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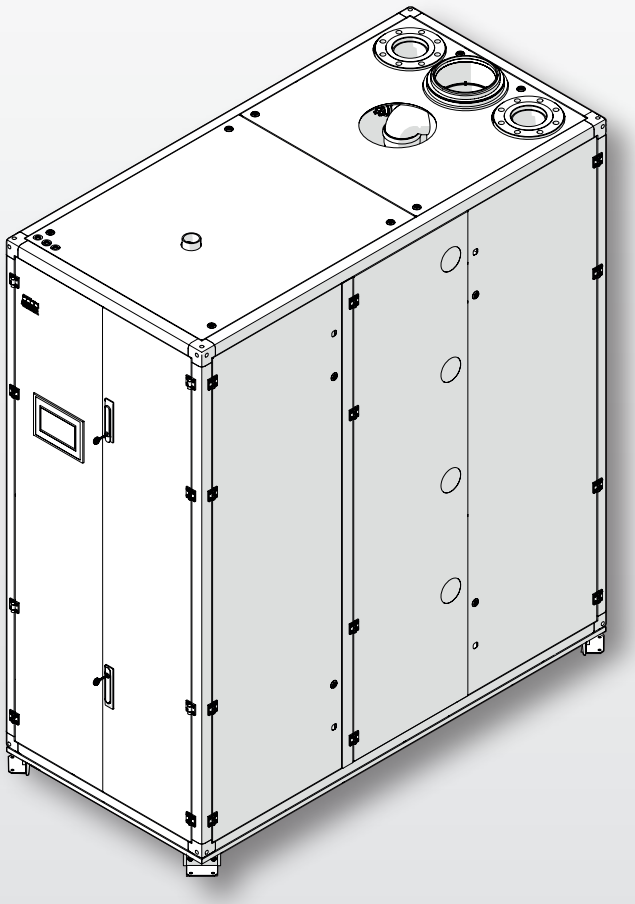

Array AR 1000 – AR 1500 – AR 2000

US INSTALLATION AND OPERATION MANUAL

RIELLO

Attention Heating Engineer,
Congratulations for purchasing a **RIELLO** boiler. This appliance ensures maximum comfort over a long life, with high reliability, efficiency, performance, quality and safety.
This manual provides information that is essential to the installation of the appliance. Used in conjunction with your own knowledge and expertise, it will enable you to install the appliance quickly, easily, and correctly.

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

CONFORMITY

The information contained in this manual is subject to change without notice from **RIELLO** SpA. **RIELLO** makes no warranty of any kind with respect to this material, including but not limited to implied warranties of merchantability and fitness for a particular application. **RIELLO** is not liable for errors appearing in this manual, nor for incidental or consequential damages occurring in connection with the furnishing, performance, or use of this material.

RANGE

MODEL	ASSEMBLY NUMBER
Array AR 1000	20177312
Array AR 1500	20177313
Array AR 2000	20177314

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 appliance.

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

Qualified installer, service agency or the gas supplier must perform installation and service.

FOR YOUR SAFETY: Improper installation and/or operation could create carbon monoxide gas in flue gases which could cause serious injury, property damage, or death.
Improper installation and/or operation will void the warranty.

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The following symbols are used in this manual:

⚠ **CAUTION! =** Identifies actions that require caution and adequate preparation.

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

1 GENERAL

The **RIELLO Array AR 1000, AR 1500** and **AR 2000** Boilers are fully modulating, high-efficiency condensing units. They represent a true industry advancement that meets the needs of today's energy and environmental concerns. Designed for application in any closed loop hydronic system, the modulating capability of the **Array** matches energy input directly to fluctuating system loads. The turn down ratio for these models is 10:1 for **AR 1000,** 15:1 for **AR 1500** and 20:1 for **AR 2000**. These **Array** models provide extremely high efficient operation and are ideally suited for modern low temperature, as well as conventional heating systems.

The **Array** Models operate within the following input and output ranges:

Array Model	Input Range (BTU/hr.)		Output Range (*) (BTU/hr.)	
	Minimum	Maximum	Minimum	Maximum
AR 1000	100,000	1,000,000	96,100	961,000
AR 1500	100,000	1,500,000	96,100	1,441,500
AR 2000	100,000	2,000,000	96,100	1,922,000

(*) The output of the boiler is a function of the unit's firing rate, return water temperature and BTU content of the supplied gas.

When installed and operated in accordance with this Instruction Manual, these boilers comply with the NOx emission standards outlined in:

South Coast Air Quality Management District (SCAQMD), Rule 1146.2

Whether used in singular or modular arrangements, the **AR 1000, AR 1500** and AR **2000** offer the maximum venting flexibility with minimum installation space requirements. These Boilers are Category IV, positive pressure appliances. Single and/or multiple breeched units are capable of operation in the following vent configurations:

- Conventional, Vertical Conventional,
- Sidewall Conventional, Direct Vent,
- Vertical Sealed, Direct Vent, Horizontal

These boilers are capable of being vented utilizing PP, CPVC, Stainless steel AL29-4C and AISI 316L vent systems.

The **Array**'s advanced electronics include several selectable modes of operation offering the most efficient operating methods and energy management system integration.

IMPORTANT: Unless otherwise specified, all descriptions and procedures provided in this Installation & Operation Manual apply to the **Array** series of boiler.

IMPORTANT: Array boilers are designed for space heating using hydronic systems. Any different application (like industrial processes with heavy-duty working conditions) must be officially authorized by **RIELLO**.

1.1 Warnings & Cautions

Installers and operating personnel MUST, at all times, observe all safety regulations. The following warnings and cautions are general and must be given the same attention as specific precautions included in these instructions.
In addition to all the requirements included in this **RIELLO** Instruction Manual, the installation of units MUST conform with local building codes, or, in the absence of local codes, ANSI Z223.1 (National Fuel Gas Code Publication No. NFPA-54) for gas-fired boilers and ANSI/ NFPASB for LP gas-fired boilers.
Where applicable, the equipment shall be installed in accordance with the current Installation Code for Gas Burning Appliances and Equipment, CSA B149.1, and applicable Provincial regulations for the class; which should be carefully followed in all cases.
Authorities having jurisdiction should be consulted before installations are made.

See pages 7 - 17 - 22 and 29 for important information regarding installation of units within the Commonwealth of Massachusetts.

IMPORTANT: This Instruction Manual is an integral part of the product and must be maintained in legible condition. It must be given to the user by the installer and kept in a safe place for future reference.

WARNING: Do not use matches, candles, flames, or other sources of ignition to check for gas leaks.

WARNING: Fluids under pressure may cause injury to personnel or damage to equipment when released. Be sure to shut off all incoming and outgoing water shutoff valves. Carefully decrease all trapped pressures to zero before performing maintenance.

WARNING: Before attempting to perform any maintenance on the unit, shut off all gas and electrical inputs to the unit.

WARNING: The exhaust vent pipe of the unit operates under a positive pressure and therefore must be completely sealed to prevent leakage of combustion products into living spaces.

WARNING: Electrical voltages up to 230 VAC maybe used in this equipment. Therefore the cover on the unit's power box (located behind the front panel door) must be installed at all times, except during maintenance and servicing.

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.

CAUTION: Many soaps used for gas pipe leak testing are corrosive to metals. The piping must be rinsed thoroughly with clean water after leak checks have been completed.

CAUTION: DO NOT use this boiler if any part has been submerged under water. Call a qualified service technician to inspect and replace any part that has been subjected to water.

1.2 Safety Instructions

Observe these instructions for your safety.
The burners and controls must be correctly installed and adjusted to ensure safe and economical operation of the gas boiler.
Read this installation and maintenance manual carefully and note the details on the boiler nameplate before placing the boiler in operation.

Risk of fatal injury from explosion of flammable gases

If you smell gas there is a danger of explosion.

- Never work on gas lines unless you are licensed contractor / gas fitter.
- Make sure that a licensed contractor / gas fitter installs the boiler, connects gas and vent, places the boiler in operation, connects the electrical power, and maintains and repairs the boiler.
- No open flame! No smoking! Do not use lighters.
- Prevent spark formation. Do not operate electrical switches, including telephones, plugs or door bells.
- Close main gas valve.
- Open doors and windows.
- Warn other occupants of the building, but do not use door bells.
- Call gas company from outside the building.
- If gas can be heard escaping, leave the building immediately, prevent other people from entering, notify police and fire departments from outside the building.

Risk to life from electrical shock.

- Disconnect the power supply to the boiler heating system before conducting any work on it, e.g. turn off the heating system emergency switch outside the boiler room.
- It is not sufficient just to turn off the control.
- Do not carry out electrical work unless you are qualified for this type of work.
- Before servicing, disconnect electrical power and lock out to prevent accidental reconnection.
- Observe and follow the local, state and federal installation regulations.

Risk of fatal injury from flue gas poisoning

Insufficient ventilation or combustion air availability may cause dangerous flue gas leaks and accumulation.

- Make sure that inlets and outlets are not reduced in size, restricted, or blocked.
- If faults are not corrected immediately, the boiler must not be operated until all faults have been corrected.
- Inform the system operator and/or owner of the fault and the danger in writing.

When working on the flue gas venting equipment or vent damper, leakage of flue gases may endanger the lives of people.

- Carefully observe proper operation of the vent damper. Do not start up the boiler unless the vent damper is operating properly.
- Use only genuine OEM parts when replacing parts.
- When replacing the vent damper, install the new one in the specified position.

Risk to life by poisoning by leakage of flue gases

- If the blocked vent switch trips frequently, the fault must be corrected and proper operation of the blocked vent switch test must be conducted.

Risk to life by poisoning by leakage of flue gases

- Make sure that the boiler is not equipped with a thermally controlled flue gas vent damper after the exhaust outlet on the boiler.

Risk of fatal injury from neglecting your own safety in case of emergency, such as with a fire

- Never put yourself at risk. Your own safety must always take priority.

Fire danger due to flammable materials or liquids

- Make sure that there are no flammable materials or liquids in the immediate vicinity of the boiler.
- Maintain a minimum distance of 15 inches from the boiler.

Installation and maintenance

- Observe all current standards and guidelines applicable to the installation and operation of the boiler heating system as applicable in your state or local jurisdiction.
- Clean and service the boiler system once a year. Check that the complete heating system operates correctly.
- Immediately correct all faults to prevent system damage.
- Only use original **RIELLO** spare parts. Losses caused by the use of parts not supplied by **RIELLO** are excluded from the **RIELLO** warranty
- Install and service the gas filter provided with the boiler according to the recommendations on Appendixes D and H..

1.3 General Warning

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. 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, state and federal 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).
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 distribution system to ensure safe operation.
Valves external to the boiler must be fitted with T-handles and condensate piping must be installed in accordance with the State Plumbing Code.

NOTICE:

- This boiler must be installed by a licensed contractor / gas fitter. Failure to do so shall void the product warranty.
- The boiler is intended only for the use for which it was specifically designed and built. **RIELLO** is hereby excluded from any liability for damages caused to persons, animals or property resulting from installation errors, improper adjustment, maintenance or use.
- In order to ensure safety and correct operation, the installation shall always take place in full compliance with the applicable codes and following the instructions provided by the manufacturer, and must always be carried out by a licensed contractor / gas fitter only.
- The equipment must be installed in an appropriate place and in combination with appropriate systems as specified by code.
- The unit may be exposed to temperatures between 5 deg F (-15°C) and 158 deg F (70°C) in its original packaging.
- After removing the packaging check the integrity and completeness of delivery and in case of non-compliance, contact your dealer.
- If there is a water leak, disconnect the boiler from the main power supply, close the water supply and immediately call technical assistance or installer/local contractor.
- Periodically check that the condensate drain is free from obstruction, dirt, grease, or other foreign material.
- Periodically check the system pressure. System pressure should be checked when the system is in standby mode and no call for heat is present.
- Maintenance is mandatory and shall be carried out at least once a year.
- This manual shall be read carefully, in order to install and operate the boiler appropriately, and safely.
- Boiler installations, settings and service should only be performed by an experienced licensed contractor / gas fitter. End Users should only make adjustments with the assistance of a licensed contractor / gas fitter.
- Any maintenance or service before disconnecting the boiler from the main power supply is forbidden.
- Do not remove or modify safety equipment.
- Do not pull or twist the electrical wires from the boiler, even if the device is disconnected from the main power supply.
- Do not obstruct or reduce the ventilation openings.
- Do not install the unit outdoors.
- Do not leave any combustibles or containers of flammable substances in the room where the boiler is installed.
- Keep packaging material out of reach of children as it can be potentially dangerous. Dispose of packaging material as required by law.
- The opening of metal casing of the device or removing of the cover are prohibited to the end user. Any service on the boiler must be carried out by authorized personnel.
- It is prohibited to dispose the product as domestic waste. The separate disposal of the appliance avoids possible negative consequences for the environment and human health deriving from inappropriate disposal. Its materials should be recycled to achieve significant savings in energy and resources.

2 PRODUCT DESCRIPTION

2.1 Introduction

- The gas-fired condensing Array boilers are designed to be used in central heating systems. Any other use is prohibited.
- This boiler can be connected to an indirect storage tank for the production of domestic hot water.
- There are several options available for venting. See section "4.15 Venting" for details.
- The quality of the system water is very important. Poor water quality can damage heating systems and boilers due to scale formation and corrosion (see section "4.6 Water quality guidelines").
- The boilers can also function directly with any hydronic emitter. When installing the boiler and system connections, the installer must consider the total head loss and flow rates in order to adequately size piping and circulator pumps.
- The Array boiler can be connected to a room thermostat or by a a remote 0-10 Vdc setpoint input.
- An outdoor air temperature sensor may be connected to the boiler for an outdoor reset supply temperature control for increased fuel efficiency and comfort.

2.2 Scope of Delivery

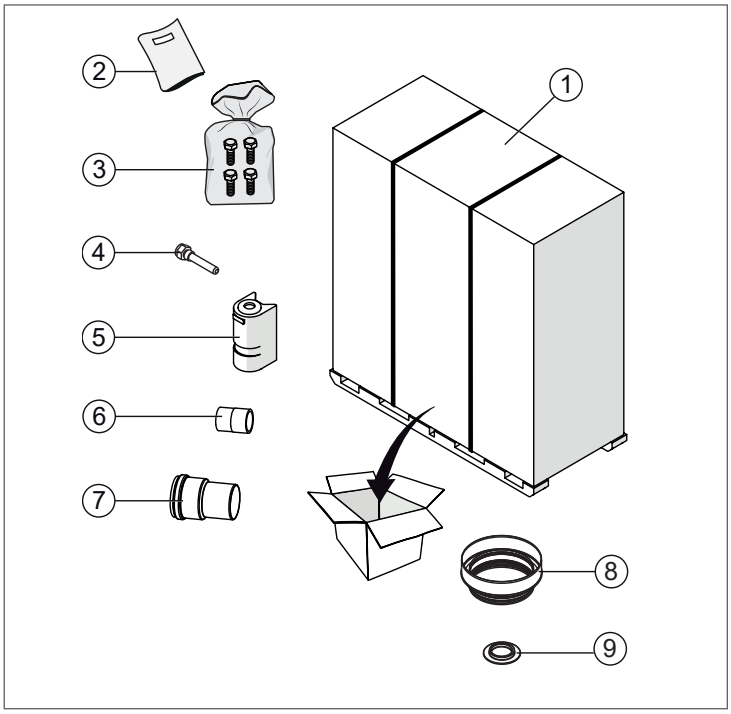


Fig. 1 *Scope of delivery*

Component		Qty	Packaging method
1	Gas condensing boiler	1	Pallet
2	Set of documents for appliance	1	Plastic package
3	Cabinet Keys	1	Cardboard box in boiler
4	System Temperature Sensor	1	Cardboard box in boiler
5	Outdoor Temperature Sensor	1	Cardboard box in boiler
6	Condensate Drain Adapter (1" PVC female)	1	Cardboard box in boiler
7	Relief Valves Drain Adapter (2.5" NPT female)	1	Cardboard box in boiler.
8	Flue adapter	1	Cardboard box in boiler.
9	Botton caps	2	Cardboard box in boiler.

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 all open loop 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. 2) located external to the unit.

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

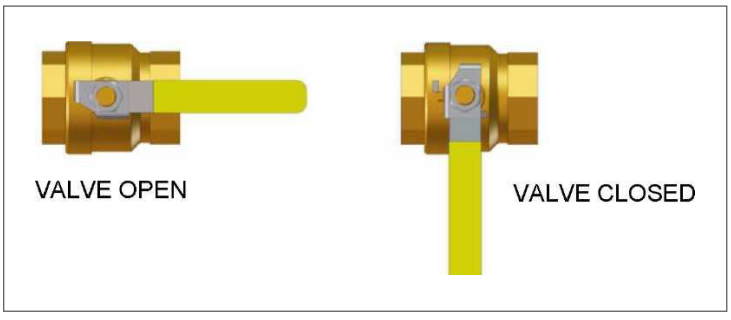


Fig. 2 *Manual Gas Shutoff Valve*

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.

2.7 Additional regulations for installations in the Commonwealth of Massachusettes

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:

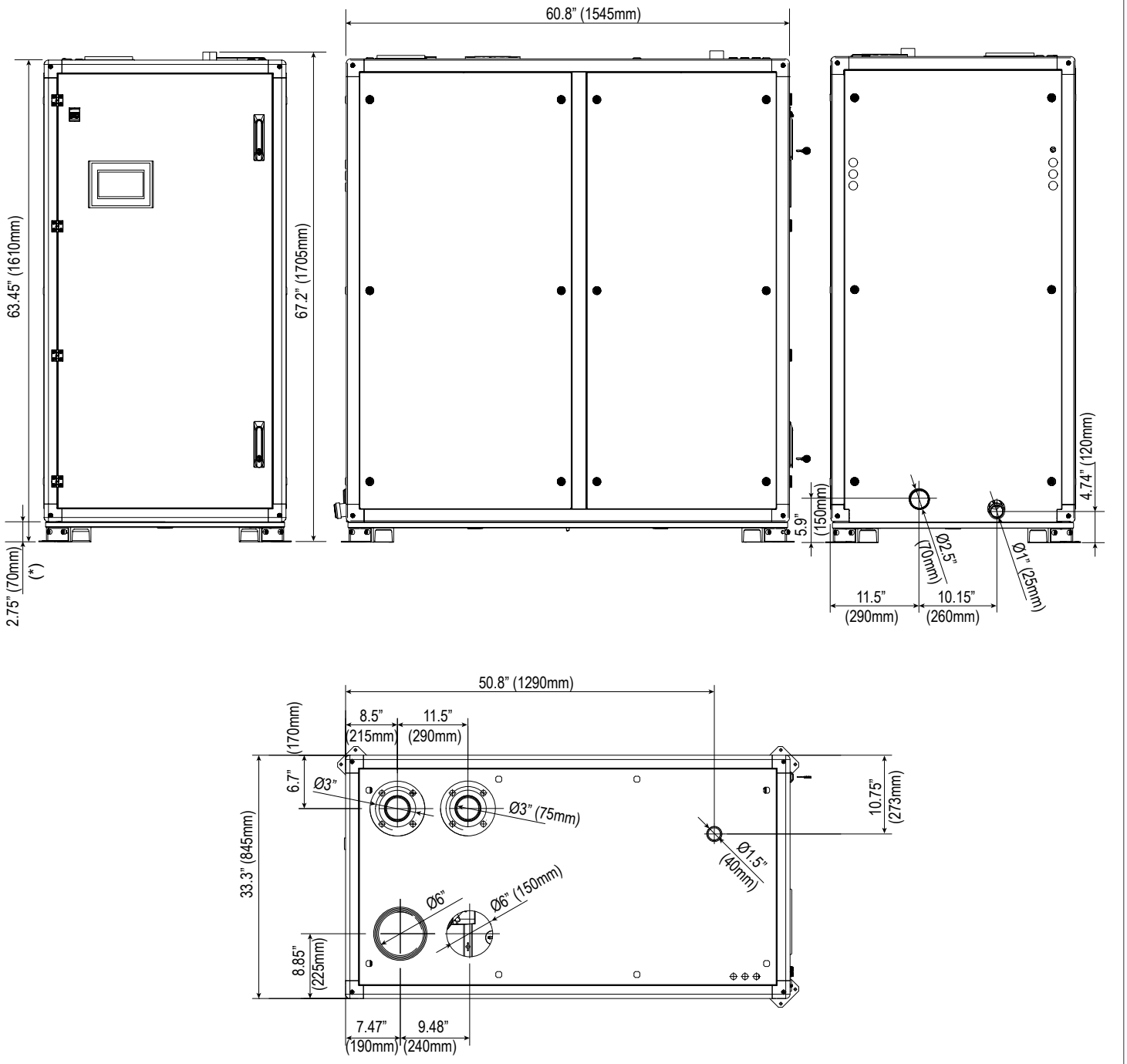
1. The referenced "special venting system" instructions shall be included with the appliance or equipment installation instructions; and
2. The "special venting systems" shall be Product Approved by the Board, and the instructions for that system shall include a parts list and detailed installation instructions.

(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)]

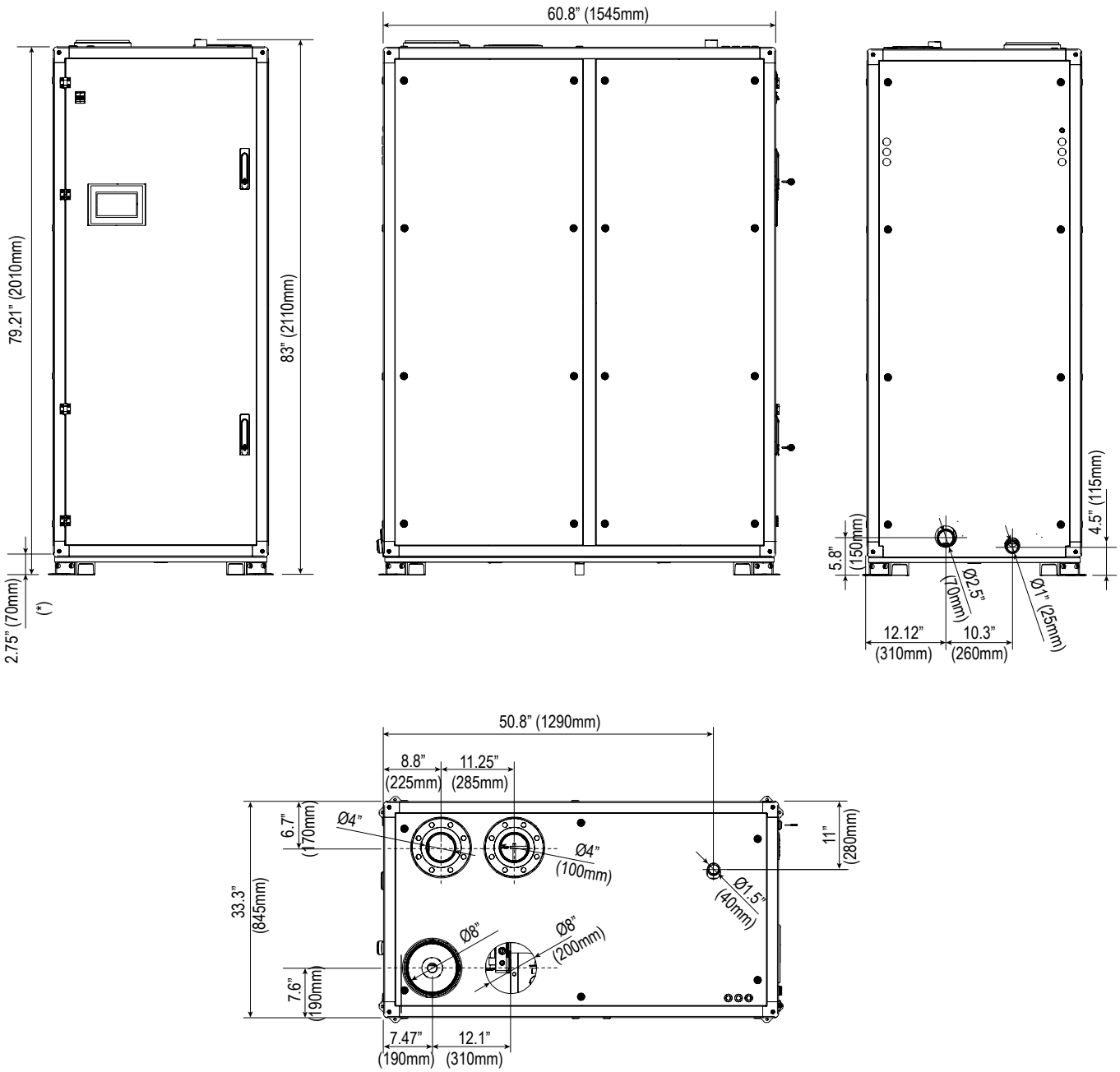
2.8 Size and Connections

ARRAY AR 1000, AR 1500



(*) 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 location.

ARRAY AR 2000



(*) 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 location.

2.9 Technical Data

	Unit	AR 1000	AR 1500	AR 2000
Boiler Category		ASME Sect.IV		
Type of Gas		Natural Gas, Propane*		
Max input rate	BTU/hr	1,000,000	1,500,000	2,000,000
	(kW)	(293)	(440)	(586)
Min input rate	BTU/hr	100,000	100,000	100,000
	(kW)	(29)	(29)	(29)
Turndown	Rate	10:1	15:1	20:1
Gas Connection (NPT)	Ø Inch	1.5"	1.5"	1.5"
Max. NG Pressure	Inch w.c.	13.5	13.5	13.5
	(mbar)	(33.6)	(33.6)	(33.6)
Min. NG Pressure	Inch w.c.	3.5	3.5	3.5
	(mbar)	(8.7)	(8.7)	(8.7)
Max. LPG Pressure	Inch w.c.	13.5	13.5	13.5
	(mbar)	(33.6)	(33.6)	(33.6)
Min. LPG Pressure	Inch w.c.	8	8	8
	(mbar)	(19.9)	(19.9)	(19.9)
02 Working Range (Natural Gas)	%	4.4 – 5.8	4.4 – 5.8	4.4 – 5.8
Water Connections	Ø Inch	3 "	3"	4"
Max. Allowable Working Pressure (MAWP)	PSI	80	80	80
	(bar)	(5.5)	(5.5)	(5.5)
Relief Drain Connection	Ø Inch	2.5"	2.5"	2.5"
	(Ø mm)	(65)	(65)	(65)
Condensate drain connection	inch (mm)	1" (40)	1" (40)	1" (40)
Water Volume	Gallon	12	18	24
	(liter)	(46)	(69)	(92)
Vent/Air Intake Connections	Ø Inch	6	6	8
	(Ø mm)	(160)	(160)	(200)
Vent Materials		CPVC, PP, Stainless Steel AL29-4C and AISI 316L		
Max operating temperature	°F	194	194	194
	(°C)	(90)	(90)	(90)
Max HE allowable temperature	°F	210	210	210
	(°C)	(98.9)	(98.9)	(98.9)
Ambient storage temperature	°F	5 to 158	5 to 158	5 to 158
	(°C)	(-15 to 70)	(-15 to 70)	(-15 to 70)
Ambient functioning temperature	°F	32 to 120	32 to 120	32 to 120
	(°C)	(0 to 49)	(0 to 49)	(0 to 49)
Max Ambient Functioning Humidity	°F	95 % at 104	95 % at 104	95 % at 104
	(°C)	(95% at 40)	(95% at 40)	(95% at 40)
Surface heat exchanger per module	SQFT	43	43	43
	(m^2)	(4)	(4)	(4)
Standard Listings & Approvals		ETL, ASME, AHRI, CSD-1, SCAQMD		
Electrical Req.		120V/1PH/60Hz **16.4 FLA - 20.0 MOCP - 18 MCA	120V/1PH/60Hz 24.6 FLA** - 30.0 MOCP - 26 MCA	240V/1PH/60Hz 16.4 FLA** - 20.0 MOCP - 18 MCA
Weight (dry)	lbs	1058	1323	1676
	(kg)	(480)	(600)	(760)
Dimension W x H x D	Inch	33.3x67.2x60.8 ***	33.3x67.2x60.8 ***	33.3x83x60.8 ***
	(mm)	(845x1707x1544)	(845x1707x1544)	(845x2108x1544)

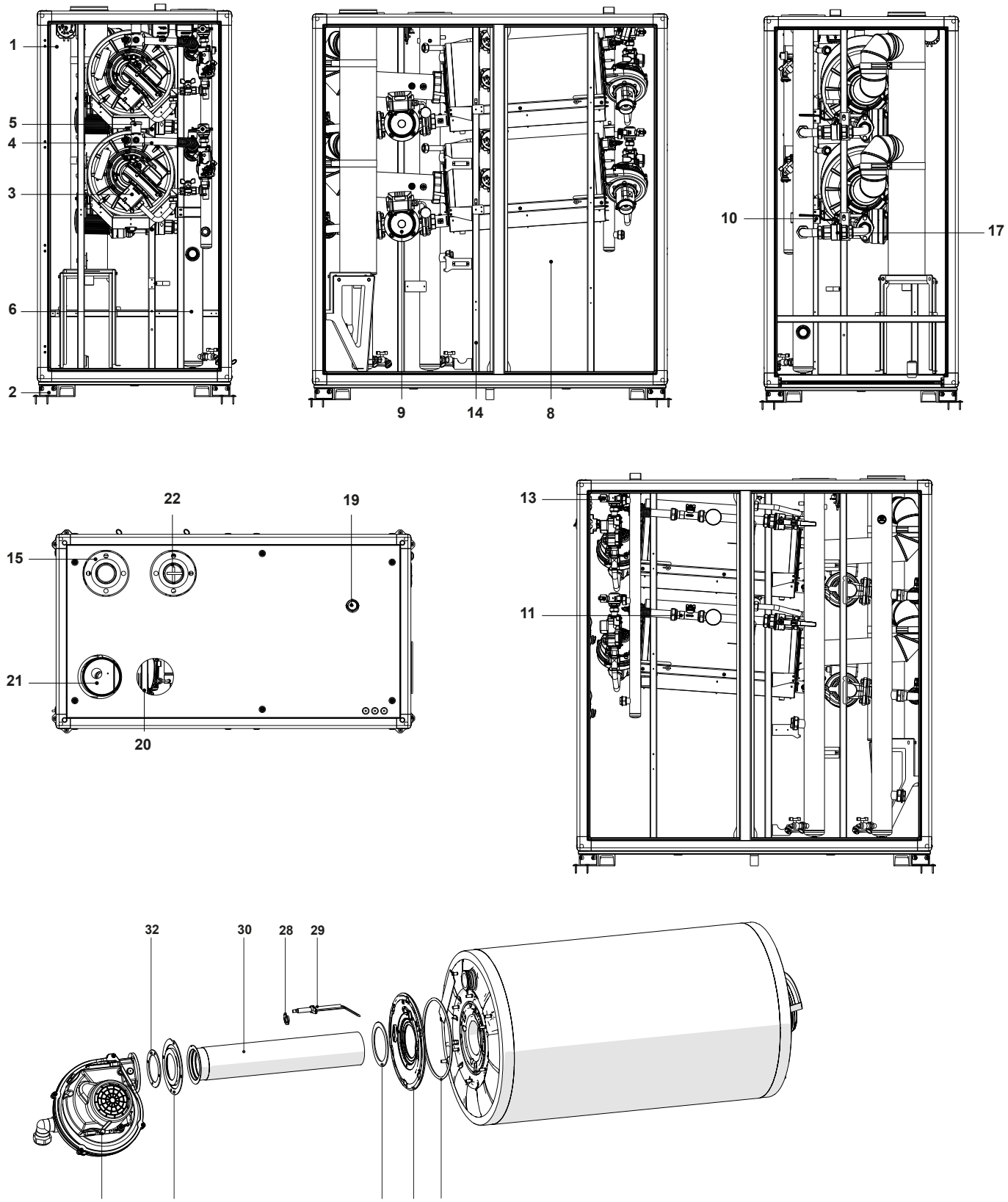
(*) For propane fuel applications, please contact factory

(**) FLA (Full Load Amperage) – maximum current drawn by the boiler if all pumps reach rated horsepower
MOCP (Maximum Over Current Protection) – MCA (Minimum Circuit Capacity)

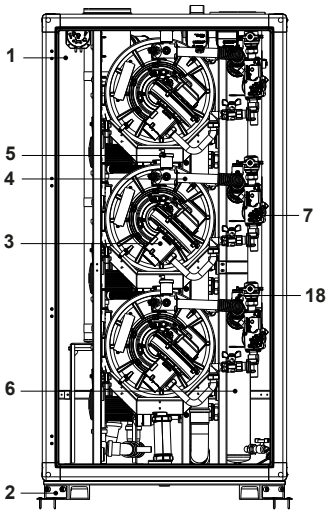
(***) Mounting feet may be removed during installation to reduce the overall height by 2". Feet must be re-installed once boiler is in its final installation location.

