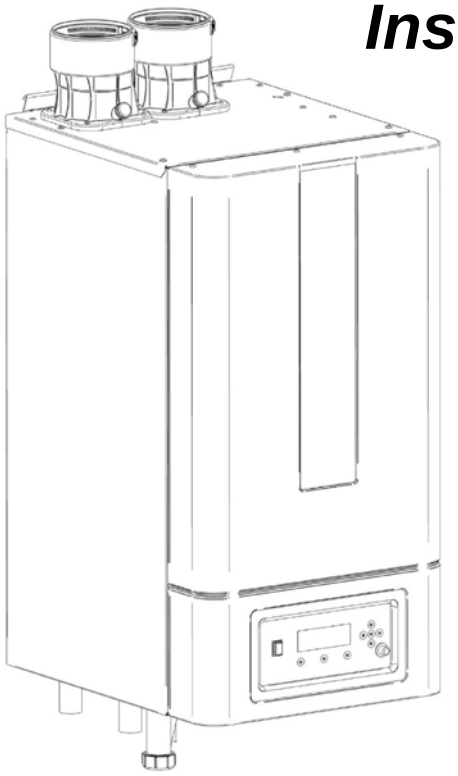
Installation and service manual



RC-300
RC-400
RC-500

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

- **Do not store or use gasoline or other flammable vapors and liquids 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.**
- **Installation and service must be performed by a qualified installer, service agency or the gas supplier.**

GASMASTER
EFFICIENT © RELIABLE © GREEN

This manual must be left with owner and must be hung on or adjacent to the boiler for reference.

AVERTISSEMENT. Assurez-vous de bien suivre les instructions données dans cette notice pour réduire au minimum le risque d'incendie ou d'explosion ou pour éviter tout dommage matériel, toute blessure ou la mort.

- **Ne pas entreposer ni utiliser d'essence ou ni d'autres vapeurs ou liquides inflammables à proximité de cet appareil ou de tout autre appareil.**
- **QUE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAZ :**
  - **Ne pas tenter d'allumer d'appareils.**
  - **Ne touchez à aucun interrupteur. Ne pas vous servir des téléphones dans le bâtiment où vous vous trouvez.**
  - **Appelez immédiatement votre fournisseur de gaz depuis un voisin. Suivez les instructions du fournisseur.**
  - **Si vous ne pouvez rejoindre le fournisseur de gaz, appelez le service des incendies.**
- **L'installation et l'entretien doivent être assurés par un installateur ou un service d'entretien qualifié ou par le fournisseur de gaz.**

California Proposition 65 Warning: This product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

TABLE OF CONTENTS

IMPORTANT

READ ALL OF THE FOLLOWING WARNINGS AND STATEMENTS BEFORE READING THE INSTALLATION INSTRUCTIONS

DANGER

Danger Sign: indicates the presence of an imminently hazardous situation that will cause death, serious personal injury or substantial property damage.

WARNING

Warning Sign: indicates the presence of a hazardous situation which can cause death, serious personal injury or substantial property damage.

CAUTION

Caution Sign plus Safety Alert Symbol: indicates a hazardous situation which will or can cause minor or moderate personal injury or property damage.

CAUTION

Caution Sign plus a lightning bolt: indicates the risk of electric shock and the potential of hazards due to electric shock.

NOTICE

Notice Sign: indicates special instructions on installation, operation or maintenance that are important but not related to personal injury or property damage.

WARNING

This Boiler must be installed by a licensed and trained Heating Technician or the Warranty is void. Failure to properly install this unit may result in property damage, serious injury to occupants, or possibly death.

1 SAFETY GUIDELINES

FOR YOUR SAFETY READ BEFORE OPERATING

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

A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.

B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

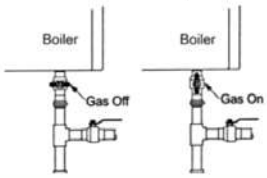
WHAT TO DO IF YOU SMELL GAS
- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.

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

OPERATING INSTRUCTIONS

1. STOP! Read the safety information above on this label.
2. Turn off all electric power to the appliance.
3. Set the thermostat to the lowest setting.
4. This appliance does not have a pilot. it is equipped with an ignition device which automaticly lights the burner. Do not try to light the burner by hand.
5. The manual gas shut off is located beneath the appliance cabinet, in the gas piping.
6. The manual gas shut off valve is located beneath the appliance cabinet; turn the handle ↷ to the full OFF position (perpendicular to the gas piping).



7. Wait five (5) minutes to clear out any gas. If you then smell gas, STOP! Follow "B" in the safety information above on this label. If you don't smell gas, go to next step.
8. Turn manual gas control valve ↶ to ON position (parallel to gas piping).
9. Turn on all electric power to the appliance.
10. Set the thermostat to the desired setting.
11. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance"and call your service technician or gas supplier.

TO TURN OFF GAS TO APPLIANCE

1. Turn off all electric power to the appliance if service is to be preformed.
2. Set the thermostat to lowest setting.
3. The manual gas shut off valve is located beneath the appliance cabinet; turn the handle ↷ to the full OFF position (perpendicular to the gas piping).

CAUTION	This boiler is equipped with a pressure switch in the event of a blocked vent the boiler will lockout. No attempt by the user/owner should be made to put the boiler back into operation. A qualified service technician should be notified of the issue. The boiler should only be reset by a qualified service technician after they have diagnosed and corrected the issued that caused the safety lockout of the boiler.

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

NOTICE	Gasmaster recommends the installation of a carbon monoxide de-tector in the boiler room for all installations.

WARNING	WARNING: There are no user serviceable parts on this boiler. Warranty does not cover defects caused by attempts to service this boiler by someone other than a qualified gas service technician. These attempts could cause property damage, personal injury or loss of life.

WARNING
WARNING: Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury (exposure to hazardous materials) * or loss of life. Installation and service must be performed by a qualified installer, service agency or the gas supplier (who must read and follow the supplied instructions before installing, servicing, or removing this boiler. This boiler contains materials that have been identified as carcinogenic, or possibly carcinogenic, to humans)

Avertissement
AVERTISSEMENT: Une installation, un réglage, une modification, une réparation ou un entretien non conforme aux normes peut entraîner des dommages matériels, des blessures (exposition à des matières dangereuses) ou la mort. L'installation et l'entretien doivent être effectués par un installateur ou un service d'entretien qualifié ou le fournisseur de gaz (qui doivent avoir lu les instructions fournies avant de faire l'installation, l'entretien ou l'enlèvement de la chaudière et les respecter. Cette chaudière contient des matériaux qui ont été identifiés comme étant cancérogènes ou pouvant l'être).

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

WARNING	WARNING: **Crystalline Silica** - Certain components in the combustion chamber may contain this potential carcinogen. Improper installation, adjustment, alteration, service or maintenance can cause property damage, serious injury (exposure to hazardous materials) or death. Refer to Section 19 for information on handling instructions and recommended personal protective equipment. Installation and service must be performed by a qualified installer, service agency or the gas supplier (who must read and follow the supplied instructions before installing, servicing, or removing this boiler. This boiler contains materials that have been identified as carcinogenic, or possibly carcinogenic, to humans).

CONSIGNES DE SÉCURITÉ.

POUR VOTRE SÉCURITÉ LISEZ AVANT DE METTRE EN MARCHE

AVERTISSEMENT: Quiconque ne respecte pas à la lettre les instructions dans la présente notice risque de déclencher un incendie ou une explosion entraînant des dommages, des blessures ou la mort.

A. Cet appareil ne comporte pas de veilleuse. Il est muni d'un dispositif d'allumage qui allume automatiquement le brûleur. Ne tentez pas d'allumer le brûleur manuellement.

B. AVANT DE FAIRE FONCTIONNER, reniflez tout autour de l'appareil pour déceler une odeur de gaz. Reniflez près du plancher, car certains gaz sont plus lourds que l'air et peuvent s'accumuler au niveau du sol.

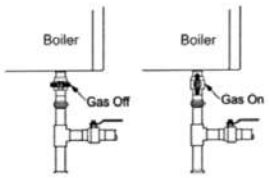
QUE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAZ
- Ne pas tenter d'allumer d'appareil.
- Ne touchez à aucun interrupteur ; ne pas vous servir des téléphones se trouvant dans le bâtiment.
- Appelez immédiatement votre fournisseur de gaz depuis un voisin. Suivez les instructions du fournisseur.
- Si vous ne pouvez rejoindre le fournisseur, appelez le service des incendies.

C. Ne poussez ou tournez la manette d'admission du gaz qu'à la main ; ne jamais utiliser d'outil. Si la manette reste coincée, ne pas tenter de la réparer ; appelez un technicien qualifié. Le fait de forcer la manette ou de la réparer peut déclencher une explosion ou un incendie.

D. N'utilisez pas cet appareil s'il a été plongé dans l'eau, même partiellement. Faites inspecter l'appareil par un technicien qualifié et remplacez toute partie du système de contrôle et toute commande qui ont été plongés dans l'eau.

INSTRUCTIONS DE MISE EN MARCHE

1. ARRÊTEZ! Lisez les instructions de sécurité sur la portion supérieure (à gauche) de cette étiquette.
2. Coupez l'alimentation électrique de l'appareil.
3. Réglez le thermostat à la température la plus basse.
4. Cette apparell ne comporte pas de veilleuse. Il intègre un dispositif d'allumage automatique du brûleur. N'essayez pas d'allumer manuellement le brûleur.
5. L'interrupteur de gaz principal se trouve directement sous la chaudière, sur la conduit d'alimentation en gaz.
6. L'interrupteur de gaz principal se trouve directement sous la chaudière. Tournez l'interrupteur de gaz principal dans le sens horaire pour couper l'alimentation en gaz.



7. Attendre cinq (5) minutes pour laisser échapper tout le gaz. Reniflez tout autour de l'appareil, y compris près du plancher, pour déceler une odeur de gaz. Si vous sentez une odeur de gaz, ARRÊTEZ ! Passez à l'étape B des instructions de sécurité sur la portion supérieure (à gauche) de cette étiquette. S'il n'y a pas d'odeur de gaz, passez à l'étape suivante.
8. Tournez la vanne manuelle de contrôle du gaz en position ON (parallèle à la tuyauterie de gaz).
9. Mettez l'appareil sous tension.
10. Réglez le thermostat à la température désirée.
11. Si l'appareil ne se met pas en marche, suivez les instructions intitulées "Comment couper l'admission de gaz de l'appareil" et appelez un technicien qualifié ou le fournisseur de gaz.

Comment couper l'admission de gaz de l'appareil.

1. Coupez l'alimentation électrique de l'appareil s'il faut procéder à l'entretien.
2. Réglez le thermostat à la température la plus basse.
3. L'interrupteur de gaz principal se trouve directement sous la chaudière. Tournez l'interrupteur de gaz principal dans le sens horaire pourcouper l'alimentation en gaz.

2 INTRODUCTION

This manual is written for the installer and service technician.
Gasmaster Industries Ltd is not accountable for any damage caused by failure to correctly follow these instructions. For service and repair purposes use only original Gasmaster recommended spare parts.
All documentation produced by the manufacturer is subject to copyright law.
This manual is subject to change without notice.

Ce manuel est écrit pour l'installateur et le technicien d'entretien.
Gasmaster Industries Ltd n'est pas respon-sable de tout dommage causé par ne pas suivre correctement de ces instructions. Pour service et réparation, utiliser seulement pièces de rechange de Gasmaster Industries Ltd.
Tout documentation produit par le fabricant est sous réserve de la loi sur le droit d'auteur. Ce ma-nuel est sujet à changement sans préavis.

2.1 *Explanations.*

RC = Condensing Boiler
DHW = Domestic Hot Water
CH = Central Heating (for central heating purposes and/or indirect hot water)
BCU = burner control unit
PB = display board/ control panel (Pixel Button)
300/400/500 = Model number of the boiler.

Explications

RC = Chaudière à condensation.
DHW = Eau Chaude Sanitaire (ECS)
CH = Chauffage central (pour objectif chauffage et/ ou eau chaude indirect)
BCU = commande (burner control unit)
PB = écran (Pixel Button)
300/400/500 = Modèle numéro de chaudière.

2.2 *Maintenance and inspection*

Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.

Entretien et inspection

Inspecter de façon visuelle le système d'évacuation pour déterminer la grosseur et l'inclinaison horizontale qui conviennent et s'assurer que le système est exempt d'obstruction, d'étranglement, de fuite, de corrosion et autres défaillances qui pourraient présenter des risques.

Maintenance and inspection of the boiler should be carried out at the following occasions:

- **When a number of similar error codes and/or lock-outs appear.**
- **At least every 12 months and/or after 2000 burning hours maximum, whichever comes first.**
- **maintenance must be done to ensure safe and efficient operation.**

Damage caused by lack of maintenance will not be covered under warranty

L'entretien et l'inspection de la chaudière doivent être effectués aux occasions suivantes :

- **Lorsqu'un certain nombre de codes d'erreur et/ou de verrouillage semblables apparaissent.**
- **Au moins tous les 12 mois et/ou après 2000 heures de combustion au maximum, selon la première éventualité.**
- **L'entretien doit être effectué pour garantir un fonctionnement sûr et efficace.**

Les dommages causés par le manque d'entretien ne seront pas couverts par la garantie

2.3 *For installations in the Commonwealth of Massachusetts.*

The following local requirements apply in addition to all other applicable NFPA requirements:
For direct- vent boilers, mechanical-vent heating appliances or domestic hot water equipment, where the bottom of the vent terminal and the intake is installed below four feet above grade the following requirements must comply:

1) If not present on each floor level where there are bedrooms, a carbon monoxide detector and alarm must be placed in a living area outside the bedrooms. The carbon monoxide detector and alarm must comply with NFPA 720 (2005 Edition).
2) **A carbon monoxide detector and alarm shall be located in the room that houses the boiler and/or equipment and shall:**
   a) Be powered by the same electrical circuit as the boiler and/or equipment such that only one service switch services both the boiler and the carbon monoxide detector;
   b) Have battery back-up power;
   c) Meet ANSI/UL 2034 Standards and comply with NFPA 720 (2005 Edition); and
   d) Have been approved and listed by a Nationally Recognized Testing Lab as recognized under 527 CMR.
3) A product-approved vent terminal must be used, and if applicable, a product approved air intake must be used. Installation shall be performed in strict compliance with the manufacturer's instructions. A copy of the installation instructions shall remain with the boiler and/or equipment at the completion of the installation. 7

4) A metal or plastic identification plate shall be mounted at the exterior of the building, four feet directly above the location of vent terminal. The plate shall be of sufficient size to be easily read from a distance of eight feet away and read "Gas Vent Directly Below".

For direct-vent boilers mechanical-vent heating boilers or domestic hot water equipment where the bottom of the vent terminal and the intake is installed higher than four feet above grade the following requirements must comply:

1) If not present on each floor level where there are bedrooms, a carbon monoxide detector and alarm must be placed in a living area outside the bedrooms. The carbon monoxide detector and alarm must comply with NFPA 720 (2005 Edition).
2) **A carbon monoxide detector shall:**
   a) Be located in the room where the boiler and/or equipment is located;
   b) Be either hard-wired or battery powered or both; and:
   c) Shall comply with NFPA 720 (2005 Edition).
3) A product-approved vent terminal must be used, and if applicable, a product- approved air intake must be used. Installation shall be in strict compliance with the manufacturer's instructions. A copy of the installation instructions shall remain with the boiler and/or equipment at the completion of the installation.

3 TECHNICAL DATA RC BOILERS

3.1 *Functional introduction*

The RC boilers are central heating boilers with a maximum high efficiency. Such a performance can be reached by, amongst other things, using a special heat exchanger made of stainless steel. This allows the flue gases to cool down below the condensation point, and so release extra heat. This has an immediate positive impact on the efficiency.

The RC boiler is set for Natural gas.
Fuel used should have Sulphur rates with a maximum annual peak over a short period of time of 150 mg/m^3 (110 ppm average) and an annual average of 30 mg/m^3 . (22 ppm average)

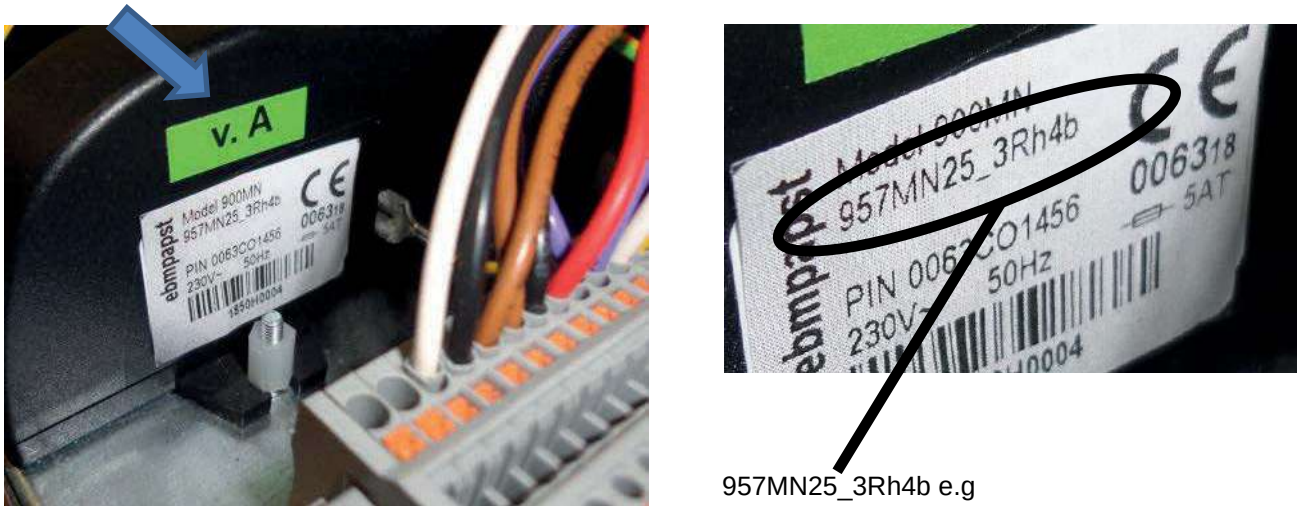
Boiler control includes:
- Cascade control for up to sixteen boilers
- Remote operation and heat demand indication from each boiler
- Weather compensation control – Outdoor reset.
- Indirect tank control

Connections for:
- On/Off thermostat or modulating thermostat
- 0-10 VDC remote flow temperature (set point) control
- 0-10 VDC remote boiler input control
- Outdoor temperature sensor
- External indirect tank pump or diverter valve
- Boiler pump
- PWM control for external boiler pump
- System pump
- External flow switch or external safety device
- Modbus
- External system sensor
- DHW indirect sensor or aquastat
- External Ignition coil

3.2 *Location of version numbers*

Parameter Version
-To be found on the small sticker at the side of the burner controller **v.A** = “Version A” for instance

Burner controller hardware version
– Mentioned at the second line on the white sticker at the side of the burner controller.



Picture 3

Burner Controller Software Versions
– Press the menu button ☰, go to Information and then to Software Versions.

Information	
Software Versions	i
Boiler Status	
Boiler History	
Error Log	

Software Versions	
Display	[63EF 83BC]
Boiler	[5C79 14A9]
Device Group	900MN

3.3 *Technical specifications datasheet*

GENERAL					
Boiler category		-	IV		
Model boiler			**RC-300**	**RC-400**	**RC-500**
Dimensions (h x w x d)		Inch (mm)	**33.3 x 17.3 x 20.9 (845 x 440 x 530)**		
Water content		Gallon (liter)	1.77 (6.7)	2.19 (8.3)	2.74 (10.4)
Weight (empty)		Lbs (kg)	174 (79)	183 (83)	187 (85)
Flow/return connection		inch	NPT 1 ½”	NPT 1 ½”	NPT 1 ½”
Gas connection		inch	NPT 1”	NPT 1”	NPT 1”
Flue connection		Inch (mm)	4” (100)	4” (100)	6” (150)
GAS CONSUMPTION			**Values min-max:**		
Natural gas		ft^3/h m^3/h	54.8 - 274 1.6 - 7.8	74.3 - 368 2.1 - 10.4	91.1 - 441 2.6 - 12.5
Propane [1]		ft^3/h m^3/h	23.6 - 118 0.7 - 3.3	32.0 - 159 0.9 - 4.5	39.2 - 190 1.1 - 5.4
Gas supply pressure nominal [2]	Nat. gas	inch W.C. (mbar)	7.0 (17.4)		
	Propane	inch W.C. (mbar)	11.0 (27.4)		

NOTES

1 Using propane, maximum fan speed needs to be reduced

2 Min. and max. gas supply pressures

	p nom inch W.C. (mbar)	p min inch W.C. (mbar)	p max inch W.C. (mbar)
Natural gas	7.0 (17.4)	3.5 (8.7)	10.5 (26.2)
Propane	11.0 (27.4)	8.0 (19.9)	13.0 (32.4)

Model boiler			RC-300	RC-400	RC-500
CO_2 flue gas [3] Low fire - High fire	Natural gas	%	9.8 - 9.2		
	Propane	%	11.0 - 10.4		
O_2 flue gas [3] Low fire - High fire	Natural gas	%	3.7 - 4.7		
	Propane	%	4.1 - 5.0		
Flue gas temperature at combustion air temperature = 70 °F (20 °C)		°F (°C)	120 - 180 (50 - 80)		
Available pressure for the flue system [4]		Inch W.C (Pa)	0.8 (200)		
INSTALLATION					
Resistance boiler	ΔT = 20 F	ft.head (m.W.C.)	26 (7.9)	31 (9.4)	27 (8.2)
	ΔT = 35 F	ft.head (m.W.C.)	9 (2.7)	10 (3.0)	10 (3.0)
Pressure boiler min-max.		psi (bar)	15.0 - 87.0 (1.0 - 6.0)		
Max. supply temperature		°F (°C)	185 (85)		
ELECTRIC					
Maximum power consumption		W	180	200	280
Power supply		V/Hz	120 / 60		
Protection class		-	IPX4D		
NOTES					
[3] CO_2 of the unit measured/set without the boiler front panel in place					
[4] Maximum allowed combined resistance of flue gas and air supply piping at high fire					

3.4 *High altitude operation.*

High Altitude Operation
The boiler is designed to operate at its maximum listed capacity in installations at elevations less than or equal to 2000 ft (610 m) above Sea Level. Since the density of air decreases as elevation increases, maximum specified capacity will be de-rated for elevations above 2000 ft (610 m) in accordance with the table underneath.

Elevations	2000 ft (610 m)	3000 ft (914 m)	4000 ft (1219 m)	4500 ft (1372 m)	Above 4500 ft (1372 m)
In USA	No de-rate	De-rate by 4 %	De-rate by 8 %	De-rate by 10 %	De-rate 4% per 1000 ft.
In Canada	No de-rate	De-rate by 10%	De-rate by 10 %	De-rate by 10 %	De-rate 4% per 1000 ft.

In USA and Canada, de-rate by 4% extra for every 1000 ft. above 4500 ft.

NOTICE

Combustion – At elevations above 2000 ft (610 m), the combustion of the appliance must be checked with a calibrated (altitude corrected) combustion analyzer to ensure safe and reliable operation. No orifices or high-altitude kits are needed, since the 1:1 Gas/Air ratio of the gas valve and the venturi will respond automatically to reduced air pressure.
It is the Installers responsibility to check the combustion of the appliance. Failure to follow these instructions may result in property damage, serious injury, or death.

How to calculate De-rating at intermediate elevations for US:

Elevation between:
2000 and 3000 ft : (New value – 2000) x 0.004 **Example**: Elevation is 2600 ft. De-rating is (2600-2000)x0.004 = 2.4 %
3000 till 4000 ft : ((New value – 3000) x 0.004)+4 **Example**: Elevation is 3700 ft. De-rating is ((3700-3000)x0.004)+4 = 6.8 %
4000 till 4500 ft : ((New value – 4000) x 0.004)+8 **Example**: Elevation is 4200 ft. De-rating is ((4200-4000)x0.004)+8 = 8.8 %
Above 4500 ft : ((New value – 4500) x 0.004)+10 **Example**: Elevation is 4800 ft. De-rating is ((4800-4500)x0.004)+10 = 11.2 %

How to calculate De-rating at intermediate elevations for Canada:

Elevation between:
2000 till 4500 ft : All values derate by 10% **Example**: Elevation is 3600 ft. De-rating = 10 %
Above 4500 ft : ((New value – 4500) x 0.004)+10 **Example**: Elevation is 7600 ft. De-rating is ((7600-4500)x0.004)+10 = 22.4 %

3.5 *AHRI Specifications*

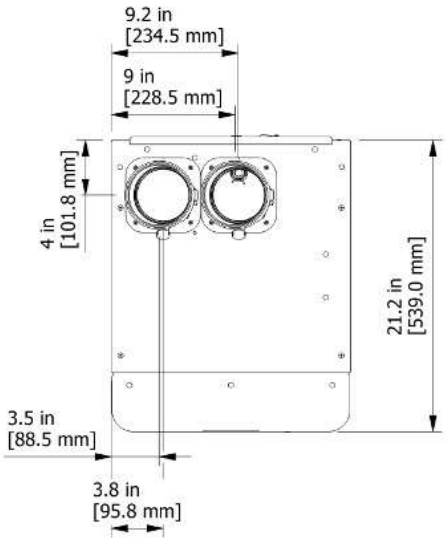
RC series

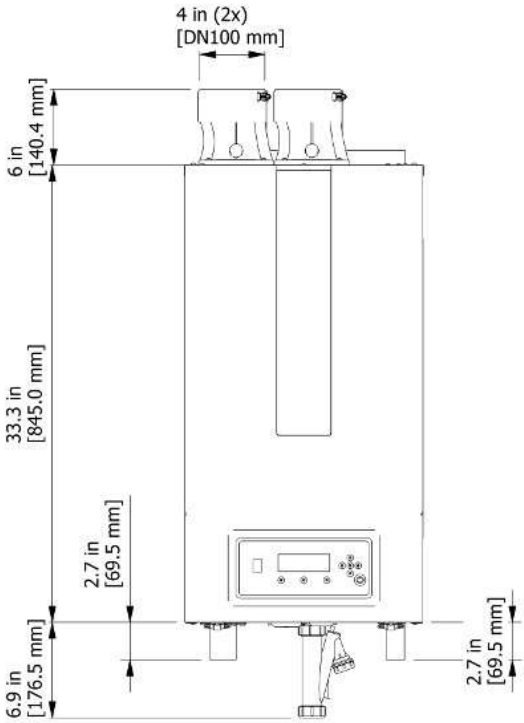
Model number	Input, MBH [1]		Output [1,2] MBH	AHRI Net Ratings Water, MBH	AFUE %	Thermal Efficiency, %	Combustion Efficiency, %
	Min	Max					
RC-300	59.0	295	274	238	95.1	-	-
RC-400	80.0	396 [3]	378	329	-	95.5	95.4
RC-500	98.0	474 [4]	453	394	-	95.6	95.1

1 Listed Input and Output ratings are at minimum vent lengths at Sea Level. Numbers will be lower with longer venting and/or altitudes greater than 2000 feet [610 m].
2 Output means 'Heating Capacity' for RC-300, and 'Gross Output' for RC-400 and RC-500.
3 The maximum input when operating on LP-Gas is 397 MBH.
4 The maximum input when operating on LP-Gas is 473 MBH.
5 Ratings have been confirmed by the Hydronics Section of AHRI.
6 The ratings and efficiencies are based on standard test procedures and calculation methods as prescribed by the United States Department of Energy.
7 As an ENERGY STAR® Partner, Gasmaster has determined that these firing rates meet the ENERGY STAR guidelines for energy efficiency.

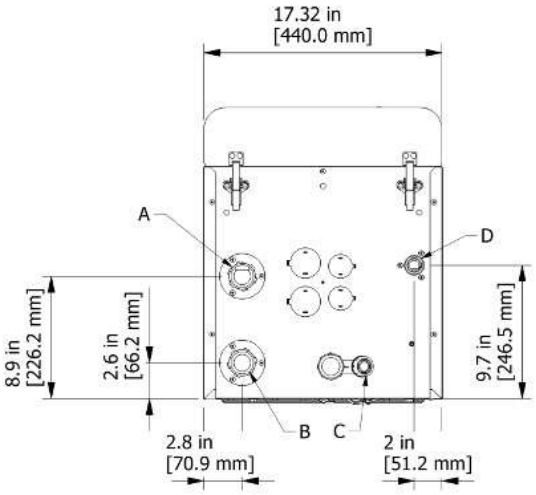
4 BOILER DIMENSIONS

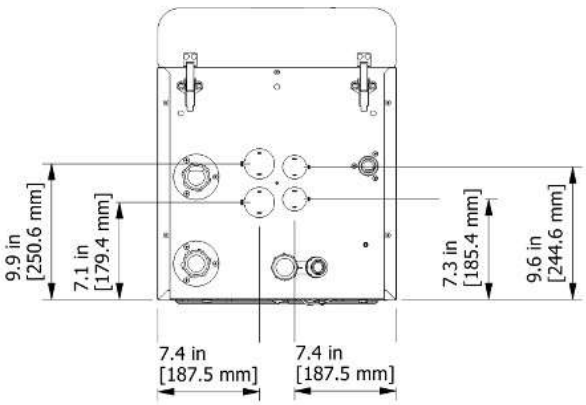
4.1 *RC-300*



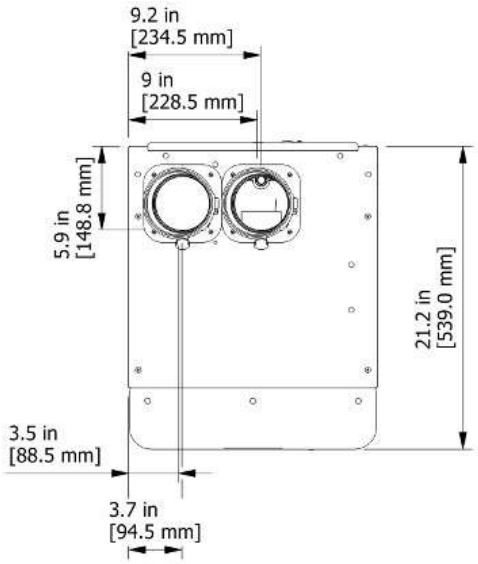


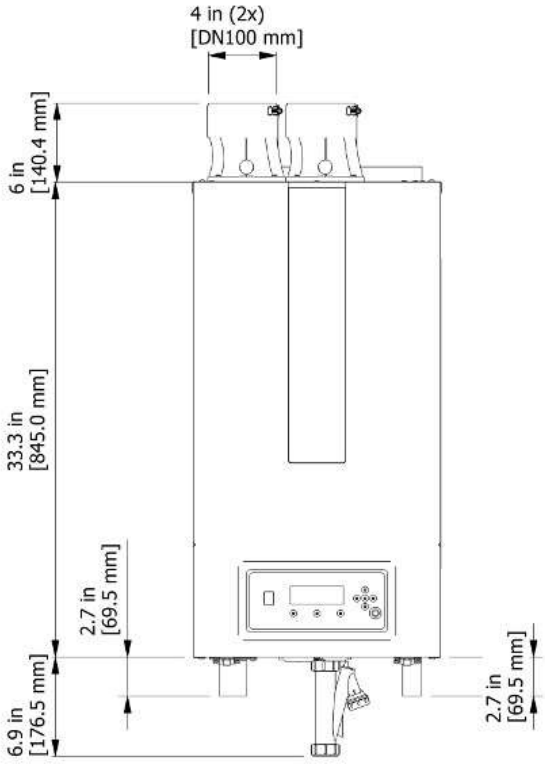
Connections		RC-300
A	Supply	NPT 1½”
B	Return	NPT 1½”
C	Condensate	Flexible hose Ø 1.06 ” (26.9 mm)
D	Gas	NPT 1”



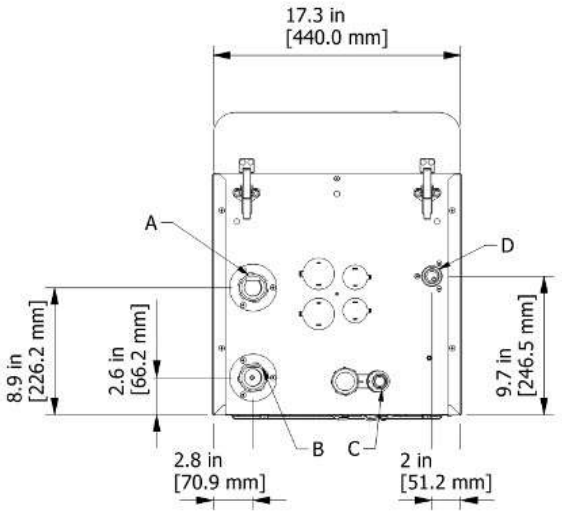


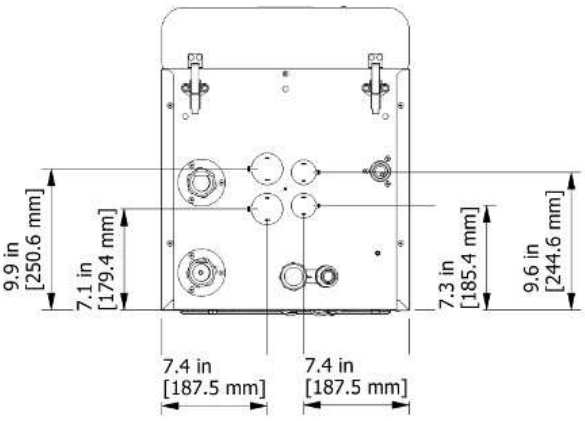
4.2 *RC-400*



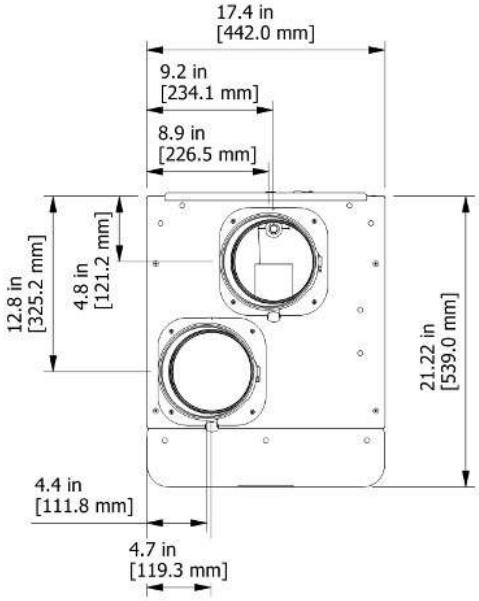


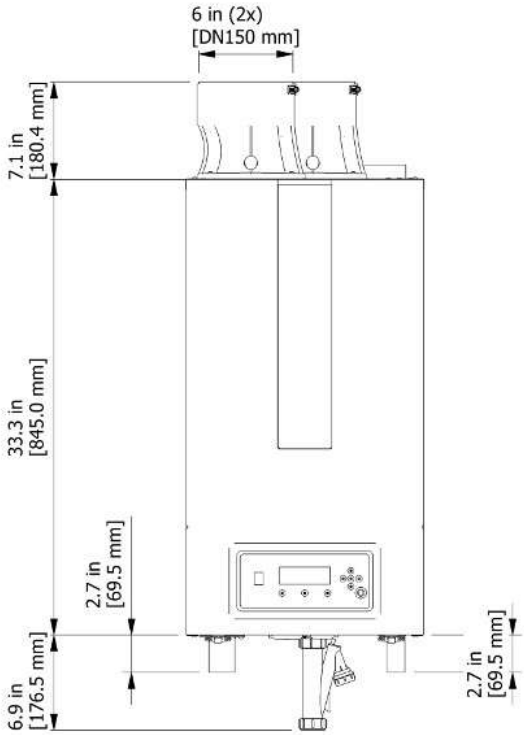
Connections		RC-400
A	Supply	NPT 1½”
B	Return	NPT 1½”
C	Condensate	Flexible hose Ø 1.06” (26.9 mm)
D	Gas	NPT 1”



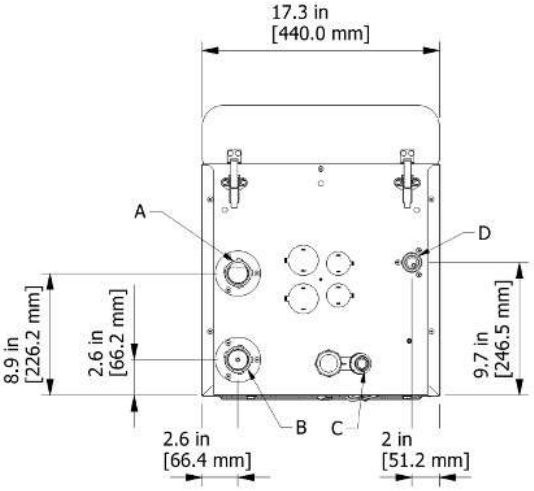


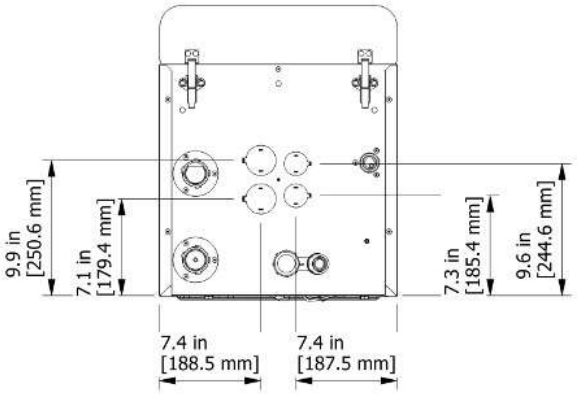
4.4 *RC-500*





Connections		RC-500
A	Supply	NPT 1½”
B	Return	NPT 1½”
C	Condensate	Flexible hose Ø 1.06” (26.9 mm)
D	Gas	NPT 1”





5 ACCESSORIES AND UNPACKING

5.1 *Accessories*

Depending on the selected controlling behavior for the central heating system and/or the optional use of an indirect tank, the following items are available as accessories.

Item	part number
Adhesive kit 04	GS022.000.001
LOCTITE® SI 5366™ 50ml	GS022.000.002
External flow temperature sensor for behind the low loss header: 10kOhm@77°F	GS022.500.021
Indirect tank sensor: 10kOhm@77°F (type B3977)	GS022.500.009
WIFI / IP module	GS022.500.006
Software + interface cable for programming the boiler with a computer/laptop	GS022.500.015
External Ignition transformer 120V	GS022.500.025
Propane kit for VMS Venturi hole Ø 6.2 RC-300	GS022.500.001
Propane kit for VMS Venturi hole Ø 6.7 RC-400	GS022.500.003
Propane kit for VMS Venturi hole Ø 7.2 RC-500	GS022.500.004
Air Filter Kit RC 300 / 400	GS022.500.018
Air Filter Kit RC 500	GS022.500.019
Gas pressure kit RC-500 If protection from gas pressure faults is demanded, this kit is available. The kit consists of two gas pressure switches, with connections to the gas valve and cabling to connect to the burner controller. The gas pressure switches are factory set to the values for natural gas.	GS022.500.007

5.2 *Unpacking*

The RC boiler will be supplied with the following documents and accessories:

No	Description	Quantity
1	“Installation, user and service instructions” manual.	1
2	"User instructions" manual.	1
3	ASME pressure 50 psi relief valve (packed into an additional box).	1
4	Wall bracket with locking plate and bolts	1
5	Spare nuts for mounting the burner plate (in a bag attached to the front of the gas valve).	3
6	Spare fuse for the boiler control (at the burner controller).	1
7	Bottom part of the condensate drain assembly.	1

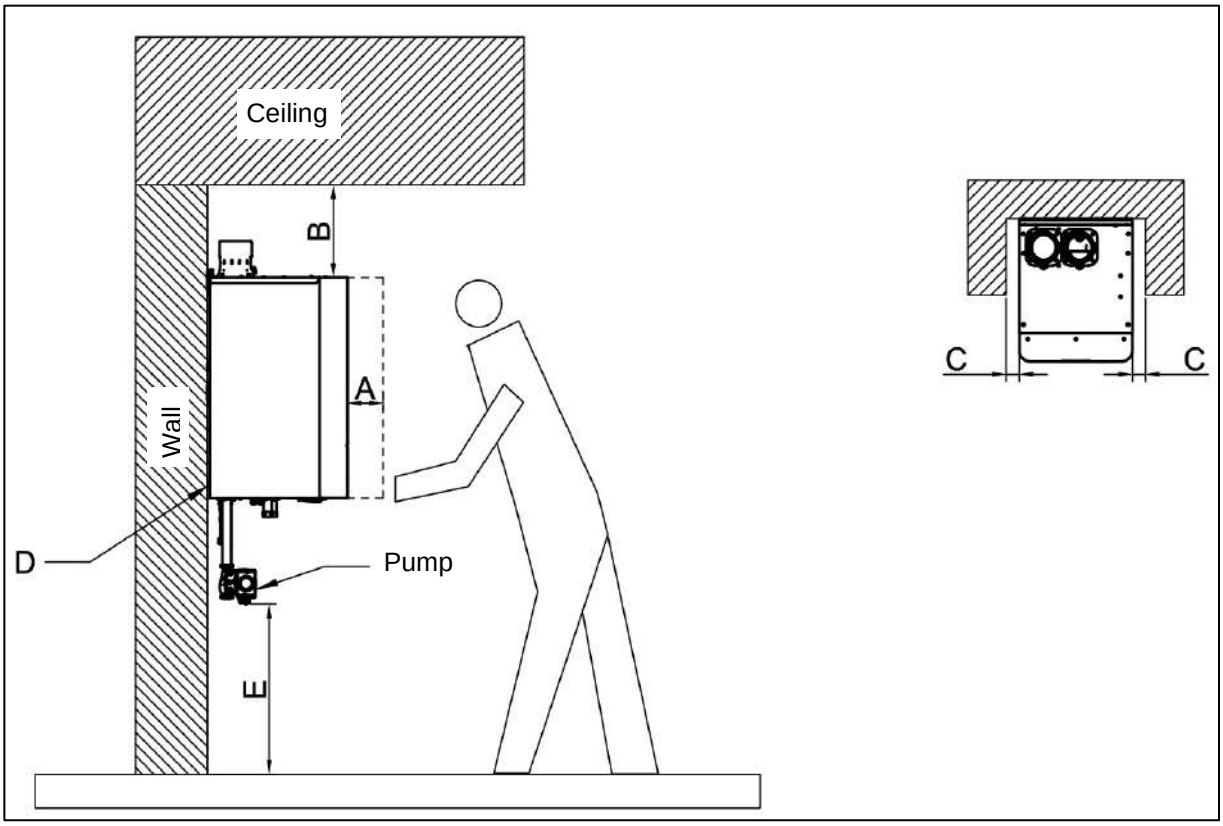
After delivery, always check the boiler package to see if it is complete and without any defects. Report any defects or missing parts immediately to your supplier.

6 INSTALLATION LOCATION OF THE RC

6.1 *Installation Clearances*

On all sides of the boiler at least 2” of clearance should be applied to walls or wall units, 14” above the top side of the boiler and 10” from the bottom of the boiler.

Model No. RC-300 RC-400 RC-500	**Clearances to wall, ceiling and floor**					
	Distances – inches					
		A: Front	B: Top	C: Sides	D: Back	E: Bottom
	Minimum service Clearances	6	12	2	0	10
	Recommended Service clearances	25	14	20	0	30
	Clearances from combustible materials 1. Hot water pipes—at least 1/4" (6 mm) from combustible materials. 2. Vent pipe – at least 1" (25 mm) from combustible materials.					



The installation area/room must have the following provisions:

- 120 V - 60 Hz power source socket with ground.
- Open connection to the sewer system for draining condensing water.
- A wall or stand to properly support the weight of the boiler.
- Depending on the current of the used pump apply a circuit breaker up to a maximum of 15 A.

NOTICE	• The installation of the Gasmaster gas appliance must conform to the requirements of this manual, your local authority and the CAN/CGA B149 Installation Codes. • 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 • The wall used for mounting the boiler must be able to hold the weight of the boiler, piping and fittings, and the weight of the water. If not, it is recommended to mount the boiler by means of a (optional cascade) stand.

CAUTION	The boiler must NOT be installed on or near carpeting.

6.2 *Boiler Installation Location Requirements:*

- The installation of this boiler when installed using room air must comply to NFPA 54.
- The flue gas pipes must be connected to the outside wall and/or the outside roof. (“Flue gas instructions” manual.)
- The installation area must be dry and frost-free.
- The boiler has a built-in fan that will generate noise, depending on the total heat demand. The boiler location should minimize any disturbance this might cause. Preferably mount the boiler on a solidly constructed wall or stand.
- There must be sufficient lighting available in the boiler room to work safely on the boiler.
- When a boiler is positioned at the highest point of the installation, the supply and return pipes must first protrude 20” above the top of the boiler, before these pipes go to the installation side. In other words, the water level must always be 20” above the top of the boiler and an automatic air vent must be installed in the supply or return pipe. It is recommended to install a low water cut off above the boiler, when the boiler is installed above the system or at the highest point in the installation.
- Do not install the boiler in a location where it will be exposed to temperatures 100 °F or higher.
- Do not install the boiler in a location where it will be exposed to high levels of humidity and moisture or where condensation might fall onto the boiler.
- Make sure there is an open connection with the sewer to drain the condensate. This connection should be lower than the condensate drains level of the boiler, if not a condensate pump will be required.
- Do not locate the boiler in an area which contains corrosive or other contaminants as outlined in § 9.6 tables "Indoor air kit"
- When considering installation locations consideration must be given to the combustion air supply whether using indoor air or sealed combustion.
- Do not allow the combustion air to come from a source or area which contains corrosive or other contaminants as outlined in § 9.6 tables "Indoor air kit"

The boiler must be positioned and installed by a qualified installer or the gas company in accordance with all applicable standards, local codes and regulations. Commissioning of the boiler must be done by a qualified installer or technician, who is trained for this type of boiler.
In the Commonwealth of Massachusetts this boiler must be installed by a licensed Plumber or Gas Fitter.

6.3 *Mounting the boiler*

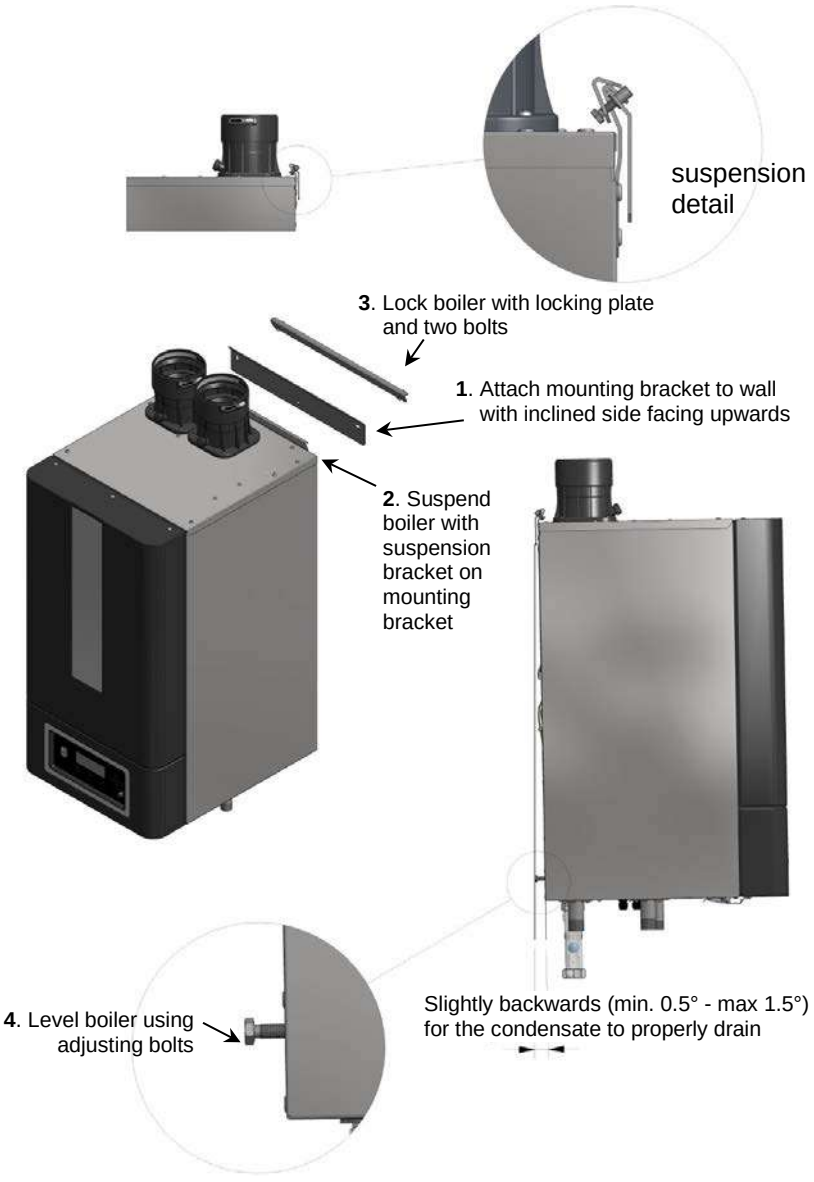
Before mounting and installing the boiler the following connections should be considered:

- Flue gas system and the flue gas pipe connections
- Air supply system and connections
- Supply and return pipe connections
- Condensate and pressure relief valve drainage
- Power supply (preferably the power connection positioned above the boiler)
- Gas pipe sizing.
- Automatic Air Vent Connection.

Needed tools : wrench 13 and 10 mm

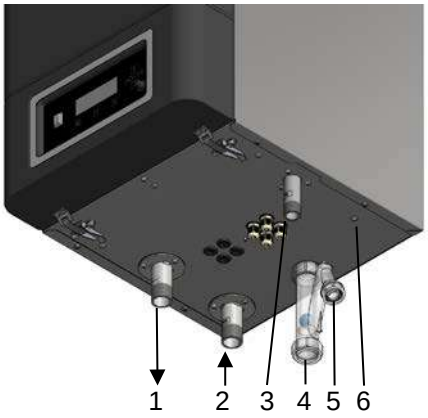
NOTICE	All lines/piping must be mounted free of tension. The weight of the installation components should be supported separately from the boiler so there will be no standing forces on the connections. This might influence the mounting position of the boiler.

