

**⚠ 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. To do so may result in an explosion or fire.

What to do if you smell gas:

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

Installation and service must be performed by a qualified installer, service agency or the gas supplier.

**This manual should be maintained in legible condition and kept adjacent to the boiler or in a safe place for future reference.**



# Array AR 399 SE – 500 SE

INSTALLATION, OPERATION AND SERVICE MANUAL

# RIELLO

## RANGE

MODEL	CODE
Array AR 399 SE	20181721
Array AR 500 SE	20181722

## CONFORMITY

The **Array AR SE** boiler range complies with:



Dear customer,

Thank you for choosing a **RIELLO** heating product, a quality product that is designed to give dependable, efficient and safe service; which will provide comfort in the home for many years to come. This manual provides information that is essential to the installation of the appliance. Used in conjunction with a qualified installer, service technician or the gas supplier's knowledge and expertise will allow for a quick, simple and correct appliance install.

Please accept our thanks, and congratulations on your choice of product.  
Riello S.p.A.

## INTENDED USE

This boiler must only be used for the purpose specified by the manufacturer and for which it is designed. The manufacturer declines all responsibility, contractual or other, for damage to property or injury to persons or animals caused by improper installation, adjustment, maintenance or use.

Installation of the boiler must comply with all applicable codes and regulations imposed by the national, Federal or local authorities and bodies. If no specific requirements are defined, in the USA, the latest edition of the National Fuel Gas Code ANSI Z223.1/ NFPA 54 must be complied with. In Canada, installation must be in accordance with the requirements of CAN/CSA B149.1, Natural Gas and Propane Installation Code.

Where required by local regulations, the system must comply with the American Society of Mechanical Engineers Safety Code for Controls and Safety Devices for Automatically Fired Boilers (ASME CSD-1).

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## 1 GENERAL INFORMATION

### 1.1 Key to symbols

#### Pay attention to these terms:

**⚠ DANGER** = indicates the presence of immediate hazards which will cause severe personal injury, death or substantial property damage if ignored.

**⚠ WARNING** = indicates the presence of hazards or unsafe practices which could cause severe personal injury, death or substantial property damage if ignored.

**⚠ CAUTION** = indicates the presence of hazards or unsafe practices which could cause minor personal injury or product or property damage if ignored.

**⚠ NOTE** = indicates special instructions on installation, operation, or maintenance which are important but not related to personal injury hazards.

**🛑 STOP!** = Identifies actions that you MUST NOT do.

### 1.2 General Safety Information

**⚠** Check that the product is complete, undamaged and as ordered as soon as you receive it. Report any discrepancies or damage to the **RIELLO** dealer who sold it.

**⚠** The boiler must be installed by a qualified installer, service agency or gas supplier.

**UPON COMPLETION OF THE INSTALLATION THE INSTALLER MUST INSTRUCT THE OWNER AND OPERATOR ON THE FUNCTIONALITY AND THE PROPER OPERATION OF THE BOILER AND THE HEATING SYSTEM.**

**THIS MANUAL SHOULD BE HANDED TO THE OWNER AND OPERATOR OF THE APPLIANCE.**

**THE INSTALLER MUST REVIEW ALL SAFETY INSTRUCTIONS WITH THE OWNER AND OPERATOR.**

The installation instructions included in this Manual are intended solely for use by a qualified installer, service agency or gas supplier. If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury, or death.

- Have installation and service performed by a qualified installer, service agency or the gas supplier.
- **RIELLO** recommends signing a service and maintenance contract with a trained and qualified installer or service agency that covers annual servicing and condition-based maintenance. Proper maintenance is a fundamental requirement for safe and efficient operation and long service life.
- The boiler must be serviced annually including the main burner, ignition system, the entire venting system, and the combustion air supply. All parts that show any signs of damage or corrosion must be replaced.

**⚠ WARNING:** This product is a gas appliance that emits poisonous gases; such as CO (Carbon Monoxide). For this reason, it is required that CO detectors be installed in buildings where the boiler is installed. Failure to do so may result in severe injury or death.

**⚠ WARNING:** when servicing the boiler and venting components ensure the boiler components and venting components are installed properly per the Installation, Operation & Service Instructions for the boiler as well as the vent manufacturer's installation instructions and the local code having jurisdiction are followed. Failure to comply may result in substantial property damage, severe personal injury, or death.

- The owner and operator is responsible for the operational safety and regulatory compliance of the heating system.
- Improper installation, adjustment, alteration, service, or maintenance can cause property damage, personal injury, or death. Refer to this manual and consult a qualified installer or service agency, or the gas supplier before installation, service or maintenance.
- The boiler must be installed such that the gas ignition system components are protected from water (dripping, spraying, rain etc.) during boiler operation and circulator replacement, condensate trap, control replacement, etc.
- The boiler must not be installed on carpeting.

**⚠** This product must only be used for the purpose for which it is designed and made, as specified by **RIELLO**. **RIELLO** declines all responsibility, contractual or other, for damage to property or injury to persons or animals caused by improper installation, adjustment, maintenance or use.

**⚠** If you notice any water leaks, disconnect the boiler from the main electrical supply and shut off the water supply.

**⚠** Periodically check that pressure in the central heating circuit, when cold, is approximately 20 psi (1.4 bar) and below the maximum limit specified for the boiler.

**⚠** If the boiler is not going to be used for an extended period of time, perform the operations described later in this manual.

**⚠** This instruction manual is an integral part of the boiler. It must be kept safe and must **ALWAYS** accompany the boiler, even if it is sold to another owner or transferred to another user or to another installation. If you damage or lose this manual, order a replacement immediately from your local **RIELLO** Technical Assistance Center.

**⚠** The equipment without packaging, before being connected to the hydraulic system and to the gas supply and being electrically powered can be exposed to temperatures ranging between 39°F (4°C) and 104°F (40°C). Once it is able to activate the antifreeze functions, it can be exposed to temperatures within -4°F (-20°C) and 104°F (40°C).

**⚠** Regularly check that the condensate drain is free from obstruction.

**⚠** We recommend cleaning inside the heat exchanger once a year, extracting the fan and burner and removing any installation debris using a vacuum. This operation should be done by a qualified installer, service agency or gas supplier only.

**⚠ WARNING:** Metal casing is an integral part of the boiler. All panels, doors and seals must be always in place, fully closed, during boiler's operation, to prevent any gas or flue leakage in case of failure.

### 1.3 Warnings

- Gas fired hot water boiler for either direct vent installation. Design according to: ANSI Z21.13-2017 CSA 4.9-2017 – Gas-Fired low pressure hot water boilers. Direct vent boiler, Category IV.
- SCAQMD Rule 1146.2

#### 1.3.1 General warnings

**⚠ DANGER:** Make sure the gas on which the boiler will operate is the same type as that specified on the boiler rating plate and on the colored sticker near the boiler gas connection.

**⚠ WARNING:** Should overheating occur or the gas supply valve fail to shut off, turn off the manual gas control valve to the appliance.

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

**⚠ WARNING:** Automatic filling systems are not recommended with this product as they will continually add fresh water to the system if there is a leak resulting in the addition of new contaminants that could reduce the lifespan of the boiler.

**⚠ WARNING:** To minimize the possibility of improper operation, serious personal injury, fire, or damage to the boiler:

- Always keep the area around the boiler free of combustible materials, gasoline, and other flammable liquids and vapors.
- The boiler should never be covered or have any blockage to the flow of fresh air to the boiler.

**⚠ WARNING:** Risk of electrical shock. More than one disconnect switch may be required to de-energize the equipment before servicing.

**⚠ WARNING:** Failure to comply with the previous warnings could result in severe personal injury, death or substantial property damage. Failure to adhere to the guidelines on this page can result in severe personal injury, death or substantial property damage.

**⚠ WARNING:** Installation and service must be performed by a gas supplier or a licensed qualified installer/service Technician.

**⚠ CAUTION:** This boiler requires forced water circulation when the burner is operating. See minimum and maximum flow rates. Severe damage will occur if the boiler is operated without proper water flow circulation.

**⚠ NOTE:** When the boiler has been filled for the first time or the system has been drained and refilled, it will be necessary to release any air that may have become trapped within the appliance heat exchanger. Loosen the bleed screw until water is released and then close. **IMPORTANT, THERE ARE NO OTHER MANUAL AIR RELEASE VALVES LOCATED ON THE APPLIANCE.**

#### The following instructions must be observed

- The boiler must only be used for its designated purpose, observing the Installation Instructions.
- Only use the boiler in combination and with the accessories and spare parts listed in the **RIELLO Array AR SE** spare parts catalog.
- Other combinations, accessories and consumables must only be used if they are specifically designed for the intended application and do not affect the system performance and the safety requirements.
- Maintenance and repairs must only be carried out by a qualified service agency at regular intervals.
- You must report the installation of a condensing gas boiler to the relevant gas and plumbing inspection authority and have it approved.
- You are only allowed to operate the condensing gas boiler with the combustion air/flue gas system that has been specifically designed and approved for this type of boiler.

#### You must also observe:

- The local building regulations stipulating the installation rules.
- The local building regulations concerning the air intake and outlet systems and the chimney connection.
- The regulations for the power supply connection.
- The technical rules laid down by the gas utility company concerning the connection of the gas connection to the local gas main.
- The instructions and standards concerning the safety equipment for the water/space heating system.
- The Installation instructions for building heating systems.
- The boiler must be located in an area where leakage of the heat exchanger or connections will not result in damage to the area adjacent to the boiler or to lower floors of the structure. When such locations cannot be avoided, it is recommended that a suitable drain pan, adequately drained, be installed under the boiler. The pan must not restrict combustion air flow.
- The boiler must be installed such that the gas ignition system components are protected from water (dripping, spraying, rain etc.) during boiler operation and circulator replacement, condensate trap, control replacement, etc.).
- The boiler must not be installed on carpeting.
- Do not restrict or seal any air intake or outlet openings.
- If you find any defects, you must inform the owner of the system of the defect and the associated hazard in writing.

**⚠ DANGER:** Flammable gas explodes. Beware if you smell gas: there may be an explosion hazard!

**⚠ WARNING:** RISK OF CARBON MONOXIDE POISONING OR FIRE DUE TO JOINT SEPARATION OR PIPE BREAKAGE. Ensure all of the venting system is properly supported and secured per these instructions, venting manufacturer's instructions and with the National Fuel Gas Code, ANSI Z223.1/NFPA 54, CAN/CSA B149.1, and/or applicable provisions of local building codes. Failure to do so may result in substantial property damage, severe personal injury or death.

**Observe these instructions as general warnings:**

- **RIELLO** recommends that an inhibitor – suitable for use with stainless steel heat exchangers – is used to protect the boiler and system from the effects of corrosion and/or electrolytic action. The inhibitor must be administered in strict accordance with the manufacturers instructions.
- When the boiler has been filled for the first time or the system has been drained and refilled, it will be necessary to purge any air that may have become trapped within the appliance heat exchanger.

**NOTE:** Propylene glycol in the system must not exceed 40%.

**Boiler water**

- If you have an old system with cast iron radiators, thoroughly flush the system (without the boiler connected) to remove sediment. The high-efficiency heat exchanger can be damaged by build-up or corrosion due to sediment
- Do not use petroleum-based cleaning or sealing compounds in the boiler system. Gaskets and seals in the system may be damaged. This can result in substantial property damage.
- Do not use "homemade cures" or "boiler patent medicines." Substantial property damage, damage to boiler, and/ or serious personal injury may result.
- Continual fresh make-up water will reduce boiler life. Mineral build up in heat exchanger reduces heat transfer, overheats the stainless steel heat exchanger, and causes failure. Addition of oxygen carried in by make-up water can cause internal corrosion in system components. Leaks in the boiler or piping must be repaired at once to prevent make-up water.
- We recommend the use of water treatment additives to prolong the life of the boiler and prevent against corrosion and contaminant build ups in the heating system.
- Ensure piping in the heating system has an oxygen barrier.

**Observe these instructions for space heating water:**

- Thoroughly flush the system prior to filling. Only use untreated potable water to fill and top off the system.
- Do not use water softeners in the system.
- When using oxygen-permeable pipes, e.g. for floor heating systems, you must separate the system using heat exchangers. Unsuitable heating system water promotes the formation of sludge and corrosion. This may damage the heat exchanger or affect its operation.

**Tools, materials and additional equipment**

For the installation and maintenance of the boiler you will need the standard tools for space heating, gas and water connection.

**Disposal:**

- Dispose of the boiler packaging in an environmentally sound manner.
- Dispose of components of the heating system (e. g. boiler or control device), that must be replaced, by taking them in to an authorized recycling facility.

**⚠ WARNING:** If the information in these instructions is not followed exactly, a fire or explosion may result causing property damage, personal injury or death.

**⚠ WARNING:** Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other boiler.

**⊖ WARNING:** Do not obstruct or restrict the vents in the room where the boiler is installed. Adequate ventilation is essential for correct combustion. Failure to comply may result in substantial property damage, severe personal injury or death.

**⊖ WARNING:** Do not expose the appliance to weather elements. It has been designed for indoor use only.

**⊖ CAUTION:** Do not switch off the appliance if the outdoor temperature may drop below 32°F (0°C) (freezing hazard).

**⊖ CAUTION:** Do not activate the boiler without adequate water in the heating system.

**⊖** Individuals without specific qualifications and skills shall not remove the boiler's casing.

**⊖** Individuals without specific qualifications and skills shall not remove the boiler's casing.

**⚠ NOTE:**

- Do not install a thermostatic flue gas damper downstream of the draft hood.
- Do not tamper with, remove, or attempt to repair a blocked vent switch.
- When replacing the blocked vent switch, install the new part in the original location.
- A blocked vent switch tripping more than once indicates a problem with the venting system or chimney which must be repaired immediately.
- Ensure none of the vent pipes and chimneys are damaged or blocked.
- Connect only one appliance to each venting system or chimney, unless using an approved cascade vent system listed in the section "Installation of the exhaust and air intake system".
- The venting system must not feed into or route through another exhaust flue.
- The venting system must be inspected annually. All parts that show any signs of damage or corrosion must be replaced.
- Never close off or reduce the size of the combustion air openings.
- The boiler must not be operated until any obstructions have been removed.

**⚠ NOTE:**

- Work on gas components may only be carried out by a qualified installer, service agency or gas supplier.
- Appliance installation, the connection of gas and vent piping, initial commissioning, electrical connections and service and maintenance must only be carried out qualified installer, service agency or gas supplier.

## 2 PRODUCT DESCRIPTION

### 2.1 Description of the appliance

The **Array AR SE** is a **condensing, pre-mixed thermal module consisting in a modulating thermal element.**

It's available in two models of power: 399.220 BTU/hr (117 kW) and 500.000 BTU/hr (146.5 kW).

Optimal combustion management supports high thermal efficiencies (Over 95%) and low polluting emissions.

The boiler is designed for sealed chamber operation.

The appliance in standard configuration is for indoor installation.

The appliance's key technical features are

- helicoidal heat exchanger with a double coil smooth stainless steel pipe, to guarantee good corrosion resistance and the option of operating with high  $\Delta t$ s (up to 72°F [40°C]), reducing system set-up times;
- maximum exhaust flue exit temperature 212°F [100°C];
- microprocessor management and control with self-diagnostics, shown by means of a display, and logging of main errors;
- Anti-Freeze function;
- pre-settings for room/heat demand thermostat for low and high temperature ranges;
- option to manage a CH circuit and a DHW circuit with storage tank;
- high-efficiency and high residual discharge head circulator;
- climate control function (available only when using the outdoor temperature sensor accessory).

### 2.2 Safety devices

All appliance functions are electronically controlled by a dual processor technology board.

Any malfunction results in the appliance being shut down and the automatic closure of the gas valve.

The following is installed on the CH water circuit:

- **Safety high-limit thermostat.**
- **Flow sensor** capable of monitoring the main heating circuit's flow on an ongoing basis and of stopping the appliance in the event of insufficient flow.
- **Temperature sensors** on supply and return lines that measure the temperature difference ( $\Delta t$ ) between input and output fluid and allow the boiler to fire when a demand is made.
- **Minimum Water Pressure Switch** (set to 7 psi/0.5 bar).
- **LWCO.**

The following is installed on the combustion circuit:

- **Gas solenoid** with pneumatic gas flow compensation depending on the suction line's air flow rate.
- **Ignition/detection electrode.**
- **Flue gas temperature sensor.**
- **Flue gas pressure switch**
- **Air pressure switch**
- **Condensate pressure switch**

**⚠ WARNING:** The triggering of safety devices indicates the malfunction of a potentially hazardous situation. Therefore, contact a service agency immediately. After a brief pause, it is possible to try and restart the appliance (see section "Initial startup").

**⚠ WARNING:** Safety devices must be replaced a qualified installer, service agency or gas supplier, using only original parts. Refer to the spare parts catalogue supplied with the appliance. After making the repair, check that the appliance is working properly.

**⚠ WARNING:** The appliance must not be put in service, even temporarily, when tampered safety devices are not in operation or have been with.

**⚠** A hot water boiler installed above the radiation level or as required by the Authority having jurisdiction, must be provided with a low water cutoff device either as part of the boiler or at the time of boiler installation.

### 2.3 Proper Use

- ▶ The **Array** boilers are designed for large residential, commercial and industrial applications.
- ▶ The **Array** boilers are delivered in compliance with CSD-1 Commercial applications.
- ▶ The appliance may only be installed in closed loop hot water central heating systems.
- ▶ Any other purpose is considered improper use. Any resulting damage is excluded from the manufacturer's warranty.
- ▶ In some heating applications like pool, spa or process water heating, a heat exchanger must be installed.

### 2.4 Environmental Responsibility / Disposal

Environmental responsibility is one of the fundamental company policies of the **RIELLO** Group.

We regard quality of performance, economy and environmental responsibility as equal objectives. Environmental protection laws and regulations are strictly adhered to.

To protect the environment, we use the best possible technology and materials while also taking into account economic points of view.

#### Packaging

All packaging materials used are environmentally-friendly and recyclable.

### 2.5 Emergency Shutdown

If overheating occurs or the gas supply fails to shut off, close the manual gas shutoff valve (Fig. 1) located external to the unit.

**NOTE:** The Installer must identify and indicate the location of the manual emergency shutoff valve.

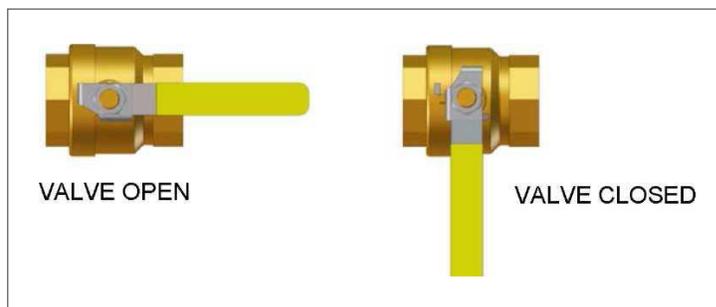


Fig. 1 Manual Gas Shutoff Valve

## 2.6 Prolonged Shutdown

After prolonged shutdown, the startup procedures and the safety device test procedures of this manual shall be performed to verify all system/operating parameters.

If there is an emergency, turn off the electrical power supply to the **RIELLO** boiler and close the manual gas valve located upstream of the unit. The installer must identify the emergency shut-off device.

### IMPORTANT – FOR MASSACHUSETTS INSTALLATIONS

Boiler Installations within the Commonwealth of Massachusetts must conform to the following requirements:

- Boiler must be installed by a plumber or a gas fitter who is licensed within the Commonwealth of Massachusetts.
- Prior to unit operation, the complete gas train and all connections must be leak tested using a non-corrosive soap.
- The vent termination must be located a minimum of 4 feet above grade level. If side wall venting is used, the installation must conform to the following requirements extracted from 248 CMR 5.08 (2):

(a) For all side wall horizontally vented gas fueled equipment installed in every dwelling, building or structure used in whole or in part for residential purposes, including those owned or operated by the Commonwealth and where the side wall exhaust vent termination is less than seven (7) feet above finished grade in the area of the venting, including but not limited to decks and porches, the following requirements shall be satisfied:

#### 1. INSTALLATION OF CARBON MONOXIDE DETECTORS

At the time of installation of the side wall horizontal vented gas fueled equipment, the installing plumber or gas fitter shall observe that a hard wired carbon monoxide detector with an alarm and battery back-up is installed on the floor level where the gas equipment is to be installed.

In addition, the installing plumber or gas fitter shall observe that a battery operated or hard wired carbon monoxide detector with an alarm is installed on each additional level of the dwelling, building, or structure served by the side wall horizontal vented gas fueled equipment. It shall be the responsibility of the property owner to secure the services of qualified licensed professionals for the installation of the hard wired carbon monoxide detectors.

- a. In the event that the side wall horizontally vented gas fueled equipment is installed in a crawl space or an attic, the hard wired carbon monoxide detector with alarm and battery back-up may be installed on the next adjacent floor level.
- b. In the event that the requirements of this subdivision cannot be met at the time of completion of installation, the owner shall have a period of thirty (30) days to comply with the above requirements; provided, however, that during said thirty (30) days period, a battery operated carbon monoxide detector with an alarm shall be installed.

#### 2. APPROVED CARBON MONOXIDE DETECTORS

Each carbon monoxide detector as required in accordance with the above provisions shall comply with NFPA 720 and be ANSI/UL 2034 listed and IAS certified.

#### 3. SIGNAGE

A metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight (8) feet above grade directly in line with the exhaust vent terminal for the horizontally vented gas fueled heating appliance or equipment.

The sign shall read, in print size no less than one-half (1/2) inch in size, **“GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS”**.

#### 4. INSPECTION

The state or local gas inspector of the side wall horizontally vented gas fueled equipment shall not approve the installation unless, upon inspection, the inspector observes carbon monoxide detectors and signage installed in accordance with the provisions of 248 CMR 5.08(2)(a)1 through 4.

#### (b) EXEMPTIONS:

The following equipment is exempt from 248 CMR 5.08(2)(a)1 through 4:

1. The equipment listed in Chapter 10 entitled “Equipment Not Required To Be Vented” in the most current edition of NFPA 54 as adopted by the Board; and
2. Product Approved side wall horizontally vented gas fueled equipment installed in a room or structure separate from the dwelling, building or structure used in whole or in part for residential purposes.

#### (c) MANUFACTURER REQUIREMENTS – GAS EQUIPMENT VENTING SYSTEM PROVIDED

When the manufacturer of Product Approved side wall horizontally vented gas equipment provides a venting system design or venting system components with the equipment, the instructions provided by the manufacturer for installation of the equipment and the venting system shall include:

1. Detailed instructions for the installation of the venting system design or the venting system components; and
2. A complete parts list for the venting system design or venting system.

#### (d) MANUFACTURER REQUIREMENTS – GAS EQUIPMENT VENTING SYSTEM NOT PROVIDED

When the manufacturer of a Product Approved side wall horizontally vented gas fueled equipment does not provide the parts for venting the flue gases, but identifies “special venting systems”, the following requirements shall be satisfied by the manufacturer:

1. The referenced “special venting system” instructions shall be included with the appliance or equipment installation instructions; and
2. The “special venting systems” shall be Product Approved by the Board, and the instructions for that system shall include a parts list and detailed installation instructions.

(e) A copy of all installation instructions for all Product Approved side wall horizontally vented gas fueled equipment, all venting instructions, all parts lists for venting instructions, and/or all venting design instructions shall remain with the appliance or equipment at the completion of the installation.

**[End of Extracted Information From 248 CMR 5.08 (2)]**

## 2.7 Identification

The products are identified by:

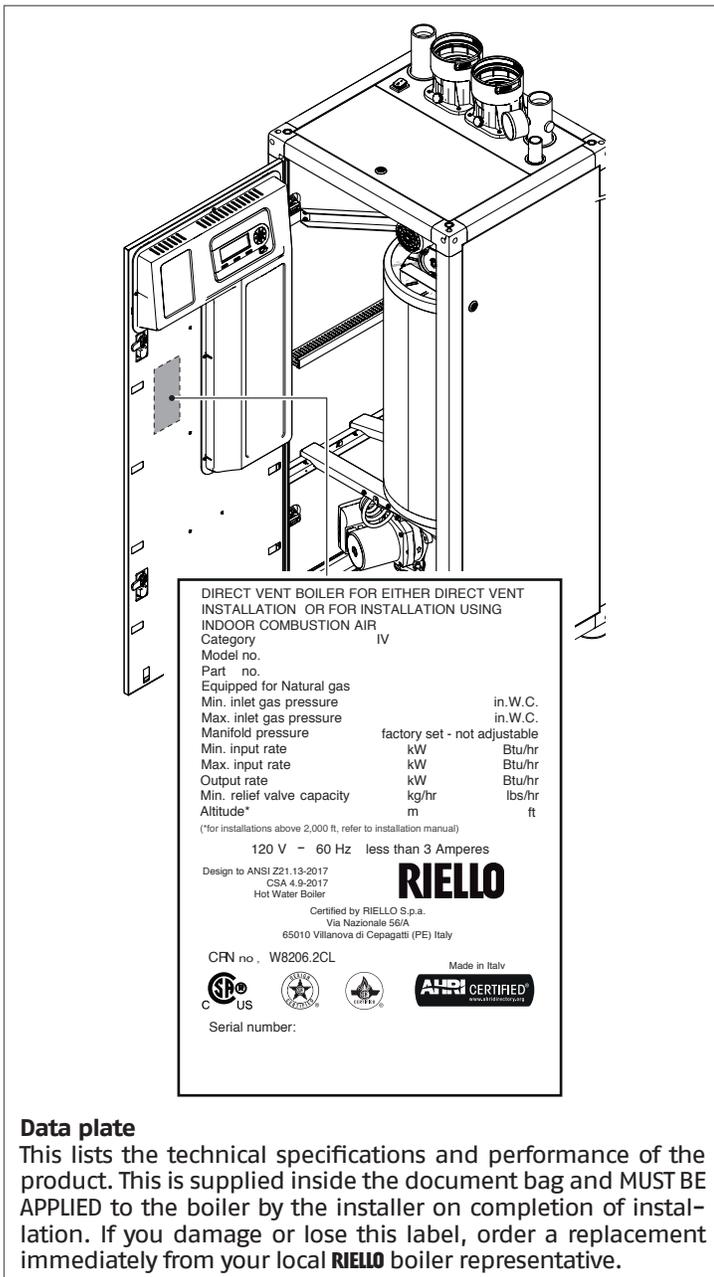


Fig. 2 Data plate

**⚠ NOTE:** If these plates or any other means clearly identifying the product are defaced, removed or lost, proper installation and servicing may be rendered difficult.

## 2.8 System layout

### Array AR SE

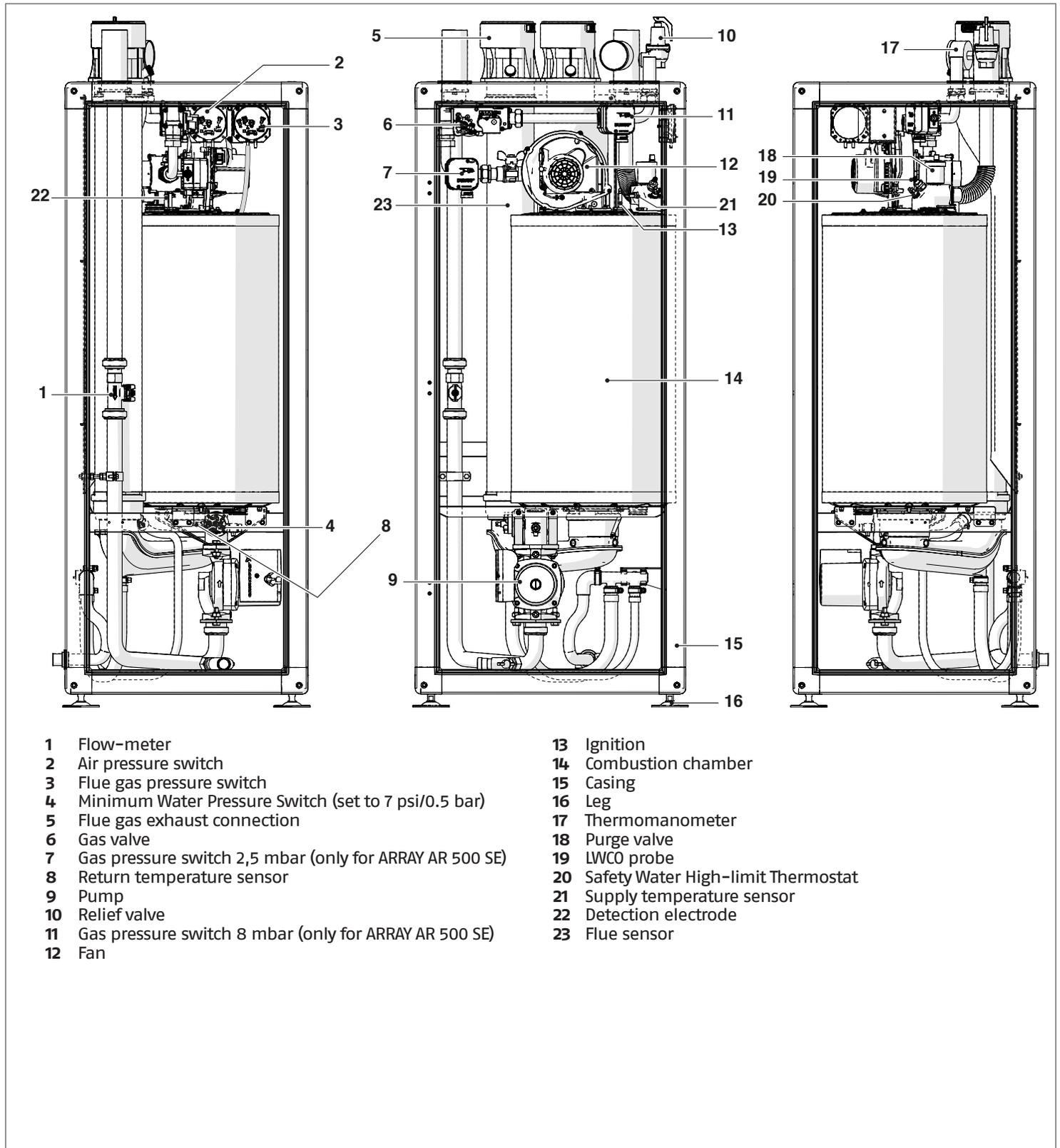


Fig. 3 System layout

## 2.9 Dimension

### Array AR SE

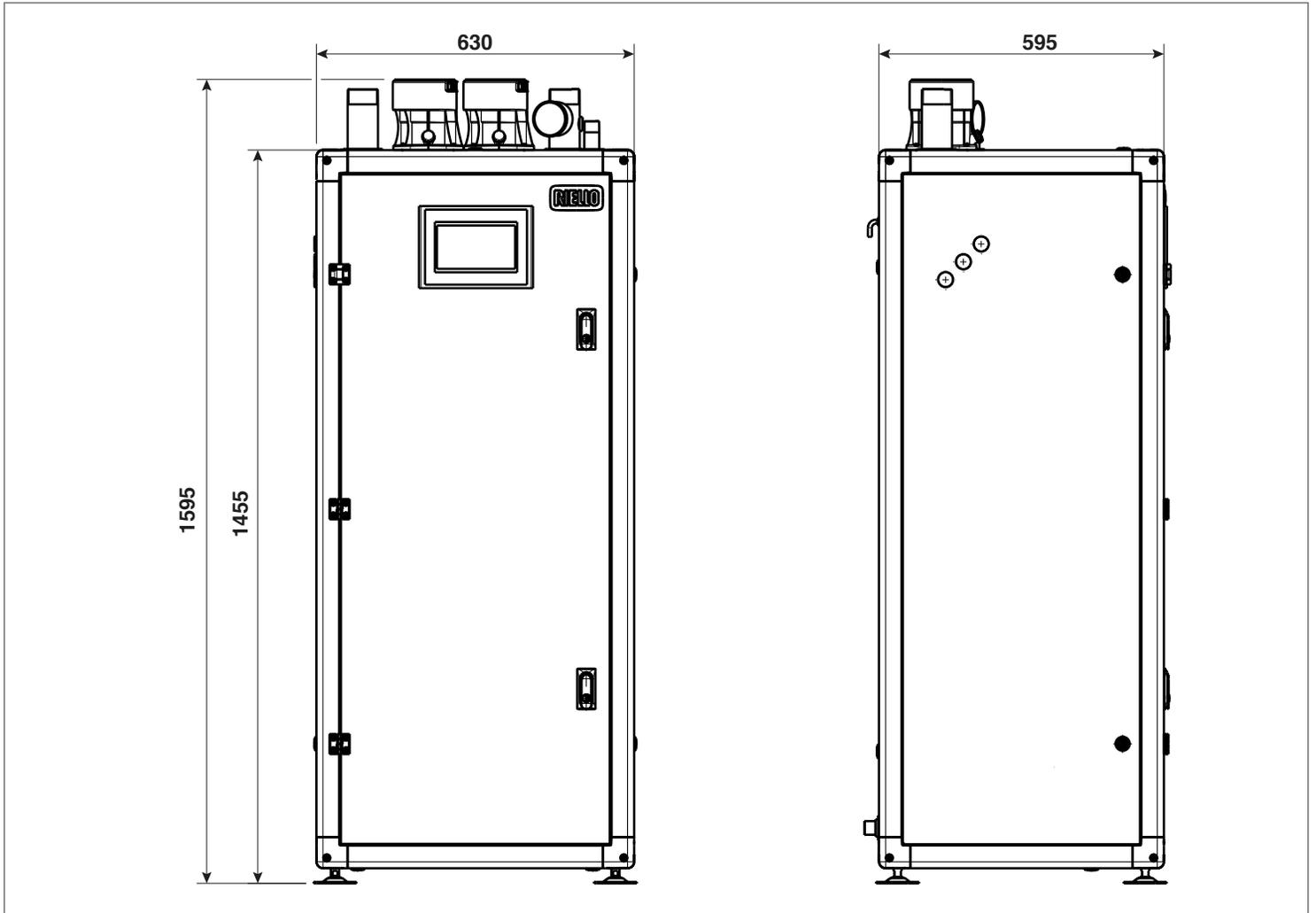


Fig. 4 Dimension

2.10 Technical specifications

	Unit	AR 399 SE	AR 500 SE
Boiler Category		ASME Sect.IV	
Type of Gas		Natural Gas, Propane*	
Max input rate	BTU/hr (kW)	399,220 (117)	500,000 (146.5)
Min input rate	BTU/hr (kW)	39,922 (11.7)	50,000 (14.6)
Turndown	Rate	10:1	10:1
Gas Connection (NPT)	Ø Inch	1"	1"
Max. NG Pressure	Inch w.c. (mbar)	13.5 (33.6)	13.5 (33.6)
Min. NG Pressure	Inch w.c. (mbar)	3.5 (8.7)	3.5 (8.7)
Max. LPG Pressure	Inch w.c. (mbar)	13.5 (33.6)	13.5 (33.6)
Min. LPG Pressure	Inch w.c. (mbar)	8 (19.9)	8 (19.9)
O <sub>2</sub> Operating Range (Natural Gas)	%	4.4 - 5.8	4.4 - 5.8
CO <sub>2</sub> Operating Range (Natural Gas)	%	8.5 - 9.5	8.5 - 9.5
Water Connections	Ø Inch	1" 1/2	2"
Condensate drain connection	inch (mm)	1" (25)	1" (25)
Max. Allowable Working Pressure (MAWP)	PSI (bar)	80 (5.5)	80 (5.5)
Relief Drain Connection (NPT)	Ø Inch (Ø mbar)	3/4" (75)	3/4" (75)
Water Volume	Gallon (liter)	4.5 (17)	6.0 (23)
Water flow at max power (ΔT 36°F / 20°C)	GPM (m <sup>3</sup> /h)	19.9 4.5	24.9 5.6
Water flow at max power (ΔT 45°F / 25°C)	GPM (m <sup>3</sup> /h)	15.9 3.6	19.9 4.5
Vent/Air Intake Connections	Ø Inch (Ø mm)	4" 110	4" 110
Vent Materials		CPVC, PP, Stainless Steel AL29-4C	
Max operating temperature	°F (°C)	194 (90)	194 (90)
Max HE allowable temperature	°F (°C)	210 (98.9)	210 (98.9)
Ambient storage temperature	°F (°C)	5 to 158 (-15 to 70)	5 to 158 (-15 to 70)
Ambient functioning temperature	°F (°C)	32 to 120 (0 to 49)	32 to 120 (0 to 49)
Surface heat exchanger per module	SQFT (m <sup>2</sup> )	27 (2.5)	43 (4)
Standard Listings & Approvals		ETL, ASME, AHRI, CSD-1, SCAQMD	
Electrical Req.		120V/1Ph/60Hz / 6.0 FLA**	120V/1Ph/60Hz /7.5 FLA**
Weight (dry)	lbs (kg)	240 (109)	269 (122)
Dimension W x H x D	Inch (mm)	24.8x22.2x62.6 (630x1595x595)	24.8x22.2x62.6 (630x1595x595)

(\*) For propane fuel applications, please contact factory.

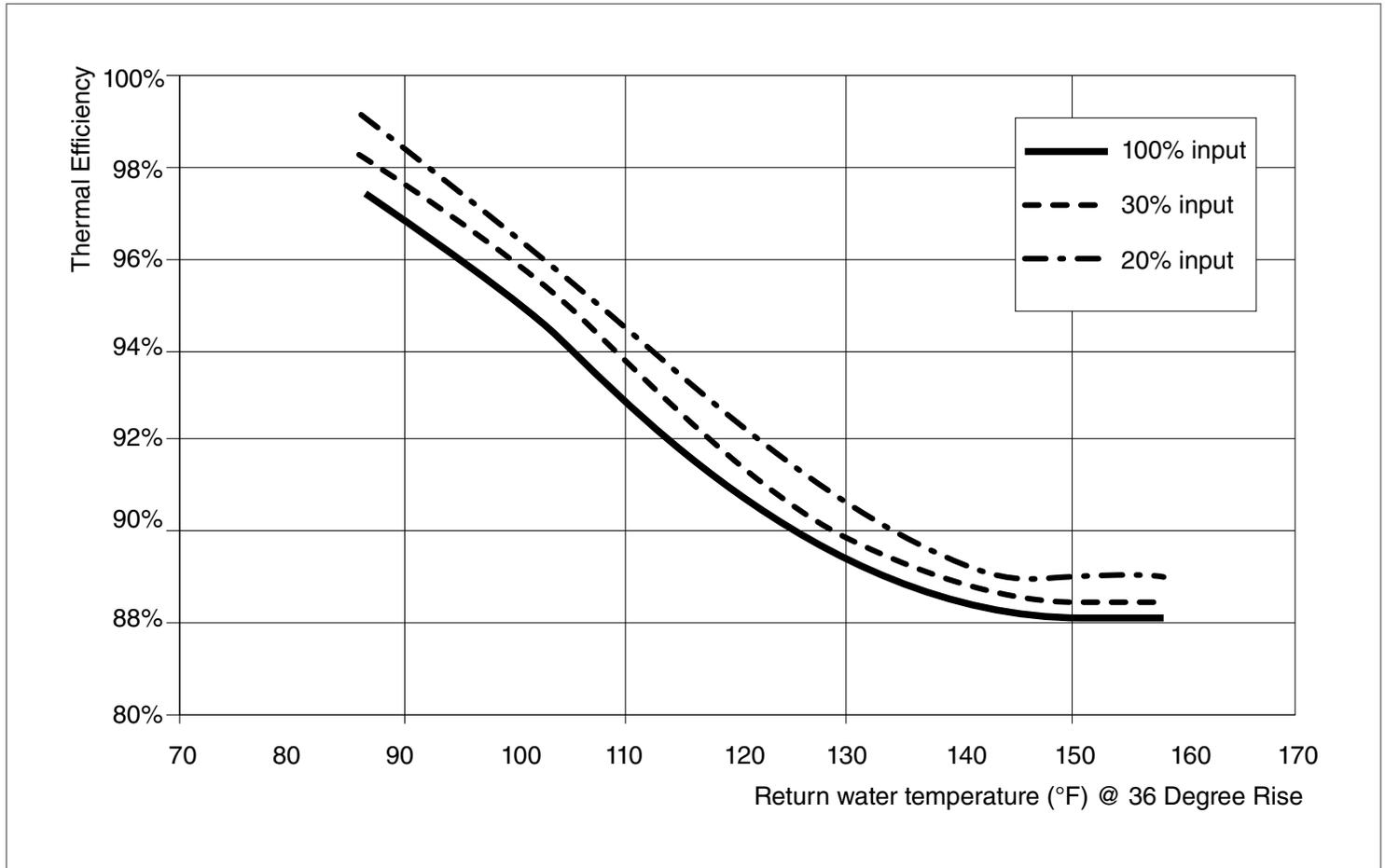
(\*\*) FLA (Full Load Amperage) – maximum current drawn by the boiler if all pumps reach rated horsepower

(\*\*\*) Mounting feet may be removed during installation to reduce the overall height by 2". Feet must be re-installed once boiler is in its final installation location.

AHRI certified ratings	Unit	AR 399 SE	AR 500 SE
Input	MBH	399.2	500.00
Heating Capacity	MBH	383.00	481.00
AFUE	%	96,1	96,1
Combustion Efficiency	%	96,1	96,1
CO2	%	8.5 – 9.5	8.5 – 9.5

## 2.11 Efficiency Curves

### ARRAY AR 399 SE – 500 SE



## 2.12 Pumps

The **Array AR 399 SE** and **Array AR 500 SE** are equipped with a built-in circulator with integrated check valve.

**⚠ CAUTION:** During the first start-up, and at least once a year, the rotation of the circulator shaft should be checked as, especially after long periods of not being operated, deposits and/or residuals could impede its free rotation.

**⚠ CAUTION:** Before loosening or removing the circulator cap, protect the electric devices located underneath from any water that exits.