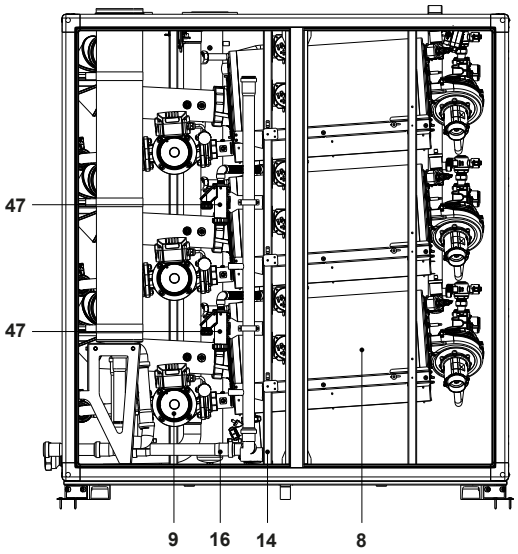
2.10 Assembly Components

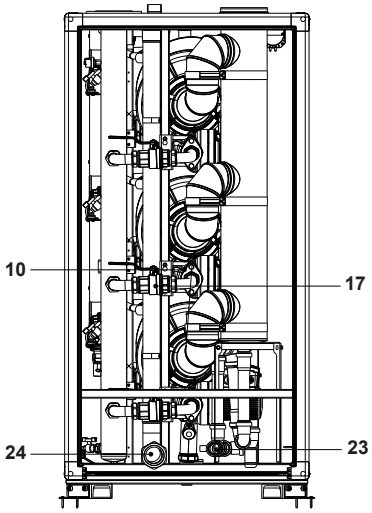
ARRAY AR1000

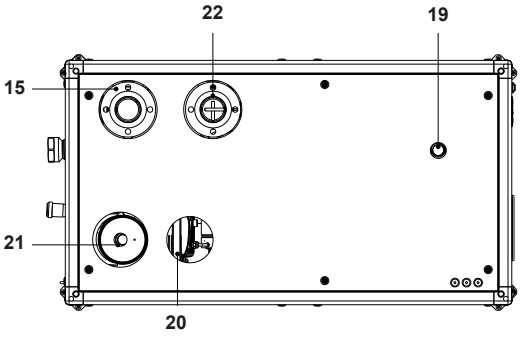


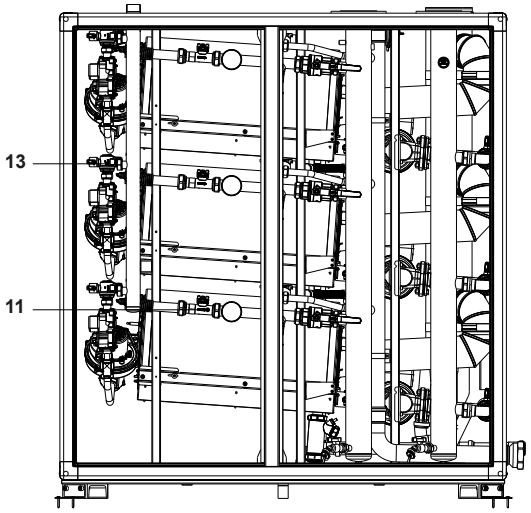
ARRAY AR1500

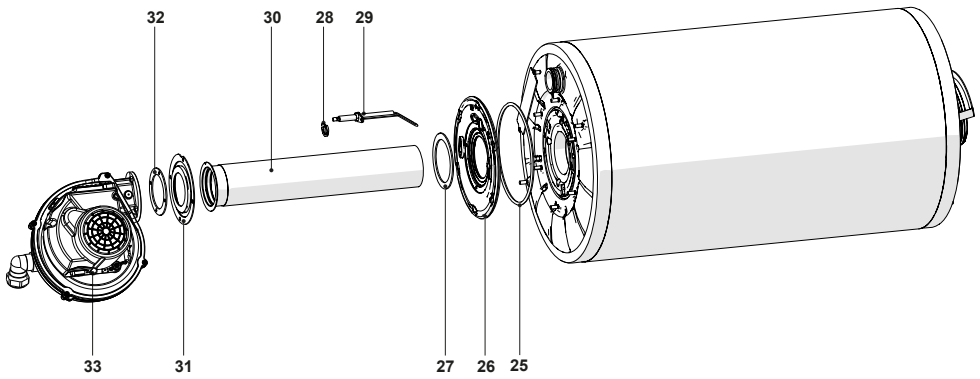




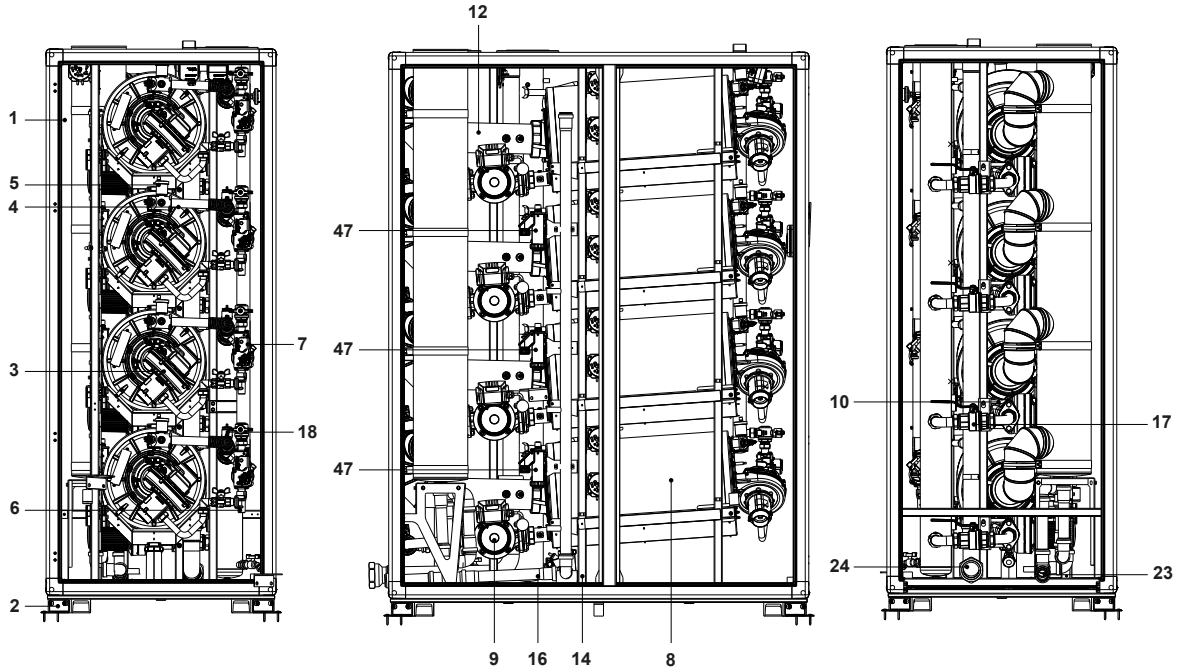


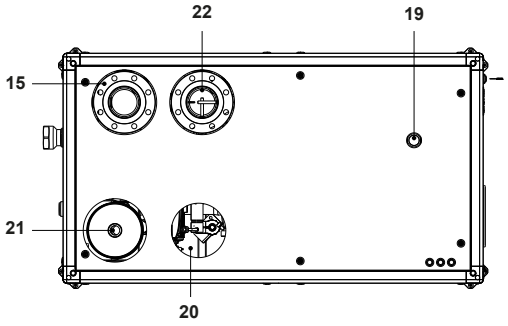


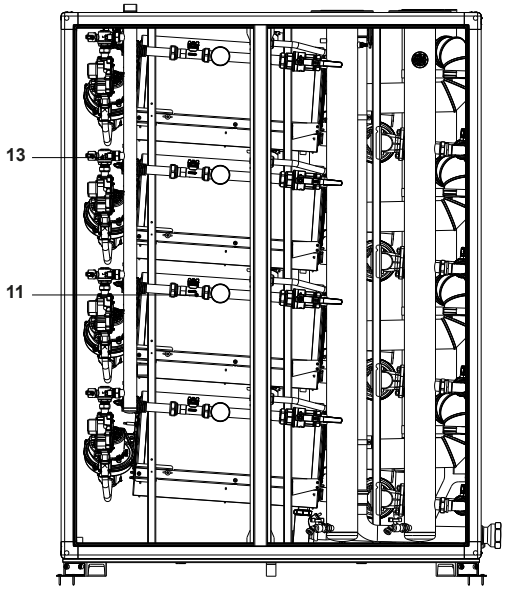


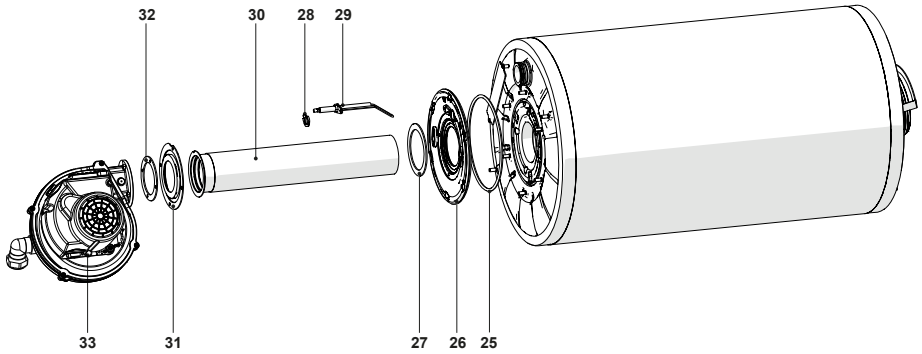


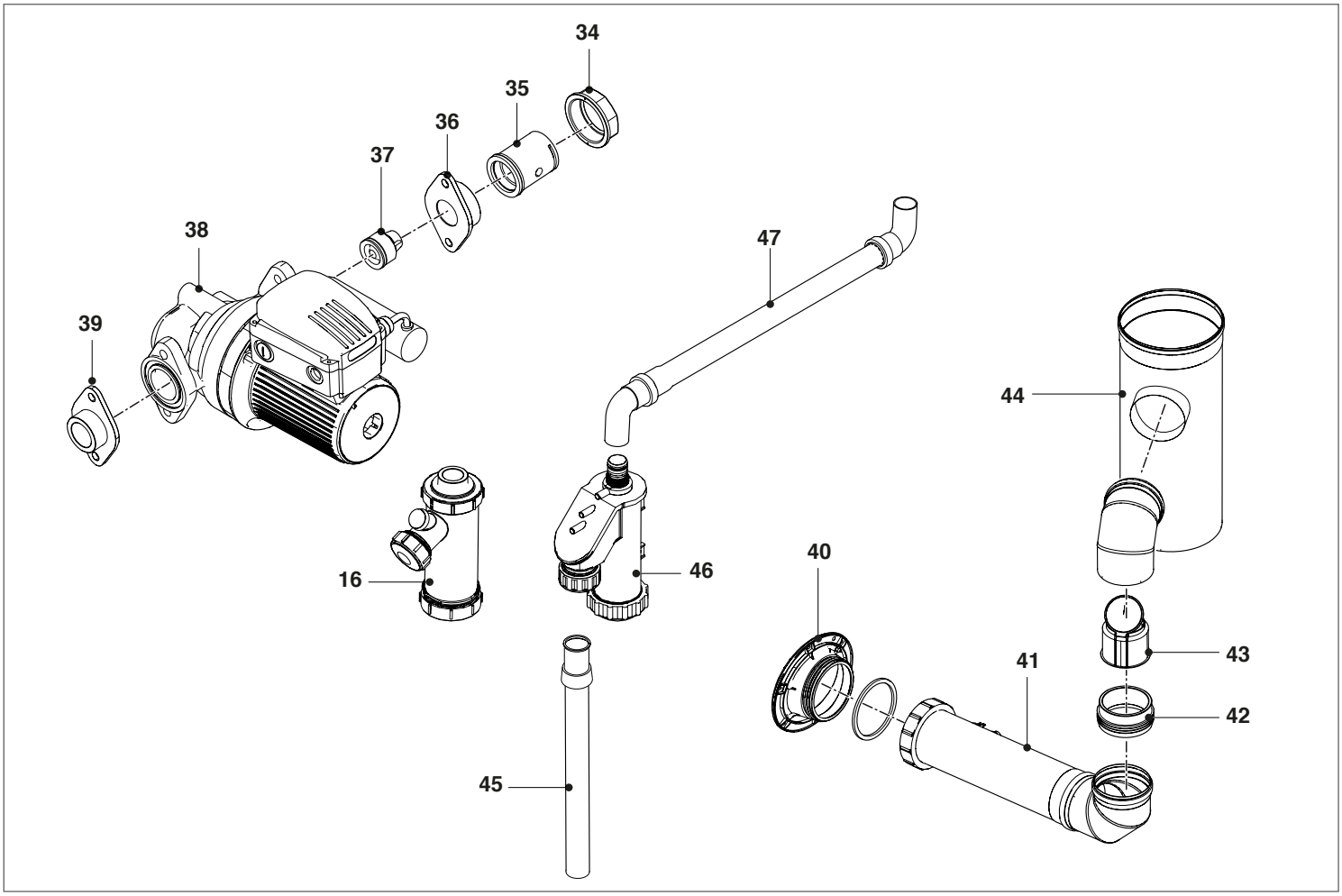
ARRAY AR2000









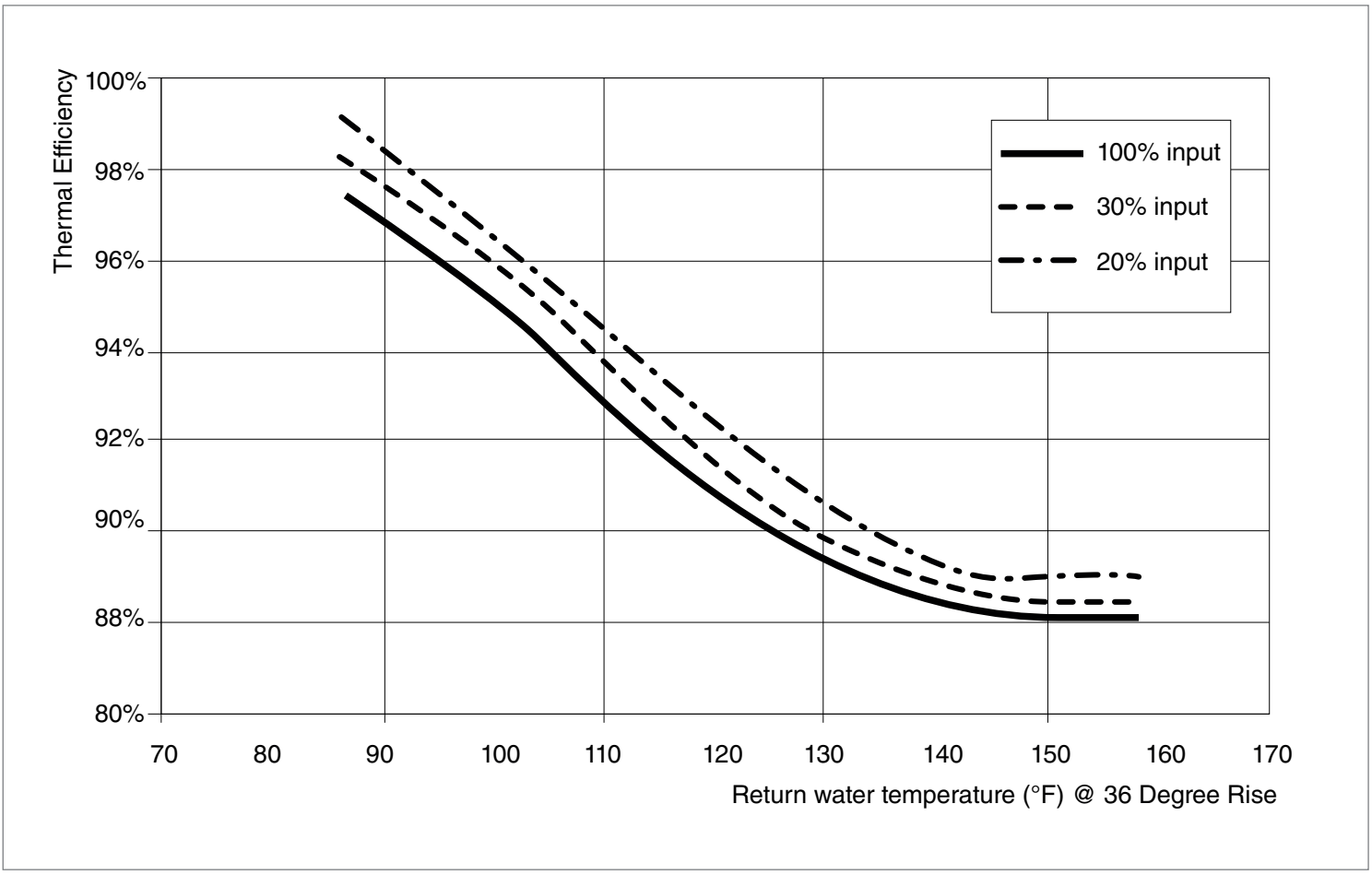


Item	Description
1	0uter frame
2	Leg
3	Fan
4	Supply pipe
5	Purge valve
6	Gas pipe
7	Gas valve
8	Heat exchanger
9	Pump
10	Water shutoff valve
11	Flow meter
12	Flue pipe
13	Gas shutoff valve
14	Inner frame
15	Vertical return manifold
16	Condensate trap
17	Horizontal return manifold
18	Relief valve
19	Gas connection
20	Air intake
21	Venting connection
22	Vertical supply manifold
23	Condensate drain
24	Relief valve drain

Item	Description
25	Burner head 0-ring
26	Burner flange (outer)
27	Burner gasket
28	Sight glass combustion
29	Igniter
30	Burner tube
31	Burner flange (inner)
32	Gasket burner flange
33	Fan
34	Brass connection
35	Brass fitting
36	Flange (2")
37	Check valve
38	Pump
39	Flange (1 1/2")
40	Flue plastic flange
41	Flue pipe with 90° bend
42	Clapet seal (EPDM)
43	Clapet valve
44	Vertical flue manifold
45	Condensate pipe outlet
46	Condensate trap
47	Condensate pipe inlet

2.11 Efficiency Curves

ARRAY AR 1000, AR 1500, AR 2000



3 REGULATIONS

NOTE: Observe all rules, regulations, standards and guidelines applicable to the installation and operation of this appliance in your country, province, state, and local municipality.

NOTE: Valves external to the boiler must be fitted with T-handles and condensate piping must be installed in accordance with the State Plumbing Code.

3.1 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. In Canada, installation must be in accordance with the requirements of CAN/CSA B149.1, Natural Gas and Propane Installation Code.
This condensing gas boiler complies in its design and mode of operation with the American National Standard ANSI Z21.13/CSA4.9, 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. Boiler requires yearly maintenance (see "Appendix D - Maintenance").

3.2 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 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.

4 INSTALLATION

4.1 Introduction

This Chapter provides the descriptions and procedures necessary to unpack, inspect and install the **RIELLO AR 1000, AR 1500** and **AR 2000.**

4.2 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.

4.3 Site Preparation

Ensure that the site selected for installation of the **Array AR 1000, AR 1500** and **AR 2000** Boiler includes:

- Access to AC Input Powerat 120VAC, single phase, 60Hz for AR 1000-1500 and 240VAC, single phase, 60Hz for AR 2000.
- Access to Natural Gas line at a recommended minimum pressure of 8 inches w.c. for 1,000,000 BTU/hr energy input for the **AR 1000,** 1,500,000 BTU/hr energy input for the **AR 1500,** OR 2,000,000 BTU/hr energy input for the **AR 2000**.
- 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.

4.3.1 Installation Clearances

The **Array** models **AR 1000, AR 1500** and **AR 2000** are packaged in cabinets which are identical in size.
The unit must be installed with the prescribed clearances for service as shown in Fig. 3. 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.

Minimum recommended clearances required are as follows:
- Sides: 24 inches
- Front: 31.5 inches
- Rear: 24 inches
- Top: 24 inches

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.

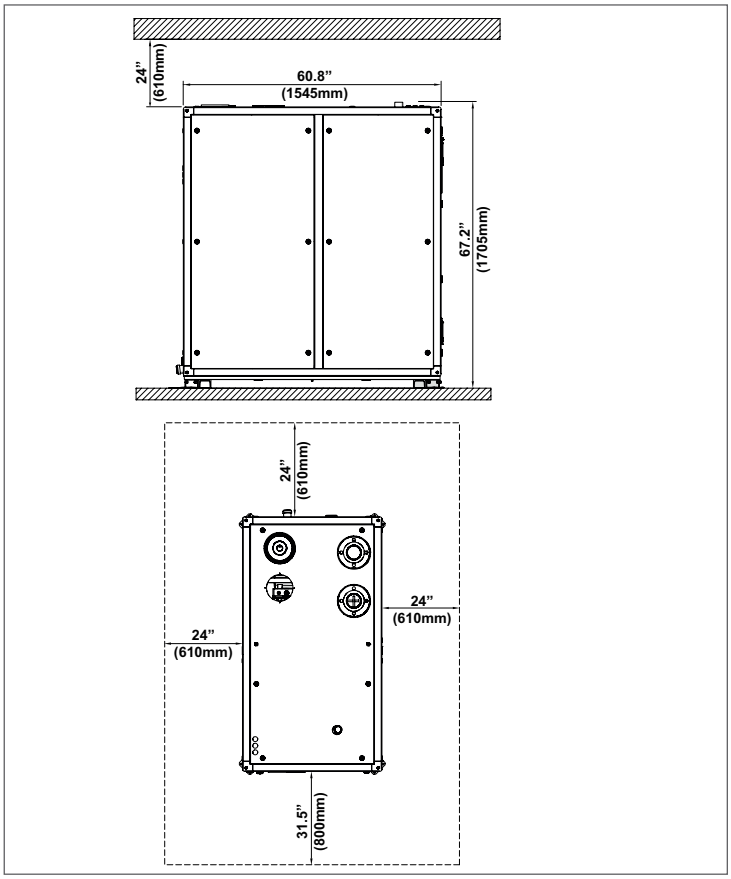


Fig. 3 *Array AR 1000, AR 1500 Clearances*

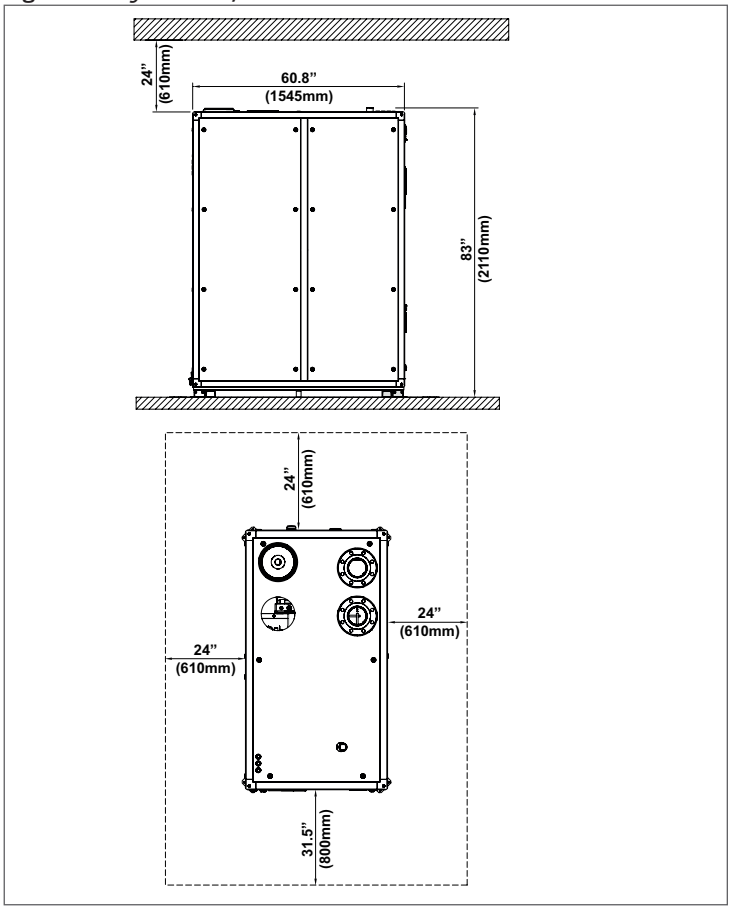


Fig. 4 *Array AR 2000 Clearances*

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 (see Fig.3).

FOR MASSACHUSSETTS 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 "Warnings & Cautions" page 4. See pages 7, 22 and 29 for additional details.

4.3.2 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. 5.

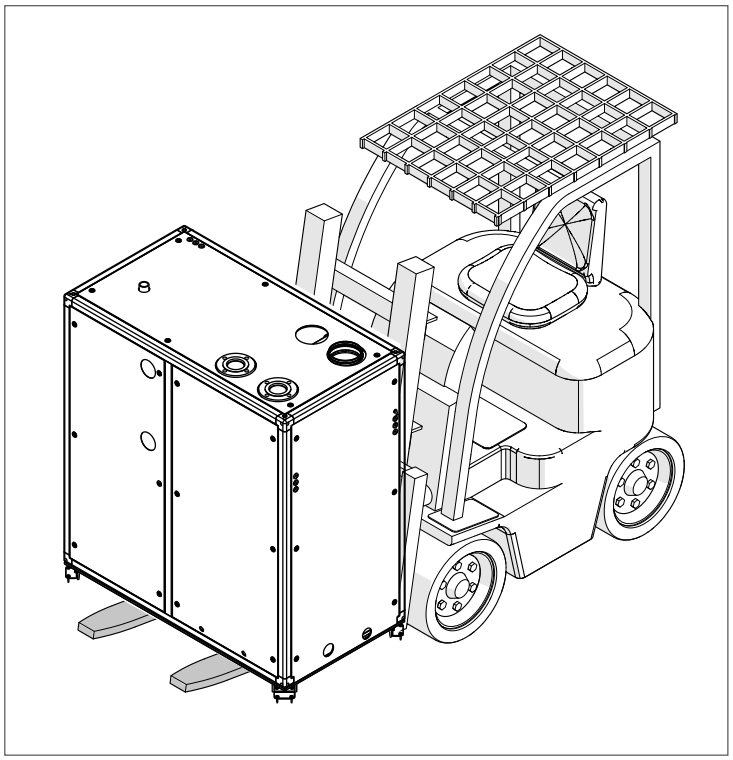


Fig. 5 *Array AR 1000, AR 1500 and AR 2000 Forklift Handling*

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.
The bands must be positioned as shown in Fig. 6 and 7.

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.

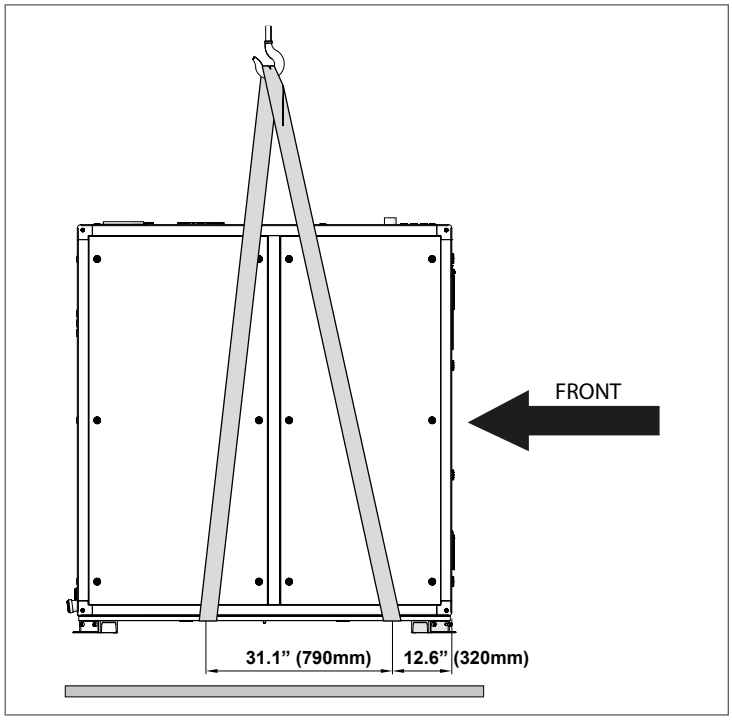


Fig. 6 *Array AR1000 and AR1500 Crane Lifting Handling*

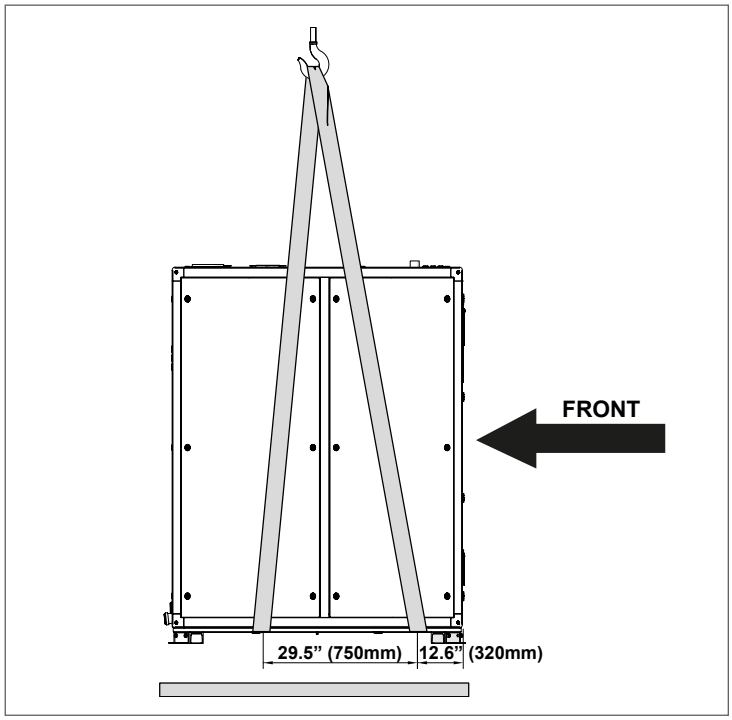


Fig. 7 *Array AR2000 Crane Lifting Handling*

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. 8). If anchoring the unit refer to Fig. 9 and Fig. 10 for anchor locations.

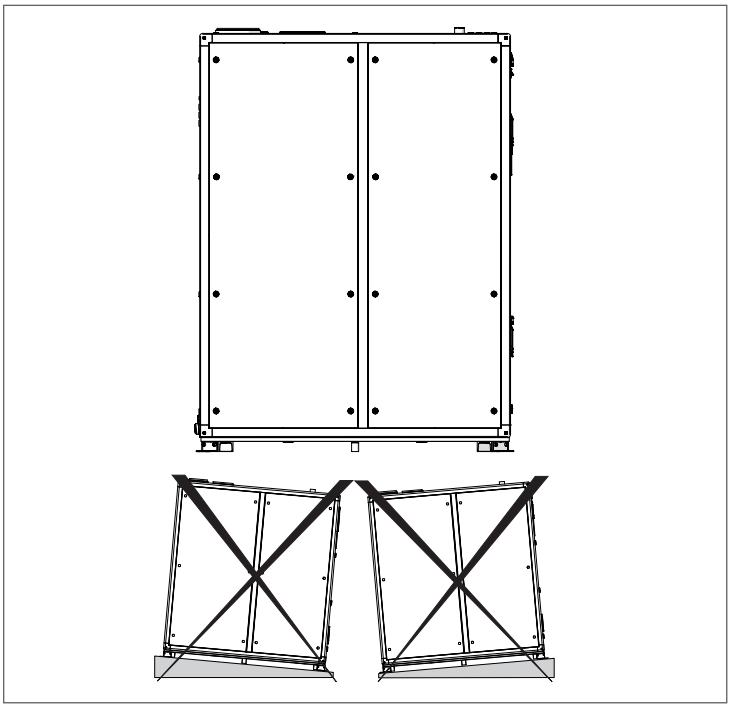


Fig. 8 *AR1000, AR1500 and AR2000 Installation*

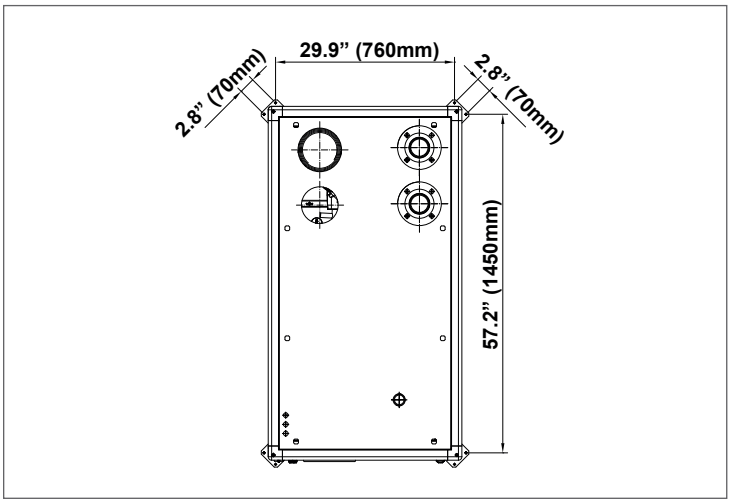


Fig. 9 *AR1000, AR1500 and AR2000 Anchoring bolts*

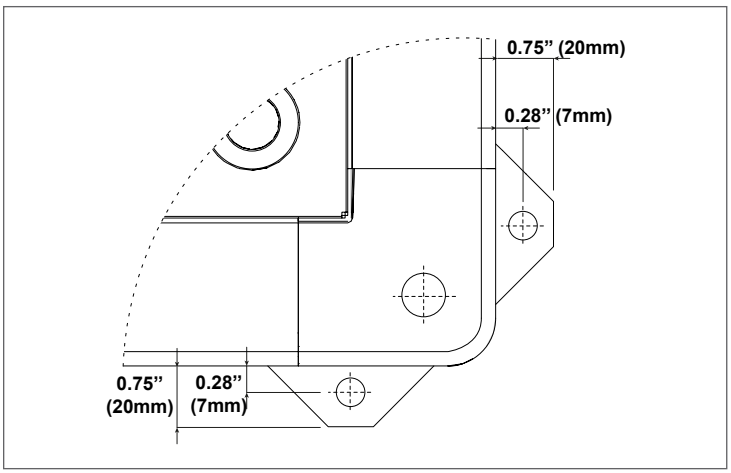


Fig. 10 *AR1000, AR1500 and AR2000 Anchoring bolt detail*

4.4 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 from combustible surfaces

4.5 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_2SO_3	mg/l	< 10
N_2H_4	mg/l	< 3
PO_4	mg/l	< 15
$CaCO_3$	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 concentration (by volume) of 50% 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).

4.6 Supply and Return Piping

The Array Boiler utilizes 3" ANSI flanges for models AR 1000 and AR 1500 and 4" flanges for model AR 2000 for the water OUTLET and INLET piping connections. The physical location of the supply and return piping connections is on the top of the unit as shown in Fig. 11.

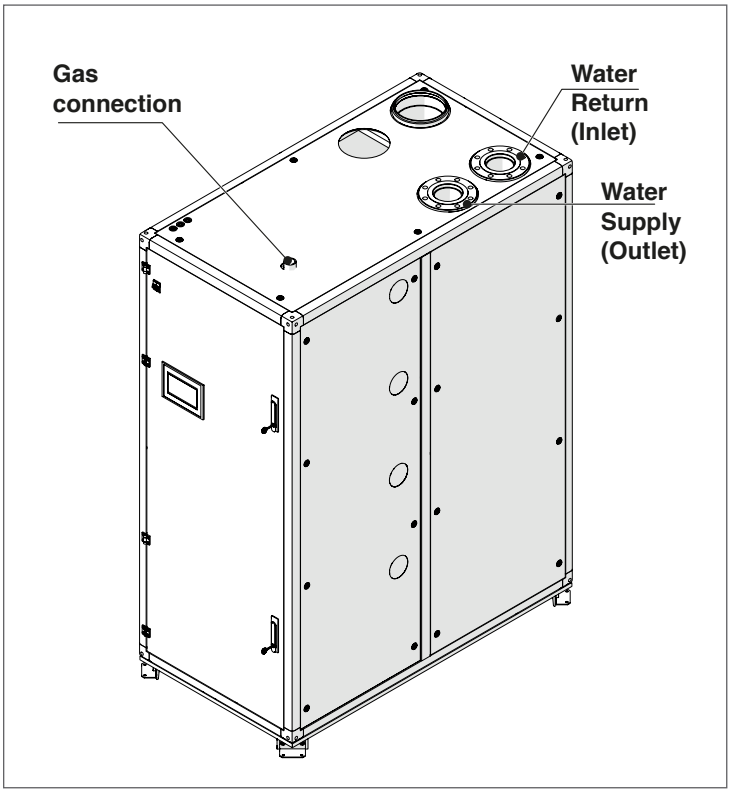


Fig. 11 *AR1000, AR1500 and AR2000 Connections*

⚠ **CAUTION:** Before connecting the boiler to the heating system, flush the heating system to remove sediment, flux, dirt, and other foreign matter. The heat exchanger may be damaged by sediment or corrosion.

⚠ **CAUTION:** Do not use cleaning fluids that are not compatible with the boiler materials, including acids (e.g. hydrochloric acid and/or similar ones) at any concentration.

⚠ **CAUTION:** Introducing fresh water to the system increases the oxygen presence and can cause corrosion of metallic components. Immediately repair any drips or leaks in the system to avoid constant introduction of air into the system.

⚠ **CAUTION:** Excessive fluctuation in pressure changes in the system can cause fatigue and stress on the heat exchanger. This is detrimental to the integrity of the boiler and system components. It is mandatory to maintain a constant operating pressure.

A minimum water pressure is required for optimum performance. Minimum water pressure required: 7.25 psi (0.5 bar).

4.7 Low Water Cutoff

A low water protection is installed at two levels:
- boiler level
- heat exchanger level

Boiler level:
a Low Water Cut Off (LWCO) sensor is installed on top of the supply header of each boiler. To check its functionality, go to the HMI touchscreen, access the Boiler screen (see section 6.3.3), push LWCO TEST button and confirm. The error message "33 LWCO/Air inlet block" will appear on the screen.
At this point press the Reset button. The error will turn off.

Module level:
A Low Water Cut Off (LWCO) sensor is installed on top of the supply fitting of each heat exchanger. To check its functionality, go to the HMI touchscreen, access the Module screen (see section 6.3.4), push MODULE TEST, then LWCO TEST button and confirm. The error message "LWC02 error" will appear on the screen.
At this point press the Reset button. The error will turn off.

4.8 High Limit Safety Switch

A high limit safety switch is installed on each heat exchanger of the boiler. To simulate a high limit lockout at 203°F (95°C)go to the relevant Module screen, press 'Module Test', then 'High Limit Test' button.

The control will display "MN: Max. Thermostat Lock Error".

At this point press the reset button on the Module screen to restart the module.

4.9 Pressure Relief Valve Installation

ASME rated Pressure Relief Valves are factory installed in each **Array** Boiler. The standard pressure rating for the relief valves is 75 PSI. The relief valves are installed on each heat exchanger of the boiler as shown in Fig. 12. The relief valves' drain piping must be connected to a nearby floor drain. In multiple unit installations the discharge lines must not be manifolded together.
Each must be individually run to a suitable discharge location.
Relief valves should be manually operated at least once a year.
If a relief valve discharges periodically, this may be due to thermal expansion in a closed water supply system.
Contact the water supplier or local plumbing inspector on how to correct this situation.
Do not plug the relief valve.

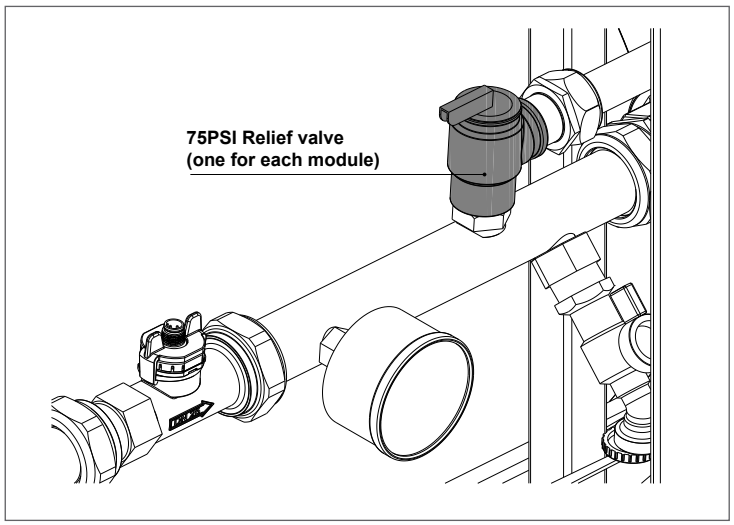


Fig. 12 *Pressure Relief Valve Location*

4.10 Condensate Drain and Piping

The **Array** Boiler is designed to condense water vapor from the flue products. Each heat exchanger of the boiler is equipped with a condensate trap (see Fig. 13), while a syphon collects the condensate of the vertical flue manifold.

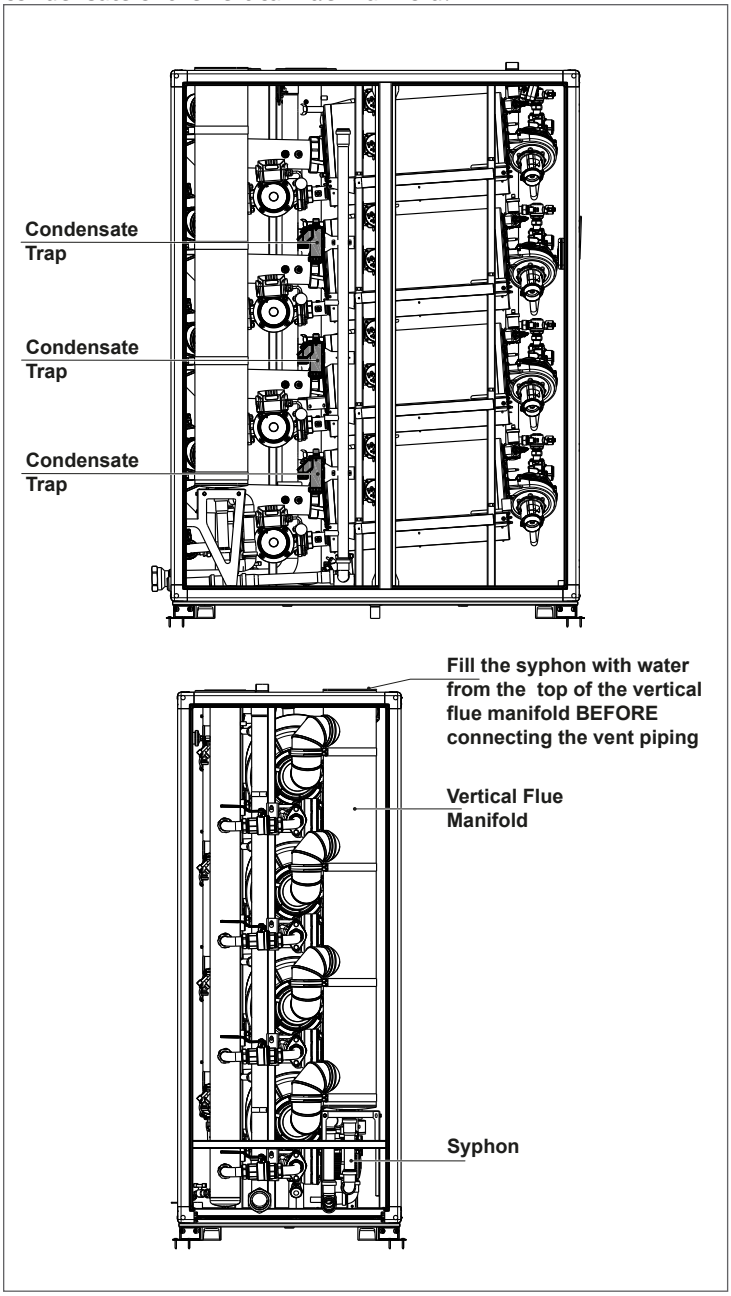


Fig. 13 *Condensate Drain System*

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 minimum) 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.