Determine the position of the boiler by using the included suspension bracket or a suspension frame (when supplied). While marking the holes, ensure that the suspension bracket or frame is perpendicular, and the boiler does not lean forward. If necessary, adjust the position with the leveling bolts at the lower rear side of the back panel (see figure below). When the leveling bolts aren't sufficient, fill the gap behind the bolts to get the boiler in position. The boiler position lies between the boiler hanging level and hanging slightly backwards (min. 0.5° - max 1.5°).
The boiler should not lean forward in the mounted position.



Lock the suspension bracket with the security cover before making any other connections to the boiler. This security cover will prevent the boiler from falling off the bracket. Don't use excessive force during the mounting of the boiler connections.

7 CONNECTIONS



7.1 *Boiler connections*

1 – Water outlet / Flow
2 – Water inlet / Return
3 – Gas
4 – Condensate trap clean out.
5 – Condensate drain
6 – Automatic air drain.

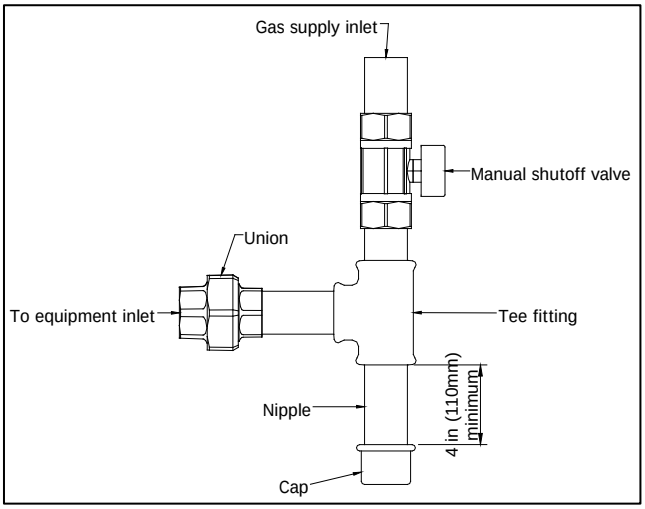
7.2 *Gas pipe connection*

The gas supply piping must conform to all local codes and regulations and/or National Fuel Gas Code, ANSI Z223.1/NFPA 54. In Canada refer to CAN/CGA B149.1 installation codes, and local codes for gas piping requirements and sizing. Pipe size running to the appliance depends on: Length of pipe; Number of fittings; Maximum input requirement of all gas appliances in the residence. See the gas sizing table below for help when sizing the gas connection. For information on propane sizing consult your local propane gas supplier.

	Schedule 40 Black Steel Pipe in Cubic Feet of Natural Gas per Hour. (Based on inlet pressure less than 2 psi, pressure drop of 0.3 W.C. and specific gravity 0.6)				
Nominal Pipe Size (In)	¾"	1"	1¼"	1½"	2"
Length (ft)					
10	273	514	1060	1580	3050
20	188	353	726	1090	2090
30	151	284	583	873	1680
40	129	243	499	747	1440
50	114	215	442	662	1280
60	104	195	400	600	1160
70	95	179	368	552	1090
80	89	167	343	514	989
90	83	157	322	482	928
100	79	148	304	455	877

7.2.1 GAS LINE CONNECTION

Consult, the gas code to determine gas pipe size. It is required to install a manual shutoff gas valve in front of the gas pressure regulator to make sure that the gas line can be closed in case of maintenance. The entire piping system, gas meter and regulator must be sized properly to prevent pressure drop greater than 1" wc as stated in the NFPA54. If you experience a pressure drop of greater than 1" w.c., regulator or gas line is undersized.
Gasmaster recommends a nominal value of 7" to 10" W.C. of gas pressure when using Natural gas and 11 to 13" W.C. when using LPG, will be available at the boiler gas valve inlet at maximum boiler firing rate. See technical specifications datasheet for minimum and maximum allowed gas pressures.
When an in-line regulator is used to drop gas pressure from 2 psi to 0.5 psi, it must be located a minimum of 6 ft from the boiler.
Gasmaster requires a minimum 1" diameter flex hose if flex gas hose is going to be used. Ensure that: the gas line connection to the appliance does not apply any weight or pressure to the gas valve.
Create an installation layout such that the piping does not interfere with the vent pipe, or any other serviceable components.
The appliance shall be installed such that the gas ignition system components are protected from water (dripping, spraying, rain etc.) during installation, operation and servicing.
No appreciable drop in line pressure should occur when any unit (or in the instance of a cascade installation when all of the installed units) lights or runs. Use common gas line sizing practices. Make sure the gas pressure is within specification during all conditions. Always use a pipe-threading compound. Apply sparingly to all male threads, starting at two threads from the end. Over doping or applying dope to the female end, can result in a blocked gas line.
DO NOT TIGHTEN FITTINGS WITHOUT SUPPORTING THE GAS VALVE, A BACKING WRENCH MUST BE USED



Install a manual “Equipment Shut-Off Valve”. The valve must be listed by a nationally recognized testing lab. Should overheating occur or the gas supply fail to shut off, turn off the manual gas control valve. The gas line piping can safely be removed from the appliance for servicing.
Leak test the gas pipe from the boiler up to the gas pressure regulator.
Carefully vent the gas pipe (outside in open air) before putting appliance into operation for the 1st time;

WARNING

A sediment trap must be provided directly below the boiler.

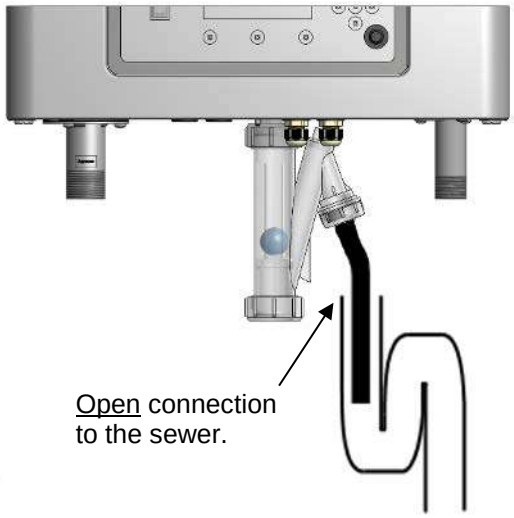
WARNING

Strain on the gas valve and fittings may result in vibration, premature component failure and leakage and may result in a fire, explosion, property damage, serious injury or death.

Do not use an open flame to test for gas leaks. Failure to follow these instructions may result in fire.

When performing a pressure test on the gas line piping, the following guidelines must be followed.
*The boiler and its individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 1/2 PSIG (3.45 kPa).
*The boiler must be isolated from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG (3.45 kPa).

Gas pressure switch
If protection from gas pressure faults is demanded an optional kit is available. This kit consists of two gas pressure switches, with connections to the gas valve and cabling to connect to the burner controller. The gas pressure switches are factory set to the values for natural gas.



7.3 *Condensate drain connection*

The condensate drain is placed at the center and at the bottom of the boiler and has a ¾ inch hose discharge. Connect this flexible hose to the sewer system.

Use only plastic parts with the condensate drain. Metal lines are not allowed.

Blockage of this drain might damage the boiler. The drain connection is correct when the condensate can be seen flowing away, e.g. using a funnel. Any damage that might occur, when the drain is not installed correctly, is not covered by the warranty of the boiler.

There should be an open connection of the condensate hose into the sewage system. A possible vacuum in the sewage system must never give the opportunity to suck on the boiler’s condensate drain hose.

WARNING

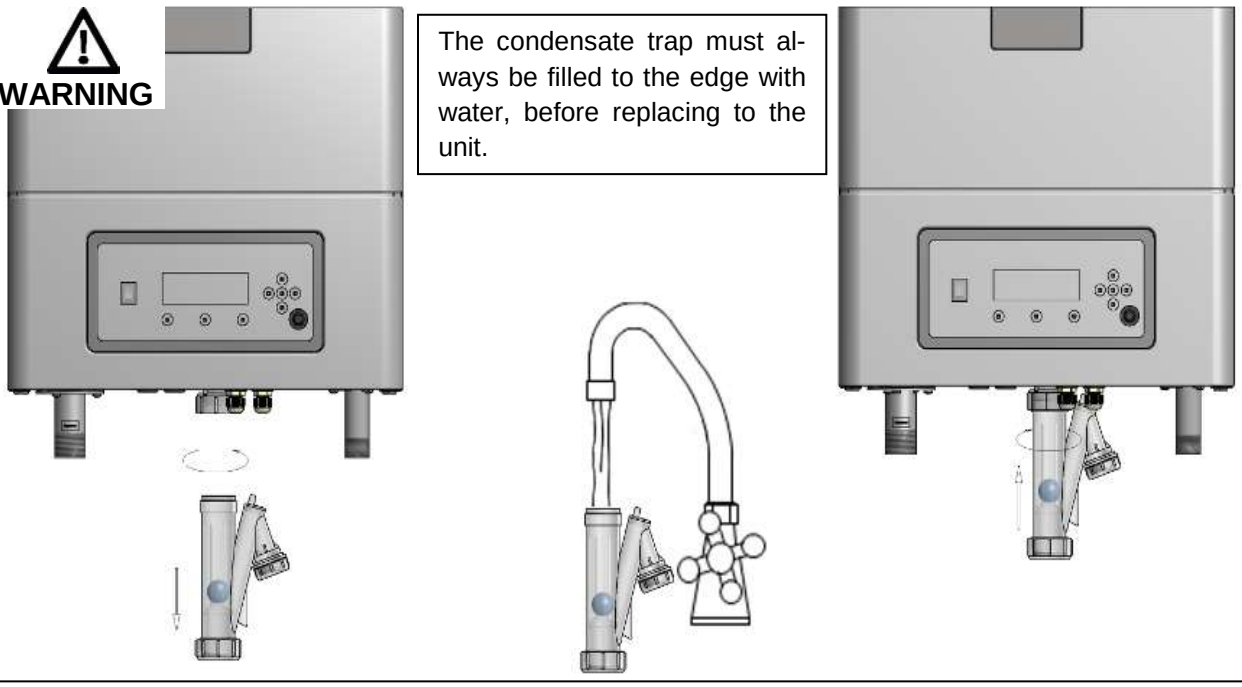
The condensate the boiler produces is acidic and should be neutralized before disposal.
If not properly neutralized it may harm some floor drains and/or pipes, particularly those that are metal. Ensure that the drain, drainpipe, and anything that will come in contact with the condensate can withstand the acidity or neutralize the condensate before disposal.
Damage caused by failure to install a neutralizer kit or to adequately treat condensate will not be the manufacturer’s responsibility.

WARNING

When mounting the bottom part of the condensate trap, before commissioning the boiler and/or after maintenance, the condensate trap must **ALWAYS** be completely filled with water. **This is a safety measure: the water in the condensate trap keeps the flue gases from leaking out of the heat exchanger via the condensate drain.**

WARNING

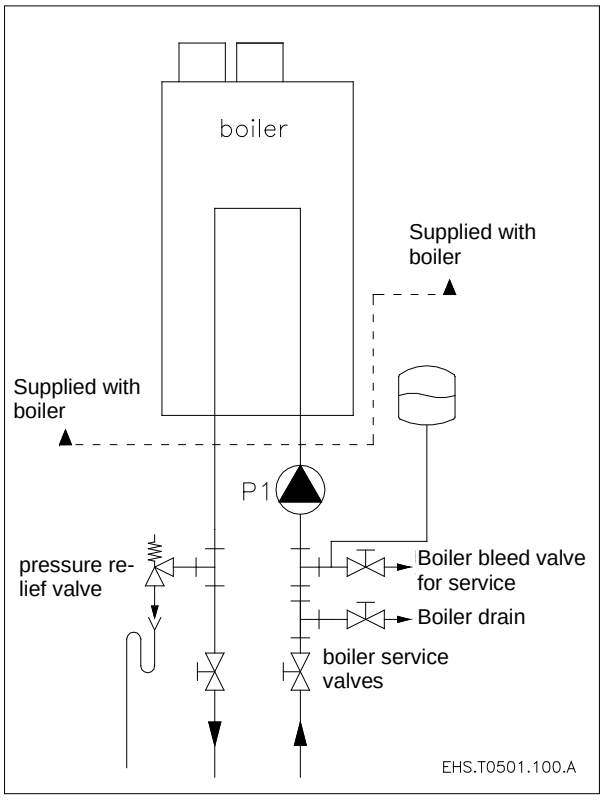
The condensate trap must always be filled to the edge with water, before replacing to the unit.



7.4 *Flow and return connections*

Use T-pieces for externally mounting the pressure relief valve and the boiler drain valve for servicing the boiler. We advise to install two service ball valves in the flow and return pipes underneath the boiler, so the boiler can be isolated from the heating system and eventually disconnected, when needed.

When using a boiler pump, this pump should always be mounted in the return pipe of the heating system.
Do not use chloride-based fluxes for soldering any pipes of the water system.
It is recommended to install service valves, so the boiler can be isolated from the heating system, when needed. Make sure that the pressure relief valve is mounted between the boiler and the service valves.



7.5 *The expansion vessel*

The capacity of the expansion vessel must be selected and based on the capacity of the central heating system and the static pressure. Suggested is to fit the expansion vessel in the return pipe of the central heating system. It can be combined with the drain and feed valves for service. See figure.

7.6 *Pressure relief valve*

The boiler has no internal pressure relief valve, but a relief valve, specially selected for this boiler, is added to the boiler shipment and can be found in the box. This should be installed close to the boiler in the flow pipe of the heating system and no shut off valve shall be placed between the relief valve and the boiler. When having cascaded boilers, each boiler should have its own pressure relief valve. The pressure relief valve's discharge must be piped to an open drain and to within 6 inches of the ground/floor. Always have an air gap between the pressure relief valve discharge piping and the drain to prevent a vacuum. No valve may be placed between the relief valve and the discharge line, do not plug or obstruct in any way the pressure relief discharge line.

7.7 *NON-Return valve.*

The RC boilers have a non-return valve installed in the gas-air mixing pipe just before the burner. Flue gas recirculation is prevented by the non-return valve. The prevention of recirculation also reduces standby loses through the flue of the boiler. This creates a higher thermal efficiency.

7.8 *Primary Secondary Piping.*

The boiler has no internal bypass. The system must have primary secondary piping to allow an adequate flow. One option for primary secondary piping is to use closely spaced tees spaced 4 pipe diameters apart and a maximum of 12" apart. Another option for primary secondary piping is to use a low loss header for this function.
The boiler flow will also be influenced when a pipe of the heating system is frozen / blocked. Make sure all heating pipes are free from the risk of frost. If there is the risk of freezing of the heating system, all the pipe section must be insulated and/or protected with the help of a heat tracing.

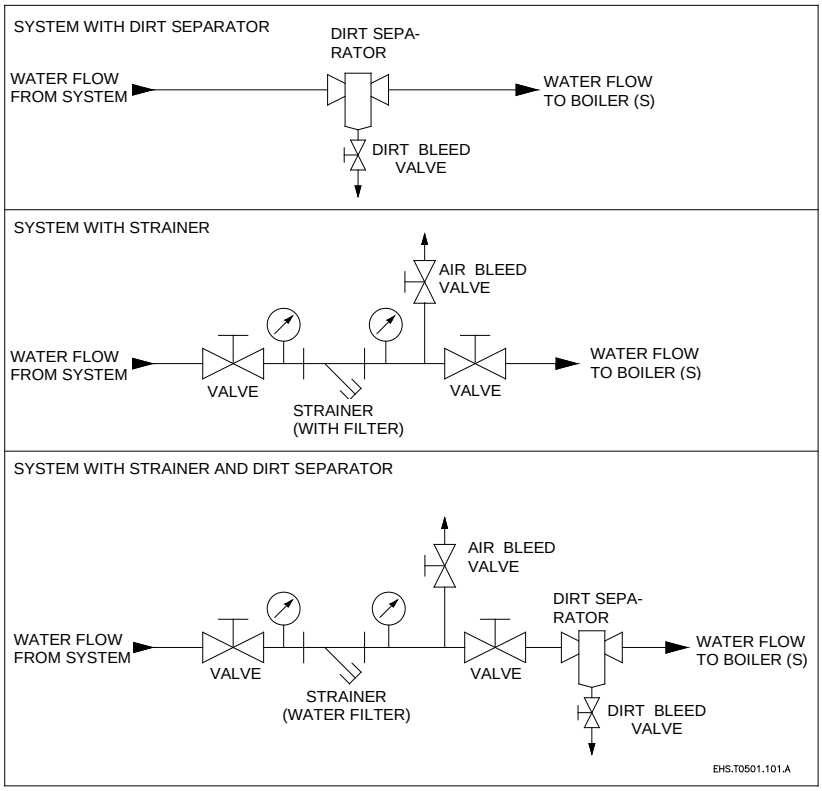
7.9 *Pump functionality*

Delta T monitoring:
A high temperature difference between supply and return of the boiler can indicate a clogged heat exchanger or filter, or a defective pump. The burner load automatically decreases when the Return/Supply temperature differential increases too much.
At maximum burner power ΔT is limited to 72 °F and at low burner power a ΔT above 86 °F is not allowed. Above these values the boiler modulates down until the temperature difference is between 72 °F and 86 °F. If the ΔT exceeds 94 °F, the boiler will be temporarily switched off.

7.10 *Frost protection*

The boiler has a built-in frost protection that is automatically activates the boiler pump when the boiler return (water) temperature drops below 50 °F/10 °C (programmable). When the boiler return temperature drops below the 41 °F/5 °C (programmable), the boiler is also ignited. The pump and/or boiler will shut down as soon as the return temperature has reached the 59 °F/15 °C (programmable). The mentioned temperatures are related to the temperatures measured by the RETURN sensor of the boiler. This frost protection function will not fire up the boiler in case of a "general blocking" of the boiler demand.
NOTICE: This "Frost Protection" function is only useable for the boiler and not for the whole central heating system. Because it concerns a programmable setting, a boiler damaged by frost is not covered under warranty.

7.11 *Installing a strainer and/or dirt separator*



Always install a Y strainer and/or a dirt separator in the return pipe of the boiler; in such a way that the water going to the boiler is free of any debris/particles. When using a Y strainer always check a week after installation to determine the strainer cleaning interval. Advice is to mount valves before and after the strainer, including an air bleed valve, so the strainer can be isolated from the heating circuit for service operations. Clean water is very important, blocked and/or polluted heat exchangers, including failures and/or damages caused by this blockage are not covered by the warranty. In existing systems when replacing a cast iron boiler or when installing in a system with cast iron radiators or cast iron piping a magnetic dirt separator must be installed.

Its advised to place pressure measuring gauges before and after the strainer. Clean the strainer (water filter) when the maximum delta P exceeds the value prescribed by the strainer manufacturer.

7.12 *Water quality*

Contaminant	Maximum allowable level	Units
pH	7.5 to 9.5	
Hardness	50 to 150	mg/l $CaCO_3$
	2.92 to 8.76	Grains/gallon
Aluminum particles	< 0.2	mg/L
Chlorides	150	Ppm
TDS	350	Ppm

The pH value is reached with the steady conditions. These steady conditions will occur, when after filling the heating system (pH around 7) with fresh water, the water will lose its air because of the air bleeding operation and heating up (dead water conditions).

If there is the risk of contamination of the water by any kind of debris/chemicals in the period after installing, a plate heat exchanger should be used to separate the boiler circuit from the heating circuit (see drawing at the next page).

It is advised to prevent the possible air intake and water leakage of the central heating system. Fresh oxygenated water might damage the heat exchanger of the boiler and should therefore be prevented! Usual spots where air is most likely to seep in are: suction gaskets, pumps, air valve working as a venting pipe, O-rings / gaskets in stuffing box, under floor heating pipes.

When a boiler is installed in a new system or an existing installation the system must be cleaned before the boiler is installed. The system is required to be cleaned using a system cleaner from the list below or an equivalent hydronic system cleaner. Follow the instructions provided by the system cleaner manufacturer. The system should then be drained and thoroughly flushed with clean water to remove any residual cleaner. **The system cleaner must Never be run through the boiler.** For recommended cleaners see table in § 7.14.
Do not use petroleum-based cleaning and sealing compounds in the boilers system as they could damage gaskets. When using antifreeze in the system always use an inhibited mono propylene glycol antifreeze approved for use in heating systems. Never use Ethylene glycol in a heating system as it is toxic and can damage gaskets.
Read the antifreeze suppliers manual for the maximum allowable level of antifreeze to be used with the boiler.

The pH and water quality of the system should be checked on a yearly basis when antifreeze is used in a system. Replace the antifreeze every 5 years or sooner based on the instructions from the manufacturer or if the pH is out of the required range.

A micro bubble air elimination device is required to be installed in all heating systems. An air scoop is not an acceptable substitute for a micro bubble air elimination device and should not be used in the installation. A few examples of acceptable devices are
* Spirovent
* Taco 4900 Series
* Caleffi Discal

If an automatic feed valve is installed in the system, it should not be left open indefinitely. A continuous feed of fresh water could damage the system. It is recommended that after a short period of time following the installation of the boiler into a heating system that the automatic feed valve be closed.

If the boiler is used in a system with snow melt where antifreeze percentages are above the suppliers specified values, it must be isolated from the snow melt with a plate heat exchanger.

7.13 *Use of glycol*

To prevent the system from freezing, the use of glycol can be considered. All materials, used in the boiler, are resistant to glycol.

Glycol at itself will acidify because of thermal degradation over time. This acidity will cause serious damage to most components in the heating system including the boiler. Because of this, specific anti-freeze products are available in the market for use in heating systems. These consist mainly of glycol, but they have additives added which act against internal corrosion and/or scale formation. An important part of these additives are so called “balancers” which are added to the product, to absorb the rise of acidity of the glycol over time because of thermal degradation.

The chemical compatibility of two specific anti-freeze products has been tested by the heat exchanger producer. These products mainly consist of glycol next to the described additives.
If these products are used according to the instruction, they will not harm the boiler.

These anti-freeze products are:

Manufacturer	Type	Composition
Fernox	Alphi 11	consists of 97% Mono Propylene Glycol next to some additives.
Sentinel	X500	estimated as being between 90-100% Mono Propylene Glycol.
Rhomar	Rhogard	Blended with VIRGIN Propylene Glycol

When using other glycol-based antifreeze products make sure that it is an equivalent product to the products mentioned above which will behave exactly the same on all materials and equipment in the heating systems.

The use of 50% glycol in the boiler system will result in an increase in the viscosity of the water/glycol mixture and a decrease in the heat transfer. When the boilers are used in a system with 50% glycol the following requirements must be followed at all times. Never exceed a 50% mixture of glycol in the system. The boiler loop must be designed to operate at a 20°F Delta T and the following guidelines in the table below must be followed for pump circulator sizing.

Boiler type	**RC 50% glycol maximum @ 20°F ΔT**
RC 500	45 gpm @ 40ft head
RC 400	36 gpm @ 42ft. head
RC 300	26 gpm @ 35ft. head

When using glycol in any RC boiler it is required to check the pH, conductivity, and all other water quality requirements listed in the manual in section “Water Quality” once per year, this is especially important with higher concentrations of glycol. It is also required to use a magnetic dirt separator in the boiler system on the system return before the boiler or boiler return if any piping in the system is galvanized, steel, or black iron.

It is required to check the frost protection and acidity of the mixture in the heating system every year.

7.14 *Chemical water treatment*

The chemical compatibility of several products for treatment of the central heating equipment has been tested on the heat exchangers and the boilers. See below for the list with the corrosion inhibitors in preventative and curative treatment for gas fired central heating boilers.

If water treatment is required when filling the system or preforming maintenance an inhibitor should be used. Follow the instructions provided by the inhibitor manufacturer when adding it to the system. The following is a list of approved inhibitors. Always check the water quality of the water and heat transfer fluid mixture in the system. The water quality of the mixture in the system and boiler must be within the stated requirements of table in § 7.12.

Corrosion-/ Scale inhibitors and recommended suppliers			
Producers ->	Fernox	Sentinel	Rhomar
Inhibitors	Protector F1 / Alphi 11	X100, X500	Pro-tek 922
Noise reducer		X200	
Universal cleaner	Restorer, Cleaner F3	X300, X400	Hydro-Solv 9100
Sludge remover	Protector F1, Cleaner F3	X400	
Antifreeze	Alphi 11	X500	Rhogard
Tightness		Leaker Sealer F4	

Treatment type	**Preventive**	**Curative**
Protector F1	X	
Cleaner F3	X	X
X100	X	
X200	X	
X300		X
X400		X
X500	X	
Alphi 11	X	
Leaker Sealer F4	X	

WARNING	**When using chemicals or any kind of additions**: Follow the instructions provided by the manufacturer.Read the suppliers manual for the maximum allowable level/mixing ratio that can be used with the boiler. Warranty will be void if these instructions are not followed exactly.Record the used products and mixing ratio in the log book, start-up-, check- and maintenance list.

7.15 *Under floor heating*

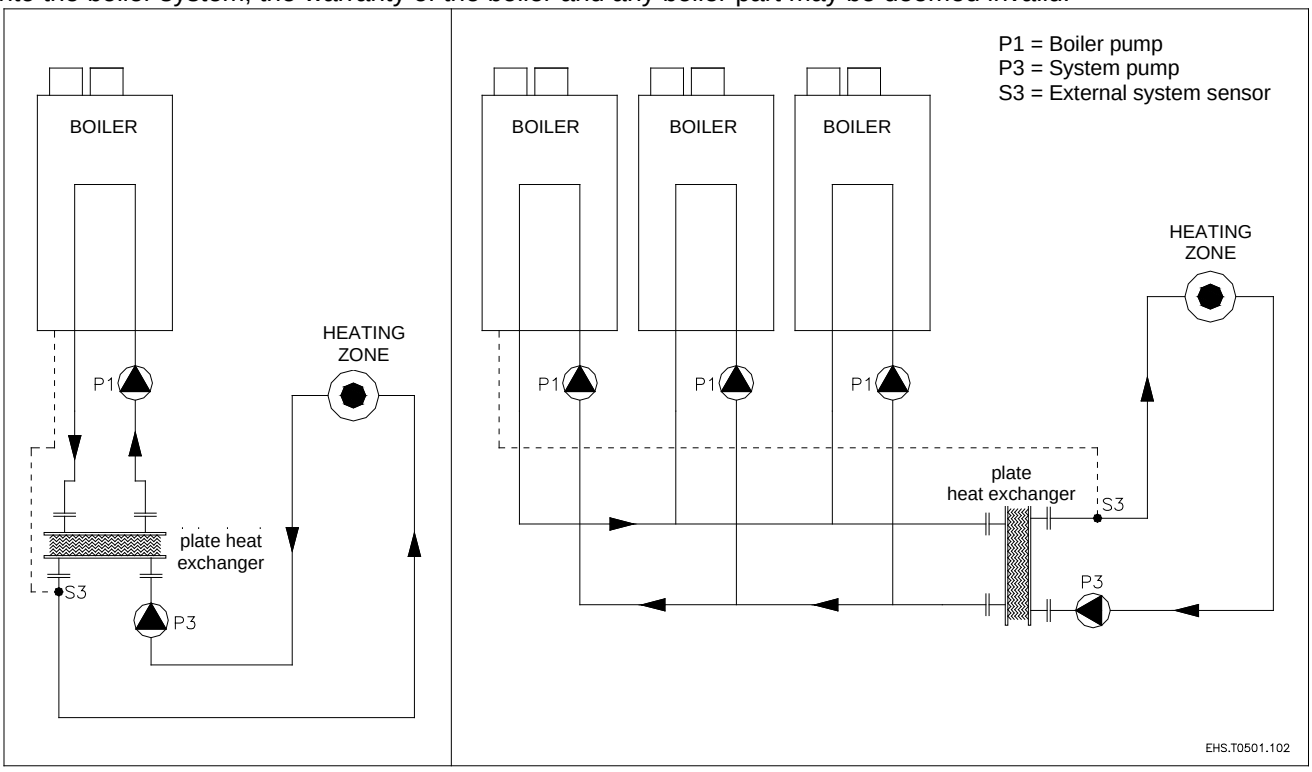
When using an under-floor heating system with non-oxygen barrier PEX,, the boiler circuit must be separated from the heating circuit with a plate heat exchanger.

7.16 *Flush the system with fresh water*

The water of the boiler and heating circuit should be free of any particles, debris and pollution. Therefore, the complete installation must always be thoroughly flushed with clean water before installing and using the boiler(s).

7.17 *Plastic piping in the heating system*

When plastic pipes with no oxygen barrier are used in the central heating system, these should be separated from the boiler system by using a plate heat exchanger. Diffusion (through the plastic) can cause air to enter the heating system. This could damage the boiler, pumps and other components in the system. Be aware that plastic piping is often used in under floor heating systems. When no measures have been taken to prevent the entrance of air into the boiler system, the warranty of the boiler and any boiler part may be deemed invalid.



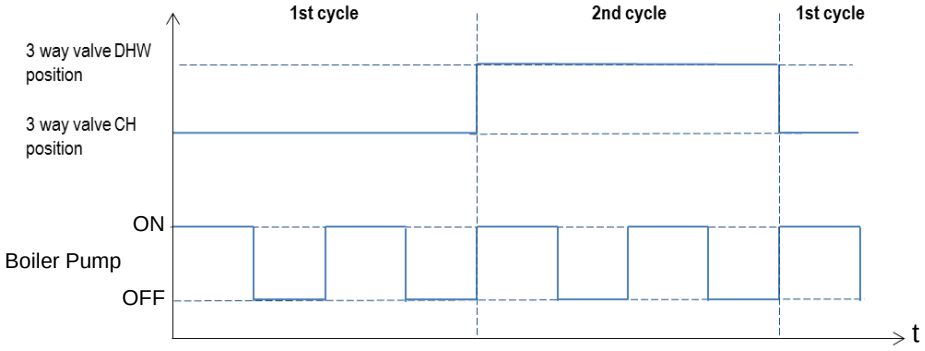
7.18 *Automatic air purging of the heat exchanger*

The De-Air sequence it is a safety function starting at every power ON and is used to remove the air from the heat-exchanger. The De-Air sequence does not start after a general reset (such as the locking error reset or 24 hours reset)
The display will show ‘dAir’ indicating that the controller is performing the De-Air sequence to purge the heat exchanger of air, by sequencing the boiler pump OFF and ON. The installer/technician can cancel the De-Air sequence by pressing a specific key-button combination from the display. By default, “De-Air” sequence takes around 14 minutes.

• 1st cycle: The 3 ways valve moves to CH position and the general pump is activated for 10 seconds, deactivated for 10 seconds, activated again for 10 seconds and then deactivated again for 10 seconds (DAir_Repetition_On-Off, which means ON/OFF/ON/OFF each time for 10 seconds = 40 seconds in total).
• 2nd cycle: it starts when 1st cycle is ended. The 3 ways valve is moved to DHW position and repeats the same cycling of the pump (DAir_Repetition_OnOff, which means ON/OFF/ON/OFF each time for 10 seconds = 40 second in total).

This sequence (1st cycles + 2nd cycles) is performed DAir_Number_Cycles times (if DAir_Number_Cycles is 10 ‘De-air’ sequence lasts (10 x 40) x 2 = 800 seconds).
During De-Air sequence no heating or hot water demand will be served.
When the water pressure is too low, or pressure sensor is in error, the De-Air sequence will be suspended until water pressure / sensor pressure is stable again. In that case the De-Air sequence will last longer than the estimated 14 minutes.

The following scheme below shows the behavior of the 3-way valve and boiler pump during one whole cycle of De-Air sequence with a DAir_Repetition_OnOff set to 2.



Relevant variables:

Specific Parameters	Level	(Default) Value	Range
De_Air_Config 0 = DAir disabled; 1 = DAir enabled.	2: Installer	0	0…1
De_Air_State	1: User	-	-
Current state of the DAir function.			
DAir_Repetition_OnOff Number of repeating ON/OFF.	2: Installer	2	0…255
DAir_Number_Cycles Number of DAir cycles.	2: Installer	10	0…255

7.19 *Automatic Feed Valve*

If an automatic feed valve is installed in the system, it should not be left open indefinitely. A continuous feed of fresh water could damage the system (fresh water is bringing fresh oxygen into the system). It is recommended that after a short period of time following the installation of the boiler into a heating system that the automatic feed valve be closed

When using an automatic water refill system some precautions should be taken, like installing a water meter to measure and evaluate the total water volume that is added to the system. A water meter can be used to detect and eliminate any water leakage as soon as possible.

When an automatic feed valve system is used, some form of logging should take place to prevent continuously filling of the system with large amounts of oxygenated fresh water. This can happen when a leak in the system is not detected and the total added water amount is not being logged.

7.20 *Water pressure*

The installation should be designed and built to conform to all applicable regulations and standards, including the right safety relief valves. IMPORTANT: Always keep the pressure in the boiler lower than the value at which its safety relief valve opens.

Sensor

A water pressure sensor has been built into the boiler. The minimum water pressure in the boiler is 15 psi and the maximum pressure is 87 psi. The normal water pressure should be between 22 and 50 psi. Or 22 and 75 psi when the optional pressure relief valve is used. The pressure sensor will stop the boiler from firing when the water pressure drops below 10 psi, and starts the boiler firing again when the water pressure reaches above 15 psi.

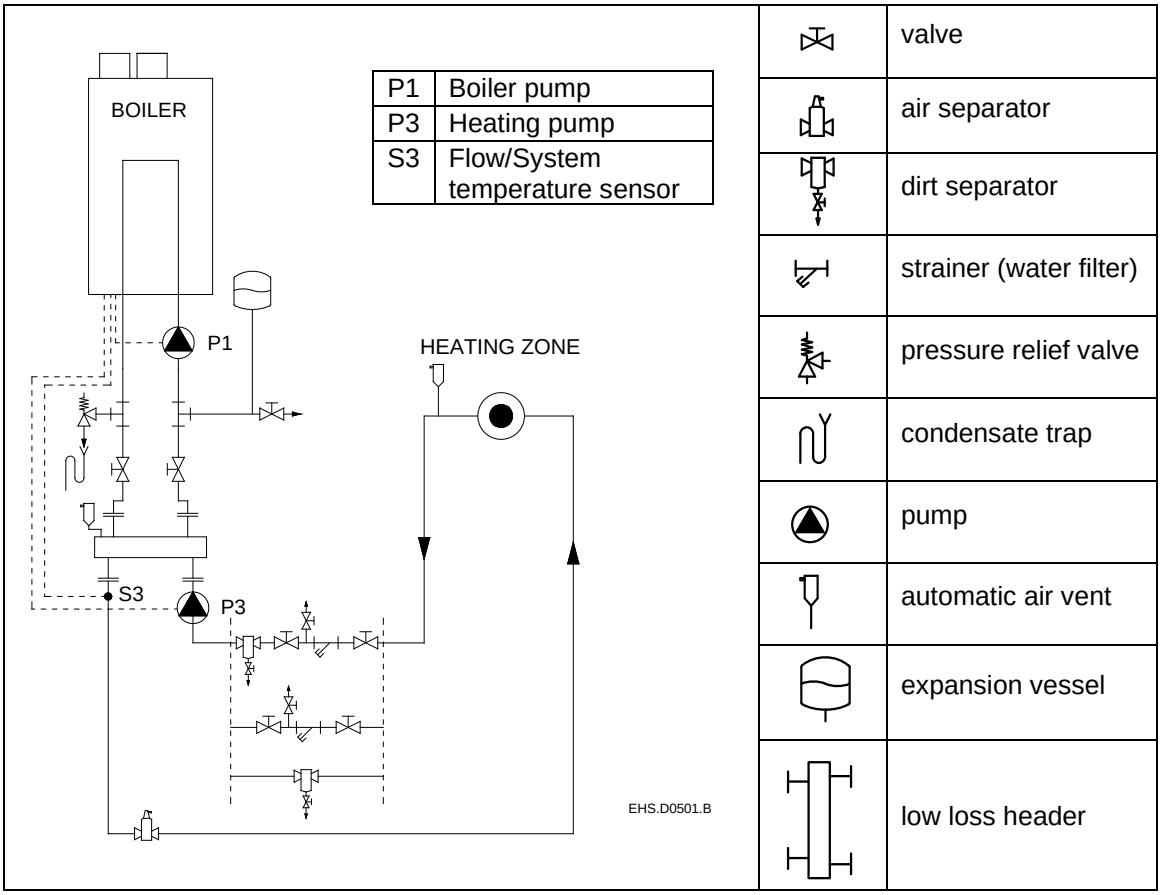
These values should never be changed in the boiler control settings. The boiler cannot be properly purged of air if the water pressure is less than 15 psi.

Higher pressure systems (e.g. in high buildings)

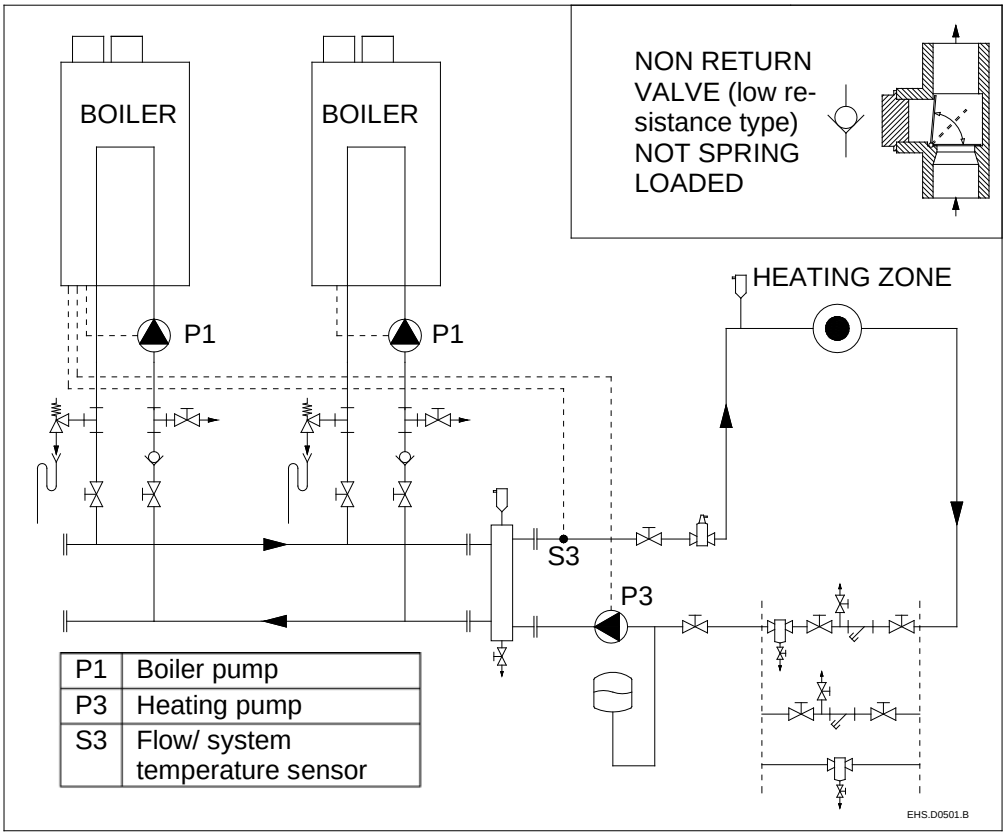
If a pressure higher than 87 psi is required for the heating system, the best solution is to separate the system from the boiler by means of a plate heat exchanger. In this way, the boiler pressure can remain under 87 psi. (60 psi recommended)

7.21 *Installation examples*

7.21.1 EXAMPLE OF A NORMAL SINGLE BOILER HEATING CIRCUIT WITH LOW LOSS HEADER (PREFERABLE)



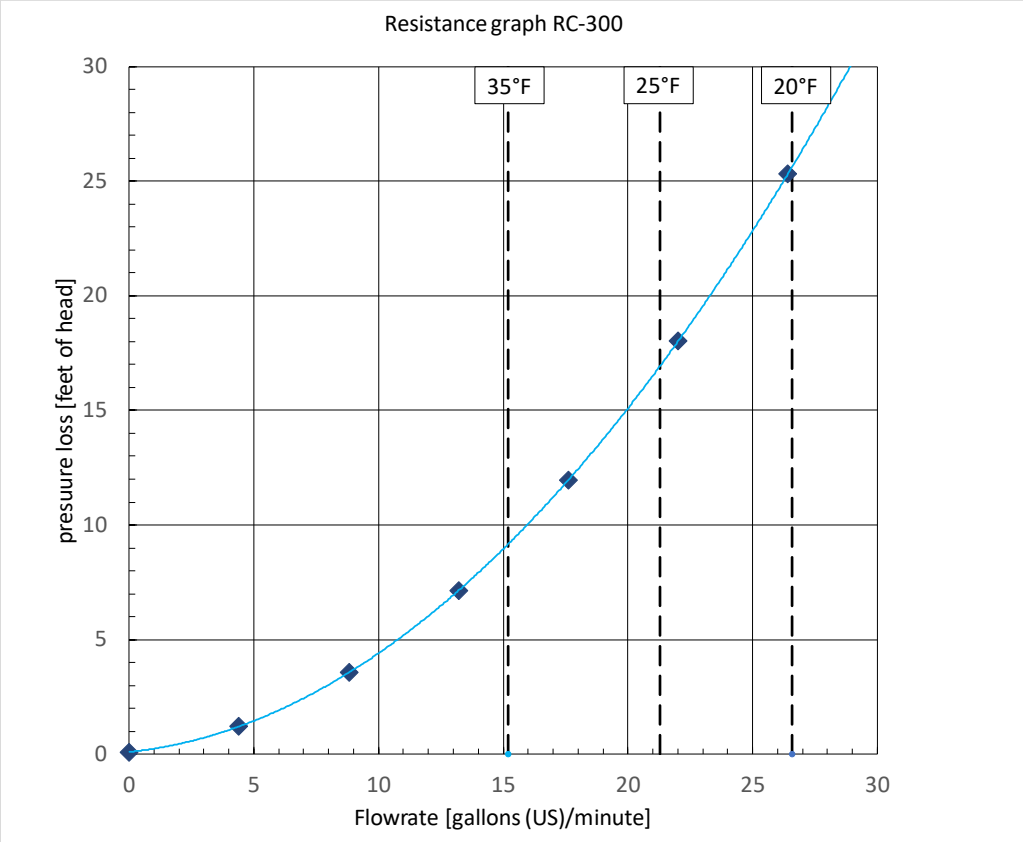
7.21.2 EXAMPLE OF A MULTIPLE BOILER HEATING CIRCUIT WITH LOW LOSS HEADER



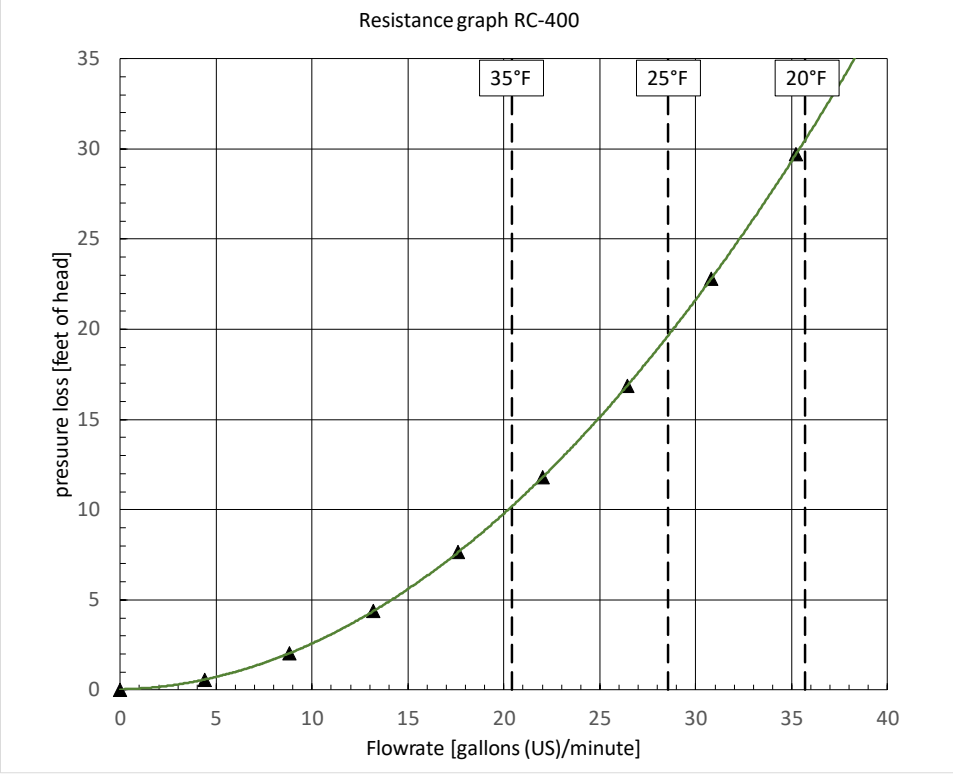
8 PUMP CHARACTERISTICS

8.1 *Hydraulic graphs*

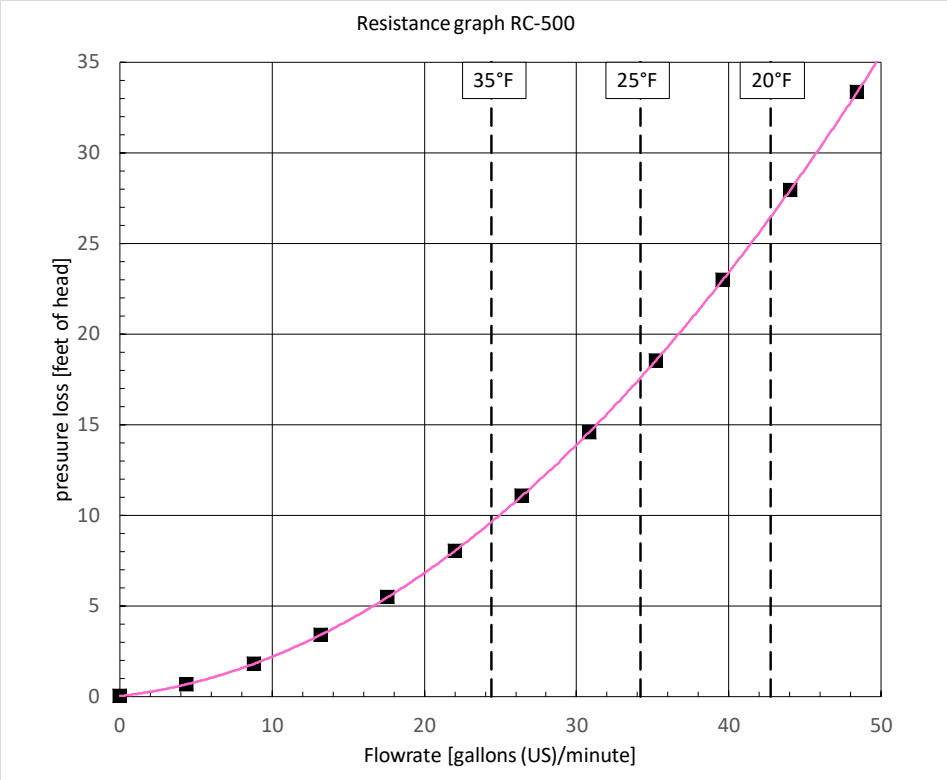
8.1.1 BOILER RESISTANCE GRAPH RC-300



8.1.2 BOILER RESISTANCE GRAPH RC-400



8.1.3 BOILER RESISTANCE GRAPH RC-500



8.2 *Minimum required pump head.*

Boiler	at flow rate [gpm]	min required feet of head
RC-300	27	33
RC-400	36	38
RC-500	43	34

8.3 *Modulating pump for CH demand*

It is possible to connect a PWM pump. The control supports PWM modulation for the general pump. Parameter 136 has to be set to modulating (Factory set to on/off pump) when using a modulating pump
The boiler pump is modulated when there is a demand for CH.
During any other demand, the PWM pump will run at a fixed speed set by the Default Duty cycle parameter. How the pump is modulated is controlled with the Modulating_Pump_Mode setting.

8.4 *Modulating pump modes*

There are several modulating pump modes implemented in the software.
By selecting a different modulating pump mode, the pump behavior can be changed. The following modulating pump modes are available.

Modulating pump mode		Details
0:	Disabled	No pump modulation; the PWM duty cycle is always 0%.
1:	Delta temperature modulation	Calculated duty cycle to create a delta temperature between the T_Supply and T_Return sensor.
2:	Fixed 20% speed	Fixed duty cycle of 20%.
3:	Fixed 30% speed	Fixed duty cycle of 30%.
4:	Fixed 40% speed	Fixed duty cycle of 40%.
5:	Fixed 50% speed	Fixed duty cycle of 50%.
6:	Fixed 60% speed	Fixed duty cycle of 60%.
7:	Fixed 70% speed	Fixed duty cycle of 70%.
8:	Fixed 80% speed	Fixed duty cycle of 80%.
9:	Fixed 90% speed	Fixed duty cycle of 90%.
10:	Fixed 100% speed	Fixed duty cycle of 100%.

8.4.1 DELTA TEMPERATURE MODULATION

When the modulating pump mode 1 Delta temperature modulation is selected the pump modulates to create a delta of T_Delta between the T_Supply and T_Return sensors. This modulation is only done when the control is in burn.
When the boiler starts the duty cycle is kept at the Default Duty cycle setting for the time set by Burn Stabilize Time. After this time, the PID calculated duty cycle is used.

During modulation, the duty cycle output changes according to the following logic:
- Actual delta temperature is greater than the selected T_Delta
- The pump speed increases so there is less time to cool down the heated water. This results in the T_Return temperature increasing.
- Actual delta temperature is smaller than the selected T_Delta
- The pump speed decreases so there is more time to cool down the heated water. This results in the T_Return temperature decreasing.

8.4.2 PID CALCULATION SCALING

For a better burner modulation, the modulating pump PID calculation interval is slower when the T_Supply sensor is close to the actual CH supply setpoint.