**⊘ STOP:** It is prohibited to operate the circulators without water.

## 2.13 Water circuit

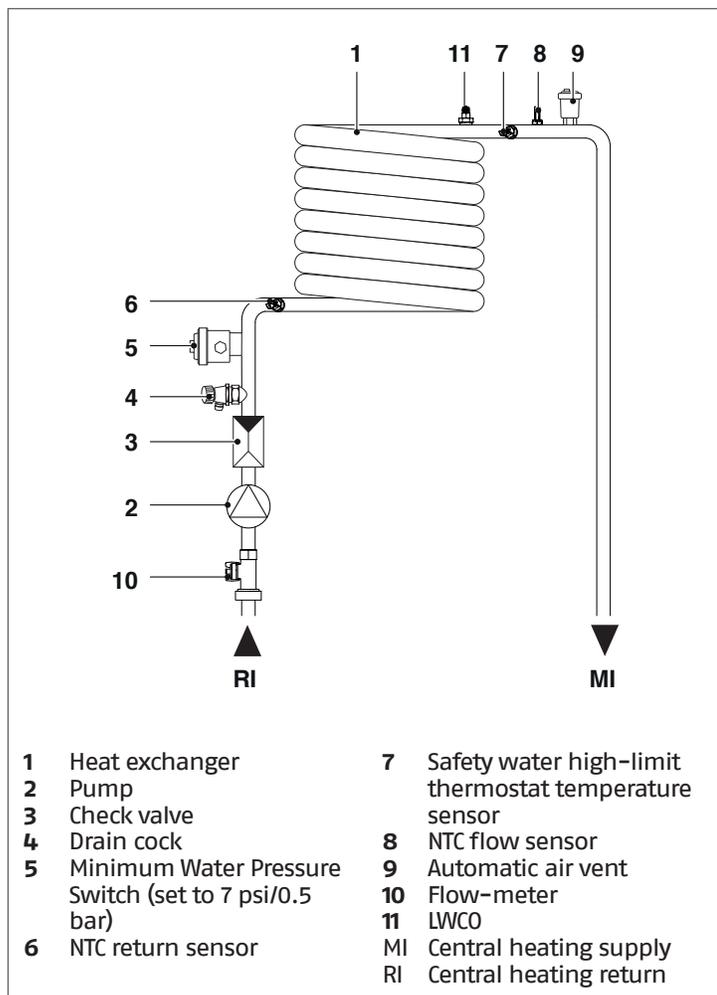


Fig. 5 Water circuit

## 2.14 Positioning of the temperature sensors

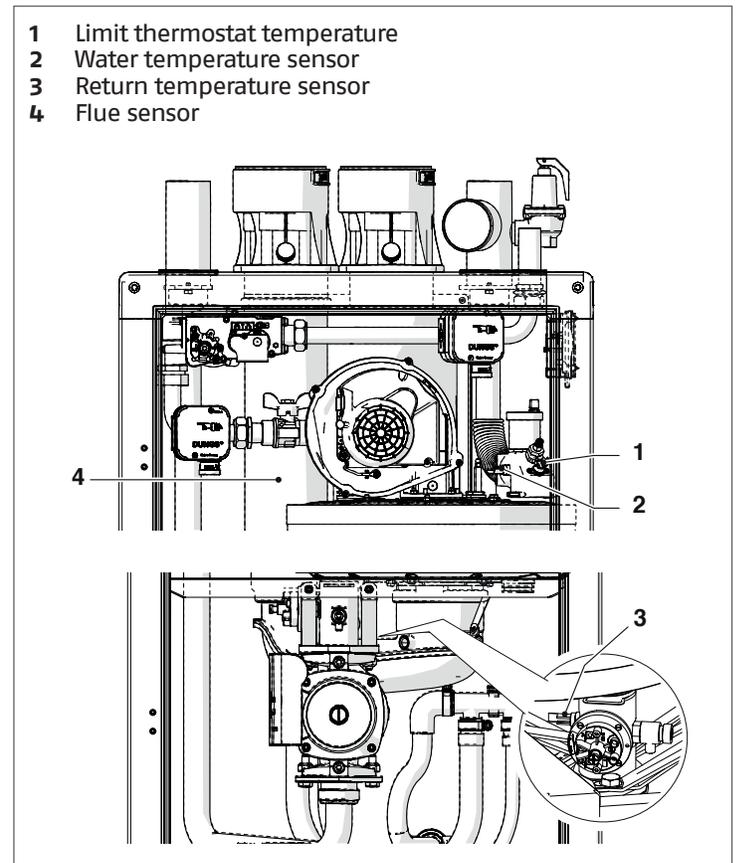


Fig. 6 Positioning of the temperature sensor

WATER PRESSURE DROP ARRAY AR 399 SE

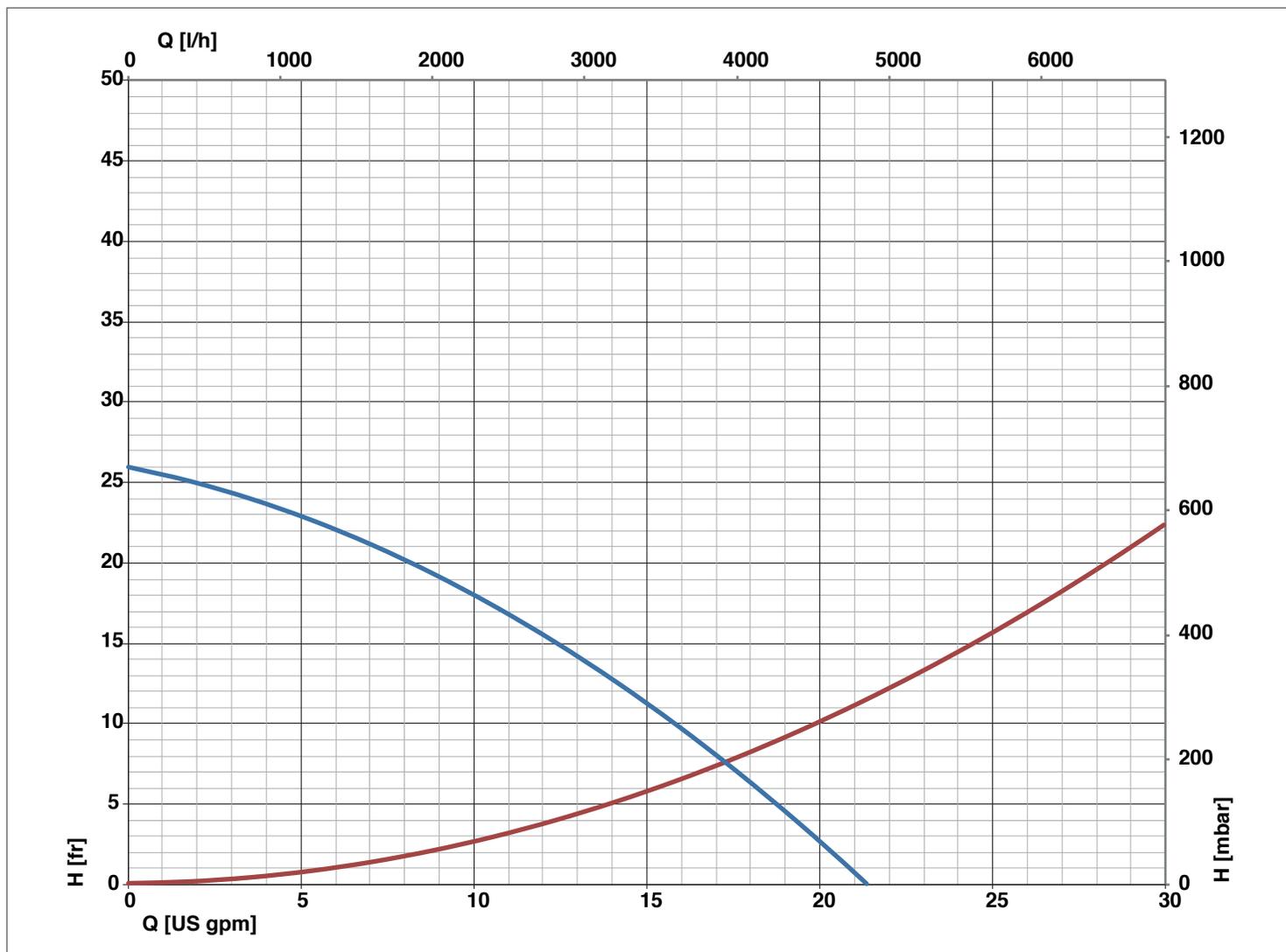


Fig. 7 Water pressure drop Array AR 399 SE

WATER PRESSURE DROP ARRAY AR 500 SE

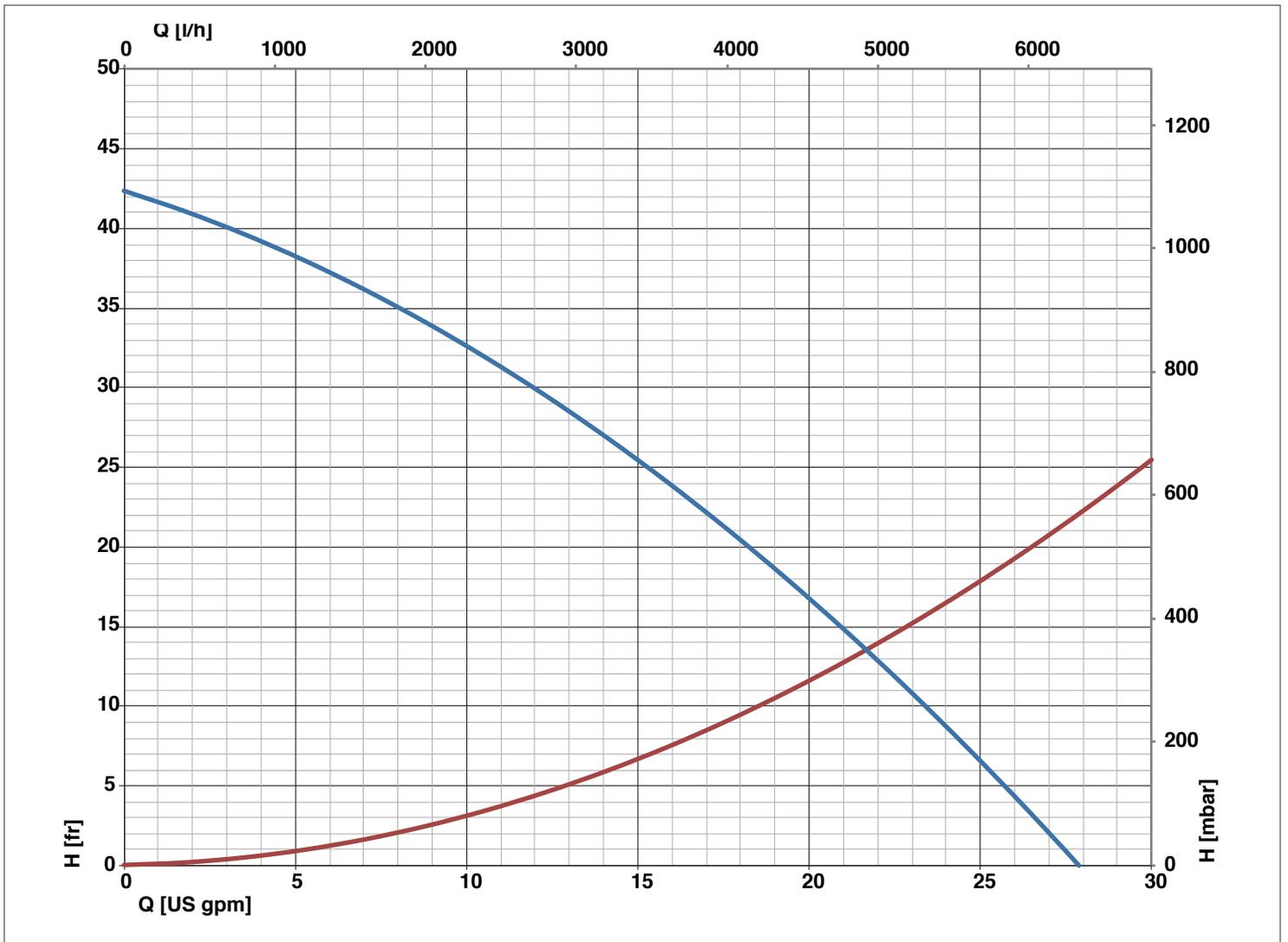


Fig. 8 Water pressure drop Array AR 500 SE

## 2.15 Service panel

### CONTROL PANEL AND SYMBOLS

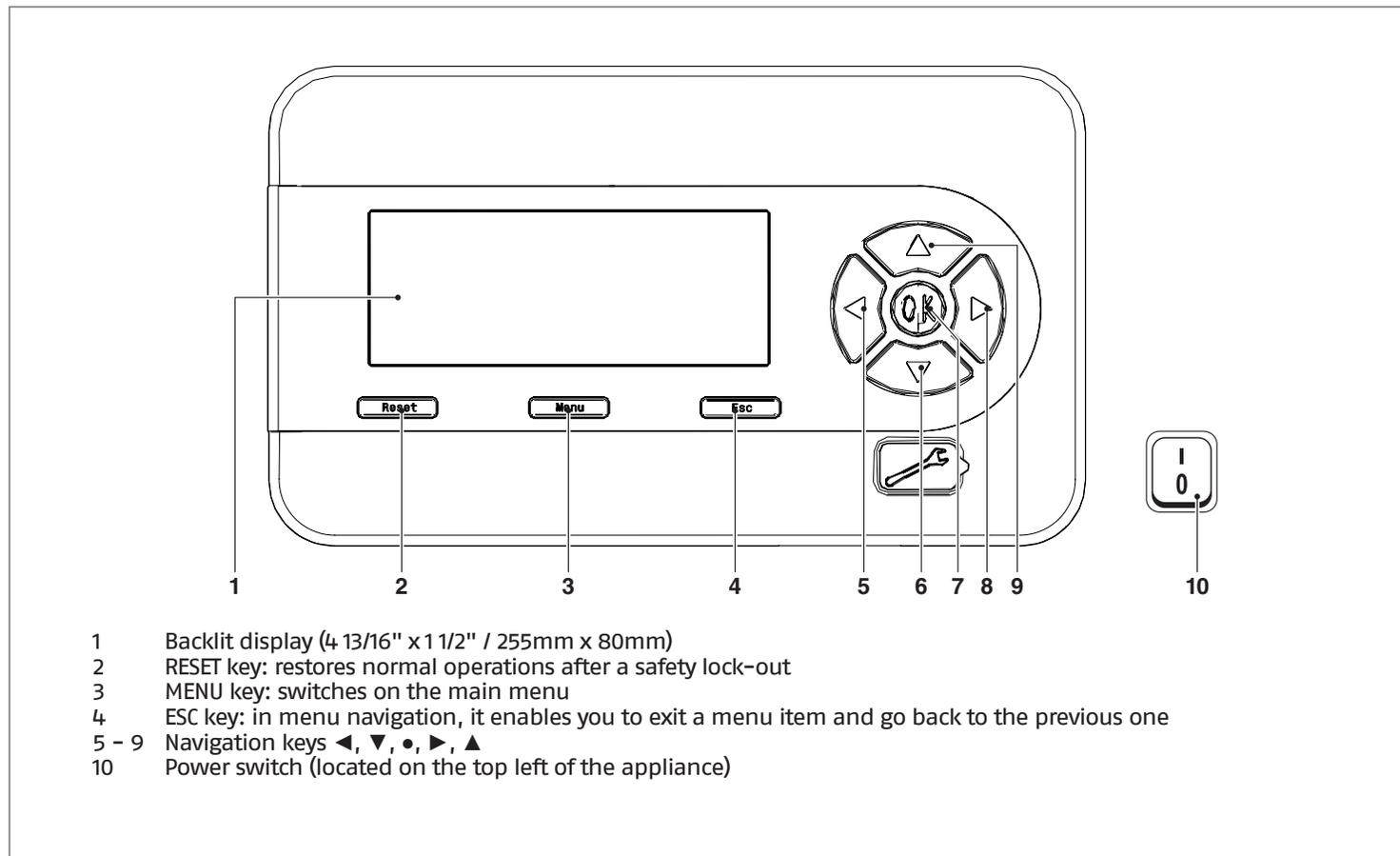


Fig. 9 Control panel

### SECONDARY INFORMATION/DISPLAY VISUALISATION

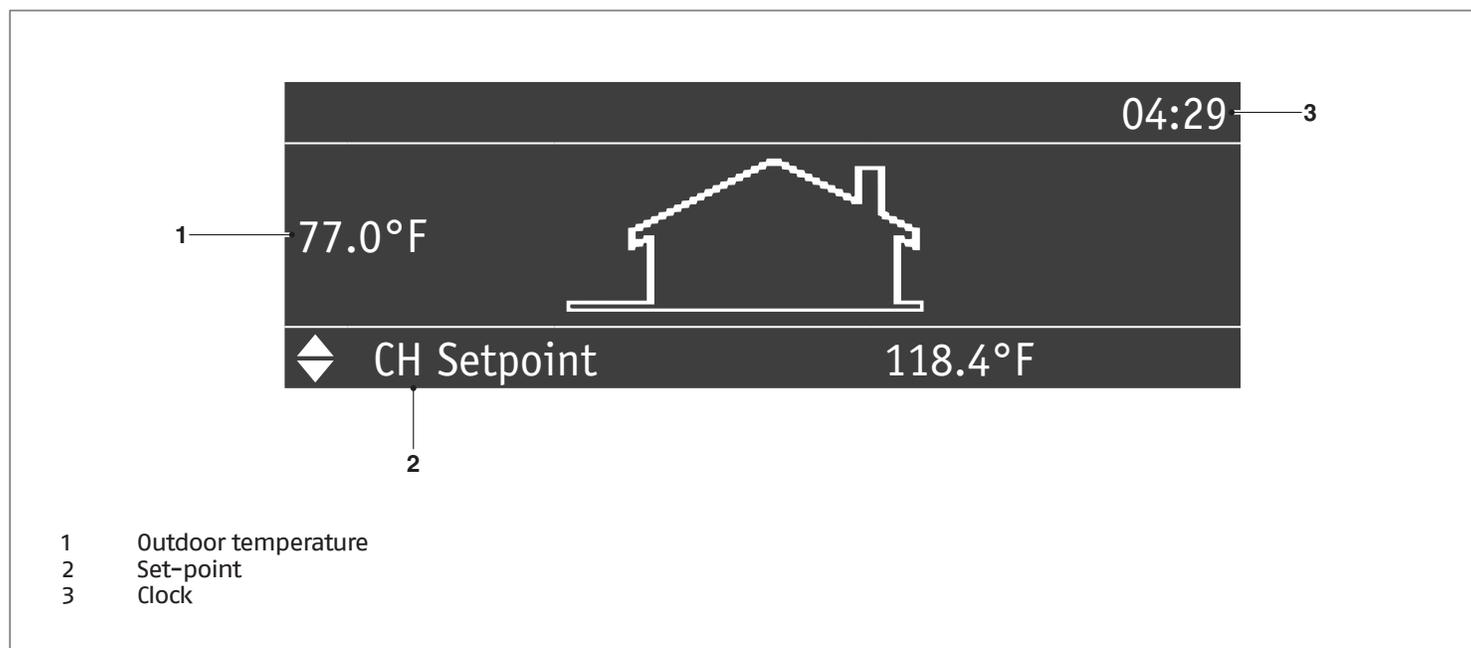


Fig. 10 Display visualisation

## 2.16 Regulations and Guidelines

**⚠ NOTE:** Observe all rules, regulations, standards and guidelines applicable to the installation and operation of this appliance in your country.

**⚠ NOTE:** Valves external to the boiler must be fitted with T-handles and condensate piping must be installed in accordance with the local plumbing code.

### 2.16.1 Compliance with standards and regulations

The installation must conform to the requirements of the authority having jurisdiction or, in the absence of such requirements, to the latest edition of the National Fuel Gas Code, ANSI Z223.1/NFPA 54, and/or Natural Gas and Propane Installation Code, CAN/CSA B149.1. This condensing gas boiler complies in its design and mode of operation with the American National Standard ANSI Z21.13/CSA 4.9, latest edition for Gas Fired Low Pressure Steam and Hot Water Boilers.

Other confirmed approvals and certifications are indicated by labels on the boiler.

Where required by the authority having jurisdiction, the installation must conform to the Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1.

Install CO detectors per local regulations. The use of a carbon monoxide detector in conjunction with the **RIELLO** heating products is required. When installing a carbon monoxide detector, the manufacturer's instructions of the carbon monoxide detector must be followed in their entirety. It is recommended to use a carbon monoxide detector in compliance with a nationally recognized standard such as ANSI/UL 2034-2002 in the United States and CSA 6.19-01 in Canada. Boiler requires yearly maintenance (see section "Maintenance")

### 2.16.2 Operating limits of the boiler

The heat exchanger has been designed and certified in accordance with the ASME Boiler and Pressure Vessel Code, Section IV.

The hot water distribution system must comply with all applicable codes and regulations. When replacing an existing boiler, it is important to check the condition of the entire hot water heating distribution system to ensure safe operation. Common practice calls for inspecting an existing system in its entirety and bringing it up to code. All pipework should be properly cleaned and flushed.

### 2.16.3 Additional regulations for installations in the Commonwealth of Massachusetts

**a)** For all side wall horizontally vented gas fueled equipment installed in every dwelling, building or structure used in whole or in part for residential purposes, including those owned or operated by the Commonwealth and where the side wall exhaust vent termination is less than seven (7) feet above finished grade in the area of the venting, including but not limited to decks and porches, the following requirements shall be satisfied:

**INSTALLATION OF CARBON MONOXIDE DETECTORS:** At the time of installation of the side wall horizontal vented gas fueled equipment, the installing plumber or gasfitter shall observe that a hard wired carbon monoxide detector with an alarm and battery back-up is installed on the floor level where the gas equipment is to be installed. In addition, the installing plumber or gasfitter shall observe that a battery operated or hard wired carbon monoxide detector with an alarm is installed on each additional level of the dwelling, building or structure served by the side wall horizontal vented gas fueled equipment. It shall be the responsibility of the property owner to secure the services of qualified licensed professionals for the installation of hard wired carbon monoxide detectors.

- In the event that the side wall horizontally vented gas fu-

eled equipment is installed in a crawl space or an attic, the hard wired carbon monoxide detector with alarm and battery back-up may be installed on the next adjacent floor level.

- In the event that the requirements of this subdivision cannot be met at the time of completion of installation, the owner shall have a period of thirty (30) days to comply with the above requirements; provided, however, that during said thirty (30) day period, a battery operated carbon monoxide detector with an alarm shall be installed.

**APPROVED CARBON MONOXIDE DETECTORS:** Each carbon monoxide detector as required in accordance with the above provisions shall comply with NFPA 720 and be ANSI/UL 2034 listed and IAS certified.

**SIGNAGE:** A metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight (8) feet above grade directly in line with the exhaust vent terminal for the horizontally vented gas fueled heating appliance or equipment.

The sign shall read, in print size no less than one-half (1/2) inch in size, "GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS".

**INSPECTION:** The state or local gas inspector of the side wall horizontally vented gas fueled equipment shall not approve the installation unless, upon inspections, the inspector observes carbon monoxide detectors and signage installed in accordance with the provisions of 248 CRM 5.08(2)(a) 1 through 4.

**b) EXEMPTIONS:** The following equipment is exempt from 248 CRM 5.08(2)(a) 1 through 4:

- The equipment listed in Section 10 entitled "Equipment Not Required To Be Vented" in the most current edition of NFPA 54 as adopted by the board;
- Product Approved side wall horizontally vented gas fueled equipment installed in a room or structure separate from the dwelling, building or structure used in whole or in part for residential purposes.

**c) MANUFACTURERS REQUIREMENTS – GAS EQUIPMENT VENTING SYSTEM REQUIRED:** When the manufacturer of Product Approved side wall horizontally mounted gas equipment provides a venting system design or venting system components with the equipment, the instructions provided by the manufacturer for the installation of the equipment and venting shall include:

- Detailed instructions for the installation of the venting system or the venting system components;
- A complete parts list for the venting system design or venting system.

**d) MANUFACTURERS REQUIREMENTS – GAS EQUIPMENT VENTING SYSTEM NOT PROVIDED:** When the manufacturer of Product Approved side wall horizontally vented gas fueled equipment does not provide the parts for the venting of flue gases, but identifies "special venting systems", the following requirements shall be satisfied by the manufacturer:

- The referenced "special venting systems" shall be included with the appliance or equipment installation instructions;
- The "special venting systems" shall be Product Approved by the Board and the instructions for that system shall include a parts list and detailed installation instructions.

**e)** A copy of all instructions for all Product Approved side wall horizontally vented gas fueled equipment, all venting instructions, all parts lists for venting instructions and/or venting design instructions shall remain with the appliance or equipment at the completion of the installation.

### 3 INSTALLATION

#### 3.1 Introduction

This Chapter provides the descriptions and procedures necessary to unpack, inspect and install the **RIELLO Array Boiler Model AR 399 SE – AR 500 SE**.

#### 3.2 Receiving the Unit

Each **Array** Boiler System is shipped as a single crated unit. The unit must be moved with the proper lifting equipment for safety and to avoid equipment damage. The unit should be completely inspected for evidence of shipping damage and shipment completeness at the time of receipt from the carrier and before the bill of lading is signed.

**NOTE: RIELLO** is not responsible for lost or damaged freight. Any visual damage to the packaging materials must be reported to the delivering carrier.

#### 3.3 Unpacking

Carefully unpack the unit, pay particular attention not to damage the unit enclosure when cutting away packaging materials. After unpacking, a close inspection of the unit should be made to ensure that there is no evidence of damage. The freight carrier should be notified immediately if any damage is detected.

The following accessories come standard with each unit and are either packed separately within the unit's shipping container or are factory installed on the unit:

- Pressure/Temperature Gauge
- ASME Pressure Relief Valve

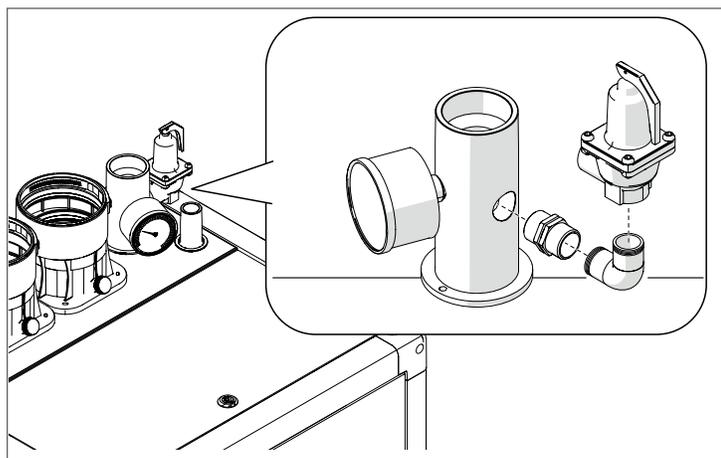


Fig. 11 ASME Pressure Relief Valve

When optional accessories are ordered, they may be packed within the unit's shipping container, factory installed on the unit, or packed and shipped in a separate container. Any standard or optional accessories shipped loose should be identified and stored in a safe place until ready for installation or use.

#### 3.4 Site Preparation

Ensure that the site selected for installation of the **Array AR SE** Boiler includes:

- Access to AC Input Power at 120VAC, single phase, 60Hz
- Access to Natural Gas line at a recommended minimum pressure of 8 inches w.c. for 399.220 BTU/hr (117 kW) for **Array AR 399 SE** and 500.000 BTU/hr (146.5 kW) for **Array AR 500 SE**.
- The boilers should be mounted on a concrete service/housekeeping pad 3,5-4" in height.
- The boiler should be located close to a floor drain in an area where leakage from the appliance or connections will not cause damage to the adjacent area or lower floor levels in the building.

#### 3.5 Installation premises

The **Array AR SE** can be installed in rooms that are permanently ventilated and equipped with suitably sized ventilation openings in line with Technical Standards and Regulations applicable to the installation site.

**⚠ WARNING:** When installing the boiler, allow sufficient space around it to access all safety and control devices and to permit easy maintenance.

**⚠ WARNING:** Check that the electric protection level of the appliance is suitable for features of the room where it is installed.

**⚠ WARNING:** Make sure that comburent air is not contaminated by substances containing chlorine or fluorine (elements found in sprays, paints, detergents etc.).

**⊘ STOP:** Do not obstruct or restrict the air vents in the room where the boiler is installed. A free air supply is essential for correct combustion.

**⊘ STOP:** It is forbidden to leave flammable containers and substances in the room where the boiler is installed.

#### 3.5.1 Installation clearances

The **Array** model **AR 399 SE – AR 500 SE** are packaged in an enclosure having identical footprint but different height. The unit must be installed with the prescribed clearances for service. The minimum clearance dimensions, required by **RIELLO**, are listed below.

However, if Local Building Codes require additional clearances, these codes shall supersede **RIELLO's** requirements.

Recommended minimum clearances for installation and servicing:

- Sides: 10 inches
- Front: 40 inches
- Rear: 5 inches
- Top: 20 inches

The minimum surface of ventilation openings is 3.2ft<sup>2</sup> (0.3m<sup>2</sup>) for gas fuel heating systems.

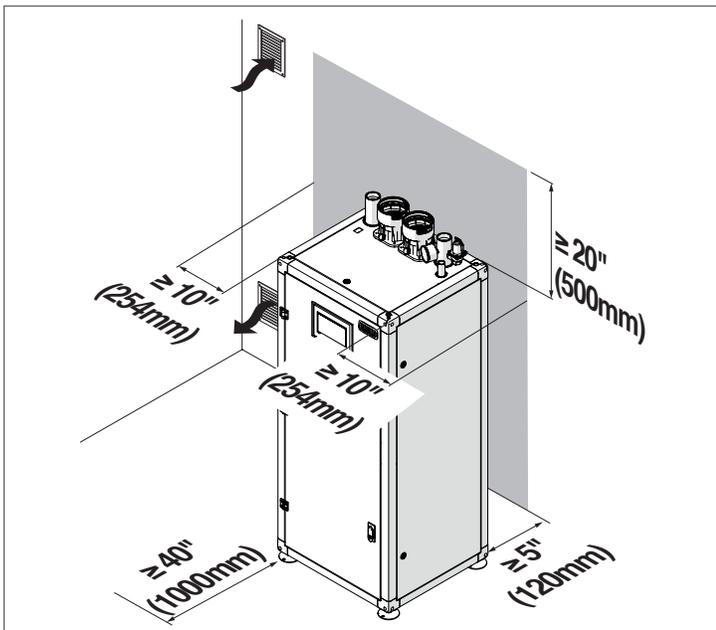


Fig. 12 Clearances (dimensions in inches [mm])

All gas piping, water piping and electrical conduit or cable must be arranged so that they do not interfere with the removal of any panels, or inhibit service or maintenance of the unit.

**⚠ WARNING:** Keep the unit area clear and free from all combustible materials and flammable vapors or liquids.

**⚠ CAUTION:** While packaged in the shipping container, the unit must be moved by pallet jack or forklift from the SIDE ONLY.

**FOR MASSACHUSETTS ONLY:**

For Massachusetts installations, the unit must be installed by a plumber or gasfitter licensed within the Commonwealth of Massachusetts. In addition, the installation must comply with all requirements specified in Warning & Cautions page 5 See pages 8 and 17 for additional details.

**3.5.2 Setting the Unit**

Remove the top and side cardboard panels, the plastic film and the polystyrene sheets. Remove the lag screws securing the unit to the shipping skid. Lift the unit off the shipping skid with a forklift and position it on the floor in the desired location.

**⚠ WARNING:** When lifting or moving the boiler: do not attempt to manipulate the boiler using the top water flanges or any other component of the boiler.

**⚠ WARNING:** When lifting or moving the boiler with a forklift: make sure the forks are longer than the boiler size (width or depth) so that the lifting forks stick out as Fig. 13.

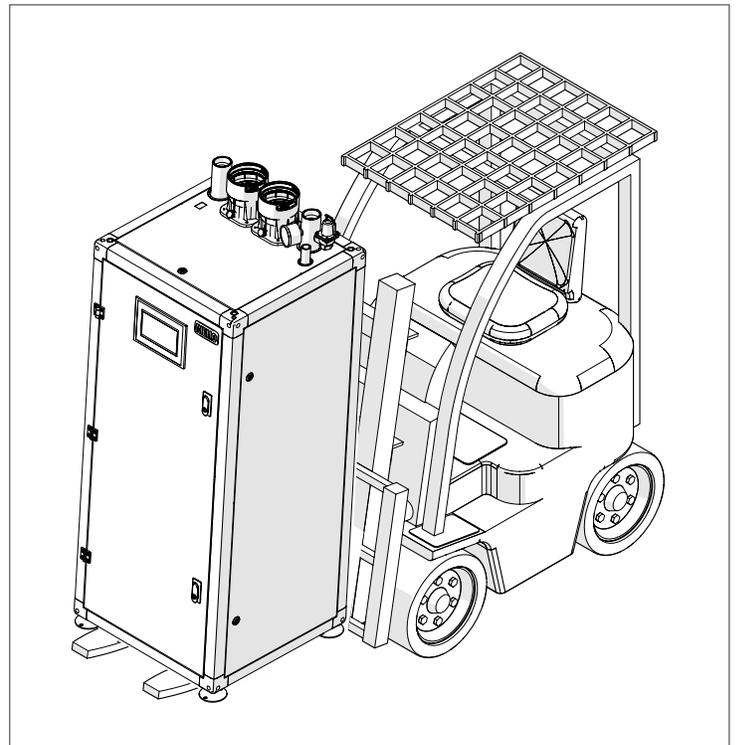


Fig. 13 Forklift Handling

If a crane is required, the boiler must be lifted through bands.

**⚠ WARNING:** When lifting the boiler with crane: use bands or straps, no chains. Bands must comply with federal, state and local rules. .

In multiple unit installations, it is important to plan the position of each unit in advance. Sufficient space for piping connections and future service/maintenance requirements must also be taken into consideration. All piping must include ample provisions for expansion.

The unit must be installed on a concrete service pad (3.5" - 4" height), with no gradient in any direction, to ensure proper condensate and water drainage (see Fig. 14). If anchoring the unit refer to Fig. 15 and Fig. 16 for anchor locations.

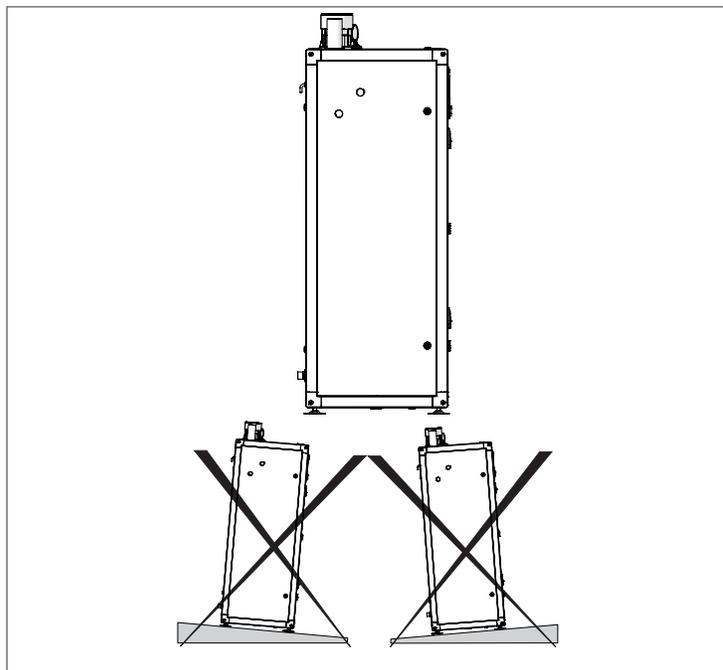


Fig. 14 Installation

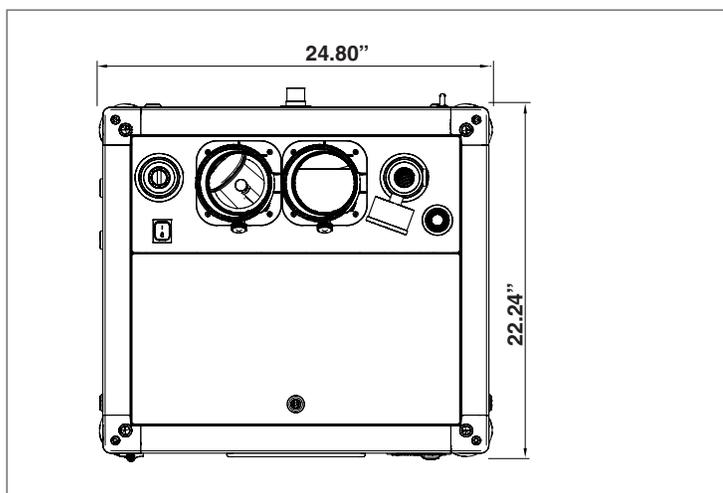


Fig. 15 Array AR SE

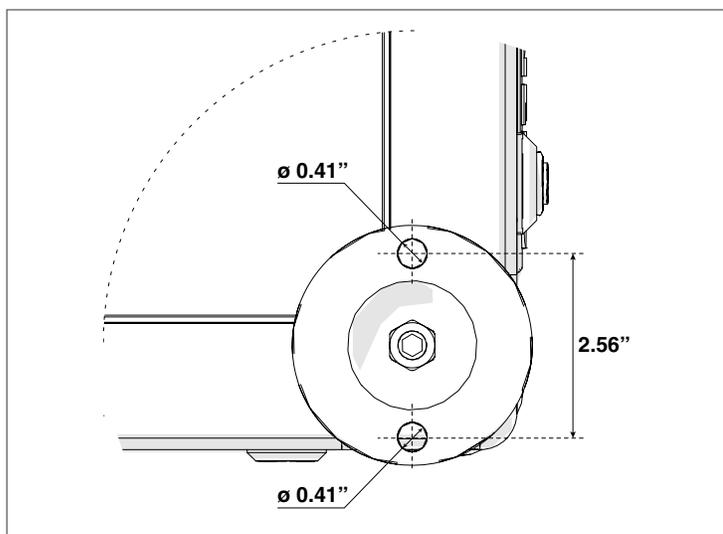


Fig. 16 Anchoring bolt detail

### 3.6 Installation in older systems and systems requiring modifications

When installing these boilers in older systems or systems requiring modifications, always perform the following checks:

- Make sure that the flue is able to withstand the temperature of the combustion gases and that it has been designed and made in compliance with applicable standards. The flue must also be as straight as possible, sealed, insulated and not blocked or choked. See section "Combustion gas exhaust" for any additional information.
- Make sure that the electrical supply system has been installed by a qualified electrician in compliance with applicable standards
- Make sure that the fuel feed line and any storage tank are made and installed in compliance with applicable standards
- Make sure that expansion tank(s) are big enough to contain the additional volume generated by thermal expansion
- Make sure that the flow rate, head and direction of flow of the pumps are suitable and correct
- The system has been washed, cleaned of mud and grime and water seals have been checked
- A treatment system is fitted when the supply/refill water has values other than those indicated in section "Water Chemistry Guidelines"

**⚠ NOTE:** The manufacturer declines all responsibility for damage caused by incorrectly constructed flue systems.

### 3.7 Boiler Location

- This boiler is suitable only for indoor installations.
- To operate properly and safely, this boiler requires a continuous supply of air for combustion. Install this boiler in a clean, dry location with adequate air supply.
- Do not locate this boiler in an area where it will be subject to freezing.
- The boiler should be located close to a floor drain in an area where leakage from the appliance or connections will not result in damage to the adjacent area or to lower floors in the structure.
- DO NOT install this appliance in any location where gasoline or flammable vapors are likely to be present.
- DO NOT install this appliance on top of carpet or combustible flooring.
- Appliance must be installed on a concrete level service pad (3.5" - 4" minimum recommended height).
- Maintain required clearances 2" (50.8mm) from combustible surfaces.

### 3.8 Water Quality Guidelines

Excessive water hardness causing a lime buildup in the stainless steel coils or tubes is not a fault of the appliance and is not covered by warranty. Water hardness must fall within the following limits:

Parameters	Units	Value
General feature -		Colorless, no sediment
PH value	PH	Min 6.5; Max 9
Dissolved Oxygen	mg/l	< 0,05
Total iron (Fe)	mg/l	< 0,3
Total copper (Cu)	mg/l	< 0,1
Na <sub>2</sub> SO <sub>3</sub>	mg/l	< 10
N <sub>2</sub> H <sub>4</sub>	mg/l	< 3
PO <sub>4</sub>	mg/l	< 15

Parameters	Units	Value
CaCO <sub>3</sub>	ppm	Min 50 ; Max 150
Trisodium Phosphate	ppm	absent
Chlorine	ppm	< 100
Pressure	PSI	Min 7.25; Max 80
Glycol	%	Max 50% (only propylene glycol)

- Avoid an automatic water fill system.
- Use only untreated water to fill the system.
- Do not use TSP (tri-sodium phosphate)
- Do not use fill water treated with salt bedding type exchangers (ion exchanger).
- Consult a local water treatment specialist for recommendations if any of the above table is outside the stated ranges.
- When using oxygen permeable PEX, the system must be separated from the boiler by a heat exchanger.
- A correctly sized and working expansion vessel must be installed.
- Excessive flow can cause erosion damage to the heat exchanger.

**⚠ CAUTION:** For freeze protection use only propylene glycol, with scale inhibitors, with a maximum volume [concentration] of 50% of glycol. Frost protection and inhibitor level has to be checked annually during the regular scheduled maintenance of the condensing boiler.

**⚠ CAUTION:** The boiler, when used in connection with a refrigeration system, must be installed so the chilled medium is piped in parallel with the boiler with appropriate valves to prevent the chilled medium from entering the boiler.

**⚠ CAUTION:** The boiler piping system of a hot water boiler connected to heating coils located in air handling units where they may be exposed to refrigerated air circulation must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle. A minimum water pressure is required for optimum performance. Minimum water pressure required: 7.25 psi (0.5 bar).

### 3.9 ASME pressure relief valve

The **Array AR SE** has a pressure relief valve supplied with the boiler. Connect the valve hydraulically on the heating supply connection and in vertical position. This device is designed for emergency safety relief and shall not be used as an operating control.

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

- The discharge line must be connected to relief valve outlet and run to a safe place of disposal. Terminate the discharge line in a manner that will prevent possibility of severe burns or property damage.
- The discharge line must be as short as possible and be the same size as the valve discharge connection throughout its entire length.
- The discharge line must pitch downward from the valve and terminate at least 6" (152 mm) above the floor drain where any discharge will be clearly visible.
- The discharge line shall terminate through plain (unthreaded) pipe. The discharge line material must conform to local plumbing code or A.S.M.E. requirements.
- No shutoff valve shall be installed between the relief valve and the boiler, or in the discharge line.
- Do not pipe the discharge to any place where freezing could occur.
- Do not plug or place any obstruction in the discharge line.
- Test the operation of the valve after filling and pressurizing

system by lifting the lever. Make sure the valve discharges freely. If the valve fails to operate correctly, replace it with a new relief valve.

- For boilers installed with only a pressure relief valve, the indirect tank (if used) must have a temperature and pressure relief valve installed. This relief valve shall comply with the standard for Relief Valves for Hot Water Supply Systems, ANSI Z21.22/CSA4.4.
- Failure to comply with the above guidelines could result in the failure of the relief valve to operate, resulting in the possibility of severe personal injury, death or substantial property damage.
- For safe operation of the appliance, the relief valve must not be removed or plugged.

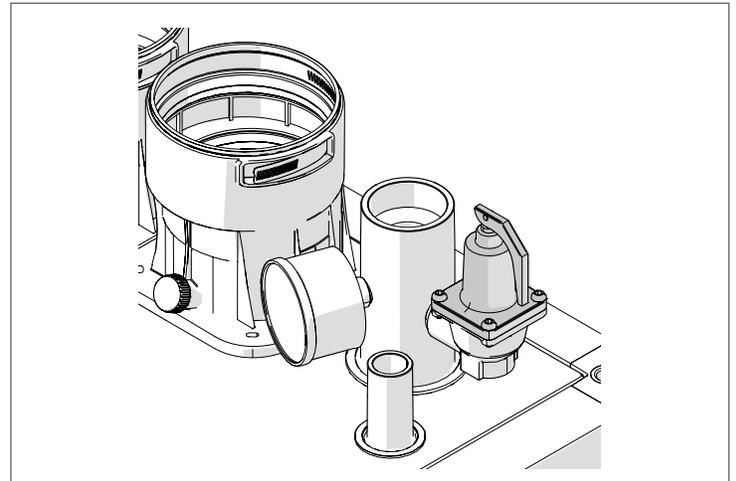


Fig. 17 Relief valve

#### Maintenance of the relief valve

**⚠ CAUTION :** The valve lever must be operated at least once a year by qualified personnel during annual maintenance to insure that water-ways are clear.

Certain natural occurring mineral deposits may adhere to the valve, rendering it inoperative.

When manually operating the lever, water will discharge and precautions must be taken to avoid contact with hot water to avoid water damage.

Before operating the lever, check to see that a discharge line is connected to this valve directing the flow of hot water from the valve to drain otherwise personal injury may result. If no water flows, the valve is inoperative. Call a qualified plumber immediately.

Pressure relief valve should be inspected at least once every three years by a licensed plumbing contractor or authorized inspection agency, to insure that the product has not been affected by corrosive water conditions and to insure that the valve and discharge line have not been altered or tampered with illegally.

Certain naturally occurring conditions may corrode the valve or its components over time, rendering the valve inoperative.

Such conditions are not detectable unless the valve and its components are physically removed and inspected.

Do not attempt to conduct this inspection on your own. Contact your plumbing contractor for a reinspection to assure continuing safety.

**⚠ WARNING :** Failure to reinspect this valve as directed could result in unsafe pressure buildup which can result in serious injury or death and/or severe property damage.

### 3.10 Condensate Drain and Piping

The **Array AR SE** is designed to condense water vapor from the flue products.