If a floor drain is not available, a condensate pump can be used to remove the condensate to an alternate drain.The maximum condensate flow rate is 7.9 GPH for Array AR 1000, 13.9 GPH for Array AR 1500 and 15.9 GPH for Array AR 2000. The drain line must be removable for routine maintenance.

⚠ **CAUTION:** Use PVC, CPVC, stainless steel, aluminum or polypropylene for condensate drain piping. DO NOT use carbon steel or copper components.

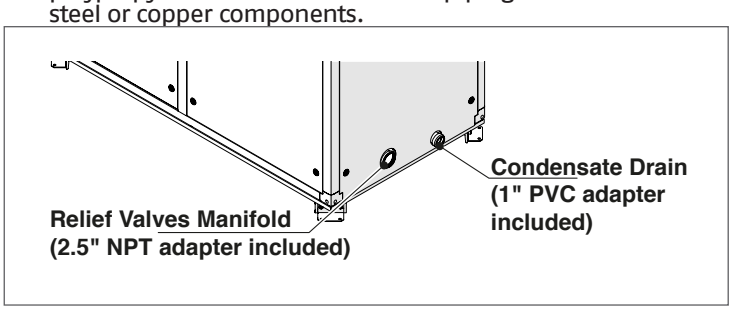


Fig. 14 *Condensate Drain and Relief Valves Manifold Locations*

The recommended procedure for **filling the siphon** at the bottom of the vertical flue manifold before the start-up or after a prolonged shutdown is described below:

- Before connecting the external exhaust venting to the boiler, access the top panel, remove the protective cap from the flue exit and pour water into it.
- Keep filling the siphon (at least 8 oz. of water are required) until some water starts flowing from the condensate drain exit.

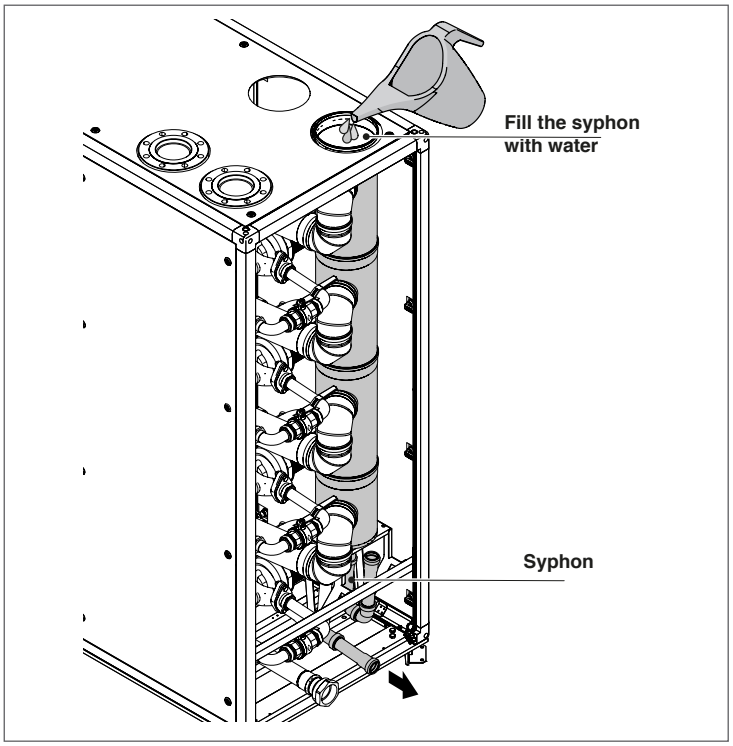


Fig. 15 *Filling the siphon*

4.11 Gas Supply Piping

Array AR 1000, AR 1500 and **AR 2000** boilers contain a 1.5 inch NPT gas inlet connection on the top of the unit as shown in Fig. 11.

⚠ **WARNING:** Never use matches, candles, flames or other sources of ignition to check for gas leaks.

⚠ **CAUTION:** Many of the soaps used for gas pipe bubble-leak testing are corrosive to metals. Therefore, piping must be rinsed thoroughly with clean water after leak checks have been completed.

NOTE: All gas piping must be arranged so that it does not interfere with the removal of any covers, inhibit service and/or maintenance, or restrict access between the unit and walls, or another unit.

- Prior to installation, all pipes should be de-burred and internally cleared of any scale, metal chips, oil, water or other foreign particles. Do not install any flexible connectors or unapproved gas fittings. Piping must be supported only from the floor, ceiling or walls, and must not be supported by the unit.
- A suitable piping compound, approved for use with natural gas, should be used. Any excess must be wiped off to prevent clogging of components.
- To avoid unit damage when pressure testing gas piping, isolate the unit from the gas supply piping. At no time should the gas pressure applied to the unit exceed 13.5" w.c. Leak test all external piping thoroughly using a soap and water solution or suitable equivalent. The gas piping used must meet all applicable codes.
- A sediment trap / drip leg must be installed on the gas supply piping.
- Installation of a union fitting at the appliance gas line connection is required for ease of service.

4.11.1 Gas Supply Specifications

The gas supply piping and pressure to the unit must be of sufficient capacity to provide 1010 cfh for AR 1000, 1515 cfh for AR 1500 and 2020 cfh for AR 2000, while maintaining the recommended minimum gas pressure at 8" w.c. for burners operating at maximum capacity.

4.11.2 Manual Gas Shutoff Valve

A manual shut-off valve must be installed in the gas supply line upstream of the boiler. Maximum allowable gas pressure to the boiler is 13.5" w.c.

4.11.3 External Gas Supply Regulator

An external gas pressure regulator is required on the gas inlet piping under most conditions. The use of a lever-acting positive lock-up type regulator with over-pressure protection (i.e., internal relief) is recommended. Regulators must conform to the following specifications:

- The external natural gas regulator must be capable of regulating
  a) 100,000 - 1,000,000 BTU/HR for **AR 1000**
  b) 100,000 - 1,500,000 BTU/HR for **AR 1500**
  c) 100,000 - 2,000,000 BTU/HR for **AR 2000**
  of natural gas while maintaining a minimum gas pressure of 4.0" w.c. natural gas, or 8.0" w.c. propane to the unit.
- The desired pressure setpoint should be 8.0" w.c for natural gas, and 12.0" w.c. for propane.
- A regulator MUST be used when gas supply pressure will exceed 13.5" W.C.

The following are **RIELLO**'s recommendations for installation of gas pressure regulator, unless superseded by state and local codes and the regulator manufacturer's specifications:

- Horizontal installation of gas pressure regulators is recommended unless stated otherwise by the regulator manufacturer. Consult the manufacturer for additional recommendations and installation options.
- For all **Array** boilers, when installed horizontally the required distance between the gas pressure regulator and the boiler is ten feet. A minimum of ten pipe diameters of straight pipe must be maintained between the regulator and any pipe fitting, elbow, reducer, valve, etc.
- When pipe size reduction is required, use only bell reducers.

MASSACHUSETTS INSTALLATIONS ONLY

For Massachusetts installations, a mandatory external gas supply regulator MUST be installed. The gas supply regulator must be properly vented to outdoors. Consult the local gas utility for detailed requirements concerning venting of the supply gas regulator.
The Commonwealth of Massachusettes prohibits the use of copper tubing for the gas line.

NOTE: It is the responsibility of the customer to source, purchase, and install the appropriate gas regulator as described above.

4.11.4 Adjusting and Setting O_2 Limits

- Insert a combustion analyzer probe into the test port shown in Fig. 166
- Go to the Touchscreen and access the Module screen (as described on "6.3.4 Module Screen" page 36) 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_2 value.

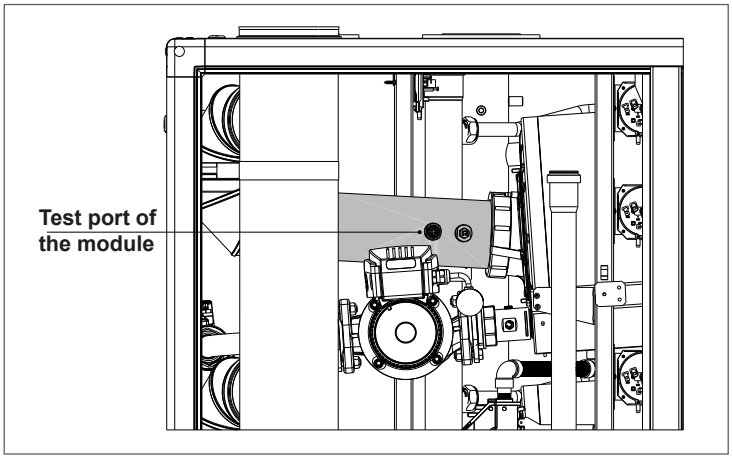


Fig. 16 *Test Port for Combustion Analysis (available on each individual heat exchanger)*

To adjust the O_2 value at high-fire turn the screw "A" (rotate counter-clockwise to decrease O_2) shown in Fig. 17. An allen type wrench is necessary for this adjustment.

Verify that the value of O_2 is stable and within the rangeindicated 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.

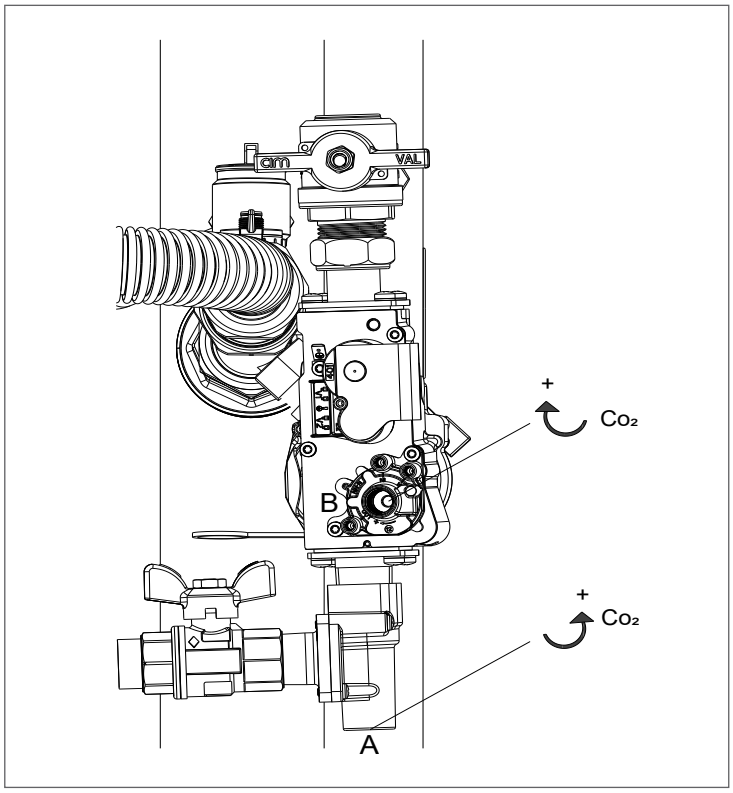


Fig. 17 *O_2 Adjustment*

To adjust the O_2 value at the minimum input, turn the screw "B" (rotate clockwise to decrease O_2) shown in Fig. 17 using a Torx T40 screwdriver.
Verify that the value of O_2 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.
Repeat above process for all heat exchangers.

Array Combustion Values		
Gas Type	**Max. Fire O_2%**	**Min. Fire O_2%**
Natural Gas	4.2 – 5.8	4.2 – 5.8
LP Gas	5.0 – 5.6	5.0 – 5.6

4.12 AC Electrical Power Wiring

External AC power is connected to the unit inside the electrical box, located on the inside of the front doors. 0pen the front doors and remove the panel mounted in the upper part of the left front door of the unit as shown in Fig. 18.

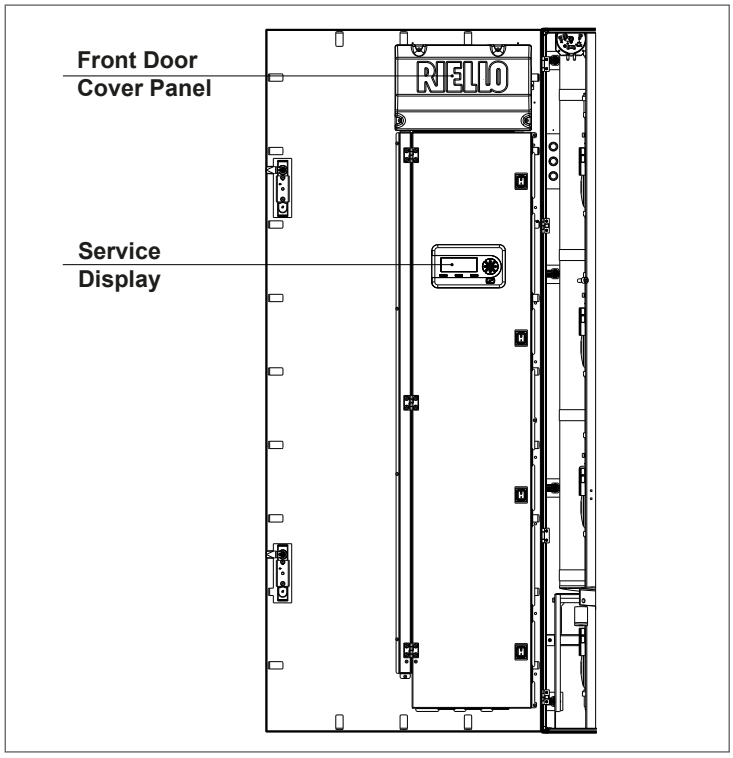


Fig. 18 *Front Doors Internal Layout*

Loosen the screws of the Electrical box cover and remove panel to access the internal connections shown in Fig. 19.

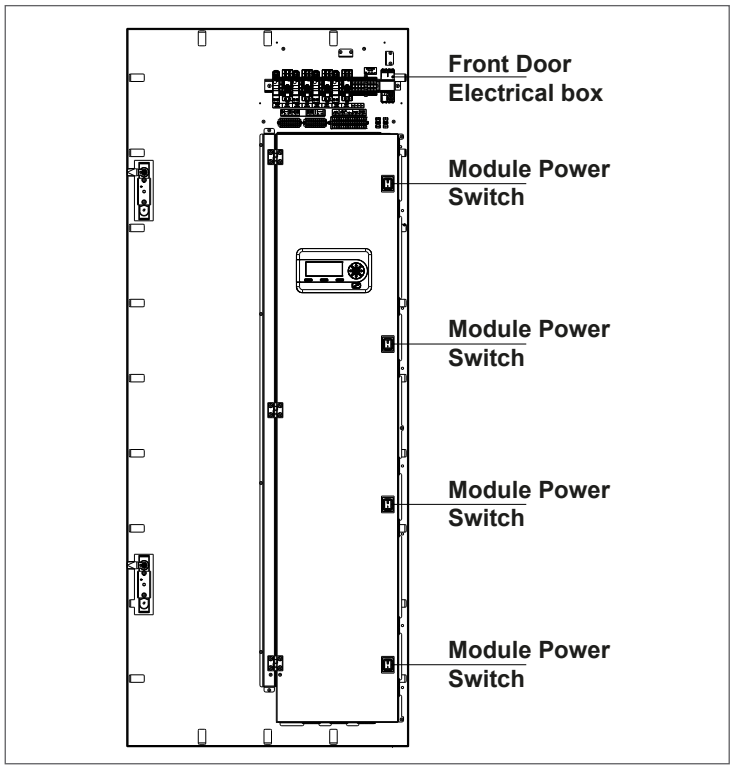


Fig. 19 *Front Doors Electrical box*

All of the components in the Electrical box are mounted on a DIN rail.

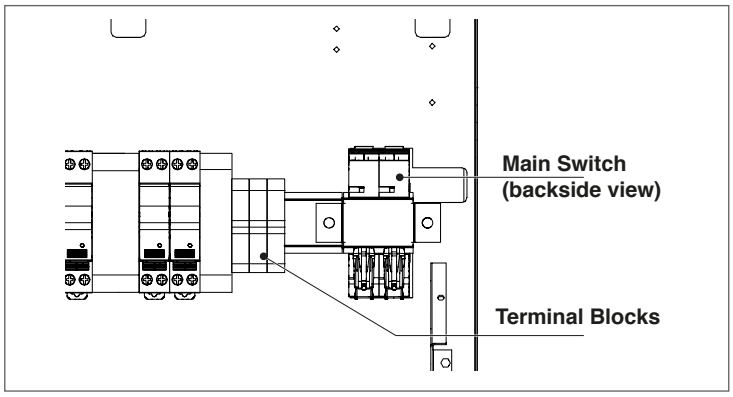


Fig. 20 *AR1000 – AR1500 Front Door Electrical components*

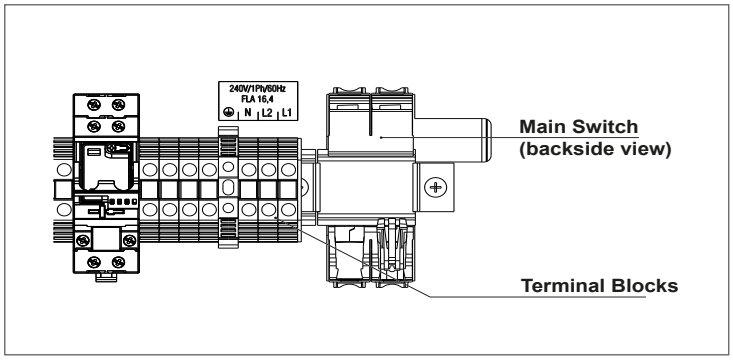


Fig. 21 *AR2000 Front Door Electrical components*

NOTE: All electrical conduit and hardware must be installed so that it does not interfere with the removal of any unit covers, inhibit service/maintenance, or prevent access between the unit and walls or another unit.

4.12.1 Electrical Power Requirements

The voltage configuration of **Array AR 1000, AR 1500** and **AR 2000** is as follows:

- **AR 1000, AR 1500:** 120VAC/1PH/60Hz
- **AR 2000:** 240V/1Ph/60Hz

Each boiler must be connected to a dedicated electrical circuit.

NO OTHER DEVICES SHOULD BE ON THE SAME ELECTRICAL CIRCUIT AS THE BOILER.

The Main Circuit four-pole switch is accessible on the front door to quickly and safely disconnect electrical service. This breaker does not remove power on the incoming power supply terminals.

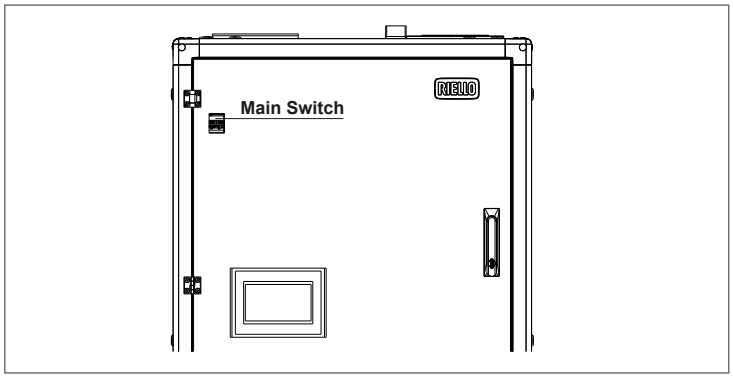


Fig. 22 *Main switch*

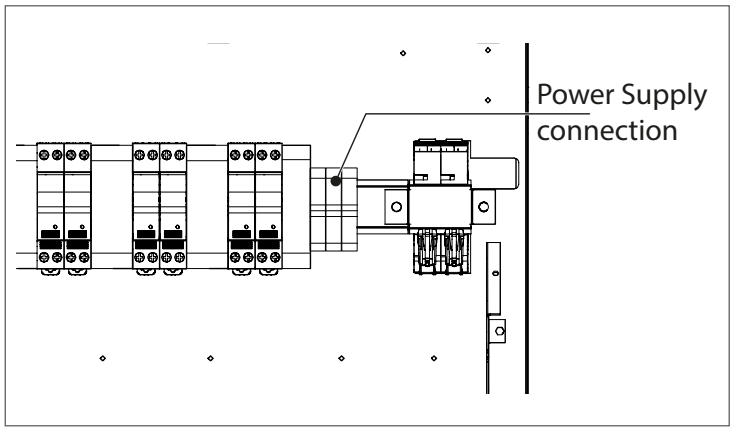


Fig. 23 *AR1000, AR1500 Power supply connection*

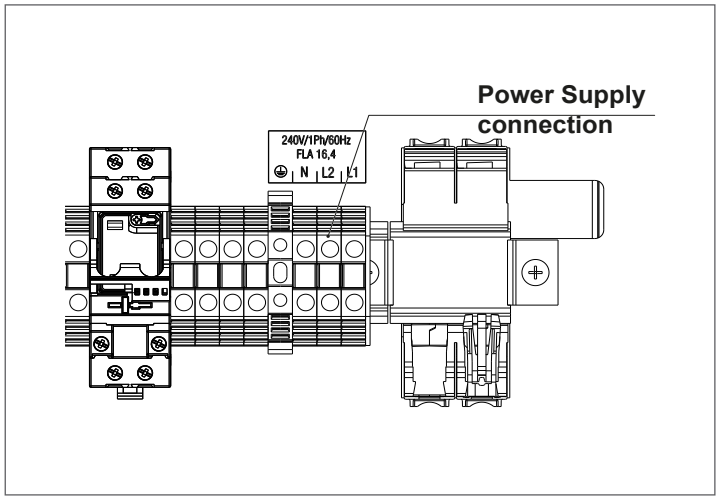


Fig. 24 *AR2000 Power supply connection*

The installed boiler must be electrically bonded to ground in accordance with the requirements of the authority having jurisdiction. In the absence of such requirements, the installation shall conform to National Electrical Code (NEC), ANSI/NFPA 70 and/ or the Canadian Electrical Code (CEC) Part I, CSA C22.1 Electrical Code.

4.13 Field Control Wiring

Each unit is fully wired from the factory with an internal operating control system. No field control wiring is required for normal operation.
However, the control system used with all **Array** boilers does allow for some additional control and monitoring features. Wiring connections for these features are made on the Input / Output (I/O) terminal strips located behind the removable cover on the inner side of the front door of the unit, as shown in Fig. 25.

NOTE: Any electrical load connected to the terminal strip (external pumps, air damper, alarm) must be powered through a relay, not included in the boiler, to be provided and wired by the installer.

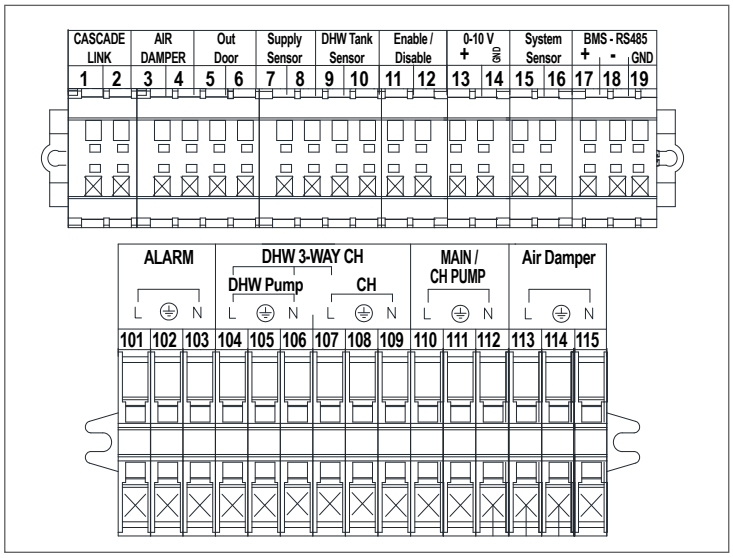


Fig. 25 *I/O Terminal Strips*

All field wiring is installed from the rear of the panel by routing the wires through one of the openings provided on the sides of the cover panels (see Fig. 26).

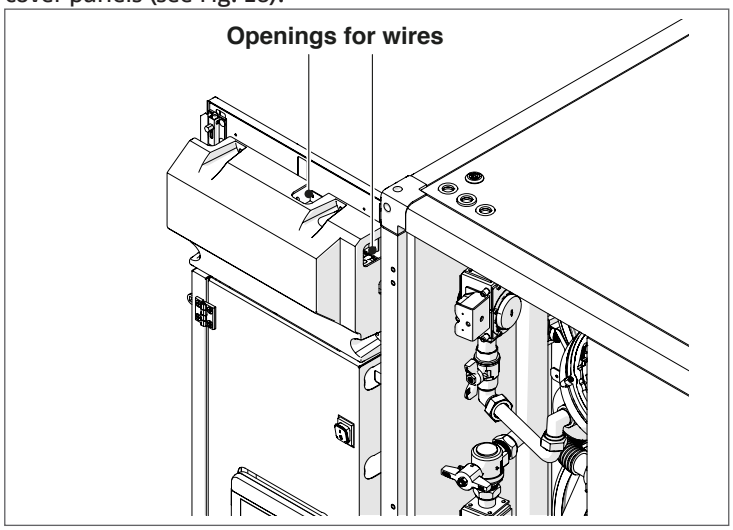


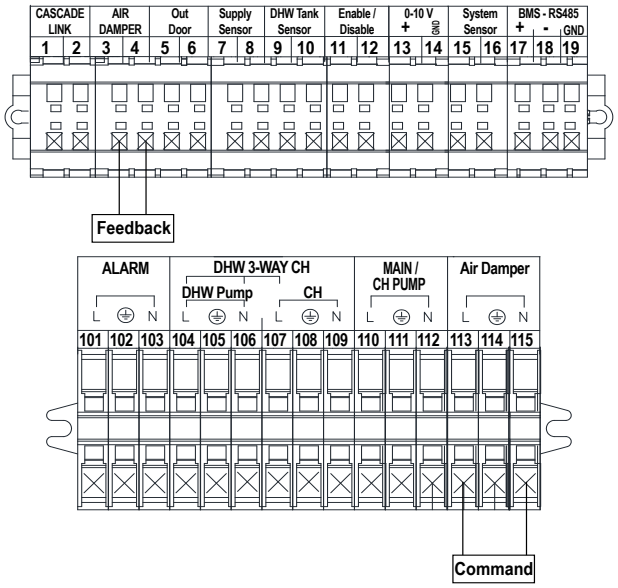
Fig. 26 *Opening on the Cover Panel*

4.13.1 Enable/Disable (Room thermostat connection)

The Enable/Disable (Room thermostat) terminals (dry contacts) come pre-wired closed (jumped) from the factory. For connecting a room thermostat, the jumper must be removed and the thermostat wires must be connected to terminals 11 and 12, as shown in Fig. 25.

4.13.2 Air Damper

The Air Damper output comes disabled from the factory.
The Air Damper command is connected to Triac output that "arrived" on the terminal strip on 113 /115
This output needs a minimum load of approx. 10VA to work correctly and the max load must be limited to 50VA at mains voltage.
Connection of an external relay to this output to be able to switch a higher load is only possible when an additional resistor or load is added to make sure the minimum load requirements are met.

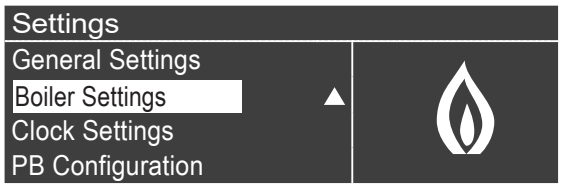


To enable the air damper function, the configuration of the Managing board must be change

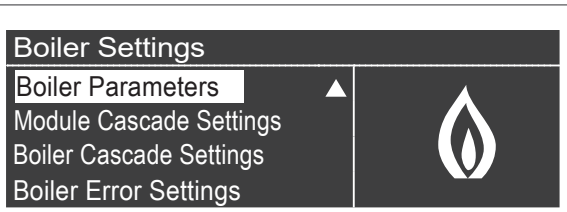
	Default	Air Damper enable
Par. 127 – Prog. Output 3	0	10

Set the Par. 127.
Proceed as follows:

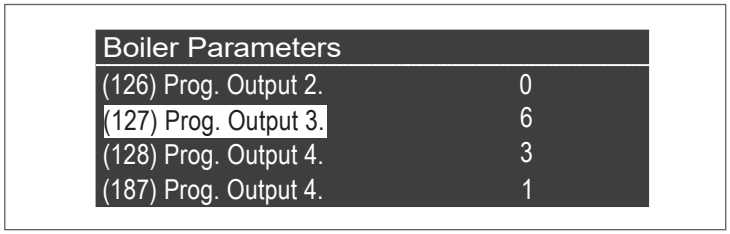
- On the home screen of the control panel, press the "Menu" key
- Select "Settings" with the ▲ / ▼ keys and press the ● key
- Select "Boiler Settings" with the ▲ / ▼ keys and press the ● key



- Enter the password as described in paragraph "Password access"
- Select "Boiler Parameters" with the ▲ / ▼ keys and press the ● key



Press the ▼ key, select "(127) Prog. Output 3." and press the ● key



4.13.3 Outdoor Temperature Sensor

If an outdoor temperature sensor is used, the outdoor probe needs to be connected to terminals 5 and 6 as shown in Fig. 25. The outdoor probe shall be installed on an outer wall, North or North/East, away from windows, door, and ventilation grids.
Never install the probe in a position exposed to the sun.
The maximum length is 300' (100 meters), if the cable length exceeds 32' (10 meters) a shielded cable is required and shall be connected to chassis ground.

NOTE: All sensors and low voltage wiring shall not be routed in direct contact or near high voltage power.

4.14 Venting

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.
AR 1000, AR 1500 and **AR 2000** boilers 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.

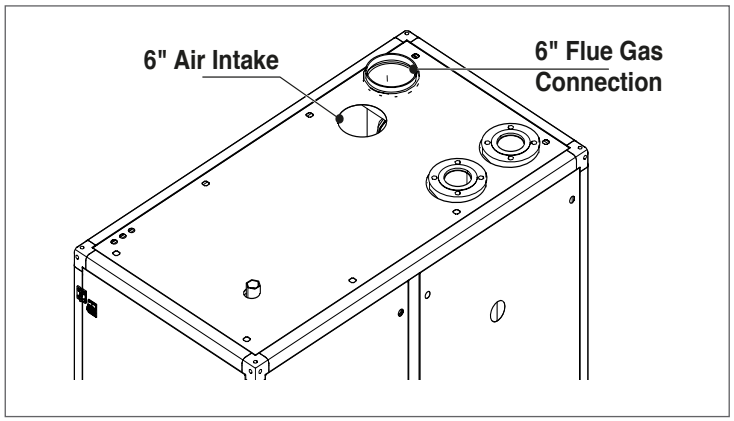


Fig. 27 *AR 1000, AR 1500 Combustion Air and Flue Gas connections*

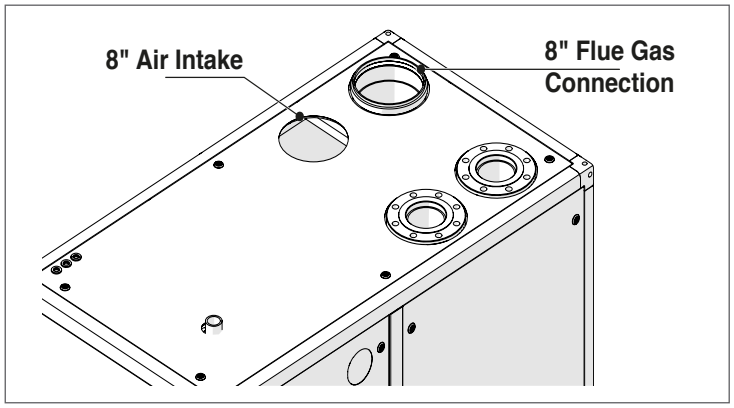


Fig. 28 *AR 2000 Combustion Air and Flue Gas connections*

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.
- 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.
- The boiler must not support the weight of any ductwork.
- 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.

VENTING CONFIGURATIONS: The following figures show the acceptable piping installation for venting and combustion air.