The temperature range in which this is limited is set by the PID Scaling Range parameter. When the T_Supply sensor is outside this range the PID calculation is performed every 100 ms. When the T_Supply sensor temperature is at its setpoint the PID calculation is performed every 1000 ms.

In the range set by the PID Scaling Range parameter the PID calculation speed is scaled in a linear way.

8.5 *Pump: maximum electrical power*

General
- The inrush current of a conventional pump is approximately 2½ x its nominal current.
- The maximum switch current of the PCB is 4 A.
- The total current of pcb and gas valve is approx. 0.5 A. all field supplied pumps and valves for the boiler loop, DHW, and the system that are connected to the boiler may not exceed 3.5 A. Use separate relays if higher currents are needed. The fan is separately connected to the main supply and has a fuse of 3.15 A.

Pump P1 - boiler pump.
This pump is NOT part of the appliance. The maximum combined current for the boiler loop pump and any additional pumps and valves may not exceed 2 A.

Pump P2 - calorifier pump.
Pump P2 is a DHW indirect tank pump, meaning it's not part of the appliance. The maximum combined current for the indirect tank pump and any additional pumps and valves may not exceed 2 A.

3-way valve.
The combined nominal current of pump P1 and the 3-way valve may not exceed 2 A.
.

Pump P3 - system pump.
The maximum combined current of pump P3 and the other connected pumps may not exceed 2 A.

Warning (ECM pumps):
When using an ECM pump, it cannot be powered directly by the boiler. Use a relay to isolate the boiler from the pump.

WARNING : Use an external relay if pump current exceeds 2 A.

NOTICE	To all outputs following applies: maximum current 2 Amp each output. Total output of all currents combined maximum 3.5 Amp. The inrush current of the 3-way valve and/or pumps is maximum 8 Amp.

9 FLUE GAS AND AIR SUPPLY SYSTEM

9.1 *General venting.*

The boiler has a positive pressure vent system.
The boiler is for either direct vent installation or for installation using indoor combustion air, category IV, appliance with sealed combustion requiring certain venting systems. All combustion air is drawn from outdoors or indoor. All products of combustion are vented directly outdoors. The vent, and if applicable air-intake piping, should be piped to the outdoors. Under no conditions may this appliance vent gases into a masonry chimney. The internal safety system shuts down the boiler in case the temperature of the flue gasses becomes too high, after which the appliance will not run until manually restarted. Installations must comply with CSA B149.1 and local requirements.

The front cover creates an air tight enclosure making sure air is only supplied by the vent air intake. Therefore, make sure the front cover always has been placed in its position during operation of the appliance.

NOTICE	• Install all horizontal vent components with a minimum angle of 3° downwards in the direction of the boiler (roughly equal to 1/4 inch per foot or 5 cm per meter). When not installed accordingly, it may result in condensate building-up in the vent gas tube, eventually causing component failure. • When using a wall terminal, there is the possible risk of ice building-up on surrounding parts/structures, because the condensate will freeze. This risk should be taken into account during the design phase of the heating installation. • Because the flue gases can have a low temperature, the boiler needs to have a high efficiency approved stainless steel or plastic vent system. These materials, including the gaskets, should be usable for positive pressure vent gas systems. • **These parts must be certified for use at temperatures of minimal 70°C / 158°F** (See also warnings below).

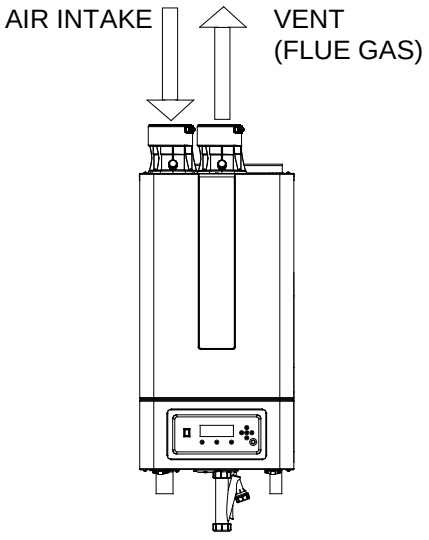
9.1.1 VENT SIZING.

Boiler	Intake Air and Exhaust
RC-300 RC-400	4"
RC-500	6"

NOTICE	Increasing or decreasing combustion air or vent piping sizes is not permitted.

Vent connector: used to provide a passageway for conveying combustion gases to the outside. A connector is provided on the unit for final connection. Vent piping must be supported per the National Building Code, Section 305, Table 305.4 or as local codes dictate.

Connections vent gas (vent) and air supply:



9.1.2 **VENT AND AIR INLET RESISTANCE TABLE**

Minimum and maximum allowable combined vent and air inlet length:

- Minimum venting length: two feet (2 ft) for all boilers
- Maximum venting length: see table below.

Maximum Exhaust Length / Maximum Combustion Air Intake Length			
	RC-300	**RC-400**	**RC-500**
4"	228' / 228'	121' / 121'	92' / 92'
5"			359' / 359'
6"			605' / 605'

NOTICE	For long lengths, check venting pipe and fittings for maximum allowable pressure. This table may only be used for a single vent/air system for one boiler. Do **NOT** use this table for common vent systems with cascaded boilers.

Pipe, elbows, tees - equivalent feet: for DuraVent PolyPro

Item\ size	4"	5"	6"
1 ft Vent Pipe	1 ft	1 ft	1 ft
1 ft Flex Pipe (same diameter as rigid)	2 ft	2 ft	NA
1 ft Flex Pipe (upsized one diameter)	0.6 ft	NA	NA
45 Elbow	5 ft	6 ft	6 ft
90 Elbow	12 ft	14 ft	14 ft
Tee	19 ft	21 ft	22 ft

Terminals equivalent feet: for DuraVent PolyPro

BOILER	TERMINAL	size	part #	
RC-300 RC-400	concentric roof:	4" vent	4PPS-VKL 4PPS-VK-TCL	37 ft
	concentric wall:	4" vent	4PPS-HKL	13 ft
	2 pipe wall:	4" vent	3x 4PPS-E90BL elbow + 2x 4PPS-BG bird screen	42 ft
RC-500	2 pipe wall:	6" vent	3x 6PPS-E90BL elbow + 2x 6PPS-BG bird screen	50 ft

9.2 *Vent and air intake pipe material*

Items	**Materials** [1]	**Venting System Standards**		**Warning**
		United States	**Canada** [3]	
Flue piping and Fittings	CPVC Schedule 40	ANSI/ASTM F441	All venting material in Canada must be ULC S636 approved.	All Vent and Air-Inlet materials installed on gas fired appliances in CAN/US must meet the Standards listed in this Table. Failure to comply could result in fire, serious injury or death.
	PVC Schedule 40	ANSI/ASTM D1785		
	Stainless Steel SS	UL-1738		
	Polypropylene PP	-		
Air inlet piping and Fittings [2]	PVC - DWV	ANSI/ASTM D2265		
	Stainless Steel SS	UL-1738		
	Polypropylene PP	-		
Pipe cement	PVC	ANSI/ASTM D2564		
	CPVC	ANSI/ASTM F493		
Primers	PVC/CPVC	ANSI/ASTM F656		

Notes:
1 PVC venting (exhaust and air-inlet) is not permitted within the Closet/alcove of a Closet/alcove installation.
2 The air-inlet does not require high temperature pipe material. Check applicable local codes for acceptable materials.
3 Use only vent gas material suitable for flue gas temperatures of 158°F (70°C) or higher.

WARNING	• Never use aluminum containing vent pipes in these boilers. • Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance. Failure to follow instructions may result in serious injury or death. • In Canada, the first piece of vent piping must be readily accessible for inspection. • Covering non-metallic vent pipe and fittings with thermal insulation is prohibited. Failure to follow these instructions may result in property damage, personal injury or death.

9.2.1 **APPROVED MANUFACTURERS**

PVC/ CPVC venting:
* IPEX System 636

Polypropylene venting:
* Duravent - PolyPro
* Centrotherm - InnoFlue

Stainless steel venting:
* Duravent - FasNSeal, FasNSeal Flex
* Security Chimneys - Secure seal SS/SSD/SSID

NOTICE	READ THE MANUAL PROVIDED BY THE VENT GAS AND AIR SYSTEM SUPPLIER CAREFULLY

9.3 *PVC / CPVC*

This product has been approved for use with the PVC/CPVC vent materials listed in this manual.
All terminations must comply with listed options in this manual and be a single-wall vent offering.
For support and special connections required, see the manufacturer's instructions. All vent is to conform to standard diameter and equivalent length requirements established.

Approved PVC/ CPVC vent pipe and fittings:

IPEX – System 636

BOILER	FITTING	PART #
RC-300 RC-400	4" Concentric Termination CPVC	197021
	4" Low profile Termination	196986
	4" FGV 45° Elbow CPVC	197172
	4" FGV 90° Elbow CPVC	197202
	4" Termination Vent Screen	196052
RC-500	6" FGV 45° Elbow CPVC	197173
	6" FGV 90° Elbow CPVC	197203
	6" Termination Vent Screen	196090

WARNING	PVC In Canada • Safety authorities in some jurisdictions are not allowing PVC venting materials with appliances of any kind, even if System 636 certified. Check with the local safety inspector to verify compliance. • Canadian installations must comply with the current CSA B149.1 Installation Code and local building codes.
NOTICE	PVC exhaust venting: When using PVC venting, the first part of exhaust venting must be approved CPVC or PP. This starter piece must have a minimum length (in feet) according to table:

Design Supply Max. Limit	RC-300	RC-400	RC-500
176°F (80°C)	0 ft	0 ft	0 ft
185°F (85°C)	0 ft	2 ft	0 ft
194°F (90°C)	0 ft	4 ft	2 ft

WARNING: "Design Supply Max. Limit" limits the "CH setpoint" (supply temperature). Default setting for this limit is 194°F (90°C), for other temperatures the installer has to change this temperature in the installer menu, to match table above.
This is "boiler parameter": no. (24) - "Design supply Max. Limit".
(chapter "Screens and settings": menu\settings\boiler settings\(password)\boiler parameters)

WARNING	• The use of cellular core PVC (ASTM F891), cellular core CPVC, or Radel® (polyphenol sulfone) in the exhaust venting system is prohibited. Failure to follow these instructions may result in property damage, personal injury or death. • The vent connection to the appliance must be made with the starter CPVC or PP pipe section provided with the appliance if PVC/CPVC vent is to be used. • Failure to follow this warning could result in fire, personal injury, or death.

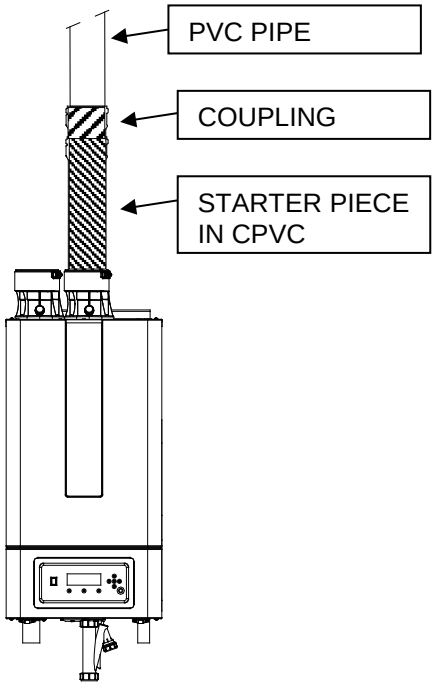
WARNING	• Insulation should not be used on PVC or CPVC venting materials. The use of insulation will cause increased vent wall temperatures, which could result in vent pipe failure. • The PVC/ CPVC pipe and fittings must be cemented using an “All Purpose Cement” suitable for PVC and CPVC pipe. Use only the vent materials, primer and cement specified in this manual to make the vent connections. Failure to follow this warning could result in fire, personal injury, or death.
NOTICE	• In Canada, CPVC and PVC vent pipe, fittings and cement/ primer must be ULC-S636 certified. • Use only cleaners, primers, and solvents that are approved for the materials which are joined together. • All PVC vent pipes must be glued, properly supported, and the exhaust must be pitched a minimum of a 1/4 inch per foot back to the boiler (to allow drainage of condensate).

9.3.1 **INSTRUCTIONS FOR WORKING WITH CEMENTING PVC/ CPVC PIPE CONNECTIONS:**

1. Work from the boiler to vent or air termination. Do not exceed the lengths given in this manual for the air or vent piping.
2. Cut pipe to the required lengths and deburr the inside and outside of the pipe ends.
3. Chamfer outside of each pipe end to ensure even cement distribution when joining.
4. Clean all pipe ends and fittings using a clean dry rag. (Moisture will retard curing and dirt or grease will prevent adhesion.)
5. Dry fit vent or air piping to ensure proper fi t up before assembling any joint. The pipe should go a third to two-thirds into the fitting to ensure proper sealing after cement is applied.
6. Priming and Cementing:
   a. Handle fittings and pipes carefully to prevent contamination of surfaces.
   b. Apply a liberal even coat of primer to the fitting socket and to the pipe end to approximately 1/2" beyond the socket depth.
   c. Apply a second primer coat to the fitting socket.
   d. While primer is still wet, apply an even coat of approved cement to the pipe equal to the depth of the fitting socket along with an even coat of approved cement to the fitting socket.
   e. Apply a second coat of cement to the pipe.
   f. While the cement is still wet, insert the pipe into the fitting, if possible twist the pipe a 1/4 turn as you insert it. NOTE: If voids are present, sufficient cement was not applied and joint could be defective.
   g. Wipe excess cement from the joint removing ring or beads as it will needlessly soften the pipe.

<u>Near boiler PVC/ CPVC venting.</u>

Starter piece must have a minimum length according table "PVC Exhaust Venting".



9.4 *Polypropylene*

This product has been approved for use with polypropylene vent with the manufacturers listed.
All terminations must comply with listed options in this manual and be a single-wall vent offering.
For support and special connections required, see the manufacturer's instructions.
All vent is to conform to standard diameter and equivalent length requirements established.

Approved polypropylene vent pipe and fittings.

SUPPLIER	TYPE
Duravent	PolyPro
Centrotherm	InnoFlue

Approved polypropylene terminations:

Duravent - PolyPro

BOILER	TERMINATION	COLOR:	ORDER #:	STOCK #:
RC-300 RC-400	4” Twin Pipe Side Wall	black	4PPS-HTPL	810009745
	4” Single Pipe Side Wall	Stainless	4PPS-HSTSL	810009744
	4” Bird Screen	Stainless	4PPS-BG	810004367
	4" concentric roof	black	4PPS-VKL	810009752
		terra-cotta	4PPS-VK-TCL	810009753
	4" concentric wall	white	4PPS-HKL	810009742
RC-500	5” Roof	black	5PPS-VTML	810009770
	5” Single Pipe Side Wall	Stainless	5PPS-HSTL	810009763
	6” Roof	black	6PPS-VTML	810009791
	6” Single Pipe Side Wall	Stainless	6PPS-HSTL	810009784
	6” Bird Screen	Stainless	6PPS-BG	810004276

Centrotherm Innoflue

BOILER	TERMINATION	COLOR	ORDER
RC-300 RC-400	4” Twin Pipe Side Wall	black	ISLPT0404
	4" Termination Tee	black	ISTT0420
	4" Termination Pipe	black	ISEP04 or ISEP0439
	4” Bird Screen	black	IASPP04
	4" Concentric roof termination		ICRT4679
	4" Concentric wall termination		ICWT462
RC-500	5" Termination Tee	black	STT0520
	5” Bird Screen	stainless	IASSS05
	6" Termination Pipe	grey	ISEP0620 or ISEP0639
	6" Termination Tee	grey	ISTT0620
	6” Bird Screen	black	IASPP06
	6" Roof flashing		IAPRF06 or IAFRF06
	6" End pipe		ISEP06
	6" Wall plate		IAWP06BP
	6" Support clamp		IASCM06

9.4.1 FLEXIBLE POLYPROPYLENE

For use of flex pipe, it is recommended to have the vent material in 32°F or higher ambient space before bending at installation. No bends should be made to greater than 45° and ONLY installed in vertical or near vertical installations.

DANGER	• Insulation is prohibited from use on all types of plastic venting material: PVC, CPVC, and Polypropylene. • Use only the adapters and vent system listed. • DO NOT mix vent systems of different types or manufacturers. • Failure to comply could result in severe personal injury, death, or substantial property damage.
NOTICE	• All vent connections MUST be secured by the vent manufacturer's joint connector. • The installer must use a specific vent starter adapter at the flue collar connection. The adapter is supplied by the vent manufacturer to adapt to its vent system. • Installations must comply with applicable national, state, and local codes. • For Canadian installation, polypropylene vent must be listed as a ULC-S636 approved system. • Installation of a polypropylene vent system should adhere to the vent manufacturer's installation instructions supplied with the vent system.

9.4.2 STAINLESS STEEL VENT.

This product has been approved for use with stainless steel using the manufacturers listed.

Approved stainless steel vent pipe and fittings.

SUPPLIER	TYPE
Duravent	FasNSeal, FasNSeal Flex
Security Chimneys	Secure Seal SS/SSD/SSID
Heat Fab	Saf-T EZ Seal

*Use of FasNSeal Flex smooth inner wall vent is to be used in vertical or near vertical sections only, taking precaution to ensure no sagging occurs of the vent system. Connect to the FasNSeal rigid vent using specially designed adapters and sealing method, see manufacturer's instructions.

WARNING	• Use only the materials, vent systems, and terminations listed. • DO NOT mix vent systems of different types or manufacturers. • Failure to comply could result in severe personal injury, death, or substantial property damage.
NOTICE	• The installer must use a specific vent starter adapter at the flue collar connection, supplied by the vent manufacturer to adapt to its vent system. • Installations must comply with applicable national, state, and local codes. Stainless steel vent systems must be listed as a UL-1738 approved system for the United States and a ULC-S636 approved system for Canada. • Installation of a stainless-steel vent system should adhere to the stainless-steel vent manufacturer's installation instructions supplied with the vent system.

Approved Stainless Steel Terminations.

	Duravent	**Security Chimneys**	**HeatFab**
	FasNSeal	Secure Seal	Saf-T EZ Seal/ EZ 316
BOILER	TERMINATION	TERMINATION	TERMINATION
RC-300 RC-400	FSBS4 (bird screen wall) FSRC4 (rain cap roof)	SS4STAU (screen termination SS4RC (rain cap roof)	5490CI (horizontal termination) 5400CI (rain cap)
RC-500	FSBS6 (bird screen wall) FSRC6 (rain cap roof)	SS6STAU (screen termination SS6RC (rain cap roof)	5690CI (horizontal termination) 5600CI (rain cap)

9.5 *Sealed Combustion Air supply*

When an air supply pipe is connected from the outside of the building to the boiler, the boiler will operate as a sealed combustion boiler.

The air supply duct can be made of PVC, PP or Stainless steel

9.5.1 COMBUSTION AIR QUALITY

Combustion air must be free of contaminants. Do not install the intake for the combustion air venting in an area which contains corrosive or other contaminants as outlined in § 9.6 tables "Indoor air kit".

9.5.2 AIR SUPPLY THROUGH HUMID AREAS

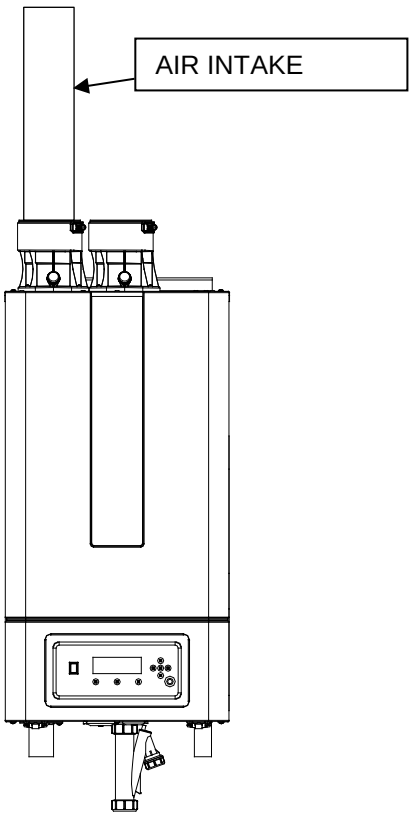
When the combustion air pipe will run through an area with high humidity (for example: greenhouses), a double walled supply pipe or an insulated duct must be used to prevent the possible condensation on the outside of the pipe. It is not possible to insulate the internal air pipes of the boiler and therefore condensation at the internal air canals must be prevented.

When the intake combustion air is terminated vertically through a roof an approved termination designed to prevent water from entering into the combustion air pipe must be used.

9.5.3 AIR INTAKE/VENT CONNECTIONS :

Combustion air intake connector (fig. below). Used to provide combustion air directly to the unit from outdoors. A connector is provided on the unit for final connection. Combustion air piping must be supported per guidelines listed in the National Mechanical Code, Section 305, Table 305.4 or as local codes dictate.

Near boiler air piping:



9.5.4 AIR INLET PIPE MATERIALS

The air inlet pipe(s) must be sealed. Choose acceptable combustion air inlet pipe materials from the following list:
- PVC, CPVC or PP
- Flexible propylene air intake
- Galvanized steel vent pipe with joints and seams sealed as specified in this section.
- Type “B” double-wall vent with joints and seams sealed as specified in this section.
- AL29-4C, stainless steel material to be sealed to specification of its manufacturer.

WARNING	Using air intake materials other than those specified can result in personal injury, death or property damage.
NOTICE	The use of double-wall vent or insulated material for the combustion air inlet pipe is recommended in cold climates to prevent the condensation of airborne moisture in the incoming combustion air.

Sealing of Type “B” double-wall vent material or galvanized vent pipe material used for air inlet piping on a wall or vertical rooftop Combustion Air Supply System:

a. Seal all joints and seams of the air inlet pipe using either Aluminum Foil Duct Tape meeting UL Standard 723 or 181A-P or a high-quality UL Listed silicone sealant such as those manufactured by Dow Corning or General Electric.
b. Do not install seams of vent pipe on the bottom of horizontal runs.
c. Secure all joints with a minimum of three (3) sheet metal screws or pop rivets. Apply Aluminum Foil Duct Tape or silicone sealant to all screws or rivets installed in the vent pipe.
d. Ensure that the air inlet pipes are properly supported.

The PVC or CPVC air inlet pipe should be cleaned and sealed with the pipe manufacturer’s recommended solvents and standard commercial pipe cement for the material used.
Proper sealing of the air inlet pipe ensures that combustion air will be free of contaminants and supplied in proper volume.
Follow the polypropylene or flexible polypropylene manufacturer’s instructions when using polypropylene material as an inlet pipe.
When a wall or vertical rooftop combustion air supply system is disconnected for any reason, the air inlet pipe must be resealed to ensure that combustion air will be free of contaminants and supplied in proper volume.

DANGER	Failure to properly seal all joints and seams as required in the air inlet piping may result in flue gas recirculation, spillage of flue products and carbon monoxide emissions causing severe personal injury or death.

9.6 *Room air*

Commercial applications utilizing the boiler may be installed with a single pipe carrying the flue products to the outside while using combustion air from the equipment room. In order to use the room air venting option, the following conditions and considerations must be followed.

• The unit MUST be installed with the appropriate room air kit (table § 9.6 Room air).
• The equipment room MUST be provided with properly sized openings to assure adequate combustion air. Please refer to instructions provided with the indoor air kit.
• There will be a noticeable increase in the noise level during normal operation from the inlet air opening.
• Using the room air kit makes the unit vulnerable to combustion air contamination from within the building. Please review the section 9.6.1 "Air contamination" in this manual, to ensure proper installation.
• Vent system and terminations must comply with the standard venting instructions set forth in this manual.

WARNING	When utilizing the single pipe method, provisions for combustion and ventilation air must be in accordance with Air for Combustion and Ventilation, of the latest edition of the National Fuel Gas Code, ANSI Z223.1/NFPA 54, in Canada, the latest edition of CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment, or applicable provisions of the local building codes.

Indoor air kit:

Duravent

Boiler	Termination	Color	order	stock
RC-300 RC-400	4” Twin Pipe Side Wall	black	4PPS-HTPL	810009745
	4” Single Pipe Side Wall	Stainless	4PPS-HSTSL	810009744
	4” Bird Screen	Stainless	4PPS-BG	810004367
RC-500	5” Roof	black	5PPS-VTML	810009770
	5” Single Pipe Side Wall	Stainless	5PPS-HSTL	810009763
	6” Single Pipe Side Wall	Stainless	6PPS-HSTL	810009784
	6” Bird Screen	Stainless	6PPS-BG	810004276

CENTROTHERM

Boiler	Termination	Color	order
RC-300 RC-400	4” Twin Pipe Side Wall	black	ISLPT0404
	4" Termination Tee	black	ISTT0420
	4" Termination Pipe	black	ISEP04 or ISEP0439
	4” Bird Screen	black	IASPP04
RC-500	5" Termination Tee	black	STT0520
	6" Termination Pipe	grey	ISEP0620 or ISEP0639
	6" Termination Tee	grey	ISTT0620
	6” Bird Screen	black	IASPP06
	5” Bird Screen	Stainless	IASSS05

9.6.1 AIR CONTAMINATION

Pool and laundry products and common household and hobby products often contain fluorine or chlorine compounds. When these chemicals pass through the boiler, they can form strong acids. The acid can eat through the boiler wall, causing serious damage and presenting a possible threat of flue gas spillage or boiler water leakage into the building.
Please read the information given in the list below, with contaminants and areas likely to contain them. If contaminating chemicals will be present near the location of the boiler combustion air inlet, have your installer pipe the boiler combustion air and vent to another location, per this manual.

WARNING	• The boiler should never be located in a laundry room or pool facility, for example, these areas will always contain hazardous contaminants. • To prevent the potential of severe personal injury or death, check for areas and products • listed in the list below, with contaminants before installing the boiler or air inlet piping. • If contaminants are found, you MUST: - remove contaminants permanently. - or - relocate air inlet and vent terminations to other areas.

Corrosive Contaminants and Sources

Products to avoid:	Spray cans containing chloro/fluorocarbons
	Permanent wave solutions
	Chlorinated waxes/cleaners
	Chlorine-based swimming pool chemicals
	Calcium chloride used for thawing
	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

Areas likely to have contaminants:	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
	New building construction
	Remodeling areas
	Garages with workshops.

9.7 *Proper vent installation and type of gas vent or vent connector.*

For boilers for connection to gas vents or chimneys, vent installations shall be in accordance with “Venting of Equipment,” of the National Fuel Gas Code, ANSI Z223.1/NFPA 54, or “Venting Systems and Air Supply for Appliances,” of the Natural Gas and Propane Installation Code, CAN/CSA B149.1, or applicable provisions of the local building codes.
Vent connectors serving appliances vented by natural draft shall not be connected into any portion of mechanical draft systems operating under positive pressure.

Covering non-metallic vent pipe and fittings with thermal insulation shall be prohibited.
For Category IV venting, the venting system shall be installed in accordance with the boiler manufacturer's installation instructions.

Non-combustible supports should be placed a minimum of every 4 feet on horizontal portions of the venting system to prevent sagging of the venting system. The supports should allow the boiler to be free from strain and prevent the weight of the venting system from resting on the boiler. The supports should allow for a ¼” (21 mm) slope upwards from the boiler to the termination. This will prevent the accumulation condensate and allow it to drain back towards the boiler and reduce the risk of icing at the termination.

9.8 *Install vent and combustion air piping*

DANGER	• The boiler must be vented and supplied with combustion and ventilation air as described in this section. Ensure the vent and air piping and the combustion air supply comply with these instructions regarding vent system, air system, and combustion air quality. See also sections "Determine vent location" at § 9.11.2 of this manual. • Inspect finished vent and air piping thoroughly to ensure all are airtight and comply with the instructions provided and with all requirements of applicable codes. • Failure to provide a properly installed vent and air system will cause severe personal injury or death.
WARNING	• This appliance requires a special venting system. Use only approved stainless steel, PVC, CPVC or polypropylene pipe and fittings listed for vent pipe, and fittings. Failure to comply could result in severe personal injury, death, or substantial property damage. • DO NOT mix components from different systems. The vent system could fail, causing leakage of flue products into the living space. Mixing of venting materials will void the warranty and certification of the appliance. • For closet and alcove installations, CPVC, polypropylene or stainless-steel material MUST BE used in the closet/alcove structure. Failure to follow this warning could result in fire, personal injury, or death. • Do not connect any other appliance to the vent pipe or multiple boilers to a common vent pipe. Failure to comply could result in severe personal injury, death, or substantial property damage.
CAUTION	Improper installation of venting systems may result injury or death.
WARNING	For US installations only, for Category II and Category IV appliances: The vent for this appliance shall not terminate: i) over public walkways; or ii) near soffit vents or crawl space vents or other areas where condensate or vapor could create a nuisance or hazard or cause property damage; or iii) where condensate vaper could cause damage or could be detrimental to the operation of regulators, relief valves, or other equipment.
NOTICE	Installation must comply with local requirements and with the National Fuel Gas Code, ANSI Z223.1/NFPA 54 for U.S. installations or CSA B149.1 for Canadian installations. Follow the instructions in this manual when removing a boiler from an existing vent system.

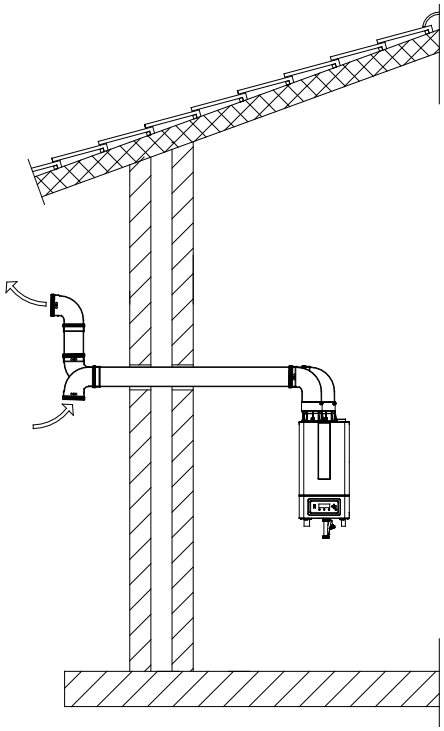
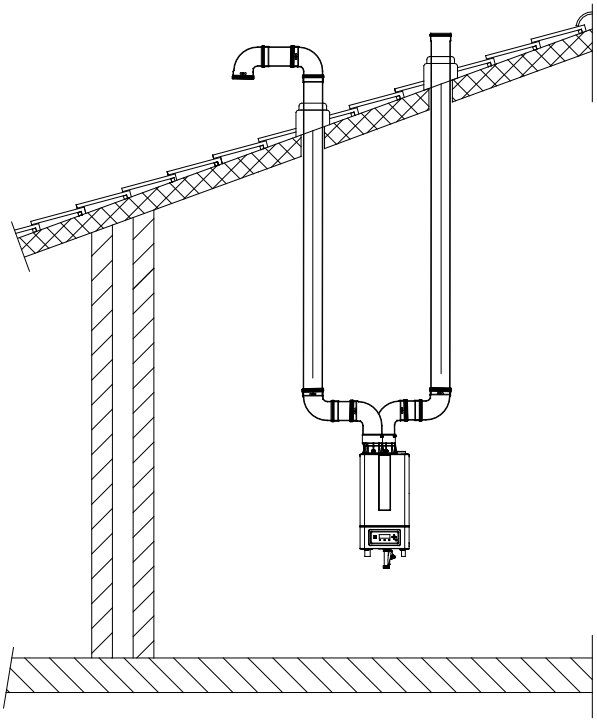
The boiler vent and air piping can be installed through the roof or through a wall. Follow the procedures in this manual for the method chosen. Refer to the information in this manual to determine acceptable vent and air piping length.
You may use any of the vent/air piping methods covered in this manual. Do not attempt to install the boiler using any other means.
You must also install air piping from outside to the boiler air intake adapter, unless following the "Room Air" instructions on page 44 of this manual. The resultant installation is direct vent (sealed combustion).

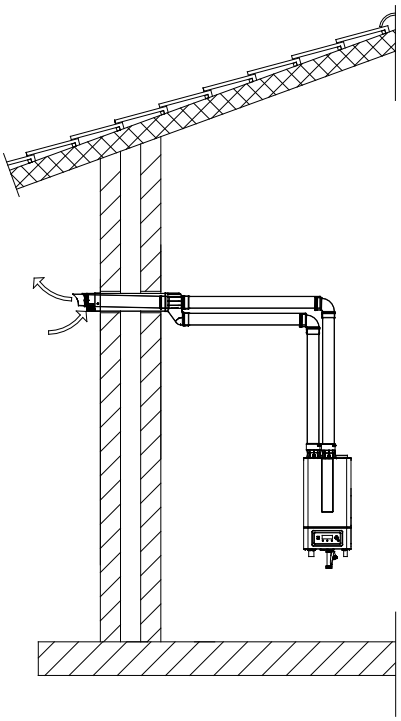
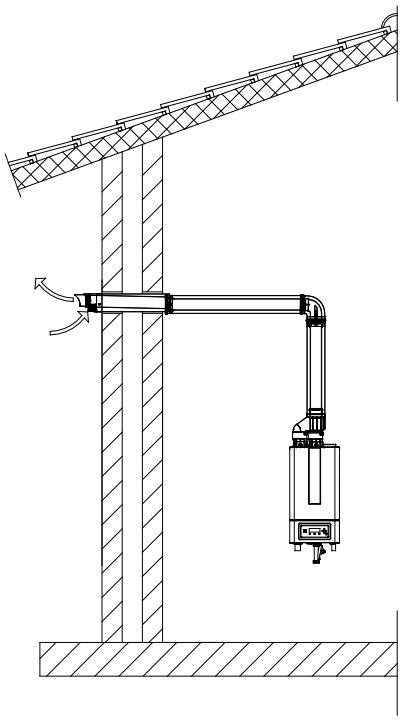
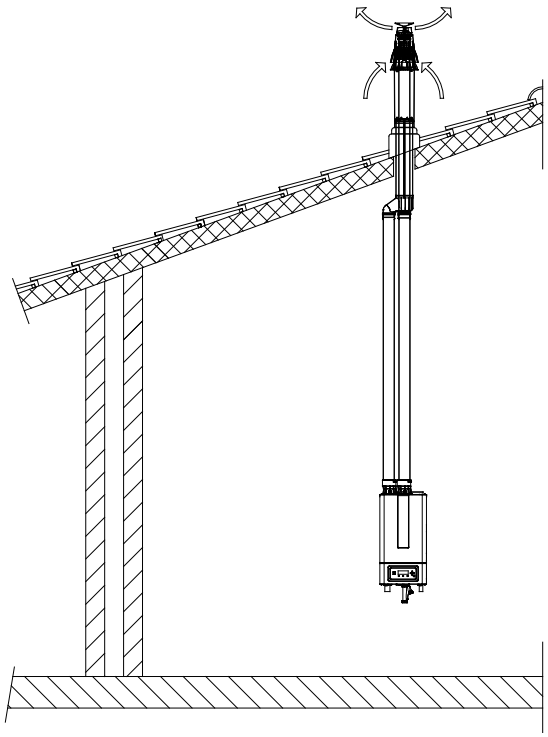
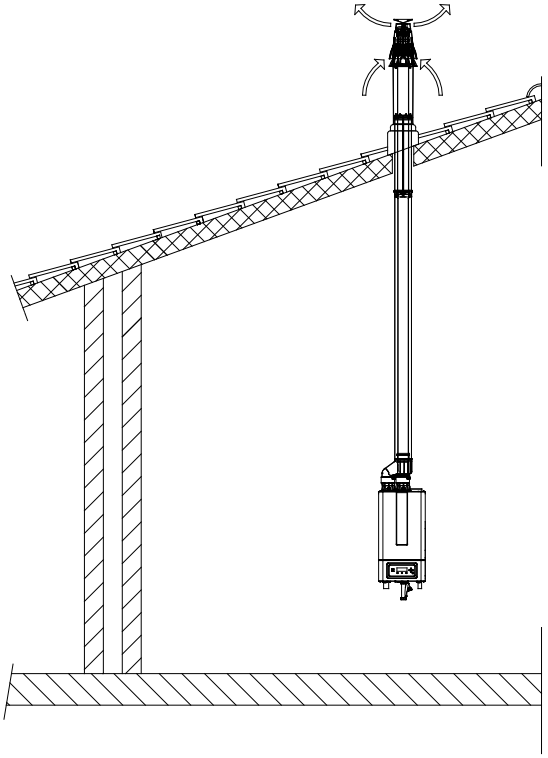
9.9 *Requirements for installation in Canada*

1. Installations must be made with a vent pipe system certified to ULC-S636.
2. The first three (3) feet of plastic vent pipe from the appliance flue outlet must be readily accessible for visual inspection.
3. The components of the certified vent system must not be interchanged with other vent systems or unlisted pipe/ fittings. For concentric vent installations, the inner vent tube must be certified vent material to comply with this requirement.

⚠ **WARNING**	• When utilizing the single pipe method, provisions for combustion and ventilation air must be in accordance with Air for Combustion and Ventilation, of the latest edition of the National Fuel Gas Code, ANSI Z223.1/NFPA 54, in Canada, the latest edition of CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment, or applicable provisions of the local building codes. • The inlet for combustion air can never be located inside a room storing chemicals or contaminants as listed in section 9.6.1. Avoid installing the boiler in any area with possible contaminants. • If contaminants are found, you MUST: - remove contaminants permanently. - or - relocate the boiler and air intake to an area free from all possible contaminants.

9.10 *Direct venting options*

Two pipe wall See page 49 for more details.	**Two pipe vertical** See page 54 for more details.
	

Concentric wall - two pipe to boiler Boilers RC-300, RC-400 only. See page 49 for more details.	**Concentric wall** - concentric to boiler Boilers RC-300, RC-400 only. See page 49 for more details.
	
Concentric vertical - two pipe to boiler Boilers RC-300, RC-400 only. See page 54 for more details	**Concentric vertical** - concentric to boiler Boilers RC-300 RC-400 only. See page 54 for more details.
	

9.11 *Wall (Horizontal) direct venting.*

9.11.1 VENT/AIR TERMINATION - WALL

WARNING	• Follow instructions below when determining vent location to avoid possibility of severe personal injury, death, or substantial property damage. • A gas vent extending through an exterior wall shall not terminate adjacent to a wall or below building extensions such as eaves, parapets, balconies, or decks. • Failure to comply could result in severe personal injury, death, or substantial property damage.

CAUTION	Maintain 12” of clearance above the highest anticipated snow level or grade or, whichever is greater. Please refer to your local codes for the snow level in your area

9.11.2 DETERMINE LOCATION

Locate the exhaust vent/air intake terminations using the following guidelines:

1. The total length of piping for exhaust vent or air intake must not exceed the limits given in the "General Venting" section on page 34 of this manual.

2. You must consider the surroundings when terminating the exhaust vent and air intake:
   a. Position the vent termination where exhaust gases will not damage nearby shrubs, plants or air conditioning equipment or be objectionable.
   b. The flue products will form a noticeable plume as they condense in cold air. Avoid areas where the plume could obstruct window views.
   c. Prevailing winds could cause freezing of condensate and water/ice buildup where flue products impinge on building surfaces or plants.
   d. Avoid possibility of accidental contact of flue products with people or pets.
   e. Do not locate the terminations where wind eddies could affect performance or cause recirculation, such as inside building corners, near adjacent buildings or surfaces, window wells, stairwells, alcoves, courtyards, or other recessed areas.
   f. Do not terminate above any door or window. Condensate can freeze, causing ice formations.
   g. Locate or guard vent to prevent condensate damage to exterior finishes.

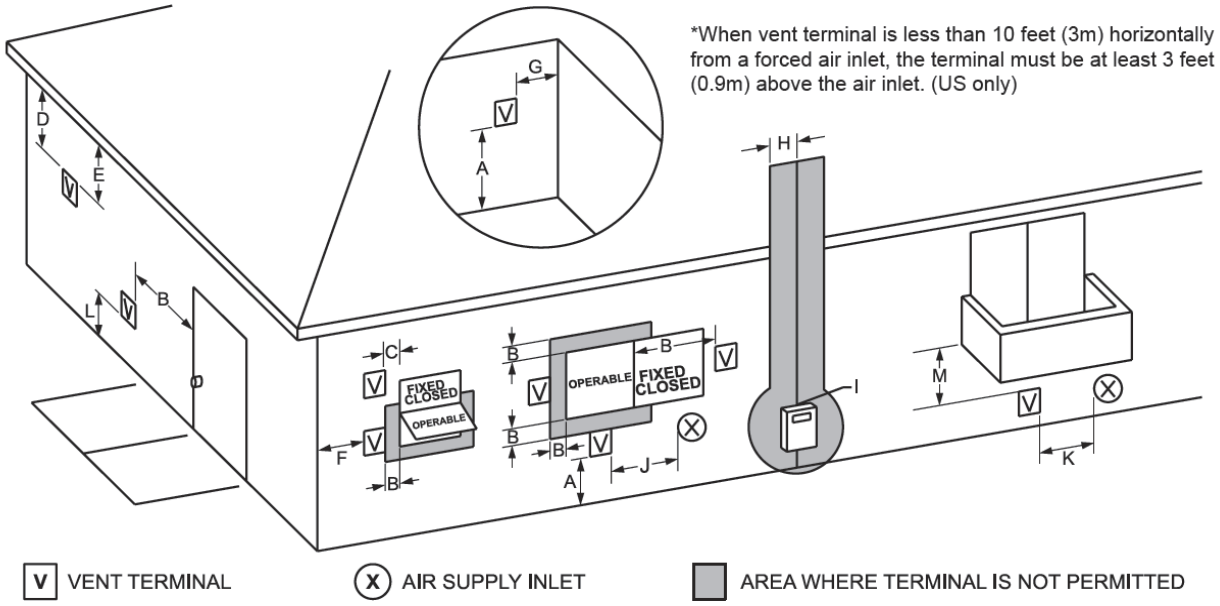
3. When using two pipe terminations the air intake piping must terminate in a down-turned elbow as shown in figure "Two pipe sidewall termination of air intake and exhaust vent". This arrangement avoids recirculation of flue products into the combustion air stream.

4. The exhaust piping must terminate horizontally in a section of straight pipe or an elbow pointed outward or away from the air inlet, as shown in figures "Two pipe sidewall termination of air intake and exhaust vent".

WARNING	Do not exceed the maximum lengths of the outside vent piping stated in this manual. Excessive length exposed to the outside could cause freezing of condensate in the vent pipe, resulting in potential boiler shutdown and possible blocked flue.

NOTICE	PVC/CPVC or PP is acceptable air intake pipe material

5. Maintain clearances as stated in this manual. Also maintain the following:

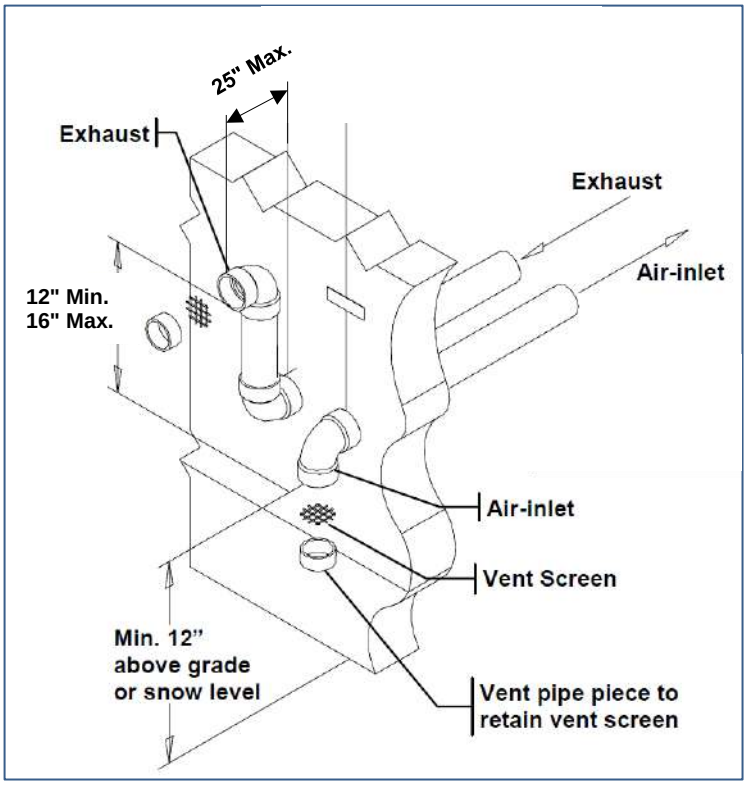


A	Clearance above grade, veranda, porch, deck, or balcony	12" (30 cm) see note 3	12" (30 cm) see note 3
B	Clearance to window or door that may be opened	Direct vent only: 12" (30 cm) Non-Direct vent: 4 ft (1.2 m) below or to side of opening; 1 ft (30 cm) above opening	36 inches (91 cm)
C	Clearance to permanently closed window	see note 4	see note 5
D	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 ft (61 cm) from the center line of the terminal	see note 4	see note 5
E	Clearance to unventilated soffit	see note 4	see note 5
F	Clearance to outside corner	see note 4	see note 5
G	Clearance to inside corner	see note 4	see note 5
H	Clearance to each side of center line extended above meter/regulator assembly	see note 4	3 ft (91 cm) within a height of 15 ft above the meter/regulator assembly
I	Clearance to service regulator vent outlet	see note 4	3 ft (91 cm)
J	Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	Direct vent only: 12” (30 cm) 300; 36” (91 cm) 400-500 Non-Direct vent: 4 ft (1.2 m) below or to side of opening; 1 ft (30 cm) above opening	3 ft (91 cm)
K	Clearance to a mechanical air supply inlet	3 ft (91 cm) above if within 10 ft (3 m) horizontally	6 ft (1.83 m)
L	Clearance above paved sidewalk or paved driveway located on public property	Vent termination not allowed.	7 ft (2.1 m)
M	Clearance under veranda, porch, deck, or balcony	see note 4	12" (30 cm) see note 6
note 1: In accordance with the current ANSI Z223.1 / NFPA 54 National Fuel Gas Code			
note 2: In accordance with the current CAN/CSA-B149.1 Installation Codes			
note 3: Maintain 12” of clearance above the highest anticipated snow level or grade or, whichever is greater. Please refer to your local codes for the snow level in your area			
note 4: For clearances not specified in ANSI Z223.1 / NFPA 54, clearance is in accordance with local installation codes and the requirements of the gas supplier.			
note 5: For clearances not specified in CAN/CSA-B149, clearance is in accordance with local installation codes and the requirements of the gas supplier			
note 6: Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor.			

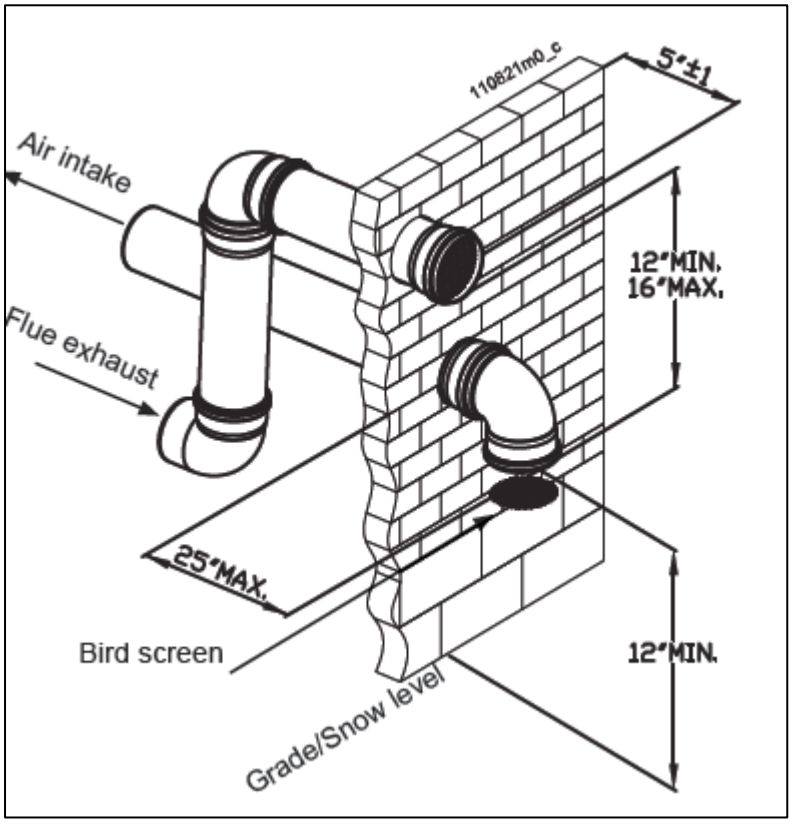
6. Locate terminations so they are not likely to be damaged by foreign objects, such as stones or balls, or subject to buildup of leaves or sediment.

Two pipe sidewall termination of air intake and exhaust vent.

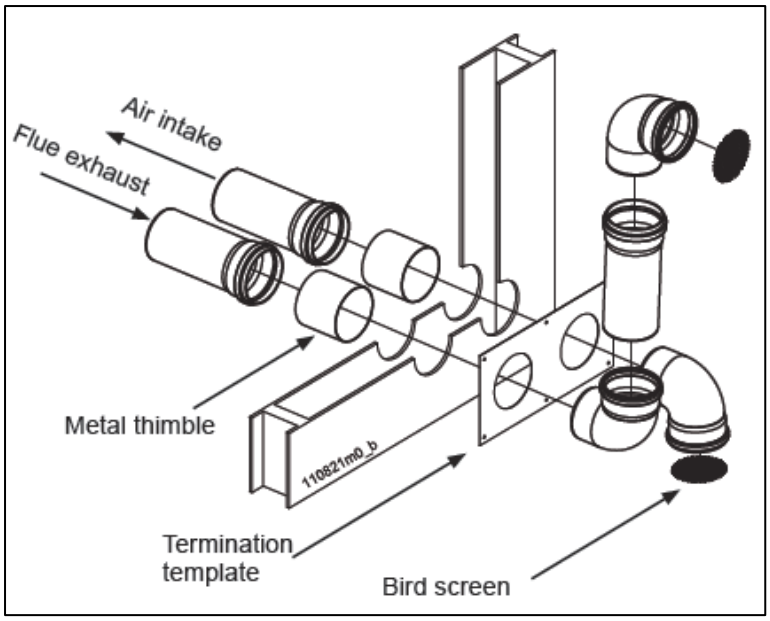
Alternate two pipe sidewall termination of air intake and exhaust vent.



