The gas pressure for natural gas should be around 7" wc at high fire and 11" wc for propane. If the gas pressure dips below 3½" wc or exceeds 15" wc, the boiler will shut down. If this occurs, you will need to reset the gas high or low pressure switch. For instructions, see *Resetting the gas high / low pressure switches on page 76*.
6. After completing the inlet gas pressure test, switch off the gas supply.
7. Remove the inlet gas pressure test fitting and manometer from the inlet gas pressure test port.
8. Insert the bolt head and tighten using a 3 mm Allen wrench.

## 6.3.6 Resetting the gas high / low pressure switches

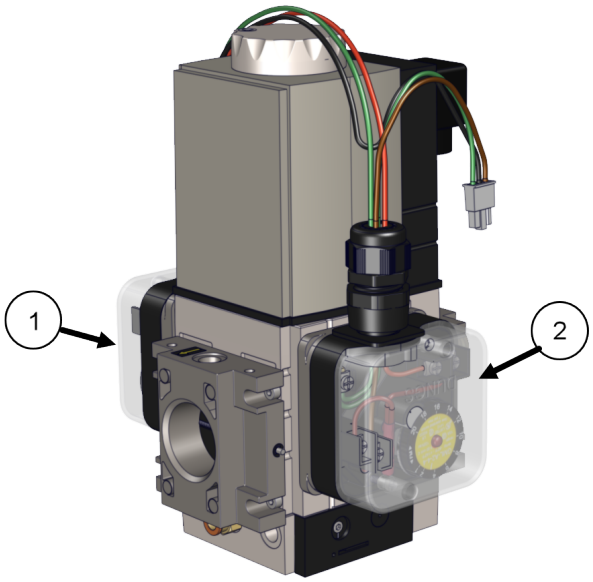
The gas high and low pressure switches are used to verify that the gas pressure is within the operating range (see images below). The gas low pressure switch responds to a drop in gas supply, and will shut down the boiler at 3½" wc (factory set). Located at the back of the gas valve, the gas high pressure switch is set to shut down the boiler at 15" wc.

After the gas to the boiler is connected and turned on, you must reset the gas low gas pressure switch.




1 High pressure switch

Figure 46 *Gas low/high pressure switches - EX 400 and EX 500*




2 Low pressure switch

Figure 47 *Gas low/high pressure switches - EX 700 and EX 850*

If the gas high or low pressure switch trips, the boiler controller will show a Red bar at the bottom of the controller screen. The white mark on the dial indicates when the gas pressure switch is set to trip.

To "reset" either the gas low or high pressure switch, press on the clear plastic cover above the Red button.

**Warning**

Do not attempt to adjust the gas high or low pressure switch in the field.

# 7.0 Service and maintenance

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

**Caution**

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

## 7.1 Maintenance checklists for manager of appliance

Managers of EX series boilers should arrange follow-up inspections and simple maintenance procedures according to IBC's suggested servicing guidelines below.

| Maintenance Required for Venting | Frequency | Check |
|---|---|---|
| Check and replace filter as needed. Site conditions will determine how often the filter will need to be replaced. For replacement instructions, see *Replacing the air filter on page 98* | As needed | ☐ |
| Inspect system for unusual noises. Call your local heating contractor for service if needed | As needed | ☐ |
| Keep vent terminals clear of obstructions (snow, dirt, etc.). | As needed | ☐ |
| Inspection of the boiler is to be performed annually by a qualified service technician. | Annually | ☐ |

## 7.2 Maintenance checklists for heating contractor

**Caution**

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

| Maintenance Required | Check |
|---|---|
| Remove any obstructions (e.g. leaves, dust, other debris) from vent terminals | ☐ |
| 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 re-installation of venting on each servicing. | ☐ |

### 7.2.1 Venting

| Maintenance Required for Venting | Frequency | Check |
|---|---|---|
| Check and replace filter as needed. For replacement instructions, see *Replacing the air filter on page 98* | Monthly | ☐ |
| Have your local heating contractor inspect the appliance annually. | Annually | ☐ |
| Inspect system for unusual noises. Call your local heating contractor for service if needed | As needed | ☐ |
| Keep vent terminals clear of obstructions (snow, dirt, etc.). | As needed | ☐ |
| Inspection of the boiler is to be performed annually by a qualified service technician. | Annually | ☐ |

### 7.2.2 Condensate trap

| Maintenance Required for Condensate Trap | Frequency | Check |
|---|---|---|
| Examine every two months to see if cleaning is necessary (see *Cleaning a condensate trap on page 99*).<br><br>Ensure that the trap has been re-filled completely before firing boiler. | Bi-monthly | ☐ |
| If condensate neutralization is used, check the pH level of condensate discharge. | Annually | ☐ |

### 7.2.3 Burner

| Maintenance Required for Burner | Frequency | Check |
|---|---|---|
| Remove the burner to inspect for extent of fouling (see *Replacing the burner in the EX 400 and 500 models on page 88* or *Replacing the burner in the EX 700 and EX 850 models on page 96*).<br><br>1. Wash the burner from outside with a domestic water pressure, and dry using compressed air.<br>2. Evaluate and establish a reasonable burner inspection and cleaning schedule. Some boiler / locations may call for annual service, others with clean burners needing attention every 2 – 5 years.<br>3. Reassemble. Visually inspect the burner through sight glass, ensuring flame is stable, without excessive fluttering. Normal flame pattern is evenly distributed over the burner surface. | Annually | ☐ |

| Maintenance Required for Burner | Frequency | Check |
|---|---|---|
| If the burner is operating improperly, remove and clean or replace. Use a $CO_2$ analyzer to determine proper combustion. See *Combustion test target ranges - CO2 / Maximum CO on page 68* for correct values. | Annually | ☐ |

**Warning**

When removing the burner for inspection or boiler servicing, examine the sealing gaskets and replace if damaged. Upon re-assembly, test all sealing areas to ensure there is no leakage of combustible gas/air premix.

## 7.2.4 Heat exchanger

| Maintenance Required for Heat Exchanger | Frequency | Check |
|---|---|---|
| In areas of poor gas quality, there may be a build-up of black plaque (typically sulfur). Other fouling agents include: airborne dust, debris and volatiles.<br><br>With the burner removed, examine the heat exchanger for signs of contamination and clean if necessary. Refer to instructions in *Replacing the burner in the EX 400 and 500 models on page 88* or *Replacing the burner in the EX 700 and EX 850 models on page 96* for access to the combustion chamber and heat exchanger. | Annually | ☐ |

## 7.2.5 Pump

| Maintenance Required for Pump | Frequency | Check |
|---|---|---|
| Check that the pump is on in normal operation and that the water Δ°T is reasonable for a given firing rate. | Annually | ☐ |

## 7.2.6 Gas piping

| Maintenance Required for Gas Piping | Frequency | Check |
|---|---|---|
| Check for damage or leaks and repair as needed. | Annually | ☐ |

## 7.2.7 Touchscreen boiler controller

| Maintenance Required for Boiler Controller | Frequency | Check |
|---|---|---|
| Check that boiler operation is consistent with the steps in the Touchscreen Boiler Controller Manual. | Annually | ☐ |
| Check that water temperature targets and setpoint is satisfactory and have not been adversely amended. | Annually | ☐ |
| Check the operating history using the boilers Logs menu and Error Logs menu.<br><br>The controller tracks the duty cycle of the boiler in each of the 4 loads separately. This information can be used to adjust the water temperatures of each load. | | ☐ |
| If a problem exists with the controller, see *Troubleshooting on page 101*. | | |

## 7.2.8 Water

| Checks for Water in the Boiler | Frequency | Check |
|---|---|---|
| Check water pressure and temperature.<br><br>There should be no noticeable change if boiler is functioning normally. Check for any noise in the system. | Annually | ☐ |
| Check water piping for damage or leaks and repair as needed. | Annually | ☐ |
| Check the water pressure. Pressure should be stable when the boiler is firing and the water temperature is rising.<br><br>If pressure rises sharply, consider replacement of expansion tank. | Annually | ☐ |
| Check also for noise at high fire, which may signal water quality problems. | Annually | ☐ |
| Water chemistry shall be of a quality generally accepted as suitable for hydronic applications. | Annually | ☐ |
| Ensure any direct “city fill” water connections are left in the closed position to minimize exposure to leaks and flooding. | Annually | ☐ |

**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.

## 7.2.9 Freeze protection

| Maintenance to prevent freezing | Frequency | Check |
|---|---|---|
| Check the freeze protection. Use only antifreeze made specifically for hydronic systems. Inhibited propylene glycol is recommended. Antifreeze volume must be between 25% and 50% of the total volume of water in the system. | Annually | ☐ |

**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, wet 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.

## 7.2.10 Boiler treatment

| Maintenance for Boiler Treatment | Frequency | Check |
|---|---|---|
| Check consistency of any boiler treatment used, for appropriate mixture. Chemical inhibitors are consumed over time, lowering their density. | Annually | ☐ |
| Verify proper operation after servicing. | Annually | ☐ |

**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.

## 7.2.11 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.

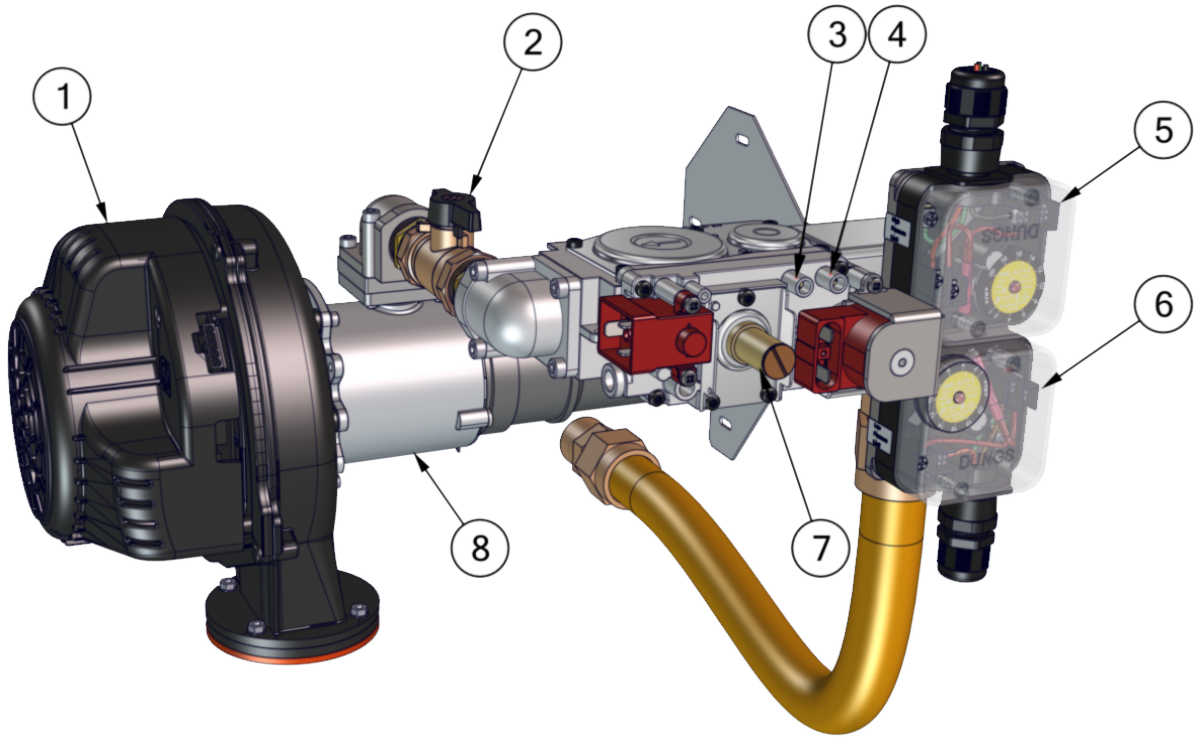
| Maintenance for Relief valve | Frequency | Check |
|---|---|---|
| Test at or near the maximum operating pressure by holding the test lever fully open for at least 5 seconds to flush the valve seat free of sediment and debris. Then release the lever and allow the valve to snap shut.<br><br>If the lever does not activate, or if there is no sign of discharge, discontinue use of equipment immediately and contact a licensed contractor or qualified service personnel.<br><br>If the relief valve does not completely seal, and fluid continues to leak from the discharge pipe - perform the test again to try and flush any debris that may be lodged in the valve. If repeated tries fail to stop the leakage, contact a licensed contractor or qualified service personnel to replace the valve.<br><br>While performing a "try lever test", a quantity of heat transfer fluid will be discharged from the piping system and the system pressure will drop. This fluid must be replaced. To refill and pressurize your system, we recommend using a system pressurization appliance such as an Axiom Industries model SF100 series. Capture the discharged fluid in a container and recycle it by returning it to the system feeder appliance. This is particularly important when your system contains treatment chemicals or glycol solutions. If the system employs plain water, the boiler auto fill valve must be turned on in order to recharge the lost fluid. | Annually | ☐ |