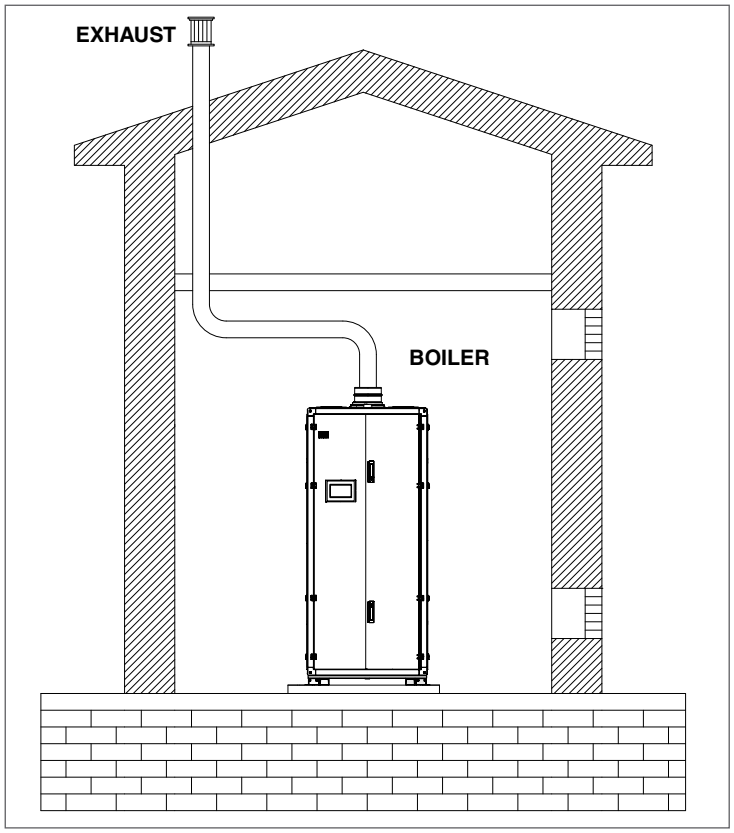


Fig. 29 *All Combustion Air from Adjacent Indoor Spaces through Indoor Combustion Air Openings*

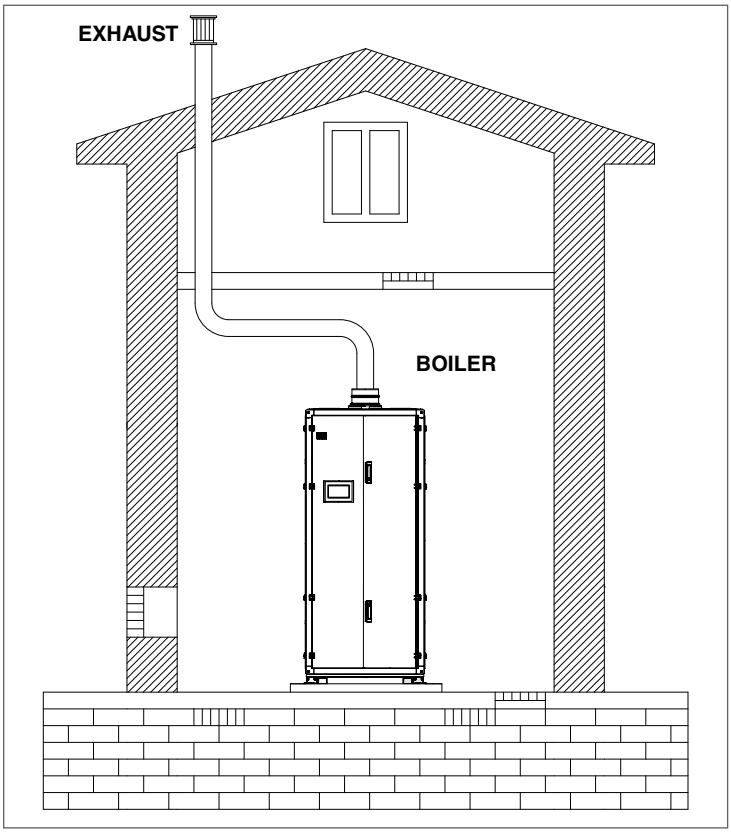


Fig. 31 *All Combustion Air From Outdoors – Inlet Air From Ventilated Crawl Space and Outlet Air to Ventilated Attic*

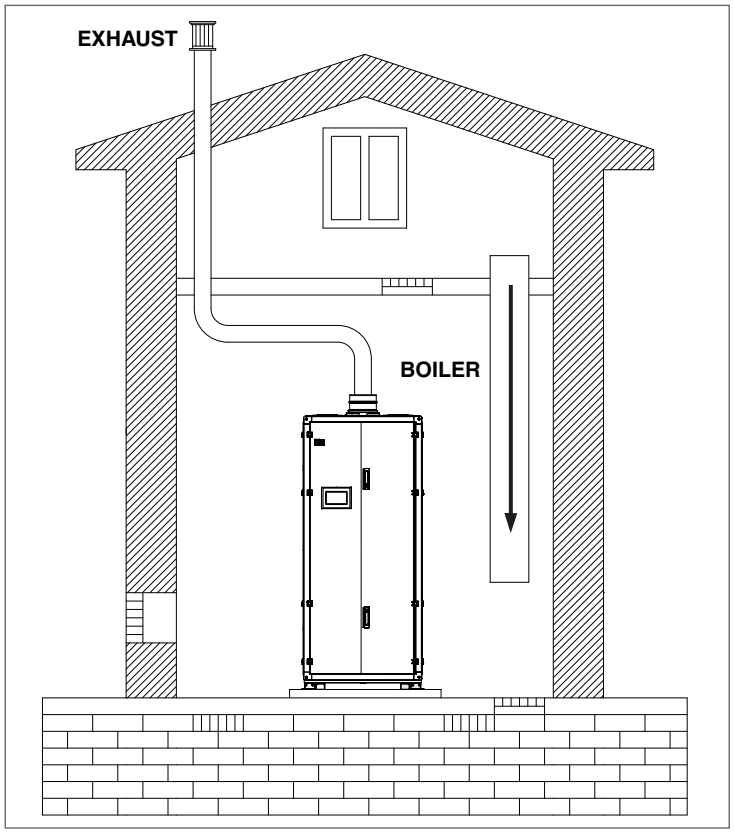


Fig. 30 *All Combustion Air from Outdoors through Ventilated Attic*

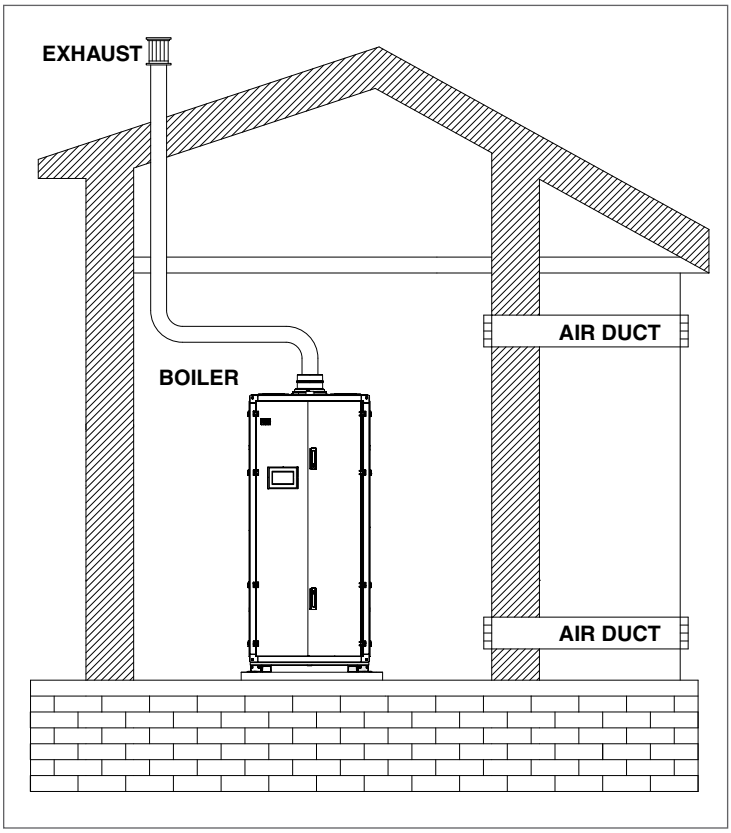


Fig. 32 *All Combustion Air from Outdoors through Horizontal Ducts*

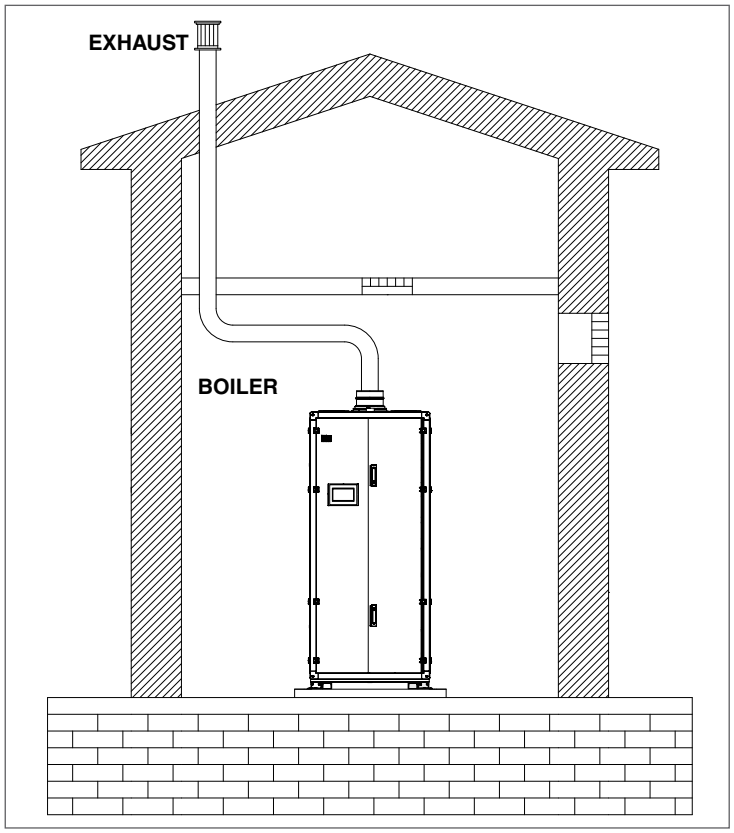


Fig. 33 *All Combustion Air from Outdoors through Single Combustion Air Opening*

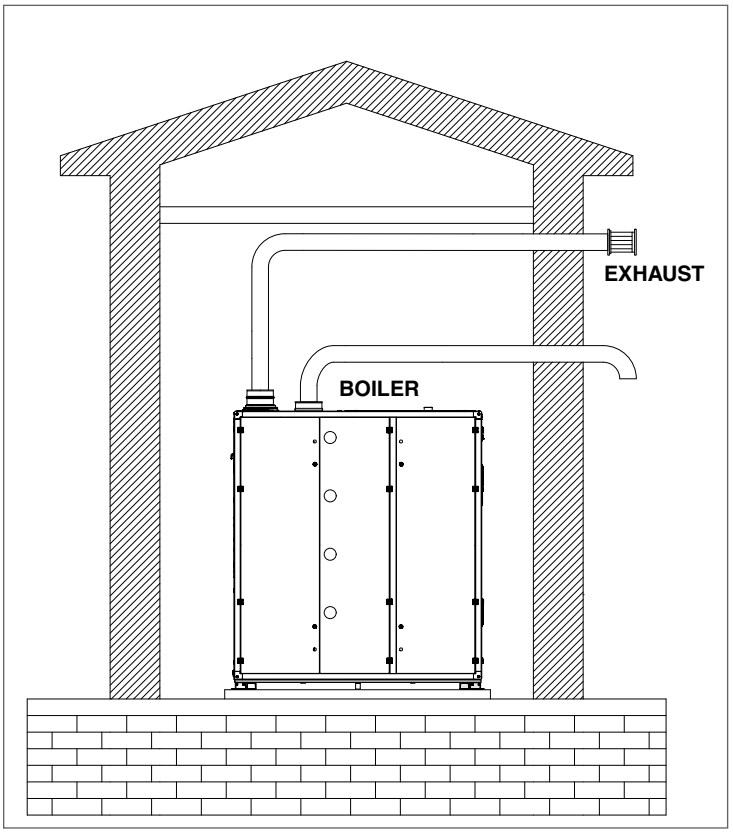


Fig. 35 *Sealed Combustion Located on Same Side with Exhaust (horizontal)*

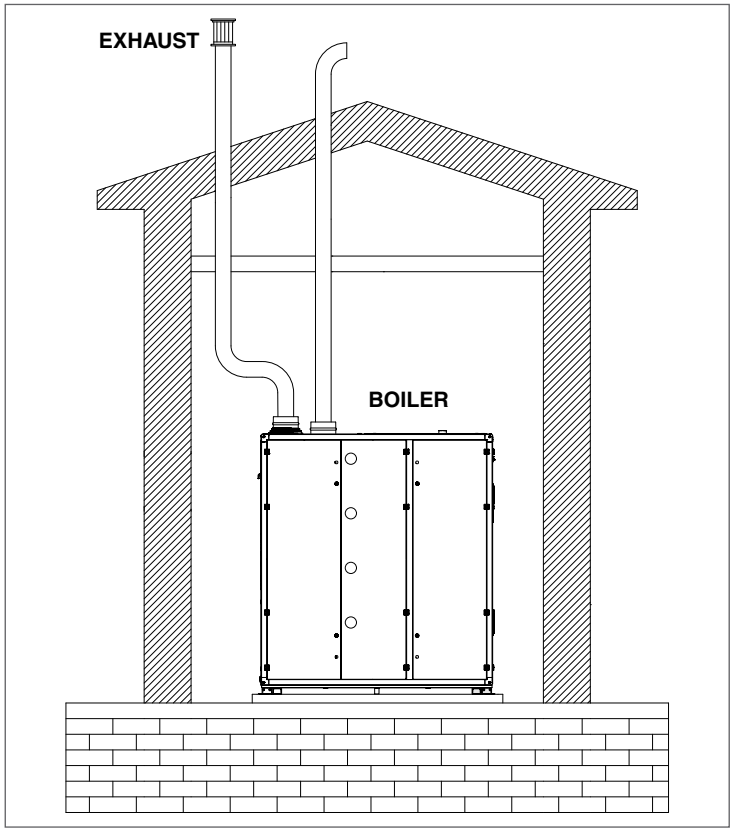


Fig. 34 *Sealed Combustion Located on Same Side with Exhaust (vertical)*

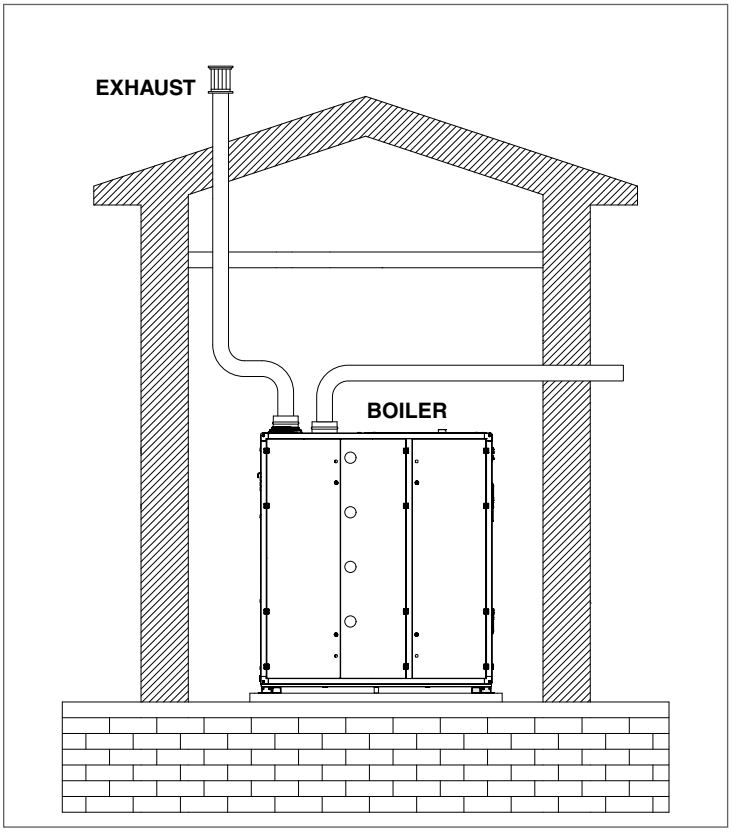


Fig. 36 *Sealed Combustion Located on Side Wall*

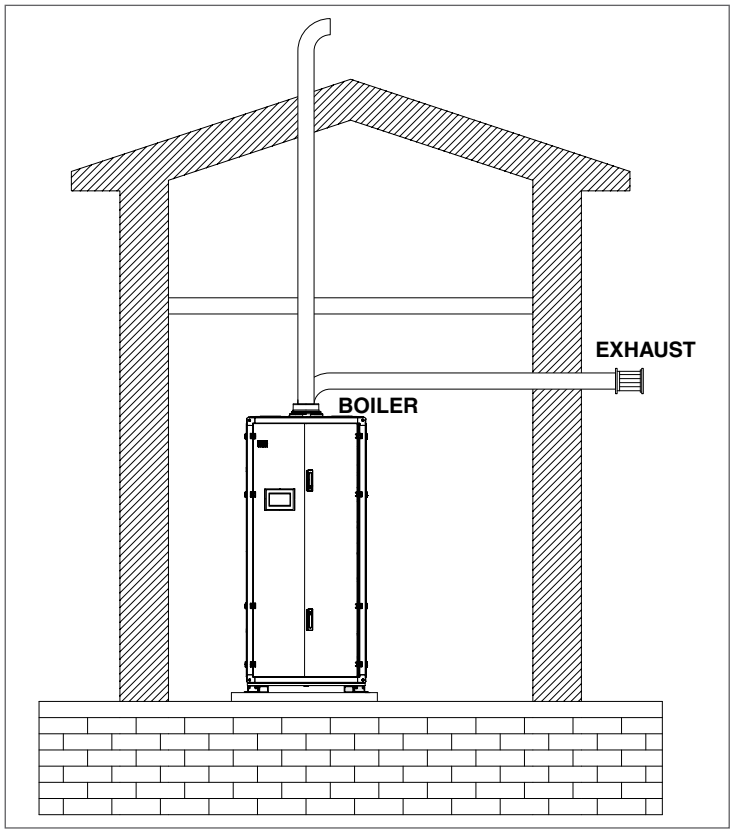


Fig. 37 *Exhaust Located on Side Wall*

- It is not recommended to terminate vent above any door or window, as condensate can freeze causing ice formations.
- Do not use chimney as a raceway if another boiler or fireplace is vented into or through chimney.
- Because the unit is capable of discharging low temperature exhaust gases, the flue must be pitched back towards the unit a minimum of 1/4" per foot to avoid any condensate pooling and to allow for proper drainage.
- While there is a positive flue pressure during operation, the combined pressure drop of vent and combustion air systems must not exceed the limits listed in "Appendix I – Venting Size Data".

Fittings as well as pipe lengths must be calculated as part of the equivalent length.

- For a natural draft installation the draft must not exceed – 0.25" w.c.
- These factors must be planned into the vent installation. If the maximum allowable equivalent lengths of piping are exceeded, the unit will not operate properly or reliably.
- For Massachusetts installations, contact companies able to provide vent systems which conform to all applicable requirements for installations within the Commonwealth of Massachusetts.
- For installation of multiple boilers, common venting shall be sized based on the data in "Appendix I – Venting Size Data".

4.15 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 can 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.

4.15.1 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.

4.15.2 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. The free area must take into account any restrictions, such as louvers.

4.15.3 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 I – Venting Size Data".

5 COMMISSIONING

5.1 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 "4 Installation" starting on page 16 must be completed before attempting to start the unit.

5.2 Filling the Condensate System

The condensate system must be filled with water according to the Section 4.10.

⚠ **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.

5.3 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. 52), 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.

5.4 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.

5.4.1 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** Series boilers can operate using one of the following two gases:

NATURAL GAS

- Maximum supply pressure = 13.5" w.c. (33.6 mbar).
- Minimum supply pressure = 4.0" w.c. (10.0 mbar).

PROPANE (LP) GAS

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

5.4.2 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 procedure may be found in Section "Appendix A – Gas Type Conversion" page 41. Conversion must be carried out by a qualified technician.

5.5 Boiler Startup Procedure

To start the boiler, do the following:

- Open the manual gas shut off valve (Fig. 2).
- Turn ON the main power switch (Fig. 22).
- Push all Module power switches to ON (Fig. 19).
- 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.
- Check/Modify the parameter (147) Number of Units. It must match the number of modules of the boiler (2 for **AR 1000,** 3 for **AR 1500** and 4 for **AR 2000**). By default the number of expected modules is 8. Follow the path below on the Service display: *Menu->Settings->Boiler Settings->Module Cascade Settings->(*) Number of Units*
- The Touchscreen Control Panel will switch on. The Splash/Stand-by screen consists of the **RIELLO** logo:

Fig. 38 *Touchscreen Control Panel Stand-by screen*

By touching the logo, the Cascade screen will appear:

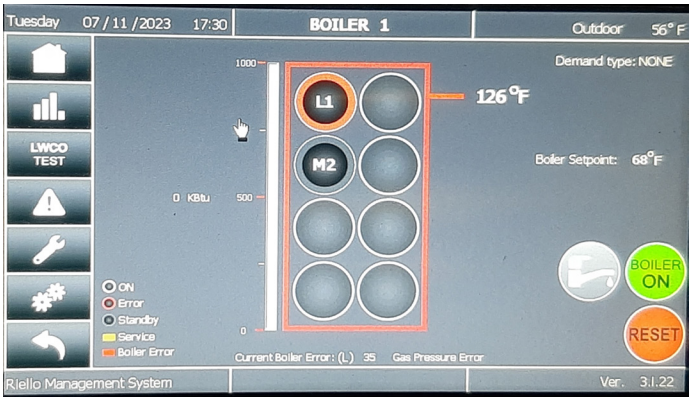
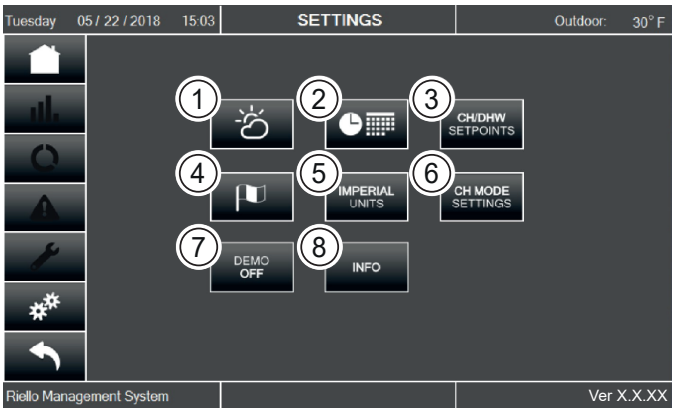


Fig. 39 *Cascade Screen*

- 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

Fig. 40 *Settings screen*

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

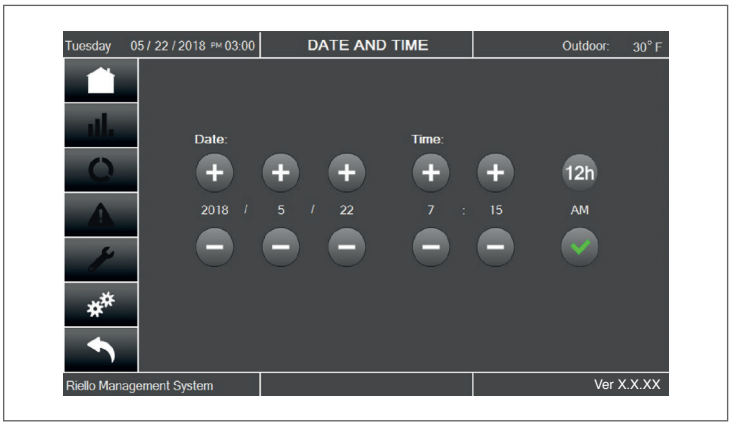


Fig. 41 *Date & Time screen*

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

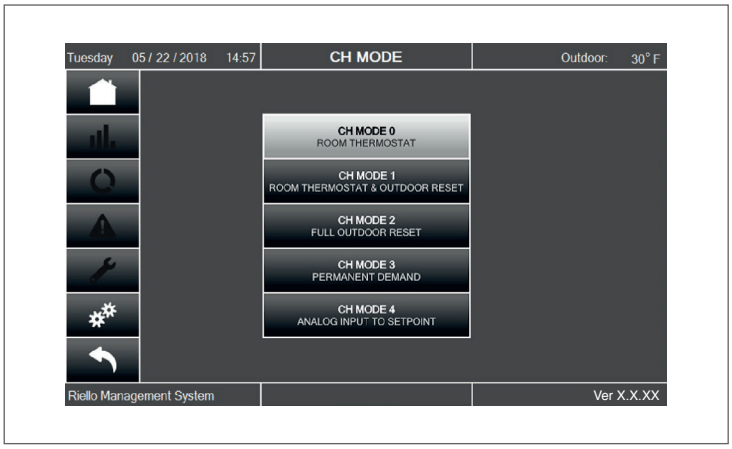


Fig. 42 *Mode Screen*

Six CH modes are available, but only five 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).

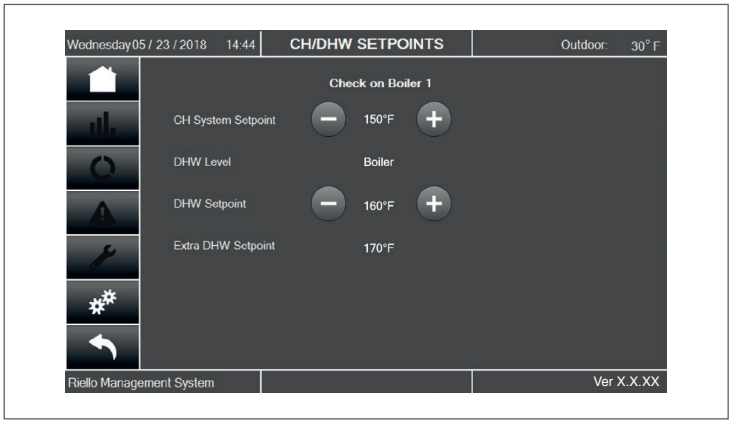


Fig. 43 *CH/DHW Setpoints*

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

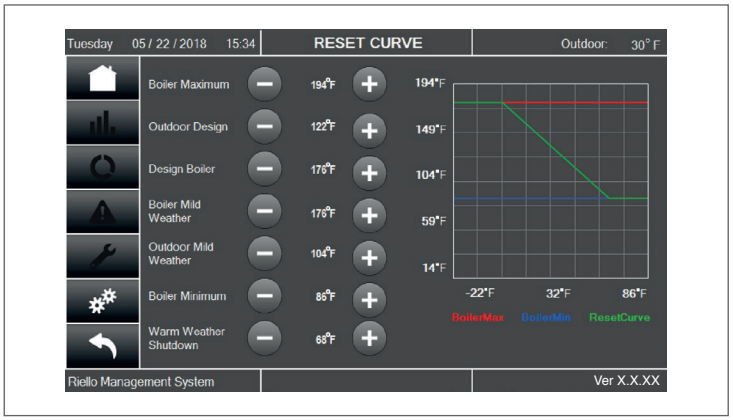


Fig. 44 *Reset Curve screen*

By adjusting the parameters on the screen, the reset curve will modify its shape and sloper to meet the needs of the specific application (see Fig. 45).

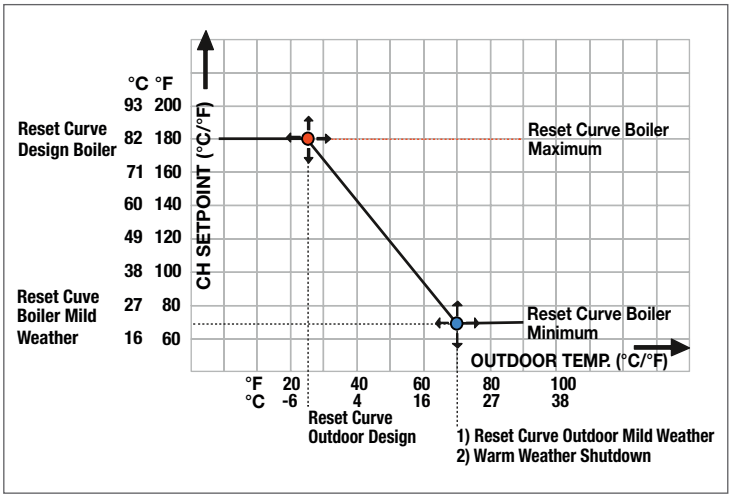


Fig. 45 *Reset Curve*

- **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 (see Fig. 25)*
  or
- *accessing the list of parameters through the Service display and move parameter #124 from 1 (default value) to 0.*

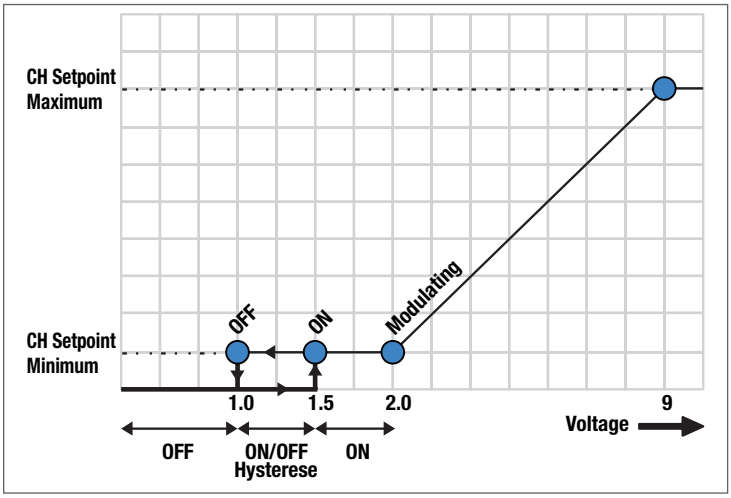


Fig. 46 *10VDC Control mode*

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).

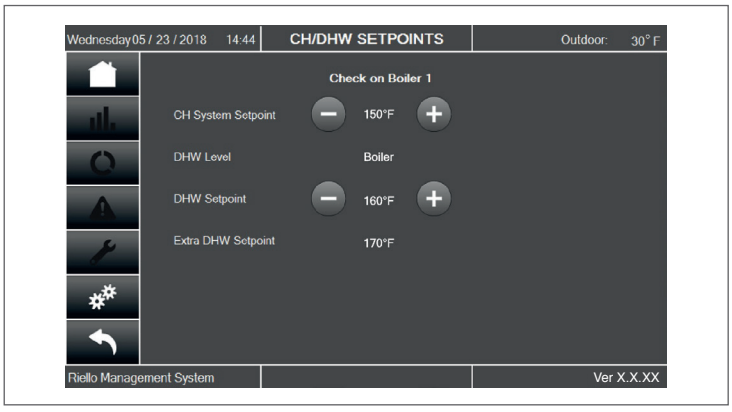


Fig. 47 *CH/DHW Setpoints*

- **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).

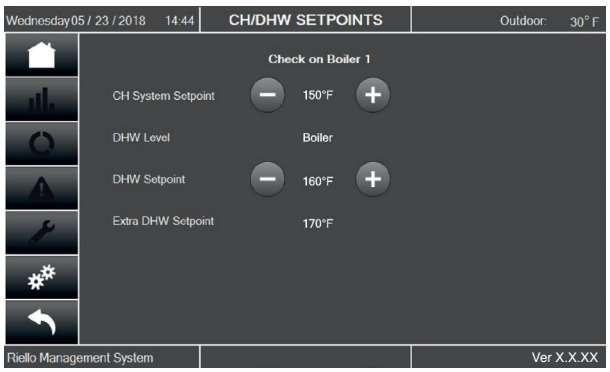


Fig. 48 *CH/DHW Setpoints*

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

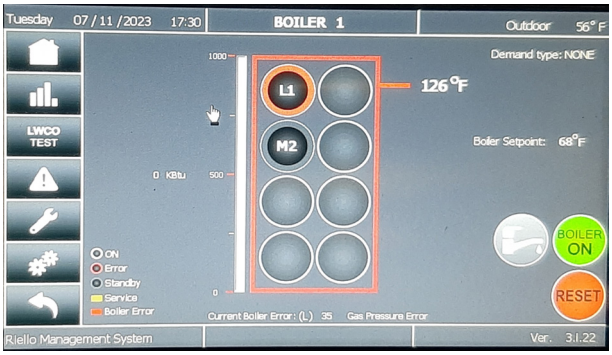


Fig. 49 *Boiler Screen*

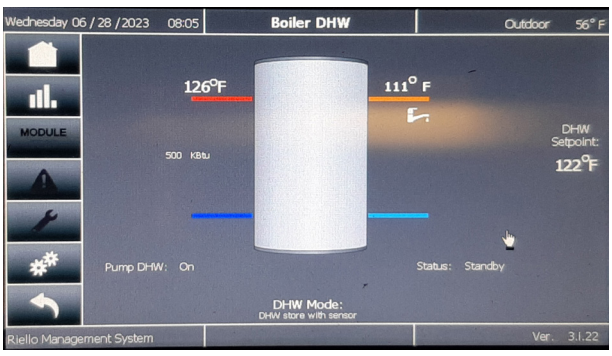


Fig. 50 *DHW Screen*

5.5.1 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 all pumps in the system are free, bled and rotate in the right direction.

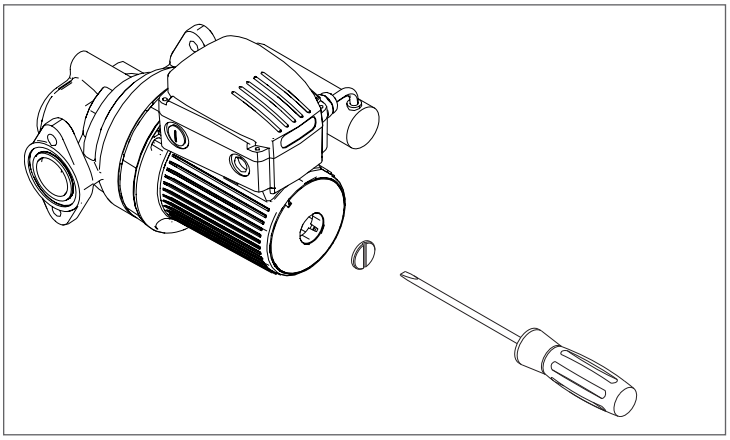


Fig. 51 *Minimum Water Flow*

5.5.2 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. 52.
The error will disappear when the pressure is back at the correct value. To prevent accidental relief valve openings, fill the heating circuit slowly.

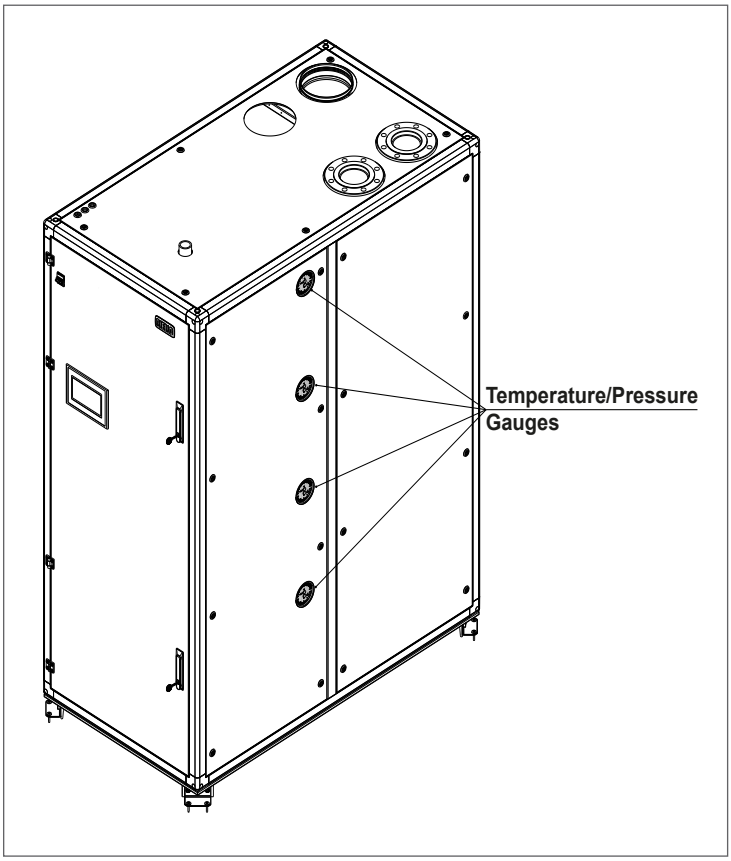


Fig. 52 *Temperature/Pressure Gauge location*

5.6 Multiple Boiler Cascade Installation and Start-Up

Appendix L 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:

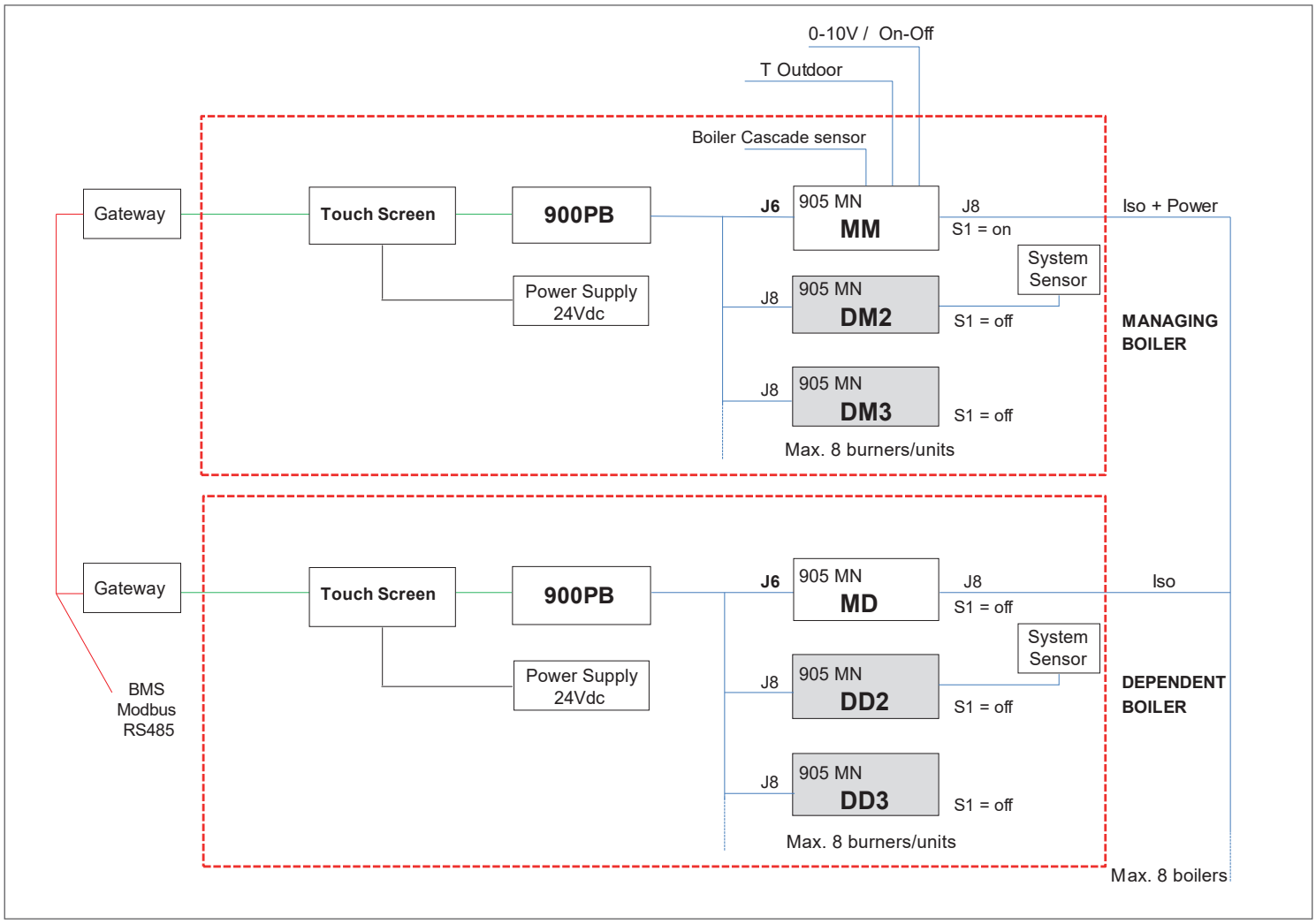


Fig. 53 *Cascade installation scheme*

After connecting the electrical wiring of the Managing controllers of each boiler of the cascade (through the "Cascade link" connections on the Low voltage terminal strips), the following steps must be must be performed.

5.7 Boiler Cascade: Set Boiler Address

Assign the Boiler Address in the managing control of each boiler in the cascade, following the path below on the Sevice display:

Menu->Setting->Boiler Settings->Boiler Cascade Settings->(73) Boiler Address

BOILER	(73) Boiler Address	BOILER	(73) Boiler Address
Managing	Managing	Dependent 4	Dep. 5
Dependent 1	Dep. 2	Dependent 5	Dep. 6
Dependent 2	Dep. 3	Dependent 6	Dep. 7
Dependent 3	Dep. 4	Dependent 7	Dep. 8

5.7.1 Boiler Cascade: Set Power Switch S1

On the Managing controller of the Cascade Managing Boiler, the Power Switch S1 must be in ON position (see picture below).
The S1 switch must be in OFF position on all other controllers of the dependent boilers in the cascade.

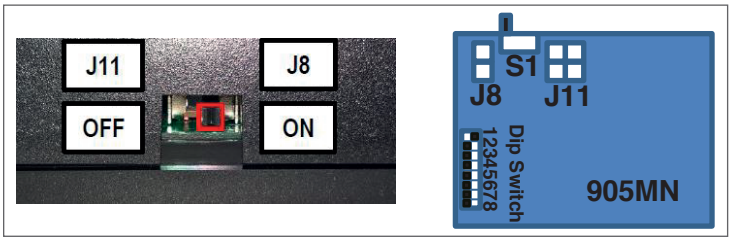


Fig. 54 *Set Power Switch S1*

6 OPERATION

6.1 Introduction

The information in this Chapter provides a guide to the operation of the **Array** 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 "4 Installation" starting on page 16 must be completed before attempting to start the unit.

6.2 Control Panel Description

All **Array** Series Boilers utilize the Touchscreen Control Panel shown in Fig. 55. 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 shown in Fig. 18.
Additional information on these items is provided in the individual operating procedures and menu descriptions provided in this Chapter.