Alternate two pipe sidewall termination of air intake and exhaust vent.



Two pipe sidewall termination assembly.



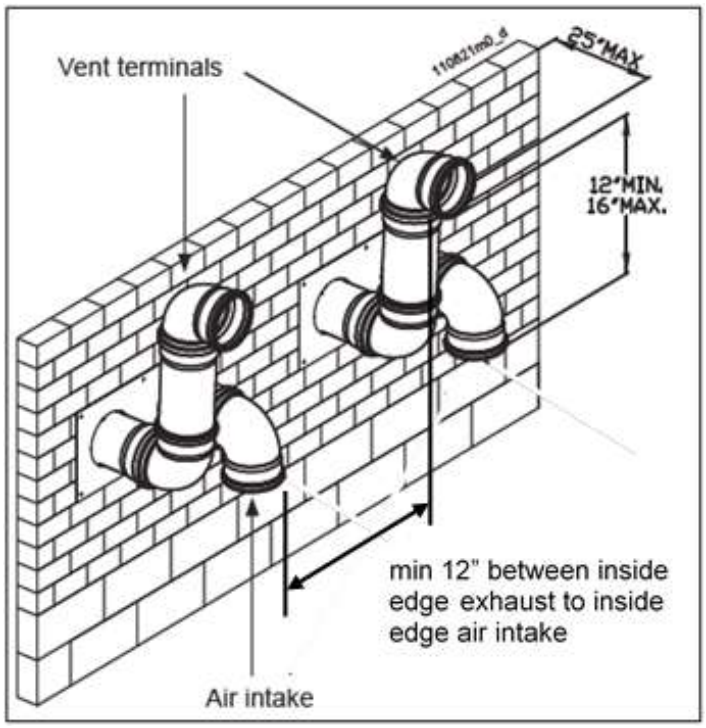
Multiple vent/air terminations

1. When terminating multiple boilers, terminate each vent/air connection as described in this manual (figure below).

⚠ **WARNING**	All vent pipes and air inlets must terminate at the same height to avoid possibility of severe personal injury, death, or substantial property damage.

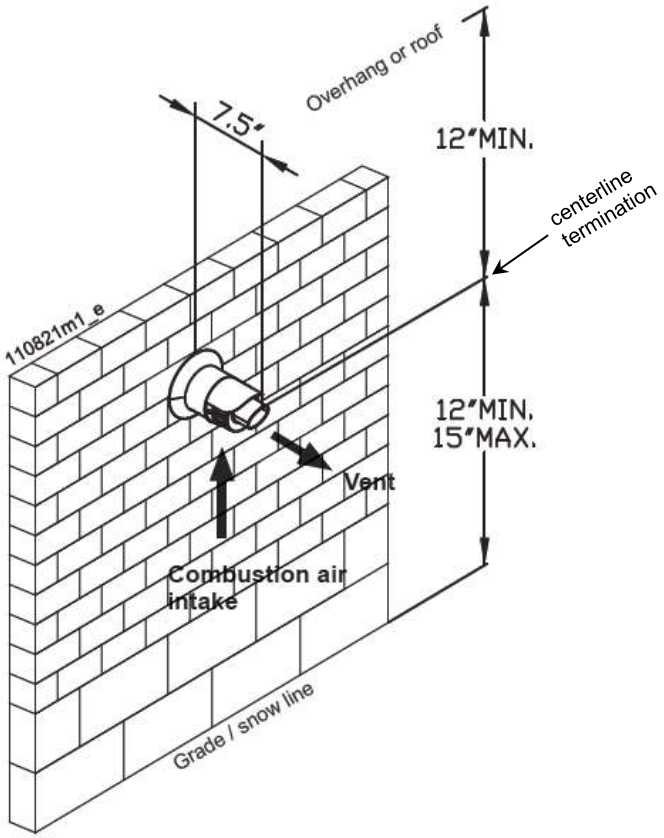
2. Place wall penetrations to obtain minimum clearance of 12 inches (305 mm) between the inside edge of the exhaust vent and the inside edge of the air intake elbow, as shown in figure below for U.S. installations. For Canadian installations, provide clearances required by CSA B149.1 Installation Code.
3. The air inlet of the boiler is part of a direct vent connection. It is not classified as a forced air intake with regard to spacing from adjacent boiler vents.

Two pipe multiple boilers vent terminations.



NOTE: Keep air intake at min. 12" from grade or snow line. Provide vent and air intake with bird screen.

Wall termination – concentric vent: boilers RC-300, RC-400 only
Description and usage: concentric combustion air and exhaust vent pipe termination. Both combustion air and exhaust vent pipes must attach to the termination kit. The termination kit must terminate outside the structure and must be installed as shown below in figure below. The required combustion vent pipe materials are listed in the table in § 9.2 "Vent and air intake pipe material" of this manual.
Concentric sidewall termination clearances: boilers RC-300, RC-400 only

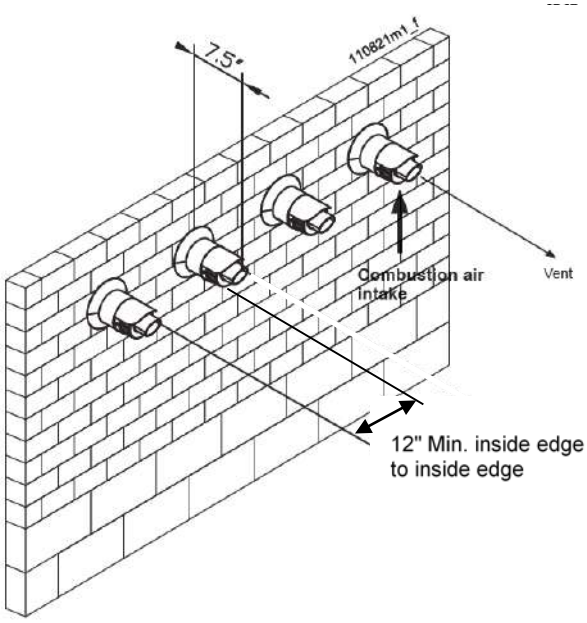


Sidewall termination installation:
- Determine the best location for the termination kit (see figure above).
- Reference § 9.11.2 on page of this manual for general termination considerations.

WARNING	Do not operate the appliance with the rain cap removed on the concentric terminations or recirculation of combustion products may occur. Water may also collect inside the larger combustion air pipe and flow to the burner enclosure. Failure to follow this warning could result in product damage or improper operation, personal injury, or death.
NOTICE	Ensure termination location clearance dimensions are as shown in figure above.
CAUTION	DO NOT use field-supplied couplings to extend concentric terminations. Airflow restriction will occur and may cause intermittent operation.

Multi venting wall terminations
When two (2) or more direct vent appliances are vented near each other, each appliance must be individually vented (see figure below). NEVER common vent or breach vent this appliance. When two (2) or more direct vent appliances are vented near each other, two (2) vent terminations may be installed as shown in figure below. It is important that vent terminations be made as shown to avoid recirculation of flue gases.

Concentric sidewall multiple boilers termination.



NOTE: keep the terminals horizontally in the same line and at min. 12” above grade or snow line.

9.12 *Roof (Vertical) direct venting.*

9.12.1 VENT/AIR TERMINATION – VERTICAL

WARNING	Follow instructions below when determining vent location to avoid possibility of severe personal injury, death or substantial property damage.

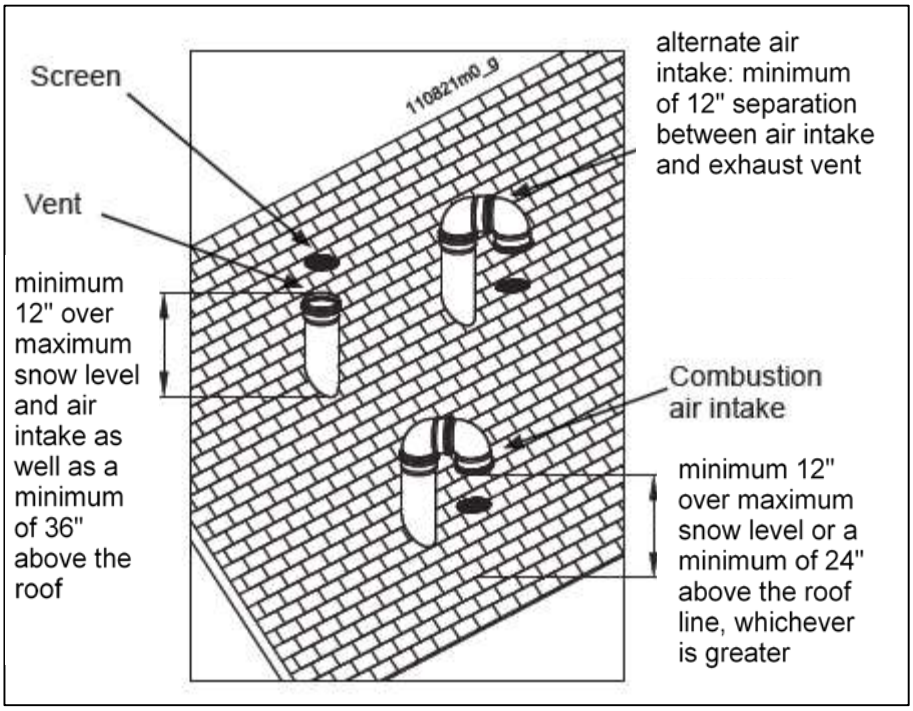
9.12.2 DETERMINE LOCATION

Locate the vent/air terminations using the following guidelines:

1. The total length of piping for vent or air must not exceed the limits given in the section 9.1 on page 34 of this manual.
2. Prepare the vent termination and the air intake termination elbow (figure below) by inserting bird screens.
3. The exhaust vent must terminate at least 3 feet above the highest place in which the exhaust vent penetrates the roof and at least 2 feet above any part of a building within 10 horizontal feet.
4. The air intake piping must terminate in a down-turned 180° direction utilizing two elbows see figure below
5. The exhaust piping must terminate in a vertical coupling as shown in figure below. The top of the coupling must be at least 1 foot above the air intake. When the vent termination uses a rain cap, maintain at least 36" (914 mm) above the air inlet. The air intake pipe and exhaust vent pipe can be located in any desired position on the roof, provided that the exhaust vent termination is at least 1 foot above the air intake.
6. Maintain the required dimensions of the finished termination piping as shown in figure below.
7. Do not extend exposed vent pipe outside of building more than shown in this document. Condensate could freeze and block vent pipe.

WARNING	Rooftop exhaust vent and air intake inlet terminations must terminate in the same pressure zone.

Two pipes vertical termination of air and vent.



8. Locate terminations so they are not likely to be damaged by foreign objects, such as stones or balls, or subject to buildup of leaves or sediment.

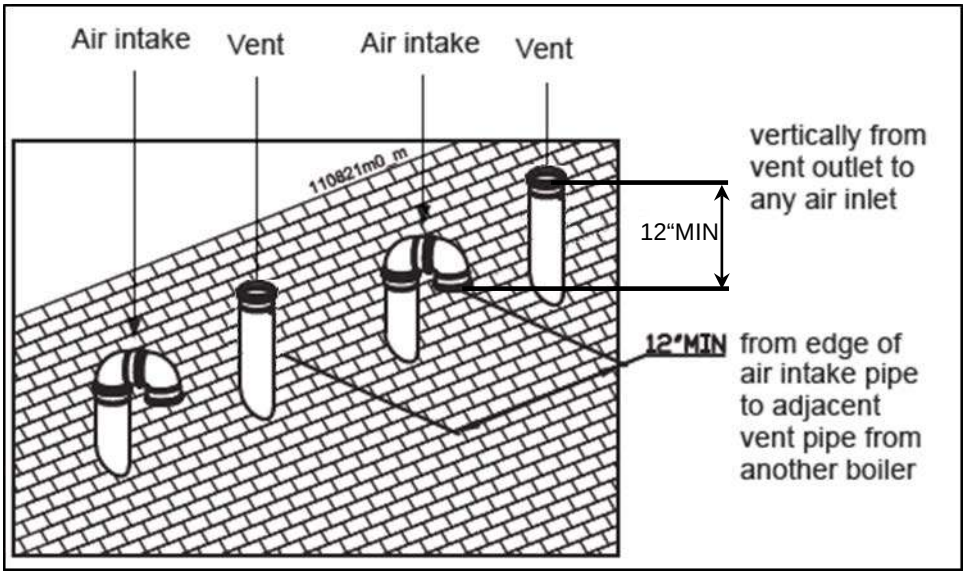
Multiple vent/air terminations

1. When terminating multiple boilers, terminate each vent/air connection as described in this manual (figure below).

WARNING	Terminate all exhaust vent pipes at the same height and all air intake pipes at the same height to avoid recirculation of flue products and the possibility of severe personal injury, death, or substantial property damage.

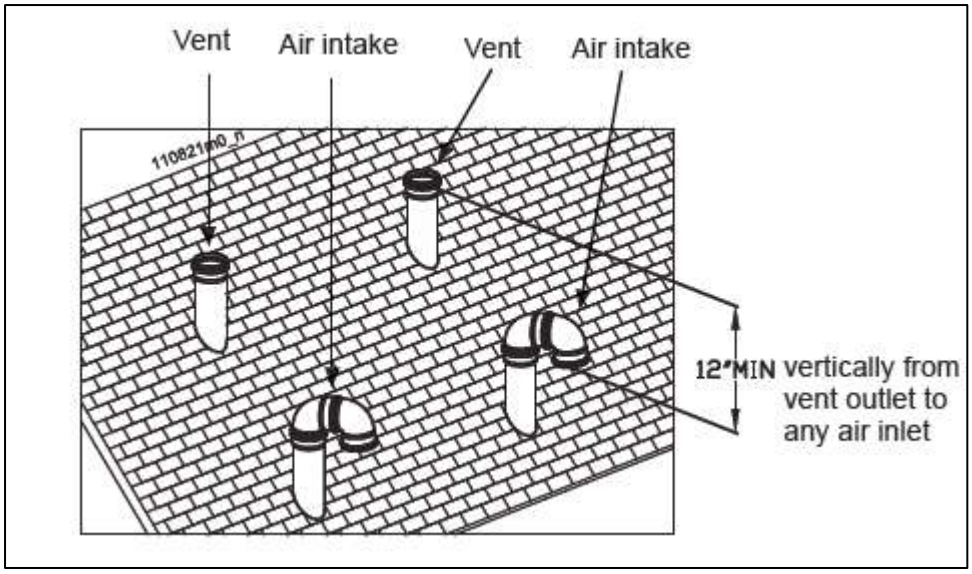
2. Place roof penetrations to obtain minimum clearance of 12 inches (305 mm) between outside edge of air intake an exhaust vent of another boiler for U.S. installations (see figure below). For Canadian installations, provide clearances required by CSA B149.1 Installation Code.

Vertical terminations with multiple boilers.



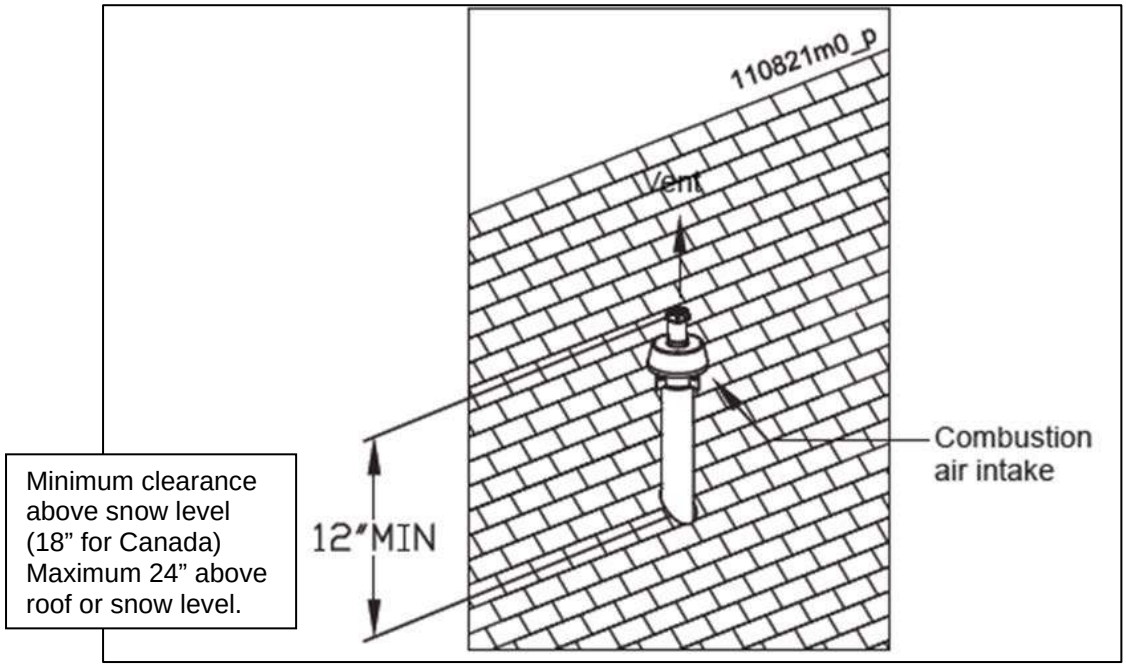
Note: keep the terminals at min. 12" above grade or snow line. Provide exhaust vent and air intake with bird screen.

Alternate vertical terminations with multiple boilers.



Note: keep the terminals at min. 12" above grade or snow line. Provide vent and air intake with bird screen.

Concentric Vertical Termination.



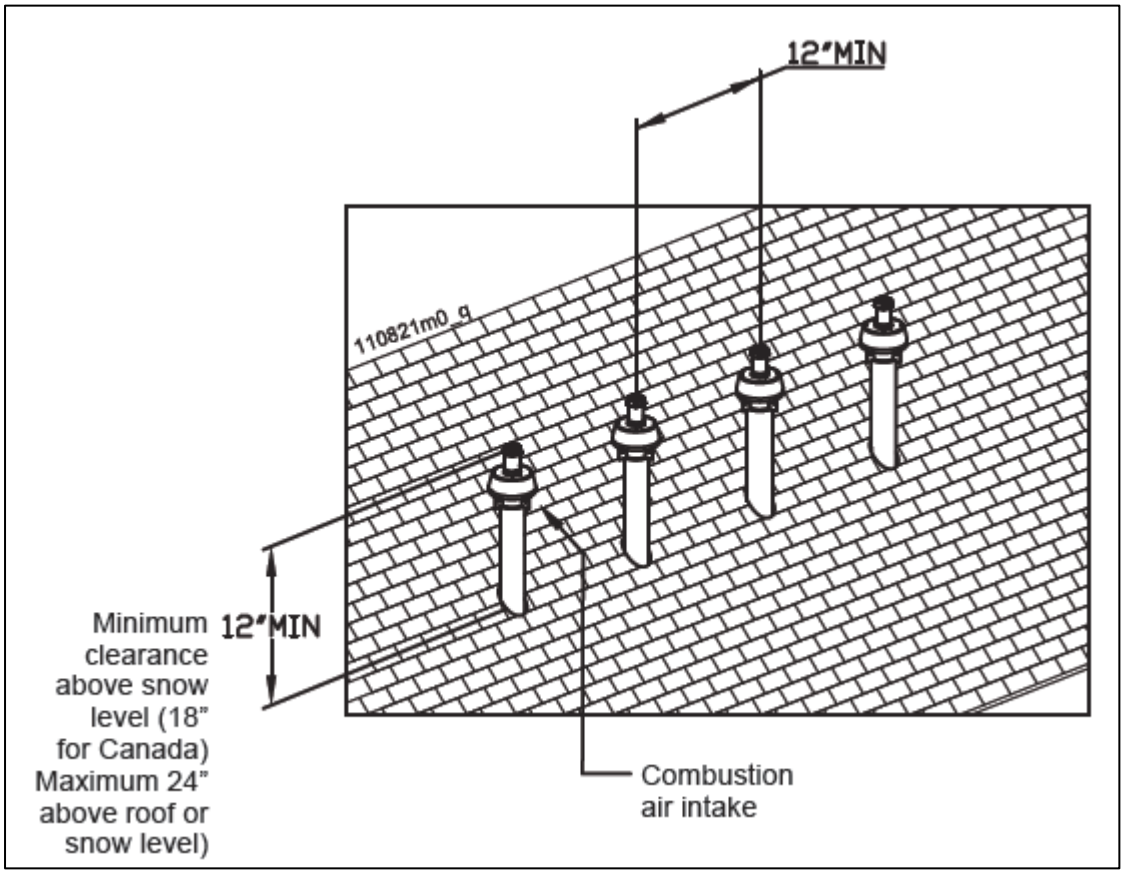
Do Not Install U-Bend or elbow on concentric termination

WARNING	• Do not operate the appliance with the rain cap removed on the concentric terminations or recirculation of combustion products may occur. • Water may also collect inside the larger combustion air pipe and flow to the burner enclosure. • Failure to follow this warning could result in product damage or improper operation, personal injury, or death.
NOTICE	• Do not allow insulation or other materials to accumulate inside the pipe assembly when installing through the hole. • Ensure termination height is above the roof surface or anticipated snow level (12 inches (305 mm) in U.S.A. or 18 inches (457 mm) in Canada) as shown in figure above.
CAUTION	DO NOT use field-supplied couplings to extend concentric terminations. Airflow restriction will occur.

Multi venting vertical terminations

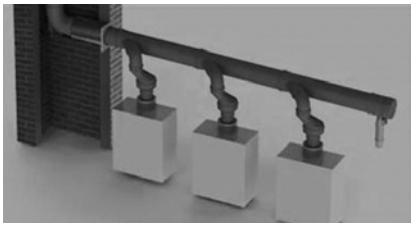
When two (2) or more direct vent appliances are vented near each other, each appliance must be individually vented (see figure below). NEVER common vent or breach vent this appliance. When two (2) or more direct vent appliances are vented near each other, two (2) vent terminations may be installed as shown in figure below. It is important that vent terminations be installed as shown to avoid recirculation of flue gases.

Concentric vent and combustion air vertical termination multiple boilers.



10 COMMON FLUE CASCADING

10.1 *Appliance*



The 300, 400 and 500 have an internal flue gas valve for an overpressure system according to the table below.
This device is needed to prevent recirculation of the flue gases.
If separated flue systems cannot be applied a zero-pressure common flue system is preferred ask a flue gas supplier for an calculation.

10.1.1 CALCULATION RC (VALID FOR PARTS SUPPLIED BY DURAVENT (M&G)).

Maximum vertical length in feet (m).					
Type of boiler	Number of appliances	DN150	DN150/200	DN200	DN200/300
RC-300	3	100 ft (30 m)	100 ft (30 m)	100 ft (30 m)	100 ft (30 m)
	4	36 ft (11 m)	100 ft (30 m)	100 ft (30 m)	100 ft (30 m)
	5		100 ft (30 m)	100 ft (30 m)	100 ft (30 m)
	6		16 ft (5 m)	100 ft (30 m)	100 ft (30 m)
RC-400	3	85 ft (26 m)	100 ft (30 m)	100 ft (30 m)	100 ft (30 m)
	4		100 ft (30 m)	100 ft (30 m)	100 ft (30 m)
	5		16 ft (5 m)	100 ft (30 m)	100 ft (30 m)
	6			100 ft (30 m)	100 ft (30 m)
RC-500	3		100 ft (30 m)	100 ft (30 m)	100 ft (30 m)
	4		65 ft (20 m)	100 ft (30 m)	100 ft (30 m)
	5			20 ft (6 m)	100 ft (30 m)
	6				100 ft (30 m)

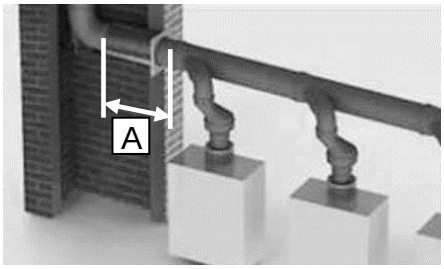
Remark 1: Dn 150/200 means: the diameter of the horizontal collector including the bend = 150 mm and after the bend the diameter of the vertical section is 200 mm with an adaptor of 150->200 mm

Remark 2: Length between shaft and last collector (no. A) = 3.3 ft (1 m).

Remark 3: For calculating other lengths (> 1meter) between the last collector and bend(distance A, see below picture), the length of the max. allowed vertical height according above table must be reduced by the extra horizontal added length and for additional added bends the following table must be used to reduce the maximum vertical height

10.1.2 TERMINALS EQUIVALENT FEET

	Diameter	
Elbow type	DN150	DN200
45°	5.6 ft (1.7 m)	12.5 ft (3.8 m)
90°	13.2 ft (4.0 m)	19 ft (5.8 m)



10.2 *Safety measures Common Flue Systems*

Above is described that RC boilers may be used with an overpressure common flue system from Duravent.
In case RC boilers are installed with a common flue system and the combustion air is drawn directly from the room, safety measures have to be taken

Indicated hazard
The RC boilers are equipped with a Non-return valve to prevent recirculation of flue gas of a running boiler through one or more boilers which are not running and are connected with a common flue system. This Non-return valve might leak over time by pollution, incorrect maintenance or other unexpected cause. In case the combustion air is drawn from the room, flue gas might enter the room, which could lead to Carbon Monoxide (CO) poisoning.

Safety measures:
To cover this risk of Carbon Monoxide (CO) poisoning, in case of an overpressure common flue system in combination with combustion air drawn directly from the room, two safety measures have to be taken:

1. Guaranteed sufficient outside air supply for combustion and ventilation according local standards, codes and regulations..
2. Use an CO detector for alarm and switching module to switch off all the boilers. The CO alarm system must be according to UL 2034 standard.

Additional Safety Advice

3. Use always the cascade manager of the boiler and check if power mode 2 is switched on. Power mode 2 is selected at parameter 148.
4. Combine all air intake terminals of the boilers, which do not necessary have to be connected to the outside.

Ad 1. Guaranteed sufficient outside air supply for combustion and ventilation according local standards, codes and regulations.

The boiler-room must have sufficient outside air supply for combustion and ventilation. There are many ways of creating sufficient outside air supply, depending on location of the boiler-room in the building. The demands for the (size of the) boiler-room and required ventilation is prescribed in local standards, codes and regulations, such as NFPA 54 paragraph 9.3.

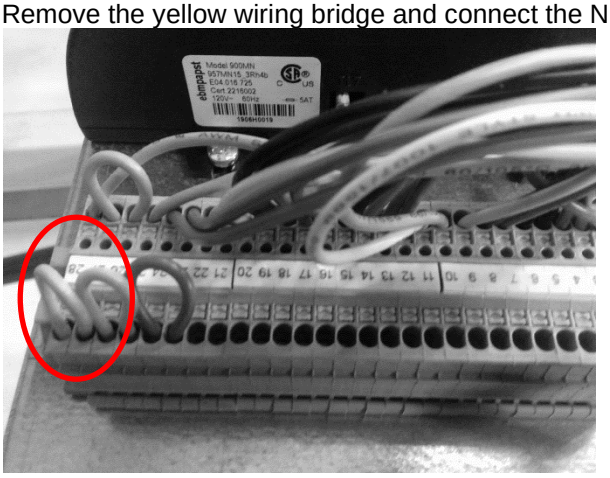
The execution and size of the outside air supply must be engineered and calculated by engineers thoroughly familiar with all aspects of the subject.

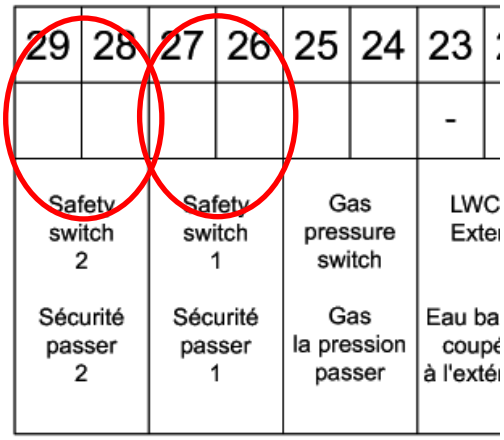
The outside air supply must be guaranteed during the lifetime of the installation. Risks of blocking or reducing the outside air supply, should be assessed and covered by this engineer and its design. Common obstacles in the outside air supply are eg. Venting opening closed/reduced by pollution, a cupboard, a parked truck / car, closed for heat loss arguments, etc, etc.

Ad 2. CO detection and switch off module:

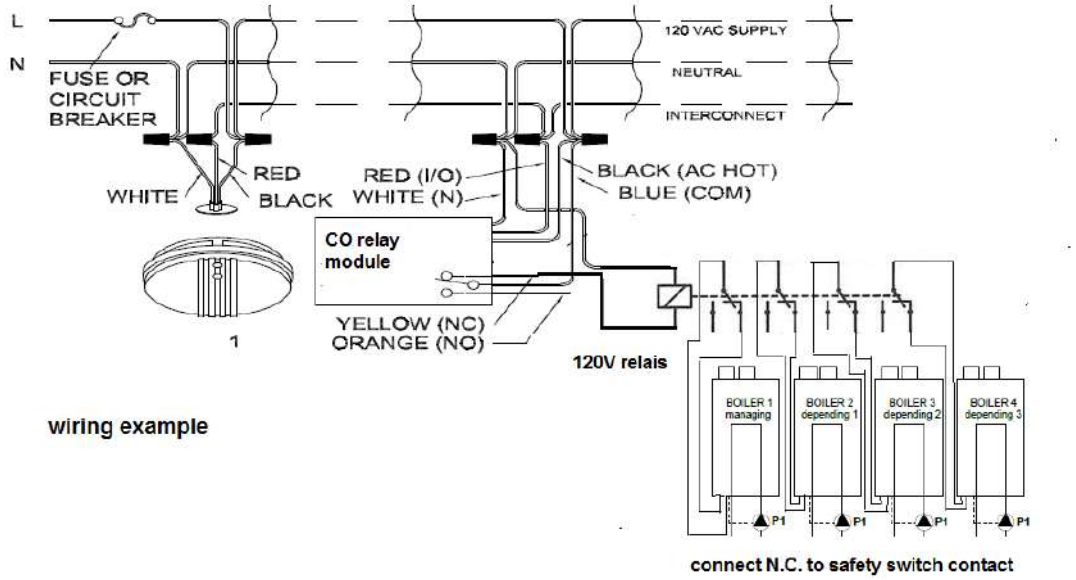
Use a CO detection system which has an alarming and switching module. Use a switching module that has an Normally Closed (N.C.) contact. The boiler safety loop will be extended with the CO detectors by connecting the N.C. contacts in series to the safety switch terminal connections 26/27 or 28/29 on the boiler to switch off the boiler in case of an alarm.

Remove the yellow wiring bridge and connect the N.C. contacts in series to the relay(s).





Low voltage connections RC boiler.



Use an extra 120V relay with 4 poles. In case of power failure on the CO alarm system and modules the boilers will shut down. Mount, install, test and maintain the CO detector according to the manufacturer's instructions. Test the system at least monthly, to ensure the boilers will switch off in case of a CO alarm.

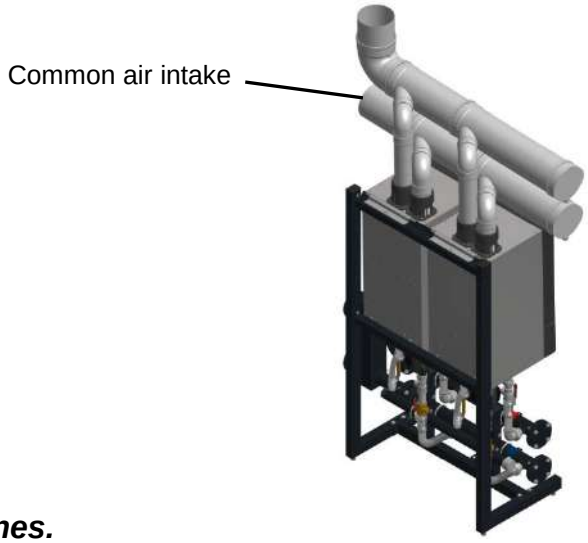
In case of an CO alarm, the display of the boiler will mention: '*Max. thermostat lock error*'.

Ad 3. Use always the cascade manager of the boiler and check if power mode 2 is switched on (parameter 148)

Check parameter setting 148. This setting must be '*Power mode 2'*. Change the parameter 148 to '*Power mode 2'* in case the current setting is different.

See manual 15.2.7 CASCADE – POWER BALANCE MODE
Several different power control modes can be selected to operate the cascade system.
• Power mode 0:Power control disabled, each boiler modulates based on the system setpoint.
• Power mode 1:Power control algorithm to have a minimum amount of boilers/boilers active.
• Power mode 2:Power control algorithm to have a maximum amount of boilers/boilers active.
• Power mode 3:Power control algorithm to have a balanced amount of boilers/boilers active.

Ad 4. Combine all air intake terminals of the boilers
Combine all air intake terminals of the boiler, which do not necessary have to be connected to the outside of the room. The purpose of a combined air intake is to have a controlled airflow towards the boilers and improve the air exchange in the room.



10.3 *Existing Common Venting Guidelines.*

Do not common vent the RC boiler with the vent pipe of any other boiler or appliance. However, when an existing boiler of Category I is removed from an existing common venting system, the common venting system is likely to be too large for proper venting of the appliances remaining connected to it. At the time of removal of an existing boiler, the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation:

1) Seal any unused openings in the common venting system.
2) Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
3) Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
4) Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.
5) Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar, or pipe.
6) After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-burning appliance to their previous condition of use.
7) Any improper operation of the common venting system must be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CAN/CSA B149.1, Natural Gas and Propane Installation Code. When resizing any portion of the common venting system, the common venting system must be resized to approach the minimum size as determined using the appropriate tables in Chapter 13 in the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CAN/CSA B149.1, Natural Gas and Propane Installation Codes.

11 ELECTRICAL INSTALLATION

11.1 *General*

- For operation, the boiler needs a power supply of 120 VAC/ 60Hz.
- The boiler main supply connection is polarity sensitive.
- The wiring for the connections can be entered at the bottom of the boiler through the wiring knockouts.
- NOTICE: Before starting to work on the boiler, it must be switched off and the power supply to the boiler must be disconnected.
- Electrical wiring should be installed according to all applicable standards and regulations.
  In the USA, electrical installation must comply with NFPA 70, National Electrical Code – latest edition, and with any other national, state, provincial or local codes and regulations.
  In Canada, electrical installation must comply with CSA C22.1, Canadian Electrical Code part 1 – latest edition, and with any other state or local codes and regulations.
- Wiring the boiler should only be done by a qualified installer or licensed electrician where required that is skilled in working on electrical installations and according to all applicable standards.
- It is not allowed to change the internal wiring fitted by the manufacturer.
- A spare fuse is mounted on the casing of the burner controller.

11.2 *Connection mains supply*

- It is advised to use a flexible cable between the cabinet entry (at the bottom) and the connection terminal.
- The earth wire has to be longer than the phase and neutral wire.
- The power supply cable must be secured by tightening the cable gland at the bottom of the boiler casing.
- In case of a flexible cable: use crimp ferrules on each wire end for the terminal connections.
- On the line voltage terminal, connect to numbers: 8 = Phase ; 9 = Neutral; PE = Earth.

11.3 *Electrical connections*

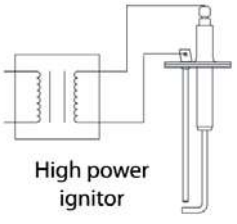
LOW VOLTAGE CONNECTIONS

29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
						-	+	-	+	Gnd				-	+			-	+	B	A	Gnd						
Safety switch 2 Sécurité passer 2		Safety switch 1 Sécurité passer 1		Gas pressure switch Gas la pression passer		LWCO Extern Eau basse coupée à l'extérieur		AL-BUS managing boiler AL-BUS chaudière gérant		Pump control PWM Commande de pompe PWM		Flow switch DHW Interrupteur de débit ECS		0-10 Vdc 0-10 Vcc		On/Off stat or Open therm heating circuit On/Off stat ou circuit de chauffage Open therm		AL-BUS depending boiler AL-BUS chaudière dépendant		Modbus			DHW sensor Capteur DHW		System sensor Capteur de système		Outdoor sensor Capteur extérieur	

HIGH VOLTAGE CONNECTIONS

	1	2	3	PE	4	5	PE	6	7	PE	8	9	PE	PE	10	11
	L1	N	L2	PE	L	N	PE	L	N	PE	L	N	PE	PE	L	N
MAXIMUM TOTAL OUTPUT 3.5 Amps NOMINAL	DHW PUMP DHW TWV (3-WAY) VALVE) Vanne DHW TWV (3 voies)				SYSTEM PUMP Pompe du système			GENERAL PUMP Pompe générale			MAINS SUPPLY Approvisionnement principal				ALARM Alarme	

High power ignitor
A separate connector for an external igniter is located on the cable tree, near the boiler controller and labelled "High power ignitor".
The "external ignition transformer" can be ordered, see § 5.1 "Accessories".
This accessory is provided with detailed mounting instructions.



11.4 *Explanation of the low voltage connections.*

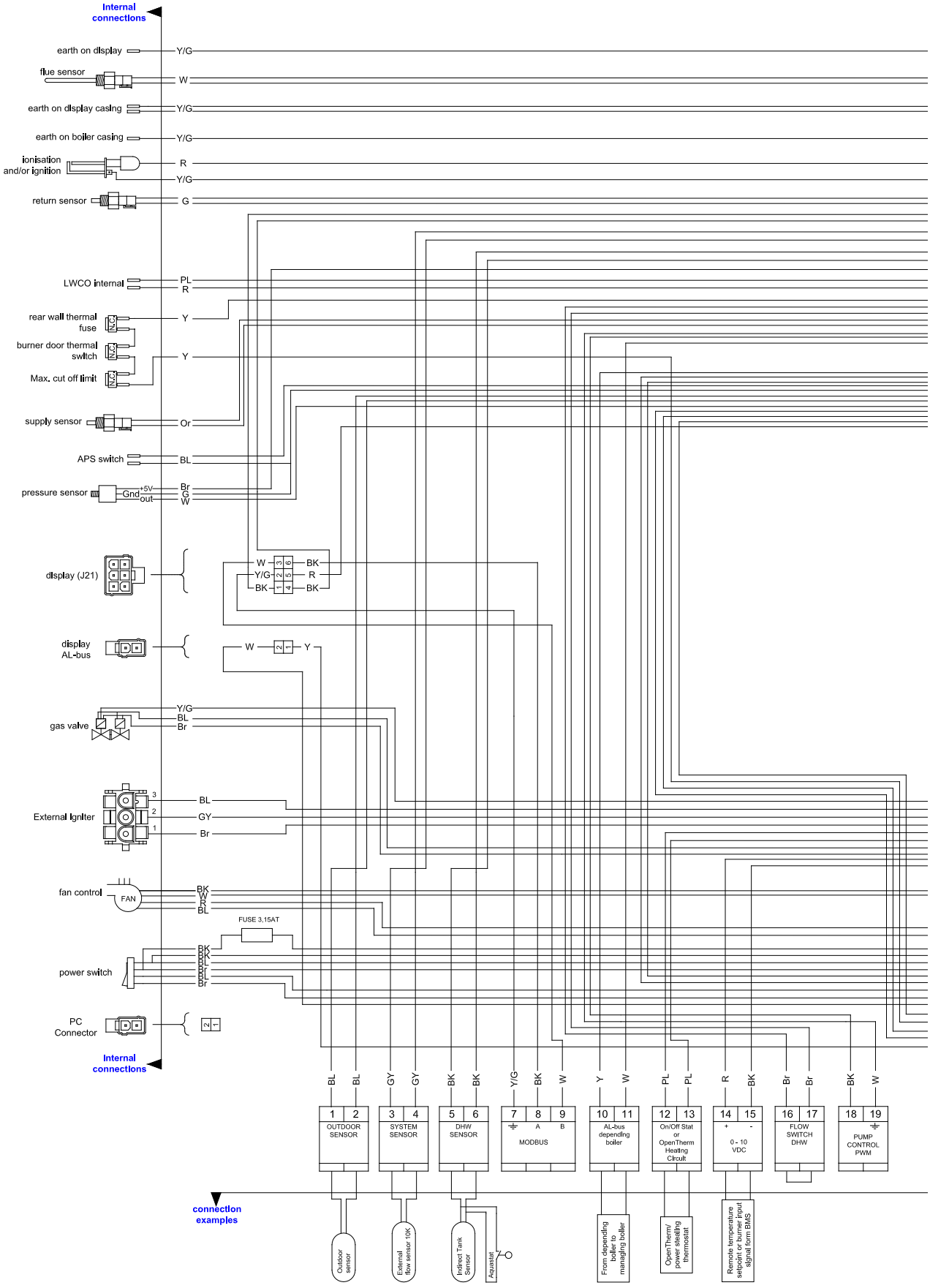
1-2	OUTDOOR SENSOR
If an outdoor temperature sensor is connected, the boiler will control the supply water temperature by using a calculated setting based on outdoor reset curve, which is related to the outdoor temperature.	
3-4	**SYSTEM SENSOR**
If a low loss header is used, this sensor measures the flow temperature at the system side. The sensor must be mounted on the supply pipe or in a sensor well at the system side, close to the low loss header. NOTICE: This sensor (see § 7.21) must be used when boilers are cascaded with the internal cascade manager. PARAMETER: boiler parameter 122, see: 11.9 "programmable in- and outputs"	
5-6	**DHW SENSOR**
When an indirect hot water tank is installed, the DHW mode must be set to 1 or 2. When the DHW mode is set to 1, a sensor can be connected. This sensor should be mounted in a well in the tank. The boiler will now modulate towards the hot water setpoint. When the DHW mode is set to 2, an aquastat can be connected. When the set temperature is reached, the aquastat will switch off and the boiler will stop serving hot water.	
7-8-9	**MODBUS**
Connections for a MODBUS communication signal. 7 = ground, 8 = A, 9 = B (A detailed Modbus bulletin is available at your supplier on request)	
10-11	**AL-BUS DEPENDING**
Cascade connections for the dependent boilers, must be parallel linked together. NOTICE: link all connections 10 to 10 and all connections 11 to 11, do not mix these. Link connections 10 of the dependent boilers to 20 of the managing boiler, and connections 11 of the dependent boilers to 21 of the managing boiler.	
12-13	**ON/OFF STAT OR MODULATING THERMOSTAT**
OPTION 1: An ON/OFF thermostat can be connected. If these terminals are bridged, the set/ programmed flow temperature of the boiler will be used. OPTION 2: A modulating controller can be connected to these terminals. The boiler software will detect and use this modulating signal automatically. PARAMETER: boiler parameter 124, see: 11.9 "programmable in- and outputs"	
14-15	**0-10 VDC CONTROL SIGNAL**
These terminals are used for an external 0-10 VDC control input signal. NOTICE: Terminal 14 [+] (positive) and terminal 15 [-] (negative).	
16-17	**DHW - FLOW SWITCH**
For DHW_Mode 3 a flow switch can be connected. If a water flow is present, the switch closes, and the DHW pump is started. The temperature of the DHW is set with DHW_Setpoint. PARAMETER: boiler parameter 117, see: 11.9 "programmable in- and outputs"	
18-19	**PWM – PUMP CONTROL**
These connections are used to control the boiler pump. The PWM signal determines the speed of the pump, when there is a heat demand. 18 = Signal: PWM input (1), 19 = Ground: signal ref (2) Parameter 136 has to be set to modulating (Factory set to on/off pump) when using a modulating pump.	
20-21	**AL-BUS MANAGING**
Cascade connection for the managing boiler. Link connection 20 of the managing boiler to connections 10 of the depending boilers, and connection 21 of the managing boiler to connections 11 of the depending boilers.	
22-23	**LWCO EXTERN**
To be used for an extra external Low Water Cut Off. The boiler goes into a lockout when this contact opens	
24-25	**GAS PRESSURE SWITCH**
To be used for an extra external gas pressure switch. The boiler goes into a lockout when this contact opens PARAMETER: boiler parameter 118, see: 11.9 "programmable in- and outputs"	
26-27	**SAFETY SWITCH 1**
To be used for an extra external safety switch. The boiler goes into a lockout when this contact opens	
28-29	**SAFETY SWITCH 2**
To be used for an extra external safety switch. The boiler goes into a lockout when this contact opens	

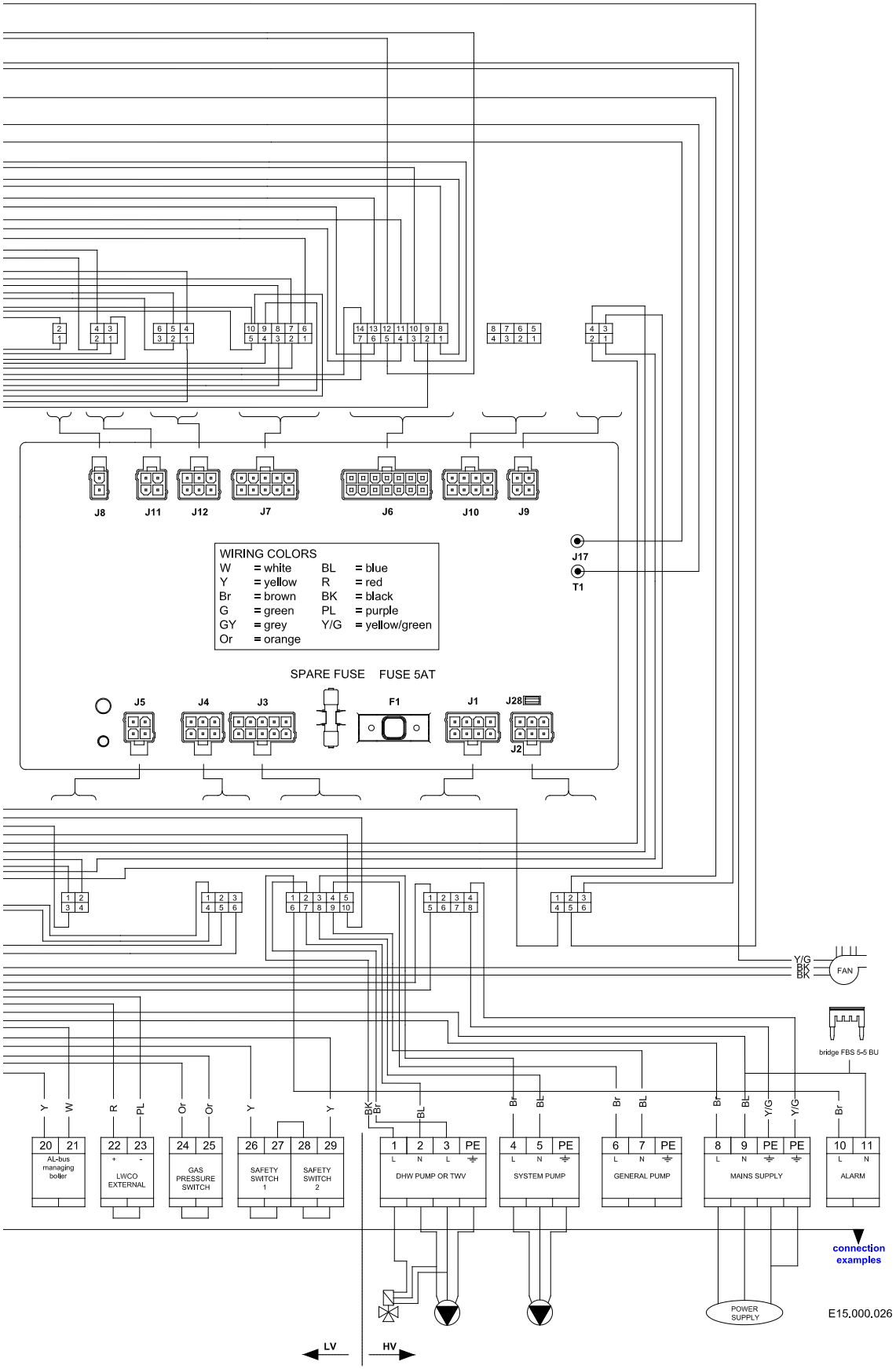
11.5 *Explanation of the line voltage connections.*

1-2-3-PE	**DIVERTER VALVE DHW indirect tank / DHW PUMP**
If an indirect domestic hot water tank is installed, a 3-way valve or a pump (P2) can be used to divert hot water to the heating coil of the tank. This 3-way valve will open, or pump will power on, when the indirect tank has a heat demand. PARAMETER: boiler parameter 128, see: 11.9 "programmable in- and outputs" 1 = L1 wire (heating position); 2 = Neutral wire; 3 = L2 (hot water position); PE = Ground. The inrush current of the 3-way valve or pump may not exceed 8 Amps, see chapter 8.5 for detailed electrical specifications.	
4-PE-5	**SYSTEM PUMP / DHW PUMP / CH PUMP**
Connections for the power supply of a central heating system pump (P3, see chapter 8.5 for detailed electrical specifications). 4 = Phase wire; 5 = Neutral wire; PE = Ground PARAMETER: boiler parameter 125, see: 11.9 "programmable in- and outputs"	
6-PE-7	**BOILER PUMP / GENERAL PUMP**
Connections for the power supply of a boiler pump. (P1, see chapter 8.5 for detailed electrical specifications).	
8-9-PE-PE	**MAINS SUPPLY**
The power supply connection of the unit. 8 = Line voltage wire; 9 = Neutral wire, PE = Ground wire	
10-11	**ALARM RELAY**
A semiconductor alarm output. This is a triac output with an active voltage of 120 VAC, it can only handle resistive loads between 5 and 50 Watt. E.g. an incandescent bulb of 10-50 watt can be added to this. This alarm will be activated 60 seconds after an error has occurred. There are a few exceptions: - Alarm output will not be activated for a service warning; - Alarm output will not be activated for warning 202 (Appliance selection). 10 = Phase wire; 11 = Neutral wire PARAMETER: boiler parameter 127, see: 11.9 "programmable in- and outputs"	
X1-X2-X3	**HIGH POWER IGNITER (external igniter)**
A separate connector for an external igniter is located on the cable tree, near the boiler controller and labelled "High power ignitor". This is a connection for an external ignition transformer. Instead of the internal igniter, an external igniter can be connected. Available as an accessory, see § 5.1 "Accessories". X1 = Neutral wire; X2 = Ionization; X3 = Phase wire. PARAMETER: boiler parameter 126, see: § 11.10 "programmable in- and outputs".	