# 7.3 Replacing the fan, gas valve, and burner in EX 400 and EX 500 models

## Replacing the fan, gas valve, and burner in EX 400 and EX 500 models

This section documents the following maintenance procedures for EX 400 and EX 500 models:

- Replacing the fan
- Replacing the gas valve
- Replacing the burner.




| | |
|---|---|
| 1 | Fan |
| 2 | Shutoff valve |
| 3 | Manifold gas pressure test port |
| 4 | Inlet gas pressure test port |

| | |
|---|---|
| 5 | High pressure switch |
| 6 | Low pressure switch |
| 7 | Low fire adjustment |
| 8 | Mixing device |

Figure 48 *Gas valve and fan components - EX 400, 500*

## 7.3.1 Replacing the fan on the EX 400 and EX 500 models

1. Turn off the electric power and gas supply to the boiler.
2. Ensure the boiler cools down to the surrounding temperature. Do not drain the boiler unless freezing conditions are expected during this procedure.
3. Remove the front cover, and then remove the boiler's top panel by removing the Torx screws on the top panel of the boiler.

   A ladder or step may be required to have a clear vertical view of the work area. Do not attempt to reach from the front without a clear view, as damage to connectors, screws or refractory may occur.
4. Unplug the electrical connectors on the front and back of the fan.
5. Position the harnesses out of the way of the heat exchanger lid.
6. Pull away the air intake tube (can slide into the filter box) from the fuel mixer (see *Figure 49* ).

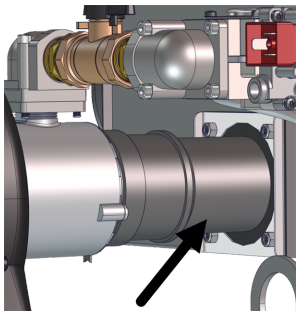


Figure 49 *Air intake tube*

7. Use a 3mm Allen key to remove the three (3) screws connecting the mixing device to the fan. (See *Figure 50* ). Ensure that the fan O-ring stays seated in the fan groove during reassembly.

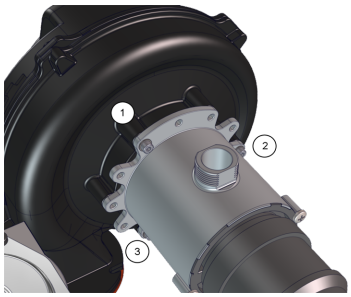



Figure 50 *Location of screws securing mixing device to fan*

8. Use a 7mm wrench to remove the four screws at the base of the fan (attaching the fan to the heat exchanger lid). It may help to unplug the ignitor for easier access.
9. Lift off the fan, and replace with the new fan. Ensure that the fan O-ring stays seated in the fan groove during reassembly.
10. Reinstall the components in reverse order. Upon reassembly, ensure that all O-rings and gaskets are correctly positioned.

> **Warning**
>
> Ensure that the fan O-ring is seated in the groove of the fan when reassembling.

## 7.3.2 Replacing the gas valve in the EX 400 and EX 500 models

1. Turn off the electric power and gas supply to the boiler.
2. Ensure that the boiler cools down to the surrounding temperature.
3. Remove the front cover, and then remove the four Torx 20 head screws on the top panel of the boiler.

   A ladder or step may be required to have a clear vertical view of the work area. Do not attempt to reach from the front without a clear view, as damage to the connectors or screws may occur.
4. Disconnect the gas valve wiring, and pull out the connectors by gripping the plastic tip, rather than the wire, to avoid breaking the connector (see ① and ② in *Figure 51* ). Note the position of the colored wires; do not cross the colored wires upon reconnection (e.g., blue on top).

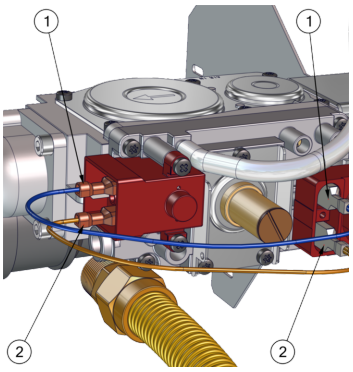



Figure 51 *Connector wires*

5. Gently remove the silicone air pressure tube from the gas valve by gripping near its base, and put aside.

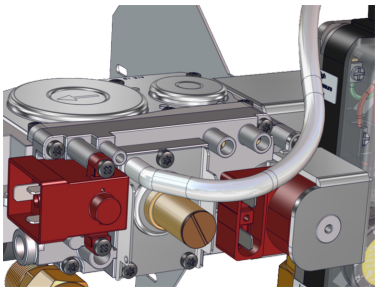


Figure 52 *Silicone air pressure tube*

6. From the inlet side of the gas valve (see ⑨ on *Figure 48* ), remove the four (4) screws using a 4mm Allen key, and put aside.

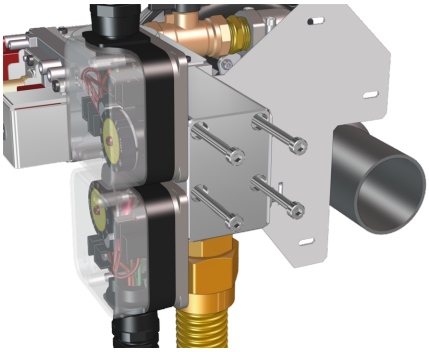


Figure 53 *Screws on gas valve inlet*

7. Remove the screws from the outlet side of the gas valve (see ⑩ on *Figure 48* ) to separate the gas valve from the appliance. To do this, ensure that you support the bottom of the gas valve when you remove the bottom two (2) screws (see *Figure 54* ) and then the top two (2) screws.

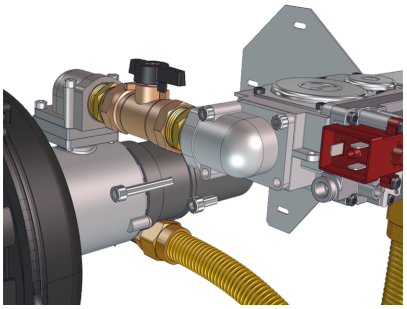


Figure 54 *Gas valve outlet screws*

8. Replace with the new gas valve following the steps in reverse order. Upon reassembly, ensure that all O-rings are well seated in their grooves.

> **Tip**: Lightly hand-tighten each screw before tightening all four screws fully on both the outlet and inlet sides of the gas valve. To prevent gas leaks, ensure that the O-rings on the outlet side and inlet side are well seated in their grooves.

9. Turn on the electric power and gas supply to the boiler.
10. Reset the low pressure switch. For instructions, see *Resetting the gas high / low pressure switches on page 76*.

## 7.3.3 Replacing the burner in the EX 400 and 500 models

**Warning**

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 that contain crystalline silica can be converted into cristobalite, classified as a possible human carcinogen.

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.

1. Turn off the electric power and gas supply to the boiler.
2. Remove the front cover, and then remove the boiler's top panel by removing the four Torx head screws on the top panel of the boiler.
3. Remove the Nylok nuts from the bracket supporting the air intake tube assembly.

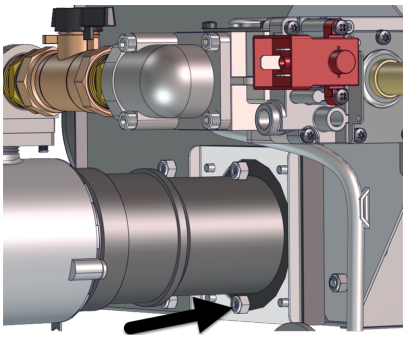


Figure 55 *Nylok nuts*

4. When loose, remove the air intake tube assembly, and put aside with screws and Nylok nuts for reassembly.

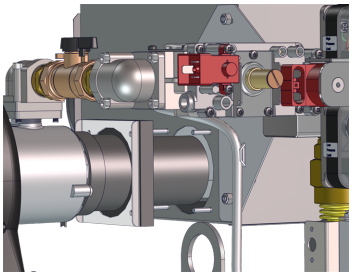


Figure 56 *Removal of air intake tube assembly*

5. Disconnect the ignitor cable and green grounding wire.
6. Remove the four (4) screws from the gas valve inlet with a 4 mm Allen key (see ⑨ on *Figure 48* ).
7. Disconnect the electrical connections and tube, but keep the gas valve attached.
8. Unplug the two connectors from the front and back of the fan (see *Figure 57* ).

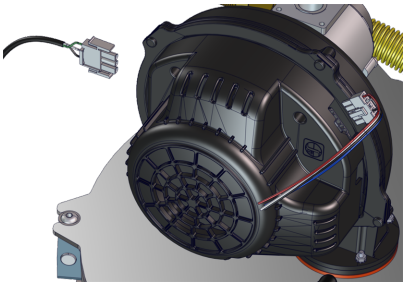


Figure 57 *Fan connectors*

9. Remove the four (4) 7 mm hex bolts that attach the fan to the heat exchanger lid with a wrench.
10. Remove the fan, mixer and gas valve assembly by pulling straight up, ensuring that no wires are caught and that the gas assembly and mixer remain in place.

**Warning**

Wear a suitable protective mask to avoid ingesting particles from the refractory.

11. To help realign the heat exchanger lid with the heat exchanger upon reassembly, draw a vertical line from the front of the lid down to the heat exchanger.
12. Loosen the eight (8) bolts securing the lid to the heat exchanger using a 5 mm Allen key.
13. Carefully lift (straight up) the heat exchanger lid, and place in a clean dry area. Take care to avoid damaging the refractory insulation.

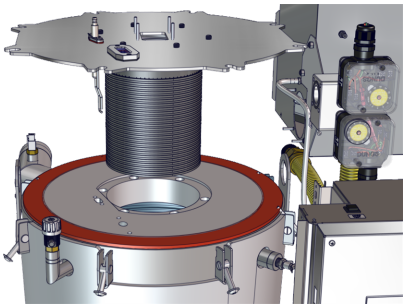


Figure 58 *Lifting heat exchanger lid with burner on underside*

14. Carefully remove the 6 M8 bolts securing the burner to the heat exchanger lid, and replace with the new one. The burner gasket may be brittle and break in the process. Replace if necessary.

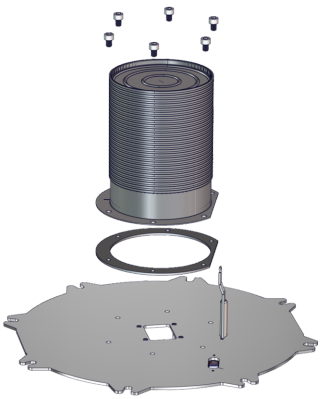
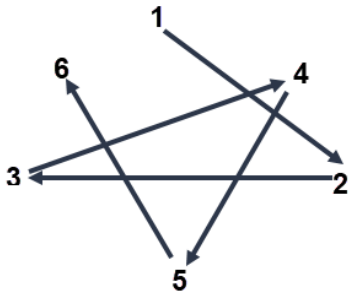


Figure 59 *Removing bolts securing burner to heat exchanger lid*

Tip: to gain better access to the burner, carefully unscrew the ignitor from the lid and place in a safe place.