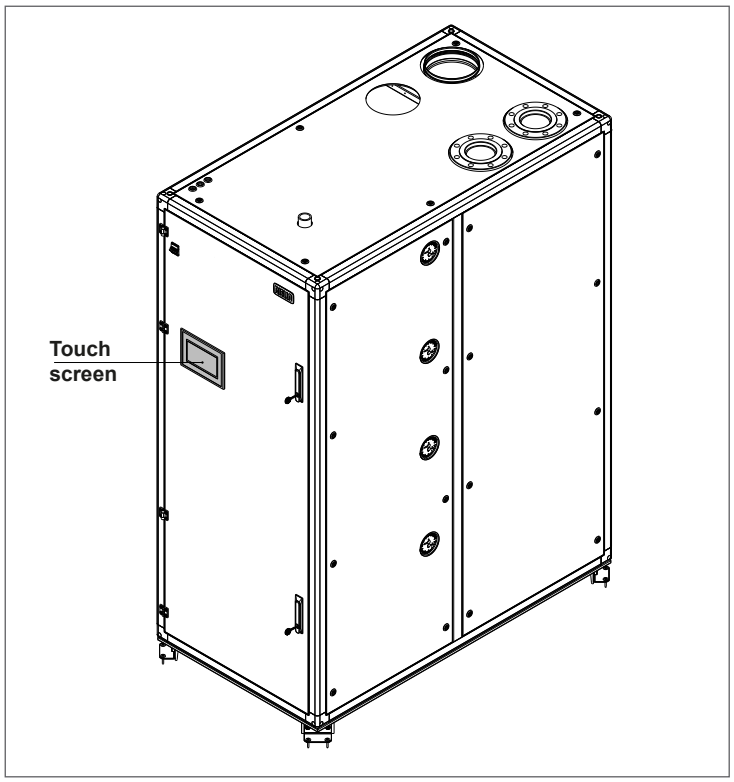


Fig. 55 *Touchscreen Control Panel*

6.3 Touchscreen Control Panel Menus

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

6.3.1 Riello Screen

Fig. 56 *Riello Screen*

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

The status bar switch is can have the following colors depending on the status:
a. White: System has no error and requires no service.
b. Yellow: System has no error, but requires service.
c. Red: System has an error.
After 30 minutes of inactivity the touchscreen will go to its screensaver. The screensaver sets the screen of the touchscreen to black. The screensaver is triggered regardless of which screen the touchscreen is currently on and will also occur if the system has an error or requires service.

6.3.2 Boilers Cascade Screen

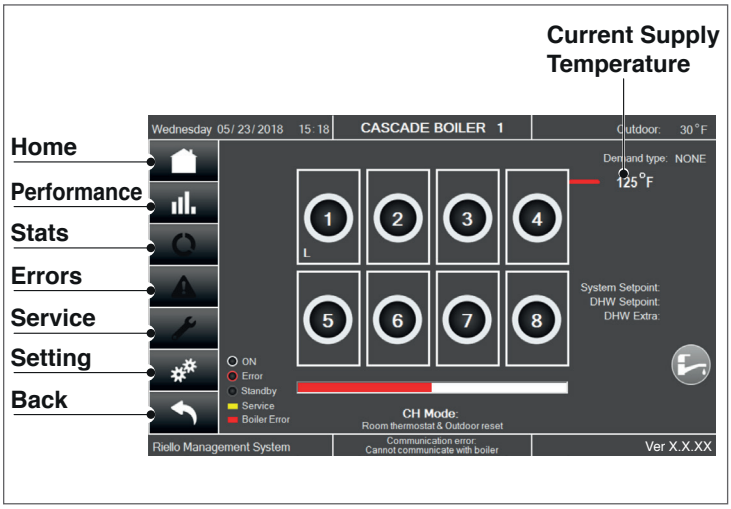


Fig. 57 *Cascade Screen*

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

Through this screen, the Boiler screen of the desired boiler can be accessed, 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;
- **Stats button:** not active;
- **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.

6.3.3 Boiler Screen

Through this screen, the following actions can be performed:

- Check the status of the modules (ON, OFF, in error);
- See the current supply temperature at the boiler header;
- Access the Module screen of the desired module, by touching it on the screen;

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 boiler;
- **Stats button:** not active;
- **Errors button:** move to the Errors screen;
- **Service button:** move to Service screen;
- **LWCO TEST button:** carry out the Low Water Cut Off functionality test at boiler level
- **Back button:** move to the previous screen.
- **ON/OFF button:** enable/disable the boiler (it does not affect the other boilers of the cascade, if any).

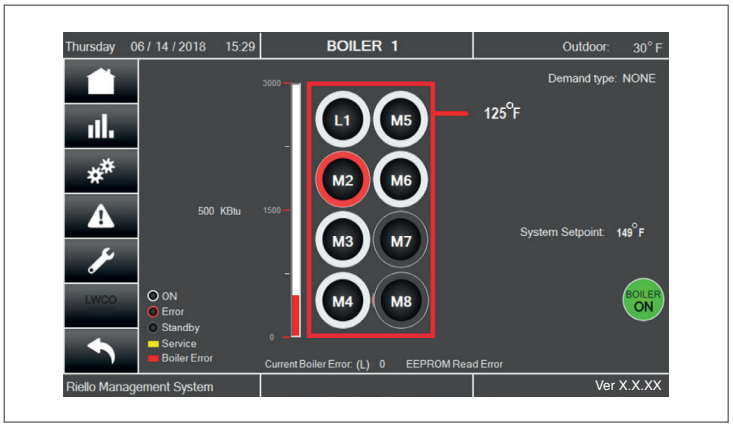


Fig. 58 *Boiler Screen*

6.3.4 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.

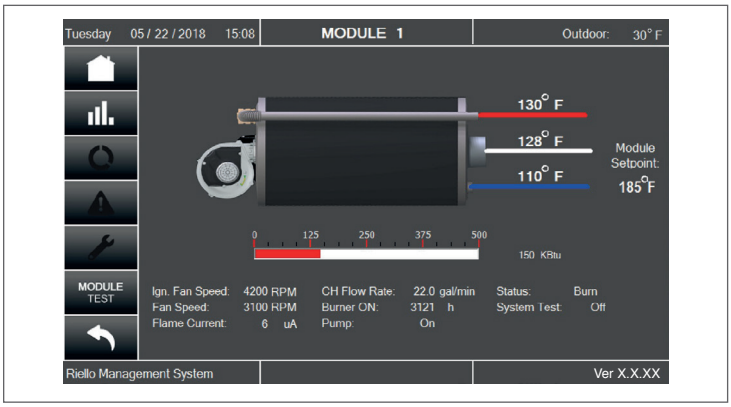


Fig. 59 *Module Screen*

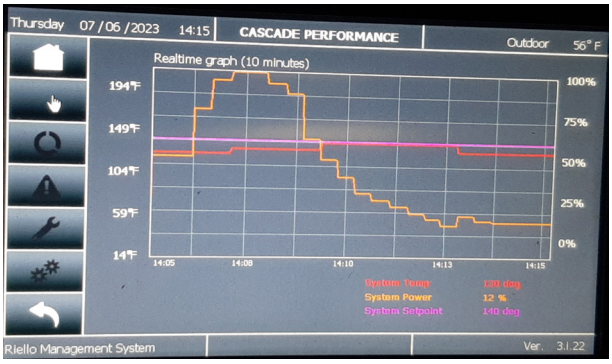
IMPORTANT: When resetting a Locking error of the Managing module, the whole boiler will be switched OFF and then restarted.

6.3.5 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.

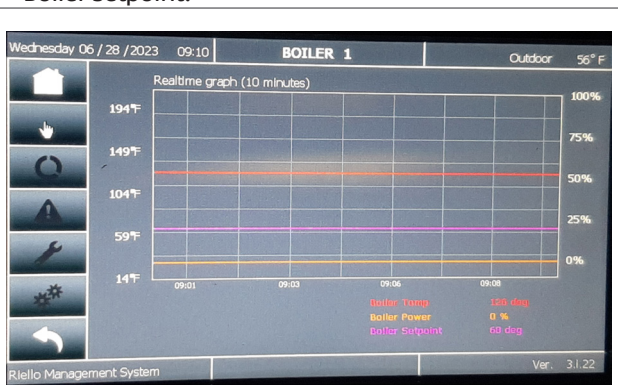
The Cascade Performance screen includes the trend of:

- System Temp;
- System Power;
- System Setpoint.



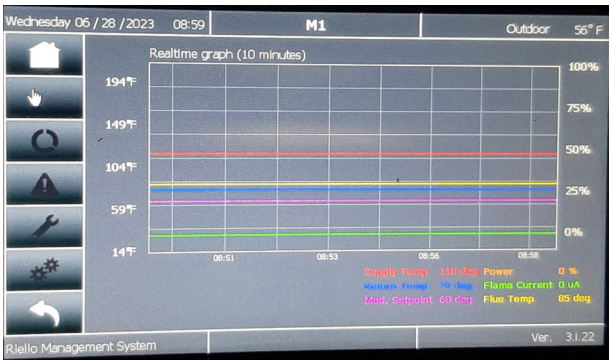
The Boiler Performance screen includes the trend of:

- Boiler Temp;
- Boiler Power;
- Boiler Setpoint.



The Module Performance screen includes the trend of:

- Supply Temp;
- Return Temp;
- Mod. Setpoint;
- Power
- Flame Current
- Flue Temp



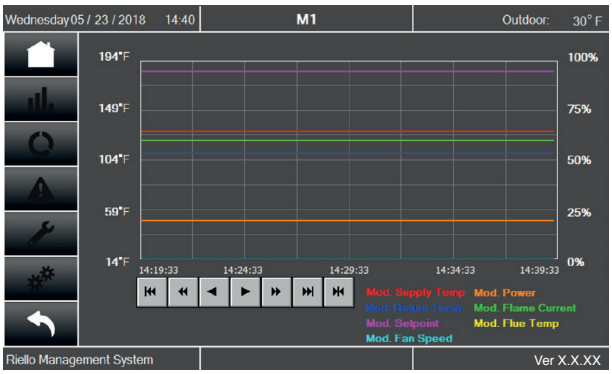


Fig. 60 *Performance Screen*

6.3.6 Error Screen

For each boiler, the Error screen shows the list of the last 40 errors occured on its own modules.
The errors are listed in chronological order, under two categories: Blocking errors (auto-reset) and Locking errors (manual reset).

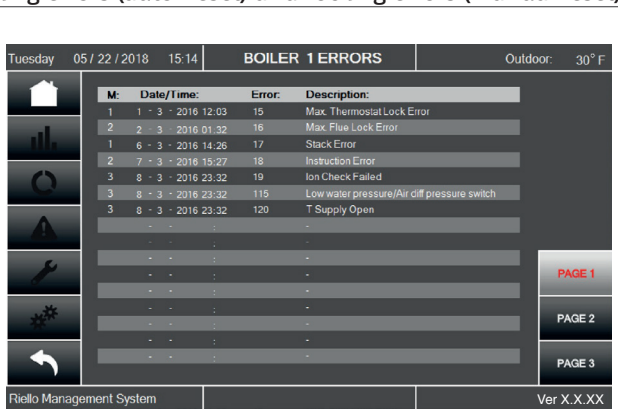


Fig. 61 *Error Screen*

6.3.7 Service Screen

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

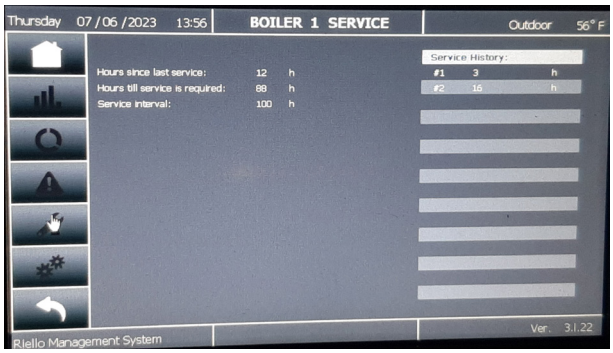


Fig. 62 *Service Screen*

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.

6.3.8 Module 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.

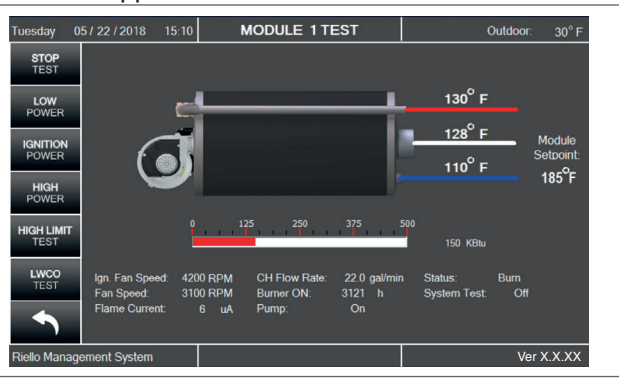
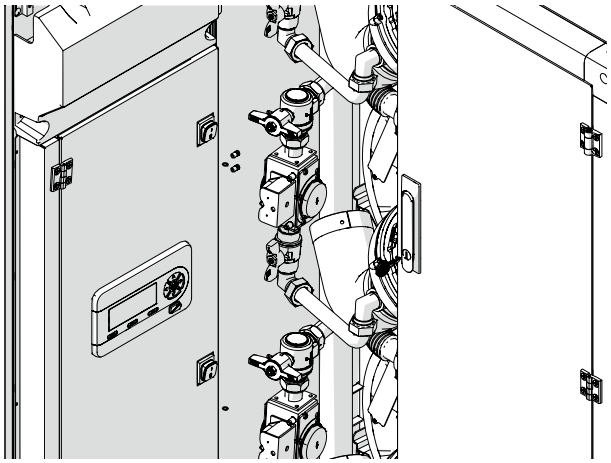


Fig. 63 *Module Test Screen*

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.
Moreover, the LWCO test button allows to perform the low water cutoff sensor test at module level.

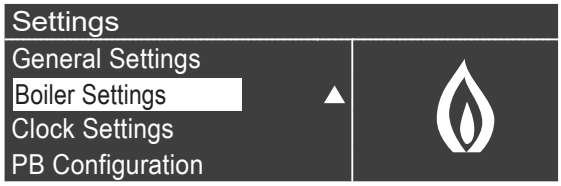
6.4 Display and Managing boards replacement

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

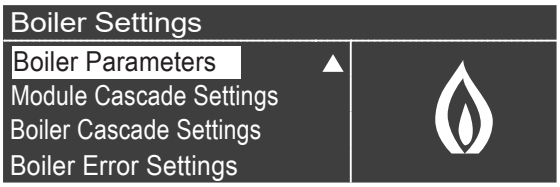


When replacing the front control panel, an initial screen with the logo is displayed on the next reboot **RIELLO**.
The system performs a consistency check between the configuration data saved on the motherboard and those saved in the user interface; therefore, when replacing the control interface, the system can detect an inconsistency between the saved data. Set the Par. 92, Par. 93 and the Par. 94.
Proceed as follows:

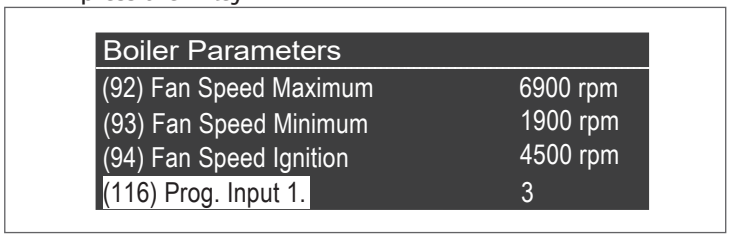
- On the home screen of the control panel, press the "Menu" key
- Select "Settings" with the ▲ / ▼ keys and press the ● key
- Select "Boiler Settings" with the ▲ / ▼ keys and press the ● key



- Enter the password as described in paragraph "Password access"
- Select "Boiler Parameters" with the ▲ / ▼ keys and press the ● key



- Press the ▼ key, select "(92) Fan Speed Maximum" and press the ● key



- Use the ▲ / ▼ keys to modify the value as shown in the following table and press the ● key

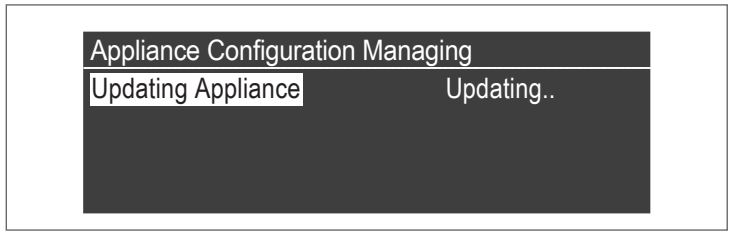
Proceed in a similar way to set the parameters "(93) Fan Speed Minimum" and "(94) Fan Speed Ignition".

Model	Par. 92	Par. 93	Par. 94
AR 1000	6900	1900	3500
AR 1500	6900	1900	3500
AR 2000	6900	1900	3500

6.5 Dependent boards replacement

⚠ System configurations must be performed only by the Technical Assistance Service or by personnel authorized by **RIELLO**.
Proceed as follows:

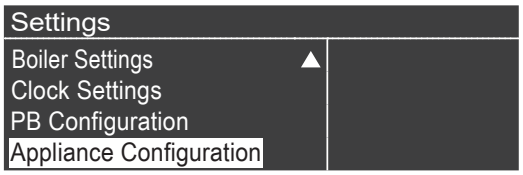
- Remove electrical power from all modules.
- Remove the broken board and place the new board in its place with the dip-switch already selected.
- Disconnect the display from the Managing board and connect it to the Dependent board.
- Electrically power the replaced board.
- The display will automatically update the board with the Managing configuration.



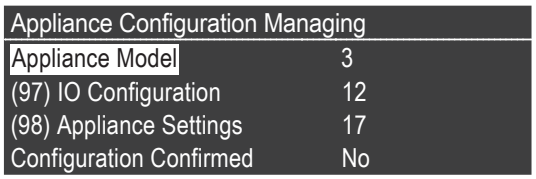
At the end of the configuration, you need to reconfigure the card into a Dependent card:

- Press the Menu key on the display
- Using the▲ / ▼ keys, position yourself on SETTINGS and press the OK key.

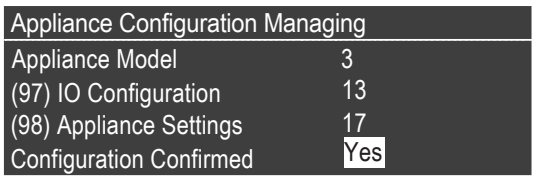
- Using the ▲ / ▼ keys, position yourself on APPLIANCE CONFIGURATION and press the OK key.



- Enter the password, the configuration menu opens.

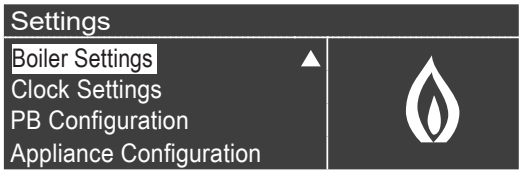


- Act on parameter (97) IO Configuration by changing it from 12 to 13 and confirm.

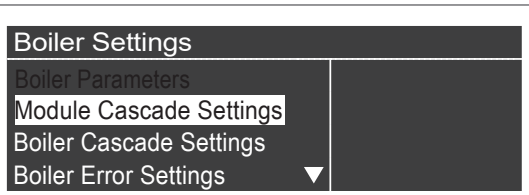


The card configuration phase will begin

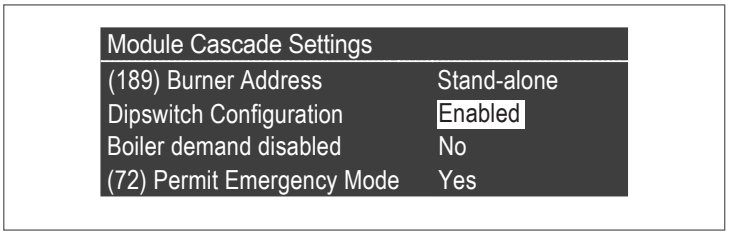
At the end of the configuration, use the ▲ / ▼ keys to position yourself on BOILER SETTINGS and confirm with the OK key



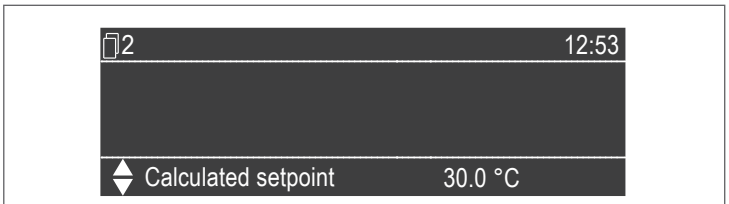
- Use the ▲ / ▼ keys to position yourself on MODULE CASCADE SETTINGS and confirm with the OK key.



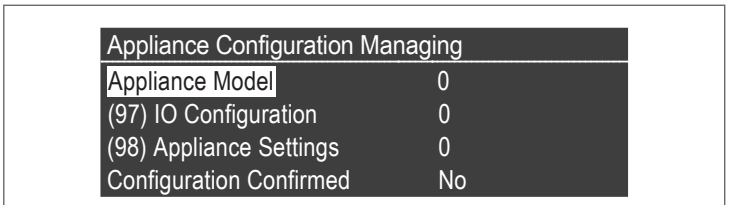
- Using the ▲ / ▼ keys, position yourself on DIPSWITCH CONFIG and set it to ENABLED, confirm with the OK key.

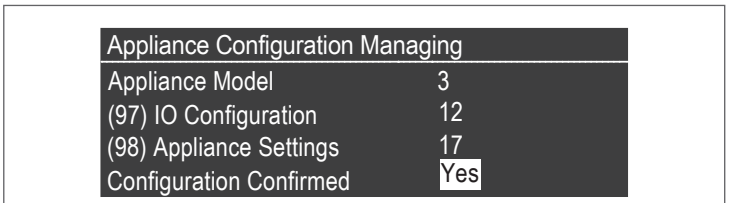


- Press the ESC key repeatedly to return to the HOME screen.



- Remove the power supply from the Dependent board, disconnect the Display from the Dependent board and connect it to the Managing board. Power up the Managing board electrically, after the initialization phase in which it shows the Riello logo, the Display positions itself autonomously in the APPLIANCE CONFIGURATION MANAGING screen and configure the parameters;

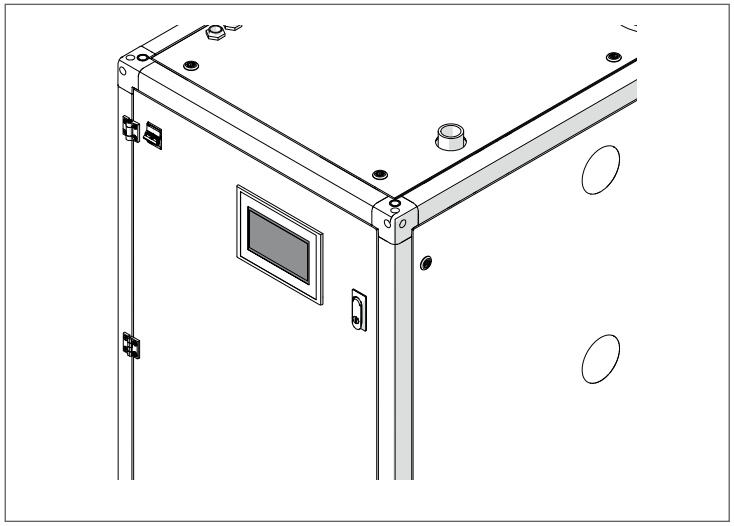




Once configuration is complete, the Display will briefly show a configuration error. Remove the power supply from the Managing board and power all the modules at the same time.
After the setting is necessary to reconfigur the fan speed as in the managing board.

6.6 Touchscreen Control Panel replacement

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



When replacing Touchscreen Control Panel no setting actions are required.

7 SHUTDOWN

⚠ **CAUTION:** Risk of system damage through frost.
When there is a frost, the heating system can freeze up if it is not operational, e.g. because of a fault shutdown.
- When there is a risk of frost, protect your heating system against freezing.
- If your heating system has been shut down for several days due to a fault shutdown and there is a risk of frost, drain the heating water at the drain & fill valve. Also leave the air vent valve at the highest point in the system open.

⚠ **NOTICE:** Risk of system damage through frost.
The heating system can freeze as a result of a power failure or if the power has been switched off.
- Check the "Control unit settings" to ensure the system remains operational (especially when there is a risk of frost).

7.1 Shutting Down the Heating System

Shut down your heating system via the control unit. Switching off the control unit also switches off the burner automatically.
- Set the On/Off switch of the control unit to Off.
- Isolate the fuel supply to the burners.

7.2 Shutting Down the Heating System in an Emergency

Only in emergencies, switch OFF the heating system via the boiler room breaker or the heating system emergency stop switch.
- In dangerous situations, immediately close the main fuel shut-off valve and the power supply of the heating system via the boiler room main breaker or the heating system emergency stop switch.
- Isolate the fuel supply to the burners.
- Never put your life at risk. Your own safety is paramount.

8 ENVIRONMENTAL PROTECTION/DISPOSAL

Environmental protection is one of the fundamental company policies of **RIELLO**. We regard quality of performance, economy and environmental protection as equal objectives.
Environmental protection laws and regulations are strictly adhered to.
To protect the environment, we use the best possible technology and materials taking into account economic points of view.

Packaging
For the packaging, we participate in the country-specific recycling programs, which guarantee optimal recycling. All packaging materials used are environmentally-friendly and recyclable.

Old appliances
Old appliances contain resources that should be recycled.
The components are easy to separate and the plastics are marked.
This allows the various components to be sorted for appropriate recycling or disposal.

APPENDIX A - 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_2 or O_2 reading taken at maximum nominal output and minimum nominal output using an electronic flue gas analyzer. The desired high-fire excess 02 level is 5.1% for natural gas.

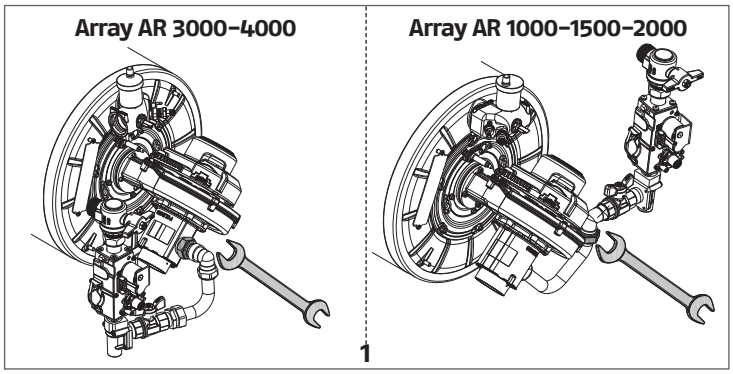
SWITCHING FROM NATURAL GAS TO LP

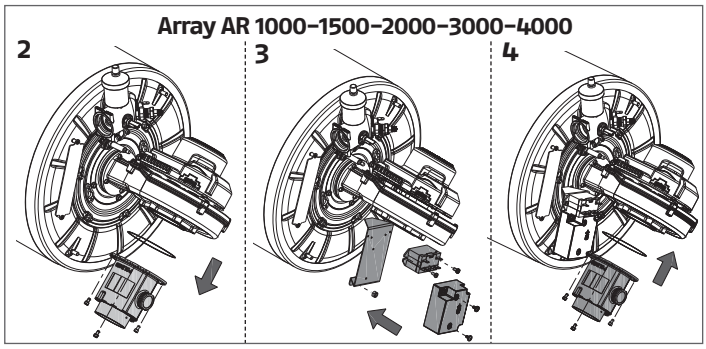
- Close the gas shutoff valve
- Disconnect the electric power supply from the boiler

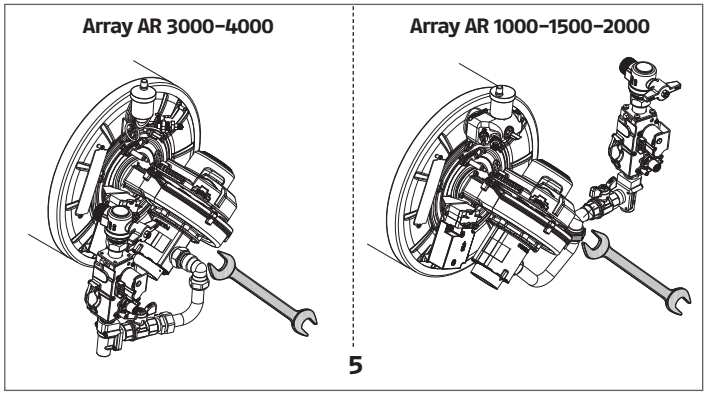
SCOPE OF DELIVERY

COMPONENTS	QUANTITY				
	AR 1000	AR 1500	AR 2000	AR 3000	AR 4000
Ignition cable	2	3	4	6	8
Managing ignition transformer connection wiring	1	1	1	1	1
Depedent ignition transformer connection wiring	1	2	3	5	7
Ignition transformer	2	3	4	6	8
Relay	2	3	4	6	8
Support for external igniter	2	3	4	6	8
Self-tapping screw 4.2x45	4	6	8	12	16
Self-tapping screw 3.5x9.5	4	6	8	12	16
M4x8 self-tapping screw	4	6	8	12	16
M6 self-locking nut	2	3	4	6	8
Gasket 1''	2	3	4	6	8
Oring	2	3	4	6	8
Mixer	2	3	4	6	8
Instruction sheet	1	1	1	1	1

Assembly
Assembly on top of heat exchanger (step 1 -5).





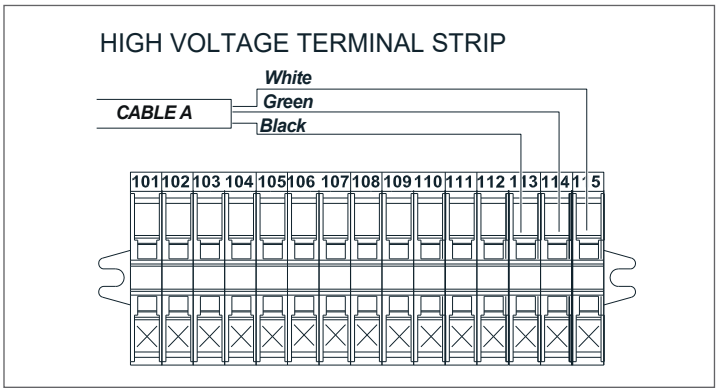


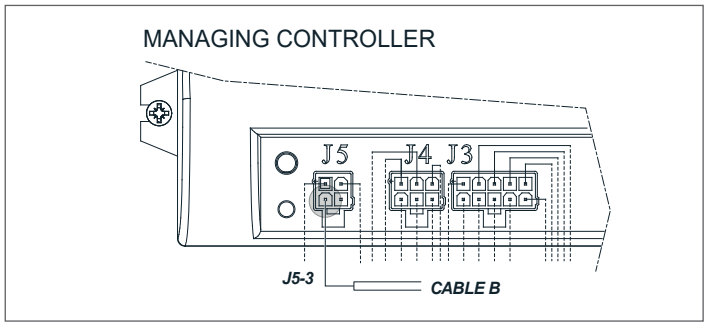
CONNECTION DIAGRAM

MANAGING CONTROL WIRING

USING «AIR DAMPER» CONNECTIONS (OUPUT3)

- Cable A to be connected to high voltage terminal strip n.
  - 113 (black)
  - 114 (green)
  - 115 (white)
- Cable B to be connected to J5-3 on managing board





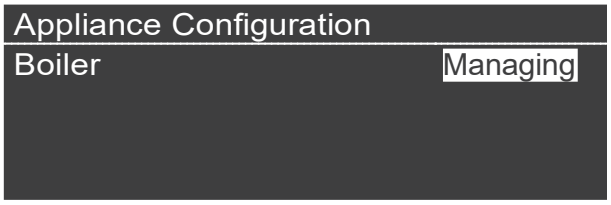
PAR. 97		
	NG	LPG
Managing	12	52

- Push the MENU button on Service display
- Select "Settings" and push OK

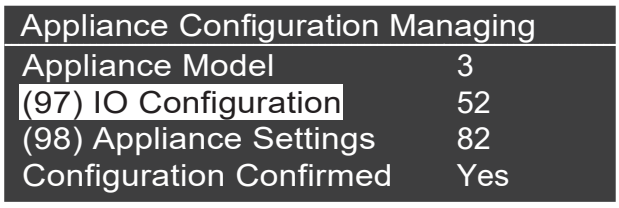
- Select "Appliance Configuration" and push OK

- Input the password (1200)

- Select "Managing" and push OK

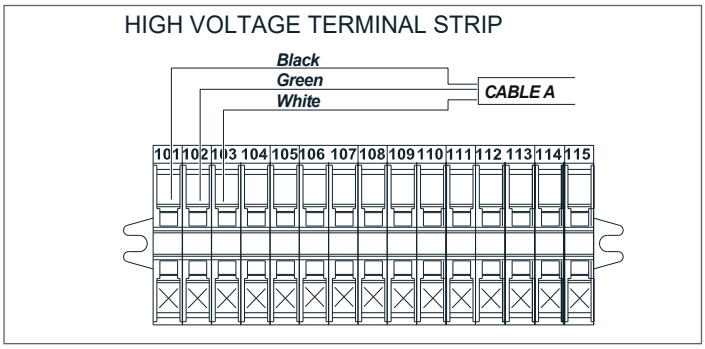


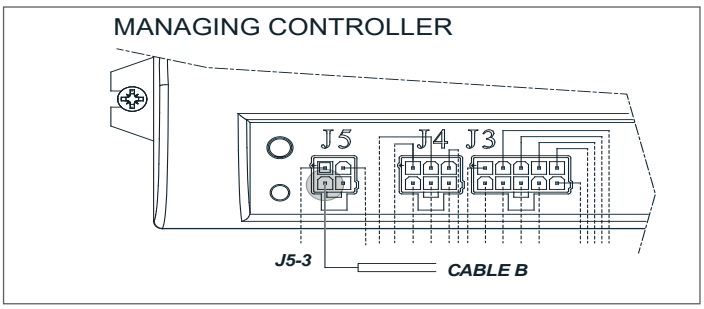
- Change parameter (97)
- Change parameter (98)



USING «ALARM» CONNECTIONS (OUPUT2)

- Cable A to be connected to high voltage terminal strip n.
  - 101 (black)
  - 102 (green)
  - 103 (white)
- Cable B to be connected to J5-3 on managing board

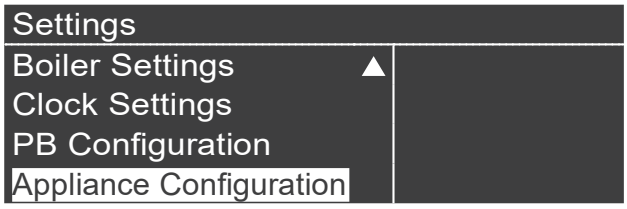




PAR. 97		
	NG	LPG
Managing	12	53

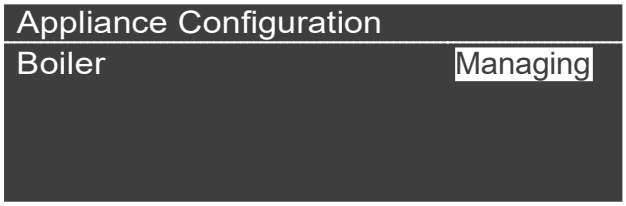
- Push the MENU button on Service display
- Select "Settings" and push OK

- Select "Appliance Configuration" and push OK

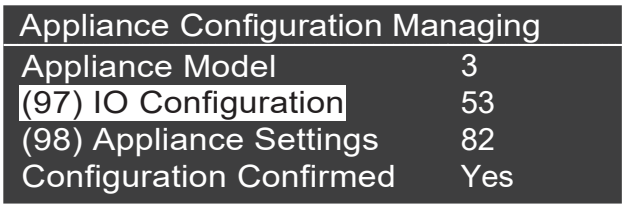


- Input the password (1200)

- Select "Managing" and push OK



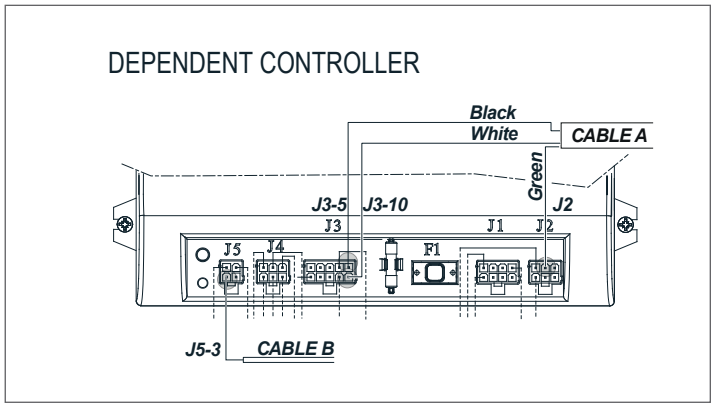
- Change parameter (97)
- Change parameter (98)



DEPENDING CONTROLLER WIRING

Dependent controller wiring (to be repeated for each Dependent module)

- Cable A to be connected to dependent controller.
  - J3-5 (black)
  - J3-10 (green)
  - J2 (white)
- Cable B to be connected to J5-3 on dependent board



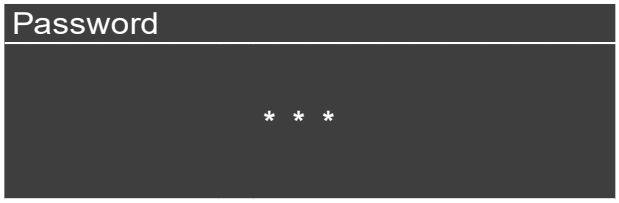
PAR. 97		
	NG	LPG
Dependent	13	51

To change the Dependent controller settings, connect the Service display to each Dependent controller using the cable available on each of them.