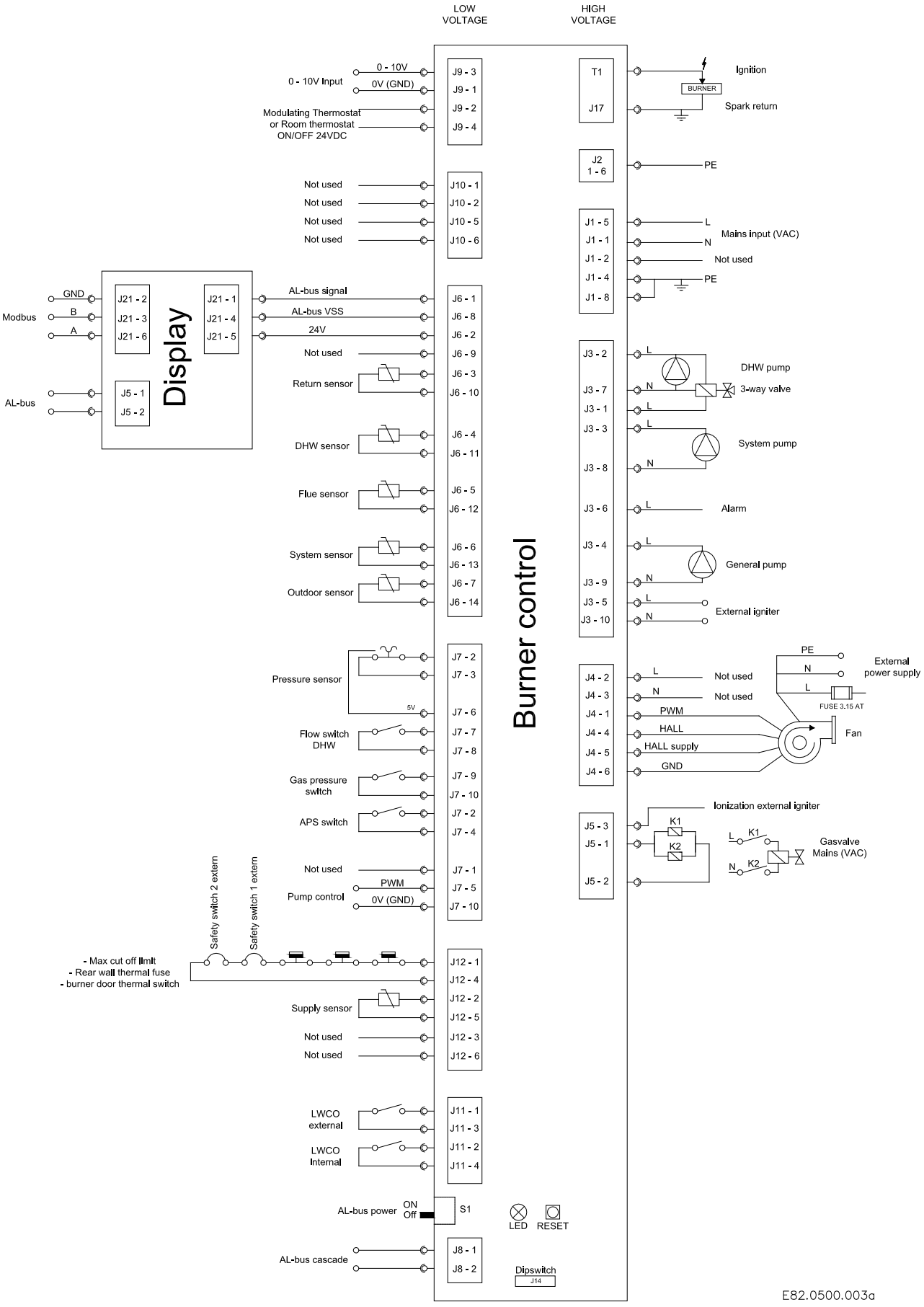
NOTICE	To all outputs following applies: maximum current 2 Amp each output. Total output of all currents combined maximum 3.5 Amp. The inrush current of the 3-way valve and/or pumps is maximum 8 Amp.

11.6 *Electrical schematics*




J8
J11
J12
J7
J6
J10
J9
J17
T1
WIRING COLORS
W = white
Y = yellow
Br = brown
G = green
GY = grey
Or = orange
BL = blue
R = red
BK = black
PL = purple
Y/G = yellow/green
SPARE FUSE FUSE 5AT
J5
J4
J3
F1
J1
J28
J2
FAN
bridge FBS 5-5 BU
AL-bus managing boiler
LWCO EXTERNAL
GAS PRESSURE SWITCH
SAFETY SWITCH 1
SAFETY SWITCH 2
DHW PUMP OR TWV
SYSTEM PUMP
GENERAL PUMP
MAINS SUPPLY
ALARM
connection examples
POWER SUPPLY
LV
HV
E15.000.026

11.7 *Ladder/Logic Diagram*



11.8 *Sensor availability*

The following table shows the sensor availability for all CH and DHW control modes. Sensors not mentioned in the table are optionally available for other functions

	CH Mode					
	0	1	2	3	4	5
T_Supply	M	M	M	M	M	M
T_Return	O	O	O	O	O	O
T_DHW	O	O	O	O	O	O
T_Outdoor	---	M	M	O	O	
0-10 Volt	O	O	O	O	M	M
Water Flow DHW	O	O	O	O	O	---
RT Switch	M	M	M	M	M	---
M = Mandatory, O = Optional, --- = Disabled.						

CH mode 0 – Central Heating demand with thermostat control
CH mode 1 – CH with an outdoor temperature reset and thermostat control
CH mode 2 – Central Heating with full outdoor temperature reset
CH mode 3 – Central Heating with permanent heat demand
CH mode 4 – Central Heating with analog input control of setpoint
CH mode 5 – Central Heating with analog input control of power output

	DHW Mode								
	0	1	2	3 N.A.	4	5 N.A.	6 N.A.	7 N.A.	8 N.A.
T_Supply	O	M	M	O	M	O	M	M	M
T_Return	O	O	O	O	M	O	---	O	M
T_DHW	---	M	---	M	M	M	M	---	M
T_Outdoor	O	O	O	O	O	O	---	---	O
0-10 Volt	O	O	O	O	O	O	O	O	O
Water Flow DHW	O	O	O	O	O	M	O	M	M
RT Switch	O	O	M	O	O	O	O	O	O
M = Mandatory, O = Optional, --- = Disabled, N.A. = Not Available.									

DHW mode 0 – No Domestic Hot Water
DHW mode 1 – Storage with sensor
DHW mode 2 – Storage with thermostat
DHW mode 3 – Instantaneous water heating with plated heat exchanger, flow switch and DHW-out sensor N.A.
DHW mode 4 – Instantaneous water heating with plated heat exchanger and DHW-out sensor
DHW mode 5 to 8 N.A.

11.9 *NTC sensor curve*

All NTC sensors are according to this characteristic: NTC 10K@25°C B3977k

Temperature		Resistance	Temperature		Resistance	Temperature		Resistance	Temperature		Re-sistance
°C	°F	Ω	°C	°F	Ω	°C	°F	Ω	°C	°F	Ω
-30	-22	175203	20	68	12488	70	158	1753	120	248	387
-25	-13	129289	25	77	10000	75	167	1481	125	257	339
-20	-4	96360	30	86	8059	80	176	1256	130	266	298
-15	5	72502	35	95	6535	85	185	1070	135	275	262
-10	14	55047	40	104	5330	90	194	915	140	284	232
-5	23	42158	45	113	4372	95	203	786	145	293	206
0	32	32555	50	122	3605	100	212	677	150	302	183
5	41	25339	55	131	2989	105	221	586	155	311	163
10	50	19873	60	140	2490	110	230	508	160	320	145
15	59	15699	65	149	2084	115	239	443	165	329	130

11.10 *Programmable in- and outputs*

It's possible to re-program some in- and outputs to other functions. To do this use below list and go to: Menu\settings\boiler settings\"1122" (installer password)\boiler parameters

boiler parameter	name	default setting	description	terminal
(117)	Prog. Input 2.	2	DHW flow switch	LV 16-17
(118)	Prog. Input 3.	2	Gas pressure switch	LV 24-25
(122)	Prog. Input 7.	3	Cascade sensor	LV 3-4
(124)	Prog. Input RT.	1	room thermostat	LV 12-13
(125)	Prog. Output 1.	2	CH pump	HV 4-5
(126)	Prog. Output 2.	9	Ext. Igniter	separate connector
(127)	Prog. Output 3.	6	Alarm semiconductor output	HV 10-11
(128)	Prog. Output 4.	3	DHW Pump	HV 2-3-PE

NOTICE

To all outputs following applies: maximum current 2 Amp each output.
Total output of all currents combined maximum 3.5 Amp.
The inrush current of the 3-way valve and/or pumps is maximum 8 Amp.

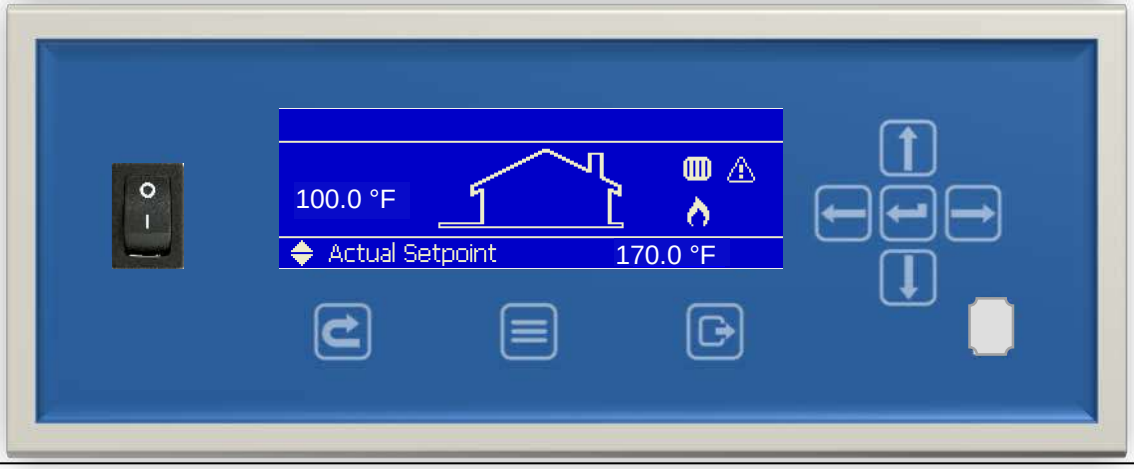
para-meter	Display:	**INPUTS:**	re-mark
(117)	Prog. Input 2.	0 Disabled	
		1 DHW flow sensor	N.A.
		2 DHW flow switch	
		3 CH flow sensor	N.A.
		4 CH flow switch	
(118)	Prog. Input 3.	0 Disabled	
		1 Drain switch	
		2 Gas pressure switch	
(122)	Prog. Input 7.	0 Disabled	
		1 T_Flue_2 sensor	N.A.
		2 T_Flue_2 with blocked flue	N.A.
		3 Cascade sensor	
		4 Blocked Flue switch	N.A.
		5 CH Sensor	
(124)	Prog. Input RT.	0 room thermstat off	
		1 room thermstat on	
	Display:	**OUTPUTS**:	
(125)	Prog. Output 1.	0 Disabled	
		1 Module pump	
		2 CH pump	
		3 DHW pump	
		4 System pump	
		5 Cascade pump	
		6 Alarm relay	
		7 Filling valve	
		8 LPG tank	
		9 Ext. Igniter	
		10 Air damper	
(126)	Prog. Output 2.	0 Disabled	
		1 Module pump	1)
		2 CH pump	1)
		3 DHW pump	1)
		4 System pump	1)
		5 Cascade pump	1)
		6 Alarm relay	1)
		7 Filling valve	1)
		8 LPG tank	1)
		9 Ext. Igniter	1)
		10 Air damper	1)

para-meter	Display:	**OUTPUTS**:	re-mark
(127)	Prog. Output 3.	0 Disabled	
		1 Module pump	N.A.
		2 CH pump	N.A.
		3 DHW pump	N.A.
		4 System pump	N.A.
		5 Cascade pump	N.A.
		6 Alarm relay	2)
		7 Filling valve	2)
		8 LPG tank	2)
		9 Ext. Igniter	2)
		10 Air damper	2)
(128)	Prog. Output 4.	0 Disabled	
		1 Module pump	
		2 CH pump	
		3 DHW pump	
		4 System pump	
		5 Cascade pump	
		6 Alarm relay	
		7 Filling valve	
		8 LPG tank	
		9 Ext. Igniter	
		10 Air damper	
		11 empty	
		12 empty	
		13 empty	
		14 empty	
		15 empty	
		16 empty	
		17 3-way Valve CH	
		18 3-way Valve DHW	
		19 3-way Valve CH (power when idle)	
		20 3-way Valve DHW (power when idle)	

Remarks:
1) Prog. output 2: (ext. igniter); this is a separate connector, the pin in the middle is for ionization, it has no PE connection. If earth is needed, it must be connected to the main earth terminal.
2) Prog. output 3: (alarm relay); this is a triac output with an active voltage of 120 VAC, it can only handle resistive loads between 5 and 50 Watt.

12 BOILER CONTROLLER AND DISPLAY.

12.1 *Display and buttons*




ON/OFF. On/off switch. Switches electrical power to the boiler


COMPUTER. Connector for computer cable


RESET. Reset lockout error


MENU. Enter the main menu


ESCAPE. Escape / Return to the status overview


RIGHT. Enter a menu item or confirm selection in Status overview (when directly setting Actual setpoint or DHW setpoint)


LEFT. Return to previous menu item or Status overview


UP. Directly select Actual setpoint of DHW setpoint in the Status overview, push RIGHT to confirm and use UP or DOWN to adjust value.


DOWN. Directly select Actual setpoint of DHW setpoint in the Status overview, push RIGHT to confirm and use UP or DOWN to adjust value.

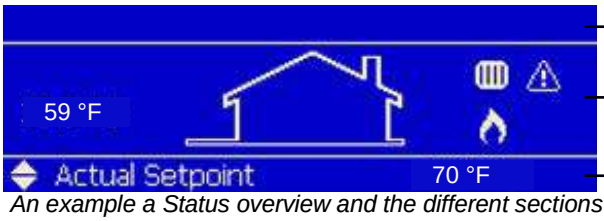

ENTER. Confirm a setting or enter a menu item

12.2 *Screens and settings.*

This screen is active during power up and will remain active until communication with the Main Control (the AL-BUS) has been established.

After communication has been established the following **Status overview** appears:

The Status overview has three different sections that show specific information:



An example a Status overview and the different sections

Header

- Left: For cascade systems the cascade icon is shown, with the cascade manager indication (M) or the dependent number.
- Center: Shows the CH and/or DHW disabled icons when CH and/or DHW is disabled
- Right: Shows the time (only if the real-time clock is available).

Icon	Description
	Cascade icon
	CH Disabled
	DHW Disabled

Middle section

- Left: Shows user-configured information (by default only the outside temperature):

Line	Info
Top	Burner state (when enabled)
Middle	Configured/selected temperature (one of the following): ▪ Outside temperature ▪ Demand based (Flow or DHW temperature based on active demand) ▪ Flow temperature ▪ DHW temperature ▪ System temperature (module cascade flow/supply temperature) ▪ Cascade temperature (boiler cascade flow/supply temperature)
Bottom	CH water pressure (when enabled)

- Center: The house icon is always displayed.
- Right side: Shows several status icons:

Icon	Description
	CH demand
	DHW demand
	Emergency mode is active (for cascade systems only)
	Burner is on (and flame is detected)
	Frost protection is active
	Anti-legionella program is active.
	Error is set in the Main Control (see footer for error description)

Footer
Shows Error/Warning messages when an Error or Warning is set in the Main Control, otherwise a quick menu is displayed where the user can quickly edit setpoints and enable/disable CH or DHW.

Quick Menu / Parameter	Description	Value / Unit	User
CH Control	Enable/disable Central Heating		0: User
CH Setpoint	Edit Central Heating setpoint (when available)		0: User
Calculated Setpoint	Show the calculated setpoint (when available)		0: User
DHW Control	Enable/disable Domestic Hot Water		0: User
DHW (Store) Setpoint	Edit the DHW (Store) setpoint (when available).		0: User

Note: Cascade dependents will only have the 'Calculated Setpoint' available.

12.2.1 SET CH SETPOINT/DHW SETPOINT DIRECTLY VIA THE STATUS OVERVIEW

When CH is active, you can adjust the CH setpoint directly on the bottom of the Status overview. When DHW is active, you can adjust the DHW setpoint directly on the bottom of the Status overview.

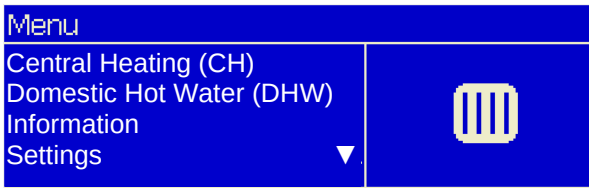
This means that when CH is active, you cannot set the DHW setpoint directly via the Status overview. When DHW is active, you also cannot set the Actual setpoint (CH setpoint) directly via the Status overview.

Press UP/DOWN ↑↓ to select the mode, then press CONFIRM ↵ or RIGHT → to confirm the mode and the Actual/DHW setpoint becomes directly settable. Use UP ↑ or DOWN ↓ to increase/decrease the setpoint.
Press CONFIRM ↵ or RIGHT → to confirm your alteration or press ESC ⎋ or LEFT ← to cancel.

A setpoint is only visible on the display when no error or alert is active. In case of an active error or alert, the bottom right part of the display is used to display the error or alert text.

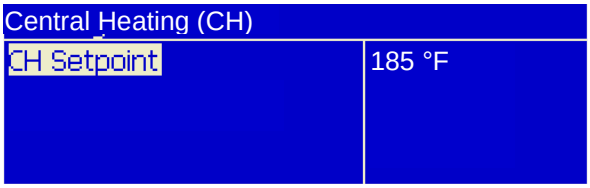
12.2.2 ENTERING THE MENU

Enter the menu by pressing the MENU ☰ button once. The header in the display shows you are inside the main menu. While scrolling through the menu you will see that the selected menu item is shown in a white rectangle.

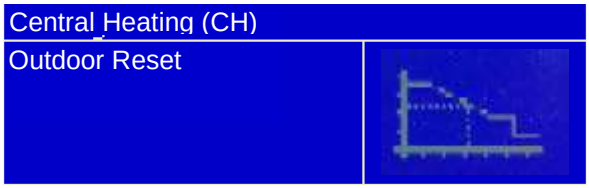


Enter a menu item by pressing CONFIRM ↵ or RIGHT →.
The header shows your location inside the menu, as seen in the following image:

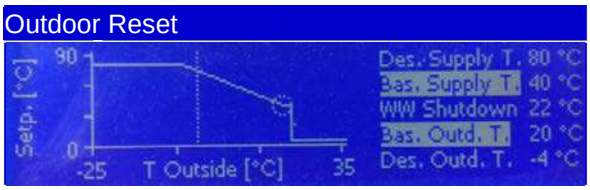
If you are inside the menu (or a menu item) and want to return directly to the Status overview press MENU ☰ or ESC ⎋ If you want to go back one step in the menu press BACK/LEFT ← .



If CH-mode is set to:
CH mode 1 – CH with an outdoor temperature reset and thermostat control
Or
CH mode 2 – Central Heating with full outdoor temperature reset
The following display will appear:



Enter a menu item by pressing CONFIRM↵ or RIGHT →
The header shows your location inside the menu, as seen in the following image:



It now is possible to set the Outdoor reset curve by changing the parameters on the righthand of the screen.

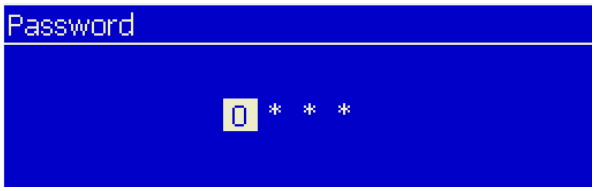
If you are inside the menu (or a menu item) and want to return directly to the Status overview press MENU☰ or ESC ⎋ If you want to go back one step in the menu press BACK/LEFT ← .

12.2.3 PROTECTED MENU ITEMS

The display supports 3 different access levels; each with its own set of available menu items/parameters:

Level	Description
0: User	Basic info and settings only that are accessible for everyone.
1: Installer	Advanced information and settings; only to be accessed by an experienced installer/person.
2: Factory	Highest level information and settings, only available/relevant for factory Engineers.

Access the Installer level by entering the correct access code (password) for the desired user level. If a certain menu item has been selected, the following password screen will appear where a specific password has to be entered:



⚠ **WARNING**	Changing protected/safety parameters should only be conducted by experienced, licensed boiler operators and mechanics. Hazardous burner conditions can happen with improper operations that may result in PROPERTY LOSS, PHYSICAL INJURY, or DEATH.

Enter the password with the following steps:

1.Use the UP/DOWN ↑↓ button to adjust the first number
2.Press CONFIRM↵ or RIGHT → to confirm and to go to the following number

Repeat this action for all numbers to enter the password.
During this action, if you want to return to the previous screen, just press MENU☰ or ESC ⎋ to cancel. After the password is entered in correctly press ENTER/RIGHT to confirm and access the menu item.
When a correct password is entered the selected user-level is unlocked. This is displayed by an icon (padlock or key) in the top bar, the associated number indicates which user-level is unlocked (1:Installer, 2:Factory).

The following menu items also require a password*:

(Sub) Menu item	Location inside menu
Startup Settings	Settings / General Settings / Other Settings / Startup Settings
Boiler Parameters	Settings / Boiler Settings / Boiler Parameters
Module Cascade Settings	Settings / Boiler Settings / Module Cascade Settings
Boiler Cascade Settings	Settings / Boiler Settings / Boiler Cascade Settings

12.2.4 DE-AERATION SEQUENCE

The “De-Aeration” sequence is a safety function that starts at every power ON of the boiler and is used to remove the air from the heat-exchanger. The DAir sequence does not start after a general reset (like the locking error reset or 24 hours reset)

The display will show the following string during DAir sequence:
• “Dair Running”
• “Dair Error Water Pressure”

12.2.5 LANGUAGE SETTINGS

The display supports the following languages:

- Chinese
- Croatian
- Czech
- Dutch
- English
- French
- German
- Greek
- Hungarian
- Italian
- Polish
- Portuguese
- Romanian
- Russian
- Slovak
- Slovene
- Spanish
- Turkish

The following paragraph describes how to change the display language. No matter which language you have set, the menu icons will always remain universal

12.2.6 CHANGE LANGUAGE VIA THE MENU

Please follow the next steps, which describe how to set the display to a specific language:

1. From the Status Overview, press the MENU button once
2. Select “Settings” (press UP/DOWN ↑↓ to highlight/select) and press the CONFIRM button
3. Select “General Settings” (press UP/DOWN ↑↓ to highlight/select) and press the CONFIRM button
4. Select “Language” (press UP/DOWN ↑↓ to highlight/select) and press the CONFIRM button
5. Select the desired language (press UP/DOWN ↑↓ to highlight/select) and press the CONFIRM button

- For Chinese select ‘中文’.
- For Croatian select ‘Hrvatski’.
- For Czech select ‘Česky’.
- For Dutch select ‘Nederlands’
- For English select ‘English’.
- For French select ‘Français’.
- For German select ‘Deutsch’
- For Greek select ‘Ελληνικά’.
- For Hungarian select ‘magyar’
- For Italian select ‘Italiano’
- For Polish select ‘Polski’.
- For Portuguese select ‘Português’.
- For Romanian select ’Românesc’.
- For Russian select ‘Русский’
- For Slovak select ‘Slovenský’.
- For Slovene select ’Slovenščina’.
- For Spanish select ‘Español’.
- For Turkish select ‘Türkçe’.

Press ESC to go back in the menu and return to the Status overview.

12.2.7 CHANGE THE LANGUAGE VIA THE MENU ICONS

The next steps describe how to change the display language via the icons displayed inside the menu, which can be useful if a foreign language is set, causing the user not able to understand the menu.

1. From the Status overview, press the MENU button once.
   Scroll down until the SETTINGS icon appears on the right-side of the display (and press ENTER):
2. In the following menu, press the SETTINGS icon again (and press ENTER):
3. In the following menu screen, select the LANGUAGE icon (and press ENTER to access the Language menu):
4. Select the desired language by scrolling through the list of available languages.
   Press ENTER to set the desired language, after you will automatically return to the General settings menu.
   Press ESC a few times until you have reached the Status Overview again.

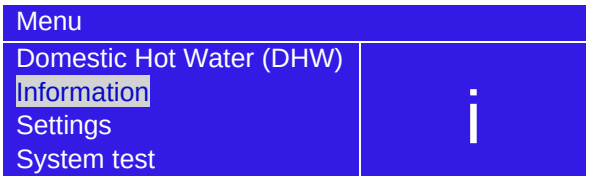
12.3 *Boiler history*

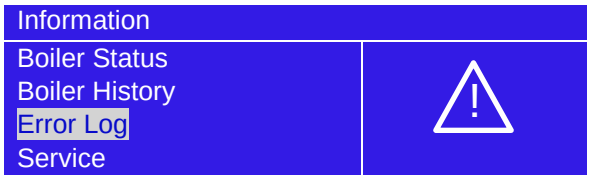
The boiler history found in the information menu displays several history counters that keep track of the boiler usage. The history cannot be erased and will continue for the burner controller life cycle. The following boiler history data is available:

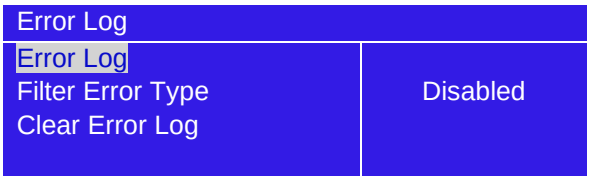
(Sub) Menu item	Description
Successful Ignitions	Number of successful ignitions.
Failed Ignitions	Number of failed ignitions.
Flame Failures	Number of flame failures (loss of flame).
Total system run time	Total hours that the appliance is operational (powered ON).
CH Burner Hours	Number of hours that the appliance has burned for Central Heating.
DHW Burner Hours	Number of hours that the appliance has burned for Domestic Hot Water.
Anti-Legionella count	Total number of completed anti-legionella cycles

12.4 *Error logging.*

Error logging is available. This functionality is linked to the Real-Time Clock functionality.
Errors will be logged for a stand-alone system or for a complete cascade system (based on the cascade settings).
The PB display will monitor the error codes it receives from the boiler(s) and if an error code is a new error code the error will be stored in the error log. An error will be logged with a (real-time clock) time stamp (date and time) when the error was detected and a boiler ID of the boiler on which the error was detected.
The error log can be viewed from the error log menu, which is located in the information menu.

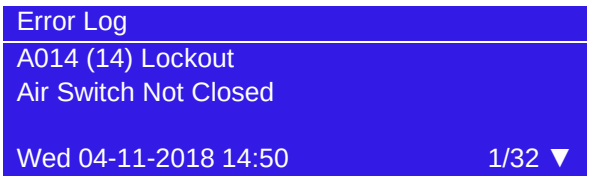






(Sub) Menu item	Description
Error Log	Show the error log (based on the selected filter options)
Filter Error Type	Filter errors based on the Error Type (Lockout/Blocking)
Filter Boiler ID (Cascade System only)	Filter errors based on Boiler ID (Managing, Dep 1, Dep 2, etc.)
Clear Error Log	Clear the error log (protected by password)

When no filtering option is selected (Disabled) the error log will show all errors for that category. So, if both filters are disabled, the error log will show all the errors in the log.



The error log screen will show on the first line: Boiler ID for which boiler the error was detected (cascade system only), Error Code, (internal) Error Number, Error Type (Lockout/Blocking).
The second line will show the Error Description.
The bottom line will show the Time Stamp (date and time) when the error was detected (in the format as configured in the Date Time Settings menu), and also the selected error index from the total number of errors in the (filtered) error log. Only Time Stamp, Code and Description is displayed.

Example, see picture above.
A014 = Error code.
(14) = Error Number (tracking number, 1-15 errors are stored maximum).
Lockout = Error type.
Air Switch Not Closed = Error description.
Wed 04-11-2018 14:50 = Time stamp when the error occurred.

12.5 *Service reminder*

The Service reminder will remind the owner/user of the appliance to service the appliance at a specified "Service_Interval", factory set on 2000 burn hours. When service is not done within this time, a service reminder will be shown on the screen: "Service is required!", alternating with the normal status display.

NOTE: with the message "Service is required" the boiler keeps running, but maintenance must be done before resetting this message.

12.5.1 SERVICE OVERDUE LOGGING

Menu/ Information/ Service/ Service history.
When the Service reminder has become active, the time (in hours) it takes before service is actually done is being logged. This time is called the Service Overdue Time.
A maximum of 15 service moments can be logged by the system. When the log is full it will overwrite the oldest log entry. Each time the Service reminder is reset, a new service moment is logged (counted) and the Service Overdue counter will be stored in the log/history.

12.5.2 SERVICE REMINDER IMPLEMENTATIONS

There are two types of service reminders: (Normal) Service reminder and Service shutdown
(Normal) Service reminder
The (normal) Service reminder will only show the Service reminder message on the screen and will log how long the service is overdue. The appliance will remain fully operational

12.5.3 RESET THE SERVICE REMINDER

It is possible to reset the Service reminder counters before the Service reminder was actually active. This must be done when the appliance was serviced before the Service reminder was active.
This means an overdue counter of 0 hours will be stored on the log (which makes sense because the service was not overdue but ahead of schedule).

To remove the message "Service is required": menu/ Information/ Service/ "Reset service reminder".
Enter the installer password, the "Reset service reminder" can be set to "YES" for resetting the service reminder.
The overdue time is recorded in the service history.

12.5.4 MENU'S AND PARAMETERS

Service status information can be viewed: Menu/ Information/ Service.
Here the installer can also reset the Service reminder (accessible at installer level).

(Sub) Menu item	Description
Service history	View the Service history (log). For each service moment the Service overdue counter is stored. When the overdue counter is 0 hrs., it means service was done before the Service reminder was active. The log is ordered so the most recent service moment is shown first (on top of the list).
Hours since last service	Shows the number of hours (or burn hours) since the last service moment
Burn hours since last service	Shows the number of burn hours since the last service moment.
Hours till service	Shows the number of hours (or burn hours) until service is required
Burn hours till service	Shows the number of burn hours until service is required.
Hours till shutdown	When the Service shutdown function is enabled and the Service reminder is active, the number of hours until the appliance is shut down will be shown
Reset service reminder	Reset the Service reminder (and store Service overdue counter in the service history). Installer must enter the installer password first before it can be reset.

12.6 *General*

The boiler controller is designed to function as a standalone control unit for intermittent operation on heating appliances with a premix (modulating) burner and a pneumatic air-gas system.

	Mains input	1 x 5AT, 120V
Flame establishing period		2 seconds
Safety time		5 seconds
Ignition attempts		5
Pre-purge time		≥ 2…60 seconds (not safety critical)
Pre-ignition time		2 seconds (not safety critical)
Flame failure response time		< 1.0 second
Flame-current	Minimum Start-detection	1.0 µA 1.5 µA
Cable length AL-BUS[1]		AWG (mm²) Cable length (m)
		23 (0.25) 328.1 ft (100)
		20 (0.5) 656.2 ft (200)
		18 (0.75) 984.3 ft (300)
		17 (1.0) 1312.3 ft (400)
		15 (1.5) 1968.5 ft (600)
1) This consists the total length of the cable, not the length between two boilers. The length differs with the diameter of the cable.		

12.6.1 PUMP START EXERCISE EVERY 24 HOURS

To protect the pump from getting stuck at a certain position it is forced to run for 10 seconds every 24 hours. This is done only for the boiler loop pump at the start-up of the board.

12.6.2 FROST PROTECTION

The Frost protection function protects the boiler and boiler loop from freezing.
The T_Supply, T_Supply_2 and T_Return sensors are checked for generating a Frost protection demand.

- When any of the sensors drop below FP_Start_Pump the boiler loop pump is switched ON for CH.
- When any of the sensors drop below FP_Start_Burn the boiler is fired.
- When all of the sensors measure above FP_Stop the Frost protection demand is ended.

When the demand for Frost protection is ended the pumps will post-circulate for CH_Post_Pump_Period.
Parameters are factory set.

12.6.3 FLUE TEMPERATURE PROTECTION

The flue temperature protection function protects against the flue gas reaching a too high temperature.

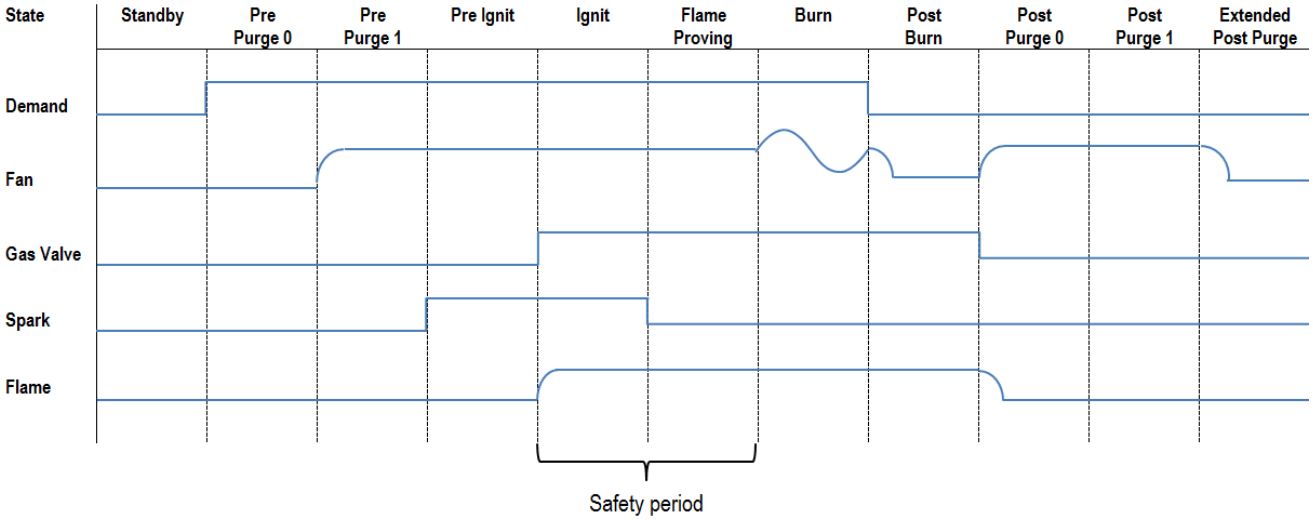
- When the T_Flue or T_Flue_2 sensor measures above the Max_Flue_Gas_Temp, the control generates a Flue_Gas_Error.
- When the Flue Switch closes, the control generates a Flue_Gas_Error.

When the control is in a Flue_Gas_Error the fan will run at the minimum fan speed.

Boiler power limitation
All boilers have a flue gas sensor. The control will limit the boiler power when the flue gas temperature reaches the set Max_Flue_Gas_Temp. The maximum boiler power is linearly limited when the flue gas temperature is within Max_Flue_Gas_Temp minus 9 F (5 ºC) and Max_Flue_Gas_Temp.
Parameters are factory set

12.7 *Ignition cycle*

During the ignition cycle multiple safety checks are active



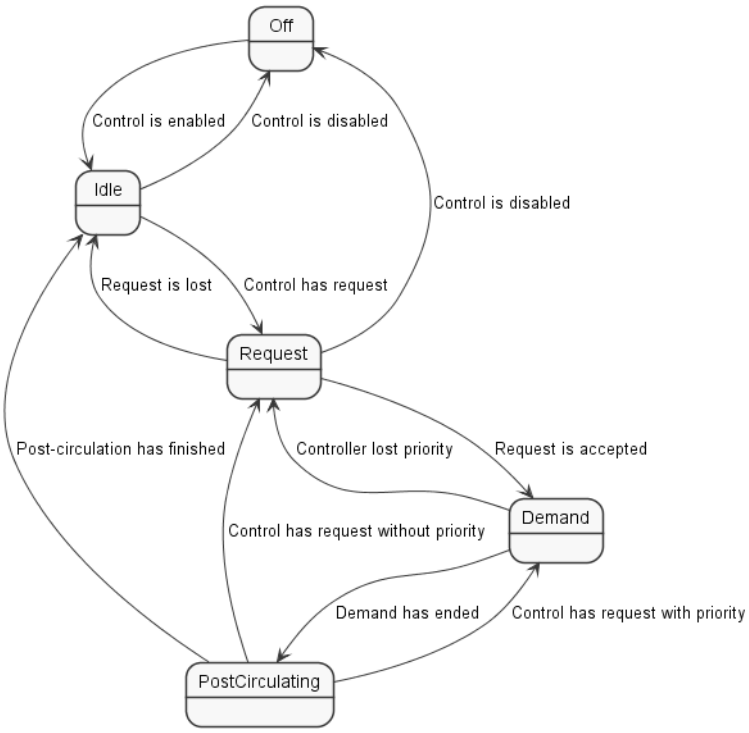
The table below shows the states of the burner ignition cycle, as shown in the diagram above:

#	Burner state	Actions
0	INIT	▪ Controller initialization
1	RESET	▪ Software reset (and initialization)
2	STANDBY	▪ Standby (waiting for demand)
3	PRE_PURGE_0	▪ Fan is not running ▪ When an APS is enabled the APS position is checked
4	PRE_PURGE_1	▪ Fan starts at ignition speed ▪ When an APS is enabled the APS position is checked
5	PRE_IGNIT	▪ Fan stays at ignition speed ▪ Igniter is started ▪ When a LPG tank is selected, the tank valve is opened
6	IGNIT	▪ Fan stays at ignition speed ▪ The gas valve is opened ▪ Igniter stays on ▪ When a LPG tank is selected, the tank valve stays opened
7	FLAME_PROVING	▪ Fan stays at ignition speed ▪ The gas valve stays opened ▪ The igniter is stopped ▪ When a LPG tank is selected, the tank valve stays opened
8	BURN	▪ The fan is modulating ▪ The gas valve stays opened ▪ When a LPG tank is selected, the tank valve stays opened ▪ When an APS is enabled the APS position is checked
9	POST_BURN	▪ Fan is set to minimum speed ▪ The gas valve stays opened
10	POST_PURGE_0	▪ The fan is set at ignition speed ▪ The gas valve is closed ▪ When a LPG tank is selected, the tank valve is closed
11	POST_PURGE_1	▪ Fan stays at ignition speed ▪ When an APS is enabled the APS position is checked
12	ERROR_CHECK	▪ Blocking error is set ▪ Checking if blocking error can be removed (error situation is solved)
13	ALARM	▪ Lockout error is set ▪ User must reset the lockout error (and the controller will reboot)
14	BURNER_BOOT	▪ Finalize processes and reboot the control

During the ignition cycle multiple safety checks are active:

False flame detection	If flame is detected at the end of the pre-spark period (*Pre_Ignit*) a lockout error will occur.
Re-ignition	If at the end of the safety period no flame is detected the control will go to *Post_Purge* to remove any unburned gas. After this a re-ignition attempt is started following the same cycle. The number of re-ignition attempts is limited to *Max_Ignit_Trials* after which a lockout occurs.
Flame establishing time	Sparking stops in the *Flame_Proving* state to allow for ionization detection. The *Flame_Proving* state takes *Safety_Period - Ignit_Period*.
Flame out too late	If at the end of the *Post_Purge* 0 state the flame is still detected a lockout follows.
Flame loss	When a flame is lost during a burn cycle the control will restart the burner. The number of restarts is limited by the *Max_Flame_Trials* setting.
Fan supervision	The fan speed is continuously monitored. The following conditions for the fan speed are checked: ▪ The actual fan speed must be within 300RPM of the target fan speed ▪ When the fan speed dutycycle is within the lower/upper 5% of the PWM dutycycle range no errors will be generated since the fan is in the limits of its working range.

12.7.1 CONTROL FUNCTIONS



Dependent on the required functions of the appliance and connected sensors and components, several operation modes for Central Heating (CH) and Domestic Hot Water (DHW) can be selected, which are described hereafter.
The demand controls all work according to a defined state machine. The diagram below shows how the controller states are implemented

Each state has a specific meaning for the controller. Below the various states are explained in more detail.

Controller State	Description
Off	The controller is disabled. The controller cannot generate request from this state. When the controller is enabled the controller state will move to the Idle state.
Idle	The controller is enabled. There is no request present. When a request becomes present the controller will move to the Request state. In case the controller is disabled the controller will move to the Off state.
Request	The controller is enabled. There is an active request present. The active request is not yet accepted by the demand controller. Once the active request is accepted the controller state moves to the Demand state. When the request is lost the controller state moves back to the Idle state. In case the controller is disabled the controller will move to the Off state.
Demand	The controller is enabled. There is an active request that has been accepted by the demand controller. The control is actively handling its heat-request. This state does not mean that the burner is on. The burner state can be monitored using the Burner State variable. When the active request is lost the controller will move to the post-circulating state. When the priority for the active request is lost the controller falls back to the Request state. In case the controller is disabled the controller moves to the Post-circulating state.
Post-circulating	The control is post-circulating. During this state the pumps continue to run for a short while. When the post-circulation time has finished the control moves to the Idle state. When the post-circulation time has finished and the control is no longer enabled the control moves to the Off state. When a higher priority demand becomes active the post-circulation is ended and the controller moves to the Idle state.

12.7.2 ON BOARD HMI AND LED COLORS.

On the burner controller a basic on-board Human Interface (HMI) is available which consists of a push button and a 2 color (red/green) LED. These are used to indicate basic status information about the control.

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Control operational
When the control is operational and there are no errors present the LED will show as a constant green color.

Control locked
When the control is locked the LED will show as a constant red color. When the control is locked the control can be reset by using the push button. When the reset has been accepted the control is reset and the status LED will return to show the green color

Control blocked
When the control is blocked the LED will alternate between green and red with a 1 second interval. When the blocking error is solved the LED will return to show only the green color.

Exceptions
In case the communication between the main and watchdog processor cannot be established the LED will not follow the status from the control. In this situation the watchdog processor will reset in an attempt to restore the communication. When this occurs the LED will appear as green with short pulses in which the LED is off.

12.7.3 FLAME DETECTION

When the boiler is firing, and the flame is not detected anymore, the gas valve will be closed, and the control will perform a post-purge, after which a restart will take place. When the flame disappears 3 times within one heat demand the control will lockout.
The presence of a flame is measured through the flame rod that points into the flame. The flame current is measured by the control as ionization in micro amps (µA).

When the flame current is above Flamerod_Setpoint + Flamerod_Hysterese (1.0 µA + 0.5 µA) a flame will be present. When the flame current is below Flamerod_Setpoint (1.0 µA) the flame will not be present.

12.7.4 FLAME RECOVERY

When the ionization current is too low, the system responds by increasing the minimal fan speed, in order to keep the flame present. This is done by increasing the minimal fan speed when the ionization current is too low.

Whenever the ionization current is high enough, the minimal fan speed will be decreased again. When the flame still disappears the minimal fan speed will be increased for the next burn cycle.

• When the flame current is below Flamerod_Setpoint + Flamerod_Delta (1.0 µA + 0.2 µA) the minimal fan speed will be increased.
• When the flame current is above Flamerod_Setpoint + Flamerod_Delta + Flamerod_Delta * 2 (1.0 µA + 0.2 µA + 0.4 µA) the minimal fan speed will be decreased.

When the flame still disappears the minimal fan speed will be increased for the next burn cycle.

No. of flame losses	Description
0	Minimal fan speed as set in the system
1	In between minimal and ignition fan speed
2	Ignition fan speed

When the system successfully completes a burn cycle, the minimal fan speed will be reset to the set minimal fan speed in the system.

12.8 *Control functions*

Dependent on the required functions of the appliance and connected sensors and components, several operation modes for Central Heating (CH) and Domestic Hot Water (DHW) can be selected.

12.8.1 ROOM THERMOSTAT ONLY; CH MODE 0 (DEFAULT SETTING)

For this mode the CH mode should be set to 0 and no outdoor sensor is needed.

If the room thermostat closes, the boiler and system pumps are switched ON. When the supply temperature drops CH_Hysterese_Down below the CH_Setpoint (settable via the menu) the boiler is switched ON. The power for the boiler is PID regulated between T_Supply and the CH_Setpoint using the PID parameters for Central Heating.
If the supply temperature reaches a temperature CH_Hysterese_Up above the CH_Setpoint the boiler is switched OFF. However, if CH_Setpoint + CH_Hysterese_Up is greater than maximum setpoint the boiler switches OFF at the maximum setpoint.
If the room thermostat opens the boiler is switched OFF (if this was not already happening) and the boiler and system pumps run ON for CH_Post_Pump_Time.

Anti-cycle period
(This function is also applicable to all other CH modes) When the boiler is switched OFF because the supply temperature reaches CH_Setpoint + CH_Hysterese_Up, the control will wait a period of time (Anti_Cycle_Period →180 sec. settable) before it is allowed to be switched ON again.
This function is to prevent fast switching ON and OFF of the burner. However, when during the anti-cycle wait time the differential between setpoint and supply temperature gets greater than Anti_Cycle_T_Diff, anti-cycle will be aborted, and the burner is allowed to start. When the request for the active CH mode is lost during anti-cycling the anti-cycle will be aborted and the burner is allowed directly when a new CH request is generated.

Maximum CH power
(This function is also applicable to all other CH modes)
The maximum boiler power during CH operation can be limited with parameter P_CH_Max.

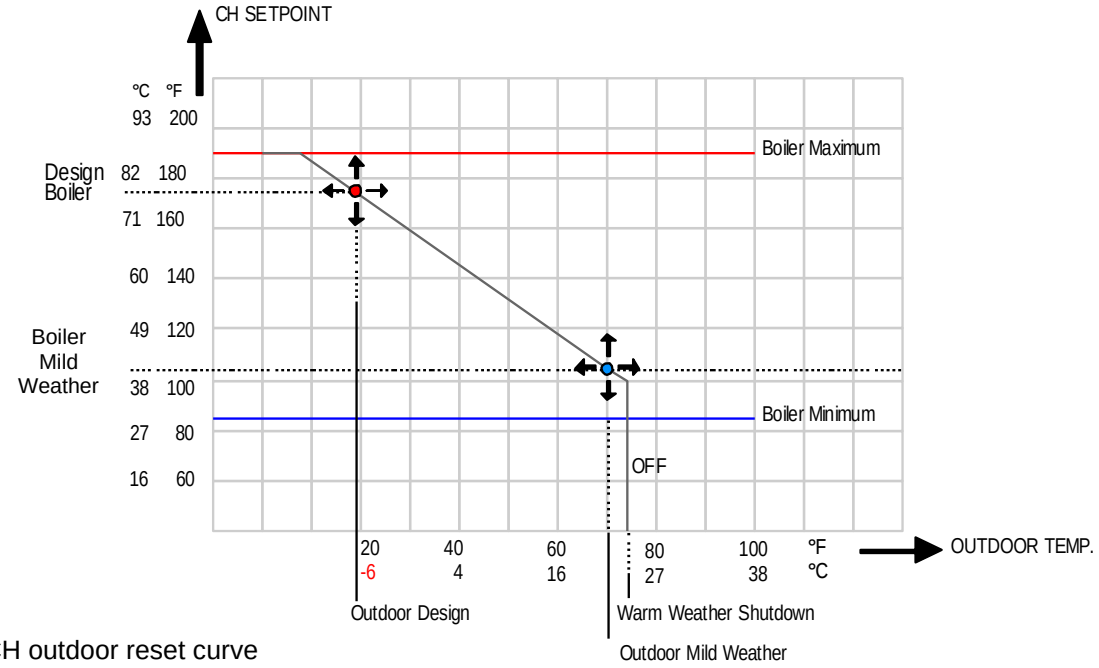
Minimum CH power
(This function is also applicable to all other CH and DHW modes)
The minimum boiler power during operation can be limited with parameter P_CH_Min.

Adjustable Set Point Heating Parameters

Specific Parameters	Level	Default Value	Range
CH_Mode	2: Installer	1	Mode 0-5
CH Setpoint Sets the required supply temperature.	1: User	176 ºF (80 ºC)	68…..194 ºF (20…..90 ºC)
CH_Post_Pump_Time	2: Installer	120 sec.	10…..900 sec
Anti_Cycle_Period	2: Installer	180 sec	10…..900 sec
Anti_Cycle_T_Diff Aborts anti-cycle time when setpoint – actual supply temp >*Anti_Cycle_T_Diff.*	2: Installer	29 ºF (16 ºC)	0…..36 ºF (0…..20 ºC)
P_CH_Max Maximum boiler power for CH operation	2: Installer	100 %	1…..100 %
P_CH_Min Minimum boiler power for CH operation	2: Installer	1 %	1…..50 %

12.8.2 CH WITH AN OUTDOOR TEMPERATURE RESET AND THERMOSTAT; CH MODE 1

If the parameter CH_Mode is set to 1, the “Outdoor temperature reset with room thermostat” mode is selected. This mode will only function when an outdoor temperature sensor is connected. If the outdoor sensor is connected, the boiler automatically uses Reset_Curve_Boiler_Maximum.
The setpoint is calculated depending on the outdoor temperature as indicated in the following graph and the boiler will react on the room thermostat (as described in § 12.7.1).