15. Re-install the components in reverse order. Ensure that you tighten each screw evenly by following the order indicated in the pattern below.




**Warning**

After removing a burner, it is imperative that you perform a gap analysis on the ignitor.

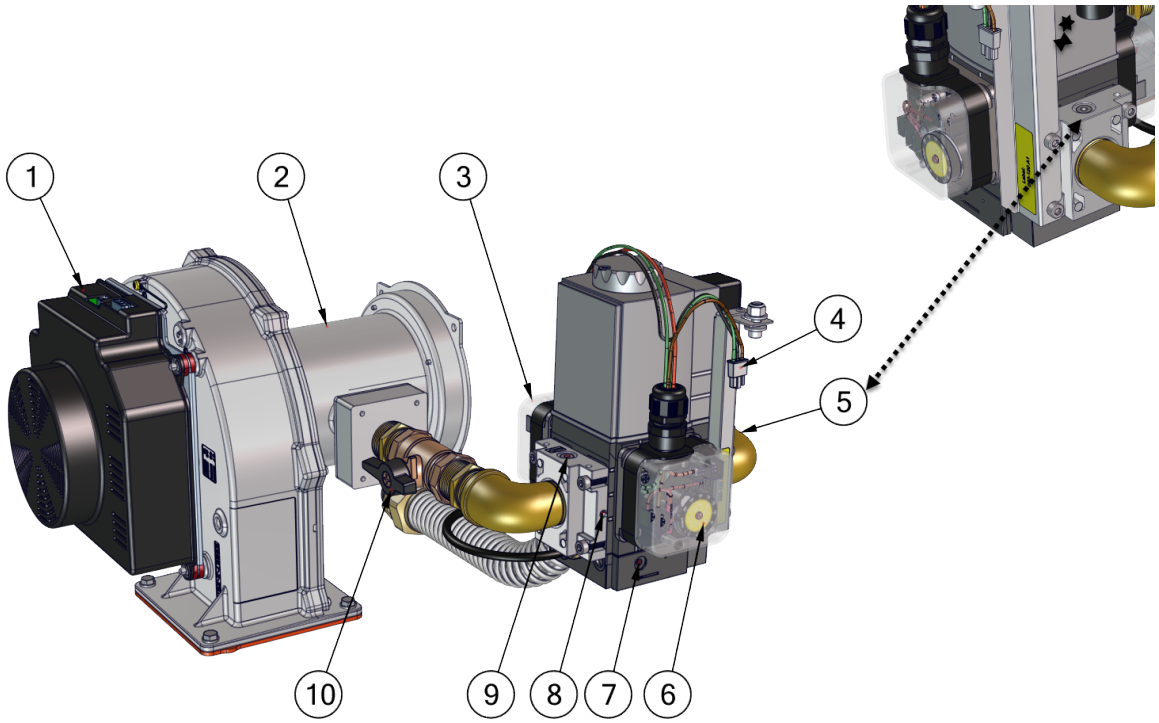
16. Turn on the electric power and gas supply to the boiler.
17. Reset the low pressure switch. For instructions, see *Resetting the gas high / low pressure switches on page 76*.

# 7.4 Replacing the fan, gas valve, and burner in EX 750 and EX 800 models

## Replacing the fan, gas valve, and burner in EX 750 and EX 800 models

This section documents the following maintenance procedures for EX 700 and EX 850 models:

- Replacing the fan
- Replacing the gas valve
- Replacing the burner.




| | |
|---|---|
| 1 | Fan |
| 2 | Mixing device |
| 3 | High pressure switch |
| 4 | Three- (3) wire Molex plug |
| 5 | Inlet gas pressure test port |
| 6 | Low pressure switch |
| 7 | Low fire adjustment (zero-offset) |
| 8 | High fire adjustment (on the side) |
| 9 | Manifold gas pressure test port |
| 10 | Shutoff valve |

Figure 60 *Gas valve and fan components - EX 700, 850*

# 7.4.1 Replacing the fan on the EX 700 and EX 850 models

1. Turn off the electric power and gas supply to the boiler.
2. Ensure the boiler cools down to the surrounding temperature. Do not drain the boiler unless freezing conditions are expected during this procedure.
3. Remove the front cover, and then remove the boiler's top panel by removing the Torx screws on the top panel of the boiler.

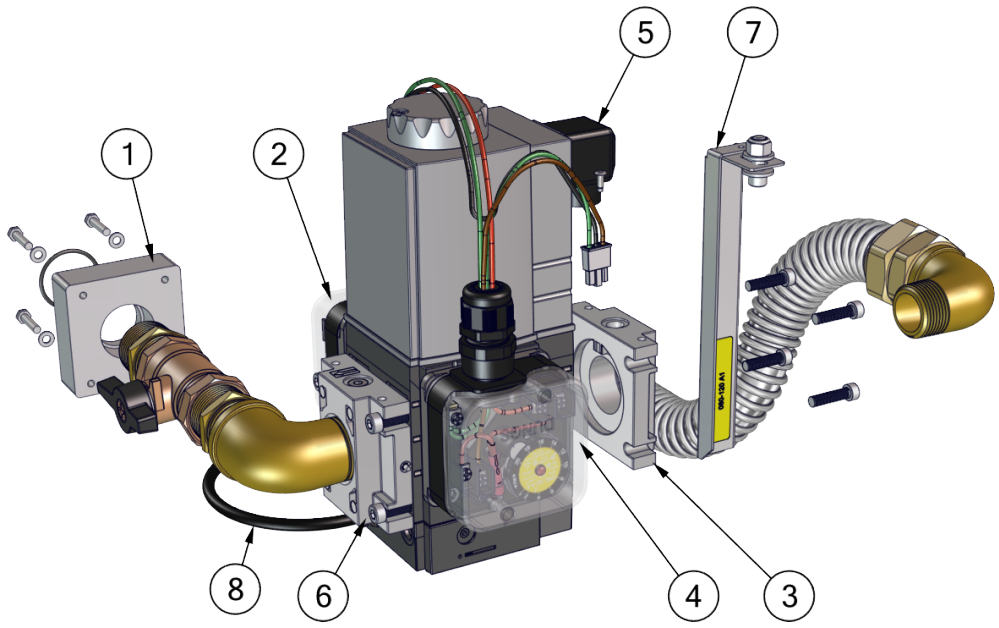
   A ladder or step may be required to have a clear vertical view of the work area. Do not attempt to reach from the front without a clear view, as damage to connectors, screws or refractory may occur.

4. Unplug both the front and back electrical connectors from the fan, and position them out of the way of the fan.
5. To separate the mixing device from the fan, remove the 6 x 6mm bolts. Note how the mixing device is positioned on the fan before separating it from the fan.

   **Note:** When you disconnect the mixer from the fan, it is still attached to the filter box and gas valve. This puts pressure on the fan, filter box and gas valve assembly, which have limited support. When you swap out the fan, place some sort of support underneath the mixer.

6. Remove the four (4) bolts at the base of the fan, connecting the fan to the heat exchanger lid.
7. Carefully lift off the fan, by pulling straight up and ensuring that no wires are caught, and that the gas line remains in place. Place the removed components in a clean, dry area.
8. Attach the new fan.
9. Ensure that the O-ring is in place on the fan before reattaching the mixer.
10. Re-install the components in reverse order. Upon reassembly, ensure that all gaskets are included and correctly positioned.

## 7.4.2 Replacing the gas valve in EX 700 and EX 850 models




| | |
|---|---|
| 1 | Four (4) bolts connecting gas valve and mixing device. Keep gasket and bolts for re-assembly. |
| 2 | Location of high gas pressure switch. |
| 3 | Gas valve inlet: Four (4) bolts of the flange. Keep gasket and bolts for re-assembly. |
| 4 | Low gas pressure switch. |
| 5 | Gas valve electrical connector |
| 6 | Gas valve outlet: Four (4) bolts of the flange. Keep gasket and bolts for re-assembly. |
| 7 | Supporting bracket for gas valve |
| 8 | Black tubing |

Figure 61 *Accessing the gas valve - EX 700, 850*

1. Turn off the electric power and gas supply to the boiler.
2. Ensure that the boiler cools down to the surrounding temperature. Do not drain the boiler unless freezing conditions are expected during this procedure.

3. Remove the front cover, and then remove the boiler's top panel by removing the four Torx head screws on the top panel of the boiler.

   A ladder or step may be required to have a clear vertical view of the work area. Do not attempt to reach from the front without a clear view, as damage to connectors, screws or refractory may occur.

4. Remove the bolt and nut securing the gas valve bracket to the frame.
5. Remove the Phillips head screw (see ① on *Figure 62* ) from the power connector plug, and pull off the electrical connector from the gas valve.
6. Remove the two screws of the bracket supporting the gas valve on the inlet side (see *Figure 62* ).

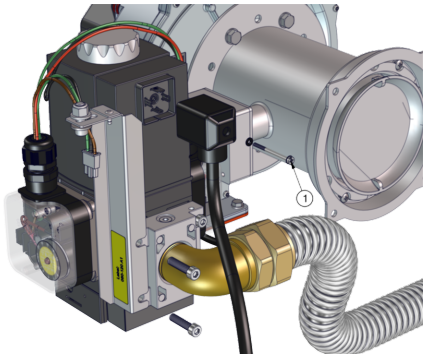



Figure 62 *Removing two screws of bracket and Phillips head screw on gas valve inlet side*

7. Pull the black tubing (see ⑧ on *Figure 61* ) from the push-to-connect fitting on the gas valve outlet side.
8. Disconnect the three- (3) wire Molex plug from the gas pressure switches.
9. Unscrew the two (2) bolts of the flange to separate the gas valve inlet from the gas line. Keep gasket and bolts for re-assembly. (See ③ on *Figure 61* .)
10. Unscrew the four (4) bolts of the flange to separate the gas valve outlet from the gas line. Keep gasket and bolts for re-assembly. (See ⑥ on *Figure 61* .)
11. Remove the gas valve and install the new gas valve.
12. Re-install the components in reverse order of the steps above.
13. Turn on the electric power and gas supply to the boiler.
14. Reset the low pressure switch. For instructions, see *Resetting the gas high / low pressure switches on page 76*.
15. Tune the gas valve. For instructions, see *Adjusting the gas valve (EX 400, EX 500) on page 67*.

## 7.4.3 Replacing the burner in the EX 700 and EX 850 models

**Warning**

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 that contain crystalline silica can be converted into cristobalite, classified as a possible human carcinogen.

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.

1. Turn off the electric power and gas supply to the boiler.
2. Ensure that the boiler cools down to the surrounding temperature. Do not drain the boiler unless freezing conditions are expected during this procedure.
3. Remove the front cover, and then remove the boiler's top panel by removing the four Torx head screws on the top panel of the boiler.

   A ladder or step may be required to have a clear vertical view of the work area. Do not attempt to reach from the front without a clear view, as damage to connectors, screws or refractory may occur.

4. Remove the two screws of the bracket supporting the gas valve on the inlet side (see *Figure 62* ).
5. Remove the Phillips head screw (see ① on *Figure 62* ) from the power connector plug, and pull off the electrical connector from the gas valve.
6. Pull the black tubing (see ⑧ on *Figure 61* ) from the push-to-connect fitting on the gas valve outlet side.
7. Disconnect the three- (3) wire Molex plug from the gas pressure switches.
8. Unscrew the two (2) bolts of the flange to separate the gas valve inlet from the gas line. Keep gasket and bolts for re-assembly. (See ③ on *Figure 61* .)
9. Remove the four 5/16" hex head bolts that attach the gas valve assembly to the mixing device. (See ① on *Figure 61* .) These bolts should be first loosened slightly in a cross sequence to prevent deformation of the mating parts.
10. Carefully move aside the gas valve assembly, and retain the O-ring for re-installing.
11. Remove the four (4) ¼" hex bolts that connect the mixing device to the air filter box. The gasket should remain attached to the air filter box.
12. Remove the four (4) 10mm hex bolts that attach the fan to the heat exchanger lid. An open-ended wrench or socket is required.
13. With the mixing device still attached, remove the fan by pulling straight up ensuring that no wires are caught and that the gas line remains in place. Place the removed components in a clean, dry area
14. Unplug the ignitor from the lid and place in a safe place.
15. Loosen the eight (8) 5mm Allen lid fasteners securing the lid to the heat exchanger. Mark the orientation of the lid onto the heat exchanger with a marker.
16. Carefully lift up on the lid and remove. Be careful not to damage the refractory insulation. Place the lid and burner assembly in a clean dry area.
17. Carefully loosen the burner cap screws and remove. Keep the cap screws for re-installation.
18. Separate the burner from lid. Replace the burner gasket upon re-installation.
19. Re-install the components in reverse order of the steps above.