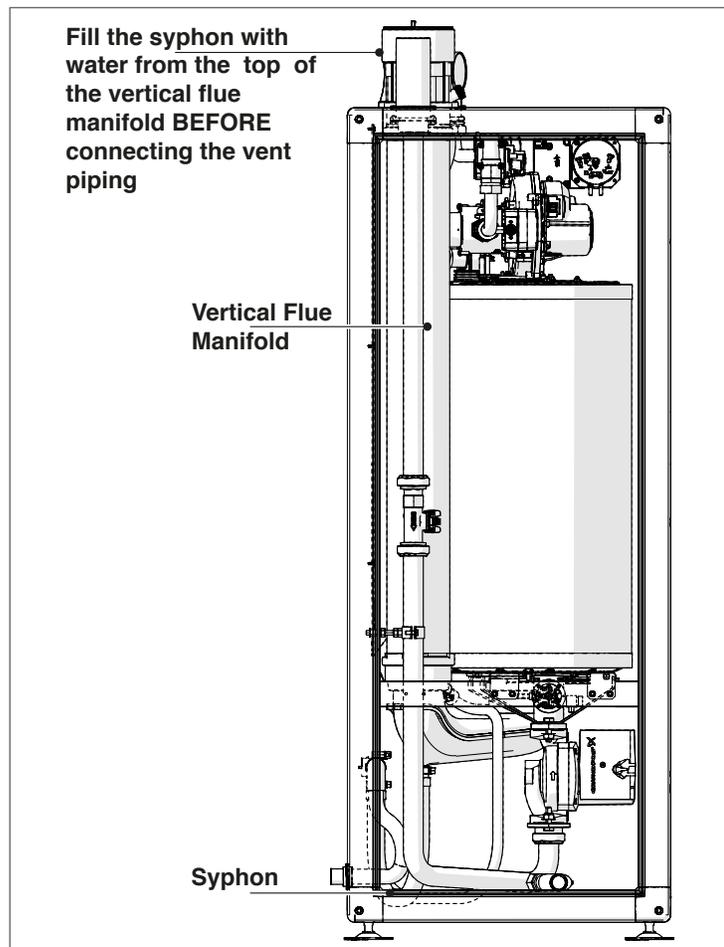


Fig. 18 Condensate drain and piping

**⚠ WARNING:** At the Start-up and after prolonged shutdown of the boiler, the condensate traps and the syphon must be filled with water prior to restarting it, otherwise combustion gases may enter the room with a risk of an excessive level of carbon monoxide.

- The installation must have provisions for suitable drainage or collection of the condensate exiting the boiler traps.
- The condensate water shall be discharged at atmospheric pressure, by dripping into a suitable drain, and shall be neutralized prior to draining per local/national codes.
- The condensate drain tube must pitch away from the boiler (1/4" slope per foot) and must never reduce its diameter downstream.
- Never use copper pipes or other material not intended for the specific purpose, because the acidic nature of the condensate will cause a rapid deterioration of the unsuitable piping and/or exposed components.
- Check that the condensate drain pipe is adequately sloping towards the discharge point avoiding high points, which can inhibit the flow of the condensate. The condensate pipe must be installed in such a way so as to avoid the freezing of any liquid.

**⚠ WARNING:** Verify condensate disposal / neutralization is in accordance with local, state and federal regulations.

### 3.11 Water connection

**⚠ NOTE:** Before connecting the boiler the protection plugs must be removed from the supply, return and condensate drain pipes.

**⚠ CAUTION:** Before connecting the boiler, it is necessary to clean the system. This step is required when the appliance replaces another one on pre-existing systems.

In order to carry out this cleaning activity, if the old boiler is still installed on the system, it is advisable to:

- add a de-scaling additive.
- Operate the system with the boiler on for around 7 days.
- Discharge the dirty system water and flush the system one or more times with clean water.

If the system is very dirty, repeat the last procedure one more time. If the old boiler is not present or available, use a pump to circulate the water + additive through the system for about 10 days and perform a final washing as described in the previous paragraph. Once the cleaning has been completed, it is recommended to add a suitable protective fluid to the system's water before installing the boiler.

In order to clean the heat exchanger's built-in water system, please contact your local **RIELLO** boiler distributor for further assistance.

**⊖ CAUTION:** Do not use incompatible liquid detergents, including acids (for instance, chloridric acid and similar) in any concentration.

**⊖ CAUTION:** Do not subject the heat exchanger to cyclical pressure changes because fatigue stress is very dangerous for the integrity of system components.

The boiler, when used in connection with a refrigeration system, must be installed so the chilled medium is piped in parallel with the boiler with appropriate valves to prevent the chilled medium from entering the boiler.

The boiler piping system of a hot water boiler connected to heating coils located in air handling units where they may be exposed to refrigerated air circulation must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

### 3.12 Gas connections

Installation of the boiler and gas connection must comply with all applicable codes and regulations imposed by the national, Federal or local authorities and bodies. If no specific requirements are defined, in the USA, the latest edition of the National Fuel Gas Code ANSI Z223.1/NFPA 54 must be complied with. In Canada, installation must be in accordance with the requirements of CAN/CSA B149.1, Natural Gas and Propane Installation Code. Ensure the gas line is sized adequately to deliver gas to the burner.

Before making the connection, check that:

- ⚠** The gas type is suitable for the appliance
- ⚠** If the appliance needs to be adapted for use with another gas fuel, refer to section "Converting gas type". For further information please contact your local **RIELLO** distributor.
- ⚠** Ensure the piping is thoroughly clean
- ⚠** The gas meter's flow rate is capable of ensuring the simultaneous use of all the appliances connected to it. The appliance's connection to the gas supply line must be carried out in accordance with the latest edition of the National Fuel Gas Code ANSI Z223.1/NFPA 54, in the USA, and CAN/CSA B149.1,

Natural Gas and Propane Installation Code, in Canada as well as local regulations.

- ⚠ Intake pressure with the appliance in the off position has the following reference values:
  - Natural Gas: optimal pressure 7" w.c.
  - Liquid Propane Gas (LPG): optimal pressure 11" w.c.

- ⚠ The minimum and maximum pressure for natural gas are 3.5" W.C. (8.7 mbar) and 13.5" W.C. (33.6 mbar) respectively.

- ⚠ The minimum and maximum pressure for LP gas are 8" W.C. (19.9 mbar) and 13.5" W.C. (33.6 mbar) respectively.

- ⊖ **WARNING:** Do not use any fuels with this product other than the fuel it is intended to be used with, either Natural Gas or LPG.

- ⚠ Ensure the gas lines are vented, bled in accordance to ANSI Z223.1/NFPA 54, National Fuel Gas Code and/or CAN/CSA B149.1, Natural Gas and Propane Installation Code.

While it is normal for the inlet pressure to decrease while the appliance is in operation, it is advisable to verify that no excessive pressure fluctuations take place. In order to limit the extent of these types of variations, the diameter of the gas supply line to be used must be assessed based on the length and the pressure drops of the line itself, from the meter to the boiler.

- ⚠ **WARNING:** If fluctuations in the gas distribution pressure are encountered, it is recommended to install an appropriate pressure regulator upstream of the appliance's gas inlet. For LPG gas supply, all the necessary precautions must be taken in order to prevent the gas from freezing in the case of extremely low outdoor temperatures.

If the gas distribution network contains solid particles, install a filter on the fuel supply line. When selecting it, consider that pressure drops due to the filter should be as low as possible.

- ⊖ **CAUTION:** The boiler and its individual shut off valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 1/2 psi (3.5 kPa).

- ⚠ A sediment trap must be provided upstream of the gas controls.

- ⚠ A gas shutoff cock shall be located upstream of the boiler on the gas supply line.

- ⚠ On completion of the installation, check that all joints are sealed.

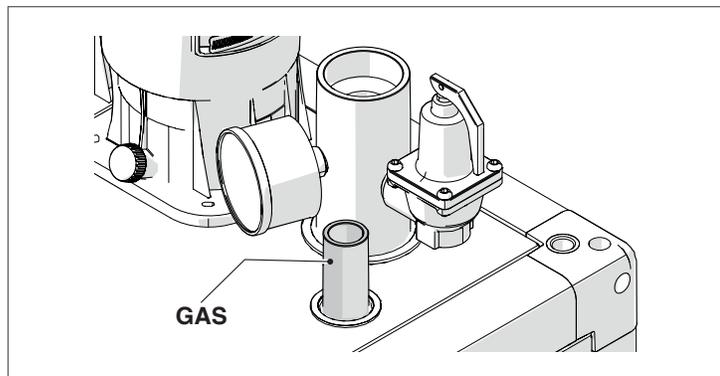


Fig. 19 Gas inlet

DESCRIPTION	Array AR 399 SE	Array AR 500 SE	
Gas inlet	1" NPT	1" NPT	∅

### 3.13 Combustion gas exhaust

For flue gas exhaust and the intake of combustion air, it is essential to use only specific approved pipes for condensing boilers and ensure that they are correctly connected, as shown in the instructions supplied by the vent manufacturer.

- ⚠ **WARNING:** Do not connect this appliance's flue gas exhaust pipes with those of other appliances, unless this is specifically authorized by the manufacturer. Failure to comply with this precaution may cause a build-up of carbon monoxide in the room where the appliance is installed causing substantial property damage, server personal injury or death.

- ⚠ **NOTE:** For further information on flue gas exhaust pipes for the **Array AR SE** series connected in a cascaded system, see section "Multiple boiler cascade system".

- ⚠ **WARNING:** Ensure that Intake combustion air is not contaminated by:
  - waxes/chlorinated detergents
  - chemical products based on swimming pool chlorine
  - calcium chloride
  - sodium chloride used to soften tap water
  - refrigerant leaks
  - paint or varnish removers
  - chloridric acid/muriatic acid
  - cements and glues
  - anti-static softeners used in dryers
  - chloride used for domestic or industrial applications as detergent, whitener or solvent
  - adhesives used to glue construction and other similar products.

- ⚠ To prevent contamination of the boiler, do not install combustion air intake and gas flue exhaust pipes near:
  - dry-cleaners/laundry rooms and factories
  - swimming pools
  - metal processing plants
  - beauty parlours
  - fridge repair shops
  - photo-processing facilities
  - body-shops
  - plastics manufacturing plants
  - furniture workshops and manufacturing plants.

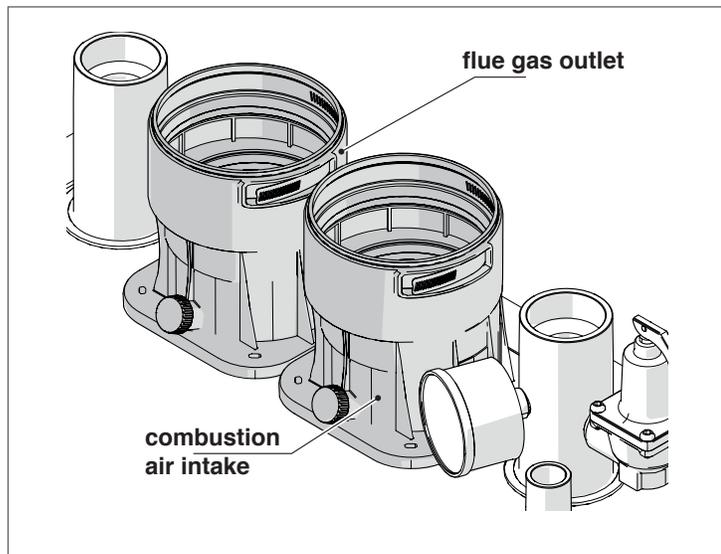


Fig. 20 Flue gas outlet & combustion air intake

DESCRIPTION	Array AR SE	
flue gas outlet	4" (102mm)	∅
combustion air intake	4" (102mm)	∅

**⚠ WARNING:** Read the requirements, instructions and prohibitions detailed below carefully, since non-compliance with them may result in substantial property damage, severe personal injury, death, or the appliance's malfunction.

**⚠ WARNING:** Check that pipes and joints are not damaged.

**⚠ WARNING:** Joint seals must be executed with materials that withstand the condensate's acidity and the temperatures of the appliance's flue gases. They must be approved joint methods as stated by the vent manufacturer's installation instructions for this type of condensing product. Failure to comply may result in substantial property damage, severe personal injury or death.

**⚠ WARNING:** When installing flue pipes, always bear in mind the direction of the flue gases and of possible condensate flows.

**⚠ WARNING:** Inadequate or incorrectly sized flue gas pipes may increase combustion noise, create condensate extraction issues and negatively impact on combustion parameters.

**⚠ WARNING:** Check that pipes are suitably far (min. 20") from flammable liquids.

**⚠ CAUTION:** Make sure that condensation is not built up along the exhaust flue pipe. For this purpose, provide a slope of at least 3 degrees towards the appliance in horizontal sections. In case of cascade application, if the horizontal or vertical section is longer than 13ft (10m) in a cascade vent application, a condensate siphon drain must be provided at the base of the pipe. The height of the siphon must be at least equal to the value "H" (see figure below). The siphon discharge must then lead to a drain with an air gap between the drain and the condensate trap. (See section "Preparation for the condensate drain")

**⚠ WARNING:** It is prohibited to block or section the flue gas exhaust pipe or the combustion air intake pipe, if any.

**⚠ WARNING:** It is prohibited to use condensate pipes that are not designed for this application, as the condensates acidity would damage them quickly.

### 3.14 Gas Type Conversion

The heating unit is factory preset for operating with natural gas. This set-up can be changed using the conversion kits supplied by the manufacturer, on demand.

**⚠ DANGER:** To prevent risks of personal injury and property damage, this conversion shall only be performed by a trained and certified installer in accordance with the manufacturer's instructions and all applicable codes and requirements of the authority having jurisdiction. If the information in these instructions is not followed exactly, or the installation, adjustment, modification, operation or maintenance is carried out by an unqualified person, a fire, explosion or generation of excessive levels of carbon monoxide may result causing property damage, personal injury or loss of life. Before carrying out electrical work, disconnect the appliance from the power supply at the emergency shutoff switch or by disengaging the heating system circuit breaker. Take appropriate measures to prevent accidental reconnection. The installer is responsible for the proper conversion of this appliance. The conversion is not complete until the operation of the converted appliance is checked as specified in these instructions.

The gas-air ratio must always be set on the basis of a CO<sub>2</sub> or O<sub>2</sub> reading taken at maximum nominal output and minimum nominal output using an electronic flue gas analyzer. The desired high-fire excess O<sub>2</sub> level is 5.1% for natural gas.

Natural Gas to Propane Conversion Kit for AR 399 SE: Part #20185234  
 Natural Gas to Propane Conversion Kit for AR 500 SE: Part #20185235

#### Switching from NATURAL GAS to LP

- Close the gas shutoff valve
- Disconnect the electric power supply from the boiler

**⚠ WARNING:** To avoid electrical shock, it is mandatory to disconnect the boiler from the power supply using an external circuit breaker or disconnect switch.

- Open the front panels
- Change the mixer with new version present in the Conversion specific Kit.
- Unscrew the nuts (1) that connect the fan to the upper flange of the heat exchanger

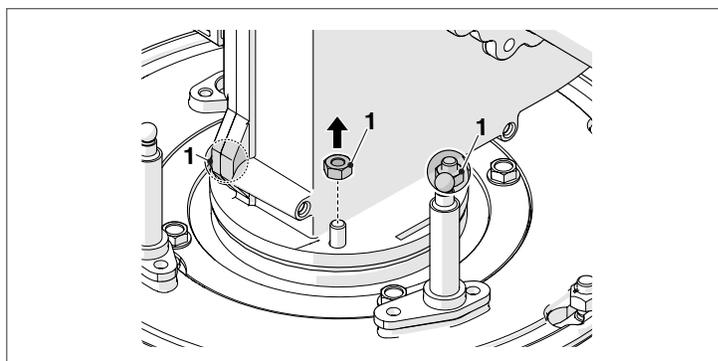


Fig. 21 NG mixer removal

- remove the tube (2), that connects the mixer and the gas valve

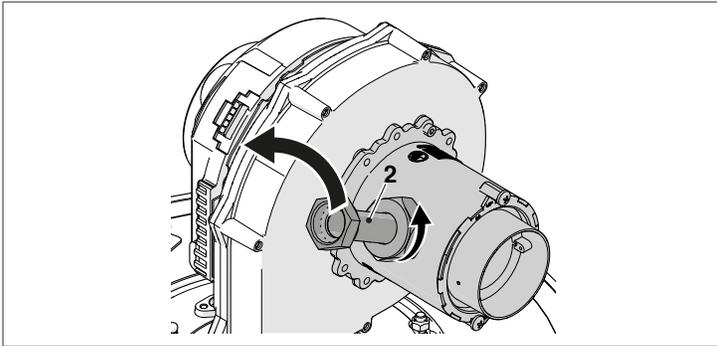


Fig. 22 NG mixer removal

- remove screws (3) in order to get out the mixer

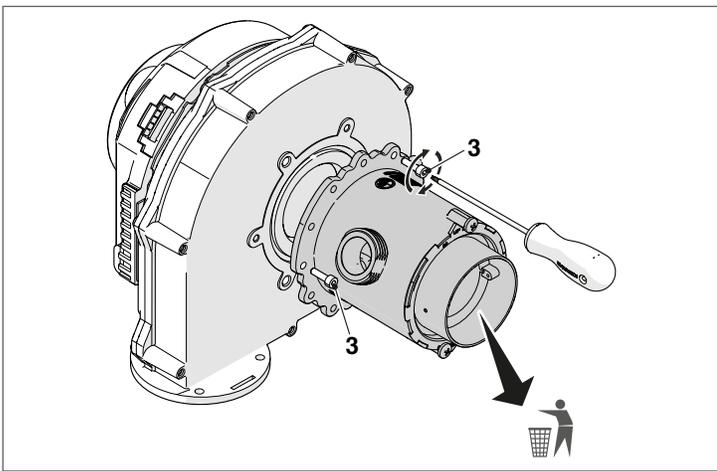


Fig. 23 NG mixer removal

- connect the LPG mixer (4) to the fan, putting in the O-ring (5) and screws (6)

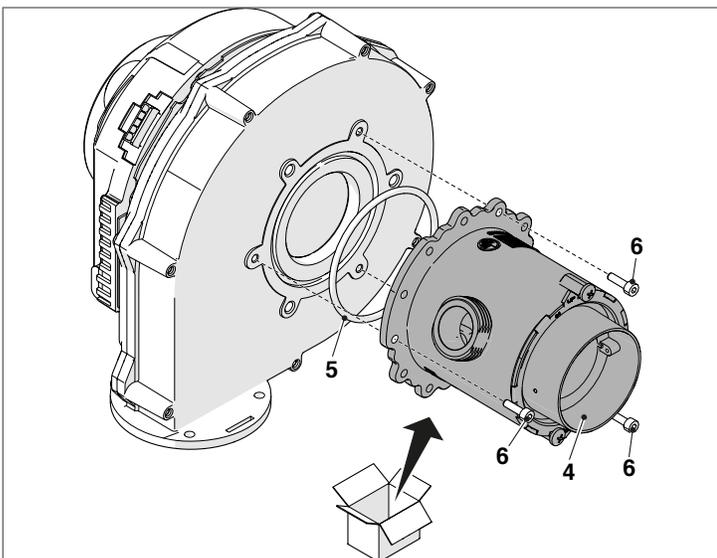


Fig. 24 LPG mixer installation

- reassemble the fan unit and the mixer by reversing the previous operations.
- Use the PB inner display to enter the appliance configuration menu and change the parameters #97 and #98:

Model	LPG	
	AR 399 SE	AR 500 SE
Par. 97	22	22
Par. 98	84	82

- Adjust the O<sub>2</sub> parameter as explained in next chapter
- Affix the gas type label from the gas conversion kit to the appliance.

### 3.15 Adjusting and Setting O<sub>2</sub> Limits

- Insert a combustion analyzer probe into the test port;
- Go to the Touchscreen and access the Module screen relevant to the module under analysis;
- Press "MODULE TEST" button;
- Press "HIGH POWER" button.

Wait 2 or 3 minutes to reach steady state conditions and record the O<sub>2</sub> value.

To adjust the O<sub>2</sub> value at high-fire turn the screw "A" (rotate counter-clockwise to decrease O<sub>2</sub>). An allen type wrench is necessary for this adjustment.

Verify that the value of O<sub>2</sub> is stable and within the range indicated in the following table (be careful to make small changes and confirm that the value is stable before making additional adjustment).

Press "LOW POWER": the fan will run at the minimum speed.

To adjust the O<sub>2</sub> value at the minimum input, turn the screw "B" (rotate clockwise to decrease O<sub>2</sub>)

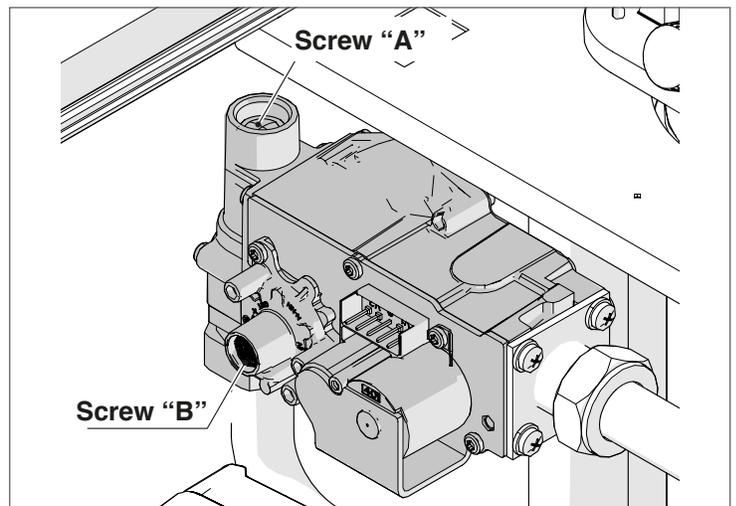


Fig. 25 Adjusting O<sub>2</sub>

Verify that the value of O<sub>2</sub> is stable and within the range indicated in the following table (be careful to make small changes and confirm that the value is stable before making additional adjustment).

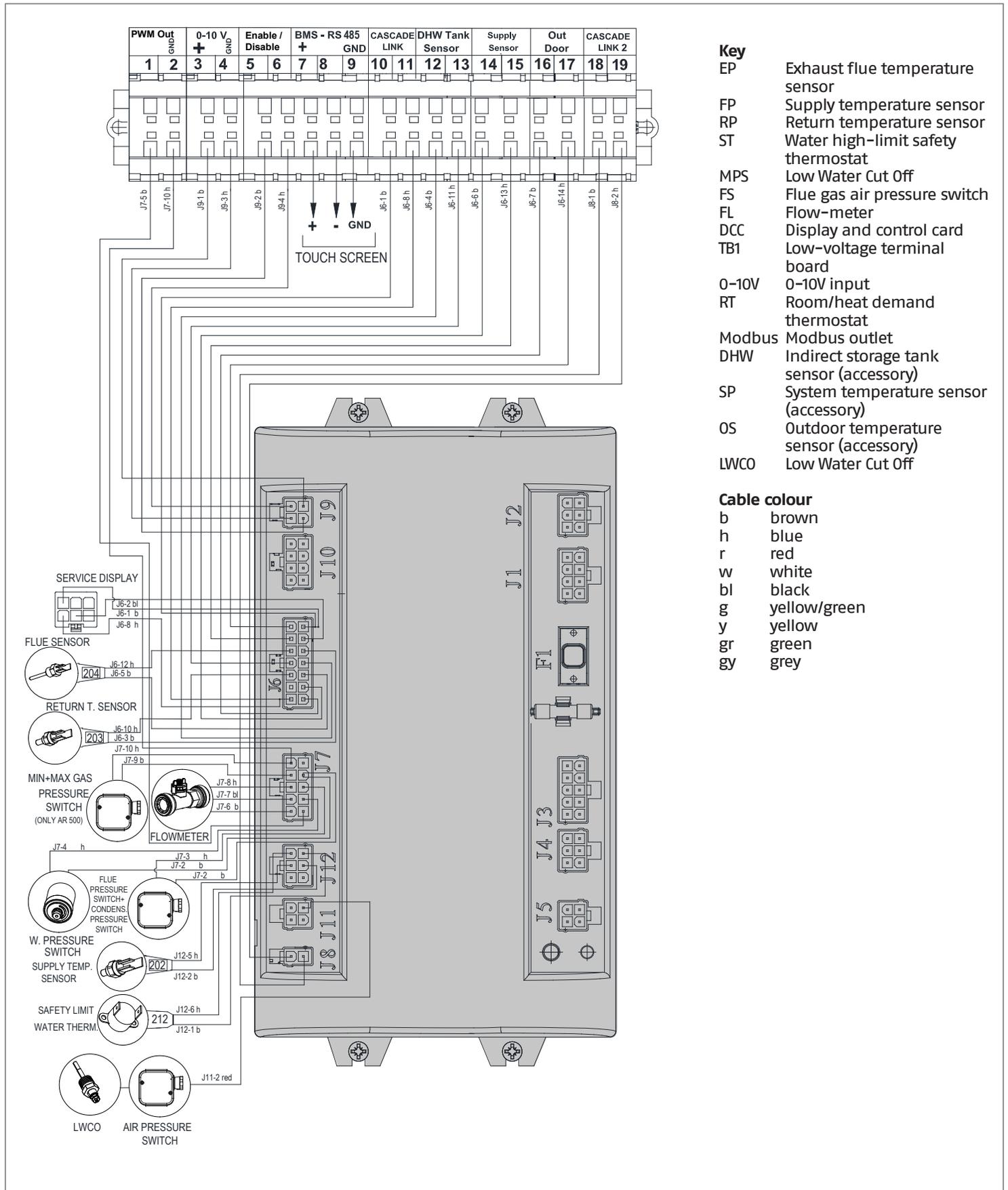
Press "Reset" and the boiler return to the "stand by" mode.

Press "Reset" to return the boiler to standby mode.

Repeat above process for all heat exchangers.

Array Combustion Values		
Gas Type	Max. Fire O <sub>2</sub> %	Min. Fire O <sub>2</sub> %
Natural Gas	4.2 - 5.8	4.2 - 5.8
LP Gas	5.0 - 5.6	5.0 - 5.6

### 3.16 Wiring diagram

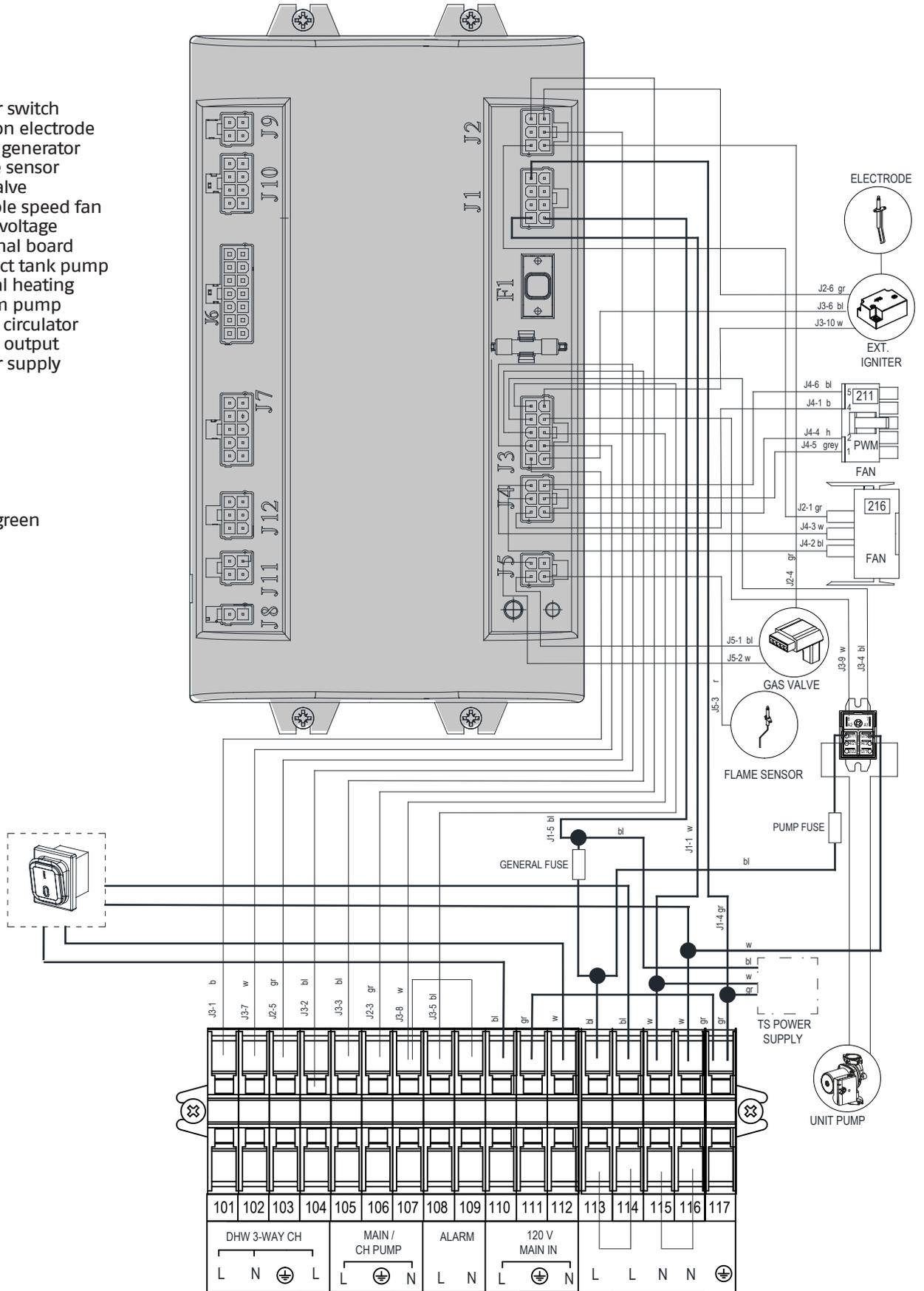


**Key**

- MS Power switch
- DE Ignition electrode
- IT Spark generator
- IE Flame sensor
- GV1 Gas valve
- FA1 Variable speed fan
- TB2 High-voltage terminal board
- SCP Indirect tank pump
- CHP Central heating system pump
- TMP Boiler circulator
- AL Alarm output
- PS Power supply

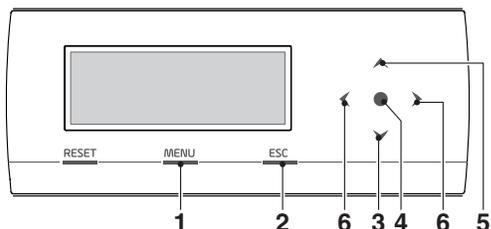
**Cable colour**

- b brown
- h blue
- r red
- w white
- bl black
- g yellow/green
- y yellow
- gr green
- gy grey

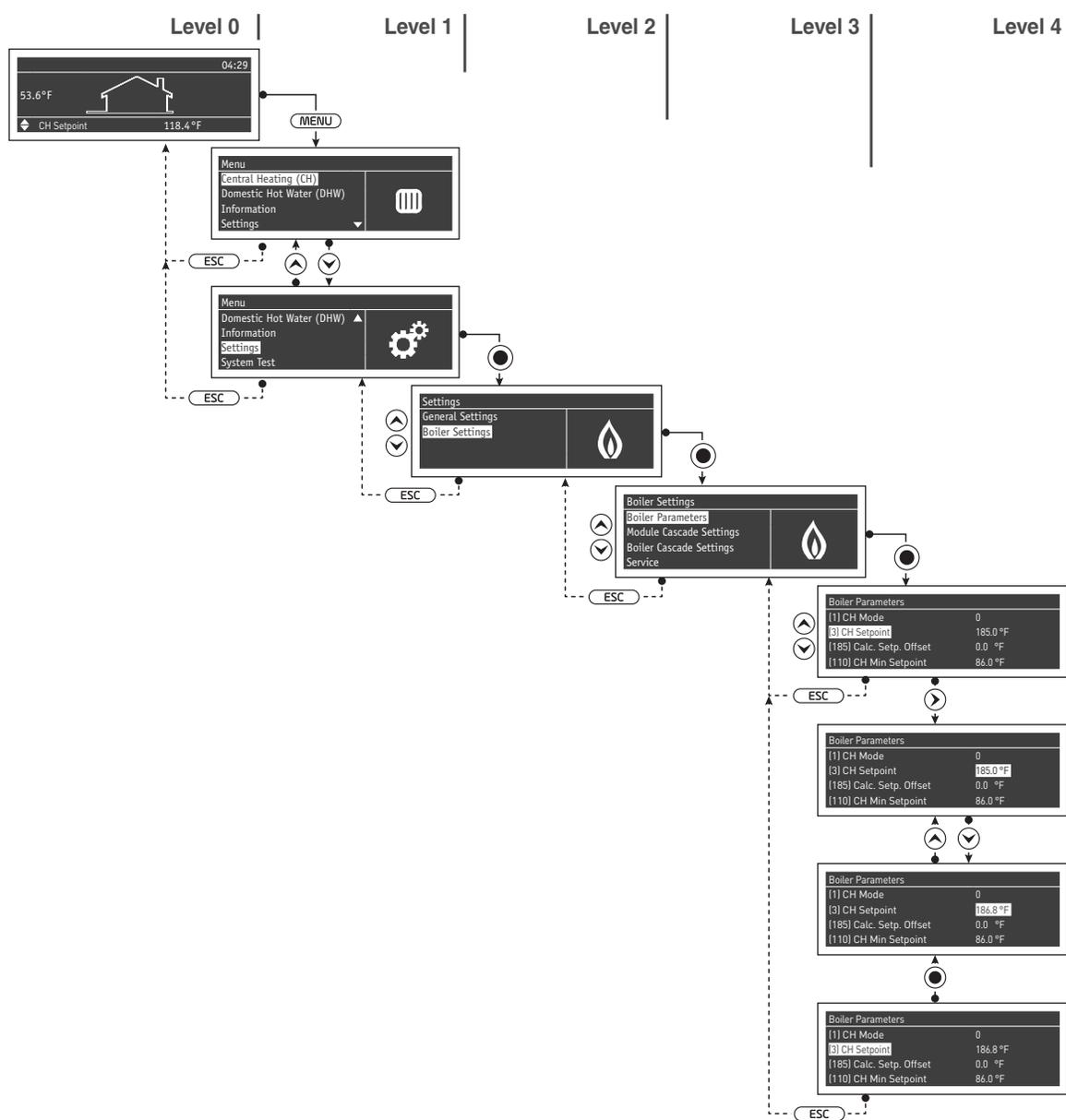


### 3.17 Electronic control

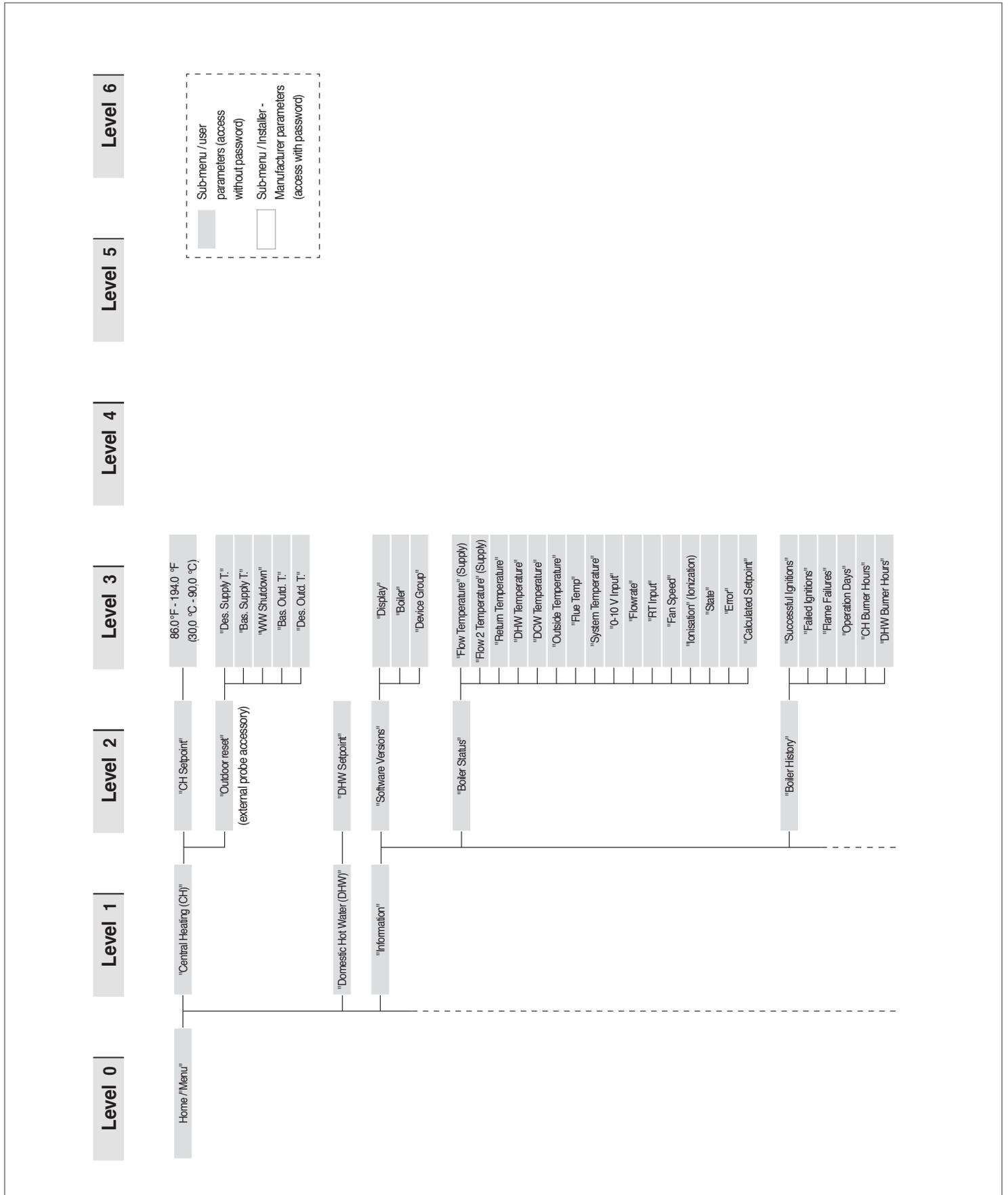
The electronic control interface menu is multi-level. Navigation between the various levels is shown in the figures below. Level 0 displays the Home Screen (Home). Level 1 displays the Main Menu screen. The subsequent levels are activated depending on available sub-menus. For the full layout, see section "Control panel". For how to access and change the parameters, see the picture on the next page. The parameters for the installer are accessible only after entering the security password (see section "Control panel"). Please note that the boiler's operating parameters are identified with a number, all other additional functions are simply descriptive.



- 1 switches on the main menu
- 2 in menu navigation, it enables you to exit a menu item and go back to the previous one
- 3 supports selecting menus or parameters or decreasing numeric values
- 4 enter
- 5 supports selecting menus or parameters or increasing numeric values
- 6 supports moving to the RH/LH area of the display



3.17.1 Menu structure



Level 6

Level 5

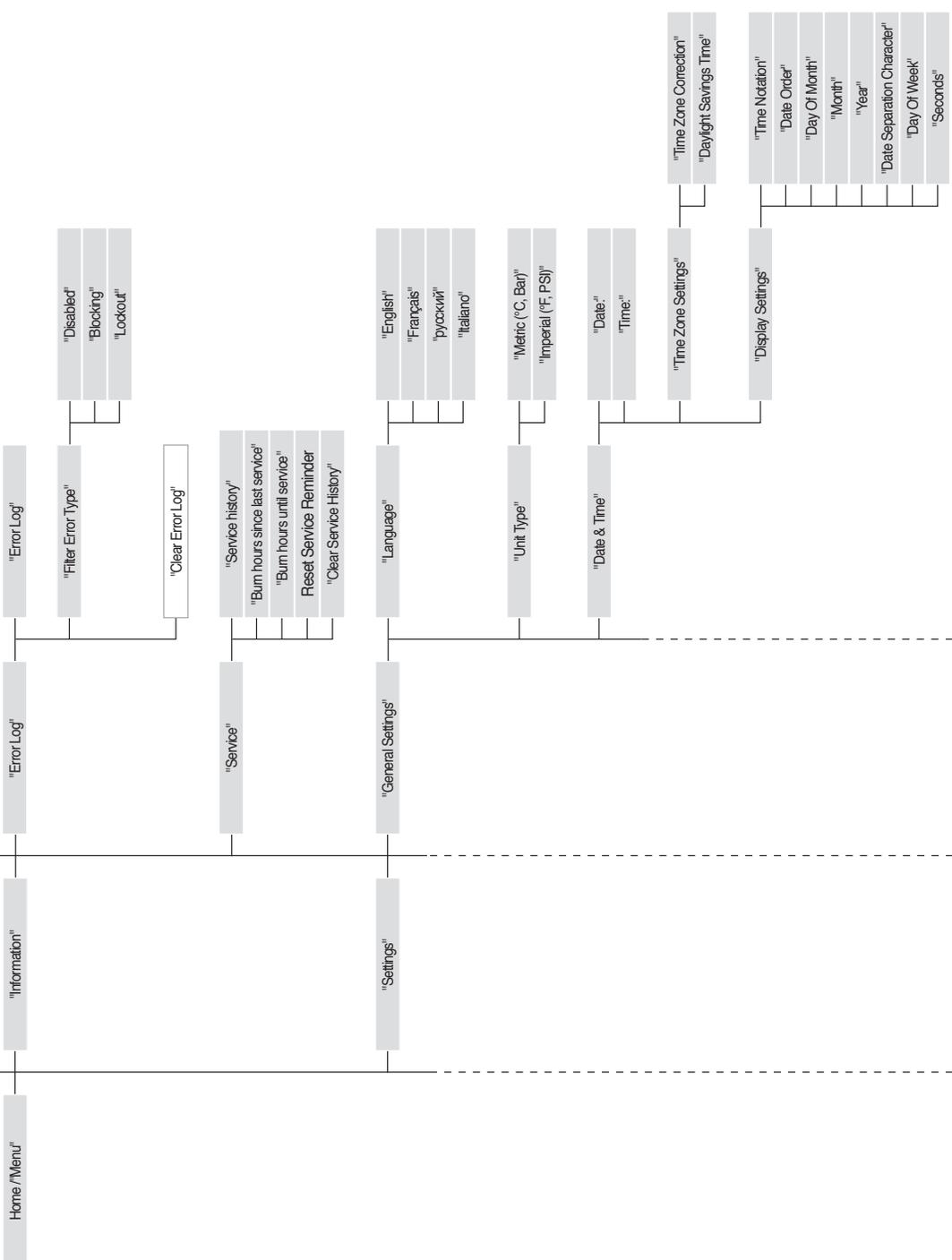
Level 4

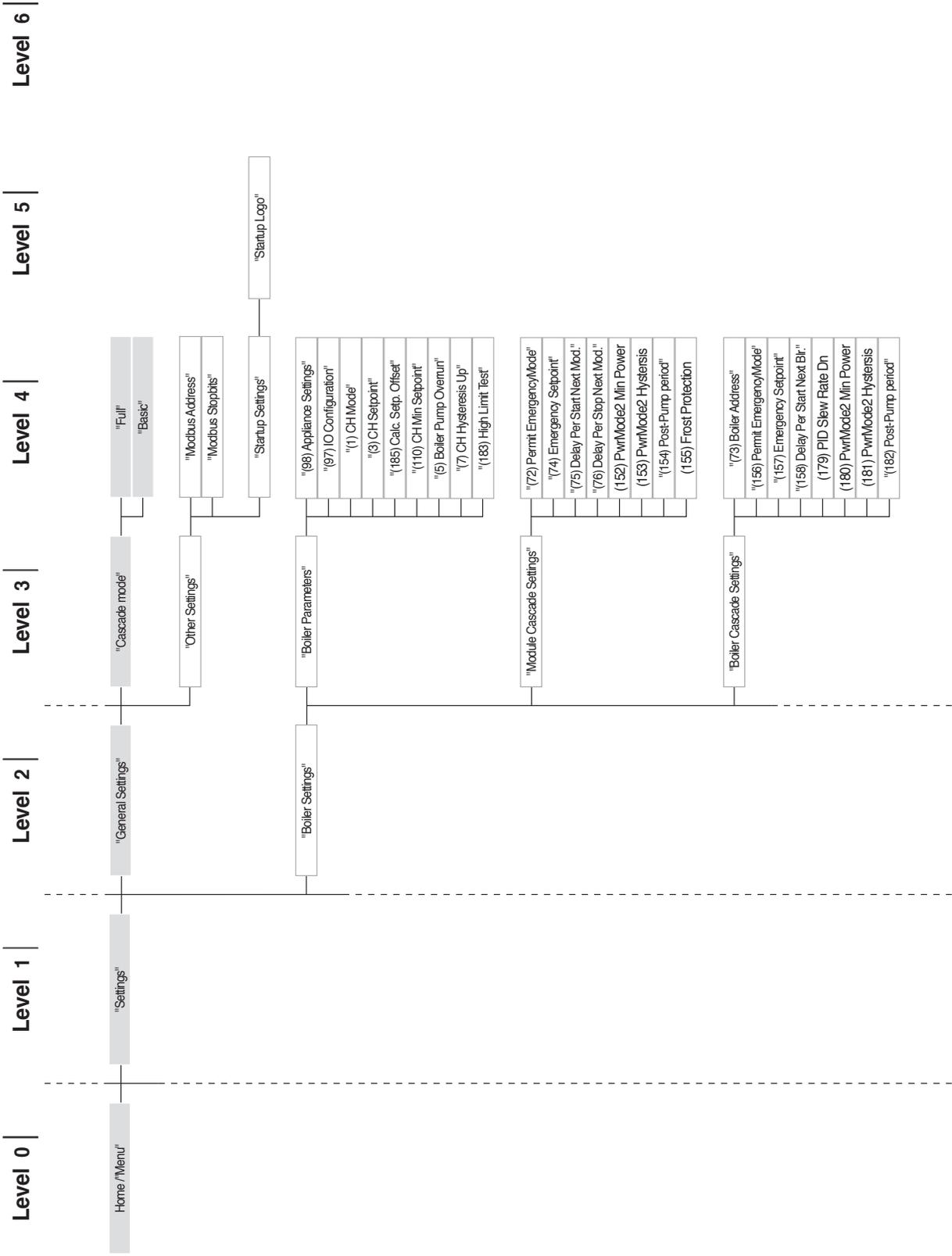
Level 3

Level 2

Level 1

Level 0





## 4 COMMISSIONING

### 4.1 Introduction

Before starting the boiler, the user must be correctly instructed by the installer, on how to operate the heater, in particular:

- Make sure that the user understands that combustion air and ventilation openings must not be restricted, closed, or modified in any way.
- Make sure that the user is informed of all the special measures to be taken for combustion air inlet and discharging flue gases, and that these must not be modified in any way.
- Make sure that the user keeps this manual and all other documentation included with the boiler.
- Make sure that the user understands never to tamper with gas control settings and the risk of fire, explosion, or CO poisoning should an unauthorized individual do so.
- Make sure that the user knows how to adjust temperatures and controls.