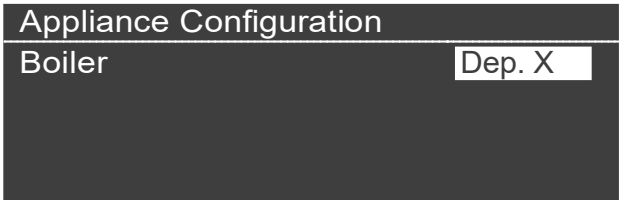
- Push the MENU button on Service display
- Select "Settings" and push OK

- Select "Appliance Configuration" and push OK

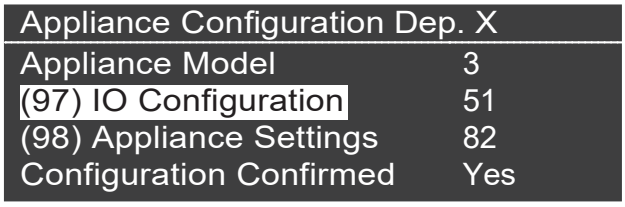
- Input the password (1200)



- Select "Dep. X" and push OK



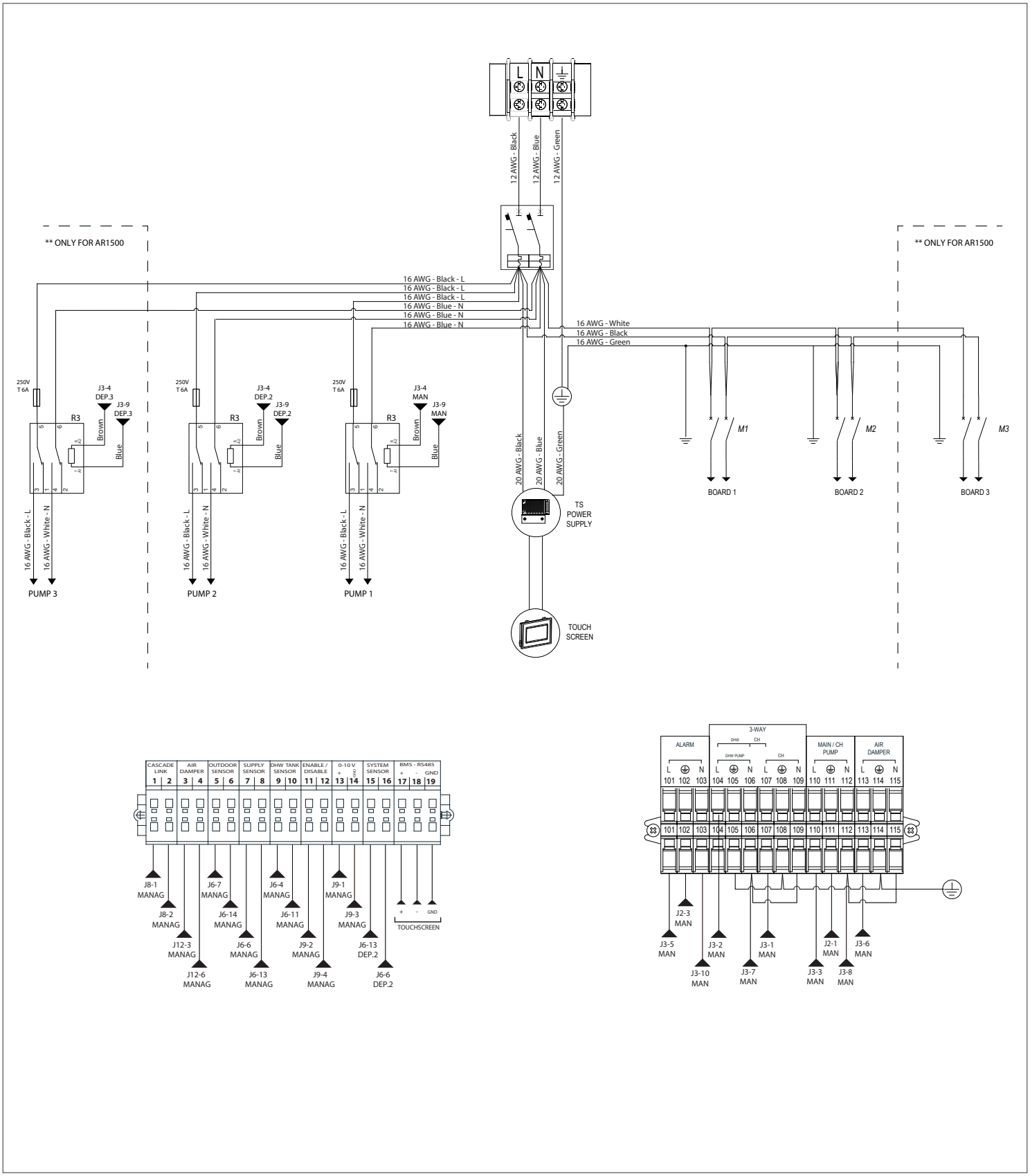
- Change parameter (97)
- Change parameter (98)



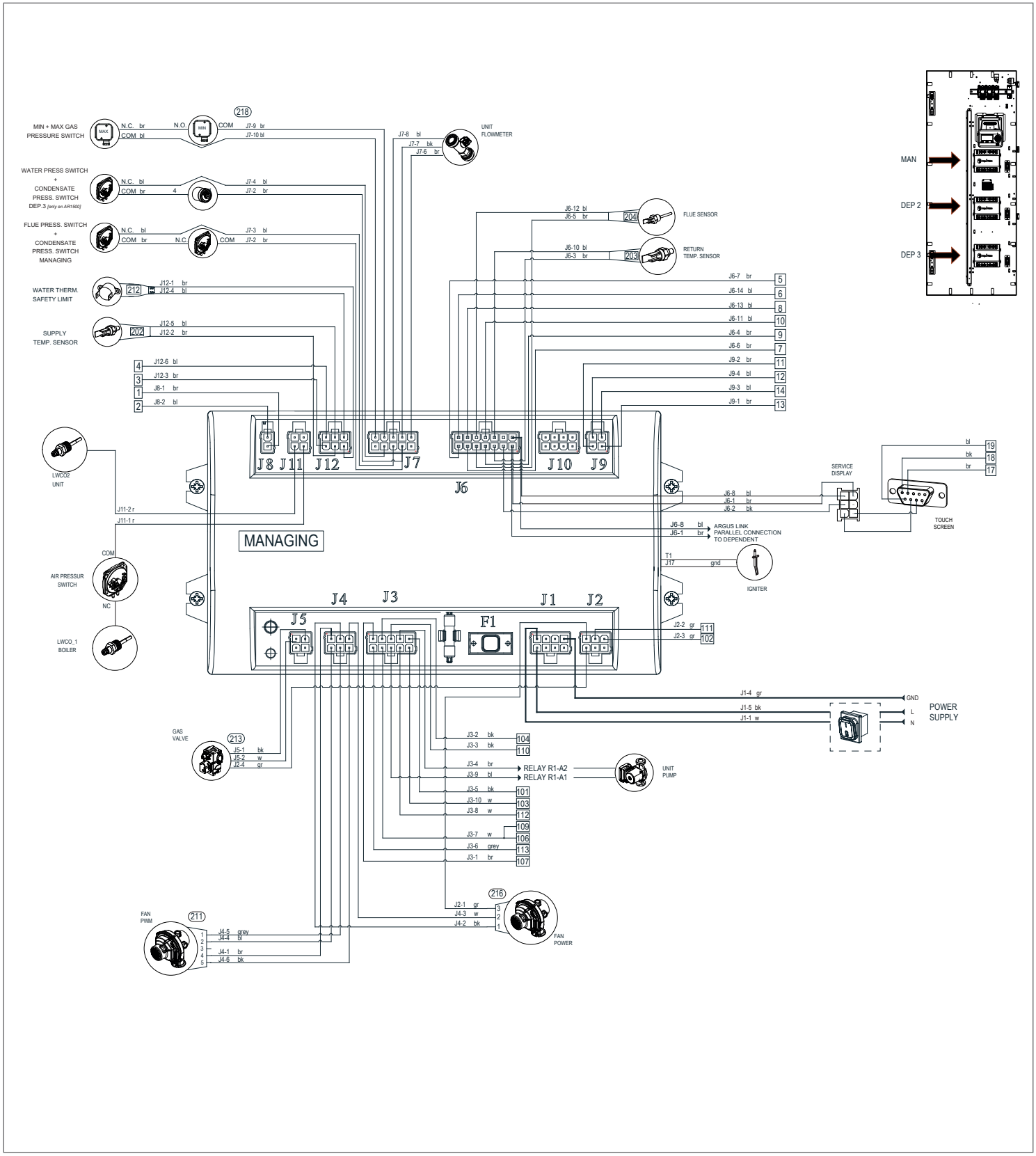
- Repeat the same procedure for each Dependent module.
- Set the parameters as shown in the follow table:

Model	Par. 92	Par. 93	Par. 94
AR 1000	6900	1900	3500
AR 1500	6900	1900	3500
AR 2000	6900	1900	3500

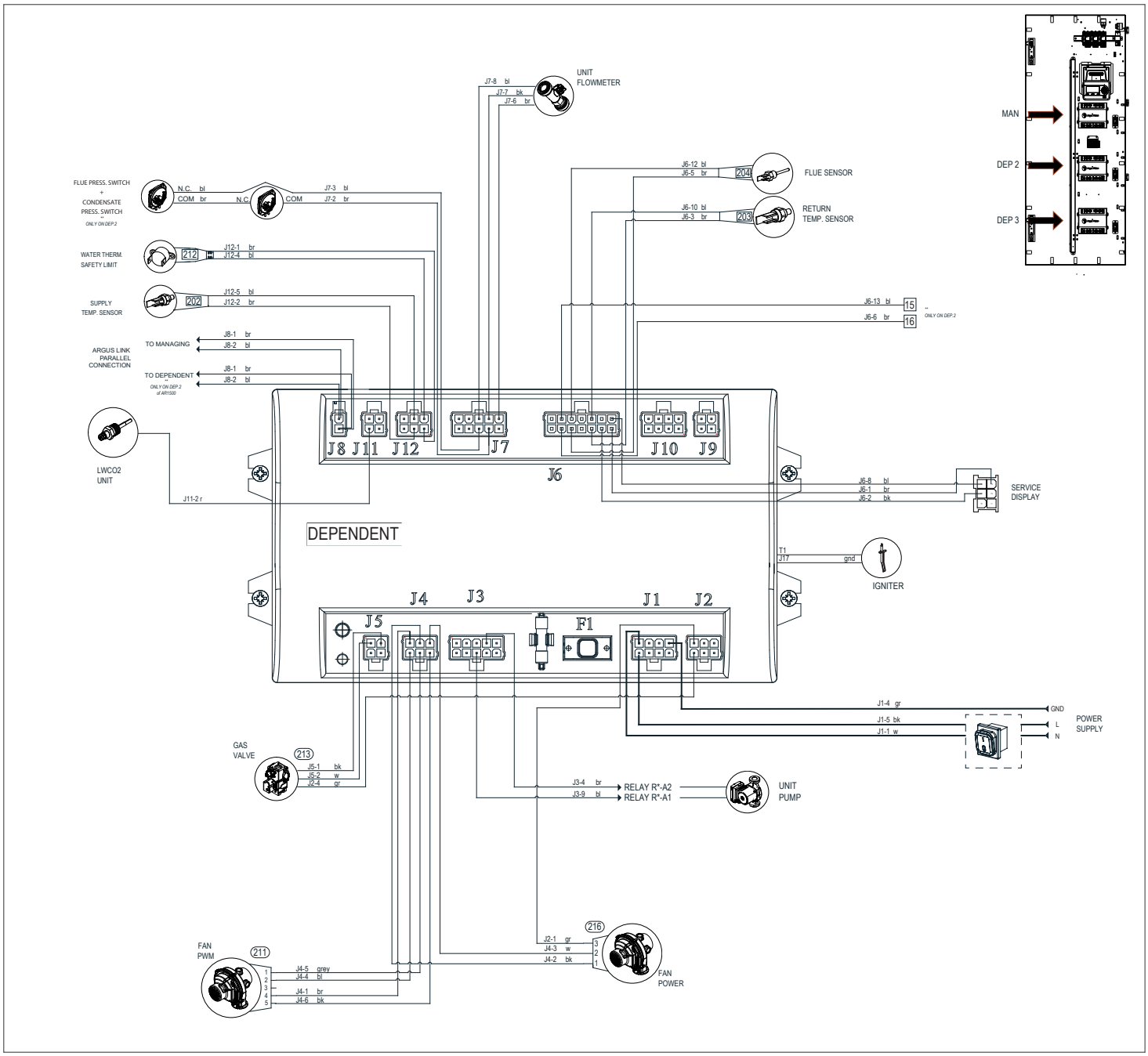
APPENDIX B – WIRING DIAGRAM AR 1000 – AR 1500



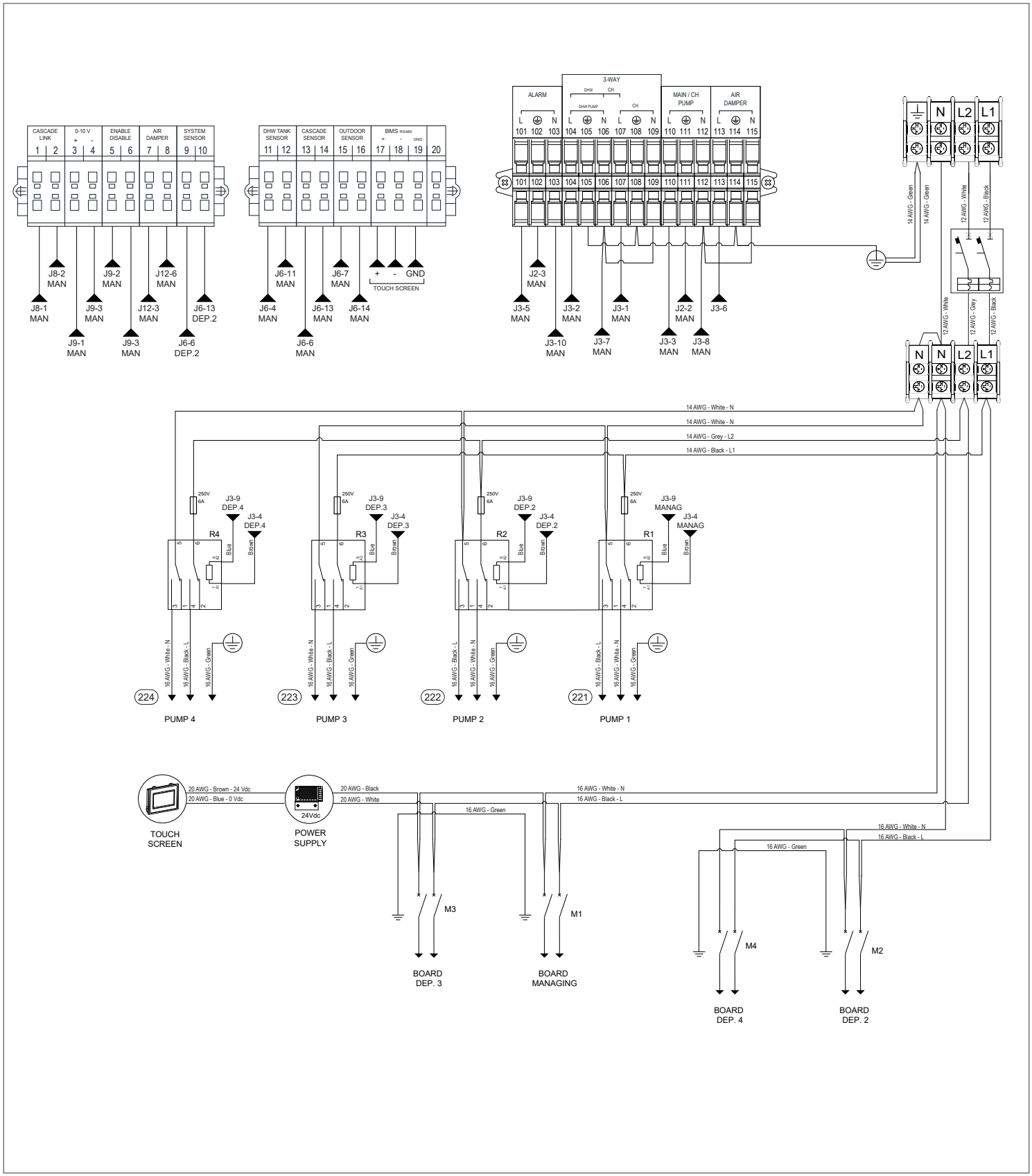
WIRING DIAGRAM AR 1000 – AR 1500 – MANAGING



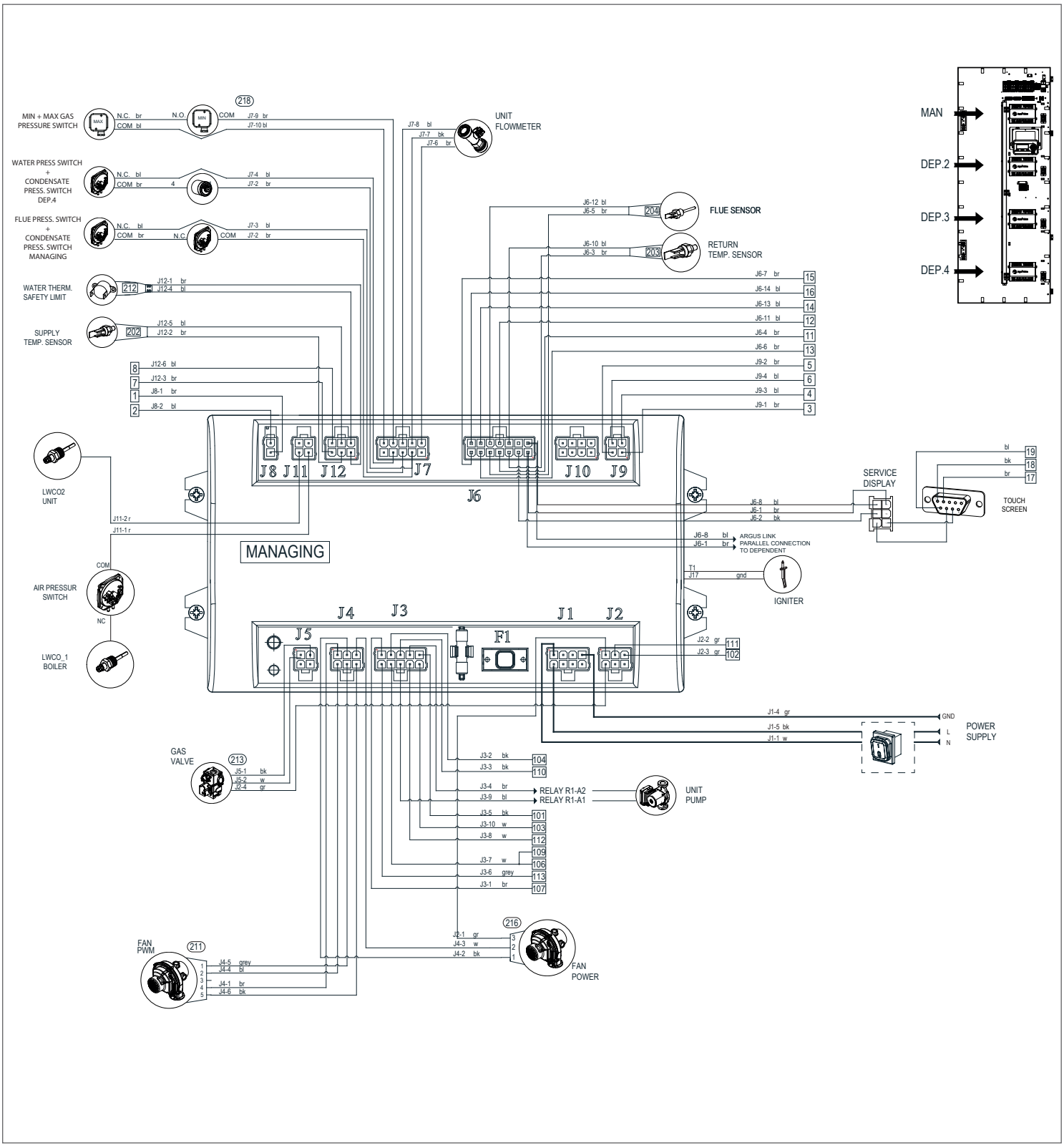
WIRING DIAGRAM AR 1000 – AR 1500 – DEPENDENT



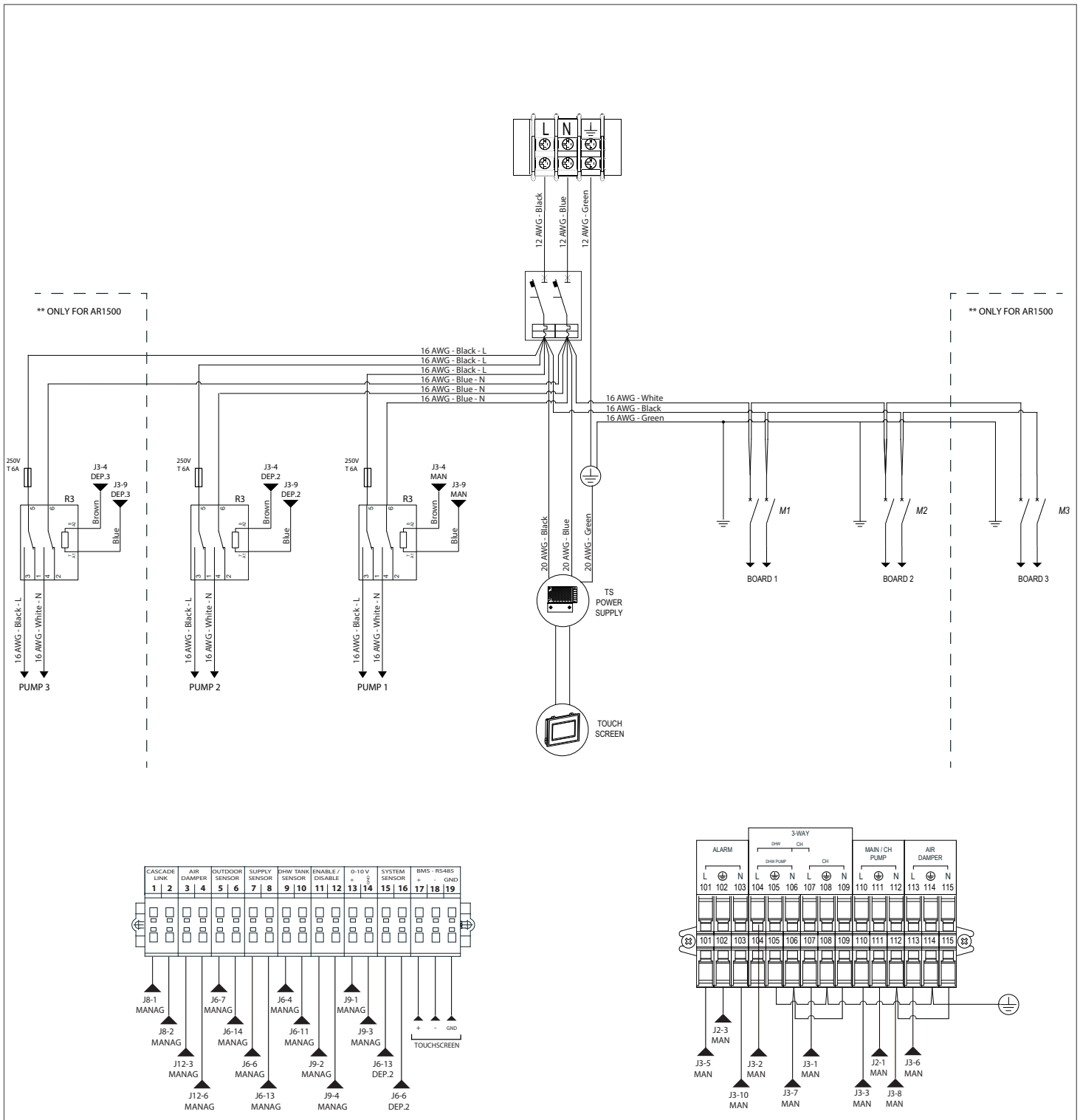
APPENDIX C – WIRING DIAGRAM AR 2000



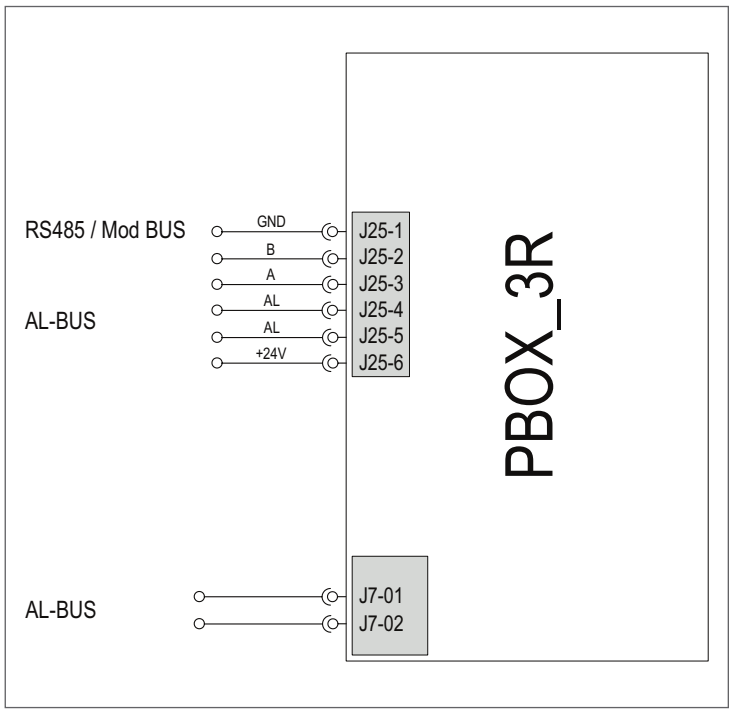
WIRING DIAGRAM AR 2000– MANAGING



WIRING DIAGRAM AR 2000 – DEPENDENT

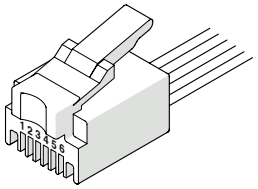


CONNECTION DIAGRAM 905PB DISPLAY



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

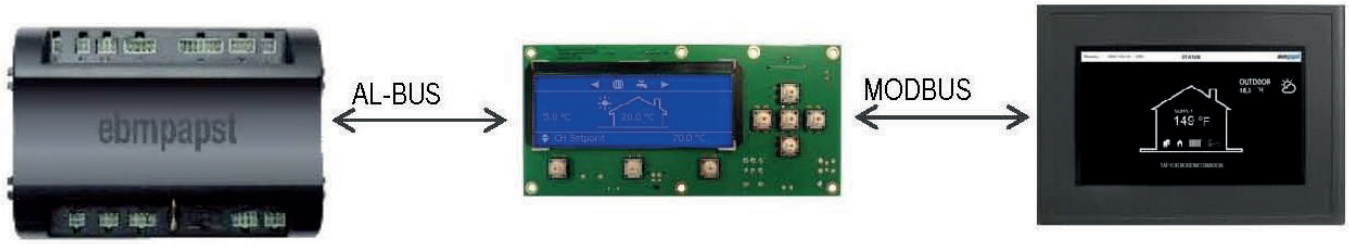
905PB05_3R Display: RJ-11 Connector:



1: GND/VSS
2: ModBus_B (= Data -)
3: ModBus_A (= Data +)
3: AL_Comm
5: VSS — **To 905MN**
6: +24V

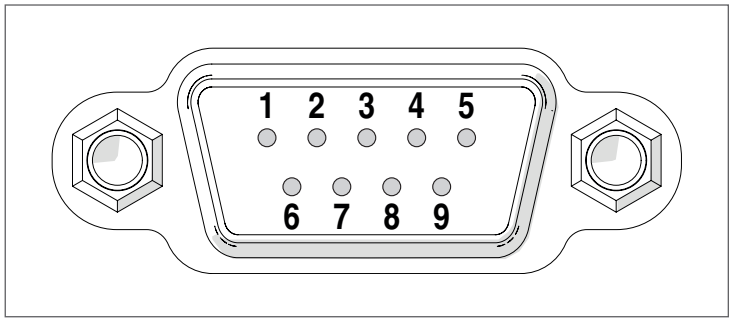
J25 Wire Colors:
J25-1: Grey
J25-2: Black
J25-3: Green
J25-4: Yellow
J25-5: Red
J25-6: Blue

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 D – 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 if leaks or obstructions are present
Annually	Check air piping and verify if leaks or obstructions are present
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 to confirm there are no leaks, including the pressure ports of the gas valves.

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

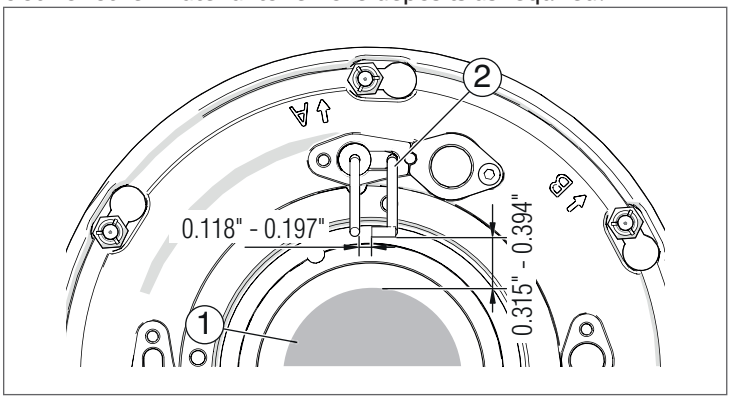


Fig. 64 *Inspection of ignition electrode*

No.	Description
1	Burner tube
2	Ignition electrode

CHECK WIRING AND CONNECTIONS
Check that all wiring is securely fastened and in good condition without any cracking or alteration 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 0CR105917) for damage.
It is mandatory 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.

GAS FILTER SERVICE
In order to ensure smooth operation:
- clean or replace the filter pad of the component annually or every 2000 hours, whichever occurs first;
- when cleaning or replacing the filter pad, no dirt may contaminate the clean gas circuit.

APPENDIX E – HEAD AVAILABLE FOR THE SYSTEM

HEAD AVAILABLE

		Available Waterside Head Pressure					
		AR 800	**AR 1000**	**AR 1500**	**AR 2000**	**AR 3000**	**AR 4000**
DT 36 °F ACROSS BOILER	**Water Flowrate (USgpm)** (Est., No Glycol, Full Firing)	42	53	80	107	160	213
	Available Head (ft-head) **Water Only**	16.0	7.5	7.0	8.0	4.5	4.0
	Available Head (ft-head) **50% Glicol**	14.4	7.0	6.0	7.0	4.0	3.0
DT 45°F ACROSS BOILER	**Water Flowrate (USgpm)** (Est., No Glycol, Full Firing)	34	43	64	85	128	171
	Available Head (ft-head) **Water Only**	20.0	16.5	16.0	16.5	14.5	14.0
	Available Head (ft-head) **50% Glicol**	18.0	16.0	15.5	15.5	14.0	13.5

Array Model	Boiler Quantity	Combined Max GPM	Common Pipe Size (Inch)	Max Equivalent Length of Pipe (ft)
AR 1000	1	50	3	1200
	2	100	3	350
	3	150	3	160
	4	200	4	350
AR 1500	1	75	3	570
	2	150	3	160
	3	225	4	300
	4	300	6	1200
AR 2000	1	100	4	350
	2	200	6	725
	3	300	6	300
	4	400	8	800

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 F – 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 1000

Altitude (ft)	From 0% to 25%	From 25% to 50%	From 50% to 75%	From 75% to 100%
0-2,000	1,000,000	1,000,000	1,000,000	1,000,000
3,000	917,896	901,967	886,035	870,105
4,000	887,540	872,047	856,645	841,243
5,000	857,004	842,131	827,256	812,383
6,000	826,557	812,212	797,866	783,520
7,000	796,112	782,296	768,478	754,661
8,000	765,665	752,376	739,087	725,800
9,000	735,220	722,461	709,701	696,939
10,000	704,773	692,541	680,310	668,078

ARRAY AR 1500

Altitude (ft)	From 0% to 25%	From 25% to 50%	From 50% to 75%	From 75% to 100%
0-2,000	1,500,000	1,500,000	1,500,000	1,500,000
3,000	1,376,845	1,352,950	1,329,053	1,305,158
4,000	1,331,174	1,308,071	1,284,967	1,261,864
5,000	1,285,507	1,263,197	1,240,885	1,218,575
6,000	1,239,836	1,218,318	1,196,799	1,175,281
7,000	1,194,169	1,173,444	1,152,716	1,131,992
8,000	1,148,498	1,128,565	1,108,631	1,088,700
9,000	1,102,831	1,083,691	1,064,551	1,045,409
10,000	1,057,160	1,038,812	1,020,466	1,002,117

ARRAY AR 2000

Altitude (ft)	From 0% to 25%	From 25% to 50%	From 50% to 75%	From 75% to 100%
0-2,000	2,000,000	2,000,000	2,000,000	2,000,000
3,000	1,835,793	1,803,934	1,772,070	1,740,211
4,000	1,774,899	1,744,094	1,713,290	1,682,485
5,000	1,714,009	1,684,263	1,654,513	1,624,767
6,000	1,653,115	1,624,424	1,595,732	1,567,041
7,000	1,592,225	1,564,592	1,536,955	1,509,323
8,000	1,531,331	1,504,753	1,478,175	1,451,600
9,000	1,470,441	1,444,921	1,419,402	1,393,878
10,000	1,409,547	1,385,082	1,360,621	1,336,256

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

We have an **ARRAYAR 1500** boiler installed at 5,400 ft with a 6" flue system. The equivalent length of the vent pipe installed is 55 ft. The equivalent length of the air combustion pipe installed is 35 ft.

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

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

Now the correct de-rating value is given from the value of the fourth column (From 75% to 100%) OF THE **AR 1500** table that crosses the row with 6,000 ft = 1,175,281 BTU/hr.

APPENDIX G – 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 spark and ignitor rod. c- Correct amount of air; d-Check for 120VAC at the gas valve. e- Ensure that the gas valve is functioning properly by checking for changes in gas pressure.	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		a- If the error occurs during boiler normal operation, replace the Control board b- If the error occurs at the electrical switching on (by main switch) of the boiler, check high sensor limit (and its wiring) integrity
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. Therefore it causes a Locking error.	a- Press RESET button to display the Blocking error description b- Check error log on touchscreen. c- The blocking error that occurred previous to current locking error will be the cause (i.e.- 163 LowExFlow).	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

Error no.	Error	Description	Checks	Solutions
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 module water temp. b- Check the pump to verify the flow circulation; c- Check if the valves on hydraulic circuit are open; d- 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.
16	FLUE_GAS_ERROR	Flue temperature exceeded the maximum allowable flue temperature		
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		
24	FLUE_SWITCH_NOT_CLOSING	The blocked flue sensor is not closed within 10 minutes		
29	PSM_ERROR	Internal software error		
30	REGISTER_ERROR	Internal software error		Control board replacement
33	LWCO_1_ERROR	Low Water Cut-Off 1 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.
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	Gas pressure switch is closed. This can either be the High or Low Gas Pressure Switch.	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.	

Error no.	Error	Description	Checks	Solutions
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	HIGH_LIMIT_FAIL	Physical high limit test failed		Control board replacement
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
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	a- Check system water pressure. b- Ensure that it is above min. recommended pressure (7.5PSI). c- Check the value of the reading of this sensor in the info screen. If the value is not in line with the system pressure check the sensor.	
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.

Error no.	Error	Description	Checks	Solutions
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.
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		
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.
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.
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		
141	T_SELECTION3_OPEN	Selection 3 sensor open		
142	T_OPTIONAL1_OPEN	Optional 1 sensor open		

Error no.	Error	Description	Checks	Solutions
143	T_OPTIONAL2_OPEN	Optional 2 sensor open		
144	T_AMBIENT_OPEN	Ambient sensor open		
145	T_CHIMNEY_CLOSED	Chimney sensor shorted		
155	FLUE_PRESSURE_ERROR	Flue pressure switch is open	a- Check flue for obstructions. Clear if found. b- Check flue pressure to ensure flue has been installed and sized properly. c- Flue pressure switch default to 2.2"wc.	a- Remove any obstructions from the exhaust system; b- Remove any obstruction from condensate discharge and confirm the condensate can flow freely.
156	AIR_DAMPER_ERROR	Air Damper feedback is not received when the relative output is closed		
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	a- Flow through the module is below recommended rate. b- Check to ensure module pump is running. c- Verify valves are open. d- Possible air entrapment.	