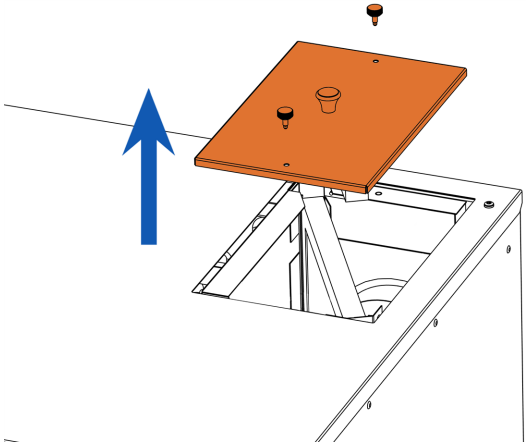
> **Warning**
>
> After removing a burner, it is imperative that you perform a gap analysis on the ignitor.

20. Turn on the electric power and gas supply to the boiler.
21. Reset the low pressure switch. For instructions, see *Resetting the gas high / low pressure switches on page 76*.

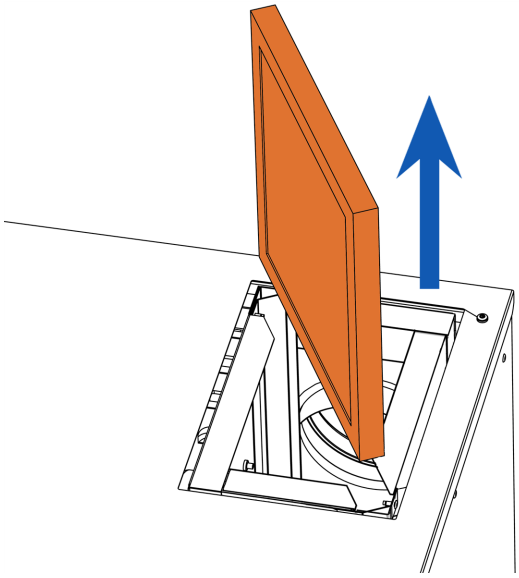
# 7.5 Replacing the air filter

Two replacement filters are shipped with each boiler. The air filter should be inspected and/or replaced monthly. When replacing the air filter in the appliance, use a MERV 8 filter sized at 10" x 10" x 1".

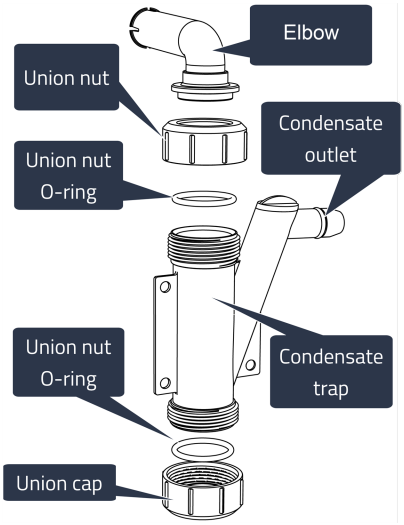
**1.** Remove the two screws of the air filter lid, and set aside.



**2.** Remove the air filter, and replace with a new one.



# 7.6 Cleaning a condensate trap




Condensate traps should be checked every two months, cleaned and refilled as necessary. Before cleaning the condensate trap, you must turn off the power to the boiler, and allow it to cool down.

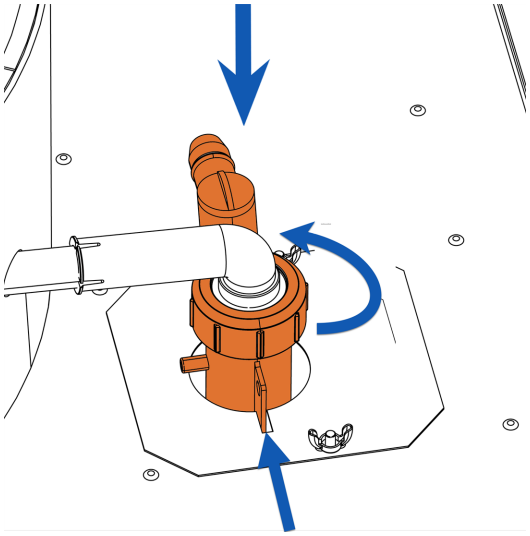
**Important**: Installers or service contractors should ensure that the end user is instructed on cleaning and refilling the trap.

**Warning**

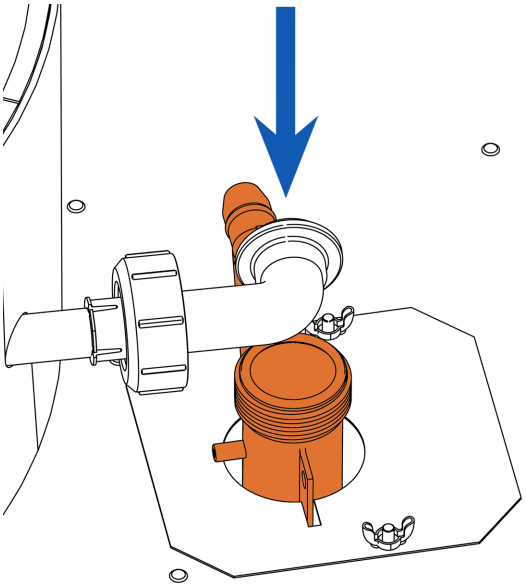
If condensate neutralization is used, check the pH level of condensate discharge.

Never operate the boiler unless the trap is filled with water. Failure to comply will result in severe personal injury or death.

**1.** Unscrew the union nut.

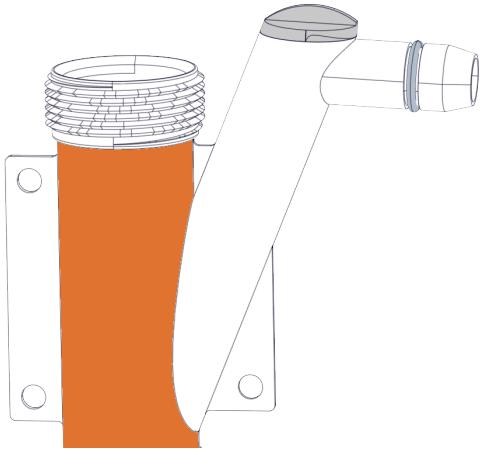


**2.** Rotate the elbow sideways, so that you can remove the condensate trap base.

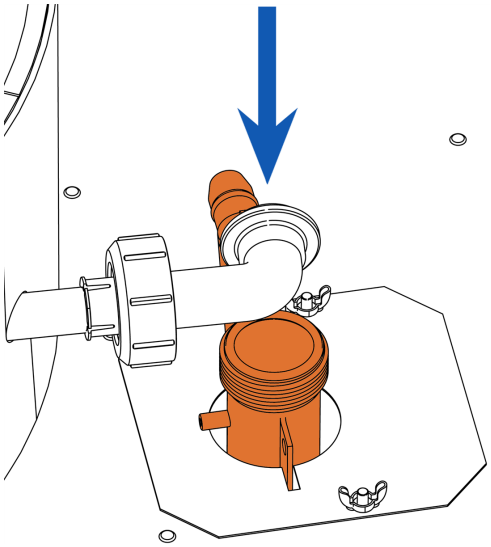


**3.** Clean and flush out the debris in the condensate trap base.

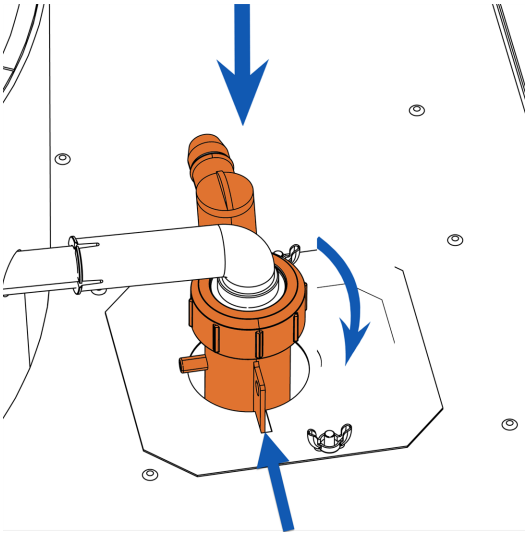
**4.** Fill the condensate trap to the top with water.



**5.** Reinsert the condensate trap through the metal plate.



**6.** Rotate the elbow, and tighten the union nut, so that elbow and condensate trap are secured. Ensure the union nut O-ring is included. Check for leaks.



# 8.0 Troubleshooting

Often, you can identify a problem and solve it through basic checks: confirming the electrical power supply, gas flow and resetting the thermostat control. For troubleshooting, we recommend that you use the three-step approach illustrated below.

> **Note**
>
> The boilers are equipped with a blocked vent shutoff system, which closes the gas supply upon detection of an irregular venting condition. In such an event, the electronic controller automatically carries out a reset/ retry every 5 minutes.

The troubleshooting section is divided into 3 sections:

- Preliminary checks
- Electronic components
- Troubleshooting error messages

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.

# 8.1 Preliminary checks

The first step in troubleshooting this system should be a review of the touchscreen controller. There are a number of diagnostic features incorporated in the software that evaluate system integrity, display error conditions and provide initial remedial actions.

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

| Preliminary Troubleshooting Checks | Check |
|---|---|
| Confirm power to the boiler: check that the touchscreen controller display is on (e.g., display is lit. The touchscreen controller's display will be fully functional in 90 seconds after power is restored to the boiler.) | ☐ |
| Check that the boiler is not in a safety lockout. | ☐ |
| Ensure wiring is clean and secure. | ☐ |
| Check that gas is reaching the appliance. | ☐ |
| Check the gas pressure switches. | ☐ |
| Confirm that the water system is properly charged to 12 psi minimum, and that the pump is serviceable. | ☐ |

# 8.2 Electronic components

This section details the method for troubleshooting the non-standard electronic components on the boiler.

## 8.2.1 Temperature sensors

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. For the supply water, return water, and vent temperature sensors, remove the wire leads by disconnecting their respective Molex connectors. Place multi-meter probes into the sensor's female Molex connector socket. Do not apply voltage to the sensor as damage may result.

The supply water and vent temperature sensors each contain two separate circuits. Test each pair. Both circuits must deliver accurate (although not necessarily identical) readings. Note that failures may occur only within certain temperature ranges.

| Temp. °F/°C | Resist. Ω – Ohm | Temp. °F/°C | Resist. Ω – Ohm |
|---|---|---|---|
| 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 |

| Temp. °F/°C | Resist. Ω – Ohm | Temp. °F/°C | Resist. Ω – Ohm |
|---|---|---|---|
| 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 / 35 | 7,334 | 190 / 88 | 983 |
| 95 / 35 | 6,532 | 195 / 91 | 903 |

*Table 12 Temperature sensor resistance values - 10K ohms*

## 8.2.2 Fan

Operating power is provided by means of a separate 120 VAC connector (white/black/green). Control of the fan is provided via a four-lead connector. 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 control connector will cause the fan to go to high speed and trigger a “Blocked Vent Error” within 6 seconds if the boiler is operating.