**⚠ WARNING:** Do not attempt to dry fire the unit. Starting the unit without a full water level can seriously damage the unit and may result in injury to personnel or property damage. This situation will void any warranty.

**⚠ CAUTION:** All of the installation procedures in "Installation" must be completed before attempting to start the unit.

### 4.2 Filling the Condensate System

The condensate system must be filled with water according to the Section 3.10.

**⚠ WARNING:** At the Start-up and after prolonged shutdown of the boiler, the condensate traps and the syphon must be filled with water prior to restarting it, otherwise combustion gases will enter the room with a risk of an excessive level of carbon monoxide.

### 4.3 Filling the Boiler Heating System

To fill the heating system, proceed as follows:

- Open any automatic air vents in the heating system.
- Open the fill valve and proceed to fill the heating system and boiler until the pressure gauge (shown on Fig. 40), reads the pressure for which the heating system is sized. The heating system water pressure must be higher than 7.5 PSI.
- Check for any water leaking from the fittings. If there is, the leaks must be repaired.
- Check the pressure gauge during the purging process. If the pressure has dropped, re-open the fill valve to bring the pressure back to the desired value.

### 4.4 Warnings Concerning the Gas Supply

When starting up the unit for the first time the following must be checked:

- That the unit is supplied with the type of fuel that it is configured to use.
- That the gas supply system is provided with all the safety devices and controls required under current national and local codes.
- That the vent and combustion air terminals are properly connected and free from any blockages.
- That the condensate drain tube is properly connected.

#### 4.4.1 Confirming the Unit's Gas Type

The type of gas and supply pressure for which the unit is configured is listed on the rating label. The **Array AR SE** Series boilers can operate using one of the following two gases:

##### NATURAL GAS

- Maximum supply pressure = 13.5" w.c. (33.6 mbar).
- 1 Minimum supply pressure = 4" w.c. (10 mbar).

##### PROPANE (LP) GAS

- Maximum supply pressure = 13.5" w.c. (33.6 mbar).
- Minimum supply pressure = 8" w.c. (19.9 mbar).

#### 4.4.2 Gas Type Conversion

If the gas available at the installation site is not the type the boiler is configured to use, the boiler must be converted. Special conversion kits are available for this purpose. The gas conversion must be carried out by a qualified technician.

### 4.5 Boiler Startup Procedure

To start the boiler, do the following:

- Open the manual gas shut off valve.
- Turn ON the main power switch.
- Push all Module power switches to ON.
- To help remove the air from the hydraulic circuit, the De-airing function can be started for each module. When activated, the "De-Air" sequence starts at every power ON and consists of a controlled cycling of the pumps OFF and ON that takes 14 minutes, during which no demand will be served. If the water pressure is too low and the water pressure switch is in error, the sequence will be suspended until the pressure switch is ON again. This function can be started through the Service display, switching the parameter (139) Dair\_active from No to Yes on each Dependent.
- The Touchscreen Control Panel will switch on. The Splash/Stand-by screen consists of the **RIELLO** logo:



Fig. 26 Touchscreen Control Panel Stand-by screen

By touching the logo, the Module screen will appear:

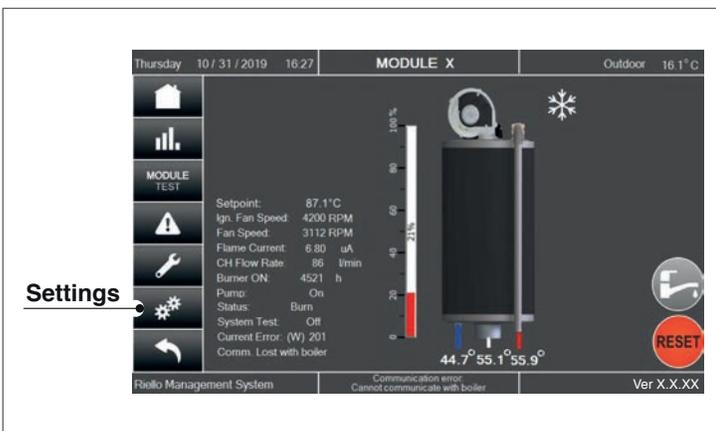


Fig. 27 Module Screen

- Pushing the Settings button, the Settings screen will appear:



- 1 Reset curve
- 2 Date & Time
- 3 CH/DHW setpoint change
- 4 Language
- 5 Units conversion
- 6 CH mode selection
- 7 Software demo
- 8 Software data
- 9 Dependent configuration (do not touch)

Fig. 28 Settings screen

- Date and Time can be adjusted through the screen below:

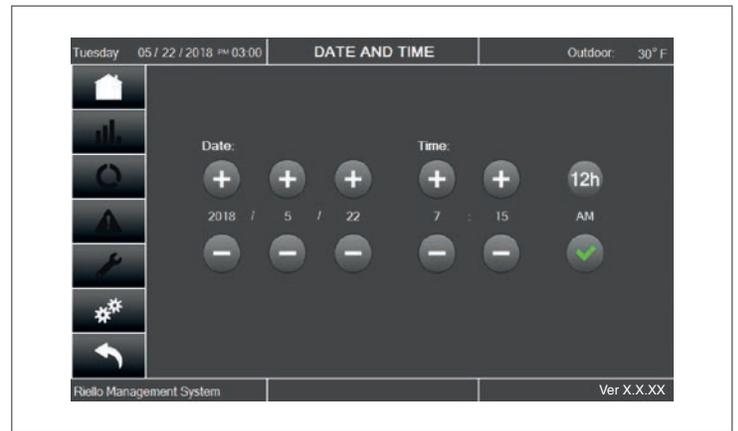


Fig. 29 Date & Time screen

- After the Date&Time setting, CH modes can be selected accessing the CH MODE settings screen below:

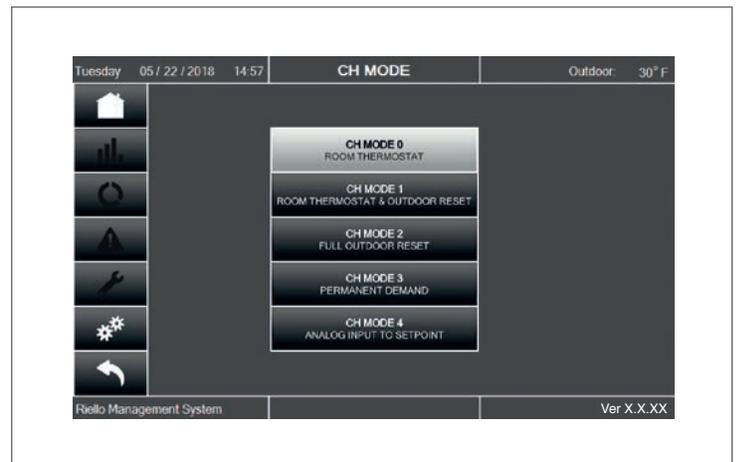


Fig. 30 Mode Screen

Five CH modes are available, but only four are mentioned in the following text:

- **CH Mode 0 - Room Thermostat (Enable/Disable):** when the room thermostat closes, the system switches ON. Temperature Setpoint is manually set on the CH/DHW Setpoints screen (through the Settings screen).



Fig. 31 CH/DHW Setpoints

- **CH Mode 1 – Room Thermostat & Outdoor Reset:** this mode requires an outdoor sensor, in addition to the room thermostat. The system functions similar to CH mode 0, except the Temperature Setpoint is automatically calculated based on the Reset curve. Curve parameters are available on the Reset curve screen (through the Settings screen).

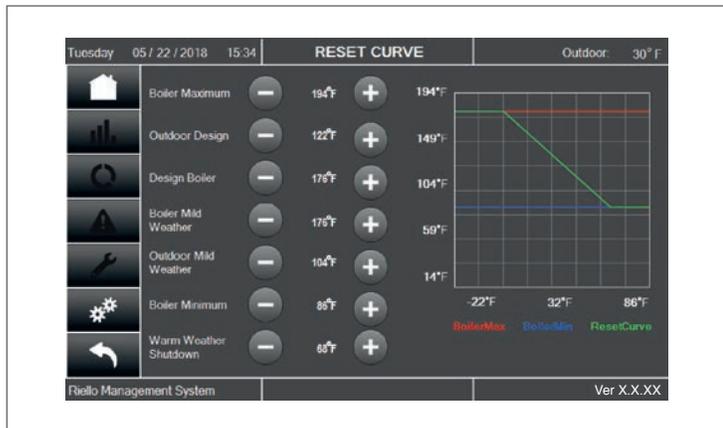


Fig. 32 Reset Curve screen

By adjusting the parameters on the screen, the reset curve will modify its shape and sloper to meet the needs of the specific application.

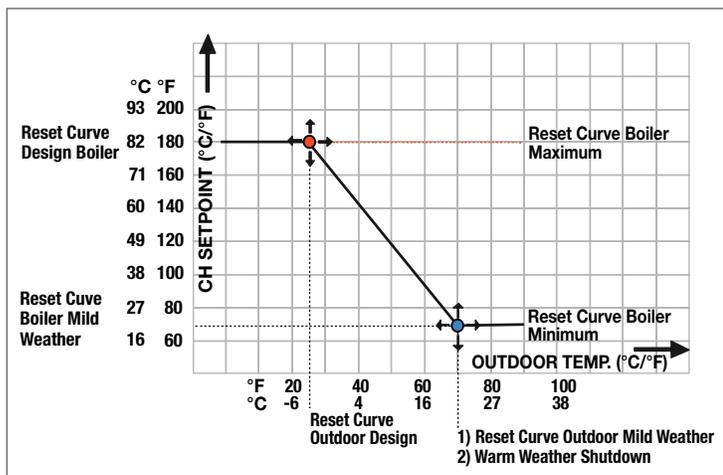


Fig. 33 Reset Curve

- **CH Mode 2 – Full Outdoor Reset:** just an outdoor sensor is required. The Temperature Setpoint is still automatically calculated based on the Reset curve. If a room thermostat is installed, it activates the Night setback function (setpoint reduction during the night) but it does not affect the CH demand.
- **CH Mode 3 – Permanent Demand:** the system works similarly to Mode 0. Supply temperature is kept at the Setpoint level steadily. If a room thermostat is installed, it activates the Night setback function (setpoint reduction during the night) but it does not affect the CH demand. Module pump is always ON.
- **CH Mode 4 – Analog Input to Setpoint:** the Temperature Setpoint is given by an analog signal provided by a remote control such as a Building Management System or a system controller. A heat demand will be generated by an input of 1.5 Volts or higher. Modulation will occur between 2 and 9 Volts. Voltage below 1 Volt will shutoff any demand.

NOTE: after selecting CH mode 4, enable it either:

- jumpering "Enable/Disable" pins (#11-12) on Terminal strip or
- accessing the list of parameters through the Service display and move parameter #124 from 1 (default value) to 0.

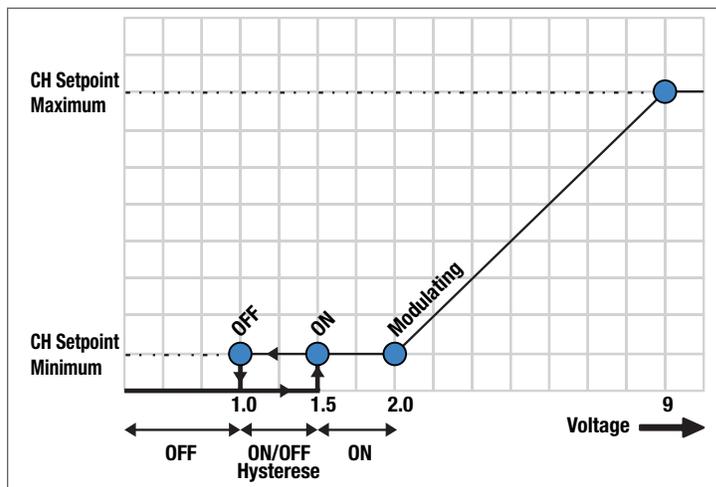


Fig. 34 10VDC Control mode

NOTE: Scale the analogue signal to match the system temperature requirements. scaling the temperature range using the boiler parameters will artificially limit the maximum operating temperature of the boiler.

Domestic Hot Water (DHW) function can be enabled using the parameter 35 on Service display. Three modes are available:

- **DHW mode 0 – DHW function disabled.**
- **DHW mode 1 – Tank with sensor:** hot water is stored in a tank where the temperature is measured by a sensor. Either a pump or a 3-way valve can be used to switch to DHW mode. When the DHW demand is on, the boiler is PID modulated to achieve the supply temperature made by the DHW store setpoint increased by an adjustable extra temperature. DHW store setpoint is manually set on the CH/DHW Setpoints screen (through the Settings screen).

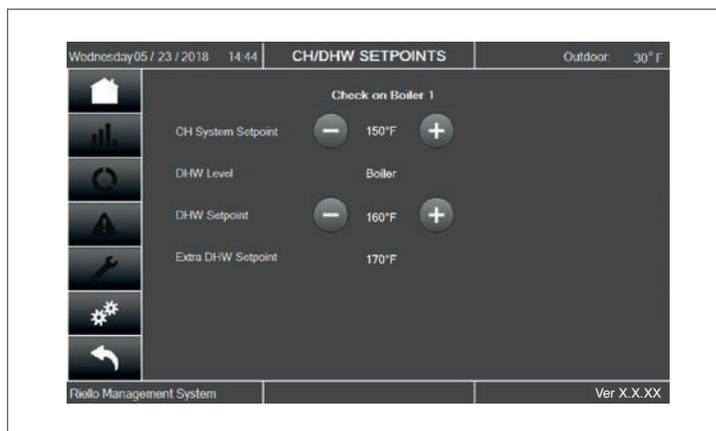


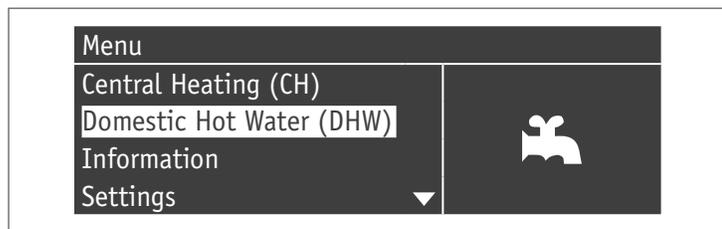
Fig. 35 CH/DHW Setpoints

The parameters that control DHW production are the following:

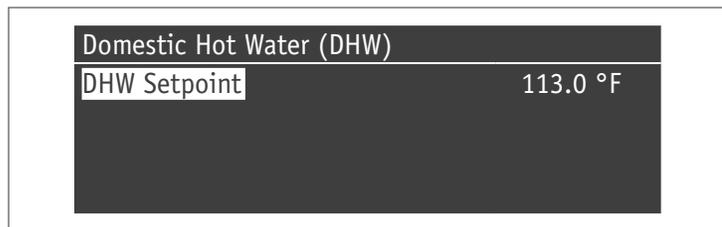
Par. No.	Description
36	Defines the hysteresis to initiate the domestic hot water demand.
37	Defines the hysteresis to stop the domestic hot water demand.
38	Defines the primary circuit's set-point increase in degrees compared to the temperature set for the domestic hot water tank.
39	Defines the primary circuit's restart hysteresis in modes 1 and 2 of DHW (valid both for cascade and stand-alone applications).
40	Defines the primary circuit's shut-off hysteresis in modes 1 and 2 of DHW (valid both for cascade and stand-alone applications).
41	Defines the value referred to the Delta T of the tank for maintenance purposes. E.g.: if it is set on 5.4 °F (3 °C), when the tank has a set point lowered of 5.4 °F (3 °C), the boiler turns on at the minimum to allow maintenance until the set point plus hysteresis. If this parameter is equal to parameter 36, this function is inactivated and the boiler starts at the maximum sanitary power.
48	Establishes the DHW storage tank set-point.

The setpoint value can be set directly, without entering the list of parameters:

- Press MENU and select "Domestic Hot Water" using the ▲ / ▼ buttons.



- Press the ● button to confirm.



- Use the ► button to highlight the value, and use the ▲ / ▼ buttons to change the selected value. Press the ● button to confirm/save the new settings.

The DHW value can be changed only when the "domestic hot water" function is enabled. See section "Password access" for instructions about outdoor recovery.

- **DHW mode 2 – Tank with thermostat:** hot water is stored in a tank where the temperature is detected by a thermostat (ON/OFF signal). Either a pump or a 3-way valve can be used to switch to DHW mode. When the DHW demand is on, the boiler is PID modulated to achieve the DHW store setpoint. DHW store setpoint is manually set on the CH/DHW Setpoints screen (through the Settings screen).

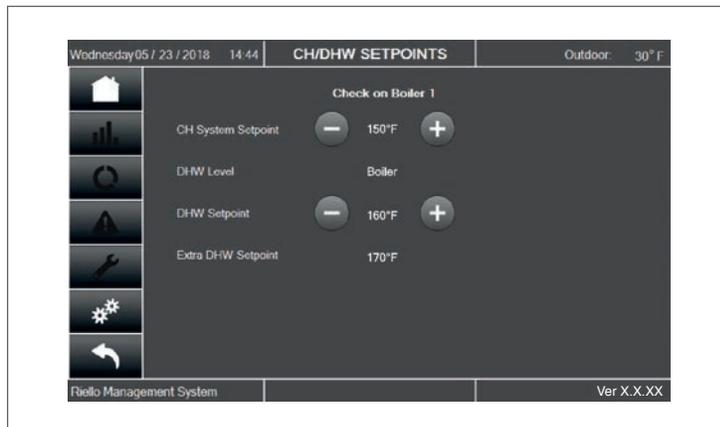


Fig. 36 CH/DHW Setpoints

Temperature summary picture of the DHW tank is available on the DHW screen, accessible through the Tap (faucet) button on the Module screen.

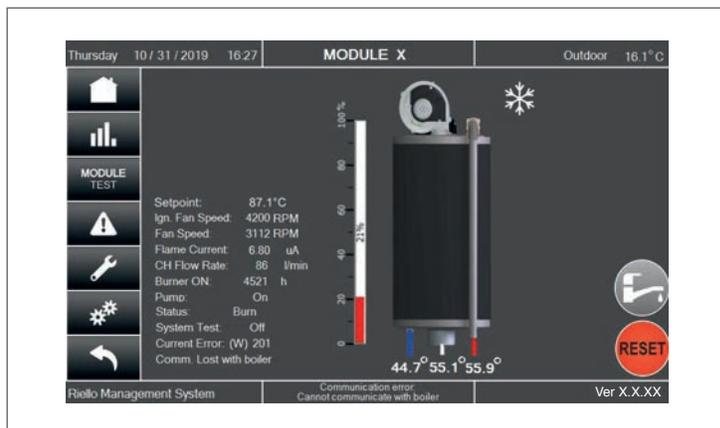


Fig. 37 Module Screen

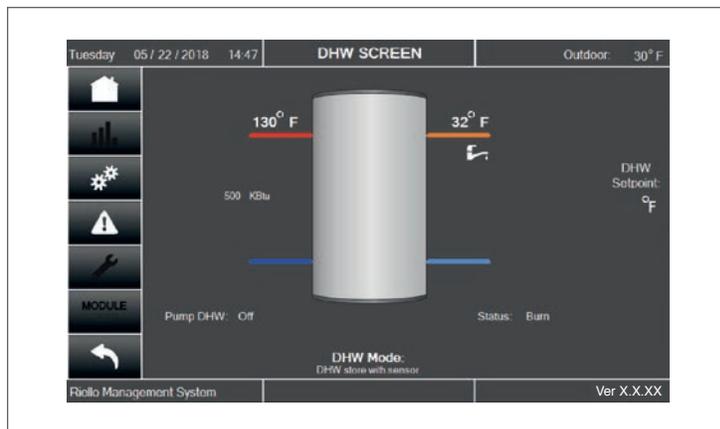


Fig. 38 DHW Screen

The parameters that control DHW production are the following:

Par. No.	Description
38*	Defines the primary circuit's set-point increase in degrees compared to the temperature set for the domestic hot water tank.
39	Defines the primary circuit's restart hysteresis in modes 1 and 2 of DHW (valid both for cascade and stand-alone applications).
40	Defines the primary circuit's shut-off hysteresis in modes 1 and 2 of DHW (valid both for cascade and stand-alone applications).
48	Establishes the DHW storage tank set-point.

(\*) Parameter 38 is active on such mode even if the indirect tank sensor is not installed and it influences the supply temperature of the boiler.  
It can be used to limit the difference between the actual supply and set temperature on the indirect tank sensor so that the system efficiency is maximized.

Also in this case, the setpoint value can be set directly, without entering the parameters list, by accessing the "Domestic Hot Water" menu, as mentioned earlier for mode 1.

**Priority setting**

Parameter 42 sets the priorities between the DHW and CH circuit. Four modes are available:

- 0 **Time:** timed priority between the two circuits. In the event of a simultaneous demand, initially the domestic hot water circuit is made to operate for a number of minutes equal to the value assigned on parameter 43. At the end of this time period, the CH circuit is operated (also for the same amount of time) and so on until demand for one or the other circuit is satisfied
- 1 **Off:** priority is to the heating circuit
- 2 **On:** priority is to the DHW circuit
- 3 **Parallel:** simultaneous operation of both circuits provided that the delivery temperature requested by the DHW circuit is lower than or equal to the setpoint requested by the heating circuit. When the temperature requested by the DHW circuit exceeds the heating setpoint, the circulation pump of the heating is turned off and priority is switched to the DHW.

**Anti-Legionella function**

When the production of domestic hot water is activated (Par. 35=1), using parameters 107 and 108 it is possible to carry out weekly scheduling of the "Anti-legionella" function. Parameter 107 sets the day of the week in which the activity is performed, while parameter 108 sets the time. At the planned time, the boiler generates a call for the DHW in-direct storage tank with a pre-set set-point of 140 °F (60 °C) (not adjustable). After reaching 140 °F (60 °C), the temperature is maintained for 30 minutes, during which the system checks that the sensor's temperature does not fall below 134.6 °F (57 °C). At the end of this time interval, the Anti-Legionella function stops and standard operation of the boiler is resumed.

Operation in "Anti-Legionella" mode has priority over other demands independently from the setting of the parameter 42.

Par. No.	Description
107	Sets the weekday on which the anti-Legionella procedure is carried out.
108	Sets the time of the day during which the anti-Legionella procedure is carried out.

**4.5.1 Minimum Water Flow (Heat Exchanger Protection)**

This unit is self-protected against low water flow. A flow meter continuously monitors the water flow to each module. If the water flow decreases below the minimum stated, the burner automatically shuts off.

**NOTE:** Make sure that the pump in the system is free, bled and rotate in the right direction.

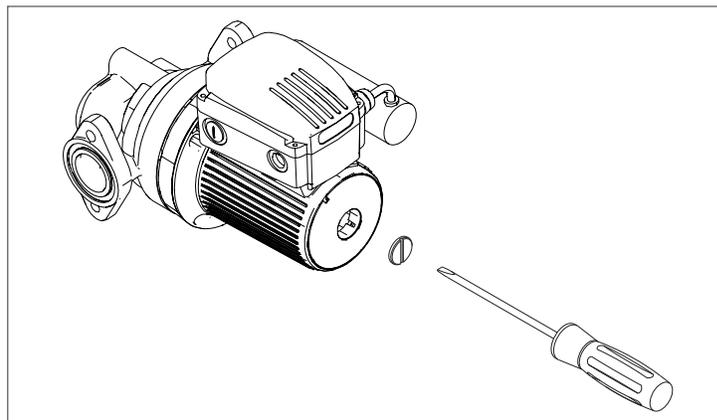


Fig. 39 Rotation pump check

### 4.5.2 Heating System Pressure Test

If the pressure inside the heating circuit falls below the minimum pressure for the system (7.5 PSI), the appliance switches off and the 905PB inner display shows "Low water pressure" to indicate that it is necessary to restore the correct pressure.

Open the filling valve and check the pressure on the temperature/pressure gauge of Fig. 40.

The error will disappear when the pressure is back at the right value. To prevent accidental relief valve openings, fill the heating circuit slowly.

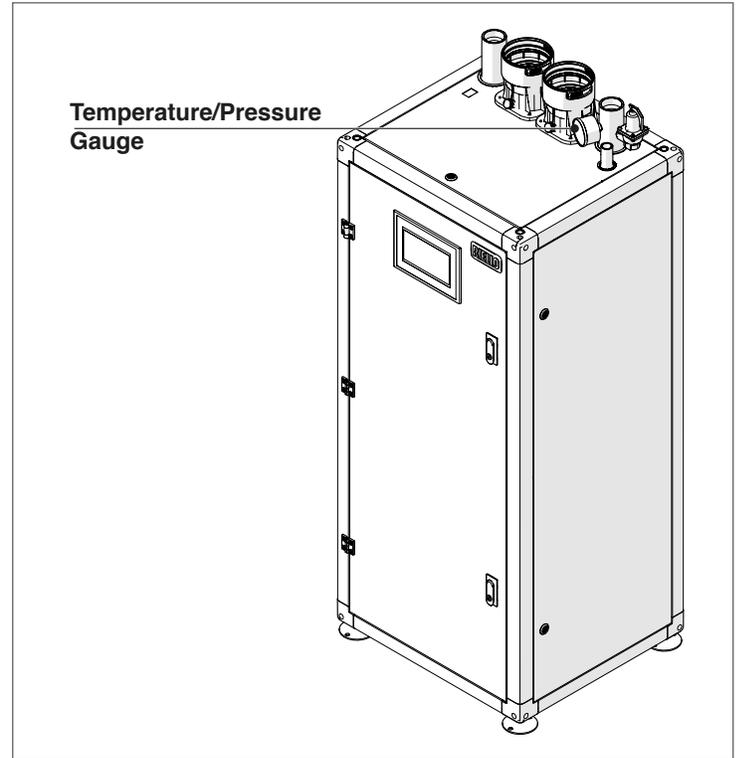


Fig. 40 Temperature/Pressure Gauge location

## 5 SYSTEM MANAGEMENT

### 5.1 Communication between the boilers

Communication between boilers is necessary when using a cascade system to prevent short-cycling and allow equal run-times between units.

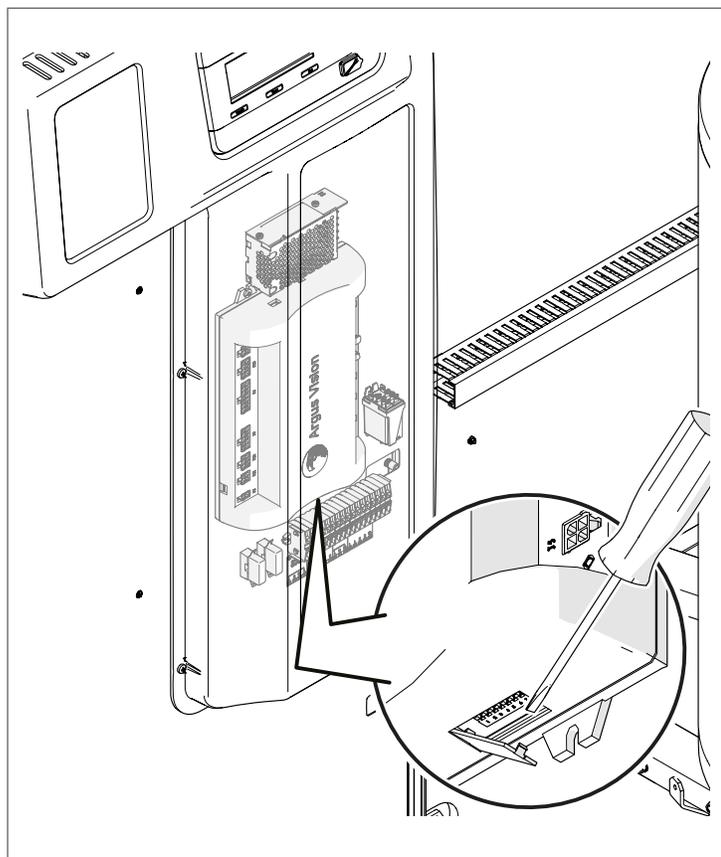
The essential steps for configuration are:

- allow the Managing boiler to recognize which and how many depending boilers are present in the system, using the dip-switches
- connect the boiler's with a BUS wire to allow communication between the control units.

#### 5.1.1 Setting the dip-switch

The dip-switches of all the boilers in the system must be set, and each must be set with an unequivocal sequence. This way the controller of the Managing boiler will be able to recognize which boilers are present in the system.

To access the dip-switches, open the hatch using a flat-head screwdriver.



**⚠ WARNING:** The setting must be carried out on each boiler. For configuration of the individual boiler, refer to the following table.

Key	
	Dip switch ON
	Dip switch OFF
Setting the Dip-switch	Boiler Configuration
	Stand-alone boiler (all the dip-switches set to OFF, configuration not used in cascade)
	1st boiler (Managing)
	2nd boiler (Depending)
	3rd boiler (Depending)
	4th boiler (Depending)
↓	↓
	8th boiler (Depending)
	9th boiler (Depending)
	10th boiler (Depending)

**⚠ NOTE:** If two boilers have the same Dip-switch setting, the Managing boiler will signal a communication error and the cascade will not work correctly.

**⚠ NOTE:** A boiler will not be recognized if it has the setting of all the Dip-switches set to OFF.

## 5.2 Multiple Boiler Cascade Installation and Start-Up

Fig. 41 shows an example of Array boilers installed in a cascade of three units. The built-in control system is capable of managing up to 8 boilers as a single, coordinated heating system. The logical schematic is:

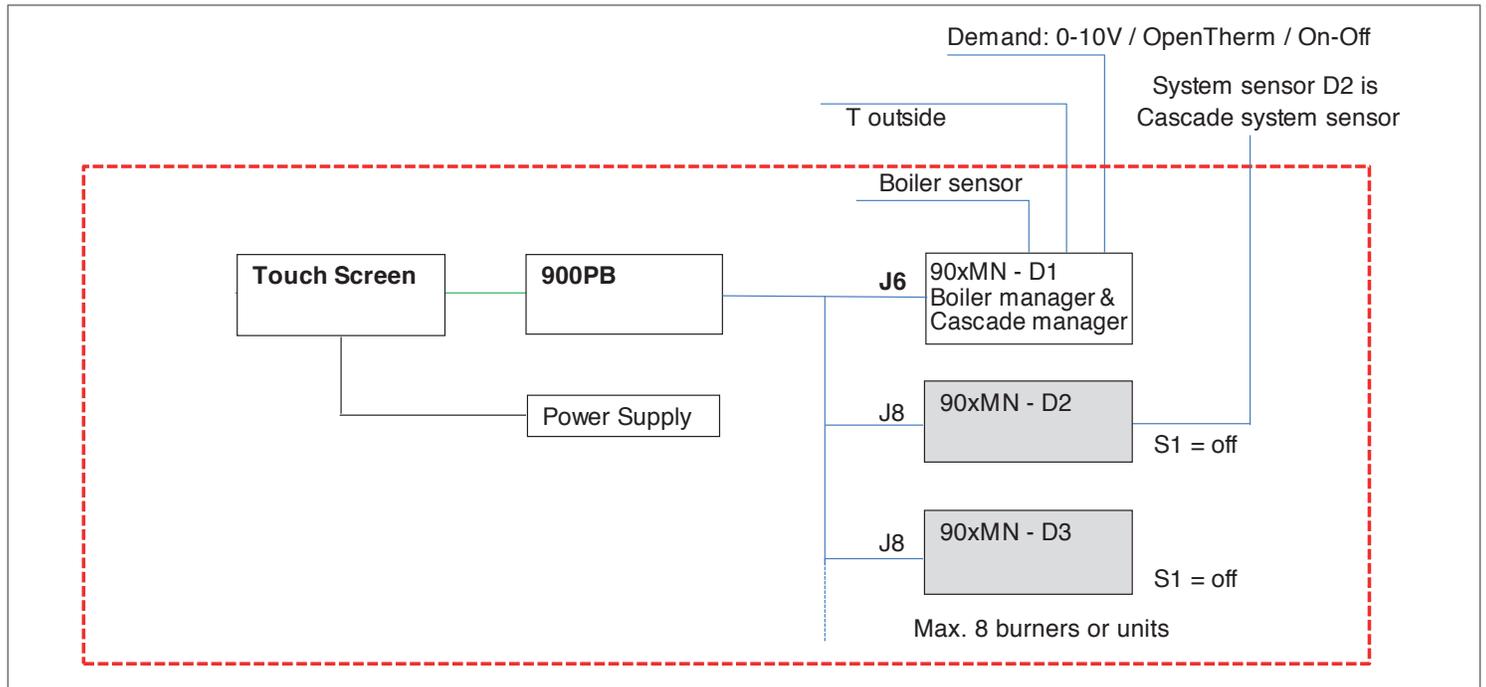


Fig. 41 *Module installation scheme*

## 6 CONFIGURATION OF THE MAIN BLOCK DIAGRAMS

**CAUTION:** The DHW and heating circuits must be completed with expansion tanks of a suitable capacity and correctly sized pressure relief valves. The discharge of the pressure relief valves and the appliances must be connected in accordance with local code and the authorities having jurisdiction. In general, the pressure relief valve should be routed to a suitable drain, the drain pipe should be within 6 inches from the floor or drain. It is not acceptable for the pressure relief valve to be routed to the outdoors.

**WARNING:** The installer is responsible for selecting and installing the system components and must work in full compliance with correct technical regulations and legislation in force.

**CAUTION:** Special supply/refill water must be conditioned using suitable treatment systems.

**WARNING:** For the connection of the devices connected to the terminal block (pumps, circulators and diverting / mixing valves) use interposed relays unless the maximum absorption of all components connected to the board (including the boiler circulator) is less than or equal to 1.5 A. Relay sizing is the responsibility of the installer depending on the type of connected device.

**WARNING:** It is prohibited to operate the boiler without water.

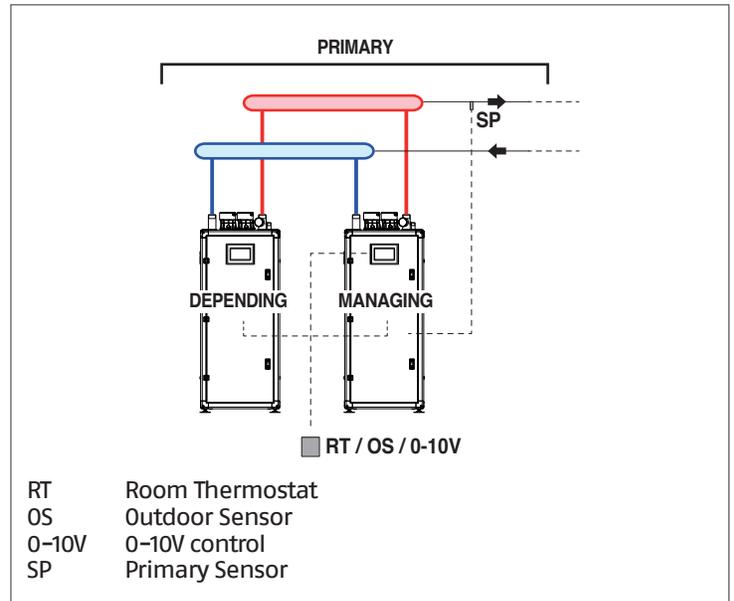
### 6.1 Configuration of the primary system

The basic cascade configuration consists of at least two boilers, One is assigned "Managing" role and the others are assigned the "Depending" role.

Cascaded boilers can be seen as the primary circuit of the heating system. This configuration could be ideal for replacing one or more larger boilers in an existing system if system reliability and efficiency is to be increased.

In order for cascade operation to be possible, the "Managing" boiler must be connected at least to the primary sensor (SP), available as an accessory.

The primary sensor is required in order to manage the cascade setpoint and is essential for managing the boilers in harmony.



Operation of the primary system can be:

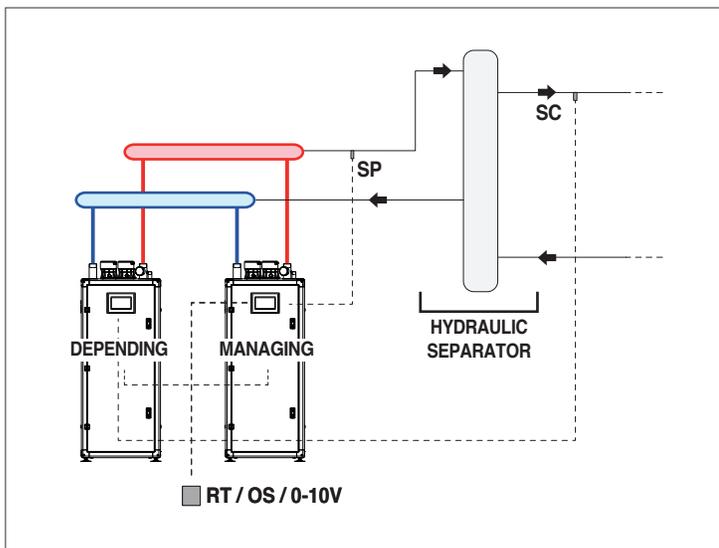
- Mode 0 - With fixed setpoint.  
This configuration requires the connection of an ambient thermostat or heat request contact (RT).
- Mode 1 - In climatic mode with variable setpoint based on the outdoor temperature.  
This configuration requires the connection of an ambient thermostat or heat request contact (RT) and an outdoor temperature sensor (OS), available as an accessory.
- Mode 2 - In climatic mode with intensity controlled by the ambient thermostat/heat request signal and variable setpoint based on the outdoor temperature.  
This configuration requires the connection of an ambient thermostat or heat request contact (RT) and an outdoor temperature sensor (OS), available as an accessory.
- Mode 3 - With fixed supply set point and the boiler controlled by the ambient thermostat/heat request signal.  
This configuration requires the connection of an ambient thermostat or heat request contact (RT).
- Mode 4 - With supply setpoint adjustment on the basis of the analog input 0-10V.  
This configuration requires an external device (for example, PLC of the central heating system) able to generate this signal connected to the analog input 0-10 V.

The functions described can be set using the "Managing" boiler's control interface. This is described in the manual of the individual thermal modules in the section "4.5 Boiler Startup Procedure" page 33.

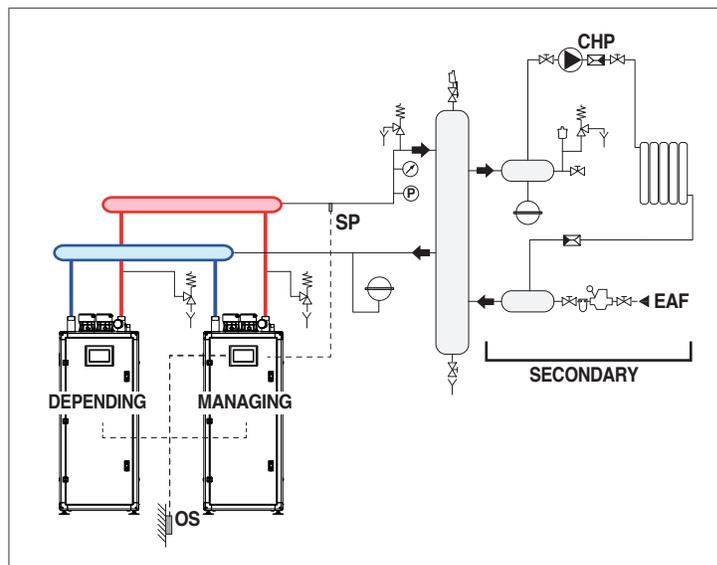
The electrical and hydraulic connections of the system are to be completed by selecting the use of the system circulator and two-way valves for each boiler (these devices are available as third party accessories).

## 6.2 Configuration of the secondary system

Optimal use of the boilers in cascade occurs by placing a hydraulic separator between the primary system (boilers in cascade) and the secondary system (such as heat distribution systems, DHW production). This device allows a different flow rate to be compensated between the primary and secondary systems.

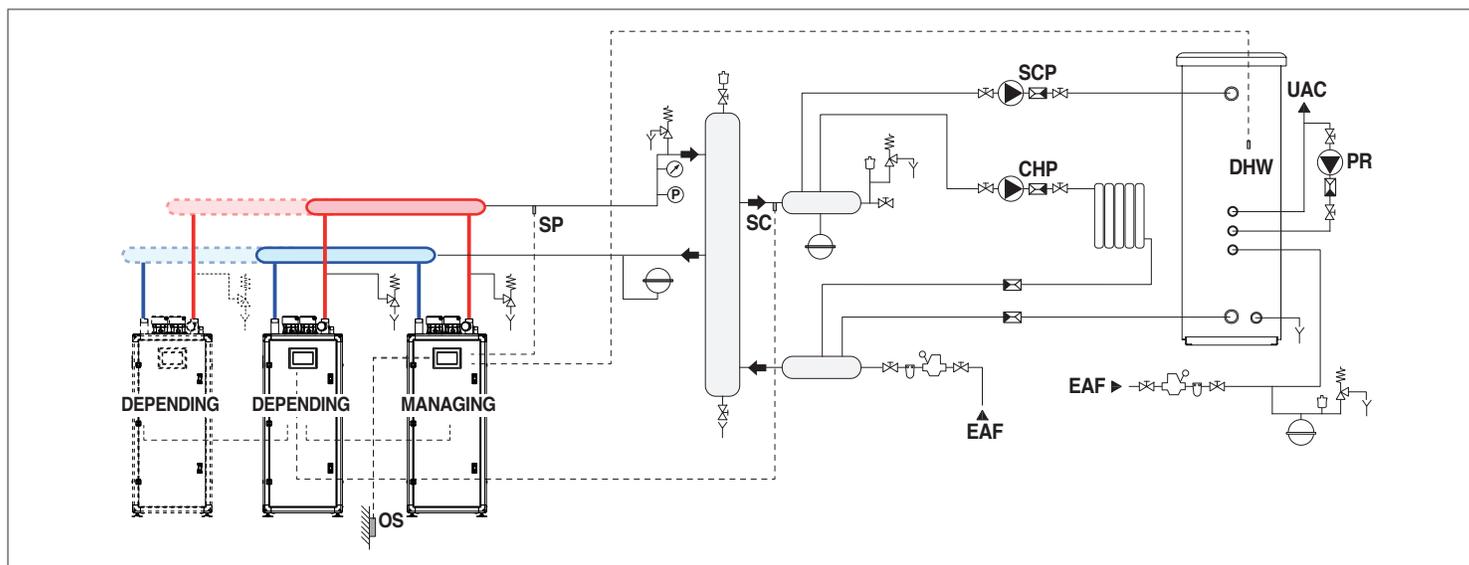


For the sake of simplicity, the hydraulic circuits downstream of the separator can be identified as the secondary system. The basic configuration of the secondary system takes place using a system circulator (CHP). This circulator, connected to the boilers in cascade, allows the transfer of the heat energy to a user circuit to be controlled, for example, a direct zone for high temperature heating of a room.