CH outdoor reset curve

The outdoor reset curve can be changed by adjusting the design and mild weather reference temperatures. The calculated CH-setpoint is always limited between parameters Reset_Curve_Boiler_Minimum and Reset_Curve_Boiler_Maximum.
The outdoor temperature used for the CH_Setpoint calculation is measured once a minute and averaged with the previous measurement. This is to avoid commuting when the outside temperature changes rapidly.
If an “open” outdoor sensor is detected the CH_Setpoint will be equal to the Reset_Curve_Design_Boiler.

Shutdown temperature
When the outdoor temperature rises above Warm_Weather_Shutdown, the call for heat is blocked and the pumps are stopped. There is a fixed hysteresis of 1.8 °F (1 °C) around the Warm_Weather_Shutdown setting.
This means that the demand is stopped when the outdoor temperature has risen above Warm_Weather_Shutdown plus 1.8 °F (1 °C). When the outdoor temperature drops below Warm_Weather_Shutdown minus 1.8 °F (1 °C) again, the demand will also start again.

Boost function
The outdoor reset boost function increases the CH_Setpoint by a prescribed increment (Boost_Temperature_Incr) if a call for heat continues beyond the pre-set time limit (Boost_Time_Delay).

Boiler Parameters		
(25) Warm Weather Shutdn	72 °F	▲
(26) Boost Temp increment	0 °F	
(27) Boost Time Delay	20 min	
(28) Night Setback Temp.	7 °F	▼

These are parameters 26 Boost Temp Increment and 27 Boost Time Delay.
And have a default value of 0 °F (0° C) and 20 min, so the function is switched off and can be activated by the installer by increasing parameter 26 by a number of degrees. Also, the time can be set when this parameter will be active in parameter 27 now set on 20 min.
CH_Setpoint increases again if the call for heat still is not satisfied in another time increment.

Setpoint adjustment
It is possible to adjust the calculated setpoint with parameter CH_Setpoint_Diff. The calculated setpoint can be increased or decreased with a maximum of 18 °F (10 ºC). The CH setpoint limits (Reset_Curve_Boiler_Minimum and Reset_Curve_Boiler_Maximum) are respected while adjusting the setpoint.
Apart from the calculated setpoint the functionality is the same as described in § 12.7.1.

Adjustable Outdoor Reset parameters

Parameters	Level	Default Value	Range
CH_Mode	2: Installer	1	Mode 0-5
Reset_Curve_Design_Boiler Sets high boiler CH setpoint when outdoor temp. is equal to *Reset_Curve_Outdoor_Design.*	2: Installer	176 ºF (80 ºC)	32…..176 ºF (0…..80 ºC)
Reset_Curve_Outdoor_Design Sets the outdoor temp at which the boiler setpoint must be high as set by *Reset_Curve_Design_Boiler*.	2: Installer	23 ºF (-5 ºC)	-4…..41 ºF (-20…..5 ºC)
Reset_Curve_Boiler_Mild_Weather Sets low boiler CH setpoint when outdoor temp. is equal to *Reset_Curve_Outdoor_Mild_Weather*.	2: Installer	104 ºF (40 ºC)	32…..104 ºF (0…..40 ºC)
Reset_Curve_Outdoor_Mild_Weather Sets the outdoor temp at which the boiler setpoint must be low as set by *Reset_Curve_Mild_Weather.*	2: Installer	68 ºF (20 ºC)	32…..86 ºF (0…..30 ºC)
Reset_Curve_Boiler_Minimum Sets the lower limit for the CH setpoint (minimum).	2: Installer	86 ºF (30 ºC)	68…..194 ºF (20…..90 ºC)
Reset_Curve_Boiler_Maximum Sets the upper limit for the CH setpoint (maximum).	2: Installer	194 ºF (90 ºC)	68…..194 ºF (20…..90 ºC)
Warm_Weather_Shutdown Set max. outdoor temp. Above this temperature heat demand is blocked.	2: Installer	72 ºF (22 ºC)	32…..95 ºF (0…..35 ºC)
Boost_Temperature_Incr CH setpoint increment when heat demand remains beyond *Boost_Time_Delay*.	2: Installer	0 ºF (0 ºC)	0…..36 ºF (0…..20 ºC)
Boost_Time_Delay	2: Installer	20 min.	1 – 120 min.
CH_Setpoint_Diff Adjusts the calculated CH setpoint.	1: User	0 ºF (0 ºC)	-18…..+18 ºF (-10…..+10 ºC)

Status variables		Range
Actual_CH_Setpoint Calculated CH setpoint, based on outdoor reset curve.		68...194 ºF (20.....90 ºC)

12.8.3 CH WITH FULL OUTDOOR TEMPERATURE RESET; CH MODE 2

When CH_Mode is set to 2, full weather compensator is chosen. For this mode an outdoor sensor has to be connected. The CH_Setpoint is calculated on the same way as described in §12.8.2.

However, the demand does not depend on the Room Thermostat input but on the outdoor temperature and the outdoor reset setpoint. When the outdoor temperature is below Warm_Weather_Shutdown (settable) CH demand is created.

During the night an input signal from an external clock can lower the CH_Setpoint. When the RT input opens CH_Setpoint will be decreased with Night_Setback_Temp. The RT input does not influence the CH demand directly!

This can be done by connecting a relay contact or clock thermostat to terminal 12 and 13 on the low voltage connectors of the boiler. The room thermostat is only being used in this function to switch between a night setback temperature and a daytime temperature, there is always a constant demand for heat in CH mode 2.
The Night Setback temperature can be set by using the installer password and changing parameter 28 in the boiler parameters, default value is setpoint - 50 °F.

Boiler Parameters		
(25) Warm Weather Shutdn	72 °F	▲
(26) Boost Temp increment	0 °F	
(27) Boost Time Delay	20 min	
(28) Night Setback Temp.	7 °F	▼

Adjustable constant Circulation Parameters

Parameters	Level	(Default) Value	Settable
CH_Mode	2: Installer	0	Mode 0 - 5
Warm_Weather_Shutdown Set max. outdoor temp. Above this temperature heat demand is blocked.	2: installer	72 ºF (22 ºC)	32...95 ºF (0...35 ºC)
CH_Setpoint_Diff Adjusts the calculated CH setpoint.	1: User	0 ºF (0 ºC)	-18...18 ºF (-10...10 ºC)

12.8.4 CH WITH CONSTANT CIRCULATION AND PERMANENT HEAT DEMAND; CH MODE 3

For this mode the CH_ Mode should be set to 3, no outdoor sensor is needed. The supply temperature is kept constantly at the setpoint temperature. The boiler is controlled in a similar way as described in §12.7.1.

When the room thermostat contact opens CH_Setpoint will be decreased with Night_Setback_Temp. In this condition the pump is always ON.

Please note that the pump starts every 24 hours function is not performed during this mode. In this mode the pump will be running continuously.

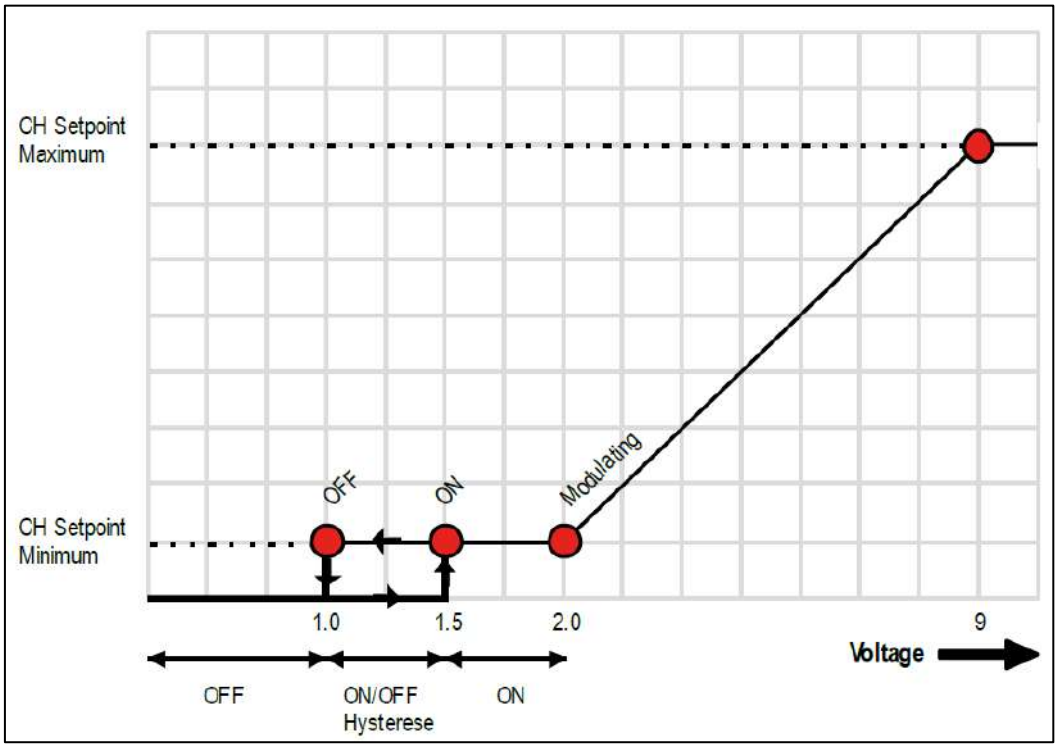
Parameters	Level	(Default) Value	Settable
CH_Mode	2: Installer	0	Mode 0 - 5
CH_Setpoint	1:User	176 ºF (80 ºC)	68.....194 ºF (20.....90 ºC)

12.8.5 CENTRAL HEATING WITH ANALOG INPUT CONTROL OF SETPOINT; CH MODE 4

CH mode is set to 4. In this mode of operation, the boiler CH setpoint is controlled by an analog input signal provided by a remote means such as a Building Management System or a system controller. The analog input 0-10 Vdc is used to adjust the boiler setpoint between the CH_Setpoint_Min and the CH_Setpoint_Max settings.

The minimum analog input signal will correspond to the CH_Setpoint_Min parameter and the maximum analog input signal will correspond to the CH setpoint maximum parameter. All other safety and control functions associated with the boiler will react normally to adverse condition and override control of the analog signal to prevent an upset condition. This means for example that when signal is going up faster than the boiler can regulate that the boiler will slow down to prevent overshoot in temperature.

The CH_Setpoint_Min and CH_Setpoint_Max parameters can be adjusted to provide the desired temperature adjustment band. A heat request will be generated by an input of 1.5 volts or higher. The setpoint modulation will occur between 2 and 9 volts. The request for heat will be removed when the voltage drops below 1 volt.



- RT input must be shorted to generate heat demand. / Min/Max CH power setting is limiting 0-10V range.

Parameters	Level	(Default) Value	Settable
CH_Mode	2: Installer	0	Mode 0, 1, 2, 3, 4, 5
CH_Setpoint_Minimum	2: Installer	68 ºF (20 ºC)	68...194 ºF (20...90 ºC)
CH_Setpoint_Maximum	2: Installer	194 ºF (90 ºC)	68...194 ºF (20...90 ºC)

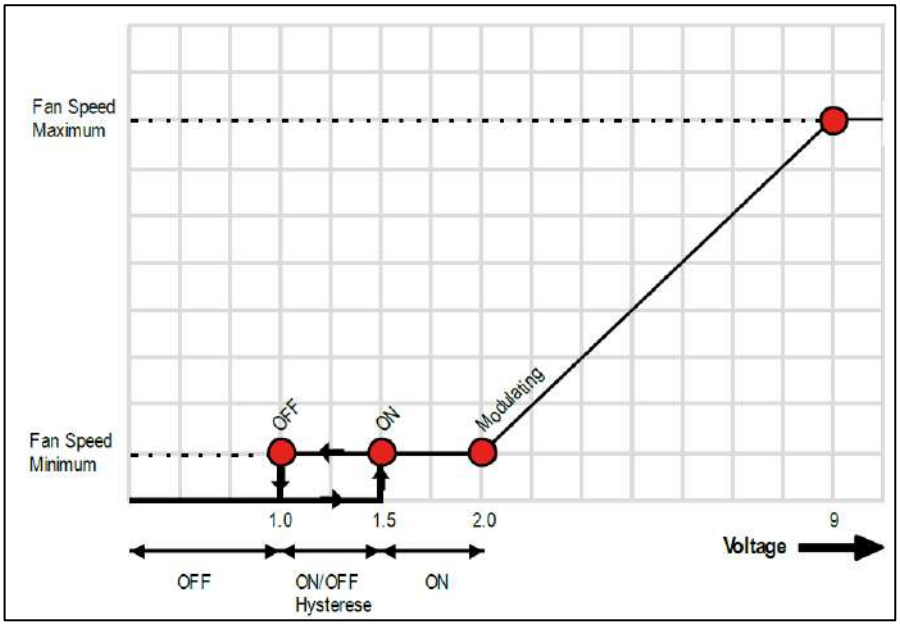
12.8.6 CH WITH ANALOG INPUT CONTROL OF POWER OUTPUT; CH MODE 5

In this mode of operation, the temperature needs to be controlled by an external temperature controller. When the boiler has a supply temperature of 203ºF (95ºC) the boiler switches off and shows a blocking code “High Temp Error” (105) wait until the temperature has dropped to 194ºF (90ºC) now the boiler will start again.
So the external controller needs to reduce the 0-10V signal or switch the boiler off before it reaches 203ºF (95ºC).
When connecting the 0-10V signal the room thermostat signal needs to be bridged to activate the signal.

When using a modulating pump on pwm signal the pomp will only run on the fixed pwm signal this signal can be changed in parameter(136) Mod. Pump Mode. The pomp will not modulate on delta T setpoint. When you want to use a delta T controlled setpoint of the pump use CH-mode 4

The minimum analog input signal value will correspond to the minimum modulation rate and the maximum modulation analog input signal value will correspond to the maximum modulation rate.
All other safety and control functions associated with the boiler will react normally to adverse condition and override control of the analog signal to prevent an upset condition.

A heat request will be generated by an input of 1.5 volts or higher. The fan speed modulation will occur between 2.0 and 9.0 volts. The request for heat will stop when the voltage drops below 1 volt.



- CH mode 5 will work without sensors.

Parameters	Level	(Default) Value	Settable
CH_Mode	2: Installer	0	Mode 0, 1, 2, 3, 4, 5

Using CH mode 5 the temperature needs to be controlled by an external temperature controller. When the boiler has a supply temperature of 203ºF (95ºC) the boiler switches off and shows a blocking code “High Temp Error” (105), wait until the temperature has dropped to 194ºF (90ºC) now the boiler will start again.
So the external controller need to reduce the 0-10V signal or switch the boiler off before it reaches 203ºF (95ºC).
When connecting the 0-10V signal the room thermostat signal needs to be bridged to activate the signal.

When using a modulating pump on pwm signal the pomp will only run on the fixed pwm signal. This signal can be modified in parameter(136) Mod. Pump Mode. The pomp will not modulate on delta T setpoint. If its neccesary to use a delta T controlled setpoint of the pump use CH-mode 4.

12.9 *Demand for Domestic Hot Water*

12.9.1 NO DOMESTIC HOT WATER; DHW MODE 0

No domestic hot water is available. The T_DHW_Out sensor does not need to be connected.

12.9.2 DHW STORAGE WITH SENSOR; DHW MODE 1

Mode 1: DHW is prepared by warming up a store. Either a DHW pump or 3-way valve can be used to switch to DHW mode.

The DHW temperature in the tank is measured with sensor T_Store and set with parameter DHW_Store_Setpoint. When this sensor drops below DHW_Store_Setpoint minus DHW_Store_Hyst_Down the control detects a demand for the store and starts the general and DHW circulator.
If the supply temperature T_Supply is below
DHW_Store_Setpoint plus DHW_Store_Supply_Extra minus DHW_Supp_Hyst_Down the boiler is started as well.

When the boiler is ON, the power is PID-modulated so T_Supply is regulated towards
DHW_Setpoint plus DHW_Store_Supply_Extra.

The boiler is stopped when the supply temperature rises above
DHW_Store_Setpoint plus DHW_Store_Supply_Extra plus DHW_Supp_Hyst_Up.

The demand for the tank is ended when the tank-sensor rises above
DHW_Store_Setpoint plus DHW_Store_Hyst_Up. The circulator continues DHW_Post_Pump_Period.

DHW Priority
Standard DHW demand has priority over CH demand but the priority period is limited up to DHW_Max_Priority_Time. The priority timer starts when both CH and DHW demand are present. After the DHW_Max_Priority_Time is achieved, the control will switch from DHW to CH operation. CH has priority now for a maximum period of DHW_Max_Priority_Time.

Different DHW Priority types can be chosen:

DHW priority	Description
0 → Time	DHW has priority to CH during *DHW_Max_Priority_Time*
1 → OFF	CH always has priority to DHW
2 → ON	DHW always has priority to CH
Default *DHW_Priority* is set to 2.	

Store warm hold function
Because of the presence of the indirect tank sensor (*T_Store*) the control can detect demand for holding the indirect tank hot.
If T_Store drops below DHW_Store_Setpoint minus DHW_Store_Hold_Warm the boiler starts at minimum power.
The boiler stops if T_Store is higher than DHW_Store_Setpoint plus DHW_Store_Hyst_Up.

Relevant variables

Specific Parameters	Level	(Default) Value	Range
DHW_Mode	2: Installer	0	0, 1, 2, 3, 5, 6, 7, 8
DHW_Store_Setpoint Sets the desired DHW temperature.	1: User	149 ºF (65 ºC)	104...160 ºF (40...71 ºC)
DHW_Store_Supply_Extra Increases the supply temperature to the store until *DHW_Store_Setpoint + DHW_Store_Supply_Extra.*	2: Installer	27 ºF (15 ºC)	0...54 ºF (0...30 ºC)

Status Variables	Value
DHW control state Central Heating controller state	0 → Idle
	1 → Request
	2 → Demand
	3 → Post circulation
	4 → Off

12.9.3 DHW STORAGE WITH THERMOSTAT; DHW MODE 2

In this mode DHW is prepared by warming up an indirect tank. Either a DHW pump or 3-way valve can be used to switch to DHW mode. The temperature of the DHW in the indirect tank is regulated by a thermostat/aquastat (instead of a sensor), which should provide only an open/closed signal to the control.

When the thermostat/aquastat closes the control detects a demand from the DHW indirect tank and starts the DHW pump.
If the supply temperature T_Supply drops below DHW_Store_Setpoint minus DHW_Supp_Hyst_Down the boiler starts. When the boiler is ON the power is PID-controlled based on T_Supply toward DHW_Store_Setpoint.

The boiler is stopped when the supply temperature rises above DHW_Store_Setpoint plus DHW_Supp_Hyst_Up. The demand for DHW ends when the indirect tank thermostat/aquastat opens. The circulator continues DHW_Post_Circulator_Period after the DHW demand has stopped.

DHW priority
See §12.8.2 – DHW Mode 1 – Storage with sensor

Relevant variables

Specific Parameters	Level	(Default) Value	Range
DHW_Mode	2: Installer	0	0, 1, 2,3, 4, 5, 6, 7, 8
DHW_Store_Setpoint Sets the supply temperature from the boiler to prepare DHW in the indirect tank	2: User	149 ºF (65 ºC)	104…160 ºF (40…71 ºC)
DHW_Priority	[-]	2	0=Time, 1=OFF, 2=ON
DHW_Max_Priority_Time Sets the maximum time for either DHW or CH priority.	2: Installer	60 min.	
DHW_Post_Pump_Period	2: Installer	120 sec.	10...900

12.9.4 INSTANTANEOUS WATER HEATING WITH PLATED HEAT EXCHANGER; DHW MODE 3

In DHW mode 3 the water flow through a plated heat exchanger is checked with a flow switch. If the switch closes a water flow is detected, and either a DHW pump or a 3-way valve can be used to switch to DHW mode. The temperature of the DHW is set with *DHW_Setpoint*.

If the *T_DHW_Out* sensor drops below *DHW_Setpoint* minus *DHW_Hyst_Down* the burner starts. When the burner is on, the power is PID-controlled based on *T_DHW_Out* toward *DHW_Setpoint*. The burner stops when the *T_DHW_Out* temperature rises above *DHW_Setpoint* plus *DHW_Hyst_Up*. When the flow switch opens the demand for the tapping is ended and the burner stops. The pump continues *DHW_Post_Pump_Period.*

Based on a DHW temperature rise of 100 °F following minimum and maximum DHW flows are advised:

Boiler model	Minimum flow (gpm)	Maximum flow (gpm)
RC-300	1.1	5.3
RC-400	1.4	7.1
RC-500	1.8	8.5

Specific Parameters	Level	(Default) Value	Range
DHW_Mode	2: Installer	0	0, 1, 2,3, 4, 5, 6, 7, 8
DHW_Setpoint Sets the desired DHW temperature	2: User	122 ºF (50 ºC)	86…176 ºF (30…80 ºC)
DHW_Post_Pump_Period	2: Installer	20 s	10…900 s

12.9.5 ANTI-LEGIONELLA PROTECTION

Anti-Legionella protection is enabled for DHW modes with an external tank with a sensor (DHW Mode 1).

To prevent legionella a special function is implemented in the software.

• When DHW Mode 1 is selected the Anti-Legionella protection will be checked on the T_DHW_Out sensor.
At least once every 168 hours (7 days) the Anti_Legionella_Sensor must reach a temperature above Anti_Legionella_Setpoint for a time specified by Anti_Legionella_Burn_Time.

If 7 days have passed and these conditions are not met, the boiler is forced to heat-up the system for Anti-Legionella. When the Anti_Legionella_Sensor temperature is below Anti_Legionella_Setpoint the control switches ON the circulators, when the Anti_Legionella_Sensor temperature is above Anti_Legionella_Setpoint plus 9 °F (plus 5 °C) the control stops the circulators.

When DHW Mode 1 is selected the boiler setpoint will be at
Anti_Legionella_Setpoint plus DHW_Store_Supply_Extra.

If the supply temperature drops below the Boiler_Setpoint the boiler is started as well. The boiler is PID controlled towards the Boiler_Setpoint. When the supply temperature rises above
Boiler_Setpoint plus DHW_Supp_Hysterese_Up the boiler is switched OFF.

When the Anti_Legionella_Sensor is above Anti_Legionella_Setpoint minus 5.4 °F (minus 3 °C) for Anti_Legionella_Burn_Time the controller goes into post circulation and ends the Anti-Legionella demand. When the controller has powered up, the Anti_Legionella_Sensor temperature must reach a temperature of Anti_Legionella_Setpoint (for Anti_Legionella_Burn_Time) within 2 hours, otherwise the boiler is forced into Anti-Legionella demand.

Every time an Anti-Legionella demand has ended the Anti_Legionella_Active_Counter is incremented to indicate how many Anti-Legionella actions have been performed. Also the Anti_Legionella_Wait_Time is started to delay the next Anti-Legionella cycle.

The anti-legionella demand has priority over any DHW and CH demand. However, when the anti-legionella protection is active and there is no heat or burn demand because the Anti_Legionella_Sensor is already at a high enough temperature CH/DHW demand will be accepted as normal.

Below parameters can be set by the installer(DHW Modus 1 only)

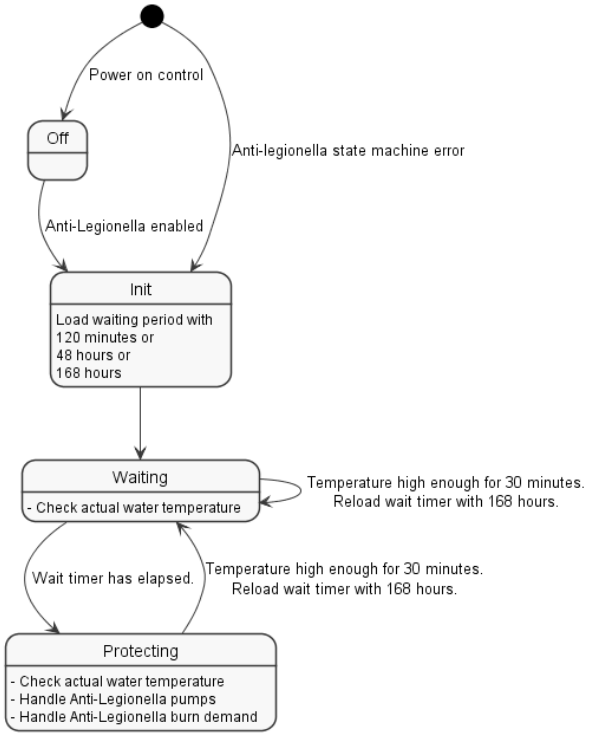
Parameter	Factory Setting.
(107) Anti Legionella Day	Sunday
(108) Anti Legionella Hour	0 hrs

Following parameters cannot be set by the installer and are factory set

Parameter	Factory Setting.
Anti_Legionella_Setpoint (Setpoint for Anti-Legionella demand)	140 ºF (60 ºC)
Anti_Legionella_Burn_Time	30 Min.
Anti_Legionella_Wait_Time Wait time for Anti-Legionella demand.	120 min after cold start, 168 h after first successful Anti-Legionella demand

After a cold boot of the control the Anti-legionella cycle is forced to start after 120 minutes.
When the Anti-legionella request is active the measured sensor temperature must stay above *Anti_Legionella_Setpoint – 3°C* for at least *Anti_Legionella_Burn_Time*. When the measured sensor temperature drops below this level the *Anti_Legionella_Burn_Time* is reloaded

The diagram below shows how the state machine for Anti-Legionella is implemented.



Burn demand generation

When the anti-legionella control has an active request a burn demand can be generated. The burn demand is generated according to the following rules

Start demand

- The demand is started when the measured sensor temperature is below the burner setpoint

Stop demand

- The demand is stopped when the measured sensor temperature is above the burner setpoint + 5°C

Status information

Every time an anti-legionella demand ends the Anti_Legionella_Active_Counter is incremented to indicate how many anti-legionella actions have been performed. This counter can be found in the 'Boiler History' screen in LabVision PC software.

12.9.6 DISPLAY MENU STRUCTURE SUMMARY.

Menu structure Display:	Access level	Description:
1. Central Heating (CH)	User	Enter the Central Heating (CH) menu
2. Domestic Hot Water (DHW)	User	Enter the Domestic Hot Water (DHW) menu
3. Information	User	Enter the Information menu
4. Settings	User	Enter the Settings menu
5. System Test	User	Enter the System Test menu
6. Reset Password	Installer	Reset the user-level back to 0: User.

1. Central Heating (CH)	min.	max.	De-fault	unit	Access level	Description:
1.1 CH Setpoint	20	90	85	°C	Installer	Set the CH setpoint if CH mode is 0
1.2 Outdoor Reset					User	Enter the Outdoor Reset menu if CH mode is 1

1.2 Outdoor reset	min.	max.	De-fault	unit	Access level	Description:
Des. Supply T.	20	90	85	°C	Installer	Set CH setpoint when outdoor temperature equals Des. Outd. T.
Bas. Supply T.	20	90	40	°C	Installer	Set CH setpoint when outdoor temperature equals Bas. Outd. T.
WW Shutdown	0	35	22	°C	Installer	Set outdoor temperature above which CH demand is locked.
Bas. Outd. T.	0	30	20	°C	Installer	Set the outdoor temperature at which CH setpoint is set to Bas. Supply T.
Des. Outd. T.	-25	25	-5	°C	Installer	Set the outdoor temperature at which CH setpoint is set to Des. Supply T.

2. Domestic Hot Water (DHW)	min.	max.	De-fault	unit	Access level	Description:
DHW Setpoint	40	71	60	°C	Installer	Set the DHW setpoint
DHW Store Setpoint	40	71	65	°C	Installer	Set the DHW store setpoint for DHW mode 1 and 2

3. Information	min.	max.	De-fault	unit	Access level	Description:
3.1 Software versions					User	Enter the Software Versions menu
3.2 Boiler Status					User	Enter the Boiler Status menu
3.3 Boiler History					User	Enter the Boiler History menu
3.4 Error Log					User	Enter the Error Log menu
3.5 Service					User	Enter the Service menu

3.1 Software versions	min.	max.	De-fault	unit	Access level	Description:
Display				xxxx xxxx	User	Display the software checksum
Boiler				xxxx xxxx	User	Display the boiler software checksum
Device Group				xxxMN	User	Display the boiler group ID

3.2 Boiler status	min.	max.	Default	unit	Access level	Description:
Flow Temperature				°C	User	Actual supply flow temperature
Flow 2 Temperature				°C	User	Actual supply 2 flow temperature
Return Temperature						
DHW Temperature				°C	User	Actual DHW temperature
DCW Temperature				°C	User	Actual DCW temperature
Outside Temperature				°C	User	Actual outside temperature
Flue Temp				°C	User	Actual flue gas temperature
Flue 2 Temp				°C	User	Actual flue gas 2 temperature
System Temperature				°C	User	Actual system temperature
0-10 V Input						
Flowrate				l/min	User	Actual DHW flowrate
RT Input				open/close	User	Actual RT input status
Gas Pr Sw				open/clos	User	Gas pressure switch input
Flow Switch				open/clos	User	CH/DHW) Flow switch input
Air Fl Sw				open/clos	User	Air pressure switch input
Water Pressure				Bar	User	Actual CH water pressure
Fan Speed						
Ionization				uA	User	Actual ionization current
State					User	Actual burner state
Error				#	User	Actual internal error code
Calculated Setpoint				°C	User	Actual CH setpoint
Module Setpoint				°C	User	Actual Module/dependent/burner setpoint (Only for module cascade.)

3.3 Boiler history	min.	max.	Default	unit	Access level	Description:
Successful Ignitions				#	User	Display the number of successful ignitions
Failed Ignitions				#	User	Display the number of failed ignitions
Flame Failures				#	User	Display the number of flame losses
Operation Days				days.	User	Display the total time in operation
CH Burner Hours				hrs.	User	Display the amount of burn hours for CH
DHW Burner Hours				hrs.	User	Display the amount of burn hours for DHW

3.4 Error Log	min.	max.	Default	unit	Access level	Description:
Error Log					User	Display the complete error log
Filter Error Type					User	Set the error log filter
Clear Error Log					Installer	Clear the complete error log

3.5 Service	min.	max.	Default	unit	Access level	Description:
Service history					User	Display the service history
Burn hours since last service				hrs.	User	Display the burn hours since last service
Burn hours till service				hrs.	User	Display the hours remaining until next service
Operation Days				days.	User	Display the total time in operation

4 Settings	min.	max.	Default	unit	Access level	Description:
4.1 General Settings					User	Enter the General Settings menu
4.2 Boiler Settings					User	Enter the Boiler Settings menu

4.1 General settings	min.	max.	Default	unit	Access level	Description:
4.1.1 Language					User	Enter the Language menu
4.1.2 Unit Type					User	Enter the Unit Type menu
4.1.3 Date & Time					User	Enter the Date & Time menu
4.1.4 Cascade Mode					User	Enter the Cascade Mode menu
4.1.5 Other Settings					User	Enter the Other Settings menu

4.1.1 Language	min.	max.	Default	unit	Access level	Description:
English			Eng		User	Select the English language
Italiano					User	Select the Italian language
Русский					User	Select the Russian language
Hrvatski					User	Select the Croatian language
中文					User	Select the Chinese language
Français					User	Select the French language
Español					User	Select the Spanish language
Türkçe					User	Select the Turkish language
Deutsch					User	Select the German language
Slovenský					User	Select the Slovak language
Nederlands					User	Select the Dutch language
Polski					User	Select the Polish language
Česky					User	Select the Czech language
Ελληνικά					User	Select the Greek language
magyar					User	Select the Hungarian language
Português					User	Select the Portuguese language
Românesc					User	Select the Romanian language
Slovenščina					User	Select the Slovene language

4.1.2 unit type	min.	max.	Default	unit	Access level	Description:
Metric (˚C, bar)			˚C/bar	˚C/bar	User	Select Metric units
Imperial (˚F, psi)			x	˚F/psi	User	Select Imperial units

4.1.3 Date & Time	min.	max.	Default	unit	Access level	Description:
Date				dd-mm-yy	User	Set the current date
Time				hh:mm	User	Set the current time
A. Time Zone Settings					User	Enter the time zone settings menu
B. Display Settings					User	Enter the display settings menu

A Time zone settings	min.	max.	Default	unit	Access level	Description:
Time Zone Correction					User	Set the time zone correction
Daylight Savings Time					User	Select the daylight savings time mode

B Display settings	min.	max.	Default	unit	Access level	Description:
Time Notation			24h	24h/12h	User	Select 24h or 12h time notation
Date Order					User	Select the date-format
Day of Month			2	1 or 2 dig.	User	Select how the day of month is displayed
Month			short text		User	Select how the month is displayed
Year			4	2 or 4 dig.	User	Select how the year is displayed
Date Separation Character			“ _”		User	Select the date separation character
Day of Week			Short text		User	Select how the day of week is displayed
Seconds			no	yes/no	User	Select if seconds are displayed

4.1.4 Cascade mode	min.	max.	Default	unit	Access level	Description:
Full			Full	Full	Installer	Select full cascade mode for more data for max 8 boilers
Basic					Installer	Select basic cascade mode for 9 to 16 boilers

4.1.5 Other settings	min.	max.	Default	unit	Access level	Description:
Modbus Address	0	255	1	0…255	User	Select the Modbus communication address
Modbus Stop bits	1	2	2	1 – 2	User	Select the number of Modbus communication stop bits

4.1.5.1 Status Overview Settings	min.	max.	De-fault	unit	Access level	Description:
Water Pressure				Off/On	User	Enable/disable the CH water pressure
State				Off/On	User	Enable/disable the burner state
Temperature selection ID					User	Enable/disable the temp. selection ID[Tx] where x is the number of the selection.
Temperature selection					User	Select which temperature is displayed: Outside temperature [T0] Demand based [T1] (Flow or DHW temperature based on active demand) Flow temperature [T2] ; DHW temperature [T3] ; System temperature [T4] (module cascade flow/supply temp.) Cascade temperature [T5] (boiler cascade flow / supply temp.)

4.2 Boiler settings	min.	max.	Default	unit	Access level	Description:
4.2.1 Boiler Parameters					installer	Enter the Boiler Parameters menu
4.2.2 Module Cascade Settings					installer	Enter the Module Cascade Settings menu
4.2.3 Boiler Cascade Settings					installer	Enter the Boiler Cascade Settings menu

4.2.1 Boiler parameters	min.	max.	Default	unit	Access level	Description:	Dis-play no:
CH mode	0	5	1	#	Installer	Set the CH mode	1
CH Setpoint	20	90	85	ºC	Installer	Set the CH setpoint	3
Calc. Setp. Offset	-10	10	0	ºC	Installer	Set the offset for CH mode 1 / 2 calculated setpoint	185
Boiler Pump Overrun	0	900	120	sec.	Installer	Set the post-circulation time for the boiler/CH pump	5
CH Min Setpoint	20	50	20		Installer	Set the minimum CH setpoint (0-10V modes	101
CH Max Setpoint	50	90	85		Installer	Set the maximum CH setpoint (0-10V modes)	111
CH Hysteresis Up	2	40	3	ºC	Installer	Set the CH hysteresis up	7
CH Hysteresis Down	2	20	5	ºC	Installer	Set the CH hysteresis down	112
Anti-Cycle Period	10	900	180	sec.	Installer	Set the burner anti-cycling period	9
Anti-Cycle Temp. Diff.	0	20	16	ºC	Installer	Set the burner anti-cycling differentia	10
Max. Power CH	1	100	100	%	Installer	Set the max. CH burner power	14
Min. Power CH	1	100	1	%	Installer	Set the minimum CH burner power	15
CH PID P	0	1275	20		Installer	Set the PID P factor for CH	16
CH PID I	0	1275	1000		Installer	Set the PID I factor for CH	17
Design Supply Temp.	4	90	85	ºC	Installer	Set CH setpoint when outdoor temperature equals Des. Outd. T.	19
Design Outdoor Temp.	-25	25	-5	ºC	Installer	Set the outdoor temperature at which CH setpoint is set to Des. Supply T.	20
Baseline Supply Temp	4	90	40	ºC	Installer	Set CH setpoint when outdoor temperature equals Bas. Outd. T.	21
Baseline Outdoor Temp	0	30	20	ºC	Installer	Set the outdoor temperature at which CH setpoint is set to Bas. Supply T.	22
Design Supply Min. Limit	4	82	20	ºC	Installer	Set the outdoor reset curve minimum setpoint	23
Design Supply Max. Limit	27	90	90	ºC	Installer	Set the outdoor reset curve maximum setpoint	24
Warm Weather Shutdn	0	35	22	ºC	Installer	Set outdoor temperature above which CH demand is blocked	25
Boost Temp Increment	0	30	0	ºC	Installer	Set the setpoint boost function temperature increment	26
Boost Time Delay	0	120	20	min.	Installer	Set the setpoint boost function delay time	27
Night Setback Temp.	0	30	10	ºC	Installer	Set the CH setpoint night setback temperature	28
DHW Mode	0	8	0	#	Installer	Set the DHW mode	35
DHW Tank Hyst. Down	0	10	5	ºC	Installer	Set the DHW tank hysteresis down	36
DHW Tank Hyst. Up	0	10	5	ºC	Installer	Set the DHW tank hysteresis up	37
DHW Tank Supply Extra	0	30	15	ºC	Installer	Set the DHW tank supply setpoint offset	38
DHW Tank Supp Hyst Dn	0	20	5	ºC	Installer	Set the DHW tank supply hysteresis down	39
DHW Tank Supp Hyst Up	0	20	5	ºC	Installer	Set the DHW tank supply hysteresis up	40
DHW Tank Hold Warm	0	10	5	ºC	Installer	Set the DHW tank hold warm hysteresis	41
DHW Priority	0	2	on	0-2	Installer	Set the DHW priority mode	42
DHW Max. Priority Time	1	255	60	min.	Installer	Set the maximum DHW priority time	43
DHW Pump Overrun	0	900	20	sec.	Installer	Set the DHW post-circulation time	44
DHW Tank PID P	0	1275	100		Installer	Set the DHW tank PID P factor	45
DHW Tank PID I	0	1275	300		Installer	Set the DHW tank PID I factor	46

cont.: 4.2.1 Boiler parameters	min.	max.	Default	unit	Access level	Description:	Dis-play no:
DHW/Tank Setpoint	39	70	60	ºC	Installer	Set the DHW setpoint	48
DHW Store Setpoint	0	90	65	ºC	Installer	Set the DHW storage setpoint	115
DHW Hysteresis Down	0	20	4	ºC	Installer	Set the DHW hysteresis down	49
DHW Hysteresis Up	2	20	4	ºC	Installer	Set the DHW hysteresis up	50
DHW Instant PID P	0	1275	100		Installer	Set the DHW instantaneous PID P factor	51
DHW Instant PID I	0	1275	160		Installer	Set the DHW instantaneous PID I factor	52
DHW On Off Period	10	60	30	sec.	Installer	Set the on/off modulation period	63
PreHeat mode	on	off	off	-	Installer	Set the PreHeat Eco mode	64
PreHeat Eco Setpoint	0	80	30	ºC	Installer	Set the PreHeat Eco setpoint	65
DHW Max. Limit	0	90	80	ºC	Installer	Limiting DHW setpoint max.	91
DHW Min. Limit	20	50	30	ºC	Installer	Limiting DHW setpoint min.	96
Fan Speed Maximum	0	12750	dep unit	rpm	Installer	Set the maximum fan speed	92
Fan Speed Minimum	0	12750	dep unit	rpm	Installer	Set the minimum fan speed	93
Fan Speed Ignition	0	12750	dep unit	rpm	Installer	Set the ignition fan speed	94
Prog. Input 1.	0	3	1	#	Installer	Select the function for programma-ble input 1	116
Prog. Input 2.	0	4	2	#	Installer	Select the function for programma-ble input 2	117
Prog. Input 3.	0	2	2	#	Installer	Select the function for programma-ble input 3	118
Prog. Input 7.	0	5	3	#	Installer	Select the function for programma-ble input 7	122
Prog. Input RT.	0	1	1	#	Installer	Select the function for the program-mable RT input	124
Prog. Output 1.	0	10	4	#	Installer	Select the function for programma-ble output 1	125
Prog. Output 2.	0	10	0	#	Installer	Select the function for programma-ble output 2	126
Prog. Output 3.	0	10	6	#	Installer	Select the function for programma-ble output 3	127
Prog. Output 4.	0	20	18	#	Installer	Select the function for programma-ble output 4	128
Mod. Pump dT	5	40	20	ºC	Installer	Set the modulating pump target delta temperature	133
Mod. Pump Start Time	0	255	120	sec.	Installer	Set the modulating pump start up time	134
Mod. Pump Type			wilo		Installer	Set the modulating pump model	135
Mod. Pump Mode	20	100	mod.	o/f or mod.	Installer	Set the modulating pump mode	136
Mod. Pump Min Pwr			30	%	Installer	Set the modulating pump minimum duty cycle	137
Appliance Type	50	55	50	#	Installer	Set the appliance type	138
Dair active	0	1	yes	Yes/No	Installer	Enable/disable the De-Air function	139
Nominal Flow	0	10	0	l/min	Installer	Sets the nominal flow	141
Anti Legionella Day	mon	sun	Sunday		Installer	Select the day for the anti-legio-nella cycle	107
Anti Legionella Hour	0	23	0	hrs.	Installer	Select the time for the anti-legio-nella cycle	108
Frost Protection			Enabled	Ena/Dis	Installer	Switch Frost protection on/off	205
Anti Legionella			Enabled	Ena/Dis	Installer	Anti Legionella protection on/off	206
DHW Detection Delay	0	255	0		Installer	Sets the detection delay.	207

4.2.2 Module Cascade Settings	min.	max.	Default	unit	Access level	Description:	Display no:
Burner Address			Stand alone		Installer	Set the cascade burner address	184
Permit Emergency Mode			Yes	Yes/No	Installer	Enable/disable the cascade emergency mode	72
Emergency Setpoint	20	90	70	°C	Installer	Set the emergency mode setpoint	74
Delay Per Start Next Mod.	0	1275	200	sec.	Installer	Set the delay time before the next module is started	75
Delay Per Stop Next Mod.	0	1275	180	sec.	Installer	Set the delay time before the next module is stopped	76
Delay Quick Start Next	0	1275	50	sec.	Installer	Set the fast delay time before the next module is started	142
Delay Quick Stop Next	0	1275	30	sec.	Installer	Set the fast delay time before the next module is stopped	143
Hyst. Down Start Module	0	40	5	°C	Installer	Set the hysteresis down after which a module is started	77
Hyst. Up Stop Module	0	40	4	°C	Installer	Set the hysteresis up after which a module is stopped	78
Hyst. Down Quick Start	0	40	10	°C	Installer	Set the fast hysteresis down after which a module is started	144
Hyst. Up Quick Stop	0	40	6	°C	Installer	Set the fast hysteresis up after which a module is stopped	145
Hyst. Up Stop All	0	60	8	°C	Installer	Set the hysteresis up at which all modules are stopped	146
Number of Units	0	16	1	#	Installer	Set the no. of modules expected in the cascade system	147
Power Mode	0	3	3	#	Installer	Set the power mode	148
Max. Setp. Offset Down	0	20	0	°C	Installer	Set the maximum setpoint offset down	79
Max. Setp. Offset Up	0	20	20	°C	Installer	Set the maximum setpoint offset up	80
Start Mod. Delay Fact.	0	60	60	min.	Installer	Set the setpoint modulation delay time	81
Next Module Start Rate	10	100	80	%	Installer	Set the next module start rate	82
Next Module Stop Rate	10	100	25	%	Installer	Set the next module stop rate	83
Module Rotation Interval	0	30	5	days	Installer	Set the rotation interval	84
First Module to Start	0	17	1	#	Installer	Set the first module to start in the rotation cycle	149
PID P			50	#	Installer	Set the cascade PID P factor	86
PID I			500	#	Installer	Set the cascade PID I factor	87
PID Slew Rate Up			0,1	#	Installer	Set the PID upwards slew rate setting	150
PID Slew Rate Dn			0,1	#	Installer	Set the PID downwards slew rate setting	151
PwrMode2 Min Power	0	100	20	%	Installer	Set the power mode 2 minimum power	152
PwrMode2 Hysteresis	0	100	40	%	Installer	Set the power mode 2 hysteresis	153
Post-Pump Period	0	255	30	sec.	Installer	Set the cascade post-circulation period	154
Frost Protection	10	30	15	°C	Installer	Set the frost-protection setpoint	155

4.2.3 Boiler Cascade Settings	min.	max.	Default	unit	Access level	Description:	Dis-play no:
Boiler Address			stand alone		Installer	Set the cascade boiler address	73
Permit Emergency Mode	0	1	yes	Yes/No	Installer	Enable/disable the cascade emergency mode	156
Emergency Setpoint	20	90	70	°C	Installer	Set the emergency mode set-point	157
Delay Per Start Next Blr	0	1275	1275	sec.	Installer	Set the delay time before the next boiler is started	158
Delay Per Stop Next Blr.	0	1275	1275	sec.	Installer	Set the delay time before the next boiler is stopped	159
Delay Quick Start Next	0	1275	400	sec.	Installer	Set the fast delay time before the next boiler is started	160
Delay Quick Stop Next	0	1275	240	sec.	Installer	Set the fast delay time before the next boiler is stopped	161
Hyst. Down Start Boiler	0	40	5	°C	Installer	Set the hysteresis down after which a boiler is started	162
Hyst. Up Stop Boiler	0	40	2	°C	Installer	Set the hysteresis up after which a boiler is stopped	163
Hyst. Down Quick Start	0	40	10	°C	Installer	Set the fast hysteresis down after which a boiler is started	164
Hyst. Up Quick Stop	0	40	4	°C	Installer	Set the fast hysteresis up after which a boiler is stopped	165
Hyst. Up Stop All	0	60	8	°C	Installer	Set the hysteresis up at which all boilers are stopped	166
Number of boilers	0	16	1	#	Installer	Set the number of boilers ex-pected in the cascade system	167
Power Mode	0	3	2	#	Installer	Set the power mode	168
Max. Setp. Offset Down	0	20	0	°C	Installer	Set the maximum setpoint offset down	169
Max. Setp. Offset Up	0	20	20	°C	Installer	Set the maximum setpoint offset up	170
Start Mod. Delay Fact.	0	255	20	min.	Installer	Set the setpoint modulation delay time	171
Next Boiler Start Rate	10	100	80	%	Installer	Set the next boiler start rate	172
Next Boiler Stop Rate	10	100	25	%	Installer	Set the next boiler stop rate	173
Boiler Rotation Interval	0	30	5	days	Installer	Set the rotation interval	174
First Boiler to Start	1	17	1	#	Installer	Set the first boiler to start in the rotation cycle	175
PID P			25	#	Installer	Set the cascade PID P factor	176
PID I			1000	#	Installer	Set the cascade PID I factor	177
PID Slew Rate Up			0,1	#	Installer	Set the PID upwards slew rate setting	178
PID Slew Rate Dn			0,1	#	Installer	Set the PID downwards slew rate setting	179
PwrMode2 Min Power	0	100	20	%	Installer	Set the power mode 2 minimum power	180
PwrMode2 Hysteresis	0	100	40	%	Installer	Set the power mode 2 hysteresis	181
Post-Pump period	0	255	30	sec.	Installer	Set the cascade post-circulation period	182

5 System test	min.	max.	Default	unit	Access level	Description:
Test State			off		Installer	Set test state (for adjusting CO2 level's)
Fan speed			xxxx	rpm	Installer	Read out fan speed
Ionization			x.x	uA	Installer	Read out flame signal

Service					Installer	Description:
Reset Service Reminder	no	yes	no	yes/no	Installer	Reset the service history

13 TEMPERATURE PROTECTION

The difference between Supply temperature and Return Temperature is continuously monitored. A too big difference can indicate a defective pump or a clogged heat exchanger. To protect the boiler, the burner controller reduces the input when the temperature difference ΔT becomes too high:

At maximum boiler input ΔT is limited to 63 °F (35 °C) - (*Hx_Diff_DeltaT_Min)*

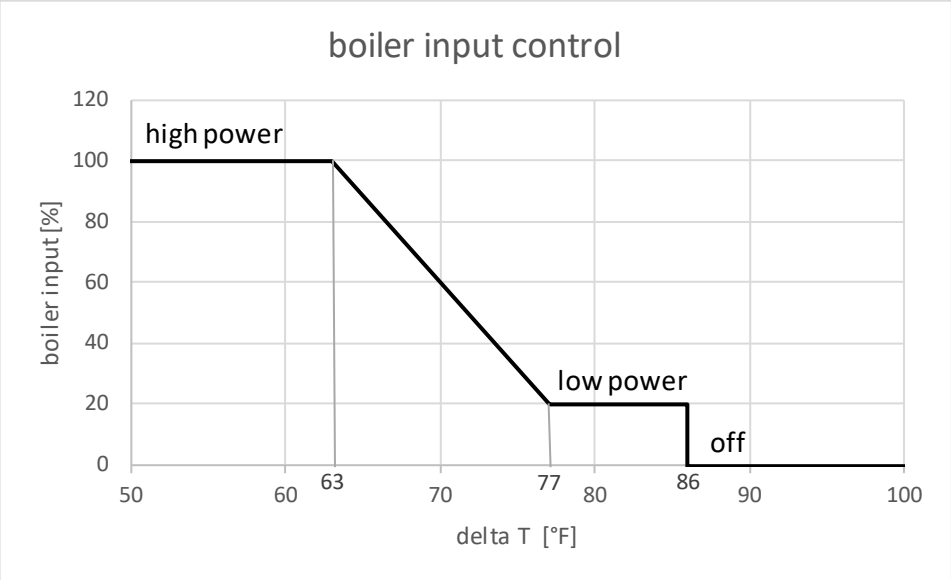
In between 63 °F (35 °C) and 77 °F(43 °C) boiler input modulates between minimum and maximum.

At minimum boiler input ΔT above 77 °F (43 °C) is allowed (Hx_Diff_DeltaT_Min plus 14 °F (+8 °C)).

Above ΔT = 86 °F (48 °C), the boiler is switched OFF during *HX_Diff_Max_Wait_Time*.

Relevant factory set variables

Parameter	Level	Factory Setting.	Range
HX Diff DeltaT Min	3: Factory	63 ºF (35 ºC)	18….144 ºF (10 ….80 ºC)
HX Diff Max Wait Time Wait time after upper limit primary heat exchanger differential has been exceeded.	3: Factory	180 Sec.	1….255 Sec.