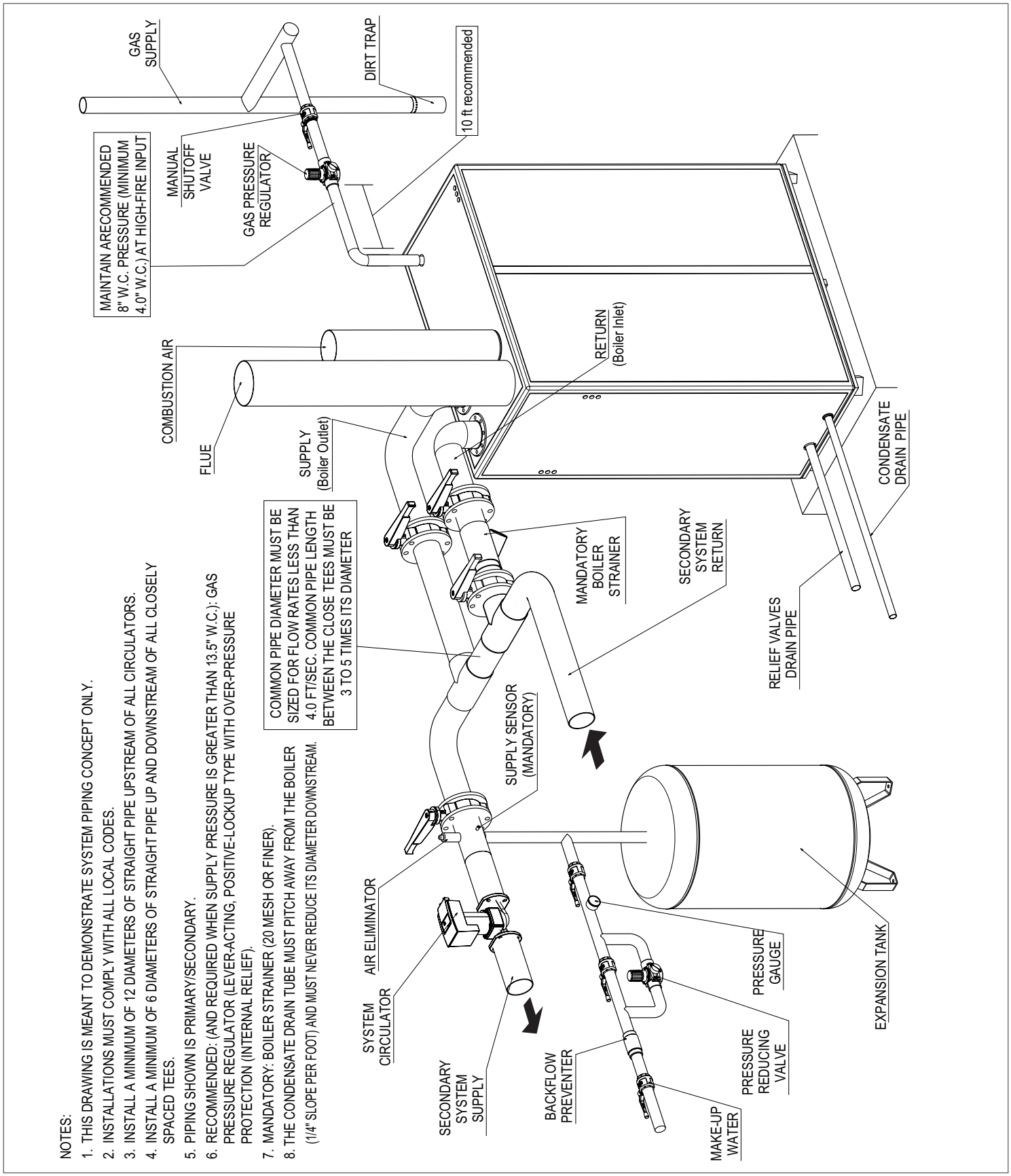
WARNINGS

Error no.	Error	Description	Checks	Solutions
200	CC_LOSS_COMMUNICATION	Cascade System: Leading burner lost communication with one of the depending burners	a- Check wiring and connections on individual Modules. b- Make sure both controllers in the boiler are powered on. c- Make sure Parameter 147 set to 2. d- Check the position of the S1 switches on the dependent module to make sure it is off.	

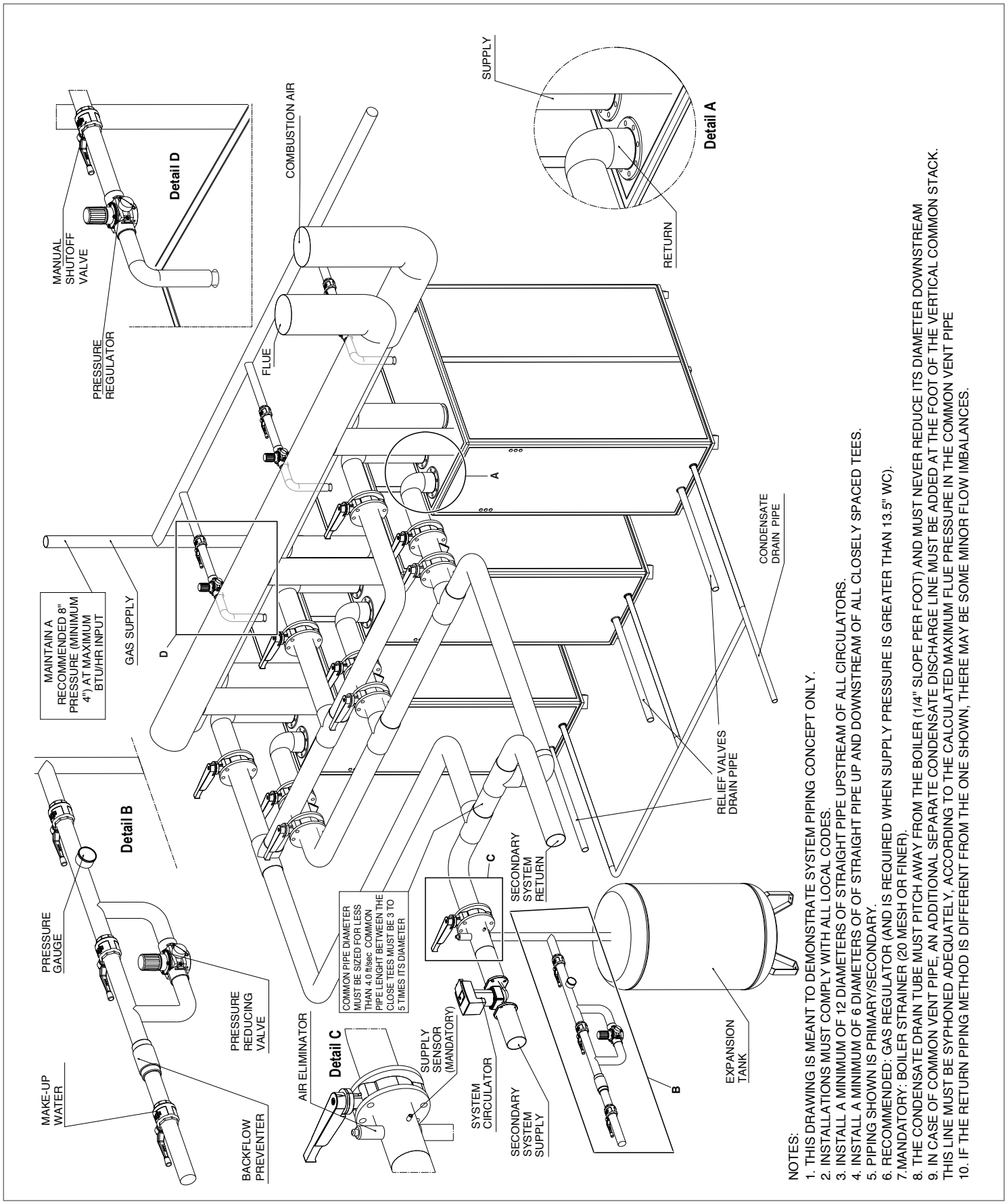
Error no.	Error	Description	Checks	Solutions
201	CC_LOSS_BOILER_COMM	Cascade System: Leading boiler lost communication with one of the depending boilers	a- Check interconnecting wiring between boilers. b- Make sure all boilers are powered on. c- Make sure that Parameter 167 set to proper number of boilers. d- Whichever boiler(s) loses communication with the Master Boiler will enter boiler level emergency mode. e- Check the position of the S1 switches on the managing boiler (on) and on the dependent boiler (off) to make sure they are set properly.	
202	OUTDOOR_WRONG	Outdoor sensor is open or shorted		
203	T_SYSTEM_WRONG	T_System sensor is open or shorted	a- Check connections of the boiler mounted sensor. b- This will cause Module Emergency Mode to activate on that particular boiler. c- Remaining cascade will continue to operate as normal. d- Check the value of the reading of this sensor on the info screen.	
204	T_CASCADE_WRONG	T_Cascade sensor is open or shorted	a- Check connections of the System sensor mounted in the header. b- This will cause Boiler level emergency mode to activate on all boilers in the cascade. c- Check the value of the reading of this sensor on the info screen.	
205	HIGH_LIMIT_TEST_WAIT_ACTIVE	Too many physical high limit test attempts within 24 hours.		
206	DHW sensor is open or shorted	Current setopint 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		

APPENDIX H – BOILER INSTALLATION (EXAMPLE DRAWINGS)

Array AR 1000 / AR 1500 / AR 2000 Single Unit Installation



Array AR 1000 / AR 1500 / AR 2000 Multiple Boiler Installation



NOTES:
1. THIS DRAWING IS MEANT TO DEMONSTRATE SYSTEM PIPING CONCEPT ONLY.
2. INSTALLATIONS MUST COMPLY WITH ALL LOCAL CODES.
3. INSTALL A MINIMUM OF 12 DIAMETERS OF STRAIGHT PIPE UPSTREAM OF ALL CIRCULATORS.
4. INSTALL A MINIMUM OF 6 DIAMETERS OF OF STRAIGHT PIPE UP AND DOWNSTREAM OF ALL CLOSELY SPACED TEES.
5. PIPING SHOWN IS PRIMARY/SECONDARY.
6. RECOMMENDED: GAS REGULATOR (AND IS REQUIRED WHEN SUPPLY PRESSURE IS GREATER THAN 13.5" WC).
7. MANDATORY: BOILER STRAINER (20 MESH OR FINER).
8. THE CONDENSATE DRAIN TUBE MUST PITCH AWAY FROM THE BOILER (1/4" SLOPE PER FOOT) AND MUST NEVER REDUCE ITS DIAMETER DOWNSTREAM
9. IN CASE OF COMMON VENT PIPE, AN ADDITIONAL SEPARATE CONDENSATE DISCHARGE LINE MUST BE ADDED AT THE FOOT OF THE VERTICAL COMMON STACK. THIS LINE MUST BE SYPHONED ADEQUATELY, ACCORDING TO THE CALCULATED MAXIMUM FLUE PRESSURE IN THE COMMON VENT PIPE
10. IF THE RETURN PIPING METHOD IS DIFFERENT FROM THE ONE SHOWN, THERE MAY BE SOME MINOR FLOW IMBALANCES.

Appendix I – 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 – 6''		PIPE SIZE – 8"	
	MAX equiv. mt	MAX equiv. ft	MAX equiv. mt	MAX equiv. ft
AR 1000	30	100	-	-
AR 1500	30	100	-	-
AR 2000	-	-	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 – 6"		90° ELBOW – 6''	
	MAX equiv. mt	MAX equiv. ft	MAX equiv. mt	MAX equiv. ft
AR 1000	1.5	5	1.8	6
AR 1500	1.5	5	1.8	6

MODEL	45° ELBOW – 8"		90° ELBOW – 8''	
	MAX equiv. mt	MAX equiv. ft	MAX equiv. mt	MAX equiv. ft
AR 2000	2.1	7	2.75	9

Data for Venting size

ARRAY AR 1000	T supply / return (F°) – 176 / 140				T supply / return (F°) – 104 / 86			
	Maximum Input		Minimum Input		Maximum Input		Minimum Input	
CO_2	9%		9%		9%		9%	
Exhaust gas mass (weight)	0.26 lb/s		0.02 lb/s		0.26 lb/s		0.02 lb/s	
Flue temperature	161.6 °F		143.6 °F		107.6 °F		89.6 °F	
Max. pressure at boiler exit @ high fire condition	0.81 in H_2O	202 Pa	0.08 in H_2O	19 Pa	0.90 in H_2O	224 Pa	0.16 in H_2O	40 Pa

ARRAY AR 1500	T supply / return (F°) – 176 / 140				T supply / return (F°) – 104 / 86			
	Maximum Input		Minimum Input		Maximum Input		Minimum Input	
CO_2	9%		9%		9%		9%	
Exhaust gas mass (weight)	0.4 lb/s		0.02 lb/s		0.4 lb/s		0.02 lb/s	
Flue temperature	161.6 °F		143.6 °F		107.6 °F		89.6 °F	
Max. pressure at boiler exit @ high fire condition	0.70 in H_2O	174 Pa	0.08 in H_2O	19 Pa	0.79 in H_2O	197 Pa	0.16 in H_2O	40 Pa

ARRAY AR 2000	T supply / return (F°) – 176 / 140				T supply / return (F°) – 104 / 86			
	Maximum Input		Minimum Input		Maximum Input		Minimum Input	
CO_2	9%		9%		9%		9%	
Exhaust gas mass (weight)	0.52 lb/s		0.02 lb/s		0.52 lb/s		0.02 lb/s	
Flue temperature	161.6 °F		143.6 °F		107.6 °F		89.6 °F	
Max. pressure at boiler exit @ high fire condition	0.75 in H_2O	187 Pa	0.1 in H_2O	25 Pa	0.84 in H_2O	209 Pa	0.18 in H_2O	45 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: "4.14 Venting" page 25

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

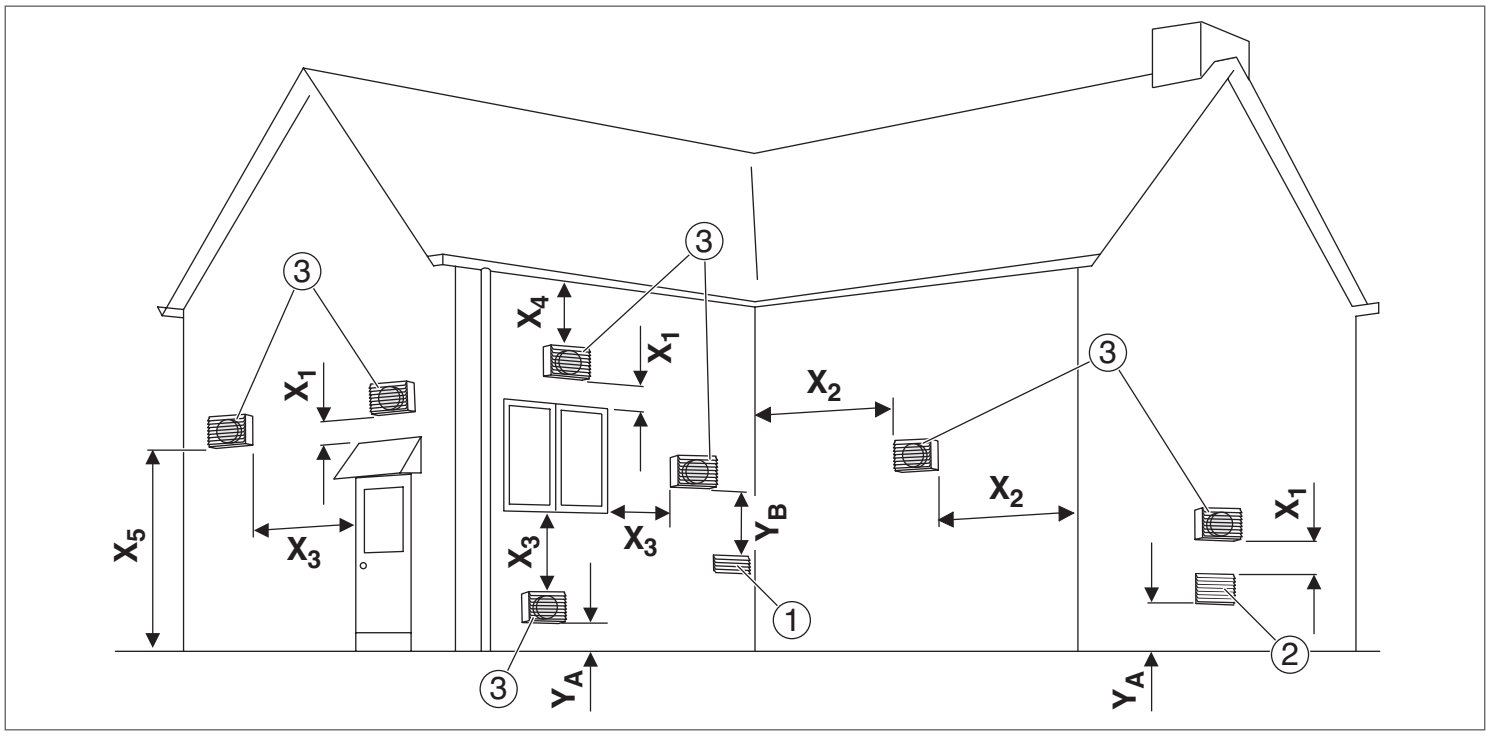
Venting components from different manufacturers shall not be mixed.

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: "4.15 Combustion Air" page 29

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 J – 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

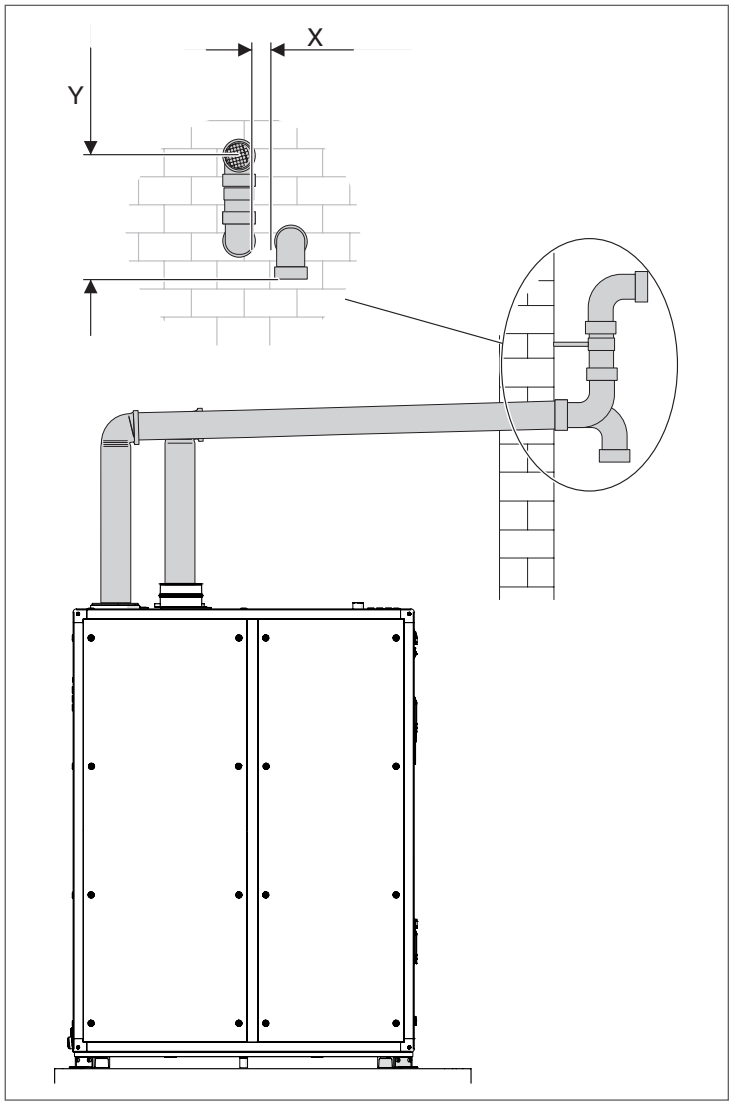
Fan assisted appliance (Room air for combustion)

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

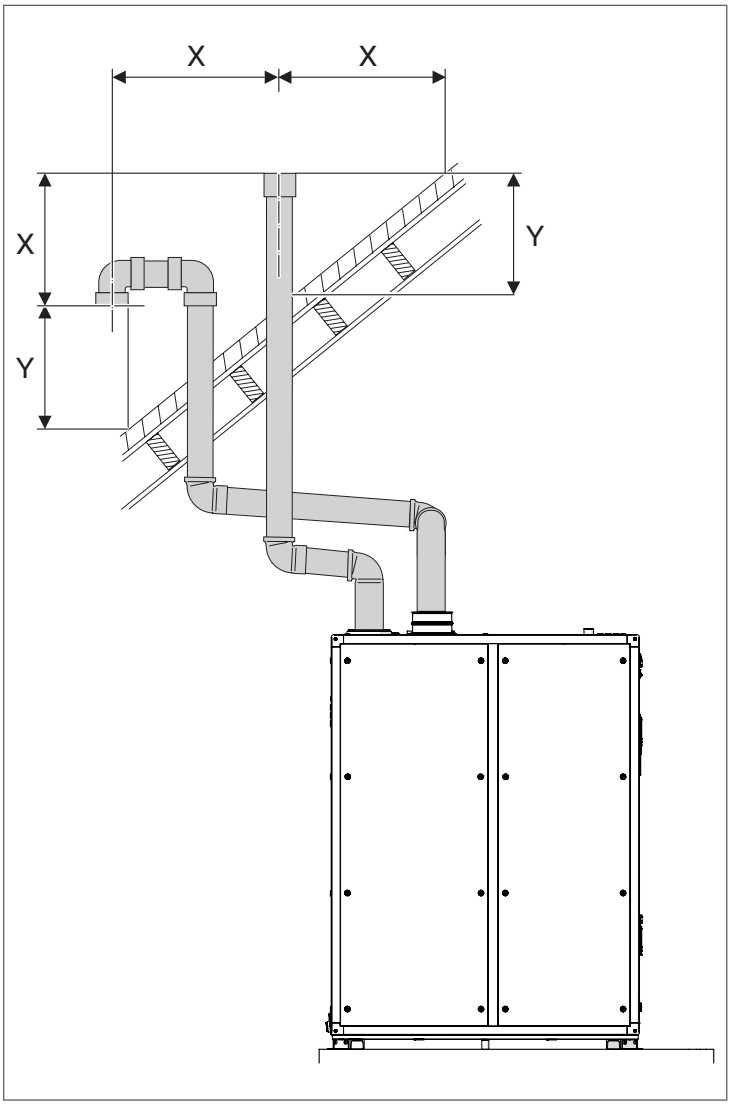
It is not recommended to terminate vent above any door or window, condensate can freeze causing ice formations.
Do not use chimney as a raceway if another boiler or fireplace is vented into or through chimney.
All CPVC vent pipes must be glued, except for the flue gas adapter pipe connection.
Vent terminations 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

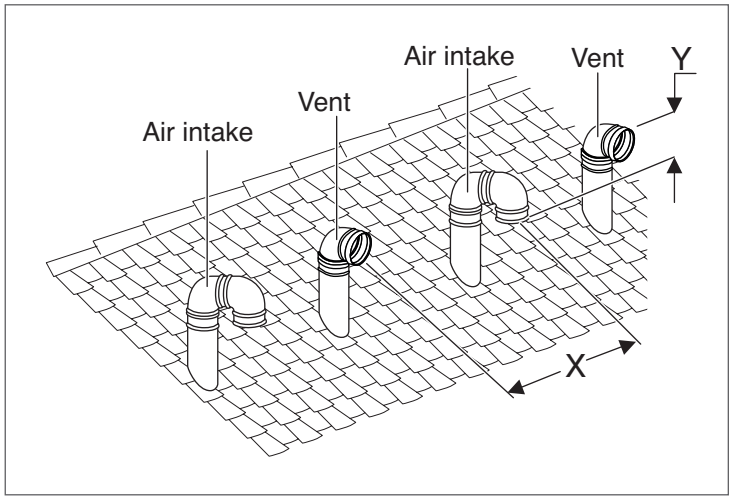
1) For Clearances not specified in ANSI Z223.1 / NFPA 54 or CSA B149.1 Clearance in accordance with local installation codes and the requirements of the gas supplier including the Authority having jurisdiction.



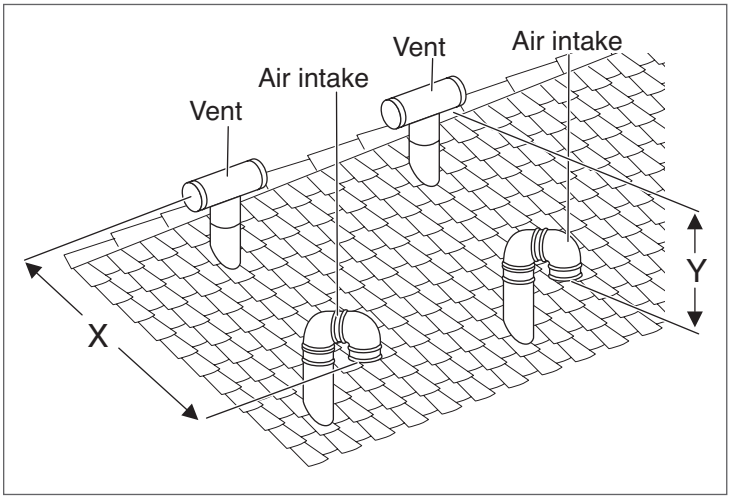
Horizontal venting system (sealed combustion):
X ≥ 4" (102 mm);
Y ≥ 12" (305 mm)



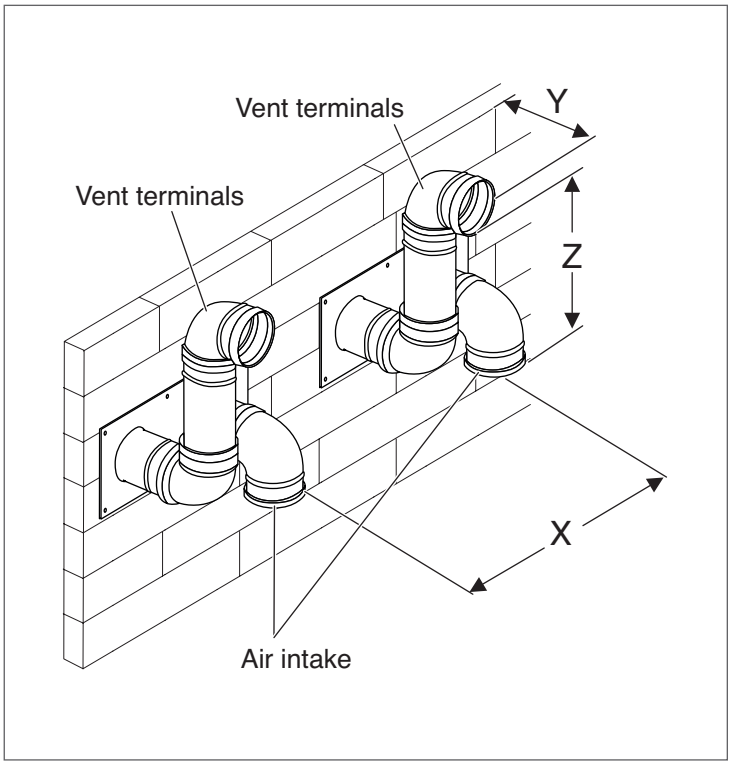
Vertical venting system (sealed combustion):
X > 12" (305 mm)
Y = 12" (305 mm) above maximum snow level or at least 24" whichever is greater



Multiple air and vent vertical termination:
X ≥ 12" (305 mm);
Y ≥ 12" (305 mm)



Multiple air and vent vertical termination:
X ≥ 12" (305 mm);
Y ≥ 12" (305 mm)



Multiple air and vent horizontal termination:
X ≥ 12" (305 mm);
Y ≤ 25" (635 mm)
Z = 12" to 16" (305 mm to 406 mm)

APPENDIX K – 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 L – LIST OF PARAMETERS (WITH RANGES AND DEFAULT VALUES)

Parameters are listed base on the reference menu.

Reference Menu
M1 Parameters Menu
M2 Cascaded module configuration menu
M3 Cascaded boiler configuration menu
M4 Appliance configuration menu

Access type
U End user
I Installer
O Manufacturer

Menu.	Par. No.	Display visualisation	Description	Range	Default setting	UM	Access type	Category
M1		CH Control	Enable or disable the heating circuit	Enabled/Disabled	Enabled		I	Heating
M1	1	CH mode	Defines the thermal module's various heating operation modes	0...5	0		I	Heating
M1	3	CH set-point	Defines the desired delivery temperature in heating mode (Par. 1) = 0	30...80 (86..176)	60 (140)	°C (°F)	U	Heating
M1	185	Calc. set-point off-set	It is possible to shift the climatic curve up and down. The calculated setpoint can be increased or decreased with a maximum of 10°C	-10...10	0	°C (°F)	I	Heating
M1	109	Comp. T. @ Bas. Outd	Establishes the set-point offset value cal-culated 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	Defines the minimum delivery tempera-ture at which the system operates in both heating and DHW mode	20...50 (68...122)	20 (68)	°C (°F)	I	Heating
M1	111	CH Max. set-point	Defines the maximum delivery tempera-ture at which the system operates in both heating and DHW mode	50...90 (122...194)	90 (194)	°C (°F)	I	Heating
M1	190	Outd. Comp. Fact		0...100	0	%	I	Heating
M1	5	Boiler Pump Overrun	Sets the overrun time in seconds of the boiler's circulator during stand-alone op-eration; cascaded operation determines the module's overrun after switch-off due to temperature control	0...900	30	Sec	I	Heating
M1	6	Flue Temp. Limit	Sets the activation temperature when the maximum flue gas temperature is exceeded. When the flue gas temperature is higher than a set value, the module switches off and an error message is gen-erated. When the flue gas temperature is in the interval between (Par. 6) -5°C and Par. 6, the module reduces its power in a linear way until it reaches minimum power when the temperature measured is equal to Par. 6	10...120 (50...248)	100 (212)	°C (°F)	O	General
M1	7	CH Hystereis Up	Sets the value in degrees beyond the set-point at which the burner switches off for thermoregulation.	0...20 (32...68)	6 (10.8)	°C (°F)	I	Heating
M1	112	CH Hystereis Down	Sets the value in degrees below the set-point at which the burner switches on again for thermoregulation	0...20 (32...68)	6 (10.8)	°C (°F)	I	Heating
M1	9	Anti-cycle Period	Sets the stand-by time before the appliance is switched on again after it switches off due to thermoregulation, independently from the delivery temper-ature dropping below the value indicated in Par. 10. Parameter valid only in stand-alone mode	10...900	180	Sec	I	Heating
M1	10	Anti-cycle Temp. Diff.	Sets the value in degrees below which the burner switches on again notwithstanding from the time spent at Par. 9	0...20 (32...68)	16 (28.8)	°C (°F)	I	Heating

Menu.	Par. No.	Display visualisation	Description	Range	Default setting	UM	Access type	Category
M1	12	Hx diff. Minimum	Sets the value of the temperature difference (Delta T) between the module's delivery and return temperature. For a Delta T value ranging between Par. 12 and (Par. 12) +8°C, the module reduces its power in a linear fashion until it reaches the minimum power. The minimum power is maintained until reaching (Par. 12) +8°C+5°C, after which the module switches off for a period of time equal to the value attributed to Par. 13; at the end of this time interval, the module switches on again	10...60 (50...140)	40 (72)	°C (°F)	0	General
M1	13	Hx Diff. Max. Wait Time	Defines the restart time after reaching the Delta T limit between delivery and return	10...250	10	Sec.	0	Heating
M1	14	Max. Power CH	Sets the heating's % max. power	50...100	100	%		Heating
M1	15	Min. Power CH	Sets the heating's % min. power.	1...30	1	%		Heating
M1	16	CH PID P	Defines the proportional parameter for modulation during heating operation	0...1275	50		0	Heating
M1	17	CH PID I	Defines the modulation integral term during heating operation	0...1275	500		0	Heating
M1	18	CH PID D	Defines the modulation derivative term during heating operation	0...1275	0		0	Heating
M1	19	Design supply Temp	Defines the max. set-point at the minimum outdoor temperature for climatic regulation	30...90 (86...194)	90 (194)	°C (°F)	U	Heating
M1	20	Design Outdoor Temp	Defines the minimum outdoor temperature to which the maximum set-point can be associated for climatic regulation	-25...25 (-13...77)	-5 (23)	°C (°F)	U	Heating
M1	21	Baseline Supply Temp	Defines the minimum set-point at the maximum outdoor temperature for climatic regulation	30...90 (86...194)	40 (104)	°C (°F)	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	0...30 (32...86)	20 (68)	°C (°F)	I	Heating
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)	4...82 (39...180)	30 (86)	°C (°F)	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)	27...90 (81...194)	90 (194)	°C (°F)	I	Heating
M1	25	Warm Weather Shutdn	Defines the temperature at which climatic regulation is switched off	0...35 (32...95)	22 (71,6)	°C (°F)	I	Heating
M1	26	Boost Temp Increment	Establishes the set-point temperature increase 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)	0...30 (32...86)	0 (32)	°C (°F)	I	Heating
M1	27	Boost Time Delay	Defines the time interval after which the setpoint 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 by how many degrees the delivery set-point is reduced when the RT (room thermostat/heat demand) contact is closed	0...30 (32...86)	10 (18)	°C (°F)	I	Heating

Menu.	Par. No.	Display visualisation	Description	Range	Default setting	UM	Access type	Category
M1	195	WWSD Enable	It is possible to enable/disable the shutdown of the entire system due to high external temperatures, both CH and ZH	Enabled/Disabled	Enabled		I	Heating
		DHW Control	Enable or disable the DHW circuit	Enabled/Disabled	Enabled		I	Heating
M1	35	DHW mode	Establishes the domestic hot water circuit's operation mode. 0 = Disabled 1 = Tank + sensor 2 = Tank + thermostat	0,1,2	0		I	DHW
M1	113	Max. Power DHW	Defines the domestic hot water circuit's % max. power	50...100	50	%	I	DHW
	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...20 (32...68)	5 (9)	°C (°F)	I	DHW
M1	37	DHW Tank Hyst. Up	Defines the hysteresis to stop the domestic hot water demand	0...20 (32...68)	5 (9)	°C (°F)	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...30 (32...86)	15 (27)	°C (°F)	I	DHW
M1	39	DHW Tank Supp Hyst Dn	Defines the primary circuit's restart hysteresis in modes 1 and 2 of domestic hot water (valid both for cascade and stand-alone applications)	0...20 (32...68)	5 (9)	°C (°F)	0	DHW
M1	40	DHW Tank Supp Hyst Up	Defines the primary circuit's shut-off hysteresis in modes 1 and 2 of domestic hot water (valid both for cascade and stand-alone applications)	0...20 (32...68)	5 (9)	°C (°F)	0	DHW
M1	41	DHW Tank Hold Warm	Defines the value of a storage cylinder's delta T required for temperature maintenance. For instance, if set at 3 degrees, when the storage cylinder is at a set-point value minus 3 degrees, the thermal module is switched on at minimum power to maintain the temperature to the set-point plus hysteresis. If this parameter is kept the same as Par. 36, this function is inactive and the thermal module is switched on to the maximum power envisaged for the DHW circuit	0...10 (32...50)	5 (9)	°C (°F)	0	DHW
M1	42	DHW Priority	Defines the priority type: 0 = Time: time priority between the two circuits defined by Par. 43; 1 = Off: priority for CH; 2 = On: priority for DHW; 3 = Parallel: parallel priority managed on the basis of the primary circuit's temperature compared to the heating circuit's set-point	0...3	0 = Time		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	60	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 module's overrun after switch-off due to thermoregulation	0...900	0	Sec.	I	DHW
M1	45	DHW Tank PID P	Defines the proportional term for modulation during operation of the DHW storage tank	0...1255	100		0	DHW
M1	46	DHW Tank PID I	Defines the integral term for modulation during operation of the DHW storage tank	0...1255	500		0	DHW

Menu.	Par. No.	Display visualisation	Description	Range	Default setting	UM	Access type	Category
M1	47	DHW Tank PID D	Defines the derivative term for modulation during operation of the DHW storage tank	0...1255	0		0	DHW
M1	48	DHW tank set-point	Establishes the DHW storage tank set-point	40...71 (104...160)	50 (122)	°C (°F)	U	DHW
M1	49	DHW Hysteresis Down	"reserved"	0...20 (32...68)	4 (7.2)	°C (°F)	0	DHW
M1	50	DHW Hysteresis Up	"reserved"	0...20 (32...68)	4 (7.2)	°C (°F)	0	DHW
M1	51	DHW Instant PID P	"reserved"	0...1255	100		0	DHW
M1	52	DHW Instant PID I	"reserved"	0...1255	160		0	DHW
M1	53	DHW Instant PID D	"reserved"	0...1255	0		0	DHW
M1	60	Flow Rate Start	"reserved"	0.1...20	1.4	l/min	0	DHW
M1	61	Flow Rate Lo Temp Pwr	"reserved"	0.1...20	1.4	l/min	0	DHW
M1	62	Flow Rate Hi Temp Pwr	"reserved"	0.1...20	1.4	l/min	0	DHW
M1	63	DHW On Off Period	"reserved"	10...60	30	Sec.	0	DHW
M1	64	PreHeat Mode	"reserved"	Off, Comfort, Eco, Anti-Fr	Off		U	DHW
M1	65	PreHeat Mode Eco Setpoint	"reserved"	20...60 (68...140)	30 (86)	°C (°F)	0	DHW
M1	67	PreHeat After Tap Hld Time	"reserved"	0...255	30	Sec.	0	DHW
M1	68	After Tap Hold Time	"reserved"	0...255	120	Sec.	0	DHW
M1	69	PreHeat Hyst Down	"reserved"	0...30 (32...86)	5 (9)	°C (°F)	0	DHW
M1	70	PreHeat Hyst Up	"reserved"	0...30 (32...86)	0	°C (°F)	0	DHW
M1	71	PreHeat Delay Time	"reserved"	0...15	10	Sec	0	DHW
M1	92	Fan Speed Maximum	Defines the number of fan rpm at max. power (it depends on the model)	0...12750	6900	RPM	I	General
M1	93	Fan Speed Minimum	Defines the number of fan rpm at minimum power (it depends on the model).	0...12750	1900	RPM	I	General
M1	94	Fan Speed Ignition	Defines the number of fan rpm when the boiler is switched on (it depends on the model).	0...12750	4500	RPM	I	General
M1	116	Prog. Input 1.	0 = Disabled 1 = Water pressure sensor 2 = CH flow switch 3 = Flue pressure switch.	0,1,2,3	Defined by Par. 97		I	General
M1	117	Prog. Input 2	0 = Disabled 1 = DHW flow sensor 2 = DHW flow switch 3 = CH flow sensor.	0,1,2,3,4	Defined by Par. 97		I	General
M1	118	Prog. Input 3.	0 = Disabled 1 = Drain switch 2 = Gas pressure switch	0,1,2	Defined by Par. 97		I	General
M1	120	Prog. Input 5	0 = Disabled 1 = T_Return sensor 2 = Extern switch	0,1,2	Defined by Par. 97		I	General
M1	121	Prog. Input 6	0 = Disabled 1 = T_Flue sensor 2 = Flue switch 3 = APS switch	0,1,2,3	Defined by Par. 97		I	General