The secondary system can be configured using the following accessories:

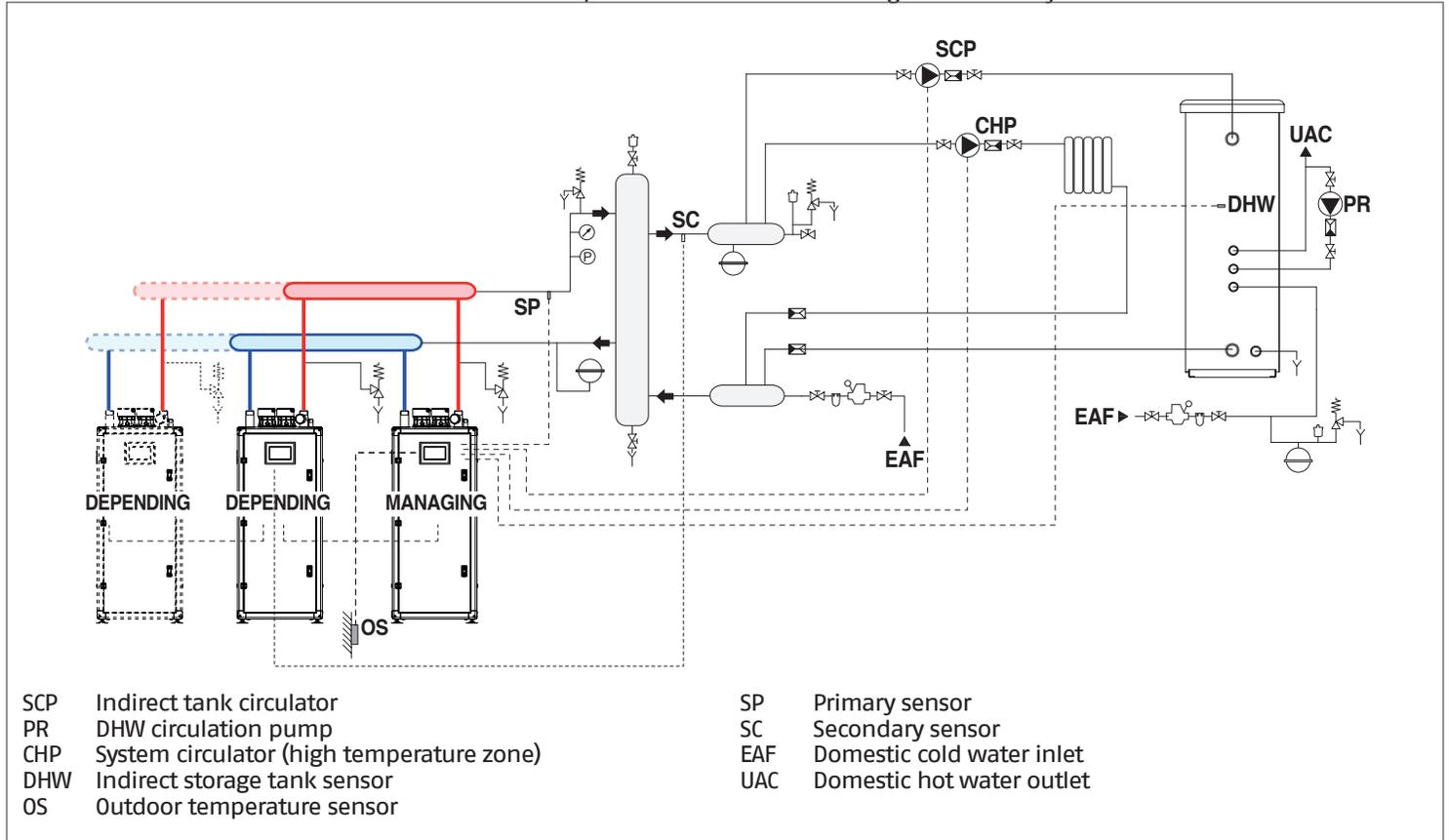
- Secondary sensor (SC)  
This is required in order to manage the setpoint, and therefore the required temperature, downstream of the hydraulic separator.  
The secondary sensor is connected to the controller of the first "Depending" boiler.
- Hot water tank sensor (DHW)  
This is required in order to manage the production of DHW in combination with an indirect hot water tank circulator (SCP).  
The indirect hot water tank sensor is connected to the controller of the "Managing" boiler.



To make the electrical connections, refer to the wiring diagrams of the selected system. For the Bus connection mode, refer to the section "6.3.3 Bus connections" page 44.

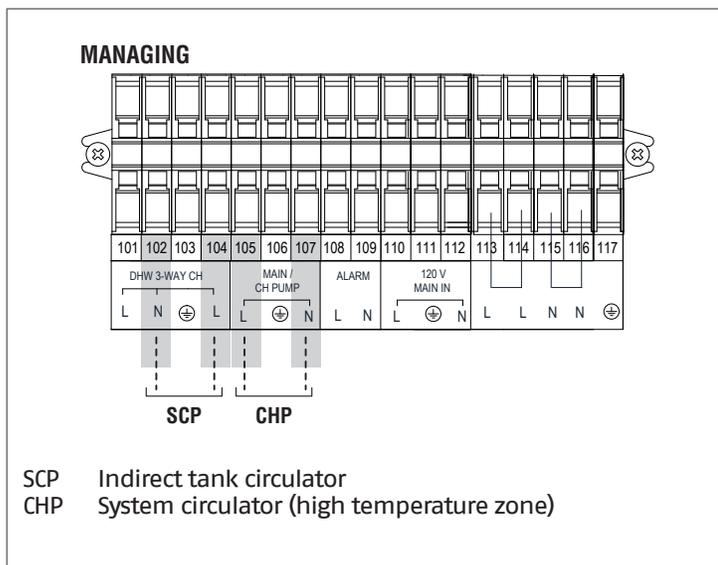
### 6.3 Block diagram

Circuit with thermal modules with their own circulator, connected in cascade. Using the secondary sensor.

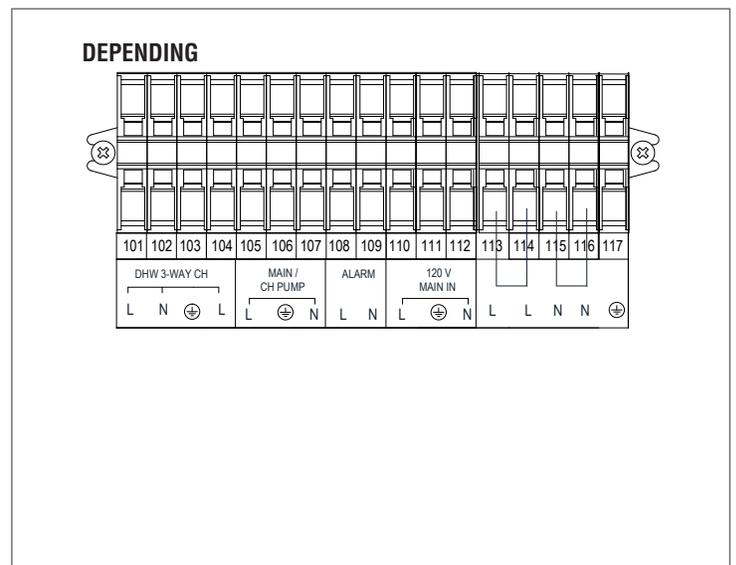


### 6.3.1 Electrical power connections

#### MANAGING CONNECTIONS

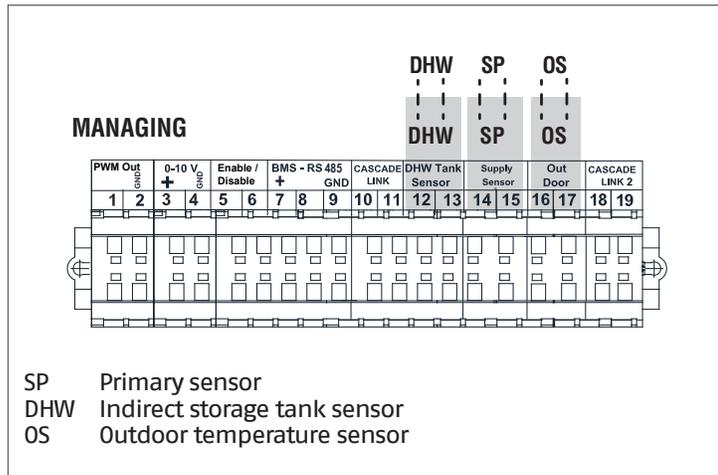


#### DEPENDING CONNECTIONS

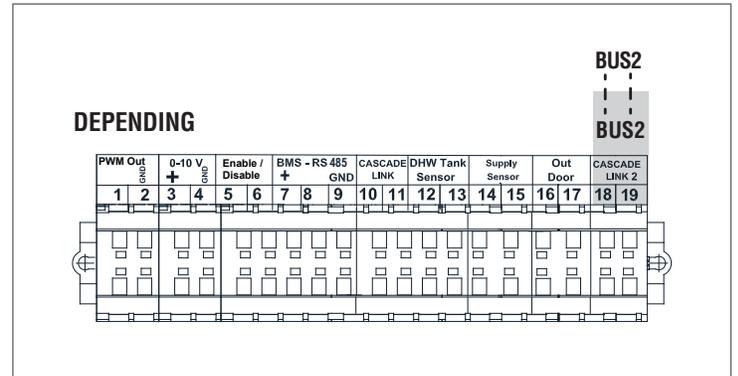


### 6.3.2 Sensor connections

#### MANAGING CONNECTIONS

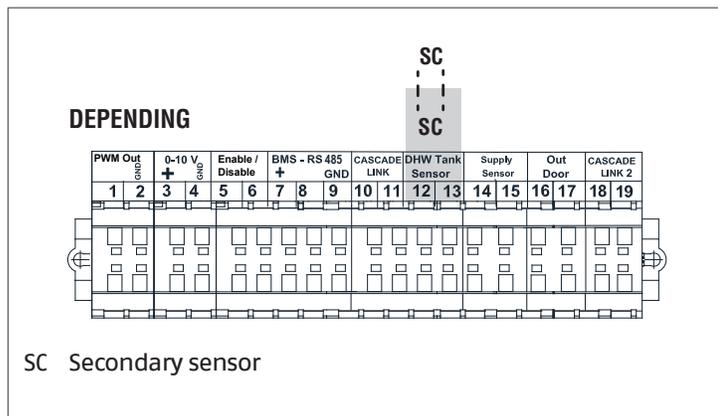


#### DEPENDING CONNECTIONS



#### DEPENDING CONNECTIONS

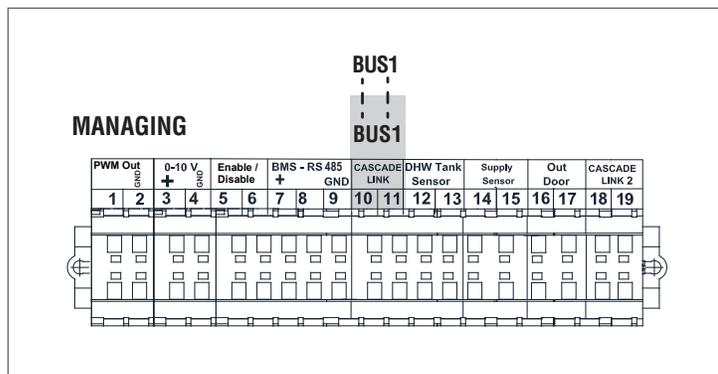
**NOTE:** Connections to be made on the first depending boiler only.



### 6.3.3 Bus connections

See section "5 System management" page 39 for a detailed description of the connections between the boilers.

#### MANAGING CONNECTIONS



### 6.4 System parameters

**NOTE:** See the section "7.5 Setting the main parameters" page 49 for a detailed description on parameter operation

#### Essential parameters to be configured for the block diagram:

	Managing	Depending
S1	OFF	OFF
Dip-switch	1 to ON	2-10 to ON
Par.73	Managing	Dependent
Par.147	no. of boiler installed	/
Par.7	greater than/equal to 18°F (10°C)	greater than/equal to 18°F (10°C)
Par.97	22	22

#### Specific parameters to be configured for the block diagram:

	Managing	Depending
Par.79	adjust according to requirements	/
Par.80	adjust according to requirements	/
Par.81	adjust according to requirements	/
Par.86	adjust according to requirements	/
Par.87	adjust according to requirements	/
Par.169	adjust according to requirements	/
Par.170	adjust according to requirements	/
Par.171	adjust according to requirements	/
Par.176	adjust according to requirements	/
Par.177	adjust according to requirements	/

## 7 OPERATION

### 7.1 Introduction

The information in this Chapter provides a guide to the operation of the **Array AR SE** Boiler using the Control Panel mounted on the front of the unit. It is imperative that the initial startup of this unit be performed by factory trained personnel. Operation prior to initial startup by factory trained personnel may void the equipment warranty. In addition, the following **WARNINGS** and **CAUTIONS** must be observed at all times.

**⚠ WARNING:** Electrical voltages in this system include 230, 120 volts AC and 24 volts DC. It must be serviced only by factory certified service technicians.

**⚠ WARNING:** Do not attempt to dry fire the unit. Starting the unit without a full water level can seriously damage the unit and may result in injury to personnel or property damage. This situation will void any warranty.

**⚠ CAUTION:** All of the installation procedures in "Installation" starting on page 19 must be completed before attempting to start the unit.

### 7.2 Control Panel Description

All **Array AR SE** Series Boilers utilize the Touchscreen Control Panel shown in Fig. 42. This Touchscreen panel contains the basic controls for monitoring the boiler. All other controls, indicators and displays necessary to operate, adjust and troubleshoot the boiler are available on the 905PB inner display.

Additional information on these items is provided in the individual operating procedures and menu descriptions provided in this Chapter.

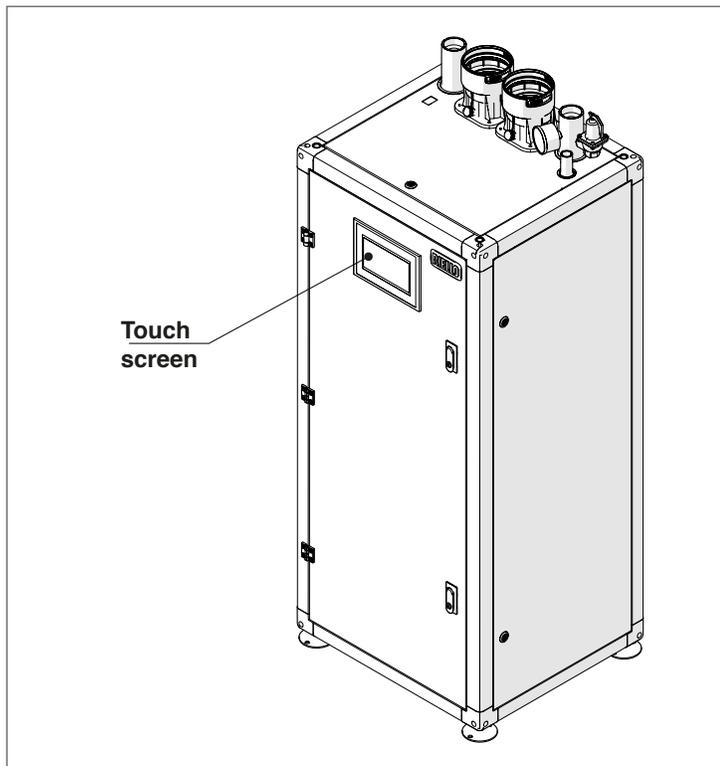


Fig. 42 Touchscreen Control Panel

### 7.3 Touchscreen Control Panel Menu

The Touchscreen Control Panel incorporates a menu structure which permits the operator to monitor and set up (basic settings only) the unit. The menu structure consists of four major screens and four secondary ones.

#### 7.3.1 Riello Screen



Fig. 43 Riello Screen

The **RIELLO** logo is the entry point of the Control System. By touching it, the system moves to the first operating screen.

#### 7.3.2 Module Screen

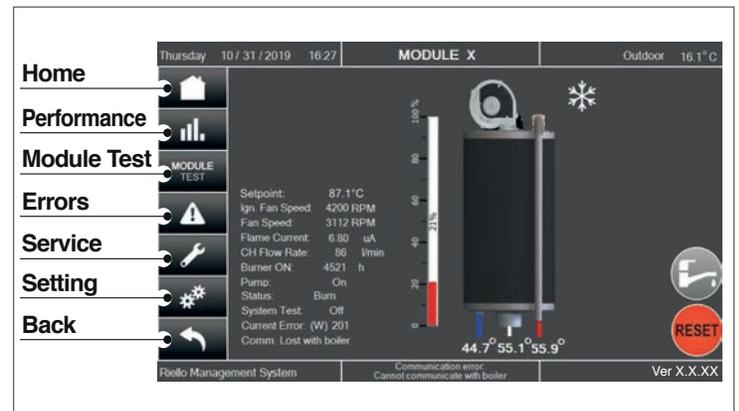


Fig. 44 Module Screen

The module screen shows the current configuration of the plant, consisting of one or more boiler.

Through this screen, the following actions can be done:

- Adjust the temperature setpoint using the "+" and "-" buttons;
- Access the Boiler screen of the desired boiler, by touching the numbered icons on the screen;
- **Home button:** move back to the **RIELLO** screen;
- **Performance button:** move to the Performance screen of the module;
- **Module test:** move to the module test screen;
- **Errors button:** move to the Errors screen;
- **Service button:** move to Service screen;
- **Settings button:** move to Settings screen;
- **Back button:** move to the previous screen.

### 7.3.3 Performance Screen

The Control system is able to show the last 10 minutes “real time” performance of the plant. The screen shows different information according to the context.

The Performance screen includes the trend of:

- Current Return Temperature
- Current Flue Temperature
- Current Flame

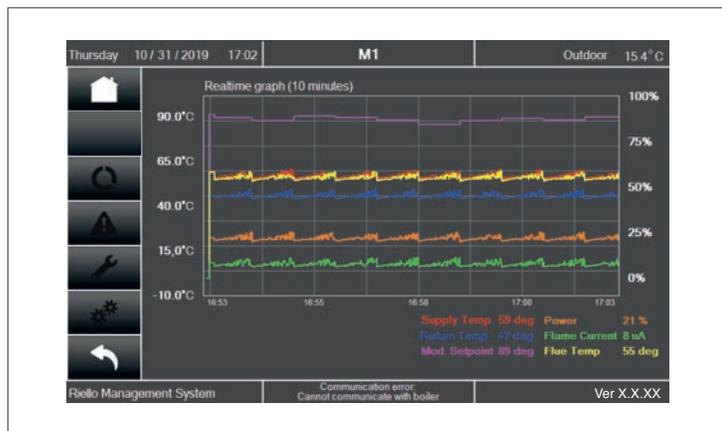


Fig. 45 Performance Screen

The Error screen shows the list of the last 40 errors occurred. The errors are listed in chronological order, under two categories: Blocking errors (auto-reset) and Locking errors (manual reset).

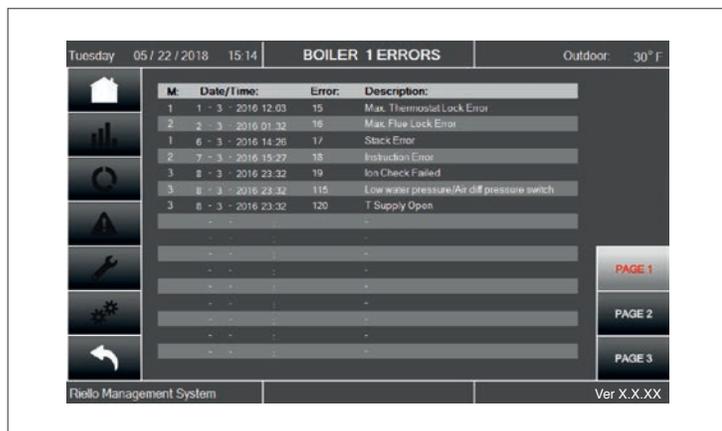


Fig. 46 Error Screen

### 7.3.4 Service Screen

The Service screen shows the main parameters of the Service Reminder function.

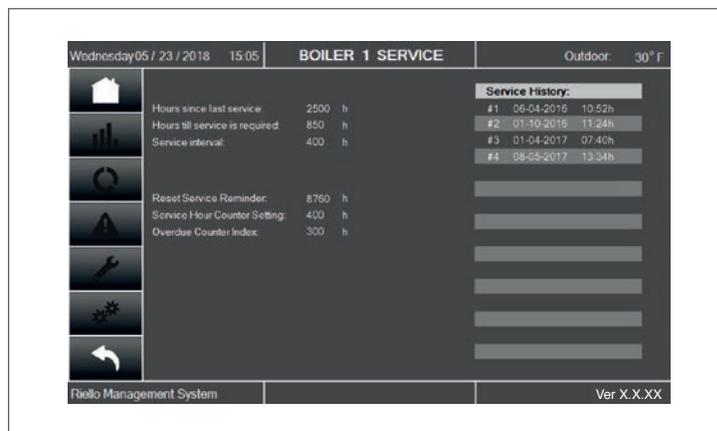


Fig. 47 Service Screen

The **Service Reminder** will remind the owner/user of the appliance to service the appliance at a specified Service\_Interval (factory setting).

When service is not done within the specified time, a service reminder will be shown on the screen, alternating with the normal status display.

The **Service Interval** can be set as the number of burn hours or the number of operational (appliance is powered) hours.

This can be done by setting the Service\_Hour\_Counter (factory) parameter.

When the Service Reminder is active, the time before service is actually done is logged by the 900PB (in hours). This time is called the Service Overdue time. With this log the factory can read back how long service was overdue on the system/appliance which can be useful when handling warranty claims.

A maximum of 15 Service moments can be logged by the 900PB, when the log is full it will overwrite the oldest log entry.

Each time the Service Reminder is being reset, a new service moment is counted and the Service Overdue counter will be stored in the log/history.

### 7.3.5 Test Screen

This screen is designed to support the installer and service activities. When pushing the Module Test button on Module screen, a new set of buttons appears on the left side of the screen.

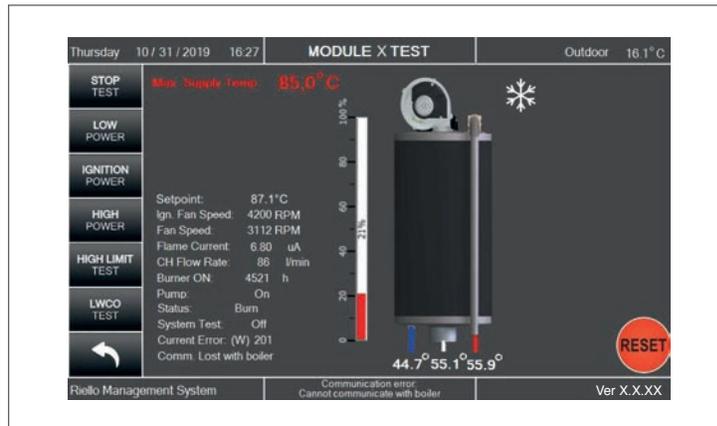


Fig. 48 Test Screen

Setup, adjustments and checks of combustion parameters can be done using the Low Power, Ignition Power and High Power buttons.

In addition, the High Limit button allows the inspector to carry out the high limit temperature switch functionality test.

### 7.3.6 Cascade Screen

In case of Cascade System, the following screen is displayed.

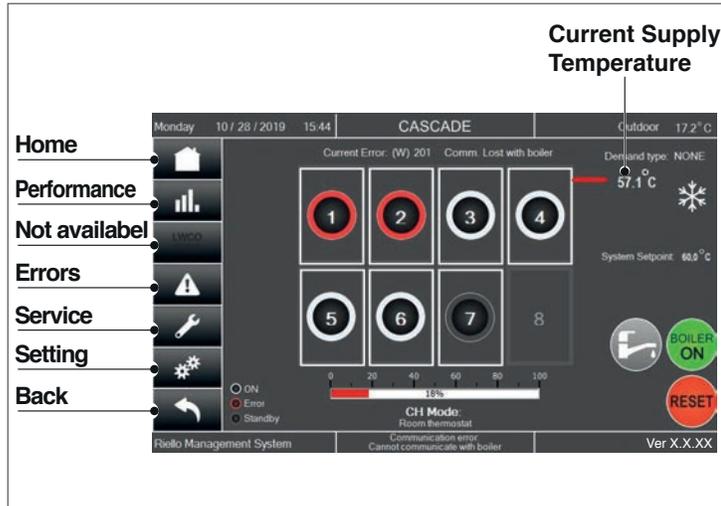


Fig. 49 Cascade Screen

The Cascade screen shows the current configuration of the plant, consisting of one or more cascaded boilers.

Through this screen, the following actions can be done:

- Adjust the temperature setpoint using the "+" and "-" buttons;
- Access the Boiler screen of the desired boiler, by touching the numbered icons on the screen;
- **Home button:** move back to the **RIELLO** screen;
- **Performance button:** move to the Performance screen of the cascade;
- **Errors button:** move to the Errors screen;
- **Service button:** move to Service screen;
- **Settings button:** move to Settings screen;
- **Back button:** move to the previous screen.

### 7.3.7 Module Screen

Through this screen, the following actions can be performed:

- See the current value of many parameters: water supply & return temperature, flue temperature, water flowrate, fan speed, flame rod ionization current, burner and pump status, any error status or service required;

Use the side buttons to perform the actions listed below:

- **Home button:** move back to the **RIELLO** screen;
- **Performance button:** move to the Performance screen of the module;
- **Stats button:** not active;
- **Errors button:** move to the Errors screen;
- **Service button:** move to Service screen;
- **MODULE TEST button:** move to the Module test screen;
- **Reset button:** clear any Locking error relevant to the module;
- **Back button:** move to the previous screen.

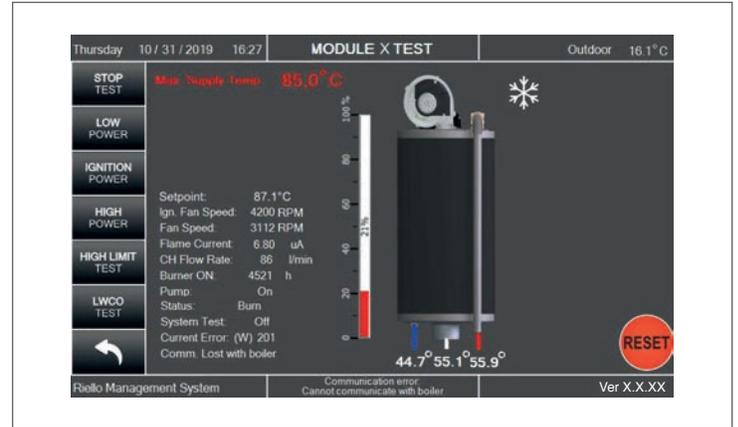


Fig. 50 Module Screen

**IMPORTANT:** When resetting a Locking error of the Managing module, the whole boiler will be switched OFF and then re-started.

### 7.3.8 Performance Screen

The Control system is able to show the last 10 minutes "real time" performance of the plant. The screen shows different information according to the context.

The Cascade Performance screen includes the trend of:

- Current power input;
- Targeted temperature setpoint;
- Current supply temperature.

The Module Performance screen includes the trend of:

- Current power input;
- Targeted temperature setpoint;
- Current supply temperature;
- Current Return Temperature;
- Current Flue Temperature;
- Current flame.

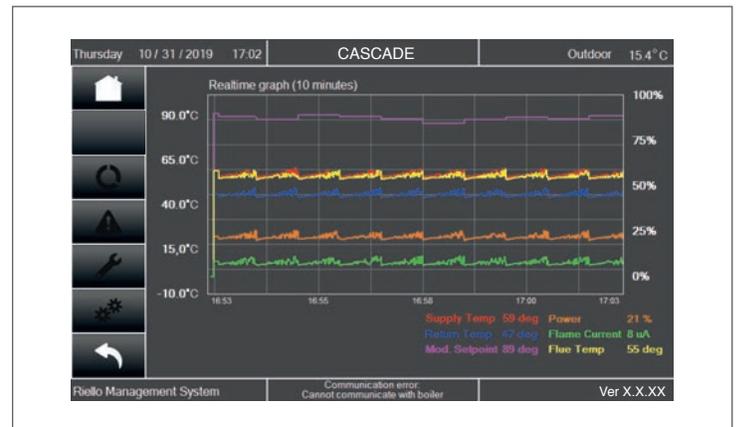


Fig. 51 Performance Screen

### 7.3.9 Error Screen

For each boiler, the Error screen shows the list of the last 40 errors occurred on its own modules.

The errors are listed in chronological order, under two categories: Blocking errors (auto-reset) and Locking errors (manual reset).

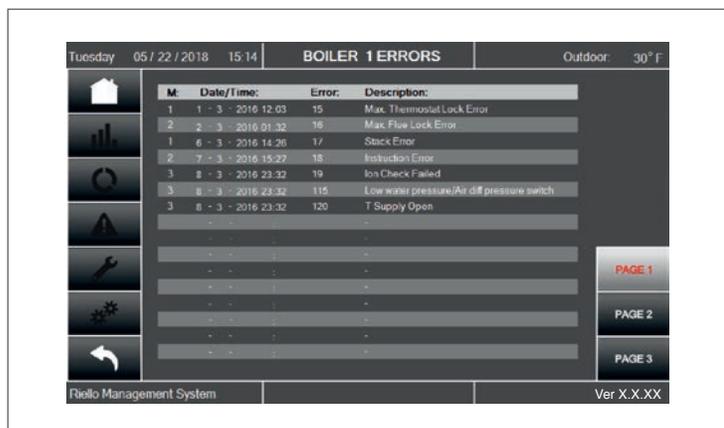


Fig. 52 Error Screen

### 7.3.10 Service Screen

The Service screen shows the main parameters of the Service Reminder function.



Fig. 53 Service Screen

The **Service Reminder** will remind the owner/user of the appliance to service the appliance at a specified Service\_Interval (factory setting).

When service is not done within the specified time, a service reminder will be shown on the screen, alternating with the normal status display.

The **Service\_Interval** can be set as the number of burn hours or the number of operational (appliance is powered) hours. This can be done by setting the Service\_Hour\_Counter (factory) parameter.

When the Service Reminder is active, the time before service is actually done is logged by the 900PB (in hours). This time is called the Service Overdue time. With this log the factory can read back how long service was overdue on the system/appliance which can be useful when handling warranty claims.

A maximum of 15 Service moments can be logged by the 900PB, when the log is full it will overwrite the oldest log entry. Each time the Service Reminder is being reset, a new service moment is counted and the Service Overdue counter will be stored in the log/history.

### 7.3.11 Module Test Screen

This screen allows to carry out the same operations shown on paragraph "Test Screen" for each cascade module.

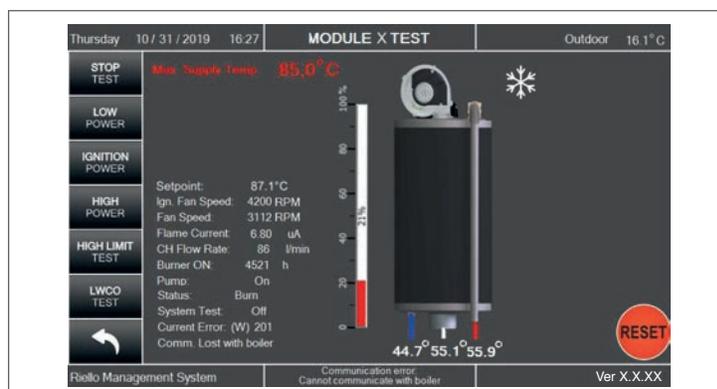


Fig. 54 Module Test Screen

### 7.4 Display board replacement

System configurations must be performed only by the Technical Assistance Service or by personnel authorized by **RIELLO**.

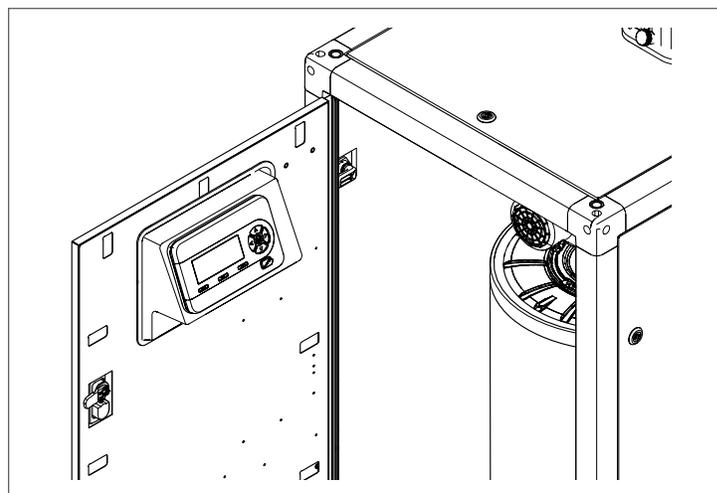


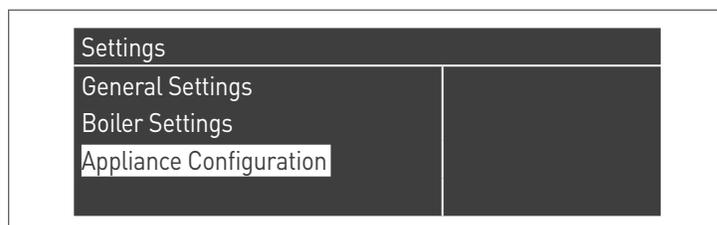
Fig. 55 Display board

When replacing the front control panel, an initial screen with the logo is displayed on the next reboot **RIELLO**.

The system performs a consistency check between the configuration data saved on the motherboard and those saved in the user interface; therefore, when replacing the control interface, the system can detect an inconsistency between the saved data. Set the Par. 97 and the Par. 98.

Proceed as follows:

- On the home screen of the control panel, press the ● key
- Select "Settings" with the ▲ / ▼ keys and press the ● key
- Select "Appliance configuration" with the ▲ / ▼ keys and press the ● key

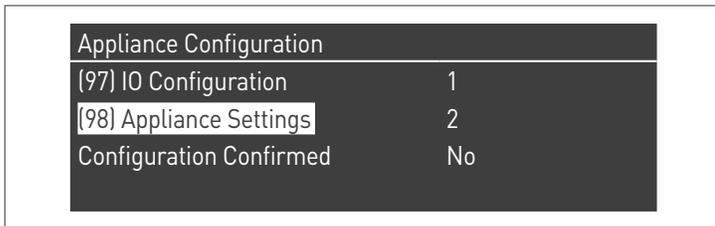


- Enter the password
- Select "(97) IO Configuration" and press the ● button
- With the ▲ / ▼ keys change the value following what is in the following table and press the ● key:

Model	Par. 97	
	NG	LPG
AR 399 SE	22	22
AR 500 SE	22	22

**!** (\*) Par. 126 = 10 (DEFAULT 6)

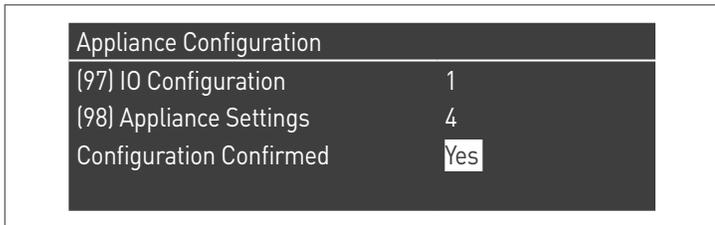
- Press the ▼ key, select "(98) Appliance Settings" and press the ● key



- With the ▲ / ▼ keys change the value following what is in the following table and press the ● key:

Model	Par. 98	
	NG	LPG
AR 399 SE	83	84
AR 500 SE	82	82

- Press the ▼ key, select "Config. Confirmed" and press the ● key
- With the ▲ / ▼ keys change the value to "Yes" and press the ● key



At this point the systems starts an application update process. Once this is finished, the menu "Settings" appears on the menu.

- Press ◀ until you return to the home screen

An error message is displayed for a few seconds and then the display returns to its normal state.

## 7.5 Setting the main parameters

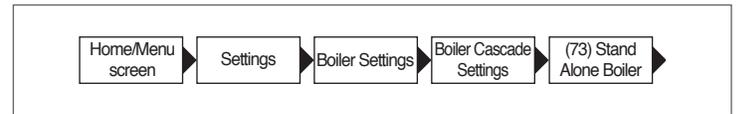
Some parameters are essential in order for the system to operate in cascade and setting these parameters is a determining factor for correct system operation.

### 7.5.1 Par.73 – Managing, Stand-alone, Dependent mode.

Parameter 73 defines how the boiler is addressed and ensures that the signal from the secondary sensor is recognized.

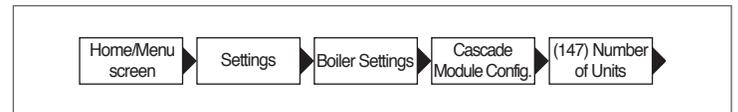
Three values can be set:

- **Managing:** to be set on the Managing boiler so that secondary sensor operation is activated.  
**NOTE:** The secondary sensor SC must be connected to the 2nd boiler (1st Depending boiler);
- **Stand Alone:** to be set on the Managing boiler so that secondary sensor operation is deactivated;
- **2 ÷ 7** to be set on all Depending boilers.



### 7.5.2 Par.147 – No. of boilers

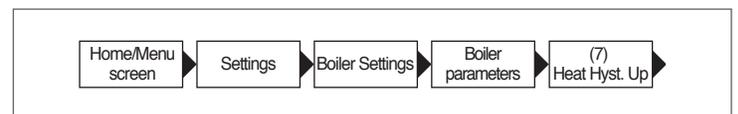
Parameter 147 serves to define the number of boilers present on the system (it is important to set the number of boilers connected in order to ensure correct system operation). This parameter must only be set on the Managing boiler.



### 7.5.3 Par.7 – heating setpoint hysteresis

Parameter 7 adjusts shutdown of the individual boilers when the setpoint is exceeded. With cascade operation, this value must be increased (up to a maximum of 36 °F (20 °C) to prevent the boiler operation from being disabled (since the default value is 9 °F (5 °C) if the system decides to increase the setpoint based on the value read on the primary or secondary sensor (see sections "General operation", "Operation with the primary sensor" and "Operation with the secondary sensor")

This parameter is to be modified (in the same way) on all boilers of the cascade system (Managing boiler and all the relative Depending boilers).



### 7.5.4 General operation

With a cascade system, the regulator of the managing boiler establishes a setpoint to be sent to the depending boilers based on parameters 86-87, the difference between the setpoint value set and the value read on the primary supply manifold (or on the basis of par 176-177 and the difference between the setpoint value set and the value read on the secondary supply manifold).

On the basis of the setpoint received from the Managing boiler, each boiler modulates based on its own PID (Par 16, Par 17 and Par 18) as a function of the difference between the setpoint (sent by the Managing boiler) and the value read by the supply sensor on the boiler itself.

**!** The PID is a Proportional-Integral-Derivative control system (abbreviated to PID) with retro-action. By reading an input value which determines the current value, it is able to react in the event of a positive or negative error (difference between the current value and the target value), tending towards 0. Reaction to the error can be regulated through the terms "proportional, integral, derivative".

### 7.6 Operation with the secondary sensor

When the secondary system is present (see block diagrams), the setpoint sent to the individual boilers to be modulated on the basis of the difference between the setpoint and the value read on the delivery manifold of the secondary system.

In the same way that modulation is based on the system sensor, the following parameters intervene:

169	defines the maximum setpoint decrease
170	defines the maximum setpoint increase
171	defines the time (from the start of the request) from which the setpoint modulation is started
176	defines the proportional term for setpoint modulation
177	defines the integrative term for setpoint modulation

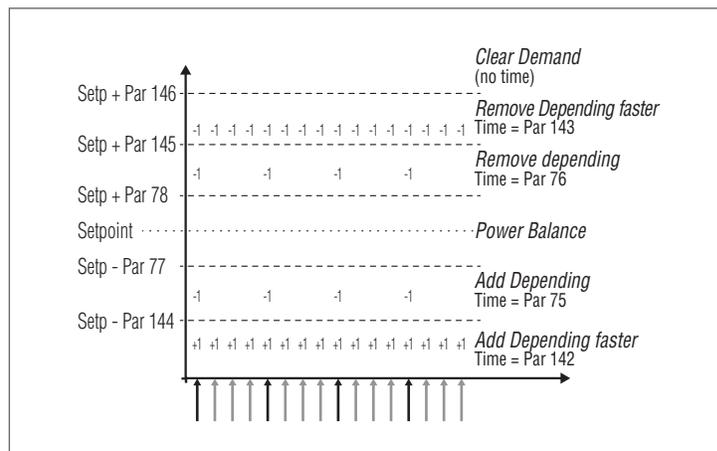
### 7.7 Parameter 148: operating mode of the cascade

It is possible to adopt cascade management which can be modified according to different strategies. These different strategies can be set using the parameter known as "Cascade mode" Par. 148.

### 7.7.1 Par 148 = 0

The start-up/shutdown of each boiler is based on the following graph.

The shut-off values of the lines with the y axis are the sum or the difference of the values of the corresponding parameter in relation to the value of the setpoint sent by the Managing boiler to the boilers.



Six options are defined on the basis of the temperature read (by the Managing boiler) on the supply manifold of the primary system.

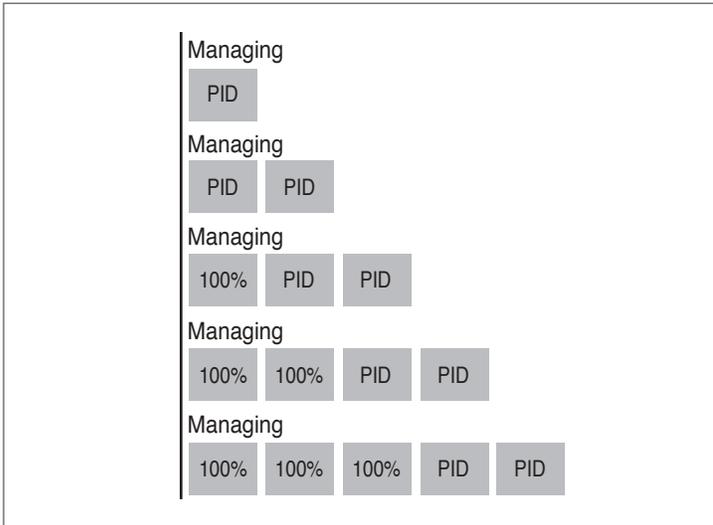
- In the central option, **Power balance**, defined (by the variable parameters) around a setpoint, no start-ups or shutdowns of the Depending boilers are made. The parameters which define this band are 77 and 78.
- In the options, **Remove dependent** and **Add dependent**, the start-ups and shutdowns are carried out with "long" time intervals which can differ between start-up and shutdown. The parameters which define this band are 77, 78, 144, 145. The time interval is defined by parameters 75 and 76.
- In the options, **Remove dependent Faster** and **Add dependent Faster**, start-ups and shutdowns are carried out with a "short" time interval which, even in this case, can differ between start-up and shutdown. The shutdown option is between the values of parameters 146 and 145, while the start-up band is below the value defined by parameter 144. The time range is defined by parameters 142 and 143.
- In the option, **Clear demand**, all the boilers are immediately stopped. This option is above the value defined by parameter 146.

### 7.7.2 Par 148 = 1

In this mode the system manages the cascade so that the minimum number of boilers is on.

The first difference in relation to mode 0 refers to the logic with which the modulation of the Depending boilers within the cascade is managed.

In fact, while each boiler modulates with its own PID in mode 0, no more than two Depending boilers modulate with the same criteria in mode 1, while the remaining boilers operate at maximum power. The diagram is represented in the following figure:



Practically speaking, if more than two boilers are on, only two boilers are controlled via PID, while the others receive a signal to move to maximum power.

The second difference refers to the start-up/shutdown rules of the individual modules.

In any case, the start-up and shutdown rules are managed according to the indications shown in the previous graph. The difference is that it is also possible to have start-ups/shutdowns of the Depending boilers in the "balancing" zone.