## 8.2.3 Air pressure sensor

The air pressure sensor monitors air flow in the venting system. If airflow through the combustion air intake or the exhaust vent becomes too restricted for safe operation, the boiler will stop firing, and display a "Fan Pressure Error". Also, to prevent avoidable Fan Pressure Errors, the system decreases the fan speed if the reading from the sensor nears the error threshold.

## 8.2.4 Water pressure sensor

The water pressure sensor ensures that there is adequate pressure in the heating system for safe operation. The pressure is displayed in PSI as the default. If the system pressure should drop below 8PSI the firing rate of the boiler is reduced. If the pressure drops to 4PSI or lower, the boiler will not fire.

Check the operation of the sensor by isolating the boiler from its system piping, and close the system fill valve, and then crack the pressure relief valve. The pressure displayed should reflect declining pressure. If it remains “fixed”, drain the boiler and replace the sensor, or dislodge any blocking debris from the sensor inlet channel and reinsert.

## 8.2.5 Gas pressure switches

The high and low gas pressure switches help protect the boiler from gas pressures outside of the acceptable range of operation. To view the location of the pressure switches on the EX series boilers, see *Figure 43* or *Figure 44* .

- The low gas pressure switch is pre-calibrated, and will trip when the inlet gas pressure falls below 3.5" w.c.
- The high gas pressure switch is pre-calibrated and will trip when the inlet gas pressure rises above 15" w.c.

You must **reset** the low gas pressure switch after the gas to the boiler is connected and turned on. To “reset” either the low or high gas pressure switch, press on the clear plastic cover above the Red button.

**Warning**

Do not attempt to adjust the High or Low pressure switch.

If either the high or low gas pressure switch trips, the boiler controller will show a Red bar at the bottom of the screen and indicate “Low/High Gas Pressure”.

## 8.2.6 Safety and Ignition Module (SIM)

The SIM is a safety control used in EX. It is certified to conform to the UL 60730-5-5 and ANSI Z21.20-2014 • CAN/CSA-C22.2 No. 60730-2-5-14 standards.

The module controls the boiler’s gas valve, including:

- Direct spark automatic ignition
- Flame detection and current measurement
- Supply water temperature sensing
- Flue gas temperature sensing
- Supply water maximum temperature shutdown
- Flue gas maximum temperature shutdown
- Low water cut-off.

The SIM continuously communicates with the boiler’s main controller reporting sensor readings and status. The sensor readings and error status, if any are displayed on the boiler controller’s screen.

### 8.2.6.1 Table showing LED operating status

Its two status LEDs indicate the operating status as shown in the table below.

| SIM Status Indicators | | | |
|---|---|---|---|
| **LED 1** | **LED 2** | **State** | **Description, LED status indication** |
| Rapid flash | | Power up or resetting | startup checks and initialization |
| Off | Off | Standby | LED 1 Off=flame or sparking<br><br>LED 2 = Burner-on call state |
| Off | On | Pre-purge or inter-purge | LED 1 Off=no flame or sparking<br><br>LED 2 = Burner-on call state |
| On | On | Heating | |
| Rapid flash | On | Igniting | |
| Off | Flashing | Lockout | |
| Flash alternately with LED 2 | Flash alternately with LED 1 | Fail-safe | Boiler requires a power cycle |

*Table 13 SIM LED status Indicators*

### 8.2.6.2 Low water cutoff function: reset and test

The low water cutoff (LWCO) function provides continuous protection against a low water incident.

If the SIM detects a low water incident, the boiler goes into a lockout condition. To clear the lockout condition in the controller, go to **Diagnostics**>**Advanced Diagnostics**>**Clear Errors**. To test the LWCO on the boiler, you can also manually place the boiler in a lockout condition.

### 8.2.6.3 Resetting the boiler after a LWCO lockout

Before you reset the boiler, ensure that the boiler is pressurized and that the air has been removed.

1. On the touchscreen controller, tap the **Home** screen.
2. On the **Main Menu**, tap the **Diagnostics** button.
3. Tap the **Advanced Diagnostics** button.
4. Tap the **Clear Errors** button.
5. Tap the **Yes** radio button, and then tap **OK**.

The system clears the errors, and resets the boiler.

### 8.2.6.4 Testing the LWCO function

1. Press and hold the **LWCO Test** button for 5 seconds (located on top of the electrical box).

   A message on the screen indicates that the boiler is in lockout mode.

2. On the touchscreen controller, select the **Reset** button.

   The message: "The SIM Module has been reset" is displayed.

3. Tap the **Close** button, and then tap the **Back** button until you return to the Home screen.

### 8.2.6.5 Water Temperature function: reset and test

The hi-limit temperature function monitors the hi-limit temperature set in the SIM. If the water temperature exceeds the hi-limit temperature, the boiler goes into a lockout condition (locks), requiring a manual reset. You can test the hi-limit cutoff temperature function on the boiler.

#### Resetting the boiler after a Hi-Limit lockout

Before you reset the boiler, ensure that the boiler is pressurized and that the air has been removed.

1. On the touchscreen controller, tap the **Home** screen.
2. On the **Main Menu**, tap the **Diagnostics** button.
3. Tap the **Advanced Diagnostics** button.
4. Tap the **Clear Errors** button.
5. Tap the **Yes** button, and then tap **OK**.

The system clears the errors, and resets the boiler.

### Testing the Hi-Limit cutoff temperature function

1. On the touchscreen controller, tap the **Home** screen.
2. On the **Main Menu**, tap the **Diagnostics** button.
3. Tap the **SIM Module** button.
4. Tap the **Hi-Limit Test** button.

   You will need to enter a cutoff temperature below the Supply Temp. value currently displayed. For example, if the Supply Temp. value is 180°F, enter 170°F in the Cut Off Temp. box.
5. Tap inside the **Cut-Off Temp.** box, and then tap a number value.
6. Tap the **OK** button.

   The message: "Hi-Limit Detected" is displayed.
7. To reset the boiler, select the **Reset** button. The cutoff value reverts to normal upon reset.

   The message: "The SIM module has been reset" is displayed.
8. Tap the **Close** button, and then tap the **Back** button until you return to the Home screen.

# 8.3 Troubleshooting error messages

Errors shown on the touchscreen controller are described below as well as diagnoses and fixes.

## 8.3.1 Touchscreen error messages

**Warning**

Never attempt to repair the control module (circuit board). If the control module is defective, replace it immediately.

The bottom line of the touchscreen displays the boiler's error status. The following colors represent the boiler's operating status:

- Green – Normal
- Yellow – Warning
- Red – Alarm

The text inside the bar will indicate the specific warning or alarm. If there is more than one alarm present the text will scroll slowly through all current alarm conditions. Besides the errors listed below, see also *Miscellaneous touchscreen controller errors on page 110*.

## 8.3.2 Maximum ignition trials error

| Maximum Ignition Trials Error | | |
|---|---|---|
| **Issue** | **Diagnosis** | **Fix** |
| Error – Ignition Failure after 3 tries boiler has failed to ignite on 3 successive attempts. Boiler is in lockout for 1 hour, then repeats 3-try sequence. Consult service technician if error recurs. | No spark when igniting. Ignition probe/flame sensor disconnected. | Check that ignition 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 ignition probe rods is too large or too small. | Adjust ignition probe rod gap between ⅛ and 3/16th (3.2-4.7 mm). |
| | 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 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 the pressure vessel is grounded. Check the ignition probe/flame sensor is electrically isolated from the vessel, and its ceramic insulator is intact. Replace ignition lead Replace spark module. |

## 8.3.3 Hi/Low gas pressure switch error

| High/Low Gas Press Error | | |
|---|---|---|
| **Issue** | **Diagnosis** | **Fix** |
| Error – High/Low Gas Press | Inlet gas pressure has risen above 15" w.c. or has fallen below 3.5" w.c. | Measure the inlet gas pressure. Then reset the switch. |

## 8.3.4 Hi Limit cut-off temperature error

| Hi Limit cutoff temperature Error | | |
|---|---|---|
| **Issue** | **Diagnosis** | **Fix** |
| Error – Water High-Limit Exceeded | Water temperature exceeds hi-limit. Boiler is in hard lockout mode. | See *Water Temperature function: reset and test on page 106*. |

## 8.3.5 Low Water Cut-off error

| Low Water Cutoff Error | | |
|---|---|---|
| **Issue** | **Diagnosis** | **Fix** |
| Error - Low Water Cutoff | The Safety and Ignition module has detected a low water condition. | See *Low water cutoff function: reset and test on page 105*. |

## 8.3.6 Aux. Interlock 1 or 2

| Aux. Interlock 1 or 2 | | |
|---|---|---|
| **Issue** | **Diagnosis** | **Fix** |
| Interlock 1 or 2 terminals are open. | Jumper lead is loose or compromised. | Replace the jumper lead. |
| | External safety is in an alarm state. | Inspect the external safety devices. |

# 8.4 Miscellaneous touchscreen controller errors

| Miscellaneous errors | | |
|---|---|---|
| **Issue** | **Diagnosis** | **Fix** |
| “ Loop/Indoor Sensor”<br><br>“Insufficient Air Flow”<br><br>“Insufficient Water Pressure” | The sensor plug is not engaged. | Check the P501 plug is fully engaged in the back of the controller board. |
| “Unknown Error” | The sensor plug is not engaged. | Check the P501 plug is fully engaged in the back of the controller board. |
| | Temperature sensor input problem. | Test each temperature sensor for appropriate readings and Replace defective temperature sensor. |
| Error - Max. Inlet/Outlet Sensor Temp. Exceeded. -> 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.<br><br>Check temperature sensor. |
| Blank – screen dark, but fan running Indicative of power-surge damage to appliance | | Check transformer; replace if damaged.Check circuit board for visible damage. |
| Controller is stuck in "service" mode after software update. | If update fails or no updates applied. | Restarting returns the boiler to normal operation. |

# 8.4.1 Ignition issues

| Ignition issues | | |
|---|---|---|
| **Issue** | **Diagnosis** | **Fix** |
| 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 $CO_2$ level via analyzer. |
| | Check for proper gas 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.<br><br>Check air reference tubing. |
| | Igniter probe/flame sensor disconnected. | Reconnect probe. |
| | 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. |

## 8.4.2 Temperature issues

| Temperature issues | | |
|---|---|---|
| **Issue** | **Diagnosis** | **Fix** |
| Low heat | Operating temperature too low. Increase temperature target. | Increase temperature target. |
| | Priority parameters or load configuration improperly set up. | Review load configuration parameters. |
| | appliance undersized. | Refer to Load Calculation vs. Boiler Output. |
| | Air trapped within system. | Bleed system as required. |
| | Improper system piping. | Refer to recommended piping guidelines for the respective boiler model. |
| | System pump undersized. | Check pump manufacturer's data/check temp differential across heat exchanger. |
| | Poor gas:air mixing. | Check $CO_2$ level. |
| | Defective thermostat. | Refer to manufacturer's instructions. |
| | Obstruction in condensate drain. | Inspect and clean condensate drain. |
| | appliance 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. |
| | Low radiation/ excessive heat loss. | Check actual length of pipe using radiation / heat loss calculation. |
| | Low flow rate to zone(s). | Check temperature drop across zone. |
| | Defective zone valve/ zone circulator. | Check operation per manufacturer's instructions. |

## 8.4.3 Miscellaneous issues

| Miscellaneous issues | | |
|---|---|---|
| **Issue** | **Diagnosis** | **Fix** |
| 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. |
| Boiler stuck on Initialize | Fan board failure | Replace fan. |
| 'Ghost' call for heat. | Triac or 'Power-robbing' thermostat sending current to boiler. | Remove Therm. connections from boiler to confirm that stray voltage, or current induced in thermostat wiring, is source of nuisance signal. Replace the Power Robbing thermostat, isolate the thermostat with a relay or install a properly sized resistor (consult the thermostat manufacturer first then IBC for instructions). |
| Error: Water High Limit / Low Water Cutoff won't clear. | Boiler is in 1 hour safety lockout. | Reset safety device and cycle boiler power off and on to reset error. |
| DHW taking too long to heat. | Sensor may be under-reading actual water temp. | Check sensor engagement; note well is 15cm / almost 6 inches deep and sensor must be fully set to back. Check programmed settings boiler temp set too close to the required DHW temperature. |
| Boiler output not modulating up to maximum despite target not being reached. | Possible flow issue: check for 35 or 40 °F temperature difference between boiler supply and return water temperatures (evokes electronic fence). | Confirm that primary pump is able to overcome head loss of boiler and primary loop piping at the required flow rate. |
| Primary Pump runs but load pumps do not. | Wiring not complete. | Supply power to the PV/L and PV/N terminals from the incoming power supply to the boiler. (Factory wired on boilers with a factory installed touchscreen controller) |