Menu.	Par. No.	Display visualisation	Description	Range	Default setting	UM	Access type	Category
M1	122	Prog. Input 7	0 = Disabled 1 = T_Flue_2 sensor 2 = T_Flue_2 + Bl. Flue 3 T_System sensor 4 = Blocked Flue switch 5 Cascade Sensor	0,1,2,3,4,5	Defined by Par. 97		I	General
M1	123	Prog. Input 8	0 = Disabled 1 = T_DCW sensor 2 = Water pressure switch	0,1,2	Defined by Par. 97		I	General
M1	188	Prog. Input 9	0 = Disabled 1 = T_DHW sensor 2 = Zone sensor	NA	Defined by Par. 97		I	General
M1	124	Prog. Input RT.	0 = Disabled 1 = Enabled	NA			I	General
M1	125	Prog. Output 1	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 16) Zone pump 17)Mixing valve open 18)Mixing valve closed 19) Anti-legionella 20) LPG Tank cascade	0,1,2,3,4,5,6,7,8,9,10,14,15 ,16,17,18,19,20	Defined by Par. 97		I	General
M1	126	Prog. Output 2	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 16) Zone pump 17) Mixing valve open 18) Mixing valve closed 19) Anti-legionella pump 20) LPG Tank cascade	0,1,2,3,4,5,6,7,8,9,10,14,15 ,16,17,18,19,20	Defined by Par. 97		I	General
M1	127	Prog. Output 3	0) Disabled 1) General Pump 6) Alarm Relay 9) External Igniter 10) Air Damper 11) External Igniter 12) Modulating pump	0,1,2,3,4,5,6,7,8,9,10,11,12	Defined by Par. 97		I	General

Menu.	Par. No.	Display visualisation	Description	Range	Default setting	UM	Access type	Category
M1	128	Prog. Output 4	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 16)Zone pump 17)Mixing valve open 18)Mixing valve closed 19)Anti-legionella 20) LPG Tank cascade	0,1,2,3,4,5,6,7,8,9,10,14,15 ,16,17,18,19,20	Defined by Par. 97		I	General
M1	187	Prog. Output 5	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 16) Zone pump 17) Mixing valve open 18) Mixing valve closed 19) Anti-legionella 20) LPG Tank cascade	0,1,2,3,4,5,6,7,8,9,10,14,15 ,16,17,18,19,20	Defined by Par. 97		I	General
M1	129	Flow Sensor	Defines the type of flow sensor used.	Bitron, Huba: DN8, DN10, DN15, DN15, DN20, DN25	Huba DN25		I	General
M1	130	Flow Scaling Factor	"reserved"	0...25.5	3.2	rpm/l	I	DHW
M1	131	Min Press.	"reserved"	Off, 0.3...5.0	0.1 (1.5)	bar (PSI)	I	DHW
M1	132	Pressure Fill Hyst.	"reserved"	Off, 0.2...5.0	0.5 (7.3)	bar (PSI)	I	DHW
M1	133	Mod. Pump dT	Defines the delta T set for the operation of the modulating circulator.	5...40 (41..104)	15 (59)	°C (°F)	I	General
M1	134	Mod. Pump Start Time	Defines the time in seconds from the moment the burner is switched on to start the modu-lation of the circulator and obtain the delta T specified in Par. 133.	0...255	120	Sec.	I	General
M1	135	Mod. Pump Type	Defines the PWM circulator model installed. 0 = Wilo 1 = Salmson 2 = Grundfos	0. Wilo Yonos 1. Salmson 2. Grundfos	0= Wilo		I	General
M1	136	Mod. Pump Mode	Defines whether the boiler's circulator oper-ates in modulating mode or at a set speed (as a percentage of maximum speed).	0. On/Off 1. Modulating 2-10 Fixed 20... 100%	ON/OFF		I	General
M1	137	Mod. Pump Min Pwr	Defines the percentage of speed that sets the minimum speed that the circulator can reach during modulation.	0...100	40	%	I	General

Menu.	Par. No.	Display visualisation	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 thermal module 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.	0.0...100 (0...26)	50	l/min	I	General
M1	196	HX flow timeout	If the minimum flow rate is not reached within the timeout, error 163 (LOWEXFLOW_PROTECTION) will be generated which will also cause the end of prepurge.	4...100	18	Sec	I	General
M1	107	Anti-legionella Day	Sets the weekday on which the anti-Legionella procedure is carried out.	Sun...Sat.	Sun	Day	I	DHW
M1	108	Anti-legionella Hour	Sets the time of the day during which the an-ti-Legionella procedure is carried out.	0...23	0	Hour	I	DHW
M1	183	High Limit Test	Enable limit thermostat physical test	Simulated/Physical	Simulated		0	General
M1	155	Frost Protection	Defines the temperature (detected by the pri-mary sen- sor) below which the thermal mod-ule circulator and the system circulator (with cascade configuration) activate. If the tem-perature of the primary sensor falls another 5 degrees below the value set by Par. 155, then a request to activate the cascade is generated. When the temper- ature of the primary sensor reaches the value defined by Par. 155 increased by 5 degrees, then the request ceases and the cascade returns to stand-by mode.	10...30 (50...86)	15 (59)	°C (°F)	I	General
M1	186	Frost protection outdoor	It defines the intervention temperature of the antifreeze function related to the external probe.	-30...15 (-22...59)	3 (37.4)	°C (°F)	I	General
M1	191	Fan Type	Defines the type of fan installed in the boiler.	0...15	Defined by Par. 97		I	General
M1	193	DHW for all	"reserved"	No...Yes	No		I	DHW
M2	**189**	**Burner address**	It is used to address the module.	Stand-alone (0) Managing (1) Dependent (2...16)	Stand alone (0)		I	DHW
M2		Dipswitch Config.	Enable or disable the dipswitch function.	Enabled/Disabled	Enabled		I	Cascade
M2		Boiler demand disabled	All requests for this boiler are disabled.	Yes/No	No	.	I	Cascade
M2	72	Permit Emergency Mode	Activates the emergency mode. This mode comes on when communication between Managing and the primary circuit's probe 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.	20...90 (68...194)	70 (158)	°C (°F).	I	Cascade

Menu.	Par. No.	Display visualisation	Description	Range	Default setting	UM	Access type	Category
M2	75	Delay Per Start Next Mod	Defines the stand-by time in seconds to restart the subsequent cascade module in normal start mode.	5...255	200	Sec.	I	Cascade
M2	76	Delay Per Stop Next Mod	Defines the stand-by time in seconds to switch off the last cascade module on in nor-mal Off mode.	5...255	180	Sec	I	Cascade
M2	142	Delay Quick Start Next	Defines the stand-by time in seconds to restart the next cascade module in quick start mode.	5...255	50	Sec	I	Cascade
M2	143	Delay Quick Stop Next	Defines the stand-by time in seconds to switch off the last cascade module on in Quick Stop mode.	5...255	30	Sec	I	Cascade
M2	77	Hyst Down Start Module	Defines by how many degrees the temperature measured by the primary circuit's probe must fall below the set-point in order for the sub-sequent module to be started after the time interval set by Par. 75.	0...40 (32...104)	5 (9)	°C (°F)	I	Cascade
M2	78	Hyst Up Stop Module	Defines by how many degrees the tempera-ture measured by the primary circuit's probe 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...40 (32...104)	4 (7.2)	°C (°F)	I	Cascade
M2	147	Number of Units	Defines the number of modules of which the cascade consists.	1...16 (basic cascade) 1...8 (full cascade)	8		I	Cascade
M2	144	Hyst Down Quick Start	Defines by how many degrees the temperature measured by the primary circuit's probe must go below the set-point in order for the sub-sequent module to be started after the time interval set by Par. 142 (quick-start mode).	0...40 (32...104)	10 (18)	°C (°F)	I	Cascade
M2	145	Hyst Up Quick Stop	Defines by how many degrees the temperature measured by the primary circuit's probe must go above the set-point in order for the sub-sequent module to be switched off after the time interval set by Par. 143 (quick stop mode).	0...40 (32...104)	6 (10.8)	°C (°F)	I	Cascade
M2	146	Hyst Up Stop All	Defines by how many degrees the temperature measured by the primary circuit's probe must go above the set-point in order for all "On" modules to be switched off at the same time.	0...40 (32...104)	8 (14.4)	°C (°F)	I	Cascade
M2	148	Power mode	Defines the cascade operation mode 0 = Disabled 1 = Min burners 2 = Max burners	0,1,2	2		I	Cascade
M2	79	Max. Setp. Offset Down	Defines the maximum decrease in the primary circuit's cascade set-point. Is based on the primary circuit's probe reading.	0...40 (32...104)	4 (7.2)	°C (°F)	I	Cascade
M2	80	Max Setp Offset Up	Defines the maximum increase in the primary circuit's cascade set-point. Is based on the primary circuit's probe reading.	0...40 (32...104)	4 (7.2)	°C (°F)	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 e 80.	0...60	60	Min.	I	Cascade

Menu.	Par. No.	Display visualisation	Description	Range	Default setting	UM	Access type	Category
M2	82	Next Module Start Rate	It defines the minimum power for at least one of the modules in the cascade in order for the next module 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	It defines the maximum power for all the modules in the cascade in order for the last module 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 modules are rotated.	0...30	5	Days	I	Cascade
M2	149	First Module to Start	Establishes the number of the next module to be rotated (this value is automatically updated at each rotation).	1...8	1		I	Cascade
M2	86	PID P	Defines the proportional term to change the setpoint of the cascade module.	0...1275	50		0	Cascade
M2	87	PID I	Defines the integral term to change the set-point of the cascade module.	0...1275	250		0	Cascade
M2	150	PID Slew Rate Up	Defines the speed (in °C/100 ms) with which the set-point of individual modules is in-creased in the event the primary circuit's set-point is not achieved (if the value is set to zero, the change is controlled by the PI of Par. 86 and87 without restrictions).	0...25.5	5		0	Cascade
M2	151	PID Slew Rate Dn	Defines the speed (in °C/100 ms) with which the set-point of individual modules is de-creased in the event the primary circuit's set-point is exceeded (if the value is set to zero, the change is controlled by the PI of Par. 86 and 87 without restrictions).	0...25.5	5		0	Cascade
M2	152	PwrMode2 Min Power	Defines the power value (in percentage terms) against which the average power of all on modules in cascade operation mode must be compared (Par. 148 = 2).	0...100	20	%	I	Cascade
M2	**153**	PwrMode2 Hysteresis	Defines the extra power value (in percentage terms) compared to the average power of all on modules in cascade operation mode (Par. 148 = 2).	0...100	40	%	I	Cascade
M2	154	Post-Pump period	Defines overrun time in seconds at the end of the cascade heat demand.	0...255	30	Sec	I	Cascade
M2	184	N. active burner in DHW	With this setting it is possible to set the num-ber of burners that are used for cascade DHW.	0...16	16		I	Cascade
M3	73	Boiler Address	Defines the way in which the boiler is man-aged.	Managing, Stand-alone, Dependent	Stand-alone	.	I	Cascade
M3	156	Permit Emergency Mode	Enable/disable emergency mode.	Yes/No	Yes	.	U	Cascade
M3	157	Emergency Set-point	Defines the emergency mode setpoint.	20...90 (68...194)	70 (158)	°C (°F)	I	Cascade
M3	158	Delay Per Start Next Blr.	"reserved"	0...1275	1275	Sec.	I	Cascade
M3	159	Delay Per Stop Next Blr.	("reserved")	0...1275	1275	Sec	I	Cascade
M3	160	Delay Quick Start Next	"reserved"	0...1275	400	Sec	I	Cascade
M3	161	Delay Quick Stop Next	"reserved"	0...1275	240	Sec	I	Cascade
M3	162	Hyst Down Start Boiler	"reserved"	0...40 (32...104)	5 (9)	°C (°F)	I	Cascade

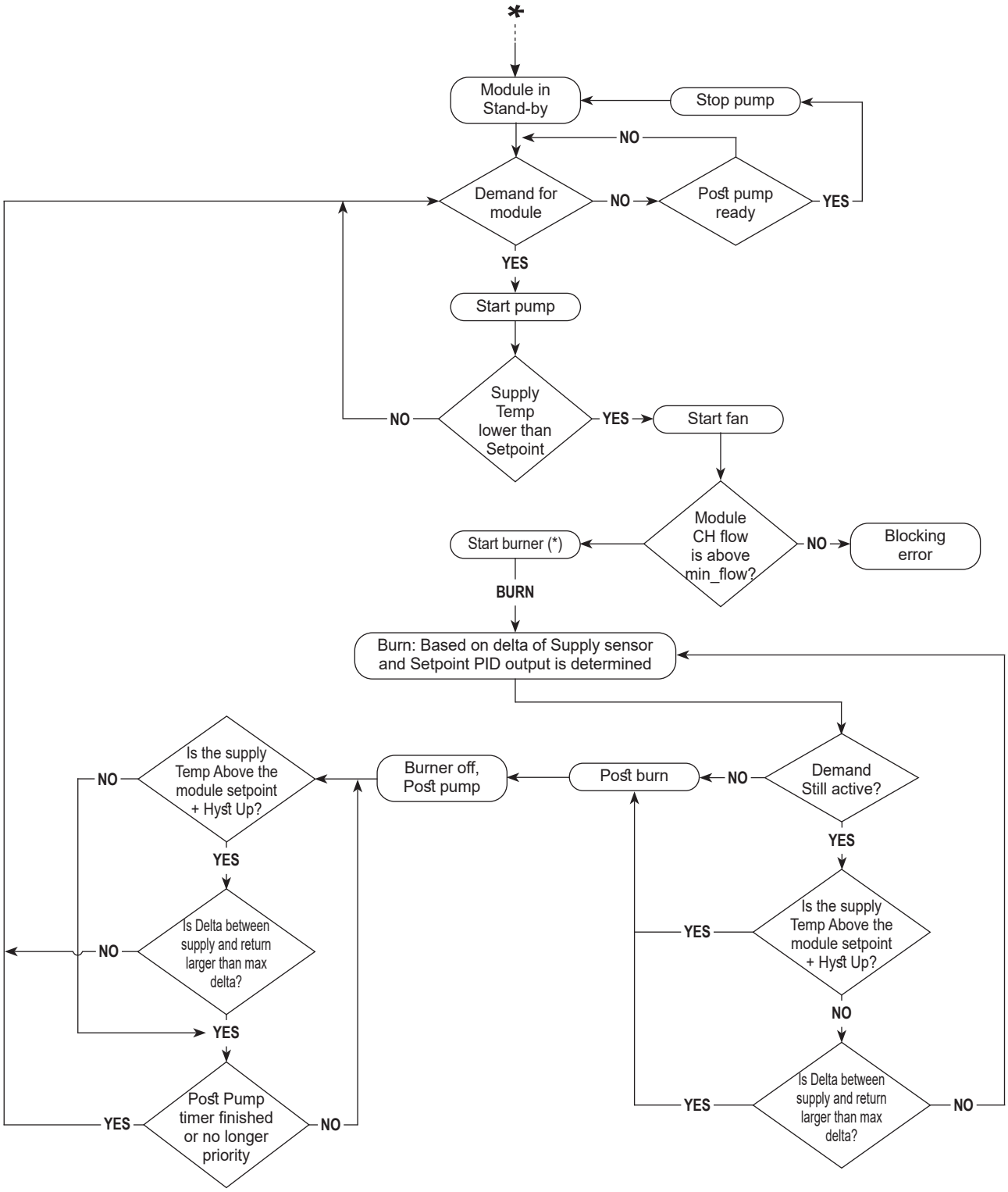
Menu.	Par. No.	Display visualisation	Description	Range	Default setting	UM	Access type	Category
M3	163	Hyst Up Start Boiler	"reserved"	0...40 (32...104)	2 (3.6)	°C (°F)	I	Cascade
M3	164	Hyst Down Quick Start	"reserved"	0...40 (32...104)	10 (18)	°C (°F)	I	Cascade
M3	165	Hyst Up Quick Stop	"reserved"	0...40 (32...104)	4 (7.2)	°C (°F)	I	Cascade
M3	166	Hyst Up Stop All	"reserved"	0...60 (32...140)	8 (14.4)	°C (°F)	I	Cascade
M3	167	Number of boilers	"reserved"	1...16 (basic cascade) 1...8 (full cascade)	1		I	Cascade
M3	168	Power Mode	"reserved"	0) Disabled 2) Max burners 3) Balanced burners	2		I	Cascade
M3	169	Max. Setp. Offset Down	Defines the maximum decrease in the primary circuit's cascade set-point. Is based on the secondary circuit's probe reading.	0...40 (32...104)	8 (14.4)	°C (°F)	I	Cascade
M3	170	Max Setp Offset Up	Defines the maximum increase in the primary circuit's cascade set-point. Is based on the secondary circuit's probe reading.	0...40 (32...104)	8 (14.4)	°C (°F)	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 e 170.	0...255	20	Min.	I	Cascade
M3	172	Next Boiler Start Rate	"reserved"	10...100	80	%	I	Cascade
M3	173	Next Boiler Stop Rate	"reserved"	10...100	25	%	I	Cascade
M3	174	Module Rotation Interval	"reserved"	0...30	5	Days	I	Cascade
M3	175	First Boiler to Start	"reserved"	1...8	1		I	Cascade
M3	176	PID P	Defines the proportional term to change the set-point of the cascade module based on the secondary circuit's temperature.	0...1275	25		0	Cascade
M3	177	PID I	Defines the integral term to change the set-point of the cascade module based on the secondary circuit's temperature.	0...1275	500		0	Cascade
M3	178	PID Slew Rate Up	Defines the speed (in °C/100 ms) with which the set-point of individual modules is in-creased in the event the secondary circuit's set-point not reached (if the value is set to zero, the change is controlled by the PI of Par. 176 and 177 without restrictions).	0...25.5	5		0	Cascade
M3	179	PID Slew Rate Dn	Defines the speed (in °C/100 ms) with which the set-point of individual modules is de-creased in the event the primary circuit's set-point is exceeded (if the value is set to zero, the change is controlled by the PI of Par. 176 and 177 without restrictions).	0...25.5	5		0	Cascade
M3	180	PwrMode2 Min Power	"reserved"	0...100	20		I	Cascade
M3	181	PwrMode2 Min Hysteresis	"reserved"	0...100	40		I	Cascade
M3	182	Post-Pump period	"reserved"	0...255	30		I	Cascade
M4		Appliance model	Defines the boiler model	1...4	3		0	General

Menu.	Par. No.	Display visualisation	Description	Range	Default setting	UM	Access type	Category
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.	1...85	17		I	General
M4	97	I0 Configuraion	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.	1...53	12		I	General

BOARD	Parameter 97 I/O Configuration	Parameter 98 Appliance
MANAGING	12	NG: 17 (Max 6900rpm Min 1900rpm Ignit 4500rpm) LPG: 18 (Max 6900rpm Min 1900rpm Ignit 4400rpm)
DEPENDENT	13	NG: 17 (Max 6900rpm Min 1900rpm Ignit 4500rpm) LPG: 18 (Max 6900rpm Min 1900rpm Ignit 4400rpm)

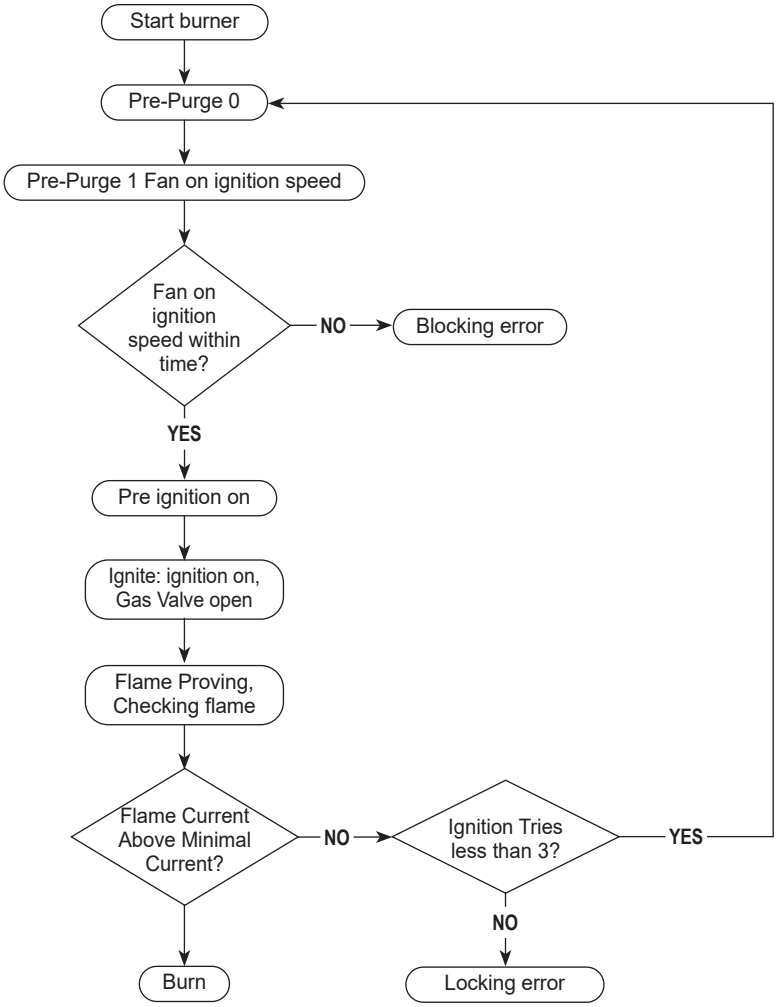
APPENDIX M – FLOWCHARTS

SINGLE MODULE

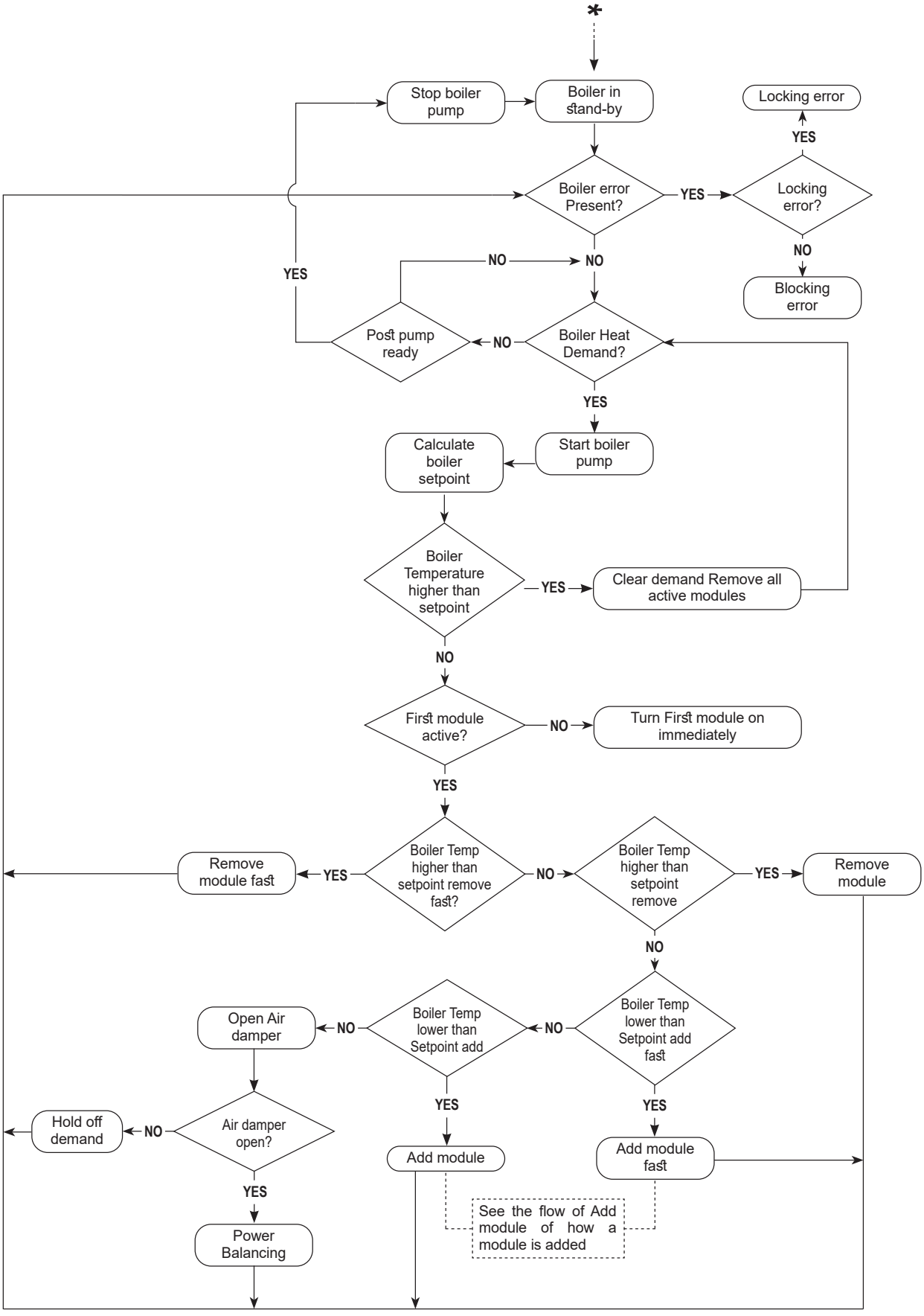


(*) see Burner ignition sequence on next page.

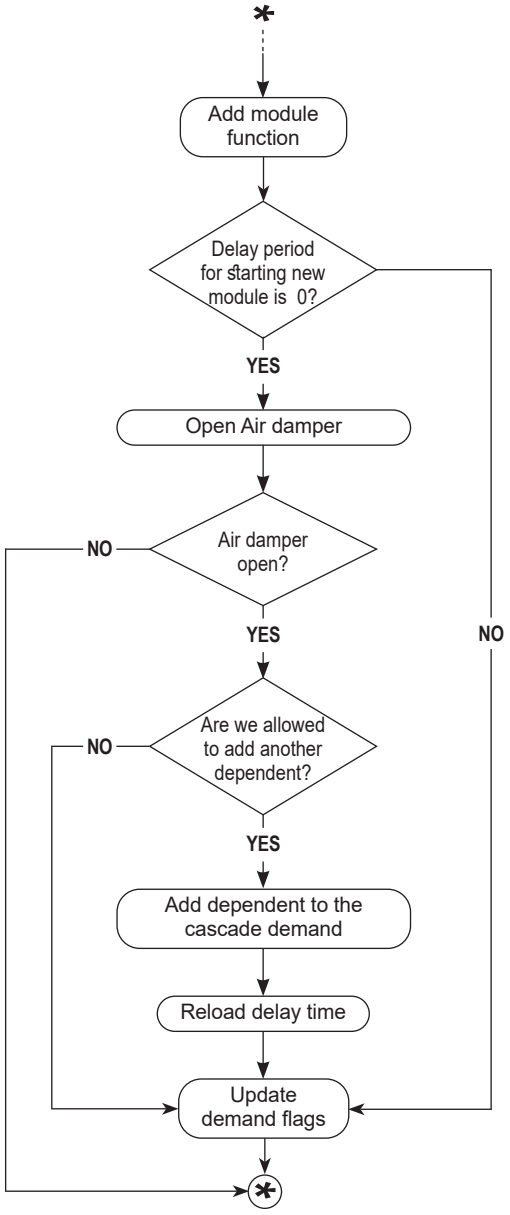
BURNER IGNITION SEQUENCE



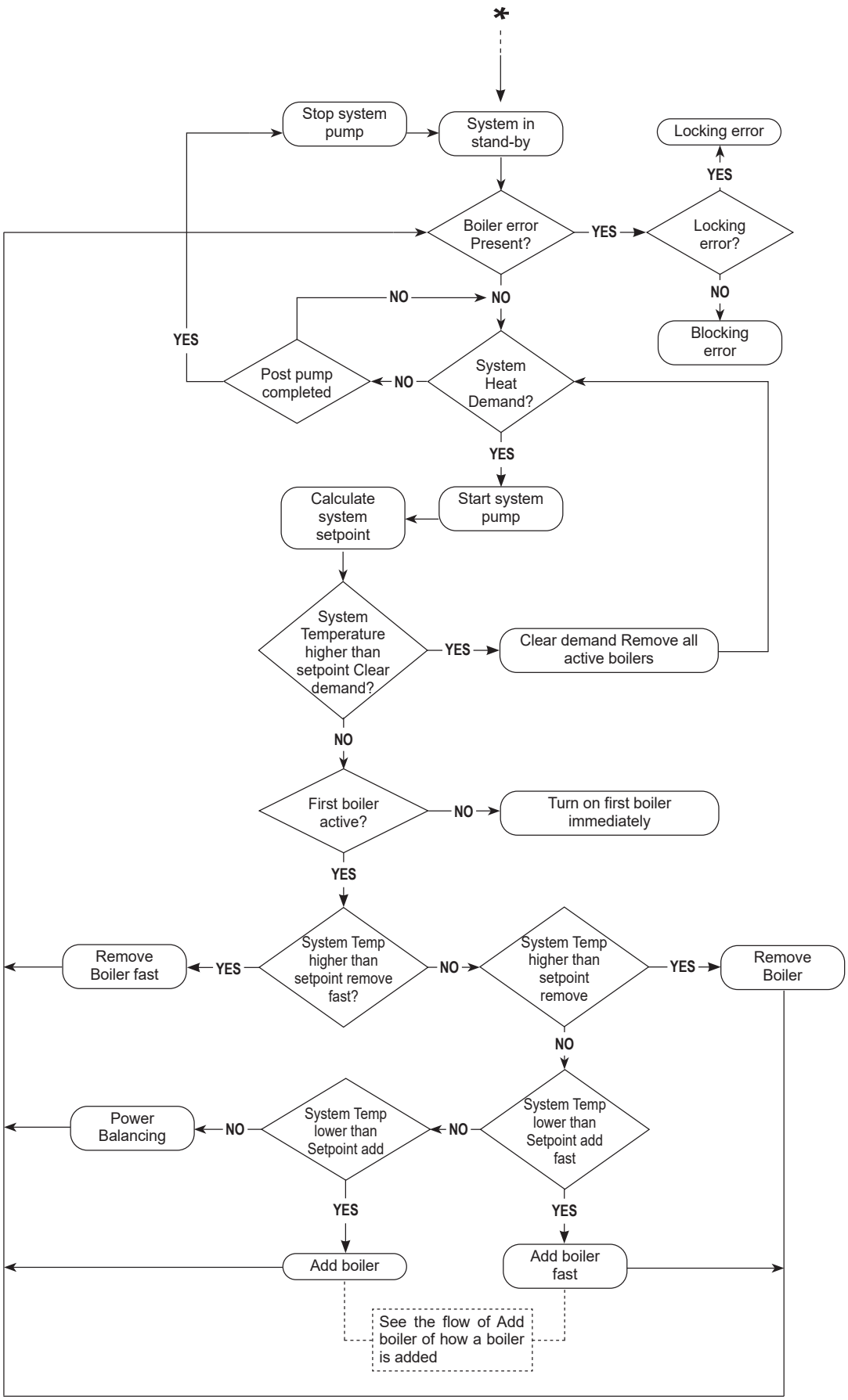
MODULE CASCADE (STAND-ALONE BOILER)



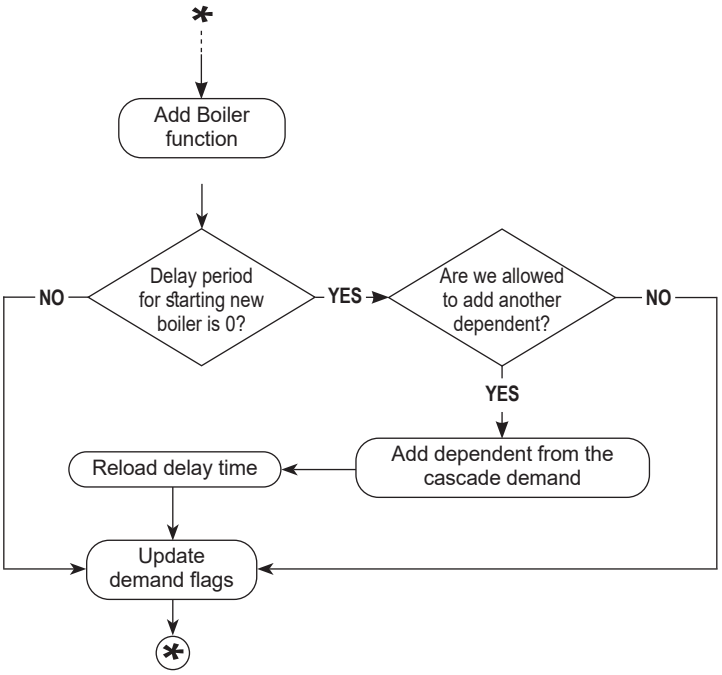
MODULE CASCADE (STAND-ALONE BOILER): ADD/REMOVE MODULE

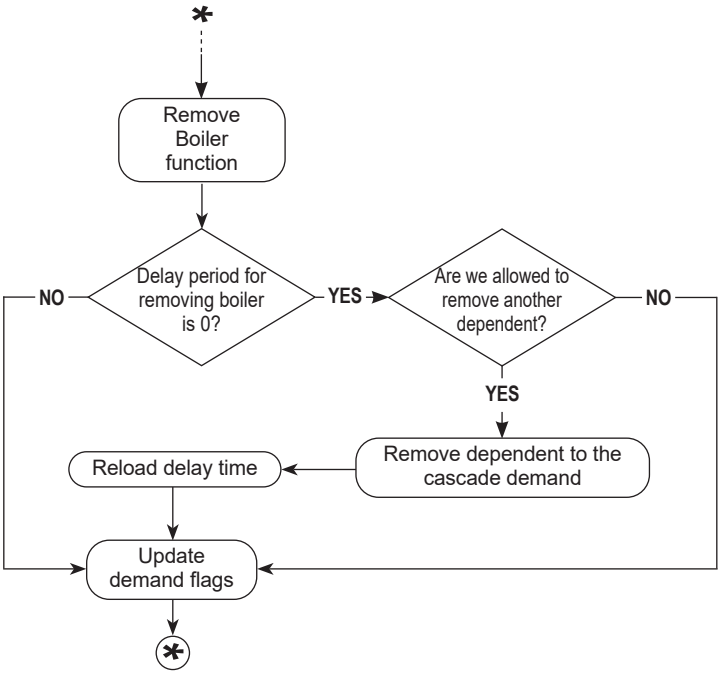


BOILER CASCADE

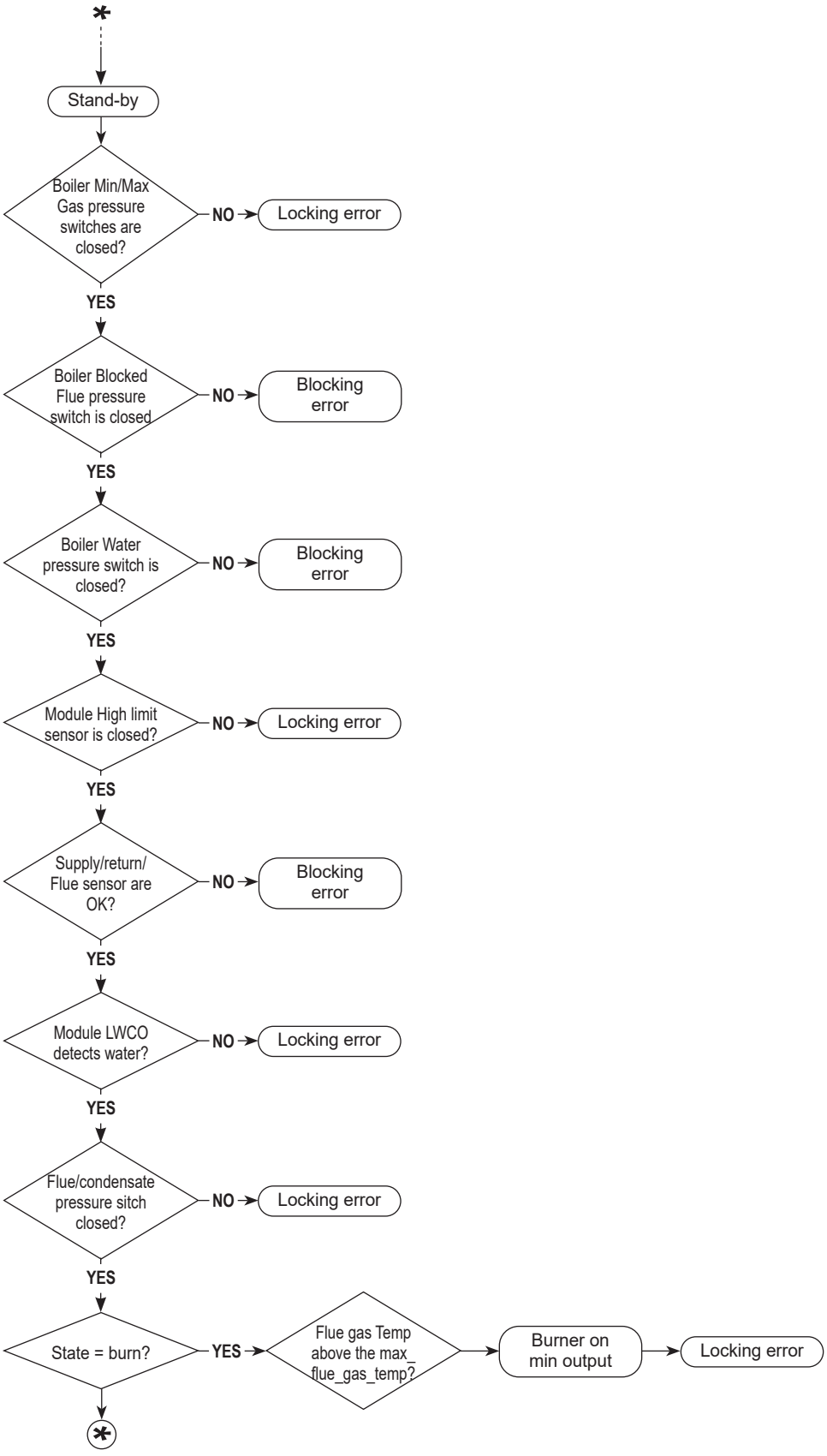


BOILER CASCADE: ADD/REMOVE BOILER





ERROR CHECKING CYCLE



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