This additional start-up criteria (valid in the balancing band only) ensures that a boiler is started-up when any one of the two boilers controlled by a PID adjustment has reached a threshold power (Par 82) once a specific wait time defined by Par 75 has elapsed.

Similarly (still within the balancing band), a boiler is shutdown if both boilers controlled by a PID adjustment have reached a percentage of power which is below the minimum power threshold (Par 83) once a specific wait time defined by Par 75 has elapsed.

### 7.7.3 Par 148 = 2

In this mode the system manages the cascade so that the maximum number of boilers is on.

This mode is similar to mode 0 apart from the start-up and shutdown rules.

In this case the rules based on the information illustrated by the previous graph are still valid, with the following differences (in any case, always applicable to the "balancing" option only):

To add an additional depending boiler, the managing boiler evaluates whether the sum of the power (calculated on the basis of the fan speed) of all the active boilers is greater than the product between the number of the active depending boilers increased by one and the minimum power value (Par 152) increased by a hysteresis value (defined by Par 153).  $[\sum (P1, P2, \dots, Pn) > (n+1) * (Par\ 152) + (Par\ 153)]$ .

To shutdown a boiler access, the managing boiler evaluates whether the sum of the power (calculated on the basis of the fan speed) of all the active boilers is less than the product between the number of the active depending boilers and the minimum power value (Par 152).  $[\sum (P1, P2, \dots, Pn) < (n) * (Par\ 152)]$ .

**NOTE:** We must consider that the percentage of power varies from a minimum of 1% and a maximum of 100% and therefore, the parameter values 152 and 153 are not to be taken as the percentage of absolute power.

## 7.8 Troubleshooting

FAULT	CAUSE	SOLUTION
There is a smell of gas	Gas supply circuit leaks	- Check the seal of the gaskets and the pressure test ports/taps for leaks
Odour of unburnt gas	Flue gas circuit	- Check the gasket seals - Make sure there are no obstructions - Check the combustion quality
Irregular combustion	Burner gas pressure	- Check the setting
	Orifice installed	- Check the diameter
	Dirty burner and heat exchanger	- Clean the burner and heat exchanger - Perform a combustion analysis
	Heat exchanger passages obstructed	- Clean the burner and heat exchanger - Perform a combustion analysis
	Faulty fan	- Check the operation of the fan; replace if necessary
Ignition delays with pulsating at the burner	Burner gas pressure	- Check the setting
	Ignition electrode	- Check the positioning and conditions
The boiler becomes dirty very quickly	Combustion	- Perform a combustion analysis
The burner does not start upon consent of the boiler control	Gas valve	- Check for the presence of 120Vac voltage on the gas valve terminals (J5 connector of main board), check wiring and connections
The boiler does not start	No electrical power supply (no message on the display)	- Check the electrical connections - Check the condition of the fuse
The boiler does not arrive at temperature	Boiler dirty	- Clean the combustion chamber
	Burner capacity insufficient	- Check and clean the burner - Perform a combustion check
	Boiler system adjustment	- Check the parameters are set correctly - Check the temperature setting is correct
The boiler triggers the water high limit error	No water	- Check the water high limit is working properly - Check the temperature setting is correct - Check the electrical wiring is not disconnected - Check the position of the sensor
	Boiler system adjustment	- Check the auto air vent is bleeding properly - Check the heating circuit pressure
The boiler is at temperature but the heating system is cold	Presence of air in the system	- Bleed the system
	Pump malfunctioning	- Check/unseize the pump - Replace the circulator - Check the electrical connection of the circulator
The circulator does not start	Pump malfunctioning	- Check/unseize the pump - Replace the circulator - Check the electrical connection of the circulator
Frequent tripping of the low water cutoff	System pressure relief valve	- Check the pressure relief valve is not out of calibration and that the low water cutoff is functioning properly
Frequent tripping of the low water cutoff	Incorrect system pressure	- Check the system pressure - Check pressure reducer functioning
Frequent tripping of the low water cutoff	Expansion tank	- Check the expansion tank is charged properly and not ruptured



## 8 RECYCLING AND DISPOSAL

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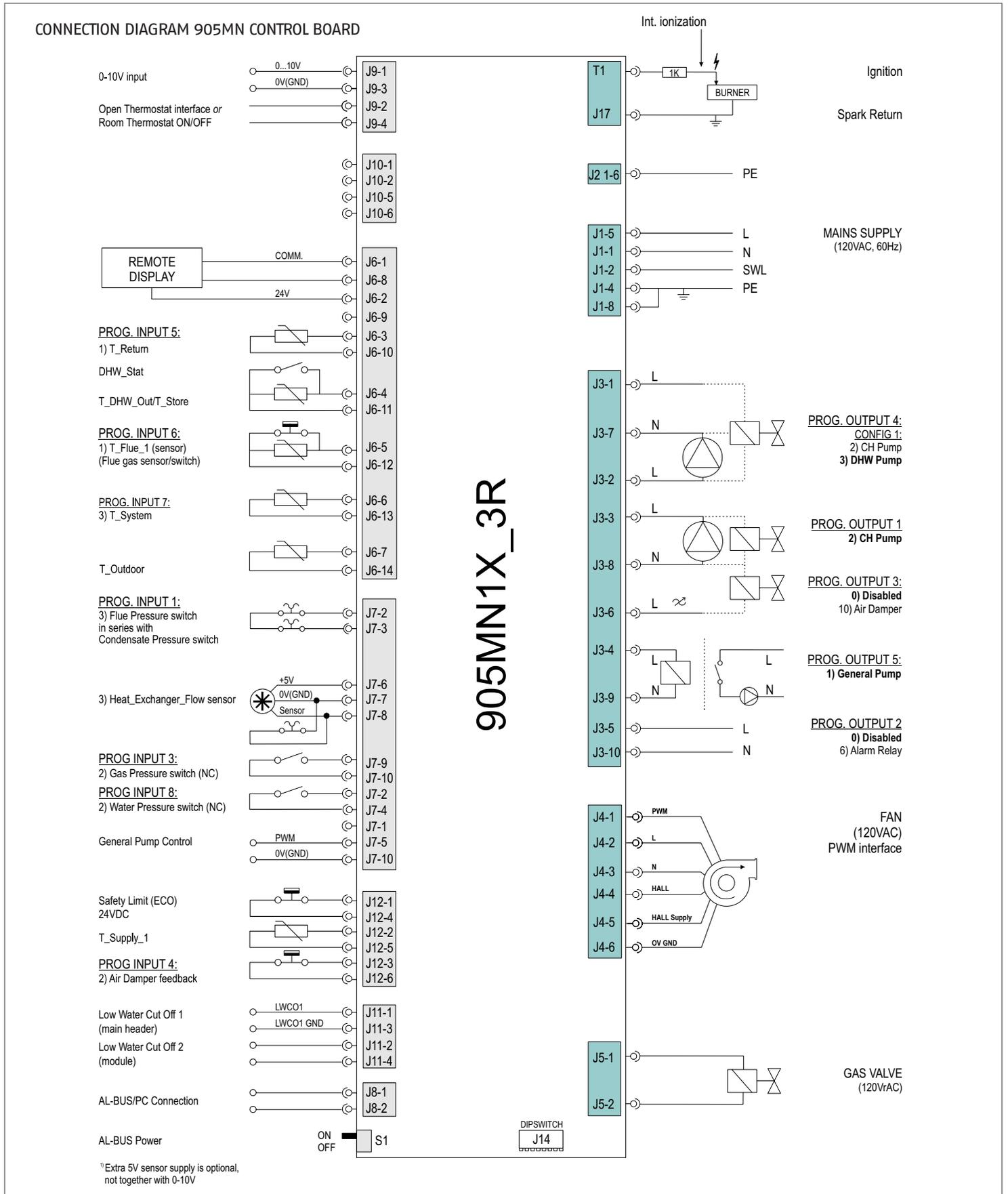
The appliance is manufactured using various materials, such as metal, plastics, and electric and electronic components. At the end of the life cycle, safely remove the components and dispose of them in a responsible manner, in compliance with the installation country's applicable environmental legislation.

**⚠ NOTE:** Adequate sorted waste collection, processing and environmentally-friendly disposal contribute to preventing possible negative impacts on the environment and health and promote the reuse and/or recycling of the materials of which the appliance consists.

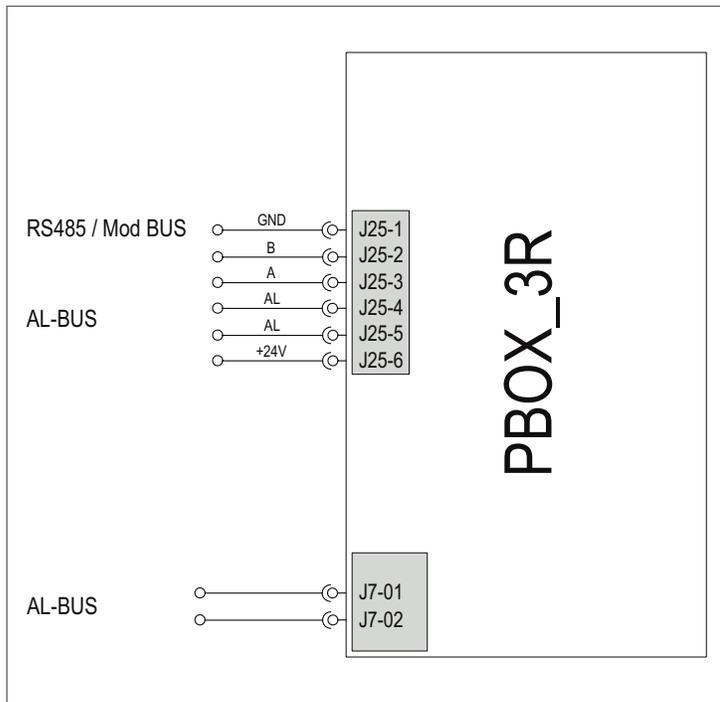
**⚠ NOTE:** Illegal disposal of the product by the owner shall be subject to administrative fines provided for by applicable laws.



APPENDIX A – CONNECTION DIAGRAM

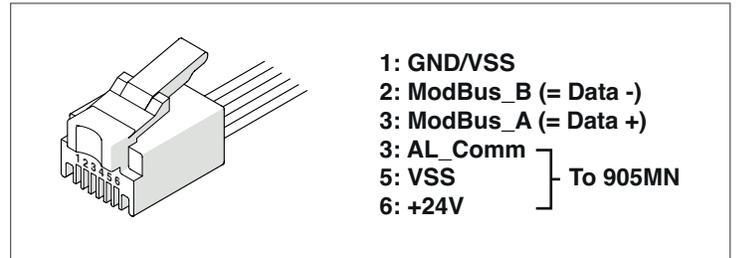


CONNECTION DIAGRAM 905PB DISPLAY



905PB05_3R	
Connector	Function
J7	PC interface
J25	Connection to MN control/Modbus

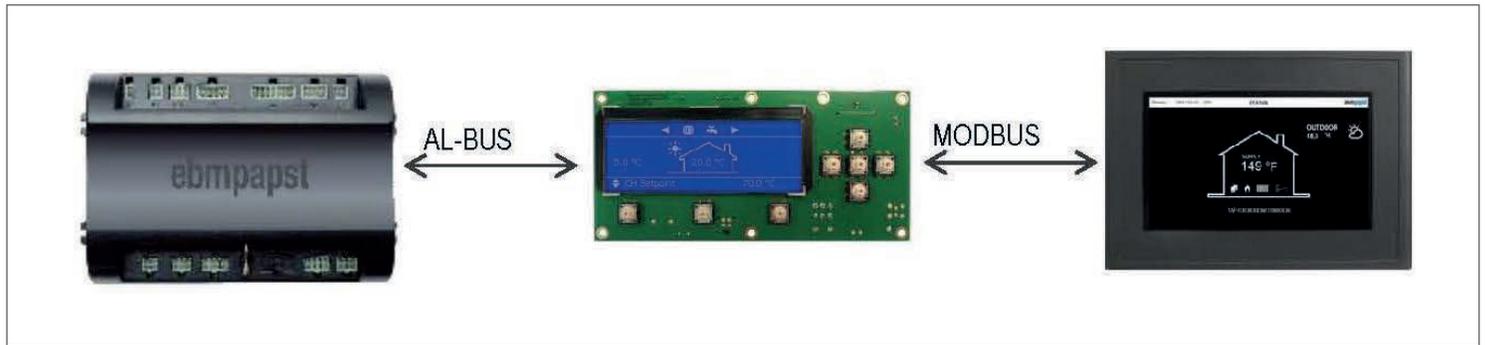
905PB05\_3R Display: RJ-11 Connector:



J25 Wire Colors:

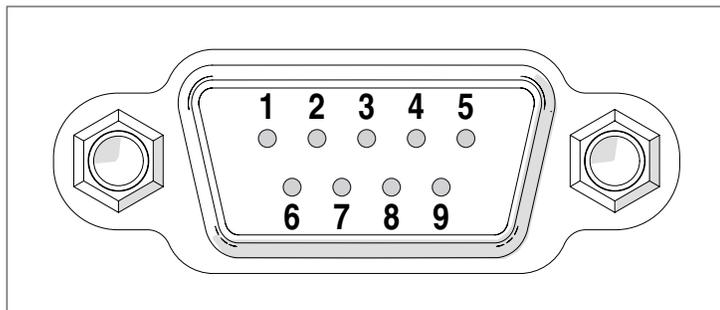
- J25-1: Grey
- J25-2: Black
- J25-3: Green
- J25-4: Yellow
- J25-5: Red
- J25-6: Blue

CONNECTION DIAGRAM 905TS (Touchscreen) AND 905PB DISPLAY



Modbus connection diagram between the 900PB and 900TS

Pins on connector COM1 of the 900TS:



Primary connection to 900PB:

Communication	Pin	Function	Connect to
COM2 (Master)	5	GND	900 PB (J25-1)
	7	RS 485 +	900 PB (J25-3)
	8	RS 485 -	900 PB (J25-2)

Secondary connection to BMS (pre-wired):

Communication	Pin	Function
COM1 (Slave)	4	RS485 +
	9	RS485 -
	5	GND

APPENDIX B – MAINTENANCE

A qualified and adequately trained technician must perform the inspection as specified in these instructions before each heating season and at regular intervals.

Servicing, inspection and adjustment must be done by a trained technician in accordance with all applicable local, state and national codes. Improper servicing or adjustment of the boiler could result in equipment damage, injury, and/or dangerous conditions.

**MAINTENANCE / INSPECTION SCHEDULE**

Time interval	Maintenance
Annually	Verify the cleanliness of the area around the boiler
Annually	Check the pressure of the hydraulic system
Annually	Check vent piping and verify if leaks or obstructions are present
Annually	Check air piping and verify if leaks or obstructions are present
Annually	Check relief valves
Monthly (follow local, state, federal or local authority having jurisdiction guidelines)	Verify the condensate discharge system
Every two months	Test low water cut off
Every two months	Inspect and test the reset button of low water cut off
Every six months	Check all piping (gas and water) for leaks
End of heating season	Shut off the boiler
Annually *	Combustion test and analysis
Annually *	Verify condition of flue and air system (including Venturi and fan)
Annually *	Check ignition electrode
Annually *	Clean the combustion chamber (including the burner tube)
Annually *	Clean condensate discharge
Annually *	Safety block check, modulation range check, gas valve closing after burner stop
Annually *	Check control parameters
Annually *	Check for gas piping leak
Annually *	Check wiring and connections
Annually *	Verify startup
Annually *	Verify the flame stability and signal strength
Annually *	Check relief valve
Annually *	Inspect the burner gasket

(\*) Annually or every 2000 hours, whichever occurs first.

**Gas Leak Inspection**

Inspect all gas piping and gas valve especially pressure inlet to confirm there are no leaks.

**⚠ DANGER:** To verify the gas leaks use a soap solution or a gas leak detector. Do not use matches, candles, or other methods that can cause a fire or explosion!

**CHECK EXHAUST AND COMBUSTION AIR PIPE SYSTEM**

Clear vent systems of any obstructions, corrosion, physical damage, water stains and rust. Verify the connection between the individual components.

Verify the outside terminations are clear. Clean the screens and the louvers if there is any debris.

**INSPECTION OF IGNITION ELECTRODE AND IONIZATION ELECTRODE**

Verify that the electrode is clean of deposits and use an emery cloth or other material to remove deposits as required.

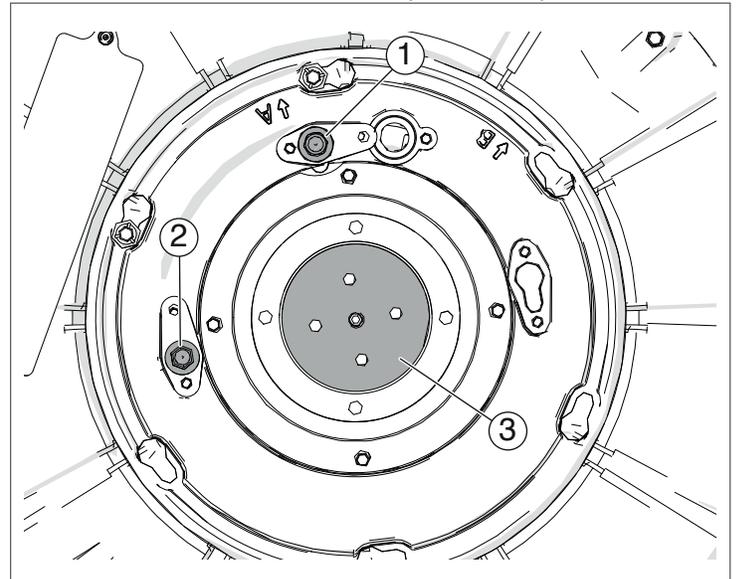


Fig. 56 Inspection of ignition electrode and ionization electrode

No.	Description
1	Ignition electrode
2	Ionization electrode
3	Burner tube

**CHECK WIRING AND CONNECTIONS**

Check that all wiring is securely fastened and in good condition without any cracking or alteration of isolation or presence of the insulation or corrosion on the metallic contacts.

**BURNER GASKET INSPECTION**

To ensure the reliability of the boiler/system, the boiler must be maintained as outlined in this manual and a qualified service technician must startup and service it at least annually.

This includes a combustion test and the cleaning of the combustion chamber.

When disassembling the heat exchanger it is crucial to inspect the Burner Gasket (part number OCR105917) for damage.

It is a must to replace the burner gasket when servicing and if there are any signs of wear, deformity or discoloration of the gasket and in any case not later than every two years.

## APPENDIX C – HEAD AVAILABLE FOR THE SYSTEM

## HEAD AVAILABLE (NO GLYCOL)

Array	$\Delta T = 36^{\circ}\text{F}$	$\Delta T = 45^{\circ}\text{F}$
AR 399 SE	3,0 ft	10,0 ft
AR 500 SE	8,0 ft	20,0 ft

## HEAD AVAILABLE (50% MAXIMUM GLYCOL)

Array	$\Delta T = 36^{\circ}\text{F}$	$\Delta T = 45^{\circ}\text{F}$
AR 399 SE	2,6 ft	8,5 ft
AR 500 SE	6,8 ft	17,0 ft

Array Model	Boiler Quantity	Combined Max GPM	Common Pipe Size (Inch)	Max Equivalent Length of Pipe (ft)
AR 399 SE	1	25	3	1800
	2	50	3	1200
	3	75	3	650
	4	100	3	350

Array Model	Boiler Quantity	Combined Max GPM	Common Pipe Size (Inch)	Max Equivalent Length of Pipe (ft)
AR 500 SE	1	30	3	1700
	2	60	3	900
	3	90	3	400
	4	120	3	60

## Notes:

Max equivalent length of pipes must account for all pipes, valves, fittings and a recommended strainer at boiler inlet.  
Multiple boilers to be piped in reverse return layout.

## APPENDIX D – DE-RATING FOR ALTITUDE INSTALLATION

When the appliance is installed at an altitude higher than 2000 ft, the fan speed must be set to the maximum of the available range in any case and a de-rating of the input capacity must be considered in function of the altitude combined with the total length of the vent and combustion air pipe as reported in the following table (input BTU/hr)

*NOTE: The following chart compensates for the affects of altitude on the energy content of the gas supply. No additional de-rate required.*

### ARRAY AR 399 SE

Altitude (ft)	From 0% to 25%	From 25% to 50%	From 50% to 75%	From 75% to 100%
0-2,000	399,220	399,22	399,22	399,22
3,000	383,251	376,48	369,83	363,30
4,000	367,921	361,42	355,04	348,77
5,000	353,204	346,97	340,84	334,82
6,000	339,076	333,09	327,21	321,43
7,000	325,513	319,76	314,12	308,57
8,000	312,493	306,97	301,55	296,23
9,000	299,993	294,69	289,49	284,38
10,000	287,993	282,91	277,91	273,00

### ARRAY AR 500 SE

Altitude (ft)	From 0% to 25%	From 25% to 50%	From 50% to 75%	From 75% to 100%
0-2,000	500,000	500,00	500,00	500,00
3,000	480,000	471,52	463,20	455,02
4,000	460,800	452,66	444,67	436,82
5,000	442,368	434,56	426,88	419,34
6,000	424,673	417,17	409,81	402,57
7,000	407,686	400,49	393,41	386,47
8,000	391,379	384,47	377,68	371,01
9,000	375,724	369,09	362,57	356,17
10,000	360,695	354,32	348,07	341,92

To calculate the de-rating of the input capacity, follow this example:

The total equivalent length of the flue system is  $55+35 = 90$  ft. The maximum equivalent length for this type of installation is 100 ft (see "Appendix G – Venting Size Data").

The % range is  $90/100 = 90\%$ . This value is within the 75% and 100%.

## APPENDIX E - TROUBLESHOOTING TABLE

## LOCKOUT CODES

Error no.	Error	Description	Checks	Solutions
0	E2PROM_READ_ERROR	Internal software error		Control board replacement
1	IGNIT_ERROR	Three unsuccessful ignition attempts in a row	a- Check gas supply pressure; b- Check ignition spark; c- Correct amount of air; d-Check for120VAC at the gas valve.	a- If the gas supply pressure is incorrect, it must be adjusted to the correct pressure; b- If spark is not present check for correct ignition electrode position; c- If the combustion air pressure is incorrect, inspect the vent system and eliminate any obstructions; d- If the voltage to the gas valve is not 120Vac the power control board must be replaced.
2	GV_RELAY_ERROR	Failure detected in the GV (Gas Valve) relay	a- Check the integrity of the wire connections between gas valve and control board.	a- If wires are damaged, replace them b- If wires are ok, replace the gas valve or the power control board.
3	SAFETY_RELAY_ERROR	Internal control board error		Control board replacement
4	BLOCKING_TOO_LONG	Control had a blocking error for more than 20 hours. This error is caused when any Blocking errors occur and are not corrected automatically.	Press RESET button to display the Blocking error description	Remove the cause of the Blocking error
5	FAN_ERROR_NOT_RUNNING	Fan is not running after 60 seconds.	a- Check for 120 VAC power connection of the fan. b- Check PWM connection of the fan.	a- If no 120 VAC voltage is present, replace the power control board; b- If no PWM signal is present, replace power control board; c- Replace the fan.
6	FAN_ERROR_TOO_SLOW	Fan runs too slow for more than 60 seconds		
7	FAN_ERROR_TOO_FAST	Fan runs too fast for more than 60 seconds		
8	RAM_ERROR	Internal software error		Control board replacement
9	WRONG_EEPROM_SIGNATURE	Contents of E2PROM are not up to date		Control board replacement
10	E2PROM_ERROR	Wrong safety parameters in E2PROM		Control board replacement
11	STATE_ERROR	Internal software error		Control board replacement
12	ROM_ERROR	Internal software error		Control board replacement
13	APS_NOT_OPEN	Air pressure switch not working		
14	APS_NOT_CLOSED	Air pressure switch not working		
15	MAX_TEMP_ERROR	The external overheat protection is enabled or the High limit sensor measures a temperature of over 95°C (203°F)	a- Check the pump to verify the flow circulation; b- Check if the valves on hydraulic circuit are open; c- Check the high limit switch.	a- Change the pump or restart it; b- Open the valves on hydraulic circuit; c- Change the high limit switch.
17	STACK_ERROR	Internal software error		Control board replacement
18	INSTRUCTION_ERROR	Internal software error		Control board replacement
19	ION_CHECK_FAILED	Internal software error		Control board replacement
20	FLAME_OUT_TOO_LATE	Flame still present 10 seconds after closing the gas valve		Replace the gas valve
21	FLAME_BEFORE_IGNIT	Flame is detected before ignition		Replace the gas valve
22	TOO_MANY_FLAME_LOSS	Three flame failures during one demand cycle	a- Check the integrity of the wire connections of the spark and the earth on heat exchanger b- check ionization signal while running	a- If wires are damaged, replace them b- check for proper combustion settings - if correct replace spark/flamerod.
23	CORRUPTED_ERROR_NR	Error code RAM byte was corrupted to an unknown error code		

Error no.	Error	Description	Checks	Solutions
24	FLUE_SWITCH_NOT_CLOSING	The blocked flue sensor is not closed within 10 minutes		
25	TSUPPLY_DIFF_ERROR	The 2 supply sensors deviate too much for more than 60 seconds		
26	TFLUE_DIFF_ERROR	The 2 flue sensors deviate too much for more than 60 seconds		
27	FILLING_TOO_MUCH	Too many automated filling attempts in a short time period		
28	FILL_TIME_ERROR	Filling takes too long		
29	PSM_ERROR	Internal software error		
30	REGISTER_ERROR	Internal software error		Control board replacement
31	T_EXCHANGE_LOCK_ERROR	Exchange temperature exceeded the maximum temperature		
32	T_EXCHANGE_DIFF_ERROR	The 2 exchange sensors deviate too much for more than 60 seconds		
33	LWCO_1_ERROR	Low Water Cut Off 1 error	Check the LWCO	a- Verify water is in the boiler. b- Verify good connection between control module and low water probe.
34	LWCO_2_ERROR	Low Water Cut Off 2 error	a- Check to ensure all valves are open, pump is running. b- Check the wiring between the controller and the LWCO probe.	a- Verify water is in the boiler. b- Verify good connection between control module and low water probe.
35	GAS_PRESSURE_ERROR	Flue pressure switch is closed	a- Check gas pressure to ensure it is steady and within the recommended range for the unit. b- Check with as many modules on as possible to ensure supply connections are sized properly.	
36	AIR_DAMPER_LOCKING	Air Damper feedback is not received when the relative output is open for the fourth time.		
37	FLUE_PRESSURE_LOCKING	Flue pressure switch is closed for the fourth time.	a- Check for obstruction in the flue piping. b- Blocking errors should be recorded prior to the occurrence of this Locking error. c- Check for condensate in the hose connecting the flue pressure switch to ensure it isn't blocked.	

## BLOCKING ERRORS

Error no.	Error	Description	Checks	Solutions
100	WD_ERROR_RAM	Internal software error		Control board replacement
101	WD_ERROR_ROM	Internal software error		Control board replacement
102	WD_ERROR_STACK	Internal software error		Control board replacement
103	WD_ERROR_REGISTER	Internal software error		Control board replacement
104	WD_ERROR_XRL	Internal software error		Control board replacement
105	HIGH_TEMP_ERROR	Supply temperature exceeds 110°C (230°F) with gas valve closed	a- Check the pump to verify the flow circulation; b- Check if the valves on hydraulic circuit are open; c- Check the supply temperature sensor.	a- Change the pump or restart it; b- Open the valves on hydraulic circuit; c- Verify that the temperature sensor has the correct resistance values. If values are incorrect sensor must be replaced.
106	REFHI_TOO_HIGH	Internal software error		Control board replacement
107	REFHI_TOO_LOW	Internal software error		Control board replacement
108	REFLO_TOO_HIGH	Internal software error		Control board replacement
109	REFLO_TOO_LOW	Internal software error		Control board replacement
110	REFHI2_TOO_HIGH	Internal software error		Control board replacement
111	REFHI2_TOO_LOW	Internal software error		Control board replacement
112	REFLO2_TOO_HIGH	Internal software error		Control board replacement

Error no.	Error	Description	Checks	Solutions
113	REFLO2_TOO_LOW	Internal software error		Control board replacement
114	FALSE_FLAME	Flame is detected in a state in which no flame is allowed to be seen		Control board replacement
115	LOW_WATER_PRESSURE_ERROR	Low water pressure error		
116	LOW_WATER_PRESSURE_SENSOR	Low water pressure		
117	BLOCKED_DRAIN	Blocked drain switch is active		
118	WD_COMM_ERROR	Watchdog communication error		Control board replacement
119	RETURN_OPEN	Return sensor open	a- Check the integrity of the wire connections; b- Check the return temperature sensor.	a- If the wiring is damaged, replace it; b- Verify that the temperature sensor has the correct resistance values. If values are incorrect sensor must be replaced.
120	SUPPLY_OPEN	Supply sensor open	a- Check the integrity of the wire connections; b- Check the supply temperature sensor.	a- If the wiring is damaged, replace it; b- Verify that the temperature sensor has the correct resistance values. If values are incorrect sensor must be replaced.
121	SUPPLY2_OPEN	Supply2 sensor open		
122	DHW_OPEN	DHW sensor open	a- Check the integrity of the wire connections; b- Check the DHW temperature sensor.	a- If the wiring is damaged, replace it; b- Verify that the temperature sensor has the correct resistance values. If values are incorrect sensor must be replaced.
123	FLUE_OPEN	Flue sensor open		
124	FLUE2_OPEN	Flue2 sensor open		
125	OUTDOOR_OPEN	Outdoor sensor open	a- Check the integrity of the wire connections; b- Check the Outdoor temperature sensor.	a- If the wiring is damaged, replace it; b- Verify that the temperature sensor has the correct resistance values. If values are incorrect sensor must be replaced.
126	RETURN_SHORTED	Return sensor shorted	a- Check the integrity of the wire connections; b- Check the return temperature sensor.	a- If the wiring is damaged, replace it; b- Verify that the temperature sensor has the correct resistance values. If values are incorrect sensor must be replaced.
127	SUPPLY_SHORTED	Supply sensor shorted	a- Check the integrity of the wire connections; b- Check the supply temperature sensor.	a- If the wiring is damaged, replace it; b- Verify that the temperature sensor has the correct resistance values. If values are incorrect sensor must be replaced.
128	SUPPLY2_SHORTED	Supply2 sensor shorted		
129	DHW_SHORTED	DHW sensor shorted	a- Check the integrity of the wire connections; b- Check the DHW temperature sensor.	a- If the wiring is damaged, replace it; b- Verify that the temperature sensor has the correct resistance values. If values are incorrect sensor must be replaced.
130	FLUE_SHORTED	Flue sensor shorted	a- Check the integrity of the wire connections; b- Check the Outdoor temperature sensor.	a- If the wiring is damaged, replace it; b- Verify that the temperature sensor has the correct resistance values. If values are incorrect sensor must be replaced.
131	FLUE2_SHORTED	Flue2 sensor shorted		
132	OUTDOOR_SHORTED	Outdoor sensor shorted	a- Check the integrity of the wire connections; b- Check the Outdoor temperature sensor.	a- If the wiring is damaged, replace it; b- Verify that the temperature sensor has the correct resistance values. If values are incorrect sensor must be replaced.
133	RESET_BUTTON_ERROR	Too many resets in a short time period		
135	T_EXCHANGE_BLOCK_ERROR	Exchange temperature exceeded 90°C		
136	T_CHIMNEY_OPEN	Chimney sensor open		
137	T_EXCHANGE1_OPEN	Exchange 1 sensor open		
138	T_EXCHANGE2_OPEN	Exchange 2 sensor open		
139	T_SELECTION1_OPEN	Selection 1 sensor open		
140	T_SELECTION2_OPEN	Selection 2 sensor open		

Error no.	Error	Description	Checks	Solutions
141	T_SELECTION3_OPEN	Selection 3 sensor open		
142	T_OPTIONAL1_OPEN	Optional 1 sensor open		
143	T_OPTIONAL2_OPEN	Optional 2 sensor open		
144	T_AMBIENT_OPEN	Ambient sensor open		
145	T_CHIMNEY_CLOSED	Chimney sensor shorted		
146	T_EXCHANGE1_CLOSED	Exchange 1 sensor shorted		
147	T_EXCHANGE2_CLOSED	Exchange 2 sensor shorted		
148	T_SELECTION1_CLOSED	Selection 1 sensor shorted		
149	T_SELECTION2_CLOSED	Selection 2 sensor shorted		
150	T_SELECTION3_CLOSED	Selection 3 sensor shorted		
151	T_OPTIONAL1_CLOSED	Optional 1 sensor shorted		
152	T_OPTIONAL2_CLOSED	Optional 2 sensor shorted		
153	T_AMBIENT_CLOSED	Ambient sensor shorted		
154	WD_CONFIG_ERROR	Watchdog fan configuration setting error		
155	FLUE_PRESSURE_ERROR	Flue pressure switch is open	a- Check for any obstruction in the exhaust system; b- Check the condensate discharge.	a- Remove any obstructions from the exhaust system; b- Remove any obstruction from condensate discharge and confirm if the condensate can flow freely.
156	AIR_DAMPER_ERROR	Air Damper feedback is not received when the relevant output is closed		
157	T_SECONDARY_SUPPLY_OPEN	Secondary circuit supply sensor open		
158	T_SECONDARY_RETURN_OPEN	Secondary circuit return sensor open		
159	T_SECONDARY_SUPPLY_CLOSED	Secondary circuit supply sensor shorted		
160	T_SECONDARY_RETURN_CLOSED	Secondary circuit return sensor shorted		
161	FILL_WARNING	Pressure is too low, demand has stopped but no error needed to be stored at this time		
162	FLUE_BLOCKED	Flue is blocked, demand needs to be stopped with fan at ignition speed but no error needed to be stored at this time		
163	LOWEXFLOW_PROTECTION	Flow is too low, demand needs to be stopped with fan at ignition speed but no error needed to be stored at this time		

## WARNINGS

Error no.	Error	Description	Checks	Solutions
200	CC_LOSS_COMMUNICATION	Cascade System: Leading burner lost communication with one of the depending burners		
201	CC_LOSS_BOILER_COMM	Cascade System: Leading boiler lost communication with one of the depending boilers		
202	OUTDOOR_WRONG	Outdoor sensor is open or shorted		
203	T_SYSTEM_WRONG	T_System sensor is open or shorted		
204	T_CASCADE_WRONG	T_Cascade sensor is open or shorted		
205	HIGH_LIMIT_TEST_WAIT_ACTIVE	Too many physical high limit test attempts within 24 hours.		
206	CH_SETPOINT_TOO_HIGH	Current setpoint is higher than 176°F (80°C)		
207	DHW_SENSOR_WRONG	DHW sensor is open or shorted		
208	ZONE_SENSOR_WRONG	Zone sensor is open or shorted		
209	BOILER_DEMAND-DISABLED	All incoming demand is disabled		

**NOTE**

In order to check if the control is functioning properly the following readings can be taken:

**AL Link**

24VDC (with S1 Switch On and open circuit). Voltage is variable while in normal operation depending on data stream.

**Pressure Switches**

(ie: Gas Pressure, Water Pressure, Flue Pressure, etc) 3.3VDC while circuit is open.

**Safety Switch**

(High Limit) 24VDC while open

**Flow Meter**

5VDC at all times

In addition to the ones listed on the Troubleshooting table, there are two error messages showing a combination of two potential failures.

In order to detect which of the combined failures is stopping the boiler, please go through the following procedures:

**1. For Array : "LWCO/Air inlet block" error message on TS Boiler screen.**

This message shows on touchscreen as a result of two possible errors:

- Boiler water level below the LWCO probe on the Supply header.
- Differential between air pressure inside the boiler cabinet and air pressure of the boiler room higher than 1.4" wc.

In order to discriminate between those two causes, it is suggested to access the differential air pressure switch inside the boiler cabinet (left side).

This pressure switch is also normally closed (NC). Confirm it is wired correctly, with connections on 1 (NC) and 3 (COM), see picture below

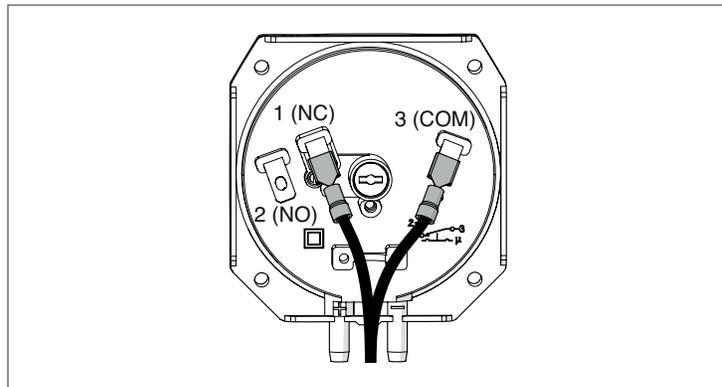


Fig. 57 Wired pressure switch

- Disconnect both wires.

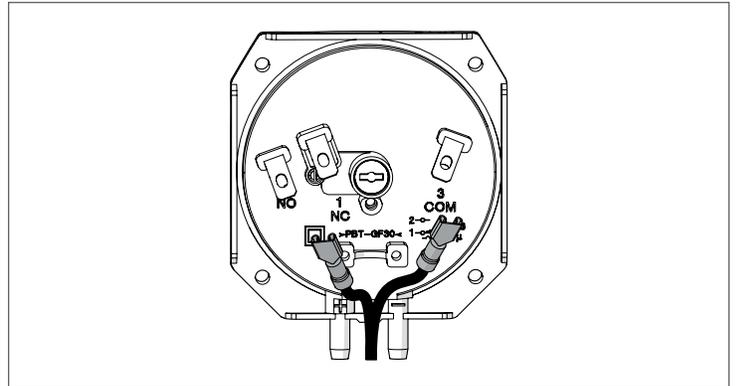


Fig. 58 Disconnect wires

- Set the multimeter device on Ohm ( $\Omega$ ).

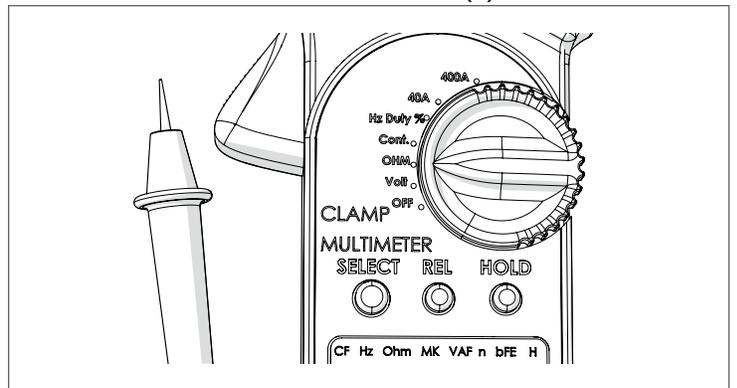


Fig. 59 Set multimeter device

- Connect the multimeter probes to 1 and 3 on pressure switch.
- Check the multimeter display. If the pressure switch works and is closed (that means the inner pressure of the condensate trap is lower than 2.2" wc), the display shows "0" or any other symbol indicating there is electrical continuity between connections 1 and 3.

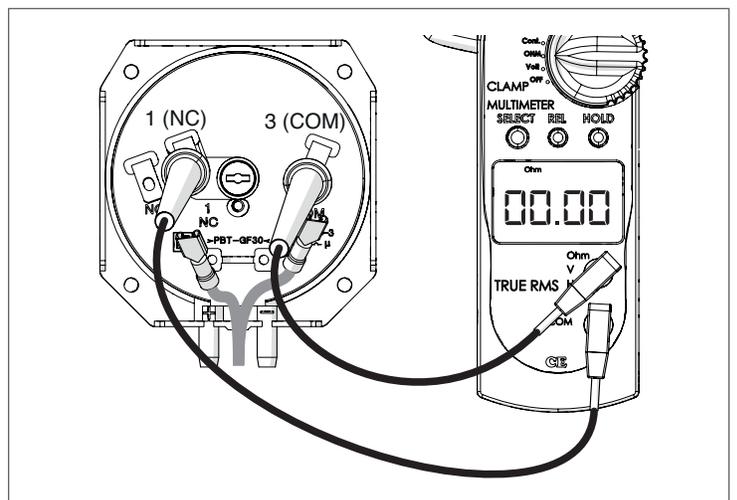


Fig. 60 Connect the multimeter probes

- Disconnect the multimeter and reconnect the wires, as shown in the picture below.

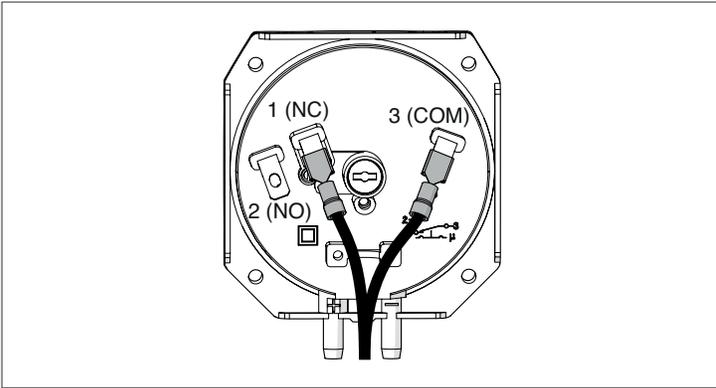


Fig. 61 *Wired pressure switch*

- Test the pressure switch on the other side of the boiler (module 4 or 8); repeat the process from Fig. 58 through Fig. 61.

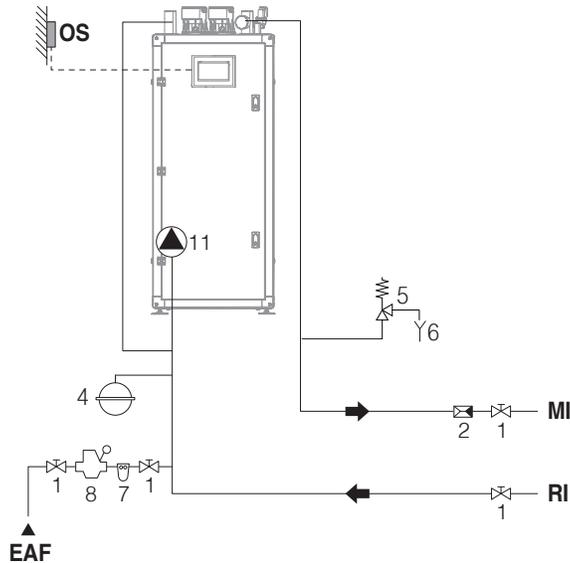
If the multimeter shows "0" (or any other symbol confirming the electrical continuity between 1 (NC) and 3 (COM) of the air pressure switch), the error on the boiler is due to a lack of water on the hydraulic circuit (or a failure of the pressure switch itself).

If the multimeter shows the air pressure switch circuit between 1 (NC) and 3 (COM) is open, the error is due to an air pressure differential between boiler cabinet and boiler room higher than 1.4"wc (or a failure of the pressure switch itself).

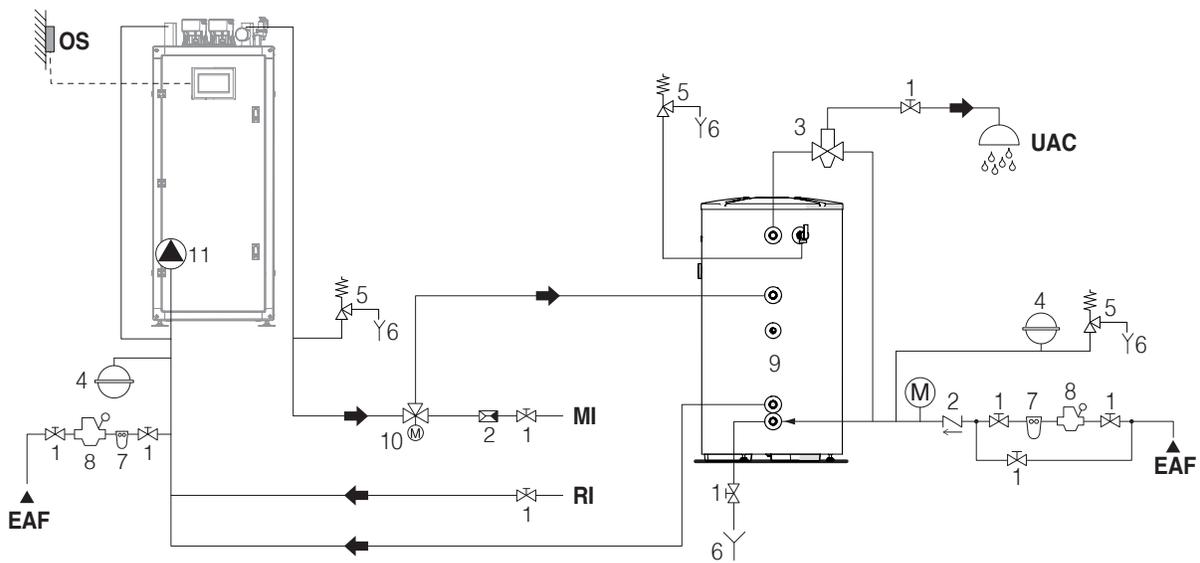
The root cause is most likely an obstruction/blockage on combustion air inlet.