14 ERROR INFORMATION.

Errors can be divided in three groups:

• Manual reset locking errors (can only be reset by the reset button).
• Blocking errors (will disappear when error is gone)
• Warnings (will disappear when the warning is gone, not stored in the BCU)

The boiler pump will continue to run during most locking and blocking error codes. This is to prevent the freezing of the Central Heating circuit when the boiler is in error during the winter period. For some non-volatile lockouts the pump will not be running, also see the error tables in this chapter for more details.

14.1 *Boiler history.*

The last 15 lockouts and 15 blocking errors are stored in the boiler control. This boiler history can be shown via the Boiler History screen via the installer boiler status menu in one of the advanced displays.

- Successful ignitions
- Failed Ignitions
- Flame Failures
- Operation days
- CH Burner Hours
- DHW Burner Hours

14.2 *Lockout codes*

Lock out code	Error	Description	Cause	Solving
0	E2PROM_READ_ ERROR	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
1	IGNIT_ERROR	Five unsuccessful ignition attempts in a row	no gas, wrongly adjusted gas valve	check gas supply and adjust gas valve, reset BCU
2	GV_RELAY_ ERROR	Failure detected in the gas valve relay	short circuit in coil of the gas valve, water on wiring or gas valve	reset BCU replace gas valve or wiring harness
3	SAFETY_RELAY_ERROR	Failure detected in safety relay	safety relay is not working correctly	reset BCU or replace BCU
4	BLOCKING_ TOO_LONG	Control had a blocking error for more than 20 hours	blocking code active for more than 20 hours	reset and check blocking code
5	FAN_ERROR_ NOT_RUNNING	Fan is not running for more than 60 seconds	electrical wiring not correctly connected, or Fan is malfunctioning	Check wiring or replace Fan if not solved check fuse on BCU or replace BCU
6	FAN_ERROR_ TOO_SLOW	Fan runs too slow for more than 60 seconds	electrical wiring not correctly connected, or Fan is malfunctioning	Check wiring or replace Fan if not solved check fuse on BCU or replace BCU
7	FAN_ERROR_ TOO_FAST	Fan runs too fast for more than 60 seconds	electrical wiring not correctly connected, or Fan is malfunctioning	Check wiring or replace Fan if not solved check fuse on BCU or replace BCU
8	RAM_ERROR	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
9	WRONG_EEPROM_SIGNATURE	Contents of E2prom is not up to date	out dated E2prom	reset BCU or replace BCU
10	E2PROM_ ERROR	Wrong safety parameters in E2prom	wrongly programmed BCU or PB	reset BCU or replace BCU
11	STATE_ERROR	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU
12	ROM_ERROR	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU
13	APS_NOT_ OPEN	Air pressure switch not opening during pre-purge 0	electrical circuit is short circuited or APS is jammed	check wiring or replace APS
14	APS_NOT_CLOSED_IN_PRE_ PURGE	Air pressure switch not closing during pre-purge 1	no air transport to the burner; flue or air inlet is blocked or APS is jammed or air signal hose not connected to the air intake pipe or water in hose	Check if there are any obstructions in the flue or air intake, replace APS if jammed, connect air hose to the air intake pipe, remove any water from the hose.
15	MAX_TEMP_ ERROR	The external overheat protection is enabled or the T_Supply sensor measures a temp. of over Prot_Overheat_Temp - SGOverheat_Duplex_Tolerance for a period of Max_Value_Period	Burner door clixon tripped because of overheating of the burner door or the water flow is restricted or back wall thermal fuse has tripped because rear wall insulation disc (combustion chamber) is damaged or broken.	Check burnerdoor gasket and replace burner door gasket and reset clixon on burner door or check pump and waterflow and replace pump or increase water flow check also if valves are closed or check if rearwall fuse is broken if so replace and also replace rear wall insulation disc (combustion chamber).

Lock-out code	Error	Description	Cause	Solving
16	FLUE_GAS_ ERROR	Flue temperature exceeded the maximum flue temperature	There is no water in the heat exchanger or flue gas sensor is malfunctioning or heat exchanger is overheated.	Check if flue sensor is working correctly if not so replace flue sensor. Check waterflow if to low increase waterflow.
17	STACK_ERROR	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
18	INSTRUCTION_ ERROR	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
19	ION_CHECK_ FAILED	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
20	FLAME_OUT_ TOO_LATE	Flame still present 10 seconds after closing the gas valve	wrong earthing of BCU and boiler	Check earthing of BCU and boiler
21	FLAME_BEFORE_IGNIT	Flame is detected before ignition	wrong earthing of BCU and boiler	Check earthing of BCU and boiler
22	TOO_MANY_ FLAME_LOSS	Three time flame lost during 1 demand	bad gas supply or CO2 level is not correct or bad ignition rod	check gas supply pressure, check CO2 level and adjust if necessary, replace ignition rod or replace ignition cable.
23	CORRUPTED_ ERROR_NR	Error code RAM byte was corrupted to an unknown error code.	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
27	FILLING_TOO_ MUCH	Too many automated filling attempts in a short time period	If output is programmed as filing valve and there are to many filing attempts	Check if there is a leak in the central heating system or if the boiler it self is leaking also check expansion vessel on internal leak
28	FILL_TIME_ ERROR	Filling takes too long	If output is programmed as filing valve and filling takes more than 10 minutes	Check if there is a leak in the central heating system or if the boiler it self is leaking also check expansion vessel on internal leak
29	PSM_ERROR	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
30	REGISTER_ ERROR	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
32	T_EXCHANGE_ DIFF_ERROR	The 2 exchange sensors deviate too much for more than 60 seconds	There is not not enough water flow through the heat exchanger	Check if the general pump is running and if all valves are open to make enough flow
33	LWCO_1_ ERROR	Low water cut off 1 error	There is no water in the heat exchanger or not electrically connected	Check if there is enough water in the heat exchanger if not so fill up the system
34	LWCO_2_ ERROR	Low water cut off 2 error	There is no water in the heat exchanger or not electrically connected	Check if there is enough water in the heat exchanger if not so fill up the system
35	APS_NOT_CLOSED_IN_POST_ PURGE	Air pressure switch not closing during post-purge 1	no air transport to the burner after heat demand; flue or air inlet is blocked or APS is jammed or air signal hose not connected to the air intake pipe or water in hose	Check if there are any obstructions in the flue or air intake, replace APS if jammed, connect air hose to the air intake pipe, remove any water from the hose.
36	GAS_PRESSURE_ERROR	Gas pressure switch open for more than E2_GPS_Timeout	wrong gas pressure on gas supply	Check if gas pressure is in limits of the gas pressure switch.

14.3 *Blocking codes*

Lock-out code	Error	Description	Cause	Solving
100	WD_ER-ROR_RAM	Internal software error	wrongly pro-grammed BCU or PB	reset BCU or replace BCU and or display unit
101	WD_ER-ROR_ROM	Internal software error	wrongly pro-grammed BCU or PB	reset BCU or replace BCU and or display unit
102	WD_ER-ROR_STACK	Internal software error	wrongly pro-grammed BCU or PB	reset BCU or replace BCU and or display unit
103	WD_ERROR_ REGISTER	Internal software error	wrongly pro-grammed BCU or PB	reset BCU or replace BCU and or display unit
104	WD_ER-ROR_XRL	Internal software error	wrongly pro-grammed BCU or PB	reset BCU or replace BCU and or display unit
105	HIGH_TEMP_E RROR	T_Supply sensor measures over Stay_Burning_Temp for a period of Max_Value_Period.	not enough water-flow over heat ex-changer	Check functioning of the pump. Check/open all valves that might restrict the water flow through the unit. Check for an external sys-tem pump that influences flow through the unit. Check if the system re-sistance exceeds the spare capacity of the unit pump.
106	REFHI_TOO_HI GH	Internal hardware error	wrongly pro-grammed BCU or PB	reset BCU or replace BCU and or display unit
107	REFHI_TOO_LO W	Internal hardware error	wrongly pro-grammed BCU or PB	reset BCU or replace BCU and or display unit
108	RE-FLO_TOO_HIG H	Internal hardware error	wrongly pro-grammed BCU or PB	reset BCU or replace BCU and or display unit
109	RE-FLO_TOO_LOW	Internal hardware error	wrongly pro-grammed BCU or PB	reset BCU or replace BCU and or display unit
110	REFHI2_TOO_H IGH	Internal hardware error	wrongly pro-grammed BCU or PB	reset BCU or replace BCU and or display unit
111	REFHI2_TOO_L OW	Internal hardware error	wrongly pro-grammed BCU or PB	reset BCU or replace BCU and or display unit
112	RE-FLO2_TOO_HIG H	Internal hardware error	wrongly pro-grammed BCU or PB	reset BCU or replace BCU and or display unit
113	RE-FLO2_TOO_LO W	Internal hardware error	wrongly pro-grammed BCU or PB	reset BCU or replace BCU and or display unit
114	FALSE_FLAME	Flame is detected in a state in which no flame is al-lowed to be seen	wrong earthing of BCU and boiler	Check earthing of BCU and boiler

Lock-out code	Error	Description	Cause	Solving
116	LOW_WATER_PRESSURE_SENSOR	Low water pressure, generated when the pressure drops below Minimal_Pressure, or when the pressure drops below 4.5 PSI .	Not enough water pressure	Fill up the system and check if there are any water leakages
118	WD_COMM_ERROR	Watchdog communication error	wrong programmed BCU or PB	reset BCU or replace BCU and or display unit
119	RETURN_OPEN	Return sensor open	malfunctioning return sensor or not connected	check connection to BCU or check resistance NTC sensor
120	SUPPLY_OPEN	Supply sensor open	malfunctioning supply sensor or not connected	check connection to BCU or check resistance NTC sensor
122	DHW_OPEN	DHW sensor open	malfunctioning DHW sensor or not connected	check connection to BCU or check resistance NTC sensor
123	FLUE_OPEN	Flue sensor open	malfunctioning flue sensor or not connected	check connection to BCU or check resistance NTC sensor
125	OUTDOOR_OPEN	Outdoor sensor open	malfunctioning outdoor sensor or not connected or wrong CH-mode programmed	check connection to BCU or check resistance NTC sensor or change CH-mode
126	RETURN_SHORTED	Return sensor shorted	malfunctioning return sensor or short circuiting	check connection to BCU or check resistance NTC sensor
127	SUPPLY_SHORTED	Supply sensor shorted	malfunctioning supply sensor or short circuiting	check connection to BCU or check resistance NTC sensor
129	DHW_SHORTED	DHW sensor shorted	malfunctioning DHW sensor or short circuiting	check connection to BCU or check resistance NTC sensor
130	FLUE_SHORTED	Flue sensor shorted	malfunctioning Flue sensor or short circuiting	check connection to BCU or check resistance NTC sensor
132	OUTDOOR_ SHORTED	Outdoor sensor shorted	malfunctioning Outdoor sensor or short circuiting	check connection to BCU or check resistance NTC sensor
133	NET_FREQ_ERROR	Net freq. error detected by the watchdog	Wrong frequency from power grid or aggregate	Check frequency on the mains of the boiler (60Hz)
134	RESET_BUTTON_ ERROR	Too many resets in a short time period	Reset many times by user or installer	wait or disconnect and reconnect power supply
135	PHASE_NEUTRAL_ REVERSED	Live and neutral of the main voltage power supply input are reversed	Fase and neutral are wrongly connected	Change fase and neutral
136	T_EXCHANGE_ BLOCK_ERROR	Exchange temperature exceeded 194 ºF (90 ºC).	water temperature is above 194 ºF (90 °C).	Check pump functioning. Check/open all valves that might restrict water flow through the unit. Check external system pump(s) that influences flow through the unit. Check if the system resistance exceeds the spare capacity of the unit pump.

Lock out code	Error	Description	Cause	Solving
155	WD_CONFIG_ERROR	Watchdog fan configuration setting error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
162	FILL_WARNING	Error is generated immediately when the pressure drops below Minimal_Pressure. Demand has stopped, but no error needs to be stored at this time.	The water pressure is below the minimum pressure level	refill the system until the pressure is above 1 Bar or 14.5 PSI
164	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	not enough water flow through heat exchanger	Check functioning of the pump. Check/open all valves that might restrict the water flow through the unit. Check for an external system pump that influences flow through the unit. Check if the system resistance exceeds the spare capacity of the unit pump.
165	VSUPPLY_TOO_LOW	Main supply voltage too low for more than 60 seconds	dip in power supply to boiler	check power supply
166	VSUPPLY_TOO_HIGH	Main supply voltage too high for more than 60 sec.	peak in power supply to boiler	check power supply

14.4 *Warnings*

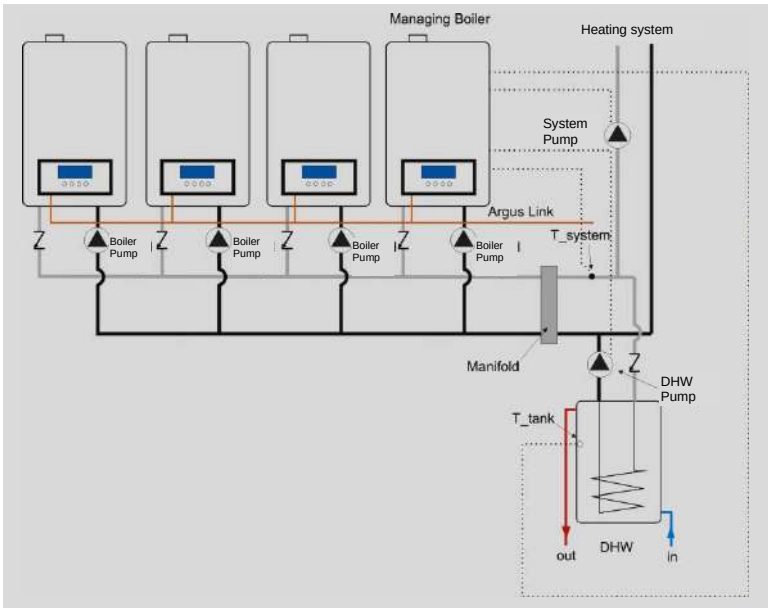
Error no.	Error	Description	Cause	Solving
200	CC_LOSS_COMMUNICATION	Cascade System: Managing cascade control lost communication with one of the depending.	connection between cascaded boilers is interrupted or wiring is broken	Check wiring between boiler or distance between boilers is to big
202	APP_SELECTION_ERROR	Unknown appliance model selected	wrongly programmed parameters	replace BCU
203	CC_LOSS_BOILER_COMM	Dual Cascade System: Managing cascade control lost communication with one of the depending.	connection between cascaded boilers is interrupted or wiring is broken	Check wiring between boiler or distance between boilers is to big
204	T_OUTDOOR_WRONG	T_Outdoor sensor measures open/shorted	malfunctioning outdoor sensor or not connected or wrong CH-mode programmed	check connection to BCU or check resistance NTC sensor or change CH-mode
205	T_SYSTEM_WRONG	T_System sensor measures open/shorted	malfunctioning system sensor or not connected	check connection to BCU or check resistance NTC sensor
206	T_CASCADE_WRONG	T_Cascade sensor measures open/shorted	malfunctioning cascade sensor or not connected	check connection to BCU or check resistance NTC sensor Or wrong cascade settings (boiler cascade settings) used, set para 73 to standalone and use MODULE cascade settings for cascading
207	HEAT_EX_PROTECTION	The heat-exchanger protection function is actively blocking the burn demand		

15 CASCADING

15.1 *System setup*

NOTE: for proper functioning of the system, some settings have to be changed, see § 15.4.2 "Emergency mode".

The boiler controller can control multiple boilers in a cascade setup.
A system sensor input is available on the main board to measure the cascade system supply temperature. A pump output is also available to run the system pump, as well as an output for the DHW pump.
When the CH supply temperature is calculated based on an outdoor sensor, only one outdoor sensor is needed. This sensor is connected to the managing boiler and calculates the CH setpoint for the cascade system.
A cascade system can be used with an DHW indirect tank. A DHW pump and sensor can be connected to the managing boiler.

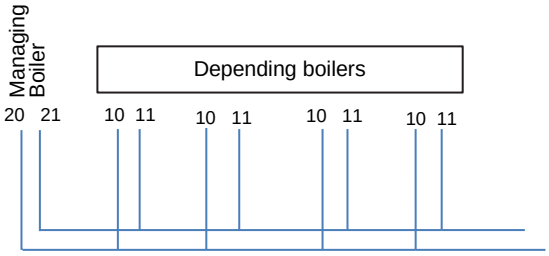


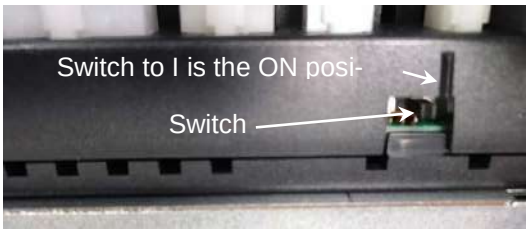
Cascade boiler circulator connections for system configuration for handling DHW indirect tank or Central Heating demand. All boilers handle **either** indirect tank **or** Central Heating demand at one time.

15.2 *Quick-guide cascade set-up*

Below a quick set-up, all settings are described in detail in the successive chapters

1. **Link the boilers with a 2-wire cable in parallel.**
   Connect 20 on the managing boiler to 10 on the dependent boilers and connect 21 on the managing boiler to 11 on the dependent boilers.





2. **Set the switch "bus power on" at the side of the boiler control to the off position.**
   Note the line of the bottom of the boiler control on adjacent picture to determine the off position.

3. **Change the burner address on every boiler that is part of the cascade**
   On dependent boilers: set as dep 1, dep 2, etc.
   Parameter: Menu - Settings - Boiler settings - **Module Cascade Settings** - Parameter 184 (Burner Address) (**DO NOT USE Boiler Cascade Settings)**
   On managing boiler: set as manager

4. **Changer number of units on manager boiler only**
   Parameter: Menu - Settings - Boiler settings - Module Cascade Settings - Parameter 147 (Number of units)
   On manager boiler: set at total amount of units that are part of the cascade (= managing + amount of dependents)
   On dependent boilers: set at 1 (= default setting)

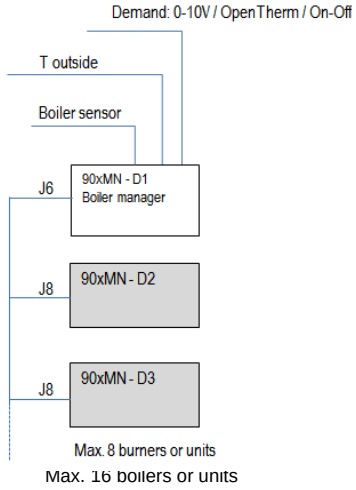
5. **Select correct CH mode on managing boiler only**
   Parameter: Menu - Settings - Boiler settings - Boiler parameters - Parameter 1 (CH mode)
   CH mode 0 – Central Heating demand with thermostat control
   CH mode 1 – Central Heating with an outdoor temperature reset and thermostat control
   CH mode 2 – Central Heating with full outdoor temperature reset
   CH mode 3 – Central Heating with permanent heat demand
   CH mode 4 – Central Heating with analog input control (0-10V) of setpoint
   CH mode 5 – Central Heating with analog input control (0-10V) of power output

6. **Connect required sensors to the managing boiler only**
   DHW temperature sensor required at Low voltage connections 5 and 6.
   System temperature sensor required at Low voltage connections 3 and 4.

7. **Deactivate de-air on managing boiler only after de-airing the boilers and system**
   Parameter: Menu - Settings - Boiler settings - Boiler parameters - Parameter 139 (Dair active)
   On managing boiler: set to No

15.3 *Boiler cascade communication setup.*

In order for the system to work for cascade the communication busses must be parallel linked together. The managing boiler uses the AL-bus connection 20-21 for the cascade. The 10-11 connection terminals of the depending boilers must be connected to the 20-21 connections of the managing boiler.
It is important that the power on the 10-11 connection terminals on all dependent boilers is switched to the OFF position (see also § 15.2.1).
All boilers in the cascade system must have a unique address selected (see also § 15.2.1).
Before commissioning a cascade installation, a number of parameters have to be changed.
These parameters can be programmed on the unit itself.



WARNING	Changes in parameter may only be carried out by a skilled commissioning/service engineer, who has had specific training for setting up the RC range boilers. He will be able to check whether the installation functions correctly after the parameter change has been done.

NOTICE	Parameters for cascade operation are found in the Module cascade settings menu, located in the Boiler settings menu. Parameters in the Boiler cascade settings menu may not be used.

15.3.1 SETTING THE BOILER ADDRESS

NOTICE

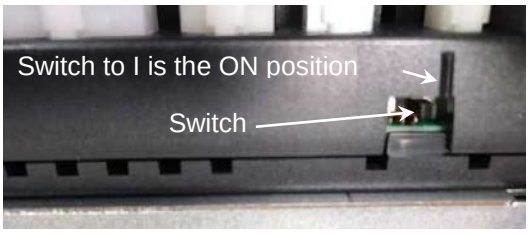
Address rules

The cascade managing address (parameter 184) must be set to ‘Managing’ on the managing boiler.
The cascade depending addresses (parameter 184) must be set in a logical numbered order from 1: Dep. 1, Dep. 2 etc. on the depending boilers.
The total number of boilers in the cascade must be stored in parameter 147 on the managing boiler.

When the number of boilers is set to 4, the first three depending controls are expected to be available for the cascade. In this case depending controls 1, 2 and 3 must be selected. When any of these 3 are not present on the communication bus the managing control detects the loss of a depending control and generates the warning: Comm. Lost with module.

The managing boiler of the cascade system is connected to the AL-BUS connection on terminals 20-21
This connection also provides the power for the communication bus. The depending boilers are all parallel connected to the managing boiler communication bus.

The bus power is provided by the managing boiler on terminals 20-21, switch S1 must be set in the OFF position (all controls).



15.3.2 SETTING OF THE CASCADE PARAMETERS

Enter the main menu by pushing the menu button now select settings by toggling the up and down arrow and enter settings by pushing the enter button.

Menu	
Central Heating (CH) Domestic Hot Water (DHW) Settings System test	i

Now select Boiler Settings

Settings	
General Settings Boiler Settings	

Select the Module Cascade Settings

Boiler Settings	
Boiler Parameters Module Cascade Settings Boiler Cascade Settings	

Change burner address into Managing or Dependent

Module Cascade settings	
(184) Burner Address	Managing
(72) Permit Emergency Mode	Yes
(74) Emercency Setpoint	65°C
(75) Delay Per Start Module	200 sec

This setting can be changed on the boiler control.

Boiler address	Boiler Operation	Function of sensor input terminal 3-4
0 (default)	Standalone burner	No function
1	1st boiler (managing)	System sensor
2	2nd boiler (depending)	No function
3	3rd boiler (depending)	No function
4	4th boiler (depending)	No function
↓	↓	
16	16th boiler (depending)	No function

Now select in parameter 147 how many boilers (units) are in the cascade

Module Cascade Settings	
(144) Hyst Down quick Start	10 °C
(145) Hyst. Up Quick Stop	6,0 °C
(146) Hyst Up Stop All	8,0 °C
(147) Number of Units	2

15.3.3 CASCADE – HEATING ONLY MANAGING BOILER

When a boiler is set as Managing (Address = 1), the controller of this boiler will drive the cascade. The CH mode of this managing boiler applies to all other boilers. It is only required to set the CH mode on the managing boiler.

- The outdoor temperature sensor connected to the managing boiler will be the outdoor sensor for the cascade operation
- The system sensor (T_System) connected to the managing boiler will be the control sensor for the cascade supply temperature.
- The (modulating) thermostat connected to the managing boiler will be the CH heat demand input for the cascade system.

Based on the system temperature (T_System) and the requested Cascade_Setpoint the managing boiler calculates a required boiler setpoint, to achieve the requested Cascade_Setpoint.
The managing boiler provides the calculated setpoint to all dependent boilers. The modulating power of the dependent boilers is PID controlled based on the calculated setpoint and dependent boiler supply temperature.

Cascade CH setpoint adaption
When the system temperature is not high enough the setpoint for all boilers will be adjusted.
The boiler setpoint will be increased when the system temperature drops below Cascade_Setpoint and decreased when it rises above Cascade_Setpoint temperature.

Dependent Boiler
The CH mode for the cascade is defined by the setting of the managing boiler. CH mode settings on dependents are ignored. In case a boiler is set as dependent (Address = 2-8/16) the setpoint is always provided by the managing boiler.
The modulating power of the ALL boilers is PID controlled by the boiler itself by comparing the calculated setpoint from the managing boiler and T_Supply. The managing boiler itself will be controlled in the cascade system as it would as if it was a dependent boiler. Only the pumps and sensor inputs are used.

Boiler input Rates
A cascade system operates most effective and efficiently when all of the boilers in the system are the same size.

15.3.4 CASCADE – DOMESTIC HOT WATER SETTINGS

In the installer DHW menu of the managing boiler control the DHW_Mode should be set.
Available DHW modes in cascade are mode 1 or 2.

Dependent Boiler
In case a boiler is set as dependent (Address = 2-8/16) the DHW setpoint is always provided by the managing boiler, the internal control of the setpoint functions are disabled.

Managing Boiler
If there is a request for a “Store Warm Hold” for the tank and no central heating request the managing boiler is going to burn for the DHW tank. This (the heating of the DHW tank) is interrupted when there comes a central heating request and the managing boiler and cascade are burning for the central heating system.

15.3.5 CASCADE – DHW PRIORITY

The boiler cascade system has multiple options for priority and parallel DHW and heating.
The following levels of priority are configurable (and possible):

Priority level		Description
0)	Switch Priority	When both CH and DHW demand have to be served, the priority it is given to the DHW demand for a given interval (indicated with parameter Minute_Switch_Priority). As soon as the interval has expired the priority switches to CH demand. The interval time will be reloaded and priority will switch again after the interval is over.
1)	CH	The priority is permanently given to CH Demand
2)	DHW	The priority is permanently given to DHW Demand

Relevant variables

Specific Parameters	Level	(Default) Value	Range
DHW Priority Both, CH or DHW priority, Parallel	2: Installer	2	0, 1, 2
DHW Max Priority Timer Interval time for switching the priority	2: Installer	60 min.	1..60 min.

15.3.6 CASCADE – START/STOP SEQUENCE

The managing boiler sends the calculated Cascade_Setpoint to the dependent boilers. The power of the boilers is PID controlled based on the Calculated_Setpoint and T_Supply. Depending on the temperature difference between T_System and Cascade_Setpoint (CH or DHW) the dependent boilers will start or stop using different algorithms.

Quick Starting and Stopping Boilers
When there is a big difference between the T_System and the Cascade_Setpoint the call for a start or stop of the next or last depending is done quicker.

15.3.7 CASCADE – POWER BALANCE MODE

Several different power control modes can be selected to operate the cascade system.
- Power mode 0: Power control disabled, each boiler modulates based on the system setpoint.
- Power mode 1: Power control algorithm to have a minimum amount of boilers/boilers active.
- Power mode 2: Power control algorithm to have a maximum amount of boilers/boilers active.
- Power mode 3: Power control algorithm to have a balanced amount of boilers/boilers active.

15.4 *Cascade – Boiler rotation*

The boiler rotation function can change the start/stop sequence for the cascade boilers.
The parameter Boiler_Rotation_Interval sets the number of days after which the sequence is updated. When Boiler_Rotation_Interval is set to 0 boiler rotation is disabled.
When the parameter Burner_Rotation_Interval is updated the boiler rotation days left will be initialized to the new Burner_Rotation_Interval setting.

When for example *Burner_Rotation_Interval* = 5 the start sequence is as following (x is the last boiler):

Days	Start/Stop sequence
Day 0-5	1-2-3-4-5..x
Day 5-10	2-3-4-5..x-1
Day 10-15	3-4-5..x-1-2
Day 15-20	4-5..x-1-2-3
Day 20-25	5..x-1-2-3-4

With parameter First_Depending_To_Start the current depending that is first to start in the sequence is selected.
When the boilers are rotated the parameter First_Depending_To_Start is automatically updated to the next depending. When boiler rotation is disabled the parameter First_Depending_To_Start is reset to 0.
When the First_Depending_To_Start is manually changed the control will clear all demand of the cascade control. After this is will start cascade demand generation with the new selection for First_Depending_To_Start.

15.4.1 NEXT DEPENDING TO START SELECTION

When the cascade Burner_Rotation_Interval has passed the control will perform the cascade rotation. At this moment the next available control based on the current First_Depending_To_Start is selected.
A depending control is available when the control is present on the communication bus and the control is not blocked by an error.

When the control is not available the control is skipped as the next First_Depending_To_Start.

Relevant variables

Specific Parameters	Level	(Default) Value	Range
Burner_Rotation_Interval	2: Installer	5	0…30 (0: Disabled)
First_Depending_To_Start	2: Installer	1	1…8/16

15.5 *Cascade Error handling*

15.5.1 CASCADE FROST PROTECTION

Frost protection on a cascade is active on two levels

1. Frost protection for burner cascade

The 'frost protection' function for a burner cascade is related to the boiler sensor temperatures.
Reactions on the supply / return temperatures of the managing boiler are as follows:

Cascade_Frost_Protection:	Below this temperature the cascade CH/system pump and the general pump of the managing boiler start running.	Default: 59 °F (15 °C)
Cascade_Frost_Protection minus 9 °F (minus 5 °C):	Below this temperature the cascade heat demand is activated; the general pumps of all the cascaded boilers will be started and the boilers start burning.	59 minus 9 = 50 °F (15 minus 5 = 10 °C)
Cascade_Frost_Protection plus 9 °F (plus 5 °C):	Above this temperature, the boilers stop burning.	59 plus 9 = 68 °F (15 plus 5 = 20 °C)

2. Frost protection on boiler

As last protection the controllers for the boilers can force themselves to burn.

If the boiler supply/return temperature drops below 41 °F (5 °C) the boiler starts at minimum power and continues burning until the lowest of both supply and return temperatures are above 59 °F (15 °C).

Specific Parameters	Level	(Default) Value	Range
Cascade frost protection Temperature for frost protection	2: Installer	59 ºF (15 ºC)	50...86 ºF (10...30 ºC)

15.5.2 EMERGENCY MODE

Managing boiler error

When the managing boiler is in error mode, the depending boilers can go into the "Emergency_Mode", if enabled. In emergency mode the system setpoint is set to the temperature of the Emergency_Setpoint and all cascaded boilers start burning on this setpoint.
NOTE: the default setting is 158 °F (70 °C)! Make sure the right temperature is set.

Specific Parameters	Level	(Default) Value	Range	Parameter
Permit Emergency Mode	Installer	Yes	Yes/No	Module Cascade parameter 72
Emergency Setpoint	Installer	158 ºF (70 ºC)	68 - 194 °F (20 - 90 °C)	Module Cascade parameter 75
Dair active	Installer	Yes	Yes/No	Boiler parameter 139

Table 15-1

For proper functioning of this emergency mode, the following settings are necessary in the managing boiler (installer password required):
- Module Cascade parameter no. 72: "Permit_Emergency_Mode" has to be set on "yes".
- Module Cascade parameter no. 75: "Emergency_Setpoint" has to be set on the right temperature.
- Boiler parameter no. 139: "Dair active" has to be set on "No".

NOTE: do not de-activate the Dair function before commissioning the system and adjusting the boilers!

When the managing unit is reset from lockout state, the cascade controllers are re-initialized.

15.5.3 LOSS OF CASCADE COMMUNICATION

The burner controller of the managing boiler is aware of how many dependents should be present in the system. The total number of boilers is stored in the BCU (parameter 147). When powering on the system the leading boiler has to detect all depending boilers within 60 seconds.
When not all dependent boilers are detected the control will show the CC_Loss_Communication warning. When the communication with any of the depending boilers is lost during operation, the control will show the CC_Loss_Communication warning after 60 seconds, which is purely informative and will not block the control.

16 SYSTEM TEST.

For testing the system at fixed power rates, a system test can be activated via the Installer menu. Via the system test the boiler can be started without CH or DHW being present. The system test has priority.

The following modes are available:

System test mode		Description
0	Not active	System test mode not active
1	Fan only	The fan is forced to run at maximum speed without starting the boiler
2	Low power	The boiler starts and after the ignition period has finished the boiler stays at low power
3	Ignition power	The boiler starts and stays at ignition power
4	High power	The boiler starts and after the ignition period has finished the boiler stays at high power
5	High power limited	The boiler starts and after the ignition period has finished the boiler stays at high power limited by the parameter *CH_ max_ power*
6	High limit error test	Simulates the *Max_Temp_Error*
7	Low water cut off 1 error test	Simulates the *LWCO_1_ Error*
8	Low water cut off 2 error test	Simulates the *LWCO_2_ Error*

Before running the system test modes first check if the heat can also be dissipated. Note that during this mode the supply temperature can be raised above 203 ºF (95 ºC). When this temperature is reached the boiler will switch OFF. When the supply temperature cools down to 194 ºF (90 ºC) the boiler will start again.

During the system test the boiler and system pump will be ON.
As the boiler will run at fixed power rates there is no setpoint control active.
Also the flame recovery is not active during system test demand. All other safety functions remain active.

The system test automatically stops after 10 minutes, after which the system continues with normal demand handling. When the system test mode is changed during an active system test, the 10-minute timer is restarted.

17 COMMISSIONING THE BOILER

17.1 *First: flushing the boiler with water*

After installation of the boiler the first step, before commissioning, is to flush the boiler and the whole heating installation with fresh water to remove pollution, debris and other materials that might cause a blocking. This must also be done with heating installations, where only the boiler is replaced.
Existing and new heating systems must be cleaned with a hydronic system cleaner; see additional information in section 7.12. System cleaner must be drained and thoroughly flushed with clean water to remove any residual cleaner, prior to installing a new boiler. NEVER leave a system cleaner for longer than recommended by the manufacturer of the cleaner. Never put system cleaner inside the boilers heat exchanger.

17.2 *Second: filling & venting the boiler and the system*

After flushing the boiler and the installation the system can be filled with fresh water. Fill the boiler and the heating system by using the appropriate filling valve. The water pressure of the system normally lies between 21.8 and 40 psi (1.5 and 2.0 bar) – see § 7.20 'Water pressure'

The boiler has an automatic air vent situated inside the boiler. This vent is always open and the venting outlet goes via a plastic tube through the bottom to the outside. Shortly after putting the boiler into operation, check the water pressure and add or remove some water to obtain the required pressure.

During the commissioning, make sure that no water can enter the boiler and make contact with the electrical parts.

17.3 *Third: check the water flow*

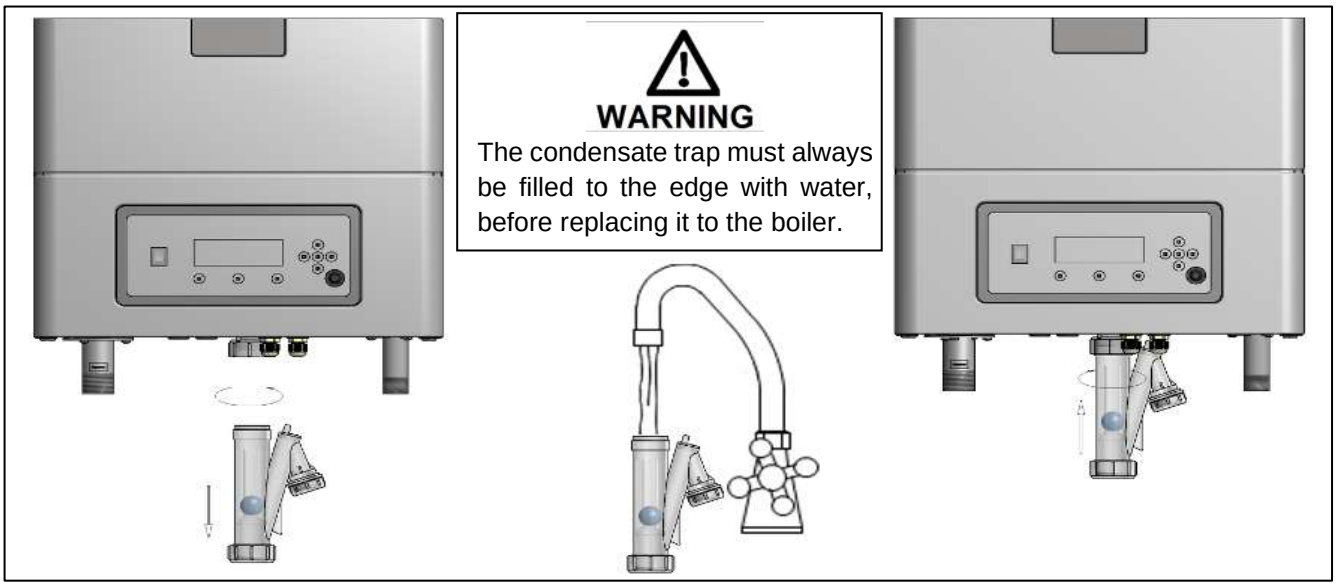
Before starting the boiler ensure the pump is installed and operating correctly and that there are no obstructions or closed valves that could prevent water flow through the heat exchanger.

NOTICE: Always ensure the boiler pump is functioning correctly and that there is flow through the heat exchanger after working on the boiler or system.

17.4 *Mounting Condensate Trap*

When mounting the bottom part of the condensate trap, before commissioning the boiler and/or after maintenance, it must **ALWAYS** be completely filled with water.

⚠ **WARNING**	**This is a safety measure: the water in the condensate trap keeps the flue gases from leaking out of the heat exchanger via the condensate drain.**



When the boiler receives a heat demand the electronics will start the operation of the boiler. Before the boiler is used, the boiler must be adjusted and set at the minimum and maximum load.

17.5 *Checking gas pressure*

Check the gas pressure available at the gas connection pipe of the boiler. Use the pressure nipple [3] of the gas safety valve for this measurement. Chapter 18.1.2 shows the position of the pressure nipple [3]

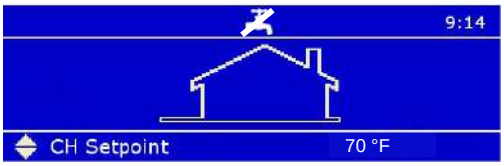
Min. and max. gas supply pressures:

Type of Gas	p nom [inch W.C./ mbar]	p min [inch W.C./ mbar]	p max [inch W.C./ mbar]
Natural gas	7.0 / 17.4	3.5 / 8.7	10.5 / 26.2
Propane	11.0 / 27.4	8.0 / 19.9	13.0 / 32.4

17.6 *Firing for the first time*

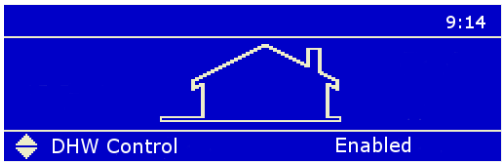
After the commissioning of the boiler and the described previous actions, the boiler display will show the following graph.

This screen is active during power up and will remain active until communication with the main Control has been established.
After communication has been established one of the following Status overview screens appears:



Central Heating only

OR



Central Heating AND Domestic Hot Water

The display describes:

- The actual operation for heating or hot water
- The temperature setting

18 ADJUSTING AND SETTING THE BOILER

WARNING

Before carrying out any adjusting of the burner, carefully read this complete chapter.

The initial lighting of the appliance must be performed by a licensed Gas Technician. Failure to follow these instructions may result in property damage, serious injury or death.

As soon as the appliance has been fully installed (with regard to hydraulics, filling and de-aeration of installation, gas, flue gas, air intake, wiring etc.) according to the preliminary installation instructions, the boiler may then be wired to an electrically grounded power supply source. The boiler should always be connected to a disconnect or external power shutoff. The boiler must be electrically bonded to the ground in accordance with the requirements of the local authority having jurisdiction or, in the absence of such requirements, the National Electrical Code, ANSI/NFPA 70, and or/the Canadian Electrical Code Part I, CSA C22.1 Electrical Code.

18.1 *Introduction*

The boiler must always be adjusted in the next situations:

- A new boiler is installed
- As part of a service/maintenance check, in case the CO_2 values turns out to be incorrect.
- The gas valve has been (re)placed.
- Gas conversion to propane. Prior to adjustments, follow the procedure in 18.5
- The venturi has been replaced. Prior to adjustments, follow the procedure in 18.4
- The fan has been replaced
- The flue gas check valve has been replaced

In any of the cases described, always check the gas/air ratio of the combustion figure (CO_2) at maximum and minimum input. First set the boiler at maximum load and subsequently at minimum load, and repeat if necessary (adjustments at maximum load influence values at minimum load and vice versa).

Chapter overview:
First, all necessary values are given in adjustment table in § 18.1.1. A drawing of the gas valve(s) and setting screws is given in § 18.1.2. In § 18.2 a general procedure, conform which the adjustments must be carried out, is presented. § 18.3 describes the specific adjustments to be made when the venturi is replaced, and § 18.4 describes the changes needed when the gas type is set to propane.

18.1.1 COMBUSTION TABLE

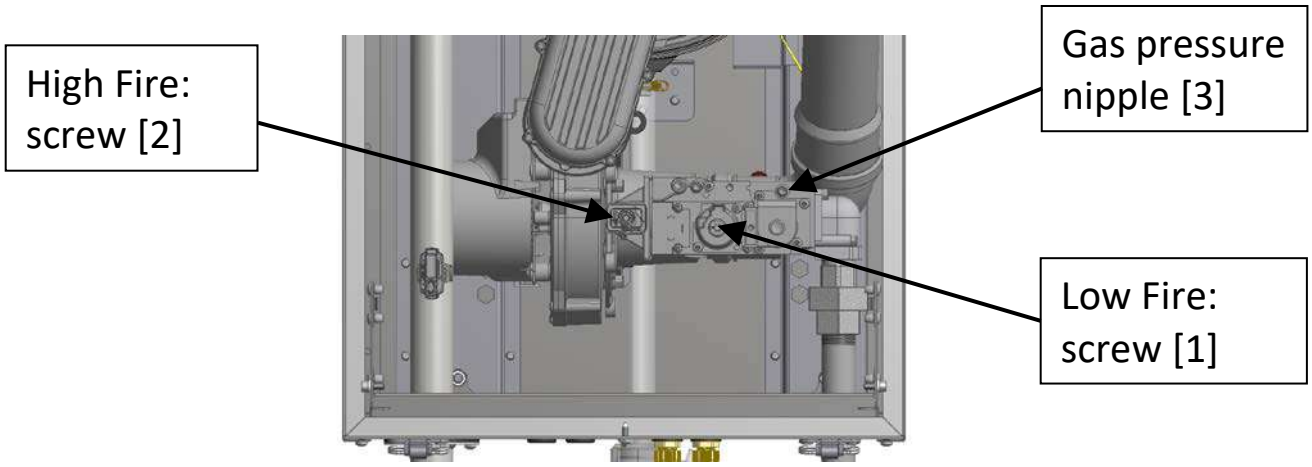
Table: CO_2 values for maximum and minimum load. [1)]

gas type	boiler type	CO_2 / O_2 [%]	CO_2 / O_2 [%]
		High Fire	Low Fire
natural gas	RC-300, RC-400, RC-500	9.2 / 4.7	9.8 / 3.7
propane[2)3)]	RC-300, RC-400 RC-500	10.4 / 5.0	11.0 / 4.1

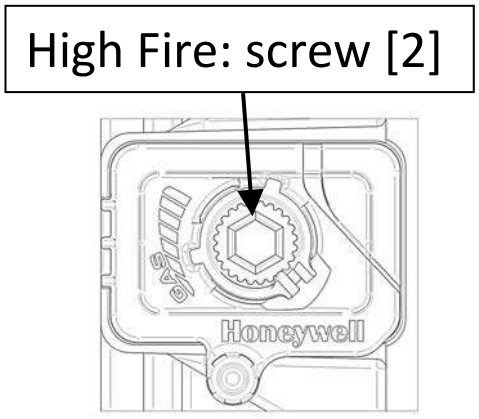
1) All values measured without front door.
2) For propane: a conversion kit (orifice) has to be mounted, see 18.4.
3) For propane: appliance type must be changed, see 18.4

18.1.2 SETTING SCREWS VENTURI- AND GAS VALVES: DRAWINGS

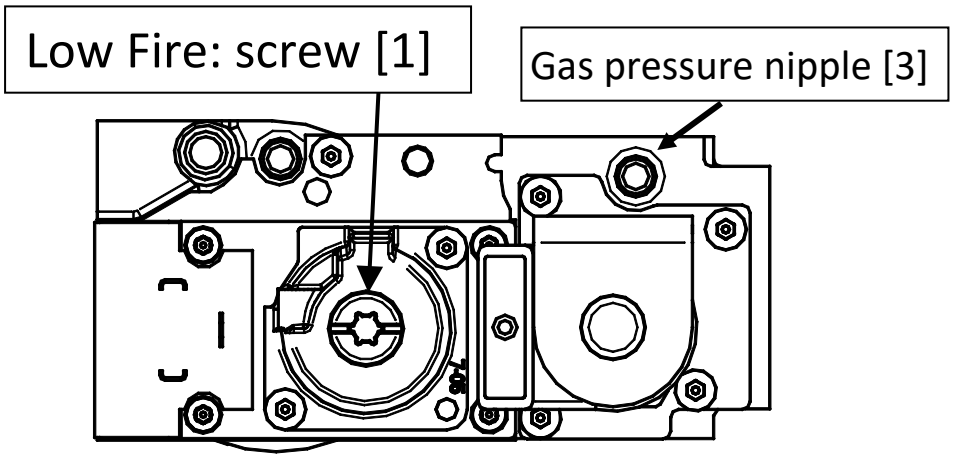
Location of the setting screws:



High Fire: venturi adjustment screw: use hex key 4 mm (5/32 Allen wrench)



Low Fire: gas valve adjustment screw: Torx T40.



18.2 *Adjustment procedures*

Procedure 1: adjust at High Fire

Carry out the next steps:

1. From status screen, press MENU ☰ .→"Central Heating/ Information/ Settings/ System Test"
2. Press UP/DOWN ↑↓ to select "System Test" Press CONFIRM ↵
3. Password needed to continue
4. Press CONFIRM↵ to activate the test state. → "Test State: **Off**"
5. Press UP/DOWN ↑↓ multiple times to select "High Power" → "Test State: **High Power**".
   The boiler becomes active, after about 10 seconds, the boiler burns at high fire.
   If the boiler doesn't start, open screw [2] two turns extra - clockwise
   Note: once the test state is active, it is not necessary to press a button, selecting the desired power is sufficient.
   Wait a minimum of 10 seconds for the boiler to stabilize before taking combustion readings between changes and adjustments to the combustion.
   For your information, "Fan speed" and "Ionization" are displayed.
6. Measure the CO_2 percentage at the flue gas test port on the vent connection.
7. By setting screw [2], adjust the gas valve to obtain the CO_2 value of the table in § 18.1.1.
8. To return to the status screen, and stop the boiler, press ESCAPE⎋ or MENU☰ 3 times, or RESET ↺ once.

Increase CO_2	**CO_2 ↑**	[2]	**O_2 ↓** **Turn screw [2] right (clockwise)**
Decrease CO_2	**CO_2 ↓**	[2]	**O_2 ↑** **Turn screw [2] left (counterclockwise)**

The system test automatically stops after 10 minutes, after this the system continues with normal demand handling. When the system test mode is changed during an active system test, the 10-minute timer is restarted.

Procedure 2: adjust at Low Fire

Carry out the next steps:

1. Press UP/DOWN ↑↓ multiple times to select "Low Power" → "Test State: **Low Power**".
   After about 10 seconds, the boiler burns at low fire.
2. Measure the CO_2 percentage at the flue gas test port on the vent connection.
3. By setting screw [1], adjust the gas valve to obtain the CO_2 value of the table in § 18.1.1.

Increase CO_2	**CO_2 ↑**	[1]	**O_2 ↓** **Turn screw [1] right (clockwise)**
Decrease CO_2	**CO_2 ↓**	[1]	**O_2 ↑** **Turn screw [1] left (counterclockwise)**

4. To return to the status screen, and stop the boiler, press ESCAPE⎋ or MENU☰ 3 times, or RESET ↺ once.

The system test automatically stops after 10 minutes, after this the system continues with normal demand handling. When the system test mode is changed during an active system test, the 10-minute timer is reloaded.

Repeat procedures 1 and 2 until measured values match table in § 18.1.1. values best

18.3 *Venturi Replacement Adjustment*

A new venturi is shipped with an unknown setting. It must be adjusted before it can be used in the boiler.

- First, turn setting screw [2] on the venturi clockwise until you feel resistance. This means that the valve is open, *do not try to tighten the screw any further*.
- Now turn screw [2] counterclockwise 38 turns.

After this, perform adjustments according to 18.2.

18.4 *Conversion from natural gas to propane*

⚠ **WARNING**	Conversion of the boiler to a different gas type must be performed by a certified technician. Parameter 92 and 93 must be set correctly! Wrong setting can lead to damage to the appliance or shorten the lifespan of the appliance! The warranty of the device will expire if a wrong selection has been made.

Use only parts/conversion kits obtained from Gasmaster and intended to be used with this particu-lar boiler. Every conversion kit is provided with in-structions how to assemble the kit to the boiler.

Required parts: (Installation Manual § 5.1 Accessories)
Propane kit for VMS Venturi hole Ø 6.2 RC-300
Propane kit for VMS Venturi hole Ø 6.7 RC-400
Propane kit for VMS Venturi hole Ø 7.2 RC-500

Converting the boiler to propane (LP) requires the following actions (details below).