## 8.4.4 Cycling issues

| Cycling issues | | |
|---|---|---|
| **Issue** | **Diagnosis** | **Fix** |
| Rapid Cycling | Improper values entered via keypad. | Check load maximum temps are above target temps, by ½ 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. |
| | 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 the heat exchanger. |
| | Slow combustion air blower. | Check that $CO_2$ level is within specification. |
| | Dirty burner/heat exchanger. | Check pressure drop. |
| | Low water flow due to improper piping. | Refer to recommended piping for the respective boiler model. |
| | Low water flow due to undersized pump. | Check manufacturer's rating charts/check temperature differential across heat exchanger. |
| | Low water flow due to restrictions in water pipe. | Check temperature differential across zone/heat exchanger. |
| | Low radiation. | Check actual amount of radiation per zone and refer to manufacturer's rating tables. |
| | appliance over-fired. | Clock gas meter/check gas pressure with manometer/ check $CO_2$ level. |
| | appliance Oversized. | Check load calculation vs. minimum boiler output. |
| | Improperly set or defective operating/safety controls. | Check operation with ohmmeter/voltmeter. |

# Appendices

## Wiring diagrams

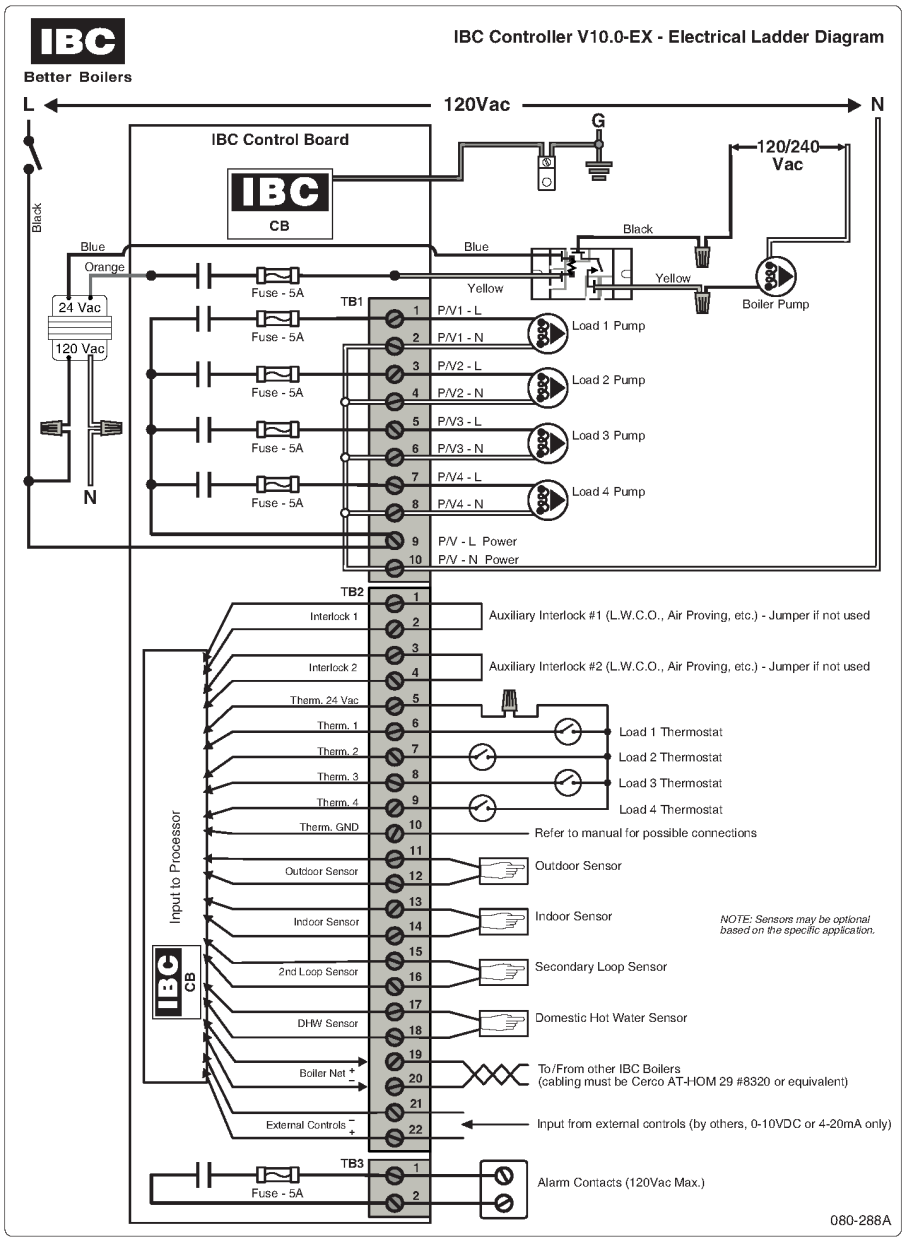



Figure 63 *Controller electrical diagram*

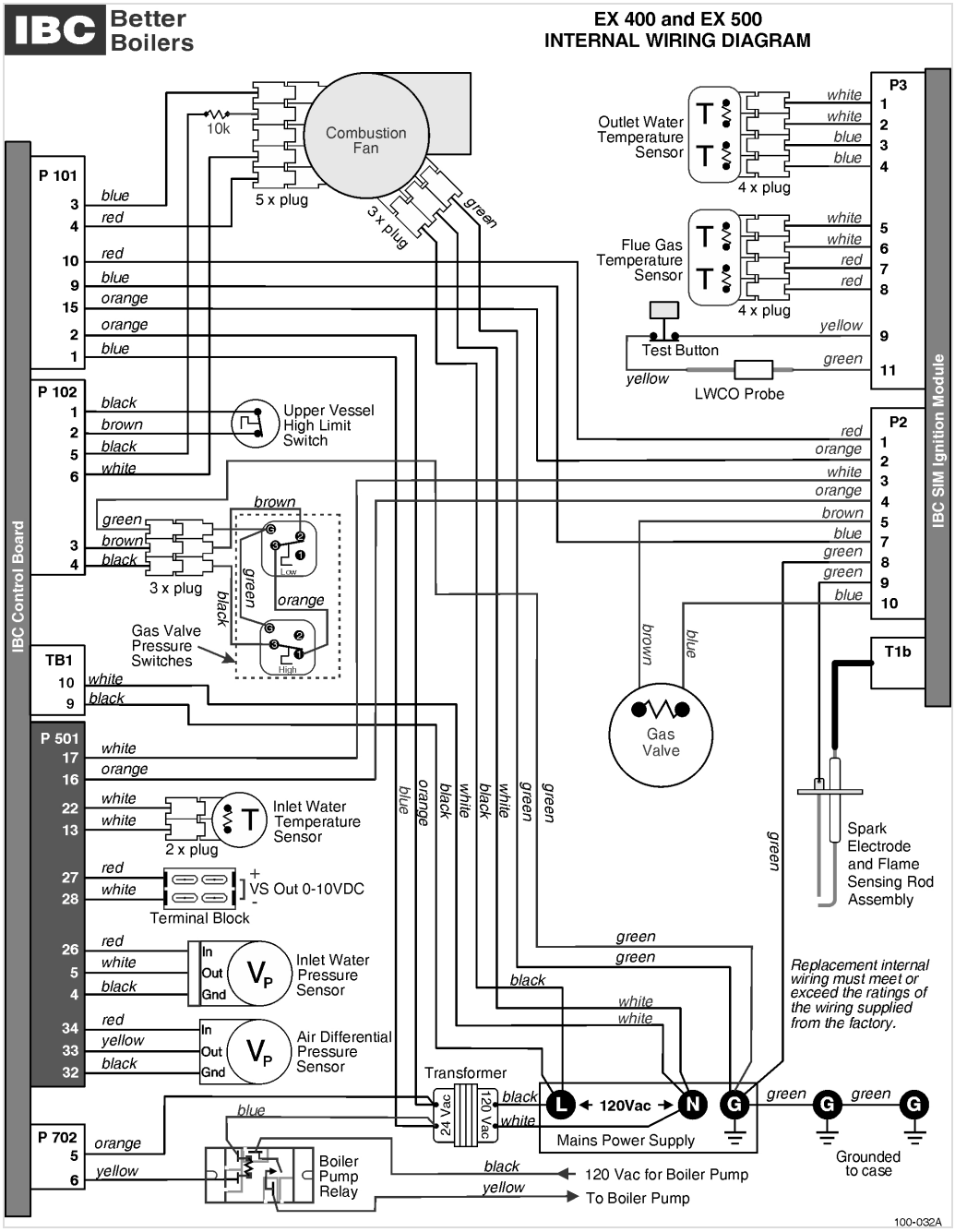



Figure 64 *Internal wiring diagram - EX 400 and EX 500 models*

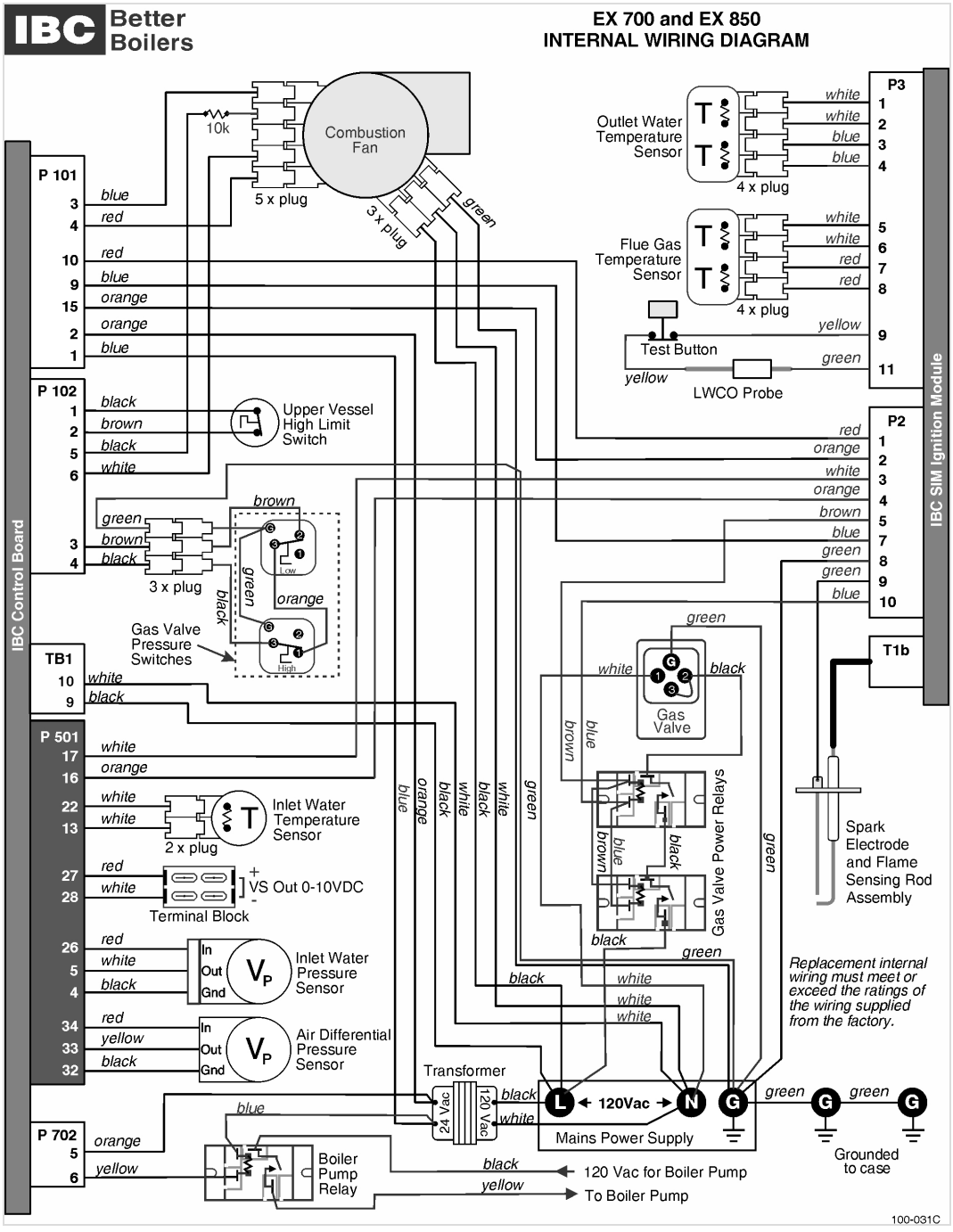



Figure 65 *Internal wiring diagram - EX 700 and EX 850 models*

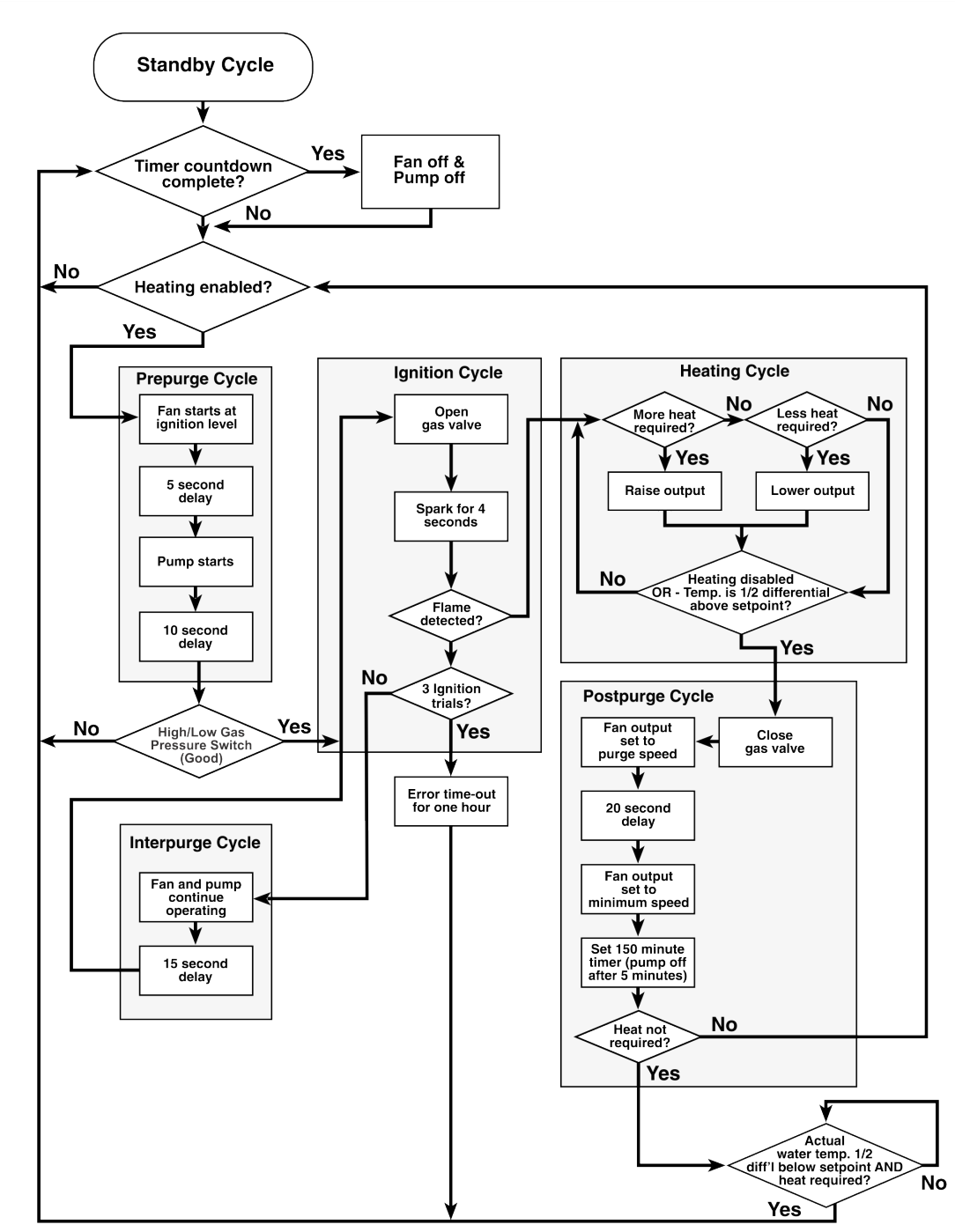