APPENDIX F – TYPICAL WATER SYSTEM SCHEMATICS

**Layout 1: circuit with boiler directly linked to heating system (check that the pump's discharge head is sufficient to ensure adequate circulation)**



**Layout 2: circuit with boiler directly linked to heating system and indirect DHW tank. (check that the pump's discharge head is sufficient to ensure adequate circulation)**



- |                           |                               |                                   |
|---------------------------|-------------------------------|-----------------------------------|
| 1 Isolating valve         | 7 Water softener filter       | OS Outdoor temperature sensor     |
| 2 Check valve             | 8 Pressure reducer            | MI High temperature system supply |
| 3 Anti-scald mixing valve | 9 Domestic water storage tank | RI High temperature system return |
| 4 Expansion tank          | 10 Diverter valve             | EAF Domestic cold water inlet     |
| 5 Pressure relief valve   | 11 Pump                       | UAC Domestic hot water outlet     |
| 6 Drain                   |                               |                                   |

**⚠ WARNING:** Domestic hot water and central heating circuits must be completed with expansion tanks of adequate capacity and suitability, correctly-sized pressure relief valves. The discharge of pressure relief valves and appliances must be connected to a suitable collection and disposal system.

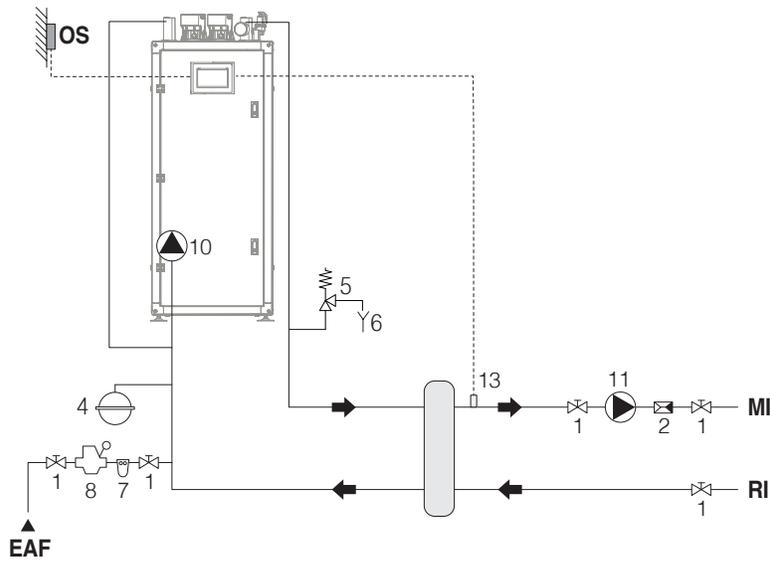
**⚠ CAUTION:** The choice of system components and the method of their installation are left up to the heating engineer installing the system. Installers must use their expertise to ensure

proper installation and functioning in conformity to all applicable legislation.

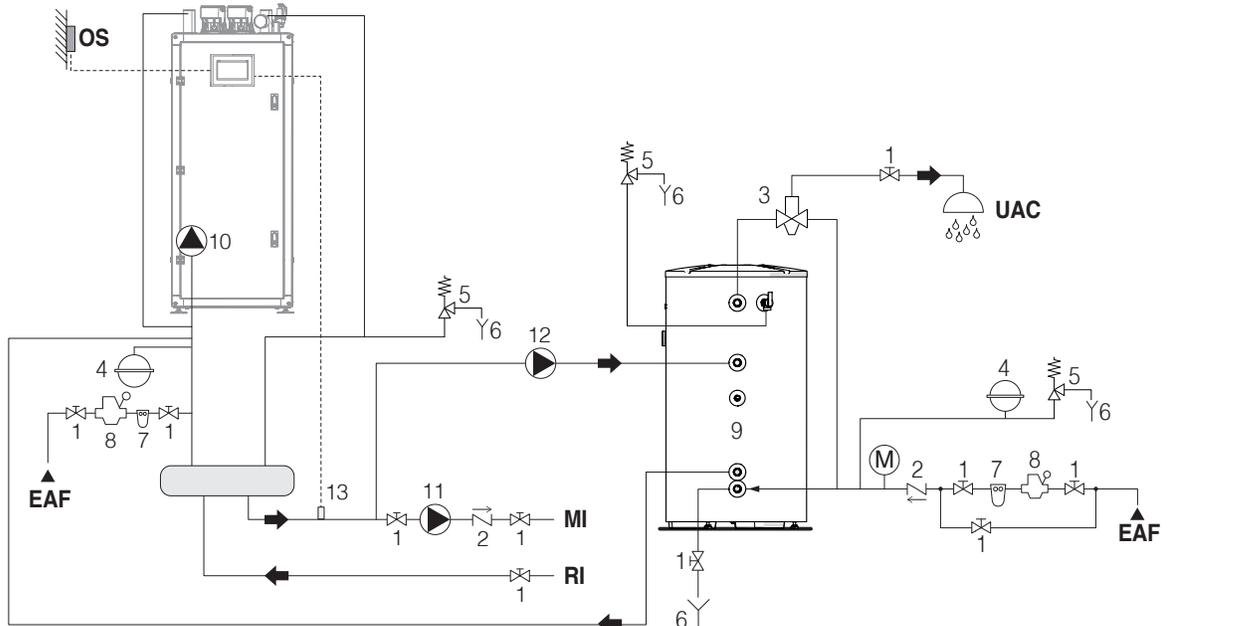
**⚠ CAUTION:** Special supply/refill water must be conditioned using suitable treatment systems.

**⊘ WARNING:** It is prohibited to operate the boiler without water.

**Layout 3: circuit with boiler connected to a heating system via a separator**



**Layout 4: circuit with boiler linked to Indirect DHW tank and heating system via a separator**



- |                           |                                       |                                   |
|---------------------------|---------------------------------------|-----------------------------------|
| 1 Isolating valve         | 8 Pressure reducer                    | OS Outdoor temperature sensor     |
| 2 Check valve             | 9 Domestic water storage tank         | MI High temperature system supply |
| 3 Anti-scald mixing valve | 10 Pump                               | RI High temperature system return |
| 4 Expansion tank          | 11 High-temperature system circulator | EAF Domestic cold water inlet     |
| 5 Pressure relief valve   | 12 Indirect tank circulator           | UAC Domestic hot water outlet     |
| 6 Drain                   | 13 Secondary sensor                   |                                   |
| 7 Water softener filter   |                                       |                                   |

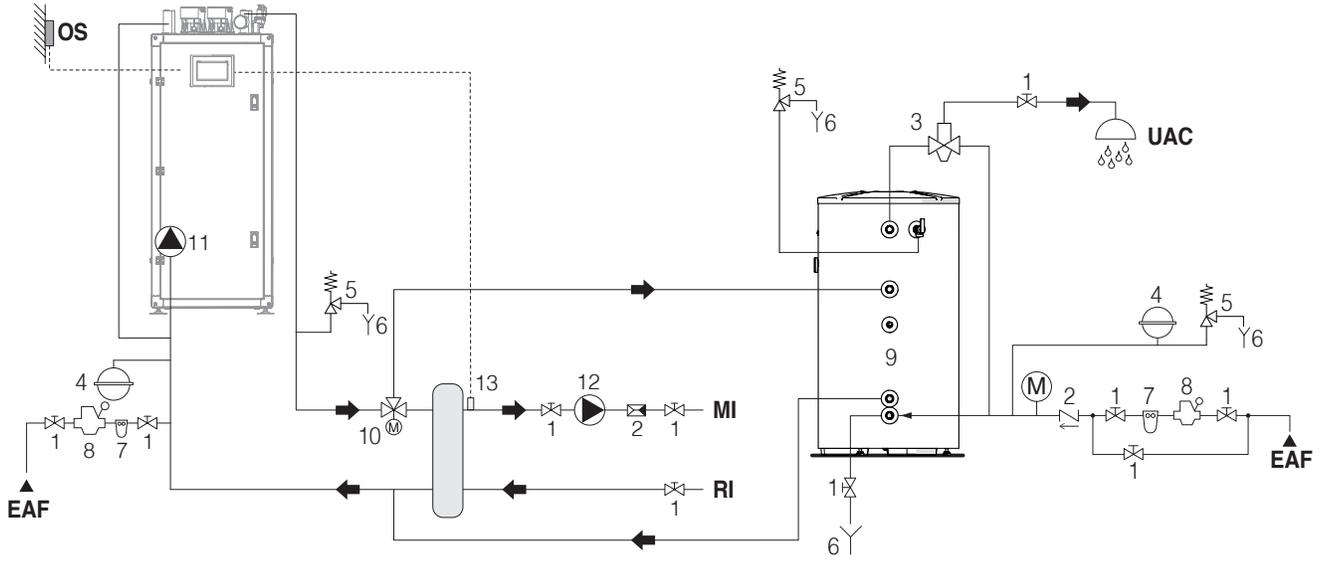
**⚠ WARNING:** Domestic hot water and central heating circuits must be completed with expansion tanks of adequate capacity and suitability, correctly-sized pressure relief valves. The discharge of pressure relief valves and appliances must be connected to a suitable collection and disposal system.

**⚠ CAUTION:** The choice of system components and the method of their installation are left up to the heating engineer installing the system. Installers must use their expertise to ensure proper installation and functioning in conformity to all applicable legislation.

**⚠ CAUTION:** Special supply/refill water must be conditioned using suitable treatment systems.

**⊘ WARNING:** It is prohibited to operate the boiler without water.

Layout 5: circuit with boiler linked to heating system and indirect DHW. tank via a separator



- |                           |                                       |                                   |
|---------------------------|---------------------------------------|-----------------------------------|
| 1 Isolating valve         | 8 Pressure reducer                    | OS Outdoor temperature sensor     |
| 2 Check valve             | 9 Domestic water storage tank         | MI High temperature system supply |
| 3 Anti-scald mixing valve | 10 Diverter valve                     | RI High temperature system return |
| 4 Expansion tank          | 11 Pump                               | EAF Domestic cold water inlet     |
| 5 Pressure relief valve   | 12 High-temperature system circulator | UAC Domestic hot water outlet     |
| 6 Drain                   | 13 Secondary sensor                   |                                   |
| 7 Water softener filter   |                                       |                                   |

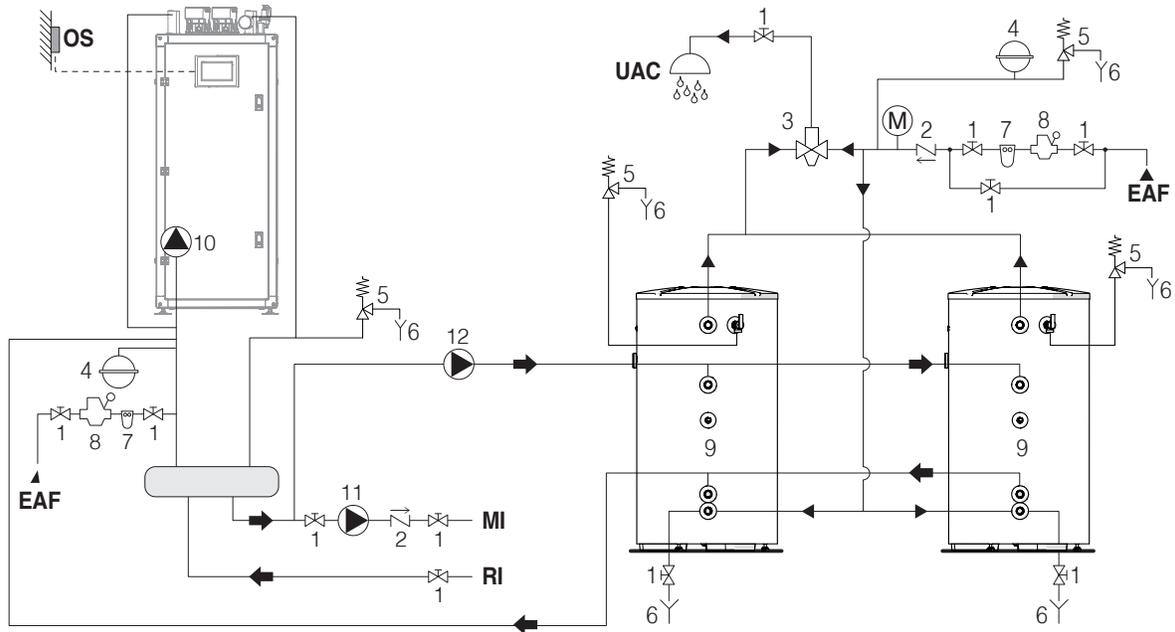
**⚠ WARNING:** Domestic hot water and central heating circuits must be completed with expansion tanks of adequate capacity and suitability, correctly-sized pressure relief valves. The discharge of pressure relief valves and appliances must be connected to a suitable collection and disposal system.

**⚠ CAUTION:** The choice of system components and the method of their installation are left up to the heating engineer installing the system. Installers must use their expertise to ensure proper installation and functioning in conformity to all applicable legislation.

**⚠ CAUTION:** Special supply/refill water must be conditioned using suitable treatment systems.

**⊘ WARNING:** It is prohibited to operate the boiler without water.

Layout 6: circuit with boiler linked to 2 Indirect DHW tank and heating system via a separator



- |                           |                                       |                                   |
|---------------------------|---------------------------------------|-----------------------------------|
| 1 Isolating valve         | 7 Water softener filter               | OS Outdoor temperature sensor     |
| 2 Check valve             | 8 Pressure reducer                    | MI High temperature system supply |
| 3 Anti-scald mixing valve | 9 Domestic water storage tank         | RI High temperature system return |
| 4 Expansion tank          | 10 Pump                               | EAF Domestic cold water inlet     |
| 5 Pressure relief valve   | 11 High-temperature system circulator | UAC Domestic hot water outlet     |
| 6 Drain                   | 12 Indirect tank circulator           |                                   |

**⚠ WARNING:** Domestic hot water and central heating circuits must be completed with expansion tanks of adequate capacity and suitability, correctly-sized pressure relief valves. The discharge of pressure relief valves and appliances must be connected to a suitable collection and disposal system.

**⚠ CAUTION:** The choice of system components and the method of their installation are left up to the heating engineer installing the system. Installers must use their expertise to ensure proper installation and functioning in conformity to all applicable legislation.

**⚠ CAUTION:** Special supply/refill water must be conditioned using suitable treatment systems.

**⚠ WARNING:** It is prohibited to operate the boiler without water.

## APPENDIX G – VENTING SIZE DATA

While there is a positive flue pressure during operation, the combined pressure drop of vent and combustion air systems must not exceed the following equivalent length:

MODEL	PIPE SIZE – 4"		PIPE SIZE – 5"	
	MAX equiv. mt	MAX equiv. ft	MAX equiv. mt	MAX equiv. ft
ARRAY AR 399 SE	30	100	–	–
ARRAY AR 500 SE	20	65	30	100

Fittings as well as pipe lengths must be calculated as part of the equivalent length, according to the following table:

MODEL	45° ELBOW – 4"		45° ELBOW – 5"	
	MAX equiv. mt	MAX equiv. ft	MAX equiv. mt	MAX equiv. ft
ARRAY AR 399 SE	1.5	5	1.8	6
ARRAY AR 500 SE	1.8	6	2.4	8

MODEL	90° ELBOW – 4"		90° ELBOW – 5"	
	MAX equiv. mt	MAX equiv. ft	MAX equiv. mt	MAX equiv. ft
ARRAY AR 399 SE	3.4	11	4.3	14
ARRAY AR 500 SE	4.0	13	4.9	16

## Data for Venting size

ARRAY AR 399 SE	T supply / return (F°) – 176 / 140				T supply / return (F°) – 104 / 86			
	Maximum Input		Minimum Input		Maximum Input		Minimum Input	
CO <sub>2</sub>	9%		9%		9%		9%	
Exhaust gas mass (weight)	6.56 lb/s		0.65 lb/s		6.56 lb/s		0.66 lb/s	
Flue temperature	161.6 °F		143.6 °F		107.6 °F		89.6 °F	
Max. pressure at boiler exit @ high fire condition	0,9 in H <sub>2</sub> O	220 Pa	0,1 in H <sub>2</sub> O	20 Pa	0,9 in H <sub>2</sub> O	230 Pa	0,1 in H <sub>2</sub> O	25 Pa

ARRAY AR 500 SE	T supply / return (F°) – 176 / 140				T supply / return (F°) – 104 / 86			
	Maximum Input		Minimum Input		Maximum Input		Minimum Input	
CO <sub>2</sub>	9,3%		9%		9,3%		9%	
Exhaust gas mass (weight)	7.99 lb/s		0.82 lb/s		7.99 lb/s		0.82 lb/s	
Flue temperature	161.6 °F		143.6 °F		107.6 °F		89.6 °F	
Max. pressure at boiler exit @ high fire condition	0,8 in H <sub>2</sub> O	200 Pa	0,1 in H <sub>2</sub> O	20 Pa	0,9 in H <sub>2</sub> O	220	0,1 in H <sub>2</sub> O	20 Pa

## Cascade Venting of Multiple Boiler Installations

When multiple boilers of the same model size are installed within a common room it is permissible to cascade the venting connecting all boilers to a single exhaust system. No more than eight (8) boilers should be cascade vented together.

The boiler/ vent installation must be in compliance with ANSI Z223.1/ NFPA 54 and all local, state, and federal regulations for building code. Venting system shall be designed to maintain suitable vent pressure at the boiler exhaust collar.

For a list of suitable venting materials consult the installation manual section: "Venting material" page 77

Adapters are available for various brands of venting materials. Consult the factory for a list of available adapters.

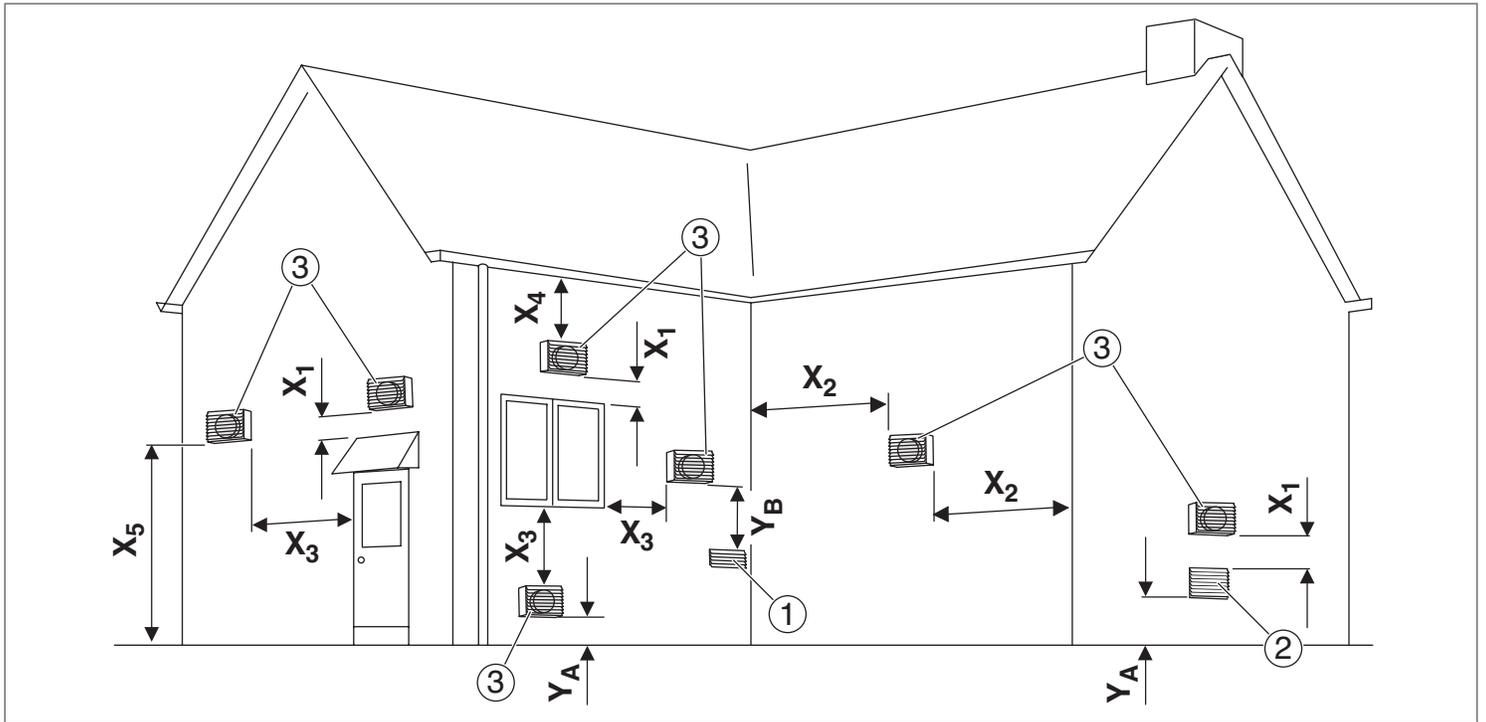
Venting components from different manufacturers shall not be mixed.

Adequate combustion air must be supplied to the boiler to ensure safe operation. A properly sized direct connected common combustion air duct may be used for sealed combustion air to the boiler cascade.

For additional information regarding combustion air supply consult the installation manual section: "Combustion Air" page 78

Prior to installing a permanent vent system refer to the Installation Manual, ANSI Z223.1/ NFPA 54, and all local, state, and federal regulations for building code to ensure compliance with the requirements of these articles.

## APPENDIX H – EXHAUST TERMINALS AND AIR INLET CLEARANCES

**Direct vent (sealed combustion)**

- 1 Forced air inlet
- 2 Gravity air inlet
- 3 Exhaust terminal
- X1 1 foot (305 mm)
- X2 See Note 1)
- X3 1 foot (305 mm) USA  
3 feet (915 mm) Canada
- X4 See Note 1)
- X5 7 feet (2135 mm)
- YA At least 1 foot (305 mm) above grade or snow line
- YB Exhaust terminal must be at least:  
3 feet (915 mm) above forced air inlet within  
10 feet (3050 mm) horizontally – USA  
6 feet (915 mm) above forced air inlet – Canada

**Fan assisted appliance (Room air for combustion)**

- 1 Forced air inlet
- 2 Gravity air inlet
- 3 Exhaust terminal
- X1 1 foot (305 mm)
- X2 See Note 1)
- X3 1 foot (305 mm) USA  
3 feet (915 mm) Canada
- X4 See Note 1)
- X5 7 feet (2135 mm)
- YA At least 1 foot (305 mm) above grade or snow line
- YB Exhaust terminal must be at least:  
3 feet (915 mm) above forced air inlet within  
10 feet (3050 mm) horizontally – USA  
6 feet (915 mm) above forced air inlet – Canada

It is not recommended to terminate vent above any door or window, condensate can freeze causing ice formations.

Do not use chimney as a raceway if another boiler or fireplace is vented into or through chimney.

All CPVC vent pipes must be glued, except for the flue gas adapter pipe connection.

Vent terminations must keep the following minimum clearances from electric meters, gas meters, regulators and relief equipment: 4 feet (1220 mm) [Canada 6 feet (1830 mm)] horizontally and in no case above and below, unless a horizontal distance of 4 feet (1220 mm) [Canada 6 feet (1830 mm)] is maintained.

**NOTE**

1) For Clearances not specified in ANSI Z223.1 / NFPA 54 or CSA B149.1 Clearance in accordance with local installation codes and the requirements of the gas supplier including the Authority having jurisdiction.

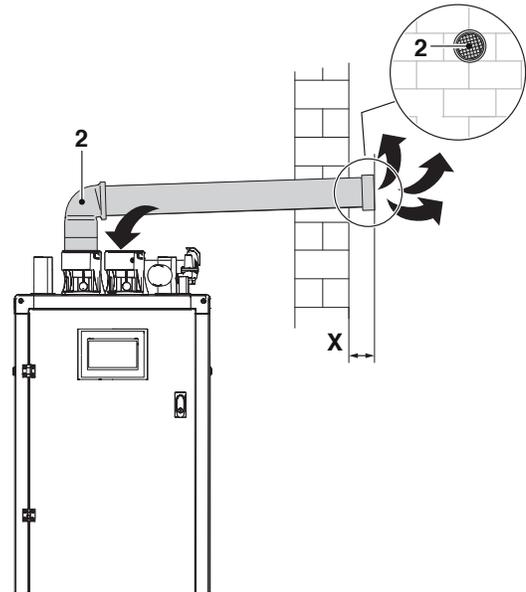
APPROVED EXAMPLES OF HORIZONTAL AND VERTICAL VENTING INSTALLATION

**⚠ NOTE:** Place pipe supports a minimum of every 5 feet (1.525 mm) for horizontal and vertical runs, beginning with a support near the boiler unless the vent manufacturer or local code states smaller intervals. Venting shall also be supported at each connection point and 90 or 45 degree elbow. The first support shall be located close to the boiler. Ensure that proper venting supports are used for the vent type per the venting manufacturer's instructions. Failure to comply may cause vent separation resulting in a risk of carbon monoxide poisoning causing severe injury or death.

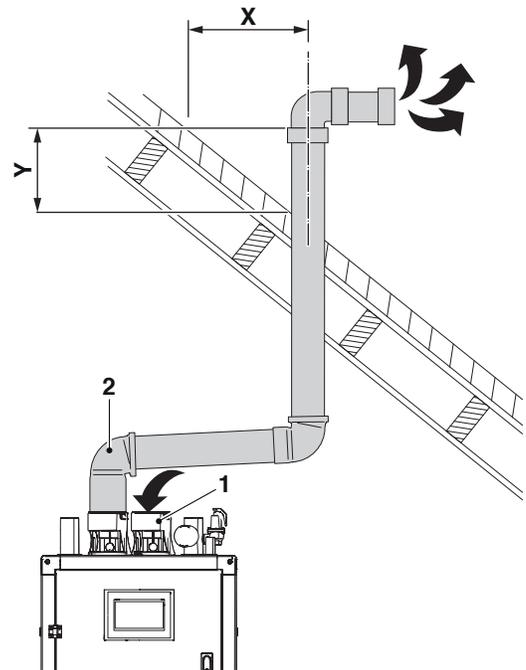
- Horizontal vent runs shall be supported where necessary to prevent sagging.
- Ensure horizontal vent runs have a upwards slope no less than 1/4 in/ft (21 mm/m) from the boiler to the vent terminal.
- The boiler and venting shall be installed so as to prevent accumulation of condensate; and where necessary, have means provided for drainage of condensate.
- The condensate must be disposed of in accordance with applicable code.
- Periodic cleaning of the vent terminal and air-intake screens is mandatory.
- Avoid locating vent terminals near equipment or building features which can be subject to degradation from exhaust gases.
- If multiple boilers are installed in a row, allow at least 1 foot (305 mm) clearance between the vent termination of one and the combustion air intake of the other.

In the following figures, the combustion air intake pipe is indicated with the number 1 (one) and the exhaust vent pipe with the number 2 (two).

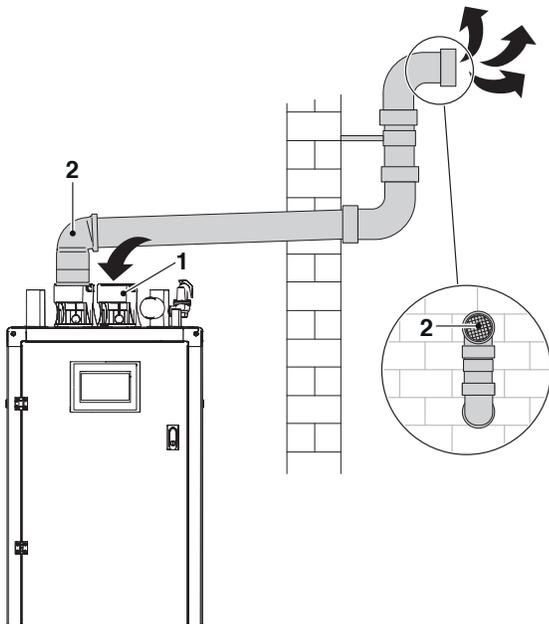
Horizontal venting system (room air only);  $X \geq 4''$  (102 mm)



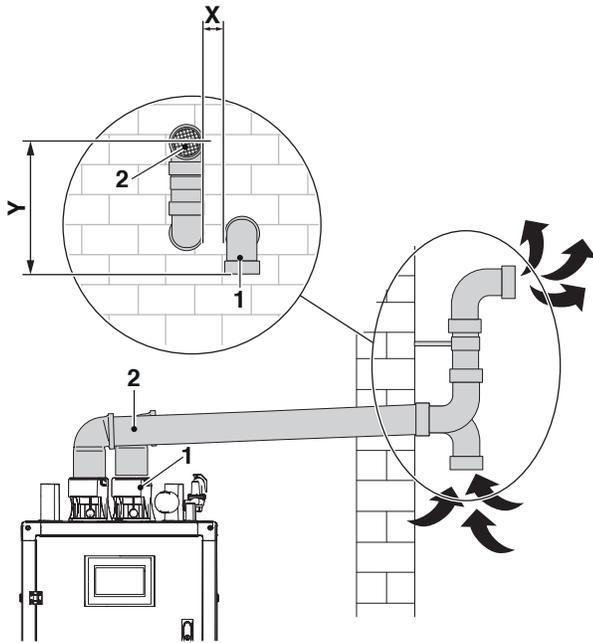
Vertical venting system (room air only);  $X > 12''$  (305 mm);  $Y$  12'' (305 mm) above maximum snow level or at least 24'' (610 mm) whichever is greater



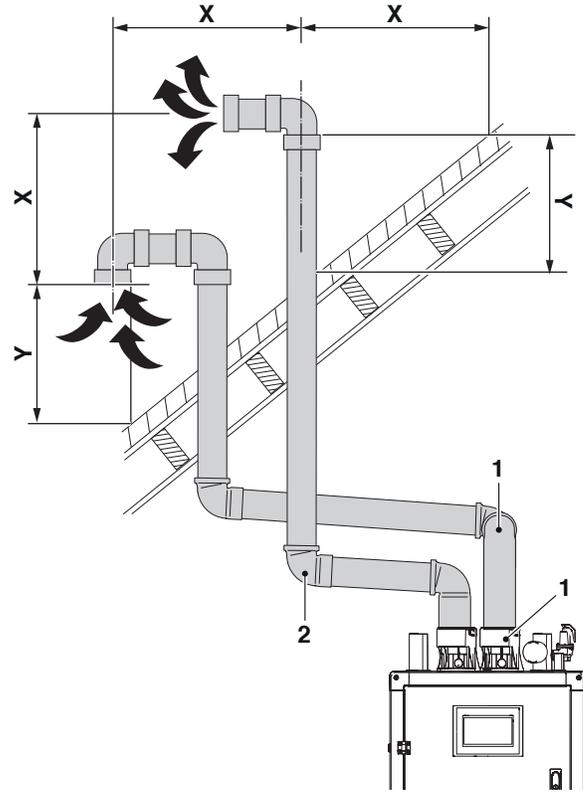
Horizontal venting system (room air only)



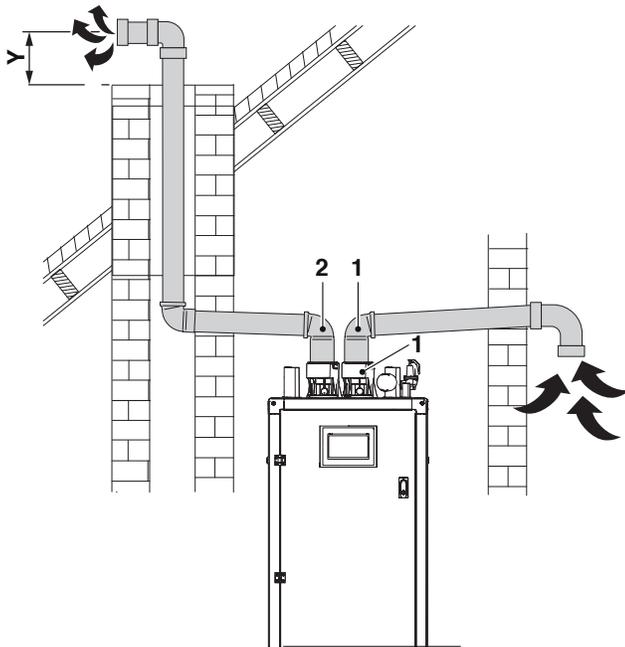
Horizontal venting system (sealed combustion);  $X \geq 4''$  (102 mm);  $Y \geq 12''$  (305 mm)



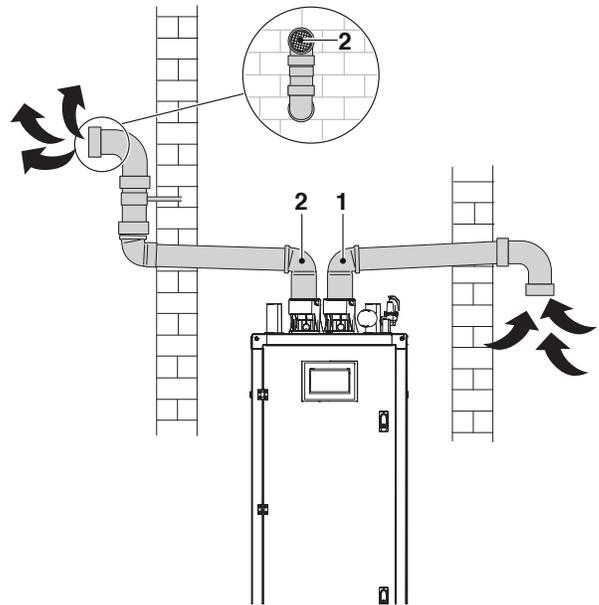
Vertical venting system (sealed combustion);  $X > 12''$  (305 mm);  $Y$  12'' (305 mm) above maximum snow level or at least 24'' (610 mm) whichever is greater



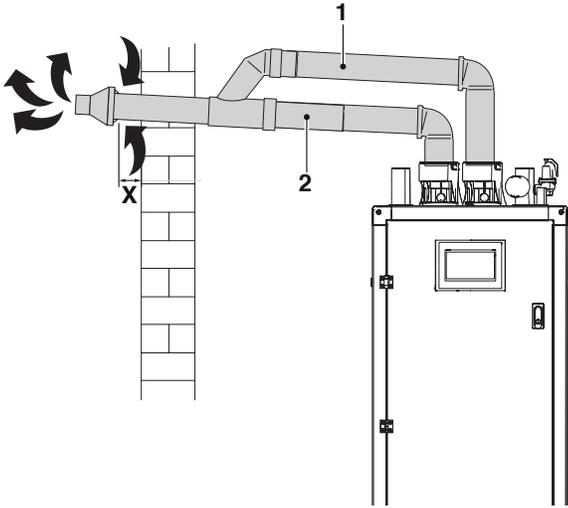
Vertical venting system (sealed combustion);  $Y$  12'' (305 mm) above maximum snow level or at least 24'' (610 mm) whichever is greater



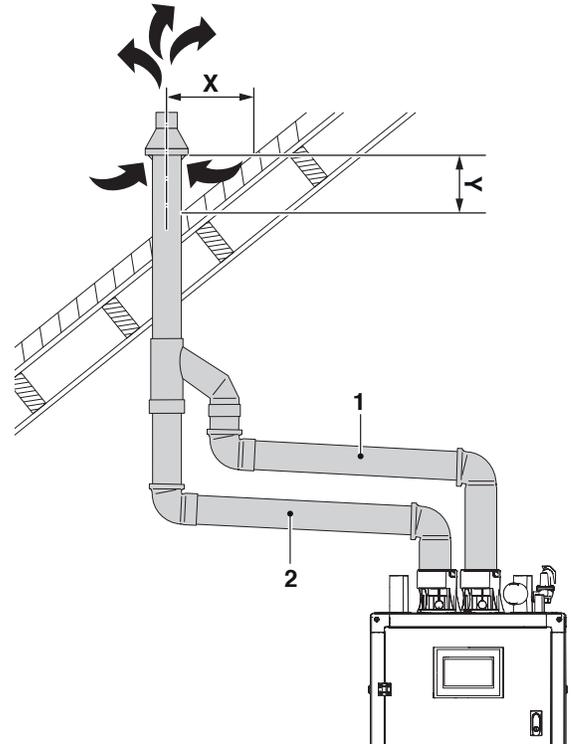
Horizontal venting system (sealed combustion)



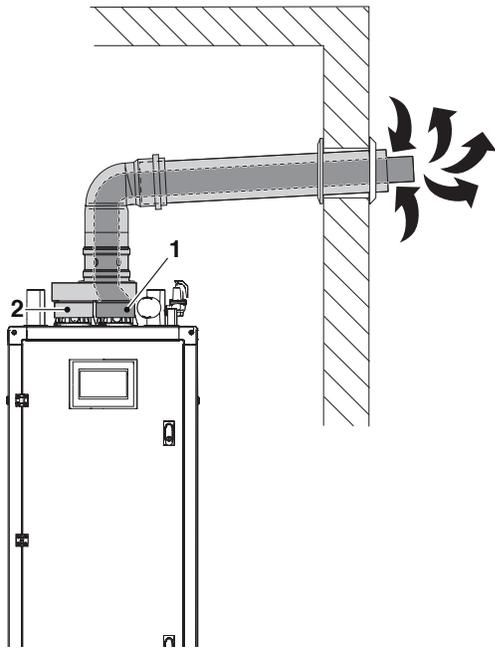
Horizontal venting system (sealed combustion);  $X \geq 4''$  (102 mm)



Vertical venting system (sealed combustion);  $X > 12''$  (305 mm);  $Y$  12'' (305 mm) above maximum snow level or at least 24'' (610 mm) whichever is great



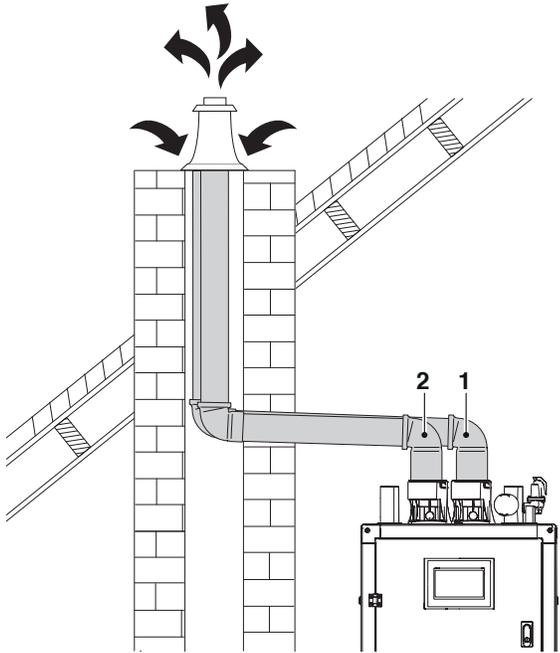
Horizontal concentric system (sealed combustion)



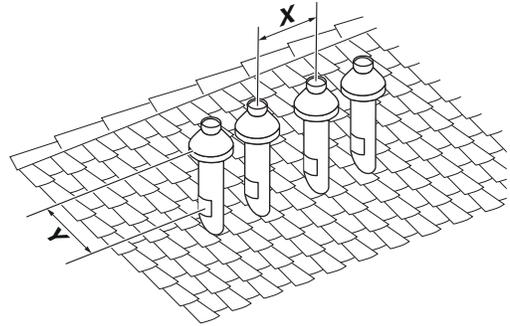
**MULTIPLE BOILERS**

- When installing multiple air and vent terminations, be sure that:
- The clearance between the vent and air termination are in accordance with the figures shown in this chapter
  - All vent pipes and air inlets must terminate at the same height

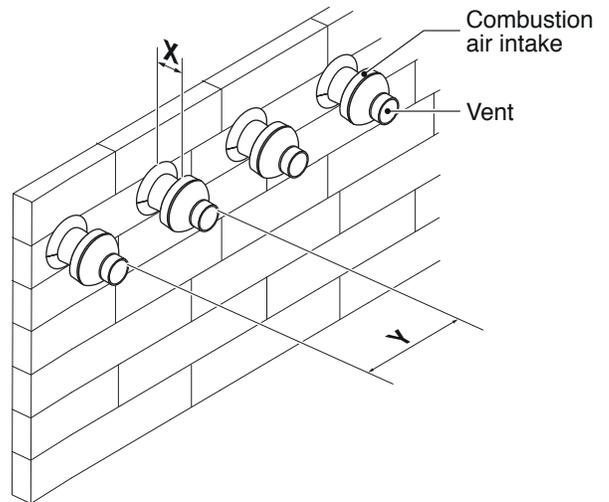
**Vertical venting system (sealed combustion)**



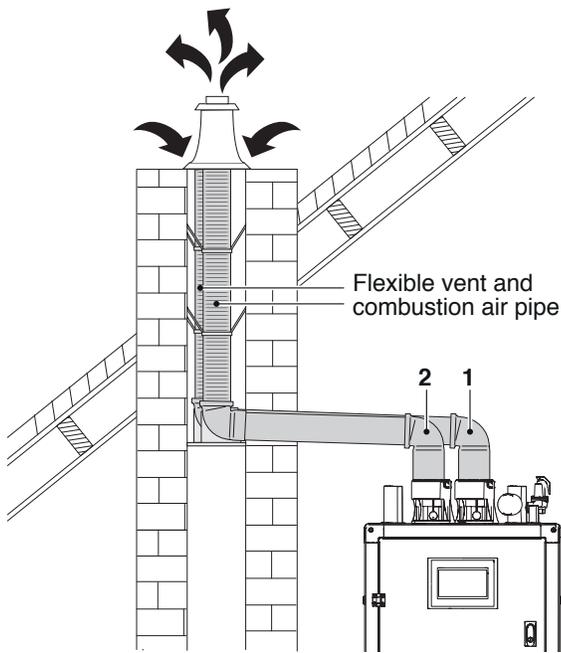
**Concentric vent and combustion air vertical termination;  $X \geq 12''$  (305 mm);  $Y \geq 12''$  (305 mm) (18'' (457 mm) for Canada and/or per CAN/CSA B149.1) above highest snow level. Maximum 24'' above roof**



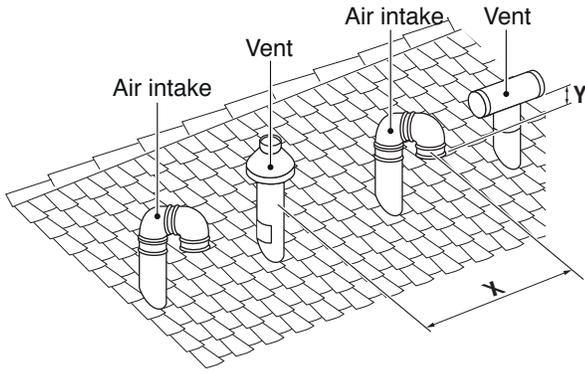
**Concentric vent and combustion air horizontal termination;  $X \geq 4''$  (102 mm);  $Y \geq 24''$  (610 mm); Note: the terminations must all be level with each other and at a 12'' (305 mm) min from grade or the snow line.**



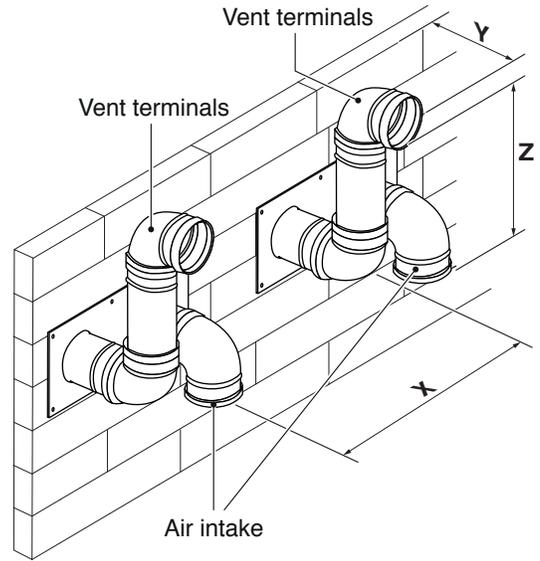
**Vertical venting system (sealed combustion)**



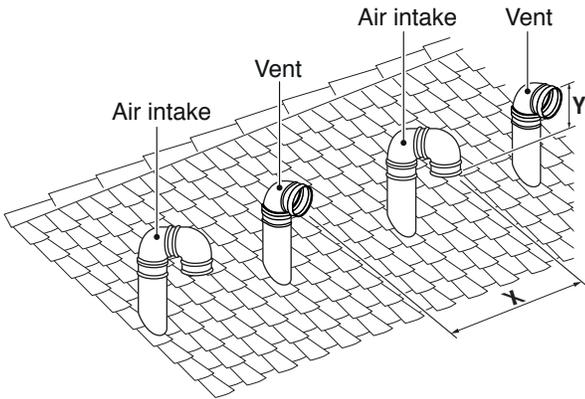
**Multiple air and vent vertical terminations;  $X \geq 12''$  (305 mm);  $Y \geq 12''$  (305 mm)**



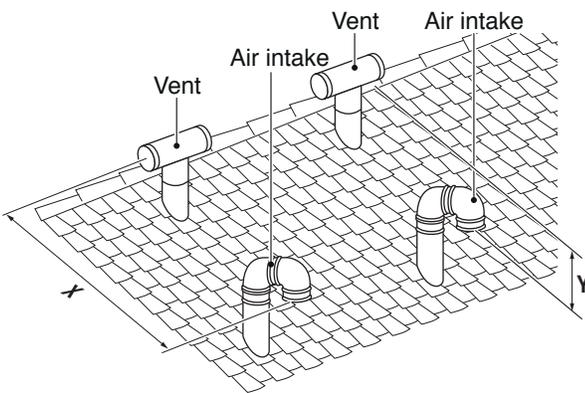
**Multiple air and vent vertical termination ;  $X \geq 12''$  (305 mm);  $Y \leq 25''$  (635 mm);  $Z = 12''$  (305 mm) to  $16''$  (406 mm)**



**Multiple air and vent vertical termination;  $X \geq 12''$  (305 mm);  $Y \geq 12''$  (305 mm)**



**Multiple air and vent vertical termination;  $X \geq 12''$  (305 mm);  $Y \geq 12''$  (305 mm)**



## VENTING MATERIAL

**Array** boilers must be vented and supplied with combustion and ventilation air as described in this section.

Installation must comply with local requirements and with the National Fuel Gas Code ANSI Z223.1. **Array** boilers vent and intake air piping can be installed through the roof or through a sidewall. Any of the vent/air piping methods covered in this manual can be used. Do not attempt to install the boilers using any other means. Suitable, UL approved, positive pressure, watertight vent materials **MUST** be used for safety and UL certification.