Figure 66 *Sequence of Operation*

# 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

☐Leak testing completed ☐ Gas piping ☐ Venting system ☐ Fan ☐ combustion components

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

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

☐ Air purge completed

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

☐ Condensate trap filled Condensate drain clear and free flowing Condensate Neutralization.

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

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

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

Combustion Readings:

$CO_2$ _____ % $O_2$ _____ % CO _____ ppm

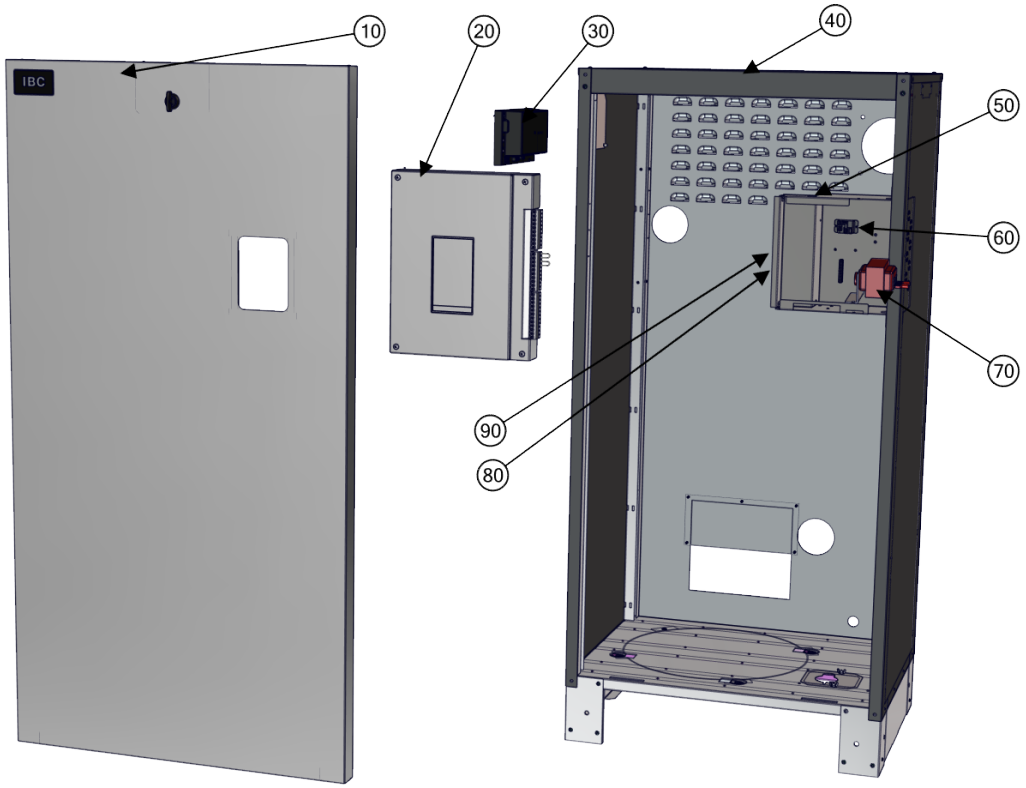
Flue temperature ___ Return water temperature (measure simultaneously with flue temp.) _____

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

Installers: send this completed sheet - Fax to 604 877 0295 - or - scan and Email to info@ibcboiler.com.

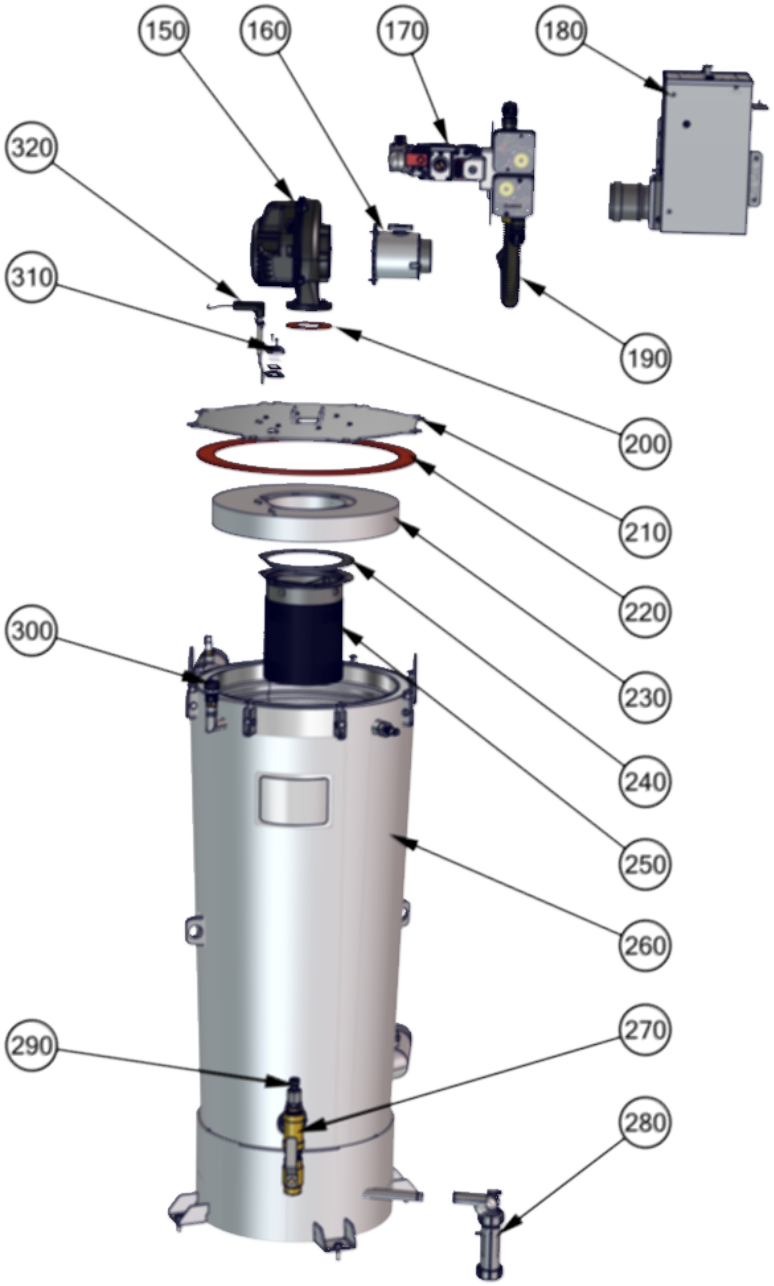
Intentionally left empty

# Boiler parts diagram - EX 400 and EX 500




| Item Number | Description | Part Number | Replacement Kit Numbers |
|---|---|---|---|
| 10 | Door | 500-134 | P-1209 |
| 20 | Controller | 500-044 | P-242 |
| 30 | Safety Ignition Module | 500-105 | P-270 |
| 40 | Top panel | 251-030 | P-1227 |
| 50 | Controller module chassis | 251-042 | P-1248 |
| 60 | Boiler pump relay | 240-165 | P-1233 |
| 70 | Transformer | 240-008 | P-9059 |
| 80 | Air pressure sensor (behind controller) | 240-162 | P-1210 |
| 90 | Vessel high limit switch | 240-030 | P-9070 |

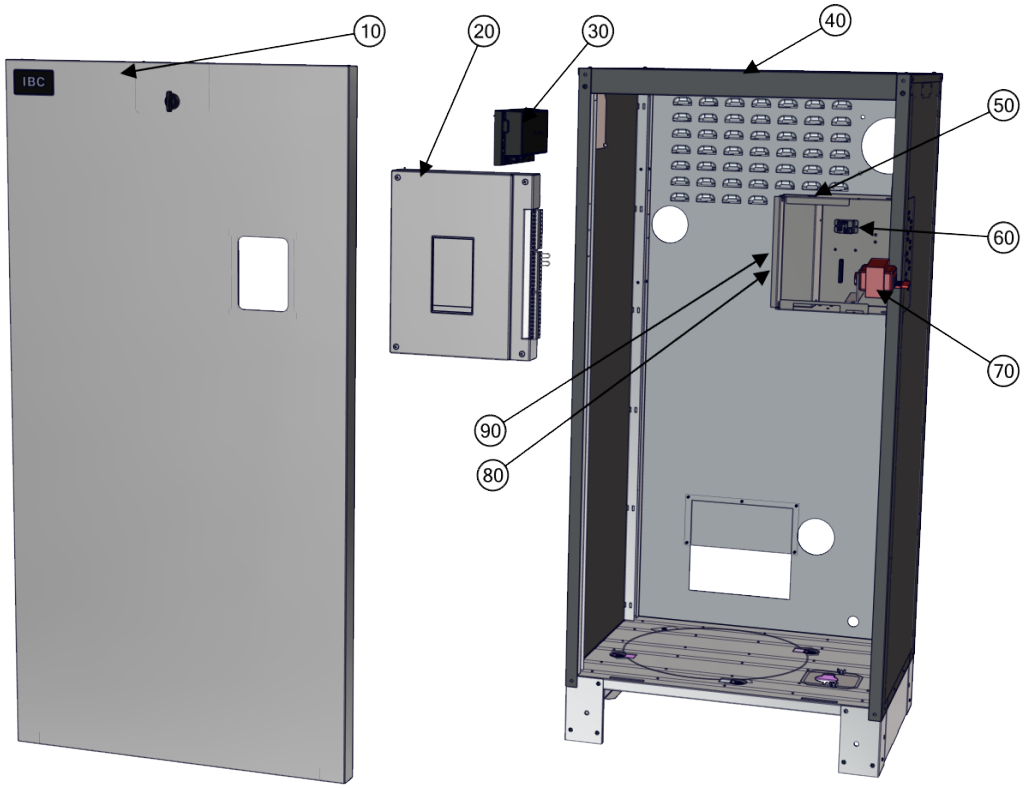
| Item Number | Description | Part Number | Replacement Kit Numbers |
|---|---|---|---|
| | (behind controller) | | |
| | Wiring harness (not shown) | | |



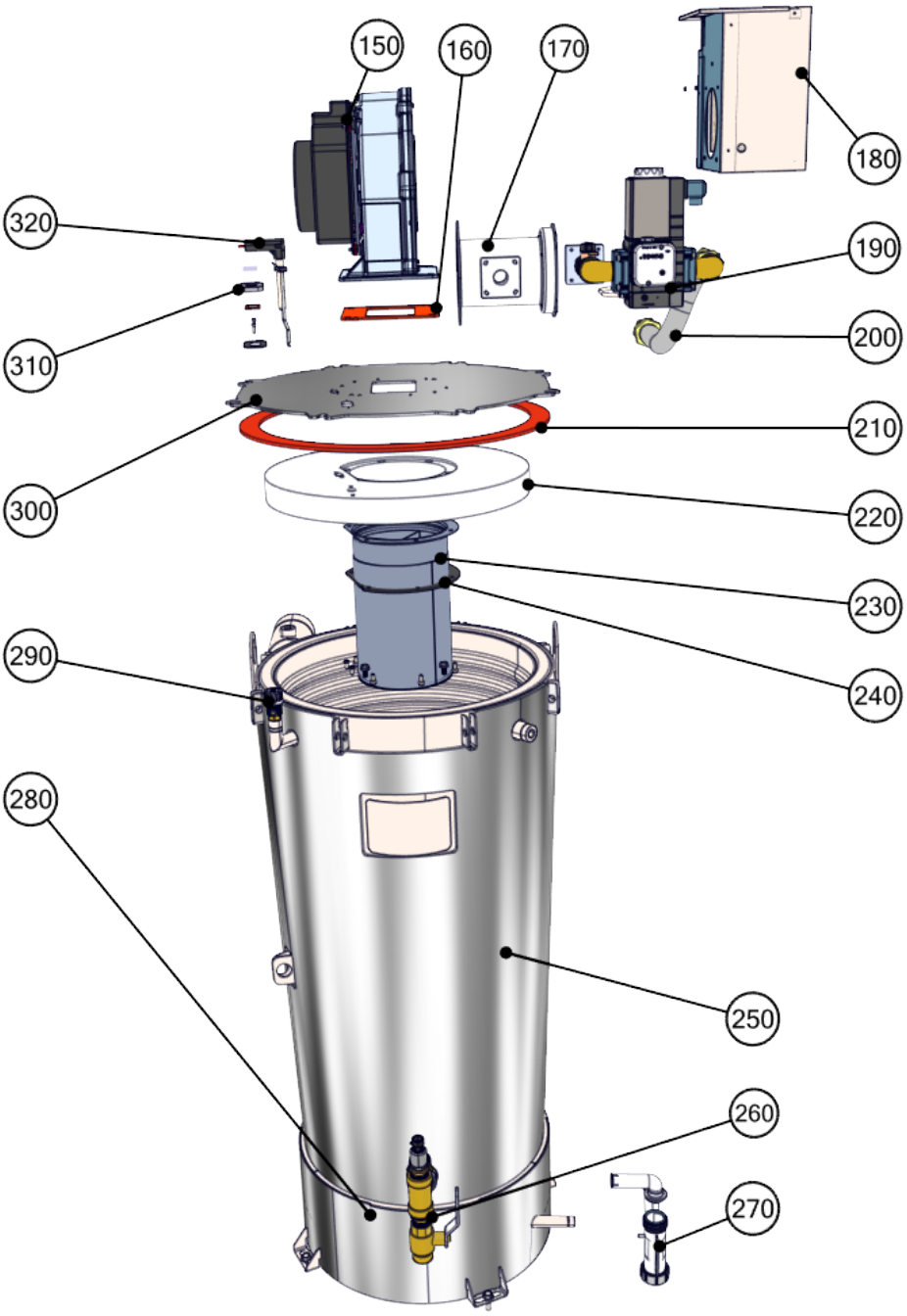
| Item Number | Description | Part Number | Replacement Kit Number |
|---|---|---|---|
| 150 | Fan | 240-113 | P-311 |
| 160 | Fuel mixer | 180-164<br>180-163<br>180-252<br>180-253 | P-1235 NG EX 400<br>P-1236 LP EX 400<br>P-1237 NG EX 500<br>P-1238 LP EX 500 |
| 170 | Gas valve | 180-288 | P-1241 |
| 180 | Air filter compartment | 500-172 | P-1239 |
| | Replacement air filters | 180-126 | P-381 |
| 190 | Gas line | 190-208 | P-1242 |
| 200 | Fan gasket | 250-322 | P-311 |
| 210 | Heat exchanger lid | 170-055 | P-1247 |
| 220 | Heat exchanger gasket | 255-136 | P-1252 |
| 230 | Refractory | 255-135 | P-1253 |
| 240 | Burner gasket | 255-128 | P-1223 |
| 250 | Burner | 180-284 | P-1243 |
| 260 | Heat exchanger - 400 | 170-054 | P-1245 |
| | Heat exchanger - 500 | 170-045 | P-1246 |
| 270 | Boiler drain with cap | 500-144 | P-1220 |
| 280 | Condensate trap | 180-268 | P-1221 |
| 290 | Water pressure sensor | 240-167 | P-1231 |
| 300 | Manual air vent | 180-258 | P-1219 |
| 310 | Sight glass kit | 500-117 | P-107 |
| 320 | Ignitor | 240-153 | P-1213 |
| | Ignitor cable | 200-154 | P-358 |


| Item Number | Description | Part Number | Replacement Part Number |
|---|---|---|---|
| 350 | Low water cut-off probe | 240-143 | P-9078 |
| 360 | Supply Water temperature sensor | 240-159 | P-1225 |
| 370 | Tridicator - field installed | 180-283 | P-1234 |
| 380 | Relief valve - field installed | 180-279 | P-1205 |
| 390 | Vent temperature sensor | 240-132 | P-361 |
| 400 | Return water temperature | 240-160 | P-1226 |

# Boiler parts diagram - EX 700 and EX 850




| Item Number | Description | Part Number | Replacement Kit Numbers |
|---|---|---|---|
| 10 | Door | 500-134 | P-1209 |
| 20 | Controller | 500-044 | P-242 |
| 30 | Safety Ignition Module | 500-105 | P-270 |
| 40 | Top panel | 251-030 | P-1227 |
| 50 | Controller module chassis | 251-042 | P-1228 |
| 60 | Boiler pump relay | 240-165 | P-1233 |
| 70 | Transformer | 240-008 | P-9059 |
| 80 | Air pressure sensor (behind controller) | 240-162 | P-1210 |
| 90 | Vessel high limit switch (behind controller) | 240-030 | P-9070 |
| | Wiring harness (not shown) | | P-1232 |


150
160
170
180
320
190
310
200
210
300
220
230
290
240
280
250
260
270

| Item Number | Description | Part Number | Replacement Kit Number |
|---|---|---|---|
| 150 | Fan | 240-156 | P-1212 |
| 160 | Fan gasket | 255-126 | |
| 170 | Fuel mixer | 180-254<br>180-255<br>180-256<br>180-257 | P-1200 NG EX 700<br>P-1201 LP EX 700<br>P-1202 NG EX 850<br>P-1203 LP EX 850 |
| 180 | Air filter compartment | 500-136 | P-1211 |
| | Replacement air filters | 180-126 | P-381 |
| 190 | Gas valve | 500-147 | P-1215 |
| 200 | Gas line | 190-201 | P-1216 |
| 210 | Heat exchanger gasket | 255-125 | P-1222 |
| 220 | Refractory | 255-123 | P-1218 |
| 230 | Burner | 180-270 | P-1224 |
| 240 | Burner gasket | 255-128 | P-1223 |
| 250 | Heat exchanger - 700 | 170-046 | P-1230 |
| | Heat exchanger - 850 | 170-047 | P-1229 |
| 260 | Boiler drain with cap | 500-144 | P-1220 |
| 270 | Condensate trap | 180-268 | P-1221 |
| 280 | Water pressure sensor | 240-167 | P-1231 |
| 290 | Manual air vent | 180-258 | P-1219 |
| 300 | Heat exchanger lid | 170-049 | P-1214 |
| 310 | Sight glass kit | 500-117 | P-117 |
| 320 | Ignitor | 240-153 | P-1213 |
| | Ignitor cable | 200-154 | P-358 |


| Item Number | Description | Part Number | Replacement Part Number |
|---|---|---|---|
| 350 | Low water cut-off probe | 240-143 | P-9078 |
| 360 | Supply Water temperature sensor | 240-159 | P-1225 |
| 370 | Tridicator - field installed | 180-283 | P-1234 |
| 380 | Relief valve - field installed | 180-279 | P-1205 |
| 390 | Vent temperature sensor | 240-132 | P-361 |
| 400 | Return water temperature | 240-160 | P-1226 |

# Revision history

R0 (October 2019) Initial release

R1 (December 2019) Updated figure 36, and added new sections on measuring the inlet gas pressure and resetting the gas high/low pressure switches.

R2 (February 2020) Introduction of the new EX 400 and EX 500 models.

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