**Array** boiler can use the following material for venting:

Material	Standard	Maximum Flue Temperature (°F)	Approved Manufacturers
CPVC Schedule 40, 80	ANSI/ASTM F441	194	
Polypropylene	ULC S636	230	Centrotherm Eco Systems (InnoFlue SW)
AL29-4C stainless steel	UL 1738	300+, limited only by rating of seals	

For specific venting components (terminals, fittings), contact the respective vent manufacturer.

**⚠ DANGER:** It is extremely important to follow these venting instructions carefully. Failure to do so can cause severe personal injury, death or substantial property damage.

**⚠ DANGER:** Use of cellular core PVC (ASTM F891), cellular core CPVC or Radel® (polyphenosulfone) in venting systems is prohibited.

**⚠ WARNING:** Do not connect this gas appliance with any other appliance unless approved by manufacturer. Failure to comply with this WARNING could result in the accumulation of carbon monoxide gas which can cause severe personal injury or death.

**⚠ DANGER:** The condensate traps must be filled with water or combustion gases will enter the room with a risk of an excessive level of carbon monoxide.

- Vent connectors serving appliances vented by natural draft shall not be connected to any portion of mechanical draft systems operating under positive pressure.
- Ensure the flue pipes and seals are not damaged.
- Use only primer and glue compounds approved for use with the vent material used.
- Never install a barometric or a thermally controlled vent damper with this boiler.
- Do not route the flue system piping through or inside another duct that is used for exhausting air or other flue gases.
- The condensate traps must be primed at all times. Failure to do so may allow combustion gases to escape into the boiler room.
- The unit is to be used for either direct vent installation or for installation using room air for combustion. When room air is used, it is necessary to provide an adequate opening for the fresh make-up air intake.
- You must use any of the vent/air piping methods shown in this manual.
- Be sure to locate the unit such that the vent and combustion air piping can be routed through the building and properly terminated.
- The boiler / vent installation must be in accordance with Venting of Appliances, of the latest edition of the National Fuel Gas Code, ANSI Z223.1/NFPA or applicable provisions of

- the local, state and federal building codes.
- All vent pipes must be installed according to the vent manufacturer's instructions.
- The exhaust vent and the combustion air inlet lines must be supported to prevent sagging per the vent manufacturer's instructions.
- The boiler must not support the weight of any ductwork.
- Do not mix components from different systems. The vent system could fail, causing leakage of flue products into the living space. Use only approved materials.
- Use of cellular core PVC and CPVC for venting system is not allowed.
- The vent system shall be installed so as to prevent the accumulation of condensate.
- Consult local and state codes pertaining to special building code and fire department requirements. Adhere to national code requirements.
- Observe the listed maximum lengths of vent system, which are boiler model dependent.
- To avoid moisture and frost build-up and to maintain clearances to openings on adjacent structures, 45° and 90° elbows or tees may be attached to the end of the vent termination pipe to direct exhaust plumes away from the adjacent structure. The total allowable vent length, maximum number of elbows and distance of air intake restrictions must be adhered to.
- Due to the high efficiency of the unit it may discharge what looks like white smoke especially when the outside air temperature is cold. This is due to the presence of water vapor, normally present in the exhaust gases.

## COMBUSTION AIR

Air supply is a direct requirement of ANSI 223.1, NFPA-54, CSA B149.1 and local codes. These codes should be consulted before a permanent design is determined.

Array boilers utilize combustion air from the space in which they are installed, or utilize combustion air ducted directly to the unit. Ventilation air must be provided in either case.

Material	Standard
ABS	ANSI/ASTM D1527
PVC Schedule 40	ANSI/ASTM D1785 or D2665
CPVC Schedule 40	ANSI/ASTM F441
Polypropylene	ULC S636
Single wall galvanised steel	26 gauge

In cold climates it is essential to provide a motorized air inlet damper to control the supply of combustion air and prevent nuisance condensation.

The combustion air must be free of:

- Permanent wave solutions;
- Chlorinated waxes/cleaners;
- Chlorine-based swimming pool chemicals;
- Calcium chloride
- Sodium chloride used for water softening;
- Refrigerant leaks;
- Paint or varnish removers;
- Hydrochloric acid/muriatic acid;
- Cements and glues;
- Antistatic fabric softeners used in clothes dryers;
- Chlorine-type bleaches, detergents, and cleaning solvents found in household laundry rooms;
- Adhesives used to fasten building products and other similar products.

To prevent contamination do not connect the combustion air inlet and exhaust near:

- Dry cleaning/laundry areas and establishments;
- Swimming pools;
- Metal fabrication plants;
- Beauty shops;
- Refrigeration repair shops;
- Photo processing plants;
- Auto body shops;
- Plastic manufacturing plants;
- Furniture refinishing areas and establishments;
- Remodeling areas;
- Garages with workshops

Whenever the environment contains these types of chemicals, combustion air MUST be supplied from a clean area outdoors for the protection and longevity of the equipment and warranty validation. The more common methods of combustion air supply are outlined in the following sections.

## COMBUSTION AIR FROM OUTSIDE THE BUILDING

Air supplied from outside the building must be provided through two permanent openings. For each unit these two openings must have a free area in accordance with the requirements of CAN/CSA B149.1, Natural Gas and Propane Installation Code. The free area must take into account restrictions such as louvers and bird screens.

## COMBUSTION AIR FROM INSIDE THE BUILDING

When combustion air is provided from within the building, it must be supplied through two permanent openings in an interior wall. Each opening must have a free area of not less than one square inch per 1000 BTUH of total input or 3000 square inches of free area. The free area must take into account any restrictions, such as louvers.

## DUCTED COMBUSTION AIR

For ducted combustion air installations, the air ductwork must be attached directly to the air inlet connection on the sheet metal enclosure.

In a ducted combustion air application, the combustion air ducting pressure losses must be taken into account when calculating the total maximum allowable venting length.

For additional details, see "Appendix G - Venting Size Data".

## APPENDIX I – SENSOR RESISTANCE

## SENSOR RESISTANCE TABLE

Temperature °F (°C) Testing tolerance ±10%	Resistance [Ω]
32 (0)	27396
41 (5)	22140
50 (10)	17999
59 (15)	14716
68 (20)	12099
77 (25)	10000
86 (30)	8308
95 (35)	6936
104 (40)	5819
113 (45)	4904
122 (50)	4151
131 (55)	3529
140 (60)	3012
149 (65)	2582
158 (70)	2221
167 (75)	1918
176 (80)	1663
185 (85)	1446
194 (90)	1262
203 (95)	1105
212 (100)	970
221 (105)	855
230 (110)	755
239 (115)	669
248 (120)	594
257 (125)	529

Resistance table for:

- Heat exchanger supply temperature sensor
- Heat exchanger return sensor
- Heat exchanger flue sensor
- Boiler supply sensor
- System temperature sensor
- Outdoor temperature sensor

## APPENDIX J – LIST OF PARAMETERS (WITH RANGES AND DEFAULT VALUES)

Parameters are listed base on the reference menu.

## Reference Menu

M1	Boiler parameters menu
M2	System cascade settings menu
M3	Boiler cascade settings menu
M4	Appliance configuration menu

## Access type

U	End user
I	Installer

Menu	Par. No.	Nr. displayed Display	Description	Range	Default setting	UM	Access type	Category
M1	1	CH mode	Defines the boiler's various heating operation modes.	0 - 5	0		I	Heating
M1	3	CH set-point	Defines the desired supply temperature in heating mode (Par. 1) = 0.	Par. 23 - Par. 24	158 (70)	°F (°C)	U	Heating
M1	109	Calc. set-point off-set	Establishes the set-point offset value calculated in climatic mode (Par. 1= 1). Offsets the climatic curve in presence of mild outdoor temperatures.	Off, - 10 - 10	0		I	Heating
M1	110	CH Min. Set-point	Sets the minimum supply temperature value in heating mode (Par. 1) = 4.	68 - 122 (20 - 50)	86 (30)	°F (°C)	I	Heating
M1	111	CH Min. Set-point	Sets the maximum supply temperature value in heating mode (Par. 1) = 4.	122 - 194 (50 - 90)	176 (80)	°F (°C)	I	Heating
M1	5	Boiler Pump Overrun	Sets the overrun time in seconds of the boiler's circulator during stand-alone operation; cascade operation determines the boiler's overrun after switch-off due to temperature control.	0 - 900	140	Sec.	I	Heating
M1	7	CH Hysteresis	Sets the value in degrees beyond the set-point at which the burner switches off for thermoregulation.	0 - 36 (0 - 20)	11 (5)	°F (°C)	I	Heating
M1	112	CH Hysteresis Down	Sets the value in degrees below the set-point at which the burner switches on again for thermoregulation.	0 - 36 (0 - 20)	11 (5)	°F (°C)	I	Heating
M1	9	An-ti-cycle Period	Sets the stand-by time before the appliance is switched on again after it switches off due to thermoregulation, independently from the supply temperature dropping below the value indicated in Par. 10. Parameter valid only in stand-alone mode.	10 - 900	120	Sec.	I	Heating
M1	10	An-ti-cycle Temp. Diff.	Sets the value in degrees below which the burner switches on again notwithstanding from the time spent at Par. 9.	0 - 36 (0 - 20)	60.8 (16)	°F (°C)	I	Heating
M1	14	Max. Power CH	Sets the heating's % max. power.	50 - 100	100	%	I	Heating
M1	15	Min. Power CH/DHW	Sets the heating's % min. power.	1 - 30	1	%	I	Heating
M1	19	Design Supply Temp.	Defines the max. set-point at the minimum outdoor temperature for climatic regulation.	86 - 194 (30 - 90)	176 (80)	°F (°C)	U	Heating
M1	20	Design Outdoor Temp.	Defines the minimum outdoor temperature to which the maximum set-point can be associated for climatic regulation.	-52 - 52 (-25 - 25)	0 (0)	°F (°C)	U	Heating
M1	21	Baseline Supply Temp.	Defines the minimum set-point at the maximum outdoor temperature for climatic regulation.	86 - 194 (30 - 90)	104 (40)	°F (°C)	I	Heating
M1	22	Baseline Outdoor Temp.	Defines the maximum minimum outdoor temperature to which the minimum set-point can be associated for climatic regulation.	-32 - 86 (0 - 30)	68 (20)	°F (°C)	I	Heating

Menu	Par. No.	Nr. displayed Display	Description	Range	Default setting	UM	Access type	Category
M1	23	Design Supply Min. Limit	Limits the minimum value that can be assigned to the set-point in heating mode (does not apply to heating mode 4).	39 - 180 (4 - 82)	86 (30)	°F (°C)	I	Heating
M1	24	Design Supply Max. Limit	Limits the maximum value that can be assigned to the set-point in heating mode (does not apply to heating mode 4).	81 - 194 (27 - 90)	176 (80)	°F (°C)	I	Heating
M1	25	Warm Weather Shutdn	Defines the temperature at which climatic regulation is switched off.	-32 - 95 (0 - 35)	71.6 (22)	°F (°C)	I	Heating
M1	26	Boost Temp Increment	Establishes the set-point temperature and increases delta T, if the heat demand in heating mode is not satisfied after the time interval specified in Par. 27 (applies only to stand-alone mode only).	0 - 54 (0 - 30)	0 (0)	°F (°C)	I	Heating
M1	27	Boost Time Delay	Defines the time interval after which the set-point is increased as defined in Par. 26 (applies only to stand-alone mode).	1 - 120	20	Min.	I	Heating
M1	28	Night Setback Temp.	Used in heating mode Par. 1= 2 or 3. Establishes how many degrees the supply set-point is reduced when the RT (room thermostat/heat demand) contact is closed.	0 - 86 (0 - 30)	50 (10)	°F (°C)	I	Heating
M1	35	DHW mode	Establishes the domestic hot water circuit's operation mode.	0 Disabled 1 Tank + Sensor 2 Tank + aquastat	0		I	DHW
M1	113	Max. Power DHW	Defines the domestic hot water circuit's max. % power.	50 - 100	100	%	I	DHW
M1	114	Min. Power DHW	Defines the domestic hot water circuit's minimum % power.	1 - 30	1	%	I	DHW
M1	36	DHW Tank Hyst. Down	Defines the hysteresis to initiate the domestic hot water demand.	0 - 36 (0 - 20)	9 (5)	°F (°C)	I	DHW
M1	37	DHW Tank Hyst. Up	Defines the hysteresis to stop the domestic hot water demand.	0 - 36 (0 - 20)	9 (5)	°F (°C)	I	DHW
M1	38	DHW Tank Supply Extra	Defines the primary circuit's set-point increase in degrees compared to the temperature set for the domestic hot water tank.	0 - 54 (0 - 30)	27 (15)	°F (°C)	I	DHW
M1	42	DHW Priority	Defines the priority type: On: priority for DHW; Off: priority for CH; Time: time priority between the two circuits defined by Par. 43; Parallel: parallel priority managed on the basis of the primary circuit's temperature compared to the heating circuit's set-point.	ON/OFF/Time Parallel	On		I	DHW
M1	43	DHW Max. Priority Time	Establishes the time in minutes during which priority is alternatively allocated to the DHW and CH circuits when Par. 43 is set to "time" mode.	1 - 255	30	Min.	I	DHW
M1	44	DHW Pump Overrun	Establishes the overrun time in seconds for the domestic hot water mode with the boiler in stand-alone operation; cascaded operation defines the boiler's overrun after switch-off due to thermoregulation.	0 - 900	60	Sec.	I	DHW

Menu	Par. No.	Nr. displayed Display	Description	Range	Default setting	UM	Access type	Category
M1	48	DHW tank set-point	Establishes the DHW indirect storage tank set-point Par. 35 in mode 2.	104-160 (40-71)	122 (50)	°F (°C)	U	DHW
M1	92	Fan Speed Maximum	Defines the fan rpm at max. power (it depends on the model and is defined at Par. 98).	0-12750	Defined by Par. 98	RPM	I	General
M1	93	Fan Speed Minimum	Defines the fan rpm at minimum power (it depends on the model and is defined at Par. 98).	0-12750	Defined by Par. 98	RPM	I	General
M1	94	Fan Speed Ignition	Defines the fan rpm when the boiler is switched on (it depends on the model and is defined at Par. 98).	0-12750	Defined by Par. 98	RPM	I	General
M1	116	Prog. Input 1.	The value of this parameter is defined by Par. 97.	0 Disabled 1 Water pressure sensor 2 CH flow switch 3 Flue pressure switch	Defined by Par. 97		I	General
M1	117	Prog Input 2.	The value of this parameter is defined by Par. 97.	0 Disabled 1 DHW flow sensor 2 DHW flow switch 3 CH flow sensor	Defined by Par. 97		I	General
M1	118	Prog Input 3.	The value of this parameter is defined by Par. 97.	0 Disabled 1 Drain switch 2 Gas pressure switch	Defined by Par. 97		I	General
M1	120	Prog Input 5.	The value of this parameter is defined by Par. 97.	0 Disabled 1 T_Return sensor 2 Extern switch	Defined by Par. 97		I	General
M1	121	Prog Input 6.	The value of this parameter is defined by Par. 97.	0 Disabled 1 T_Flue sensor 2 Flue switch 3 APS switch	Defined by Par. 97		I	General
M1	122	Prog Input 7.	The value of this parameter is defined by Par. 97.	0 Disabled 1 T_Flue_2 sensor 2 T_Flue_2 + Bl. Flue 3 T_System sensor 4 Blocked Flue switch 5 Cascade Sensor	Defined by Par. 97		I	General
M1	123	Prog Input 8.	The value of this parameter is defined by Par. 97.	0 Disabled 1 T_Flue_2 sensor 2 T_Flue_2 + Bl. Flue 3 T_System Sensor 4 Blocked Flue Switch 5 Cascade Sensor	Defined by Par. 97		I	General

Menu	Par. No.	Nr. displayed Display	Description	Range	Default setting	UM	Access type	Category
M1	124	Prog. Input RT.	The value of this parameter is defined by Par. 97.	0 Disabled 1 Enabled	Defined by Par. 97		I	General
M1	125	Prog. Output 1.	The value of this parameter is defined by Par. 97.	0 Disabled 1 General Pump 2 CH Pump 3 DHW Pump 4 System Pump 5 Cascade Pump 6 Alarm Relay 7 Filling Valve 8 LPG Tank 9 External Igniter 10 Air Damper 14 Alarm Burner CC 15 Status Burner CC 17 Anti-legionella pump	Defined by Par. 97		I	General
M1	126	Prog. Output 2.	The value of this parameter is defined by Par. 97.	0 Disabled 1 General Pump 2 CH Pump 3 DHW Pump 4 System Pump 5 Cascade Pump 6 Alarm Relay 7 Filling Valve 8 LPG Tank 9 External Igniter 10 Air Damper 14 Alarm Burner CC 15 Status Burner CC 17 Anti-legionella pump	Defined by Par. 97		I	General
M1	127	Prog. Output 3.	The value of this parameter is defined by Par. 97.	0 Disabled 1 General Pump 10 Air Damper 11 HIS 12 Modulating Pump	Defined by Par. 97		I	General
M1	128	Prog. Output 4.	The value of this parameter is defined by Par. 97.	0 Disabled 1 General Pump 2 CH Pump 3 DHW Pump 4 System Pump 5 Cascade Pump 6 Alarm Relay 7 Filling Valve 8 LPG Tank	Defined by Par. 97		I	General
M1	129	Flow sensor	Defines the type of supply sensor used.	Bitron, Huba: DN8, DN10, DN15, DN15, DN20, DN25	Huba DN25		I	General
M1	138	Appliance type	Value can vary depending on appliance configuration based on Par. 97 and 98. This value is calculated by the board, which, based on an internal logic, defines as a single number the settings of Par. 97 and 98.	0 - 255	Depends on boiler model		I	General

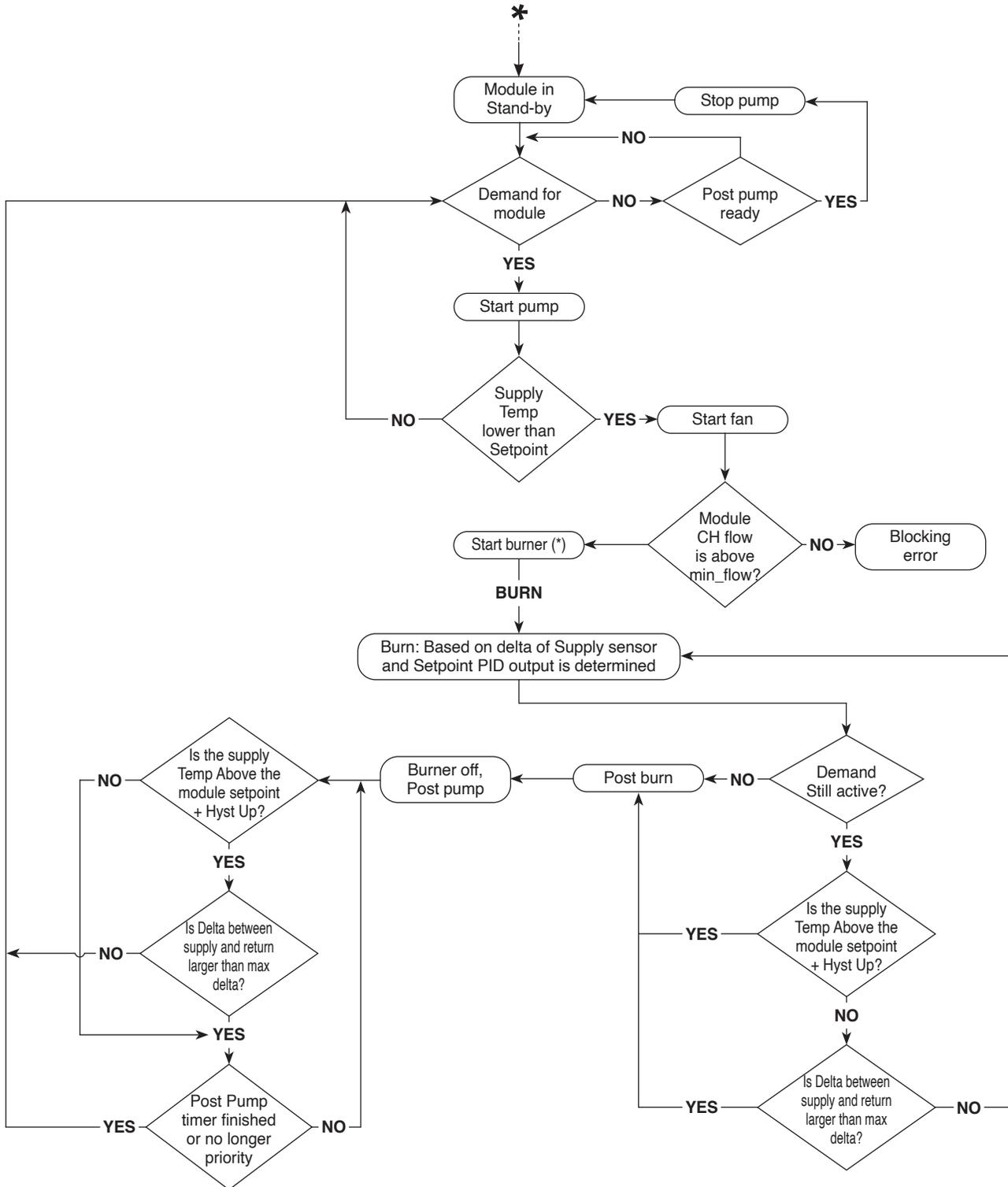
Menu	Par. No.	Nr. displayed Display	Description	Range	Default setting	UM	Access type	Category
M1	139	Dair active	Activates bleeding the system's air. To activate air bleeding, it is necessary to switch on the boiler and change the parameter from "No" to "Yes". Wait for one minute. Switch off and restart. At this stage, when it is restarted the boiler will initiate the automatic bleeding procedure (lasting around 20 minutes). With the parameter set to "Yes", the procedure is carried out each time the boiler is switched off and restarted using its master switch. The value must be set to "No" if you do not wish to initiate the bleeding procedure when the boiler is switched on.	Yes, No	No		I	General
M1	140	Minimum Flow	Defines the flow rate below which the boiler is switched off. The value varies depending on the model.	0 - 26 (0.0 - 100)	13 (50)	gal/min (l/min)	I	General
M1	107	Anti-Le-gionella day	Sets the weekday on which the anti-Legionella procedure is carried out.	Sun - Sat	Sun	Day	I	DHW
M1	108	Anti-Le-gionella Hour	Sets the time of the day during which the anti-Legionella procedure is carried out.	0 - 23	0	Hour	I	DHW
M2	72	Permit Emergency Mode	Activates the emergency mode. This mode comes on when communication between Managing and the primary circuit's sensor is lost. In this event, if Par. 72 is set to "Yes", the cascade is initiated, working to the fixed set-point determined by Par. 74.	Yes/No	Yes		U	Cascade
M2	74	Emergency Set-point	Set-point active in emergency mode.	68 - 194 (20 - 90)	158 (70)	°F (°C)	I	Cascade
M2	75	Delay Per Start Next Mod.	Defines the stand-by time in seconds to restart the subsequent cascade boiler in normal start mode.	5 - 255	120	Sec.	I	Cascade
M2	76	Delay Per Stop Next Mod.	Defines the stand-by time in seconds to switch off the last cascade boiler on in normal Off mode.	5 - 255	30	Sec.	I	Cascade
M2	142	Delay Quick Start Next	Defines the stand-by time in seconds to restart the next cascade boiler in quick start mode.	5 - 255	60	Sec.	I	Cascade
M2	143	Delay Quick Stop Next	Defines the stand-by time in seconds to switch off the last cascade boiler on in Quick Stop mode.	5 - 255	15	Sec.	I	Cascade
M2	77	Hyst. Down Start Module	Defines how many degrees the temperature measured by the primary circuit's sensor must fall below the set-point in order for the subsequent boiler to be started after the time interval set by Par. 75.	0 - 72 (0 - 40)	9 (5)	°F (°C)	I	Cascade
M2	78	Hyst. Up Stop Module	Defines by how many degrees the temperature measured by the primary circuit's sensor must go above the set-point in order for the subsequent module to be switched off after the time interval set by Par. 76.	0 - 72 (0 - 40)	7 (4)	°F (°C)	I	Cascade
M2	144	Hyst. Down Quick Start	Defines how many degrees the temperature measured by the primary circuit's sensor must go below the set-point in order for the subsequent boiler to be started after the time interval set by Par. 142 (quick-start mode).	0 - 72 (0 - 40)	36 (20)	°F (°C)	I	Cascade

Menu	Par. No.	Nr. displayed Display	Description	Range	Default setting	UM	Access type	Category
M2	145	Hyst. Up Quick Stop	Defines how many degrees the temperature measured by the primary circuit's sensor must go above the set-point in order for the subsequent boiler to be switched off after the time interval set by Par. 143 (quick stop mode).	0 - 72 (0 - 40)	11 (6)	°F (°C)	I	Cascade
M2	146	Hyst. Up Stop All	Defines how many degrees the temperature measured by the primary circuit's sensor must go above the set-point in order for all "On" sensor to be switched off at the same time.	0 - 72 (0 - 40)	14 (8)	°F (°C)	I	Cascade
M2	147	Number of Units	Defines the number of boilers of which the cascade system consists of.	1 - 6	6		I	Cascade
M2	148	Power Mode	Defines the cascade operation mode.	0 Disabled 1 Min burners 2 Max burners	2		I	Cascade
M2	79	Max. Setp. Offset Down	Defines the maximum decrease in the primary circuit's cascade set-point. It is based on the primary circuit's sensor reading.	0 - 72 (0 - 40)	5.6 (2)	°F (°C)	I	Cascade
M2	80	Max. Setp. Offset Up	Defines the maximum increase in the primary circuit's cascade set-point. It is based on the primary circuit's sensor reading.	0 - 72 (0 - 40)	9 (5)	°F (°C)	I	Cascade
M2	81	Start Mod. Delay Fact.	Defines the time in minutes from the moment the demand is triggered until the activation of the set-point increases or decreases provided for by Par. 79 and 80.	0 - 60	60	Min.	I	Cascade
M2	82	Next Module Start Rate	Defines the minimum power for at least one of the boilers in the cascade system in order for the next boiler to be switched on (if the other conditions linked to Par. 75 and 77 are met).	10 - 100	80	%	I	Cascade
M2	83	Next Module Stop Rate	Defines the maximum power for all the boilers in cascade in order for the last boiler on to be switched off (if the other conditions linked to Par. 76 and 78 are met).	10 - 100	25	%	I	Cascade
M2	84	Module Rotation Interval	It defines the time interval (in days) after which boilers are rotated.	0 - 30	1	Days	I	Cascade
M2	149	First Module to Start	Establishes the number of the next boiler to be rotated (this value is automatically updated at each rotation).	1 - 16	1		I	Cascade
M2	152	Pwr-Mode2 Min Power	Defines the power value (in percentage terms) against which the average power of all on boilers in cascade operation mode must be compared (Par. 148 = 2).	0 - 100	20	%	I	Cascade
M2	153	Pwr-Mode2 Hysteresis	Defines the Hysteresis power value (in percentage terms) compared to the average power of all on boilers in cascade operation mode (Par. 148 = 2).	0 - 100	40	%	I	Cascade
M2	154	Post-Pump Period	Defines pump overrun time in seconds at the end of the cascade heat demand.	0 - 255	60	Sec.	I	Cascade
M2	155	Frost Protection	Defines the temperature (detected by the primary sensor) below which the boiler circulator and the system circulator (with cascade configuration) activate. If the temperature of the primary sensor falls another 9°F (5°C) below the value set by Par. 155, then a request to activate the cascade system is generated. When the temperature of the primary sensor reaches the value defined by Par. 155 increased by 9°F (5°C), then the request ceases and the cascade returns to stand-by mode.	18 - 54 (10 - 30)	27 (15)	°F (°C)	I	Cascade

Menu	Par. No.	Nr. displayed Display	Description	Range	Default setting	UM	Access type	Category
M3	73	Boiler Address	Defines the way in which the boiler is managed.	Managing, Stand-alone, Dependent	Stand-alone		I	Cascade
M3	169	Max. Setp. Offset Down	Defines the maximum decrease in the primary circuit's cascade set-point and is based on the secondary circuit's sensor reading.	0 - 72 (0 - 40)	5.6 (2)	°F (°C)	I	Cascade
M3	170	Max. Setp. Offset Up	Defines the maximum increase in the primary circuit's cascade set-point and is based on the secondary circuit's sensor reading.	0 - 72 (0 - 40)	9 (5)	°F (°C)	I	Cascade
M3	171	Start Mod. Delay Fact.	Defines the time in minutes from the moment the request is triggered until the activation of the set-point increases or decreases provided for by Par. 169 and 170.	0 - 60	40	Min.	I	Cascade
M4	98	Appliance Settings	Supports uploading the values of Par. 92, 93 and 94 from a set of pre-defined rpm values that identifies the boiler type.	-	Array AR 399 SE P=83 Array AR 500 SE P=82		I	General
M4	97	IO Configuration	Supports uploading the values of Par. from 116 to 128 from a set of pre-defined rpm values that defines the configuration of the boiler's inputs and outputs.	-	22		I	General

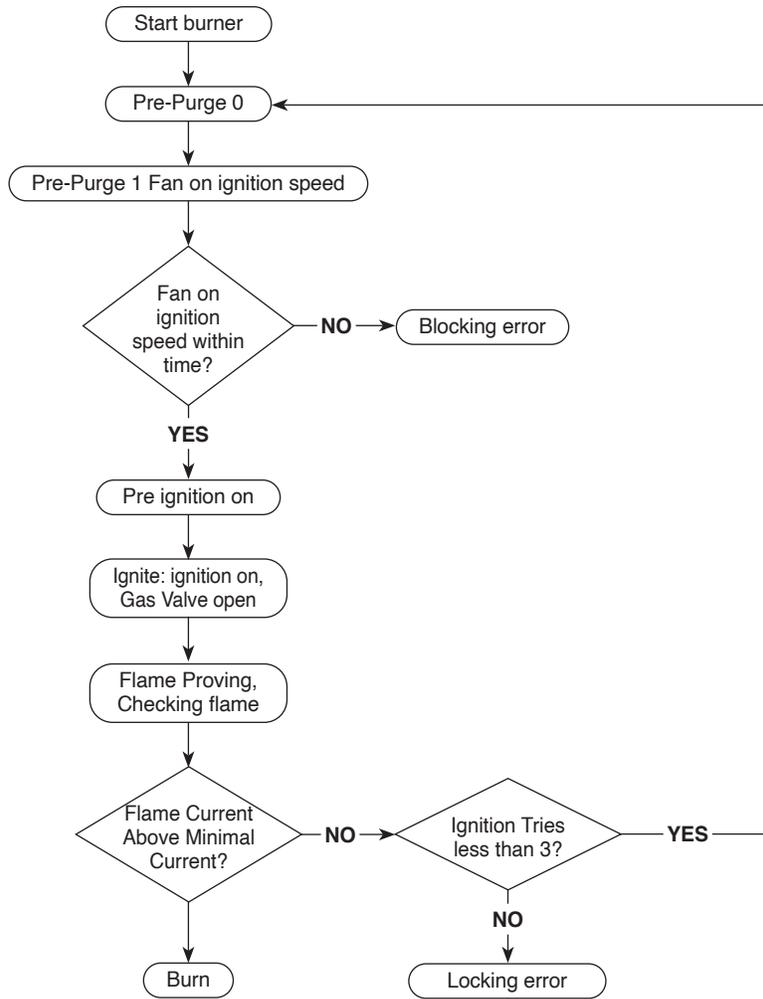
APPENDIX K – FLOWCHARTS

SINGLE MODULE

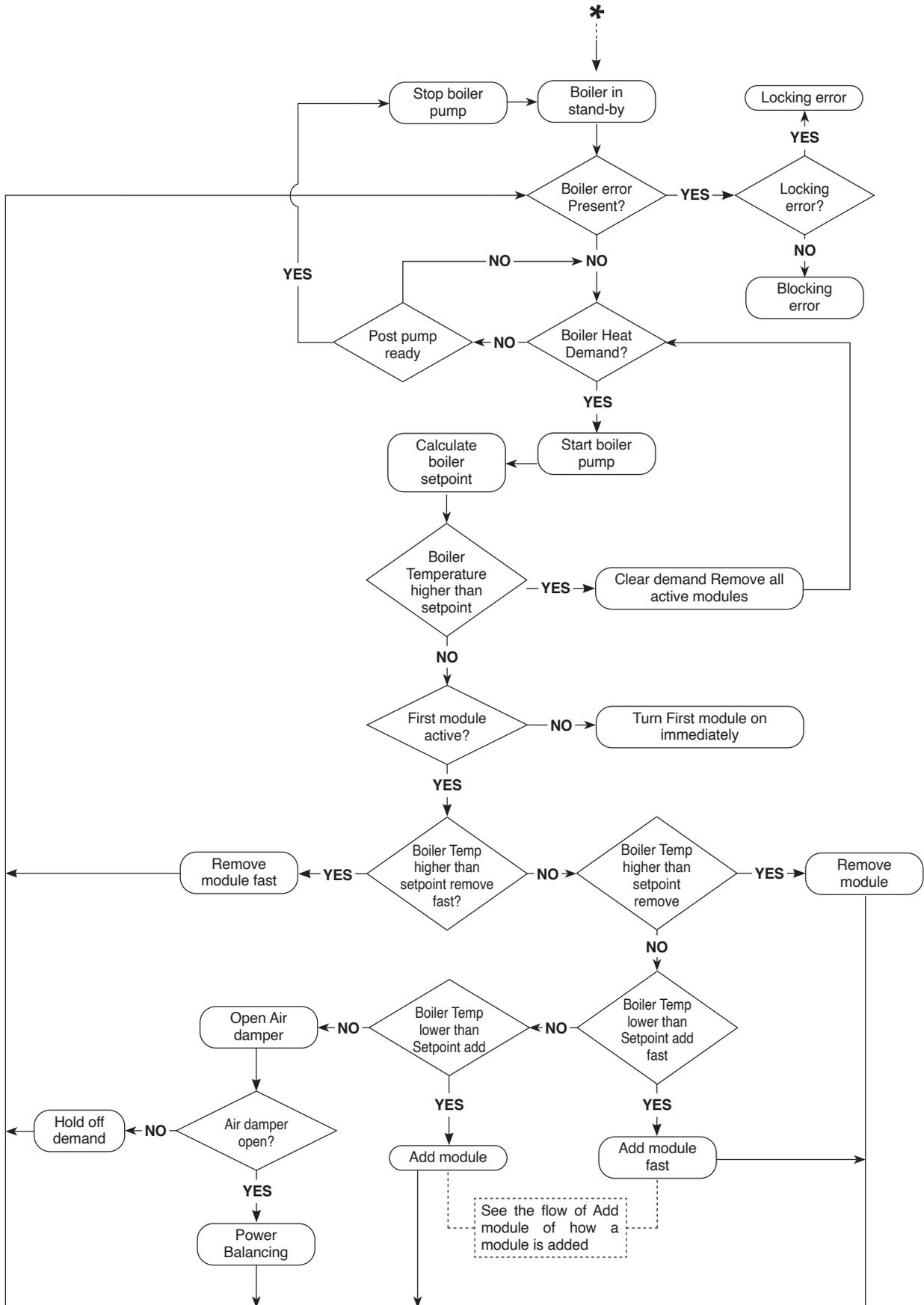


(\*) see Burner ignition sequence on next page.

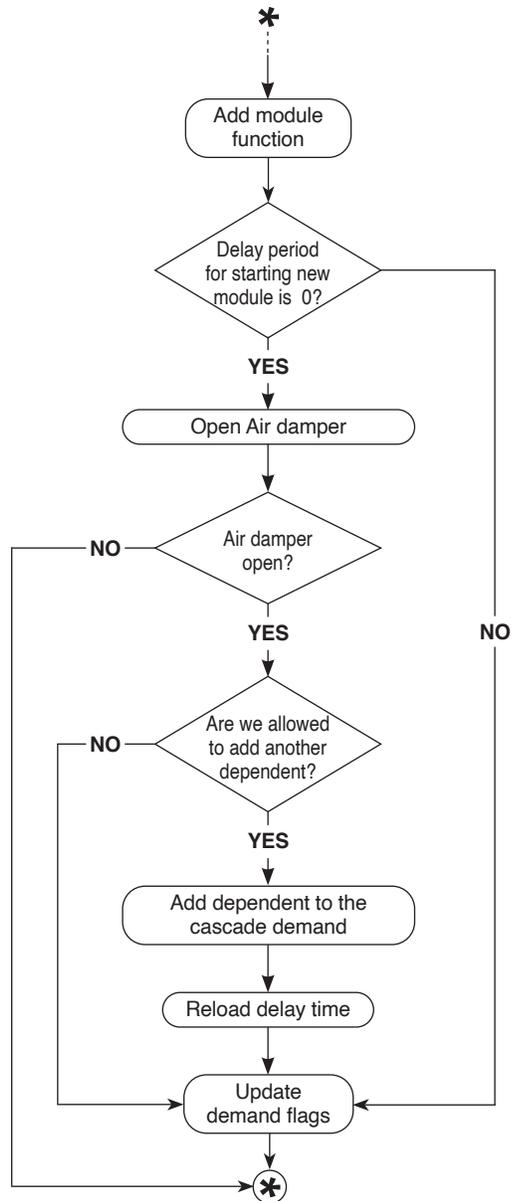
BURNER IGNITION SEQUENCE



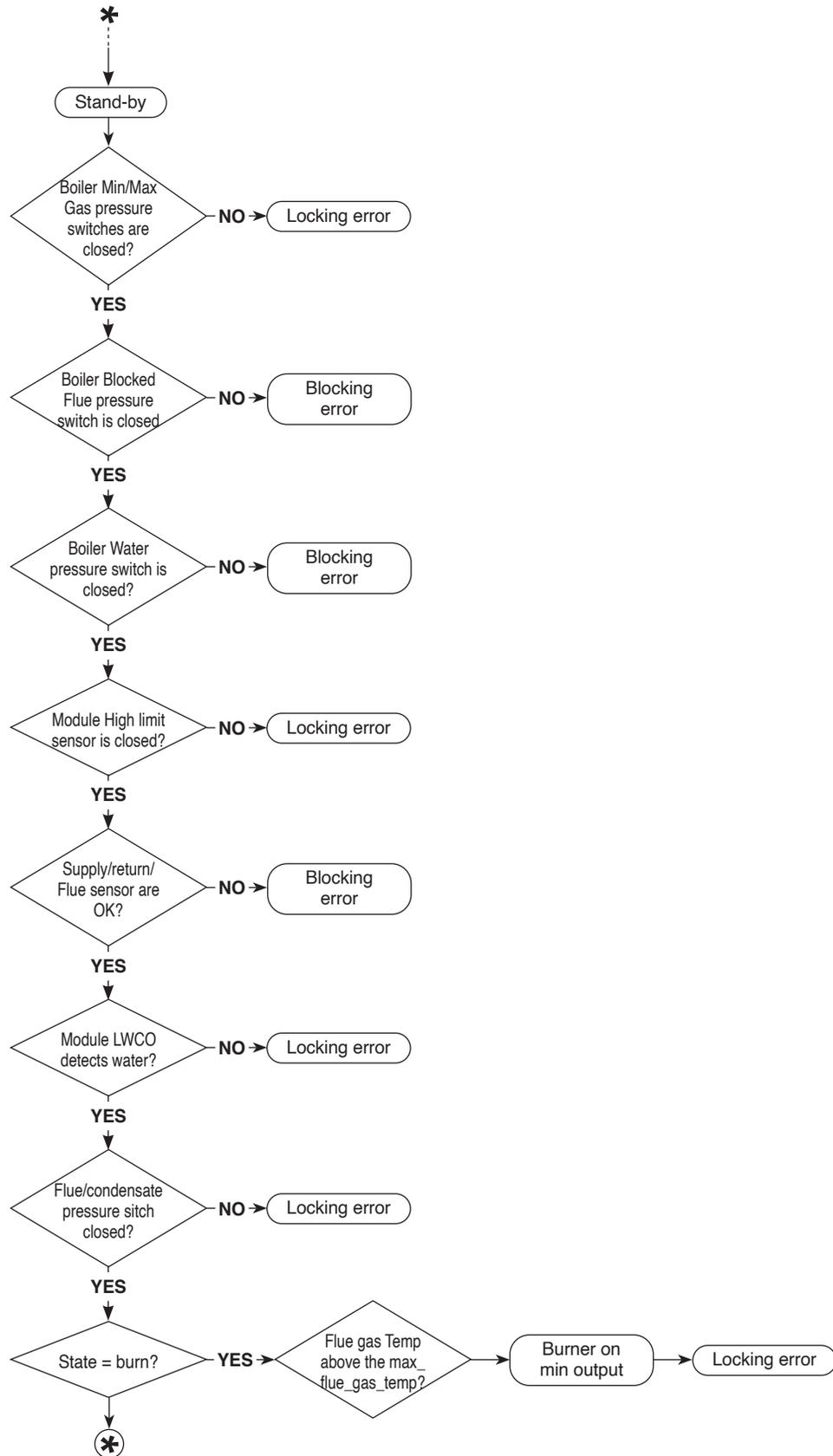
MODULE CASCADE (STAND-ALONE BOILER)



## MODULE CASCADE (STAND-ALONE BOILER): ADD/REMOVE MODULE



ERROR CHECKING CYCLE



# RIELLO

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