1. mount the orifice
2. set parameter 92 and 93
3. adjust the CO_2 / O_2 percentage
4. confirmation: apply the propane sticker and mark the boxes

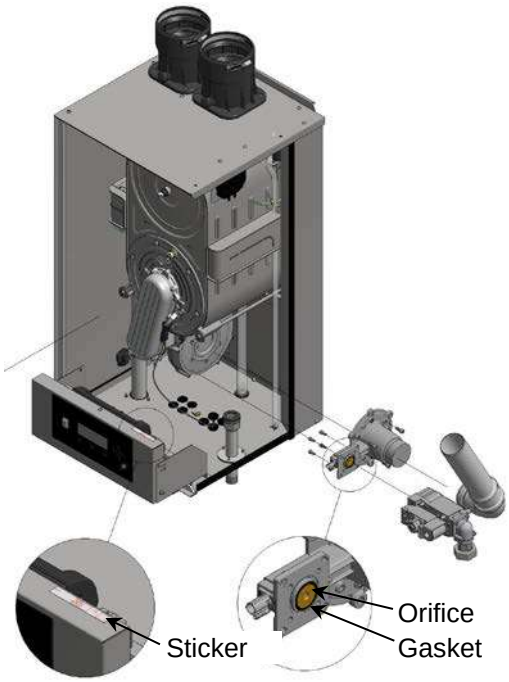
1. Mount the orifice:

Boiler type	Orifice Inner Diameter
RC 300 CH	**6.2**
RC 400 CH	**6.7**
RC 500 CH	**7.2**

Converting the boiler to propane is done by placing a propane orifice between gas valve and venturi. By using the correct orifice size (see table), the measured CO_2 (O_2) percentage in the flue gas will already be close to the desired value.

Installing the orifice (see also picture):
Required tools: wrench 55, hex key 5 mm and hex key 4 mm.

1. Close the external gas shutoff valve and disconnect the electrical power before opening the boiler.
2. Use a wrench to open the coupling in the gas line in the boiler. The three screws, with which the venturi is mounted onto the fan, can now be removed.
3. Venturi and gas combination valve can now be separated. The orifice is to be placed between venturi and gas combination valve. The rounded side of the orifice must be on the side of the gas combination valve.
   The orifice must be mounted into the gas entrance of the venturi and secured with the rubber gasket.
4. Venturi and gas combination valve can now be reconnected.
5. Remount the gas combination valve and the venturi onto the fan. Close the union in the internal gas line. (Include the gasket)
6. Now open the external gas valve.
7. Check for gas leaks.
8. Reconnect the electrical power.
9. If in operation, check again for gas leaks on all parts that have been apart.



2. Set fan speed

The fan speed has to be changed in the software of the boiler according to the tables below:.

	Boiler type	fan speed high fire parameter 92	Fan speed low fire parameter 93
Internal igniter	RC-300 & HWB-300	6450	1750
	RC-400 & HWB-400	6700	1800
	RC-500 & HWB-500	7400	2000

1. From status screen, press MENU button once.
2. Press UP/DOWN ↑ ↓ to select "Settings" and press ENTER ↵
3. Press UP/DOWN ↑ ↓ to select "Boiler Settings" and press ENTER ↵
4. Enter installer password by pressing UP/DOWN ↑ ↓ and LEFT ← / RIGHT →.
5. Press UP/DOWN ↑ ↓ to select "Boiler parameters" and press ENTER ↵
6. Press UP/DOWN ↑ ↓ to select parameter “(92) Fan Speed Maximum” and press ENTER ↵
7. Press UP/DOWN ↑ ↓ to adapt the fan speed according to the table and press ENTER ↵
8. Press UP/DOWN ↑ ↓ to select parameter “(93) Fan Speed Minimum” and press ENTER ↵
9. Press UP/DOWN ↑ ↓ to adapt the fan speed according to the table and press ENTER ↵

To return to the status screen, press ESCAPE ⎋ or MENU ☰ 4 times, or RESET ↺ once.

WARNING!	In case a CSD kit (gas pressure switch kit) is mounted (on the gas valve), adjust the right-hand pressure switch to 9.0 inch.w.c!

WARNING!	Check during start-up of the boiler no gas mixture is leaking on all parts that have been apart!

3. Adjust the CO_2/ O_2 percentage

Perform CO_2/ O_2 adjustments according to the procedures in the installation manual; § 18.2, using the values in table § 18.1.1.

4. Confirmation

When finished:
- Apply the corresponding sticker at the appropriate position in the boiler.
- Mark the box for the used gas type.
- Mark the box, indicating that the correct value has been set for the appliance type.

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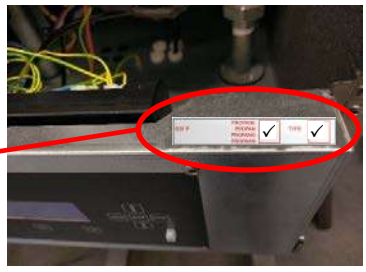


WARNING!	Please ensure the boiler is clearly labelled if operating on propane supply!

18.5 *Start Up Checklist*

Installation/start-up checklist

Installer information	
Company	
Engineer name	
Address	
Postal code	
City	
State/province	
Telephone number	

Site information	
Site name	
Site contact (owner/enduser)	
Address	
Postal code	
City	
State/province	
Telephone number	

Boiler information	
Model	
Serial number	
Installation date	
New boiler or replacement	
Cascade installation (Y/N)	(YES/NO)
Number of boilers	
Type of boilers in cascade	

GASMASTER

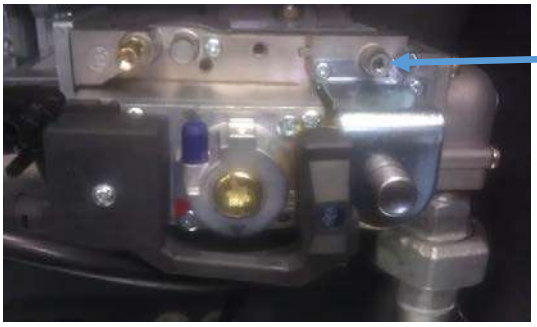
After filling in form please send a copy by e-mail to: sales@gasmaster.ca or send a copy to address:

Gasmaster Industries Ltd.
3105-6900 Graybar Rd.
Richmond, BC V6W 0A5

Venting information		
Direct vent or using combustion air from indoor?	indoor / outdoor	
	Air inlet	**Flue outlet**
Diameter		
Total length		
Length horizontal		
Length vertical		
Length sloped at …..°		
Number elbows 90°		
Number elbows 60°		
Number elbows 45°		
Number elbows 30°		
Air intake location (e.g. roof/ wall)		
Distance vertical from roof		
Distance from (closest) wall		
Common air intake system	(YES/NO)*	
If YES => how many Air intake's are joined?		
Air intake (under)pressure (on top of boiler)		
Possibility of dust/chemicals drawn in to air intake?	(YES/NO)*	
If YES => of which kind?		
Distance from Flue outlet (top of chimney) vertical		
Distance from Flue outlet (top of chimney) horizontal		
Is there a condensate drain installed to common flue system?		
Flue outlet pressure (on top of boiler)		

Condensate Drain	
Check the level of the heat exchanger; It must have a slight angle from the rear to ensure that the condensate drains from the heat exchanger.	(YES/NO)
Condensate trap (from package) installed according installation manual?	(YES/NO)
Inside diameter of drain piping	mm/inch
Is there a definite air gap between the condensate trap and the connection to drain pipe?	(YES/NO)
Total drop in height from boiler to drain piping exit point	
Any additional trap points?	(YES/NO)
Perform PH test and register PH value	
Condensate neutralizer installed	(YES/NO)

Water circulation & temperature regulation (for DHW)	
Piping diameter	
Total length of straight pipe between boiler & tank	
Number of elbows	
Number of tees	
Temperature rise between inlet and outlet after 5 min. cold-start operating max. power	°C / °F
Water temperature setpoint	
Test of Water Flow Switch (DHW)?	(Yes/No)
Minimum required water pressure in system set to 14.5 psi (1.0 bar)?	(Yes/No)



**Gas valve
Pressure Nipple

Gas supply	
Type of Gas from installation	
Is gas isolation valve installed under boiler according to installation manual?	(YES/NO)
Which diameter gas isolation valve is installed?	
Gas piping (inside) diameter	
Gas piping material (if possible specify mark/type)	
Gas piping flexible (YES/NO)	(YES/NO)
Gas piping inside structure (e.g. smooth/corrugated)	
Measured Gas pressure @Gas valve (Static) **	
Measured Gas pressure @Gas valve (dynamic - all gas appliances in the building should be turned on and running at full load)	
Is there a secondary gas pressure regulator before the boiler?	(YES/NO)
If YES what is the length of the Gas piping in between?	
If YES what is the Brand & Model?	

Combustion settings		unit:
Set for NG (Natural Gas) or LP (Liquid Propane)?	NG or LP?	
If LP is the right gas orifice mounted?	(YES/NO)	
diameter gas orifice for LP?		mm
CO2 level at high fire …%		%
CO2 level on low fire …%		%
Flue pressure @ CO2 measuring point at high fire		Pa
Flue pressure @ CO2 measuring point at low fire		Pa
If cascaded with common flue system run all appliances at high fire and measure Flue pressure		Pa
If cascaded with a common flue system; run all appliances, measure the flue pressure at low- and at high fire.		Pa

Electronics & Power supply		unit:
Version Burner Controller Hardware (see § 3.2 for location)		
Version Burner Controller Firmware (see § 3.2 for location)		
is ground connected to building grounding system	(YES/NO)	
Voltage incoming (Hot to Neutral)		V
Voltage incoming (Hot to Neutral)		V
Voltage measured between Ground and Neutral		V
Total of amperage switched by the Boiler Control is below 3.5 A or 400 W?		A

Additives	
Used chemical additions	
Mixing Ratio	

19 INSPECTION, MAINTENANCE AND SERVICE.

19.1 *General*

For a good, safe and long-time operation of the boiler and to maintain warranty it is mandatory to carry out inspection, maintenance and service on the boiler at least once a year and/or after 2000 burning hours maximum, whichever comes first..

Inspection, maintenance and service of the boiler should also be carried out on the following occasions:

- **When a number of similar error codes and/or lock-outs appear.**
- **At least every twelve months and/or after 2000 burning hours maximum, whichever comes first, maintenance must be done to ensure safe and efficient operation.**
- **Damage caused by the lack of maintenance will not be covered under warranty**

Service intervals

The normal service frequency for the boiler is once a year and/or after 2000 burning hours maximum, whichever comes first. Every year the boiler should be cleaned and checked, according to the maintenance procedures. If there is doubt whether the boiler is operating with the correct water and/or combustion air quality, it is advised that a first check is already executed after six months. This check serves to determine the frequency of the future services. The maximum interval between two services is one year and/or after 2000 burning hours maximum, whichever comes first.

WARNING	INSPECTION, MAINTENANCE AND SERVICE MUST BE EXECUTED FOR A SAFE AND EFFICIENT OPERATION OF THE BOILER.

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

"Verify proper operation after operation servicing."

19.2 *Safety instructions Crystalline Silica*

WARNING	**Warning** **Crystalline Silica – Read instructions below carefully**

Refractory Insulation

The refractory insulation of the heat exchanger (located on the rear wall inside the heat exchanger and burner door) must be inspected. If this insulation disk shows any signs of (water) damage or degradation it should be exchanged. Also check if there are any indications in the burner room of a high condensate level (caused by a blocked condensate trap) that might have wetted the rear wall insulation. When this has happened the rear wall, insulation should also be replaced.

Only use the insulation disk that is supplied by the boiler manufacturer.

The same procedure must be applied on the insulation and gaskets fitted on the burner door.

Refractory Ceramic Fibers (RFC)

Personal Protective Equipment Required - Read the following warnings and handling instructions carefully before commencing any service work in the combustion chamber. The insulating material on the inside of the burner plate and the rear combustion chamber wall contain *Refractory Ceramic Fibers* and should never be handled without personal protective equipment. When disturbed as a result of servicing, these substances become airborne and, if inhaled, may be hazardous to your health.

Potential Carcinogen - Use of *Refractory Ceramic Fibers* in high temperature applications (above 1805 °F) can result in the formation of Crystalline Silica (cristobalite), a respirable silica dust. Repeated airborne exposure to crystalline silica dust may result in chronic lung infections, acute respiratory illness, or death. Crystalline silica is listed as a (potential) occupational carcinogen by the following regulatory organizations: International Agency for Research on Cancer (IARC), Canadian Centre for Occupational Health and Safety (CCOHS), Occupational Safety and Health Administration (OSHA), and National Institute for Occupational Safety and Health (NIOSH). Failure to comply with handling instructions in the table in § 19.2 may result in serious injury or death.

Crystalline Silica - Certain components in the combustion chamber may contain this potential carcinogen. Read warnings and handling instructions pertaining to Refractory Ceramic Fibers before commencing service work in the combustion chamber. Take all necessary precautions and use recommended personal protective equipment as required see the table in § 19.2 Installation and service must be performed by a qualified installer, service

agency or the gas supplier who must read and follow the Installation, Operation, and Service Manual before performing any work on this boiler. Improper installation, adjustment, alteration, service or maintenance can cause property damage, serious injury (exposure to hazardous materials) or death.

AVOID Breathing Fiber Particulates and Dust
Precautionary Measures:
Do not remove or replace RCF parts or attempt any service work involving RCF without following the guidelines and wearing the following personal protective equipment outlined in the table below:

Avoid the Following	• Avoid Contact with the skin and eyes • Avoid breathing in the dust in the combustion chamber • Avoid transferring the contamination from clothing and items at the job site
Personal Protective Equipment	• Wear long-sleeved shirt and pants, gloves, and safety goggles • Wear a respirator with a N95 rated filter efficiency or better. [1]
Working Environment	• Use water to reduce airborne dust levels when cleaning the combustion chamber • Do not dry sweep silica dust. Pre-wet or use a vacuum with a high efficiency HEPA filter • Take all possible steps to provide adequate ventilation in the boiler room
Clean-up	• Remove all contaminated clothing after use. Store in sealable container until cleaned • Wash contaminated clothing separately from other laundry and rinse washing machine after use to avoid contaminating other clothes. • Wash all exposed body areas gently with soap and water after contact.
Disposal	• Discard used RCF components by sealing in an airtight plastic bag. RCF and crystalline silica are not classified as hazardous wastes in the United States and Canada.
First aid	• If contact with eyes: Flush with water for at least 15 minutes. Seek immediate medical attention if irritation persists • If contact with skin: Wash affected area gently with soap and water. Seek immediate medical attention if irritation persists. • If breathing difficulty develops: Leave the area and move to a location with clean fresh air. Seek immediate medical attention if breathing difficulties persist. • Ingestion: Do not induce vomiting. Drink plenty of water. Seek immediate medical attention

Notes:
1 Respirator recommendations based on OSHA and CCOHS requirements at the time this document was written. Consult your local regulatory authority regarding current requirements for respirators, personal protective equipment, handling, and disposal of RCF's.

For more information on Refractory Ceramic Fibers, the risks, recommended handling procedures and acceptable disposal practices contact the organization(s) listed below:

United States (OSHA): Telephone directory listing under United States Government - Department of Labor - Occupational Safety and Health Administration; or website http://www.osha.gov.

Canada (CCOHS): Telephone directory listing under Government Blue Pages Canada - Health and Safety - Canadian Centre for Occupational Health and Safety; or website http://www.ccohs.ca.

19.3 *Inspection, maintenance and service.*

Inspection, maintenance and service including the replacement of boiler parts must only be carried out by a licensed professional, service agency or the gas supplier. Apart from the maintenance proceedings it is required to maintain a service log for each boiler that includes all of the following information:

- Serial number
- Date and time of maintenance
- Name of maintenance engineer
- Which parts were exchanged during maintenance
- Which settings (software) were changed during maintenance
- Special remarks / findings
- Future aspects that need extra attention
- Additional aspects: measurement reports, complaints by the (end)-user, lock-out codes, etc.
- Static Gas Pressure inches W.C.
- CO2 % at high fire
- Gas Pressure at high fire
- Gas Pressure at low fire
- pH of the water or water/glycol in the system
- name of service company
- date of service

During maintenance, the following items in bold listed below of the boiler must be checked and inspected.
NOTICE: Before starting to work on the boiler:

- Switch off the electrical power to the boiler (service switch and/or unplug boiler)
- Close the gas valve to block gas supply to the boiler

Customer comments
Comments and remarks from the customer should be analyzed and used to find possible causes for any occurring problems and complaints.

Service history
The operational and fault history (total amount and since the last service) can be viewed in the boiler control
This information can be used to specify the maintenance and service proceedings in relation to the boiler (parts).

Boiler History	
Successful Ignitions	32
Failed Ignitions	10
Flame Failures	0
Operation Days	0 days ▼

Water leakage
The water pressure of the heating installation should be more than 21 psi (1.0 bar) and at a maximum of 45 psi (4.0 bar) in normal operation. When the water pressure drops below the minimum occasionally, there might be a water leak. Check the boiler and the complete heating installation for any water leakages and have these repaired. higher water pressures are allowed with the use of a different relief valve and a pressure switch kit

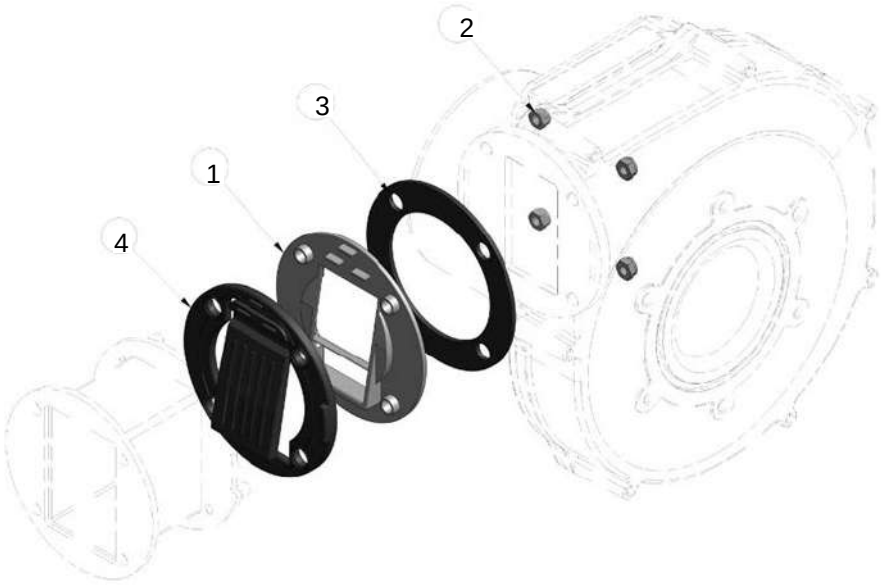
Flue gas & air supply
The flue gas pipes and the air supply pipes must be checked for gas tightness. Also check if the mounting of these pipes is correct, safe and not damaged. Check the top side of the boiler housing for signs of water leakage and traces of water coming from the air supply pipe, the air vent or any condensate coming from the flue gas pipes.
Check to ensure the flow there are no obstructions for the exhaust venting or the intake combustion air venting.
Check that all intake and exhaust venting has been properly reassemble and sealed before leaving the job site

Gas supply & safeties
The gas pipes must be checked for gas tightness. Also check if the mounting of these pipes is correct, safe and not damaged. Any built-in safeties should be checked for a correct functioning. Any gas pipe or fitting that have been opened or adjusted should be checked for leaks.

Remove complete burner unit
The complete boiler unit consists of the fan, venturi, gas valve, the burner plate and the internal burner. To make more space to dismantle the complete burner unit pull down the burner controller unit.
To remove this part for an internal heat exchanger check: remove the six M6 nuts, the ignition cable and the thermal fuse cables. Close the gas tap under the boiler and loosen the gas coupling by untighten the swivel joint under the gas valve. Remove the air intake pipe from the venturi.
After this, take out the complete burner unit by moving it forward out of the boiler housing. NOTICE: Watch out not to damage the burner plate insulation during this operation.
While removing the complete burner unplug both of the electrical and controlling cables of the fan. After all this dismantle the venturi on the suction side of the fan and check the blade wheel of the fan.

WARNING	**Warning** **Crystalline Silica – Read instructions of § 19.2 carefully**

Checking Non-return Valve (NRV)
The non-return valve is placed directly after the fan and has to be replaced every year during maintenance. Replace the non-return valve by removing the 4 nuts that are holding the fan. All the parts included in the NRV maintenance kit must be replaced the gaskets, NRV seat, lock nuts, and non-return valve, do not reuse any of the old parts.
Reassemble the Non-return valve to the burner unit be sure that the nuts are tightened again so no air/gas mixture is leaking into the cabinet. Check during startup of the boiler to ensure no gas mixture is leaking on these gaskets near the non-return valve.
Replace parts 1 to 5 of the check valve once a year.
Needed tools: Wrench 55, 10 and 8 mm, Hex key 5 mm



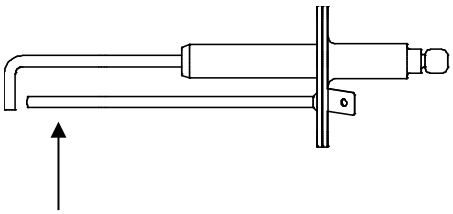
1 = Seat check valve small
2 = Lock nut M5 DIN985
3 = Gasket gas air mixing
4 = check valve small

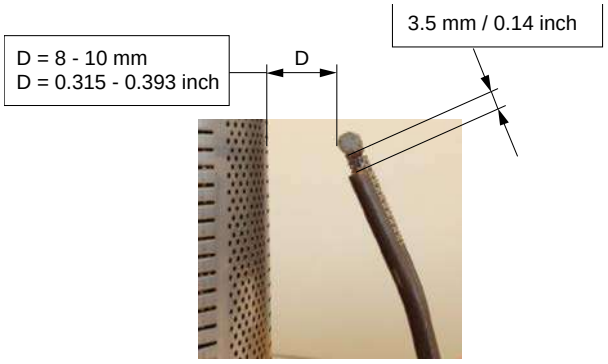
WARNING	Always check gaskets on non-return valve for air/gas leakage!!

Burner
Check the burner surface to see if it has damages, signs of rust and/or cracks. When the burner surface is damaged the burner must be replaced. The burner can be cleaned by using a soft (non-metallic) brush. The dust can be removed with a vacuum cleaner or pressurized air.

Ignition / ionization electrode
When the complete burner is removed, it is very easy to check the ignition electrode. First check if the distances between the electrodes and between the electrode and the burner are according to the figure below. When these are not correct, try to bend the electrodes into the right position. Notice: the electrodes undergo high temperatures, therefore the electrodes become hard and are difficult to bend. While bending used electrodes they might break or burst. Check the electrode, after bending, for any tear/crack and signs of rust. When they are damaged in any manner or rusty, replace the electrode. Also replace the electrode when there is a crack in the ceramic insulation of the electrode. When the electrode is replaced, also the gasket must be replaced. The electrode should be cleaned annually by lightly rubbing its surface with a dollar bill. Emory cloth, sandpaper, and any other abrasive material should never be used to clean the electrode.

Needed tools: Phillips #2 screwdriver.





WARNING	**Warning** **Crystalline Silica – Read instructions of § 19.2 carefully**

Burner door thermostat
Needed tool: Wrench 16 mm.
This thermostat is activated if the temperature of the burner door has been too high. In this case, it has to be replaced (spare part).

Replacement:
- Disconnect the wiring and remove the thermostat.
- Tighten the burner door's thermostat with a torque of 2 Nm.
- Reconnect the wiring.

Burner door gaskets
If any part of a gasket has discolored, changed texture, or hardened then, the rubber has cured and/or has damages, these gaskets must be replaced. Notice: only use the gaskets that are supplied by the boiler manufacturer.

Burner door gasket replacement:

- Remove the old gasket
- Place a new gasket in its groove.
- Respect the mounting direction.

Fiber braid replacement

If the high temp braided rope is damaged and needs to be changed, it has to be replaced by new braids using the method described below.

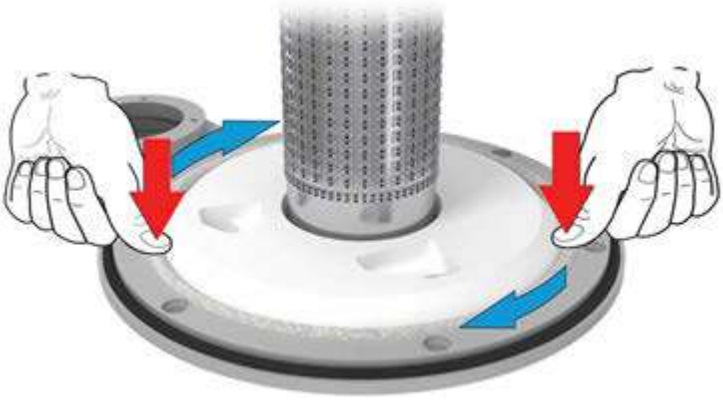
The high temp braided rope is maintained by silicone glue.

- Remove electrodes.

- Remove the braids by sliding under the periphery a thin tool to loosen the braids and remove it.
- Remove and clean the residues of the braids and silicone glue.

- Put a thin string of glue silicone temperature-resistant in the seal housing. (Loctite 5366 or Ottoseal S17)

- Engage the high temp braided rope and place it in contact of the glue and press the braids.



- Reinstall electrodes

WARNING	**Warning** **Crystalline Silica – Read instructions of § 19.2 carefully**

Rear wall insulation disk; changing procedure:
If the insulation disk has been degraded or damaged, it has to be replaced.
- be sure the heat exchanger is cooled down, wait a few hours after burning. In this way, the protective film is not sticking anymore on the rear side of this insulation disk.
- make the insulation wet, by spraying water over it. This in order to keep airborne dust to a minimum.

- with a knife, cut a cross in the insulation disk, avoiding the central insert (on the back, not visible)

- make a square cut around the central insert

- remove the segments

- remove the central insert

The new disc has the clip on the back.
- do **NOT** remove the film on the new disc
- with the central insert on the back, place the new insulation disk by pushing it to the rear of the wall. A "click" means the fitting is ok.

Replacement of burner door insulation.

Removal of the insulation:
- remove electrode
- remove the defective insulation by sliding under the periphery of the insulation a thin tool to loosen the insulation and remove it.

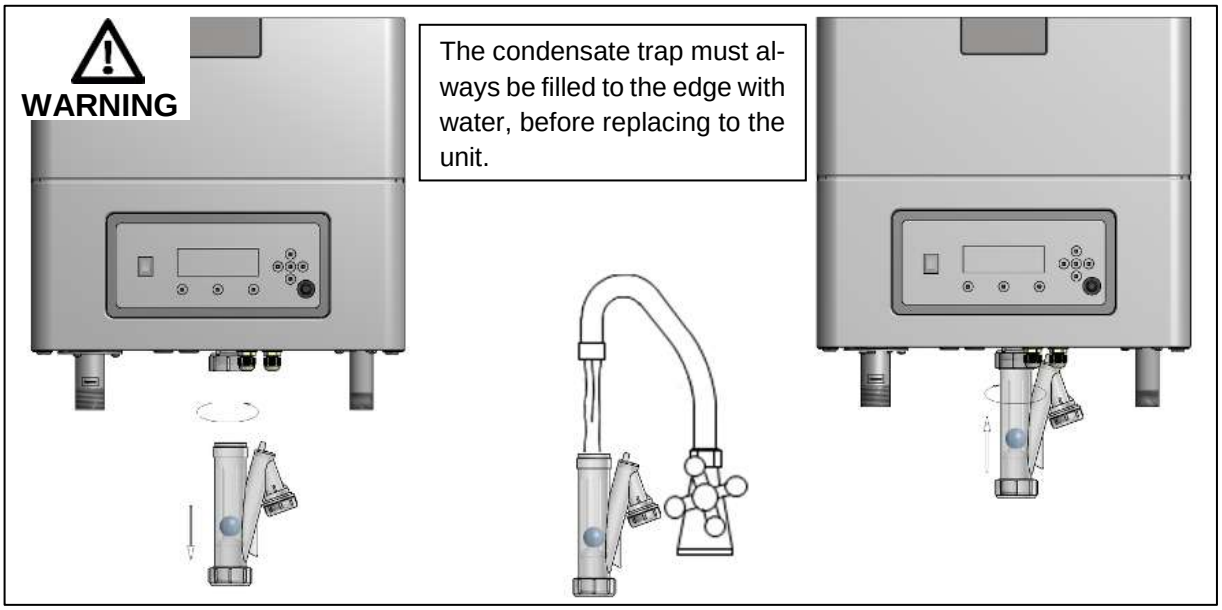
- remove and clean the residues of the insulation and silicone glue

Install the new insulation:
- put two dots of glue silicone, temperature-resistant (Loctite 5366 or Ottoseal S17), according to the location indicated.
- make sure that the burner is in proper condition, remove any possible insulation residues on the burner
- put a plastic protection skirt around the burner to protect the insulation from the burner.
- engage the insulation carefully and place it in contact with the two dots of silicone glue
- remove the plastic protection skirt
- check the condition of the electrode, if necessary replace it
- reinstall electrodes- mount the burner door correctly back onto the heat exchanger, taking in account the correct torque values, see § 19.3.1

Fan
When the fan blades are polluted and dirty, carefully clean the blades with a soft brush. Notice: do not use too much force on the blades or else the fan might be out of balance and run irregularly, causing noises and fan failures. Check the fan also for any water damages. In doubt always replace the fan of the boiler.

Condensate trap
Disassemble the condensate trap and clean every part of it. Check the condensate trap connection of the heat exchanger for any blocking or pollution and clean it (if necessary). Check the functioning of the condensate trap by pouring clean tap water in the boiler combustion chamber (when burner door is removed). This water will exit the heat exchanger by the condensate trap. Notice: don't wet the rear wall insulation.

⚠ **WARNING**	When mounting the bottom part of the condensate trap, before commissioning the boiler and/or after maintenance, the condensate trap must **ALWAYS** be completely filled with water. **This is a safety measure: the water in the condensate trap keeps the flue gases from leaking out of the heat exchanger via the condensate drain.**



Heat exchanger and boiler combustion chamber
After the removal of the complete burner unit check if there is any debris and dirt in the heat exchanger. The coils of the heat exchanger can be cleaned by using a **non-metallic** brush. After this the dirt and dust can be removed with a vacuum cleaner and by flushing the boiler combustion chamber with water. Never expose the refractory insulation in the back of the combustion chamber to water or get it wet. Don't forget afterwards to clean the condensate trap once again.

Gas/air ratio
With every service check and/or maintenance of the boiler always check the gas/air ratio by measuring the CO_2 percentage (flue gas) at the maximum and minimum load of the boiler. If necessary, adjust these values. See for information chapter "Adjusting and setting the boiler" chapter 18.

Pump (supplied separated from the boiler)
Check the electrical parts and the motor of the pump for a correct functioning. The pump must generate a sufficient water flow over the (heat exchanger of) the boiler. When the pump produces noise, is operational for more than five years or has signs of water leakage it is recommended to replace the pump as a precaution.

⚠ **WARNING**	• When faults and abnormalities are found by the service technician during service and maintenance and these are not repairable, this information should be reported to the owner/end-user of the installation. Also the owner/end-user should be advised how to fix these faults and these faults should be reported in the service report / log file of the boiler. • During service and maintenance, the gas, supply air, flue gas and condensate connections are disconnected, checked and replaced. Make sure that all these components are mounted correctly before commissioning the boiler again. • Cleaning the combustion chamber and heat exchanger with acid or alkali products is prohibited.

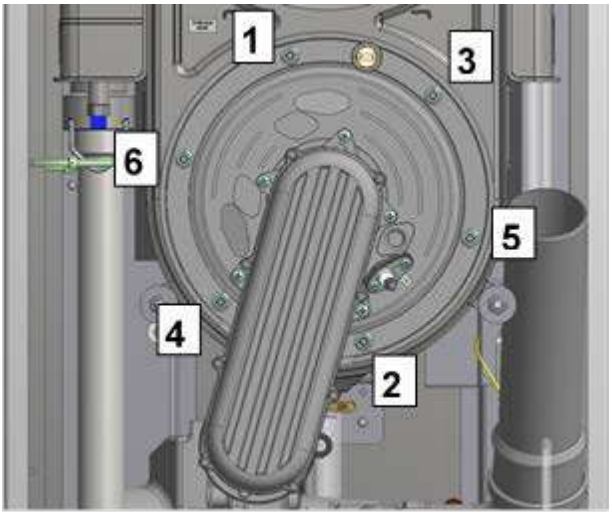
19.3.1 MOUNTING THE BURNER DOOR

IMPORTANT:
Before mounting the burner door, make sure that its gaskets and insulation are in excellent shape.
If any signs of damage or ageing are present, these parts must be replaced.

The burner door must be mounted back on the heat exchanger as follows:

- Place the burner door with its holes over the six threaded studs.
  Careful! When handling too rough or misplacing the holes over the threaded studs, the burner door insulation and/or gaskets can be damaged.
  Ensure that the door is well positioned with respect to the threaded studs, before pushing it onto the exchanger.
- Keep the burner door firmly in place by pushing the gas/air premix manifold with one hand at the middle at point A.
- Hand tighten the flange nuts with the other hand as far as possible onto the threaded studs.

Now the burner door is in place and the nuts can be tightened with a torque wrench.
Tighten the nuts in the order given in the picture.
The specified torque value for tightening the burner door flange nuts is **70.8 inch lbs (8 Nm).**



Tighten in given order.

torque = 70.8 inch lbs (8 Nm)

Picture 19.16

19.4 *Maintenance Checklist*

WARNING	Allowing the boiler to operate with a dirty combustion chamber will hurt operation. Failure to clean the heat exchanger as required by the manual and dictated by the operating location could result in boiler failure, property damage, personal injury, or death. Such product failures ARE NOT covered under warranty

Periodic maintenance should be performed once a year and/or after 2000 burning hours maximum, whichever comes first, by a qualified service technician to assure that all the equipment is operating safely and efficiently. The owner should make necessary arrangements with a qualified heating contractor for periodic maintenance of the heater. The technician must also inform the owner that the lack of proper care and maintenance of the boiler may result in a hazardous condition.

Maintenance Table

Inspection Activities		**Date Last Completed**			
		1st Year	2nd Year	3rd Year	4th Year
Near boiler piping	Check system and boiler piping for any sign of leakage. Take off boiler cover and inspect connections in boiler for any leaks or corrosion				
Vent	Check condition of all vent pipe and joints				
	Check to ensure vent termination not blocked or obstructed				
Gas	Check gas piping, test for leaks and signs of aging. Record gas pressure and note pressure drop upon start-up. Record CO2 at high and low fire				
Visual and Temperature	Do visual inspection of all system components and verify programmed temperature settings				
Connections	Check wire connections and make sure they are tight				
Combustion chamber	Check burner tube and combustion chamber coils. Clean with nylon brush and vacuum. Avoid touching white ceramic fiber. Also see maintenance section of manual				
Spark igniter	Ensure spacing of igniter prongs are aligned properly.				
Replace NRV	Replace non-return valve every year. And be sure it is not leaking gas after reassembling.				
Condensate trap	Disconnect condensate hose and trap. Ensure no blockage, rinse and clean out. Fill completely again with fresh water and re-install				
Relief Valve	Check to make sure it is not weeping				
Pump and Fan	Listen to sound of the pump and fan. If either makes noise during operation, it is recommended to replace the part.				
Low water cut-off	Check the LWCO is not leaking and check for right pressure value by draining the water from the boiler and comparing the value with a calibrated meter.				
Homeowner	Question homeowner before maintenance if they have any issues and after done, confirm activities you performed during maintenance visit				
Chemical additions	Check the chemical additives and add or renew if the mixing ratio is out of spec.				
Mixing Ratio					

20 USER INSTRUCTIONS

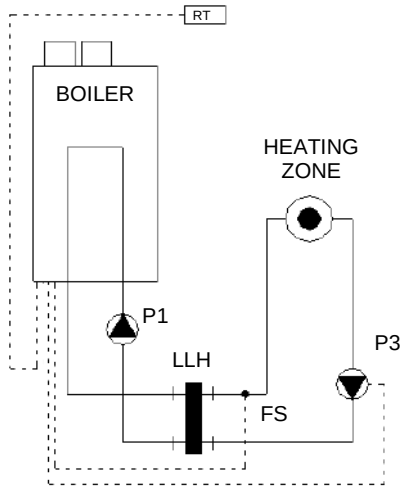
After installing and commissioning of the boiler, demonstrate the operation of the entire central heating system to the end-user. The user should be made familiar with all safety precautions of the boiler and the installation. The user should be instructed that service and maintenance of the boiler is required every twelve months. Regular service and maintenance is essential for a safe and proper operation of the boiler. Hand over the documents supplied with the boiler.

21 INSTALLATION EXAMPLES

The following schematics present several examples of heating installations:

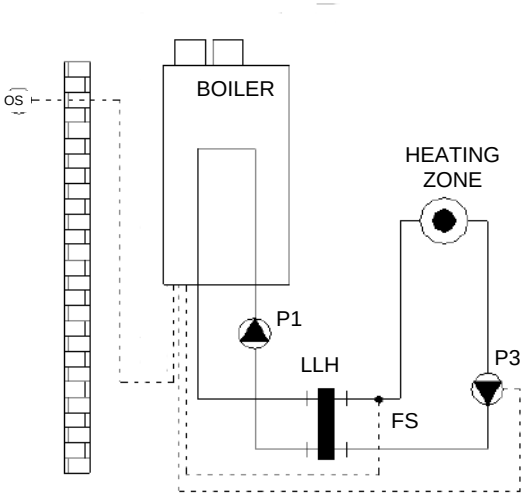
WARNING	**All schematics are purely functional.** **Safety components, bypass, control devices and so on must be added conform all applicable standards and regulations.**

System Example 1



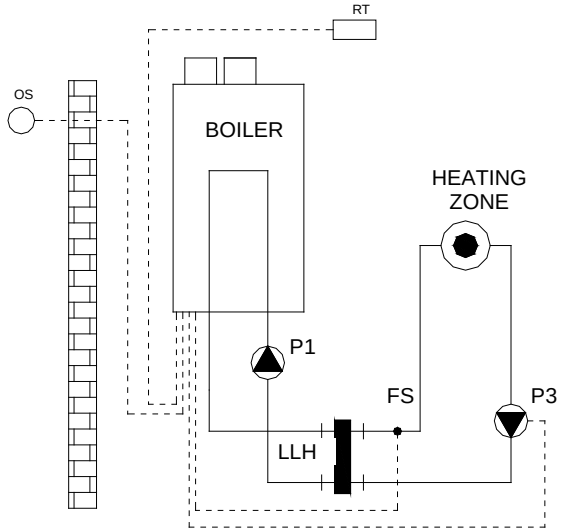
Low Voltage Connections		
	Name	**Wire terminal**
RT	Room thermostat	12-13
FS	System temperature sensor	3-4
LLH	Low loss header	
Line voltage Connections		
P1	boiler pump	4-PE-5
P3	system heating pump	6-PE-7

System Example 2



Low Voltage Connections		
	Name	**Wire terminal**
OS	outdoor temperature sensor	1-2
FS	System temperature sensor	3-4
LLH	Low loss header	
Line voltage Connections		
P1	boiler pump	4-PE-5
P3	system heating pump	6-PE-7

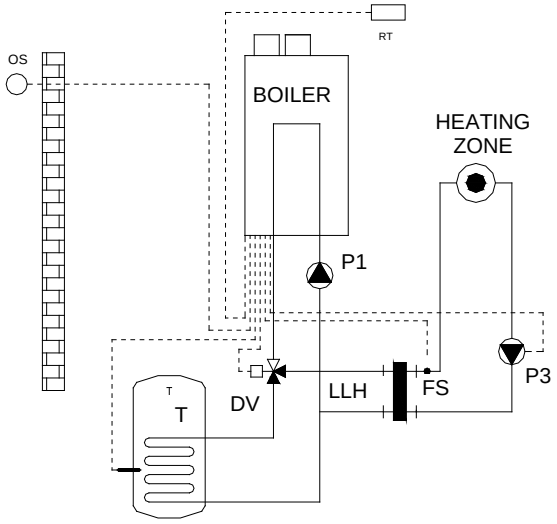
System Example 3



Low Voltage Connections		
	Name	**Wire terminal**
RT	Room thermostat	12-13
OS	outdoor temperature sensor	1-2
FS	System temperature sensor	3-4
LLH	low loss header	

Line voltage Connections		
P1	boiler pump	4-PE-5
P3	System heating pump	6-PE-7

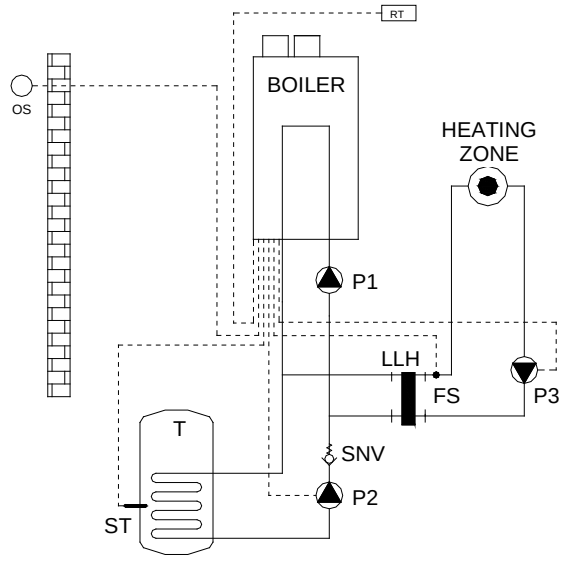
System Example 4



Low Voltage Connections		
	Name	**Wire terminal**
RT	Room thermostat	12-13
FS	System temperature sensor	3-4
OS	outdoor temperature sensor	1-2
ST	Tank thermostat or sensor	5-6
LLH	low loss header	
T	DHW indirect Tank	

Line voltage Connections		
P1	boiler pump	4-PE-5
P3	System heating pump	6-PE-7
DV	diverter valve (3-way-valve)	1-2-3-PE

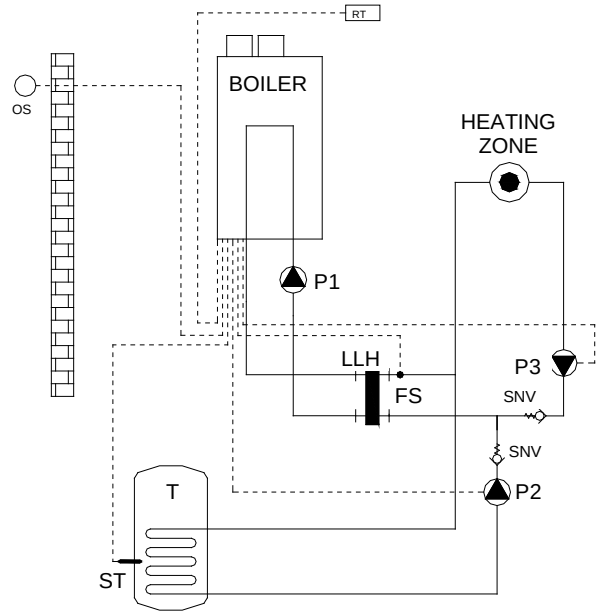
System Example 5



Low Voltage Connections		
	Name	**Wire terminal**
RT	Room thermostat	12-13
FS	System temperature sensor	3-4
OS	outdoor temperature sensor	1-2
ST	Tank thermostat or sensor	5-6
LLH	low loss header	
T	DHW indirect Tank	
SNV	non-return valve (low resistance type)	

Line voltage Connections		
P2	DHW indirect tank pump	2-3-PE
P1	boiler pump	4-PE-5
P3	System heating pump	6-PE-7

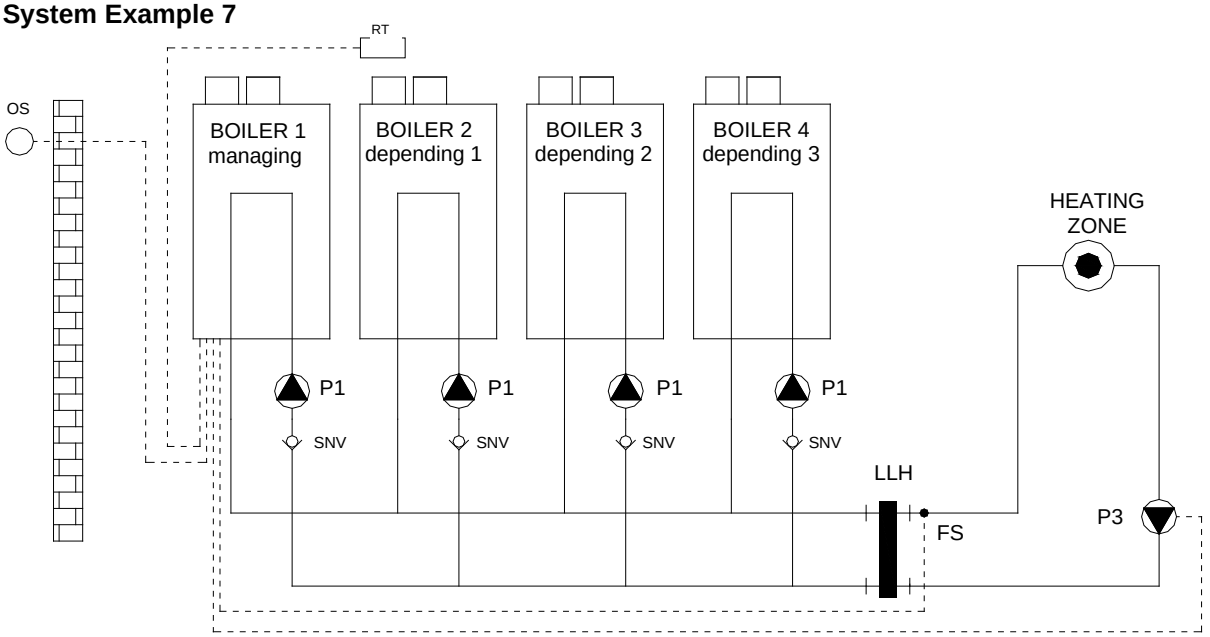
System Example 6



Low Voltage Connections		
	Name	**Wire terminal**
RT	Room thermostat	12-13
FS	System temperature sensor	3-4
OS	outdoor temperature sensor	1-2
ST	Tank thermostat or sensor	5-6
LLH	low loss header	
T	DHW indirect Tank	
SNV	non-return valve (low resistance type)	

Line voltage Connections		
P1	boiler pump	4-PE-5
P2	HWS primary pump	2-3-PE
P3	System heating pump	6-PE-7

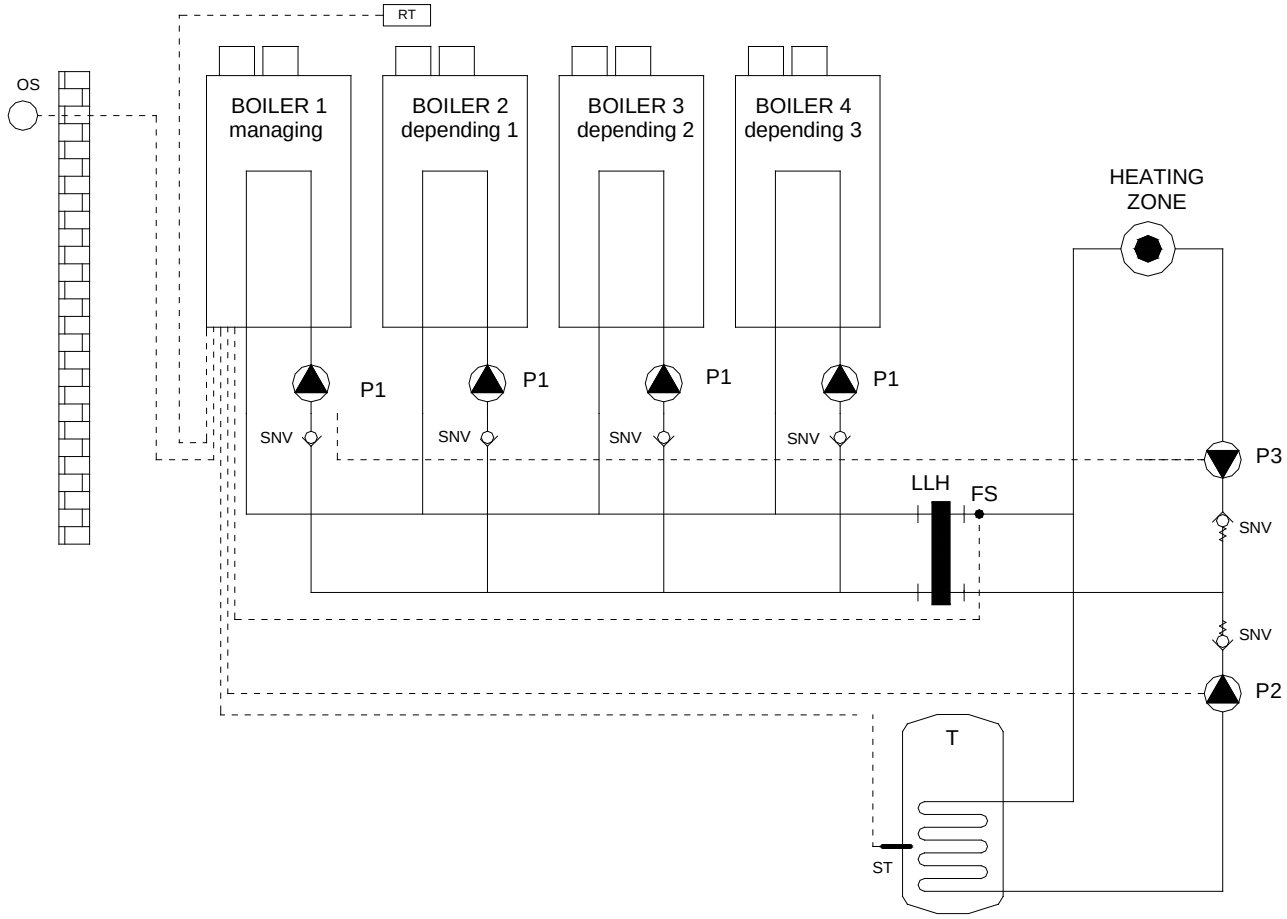
System Example 7



Low Voltage Connections		
	Name	**Wire terminal**
RT	Room thermostat	12-13
OS	outdoor temperature sensor	1-2
FS	System temperature sensor	3-4
SNV	non-return valve (low resistance type)	
LLH	low loss header	

Line voltage Connections		
P1	boiler pump	4-PE-5
P3	System heating pump	6-PE-7

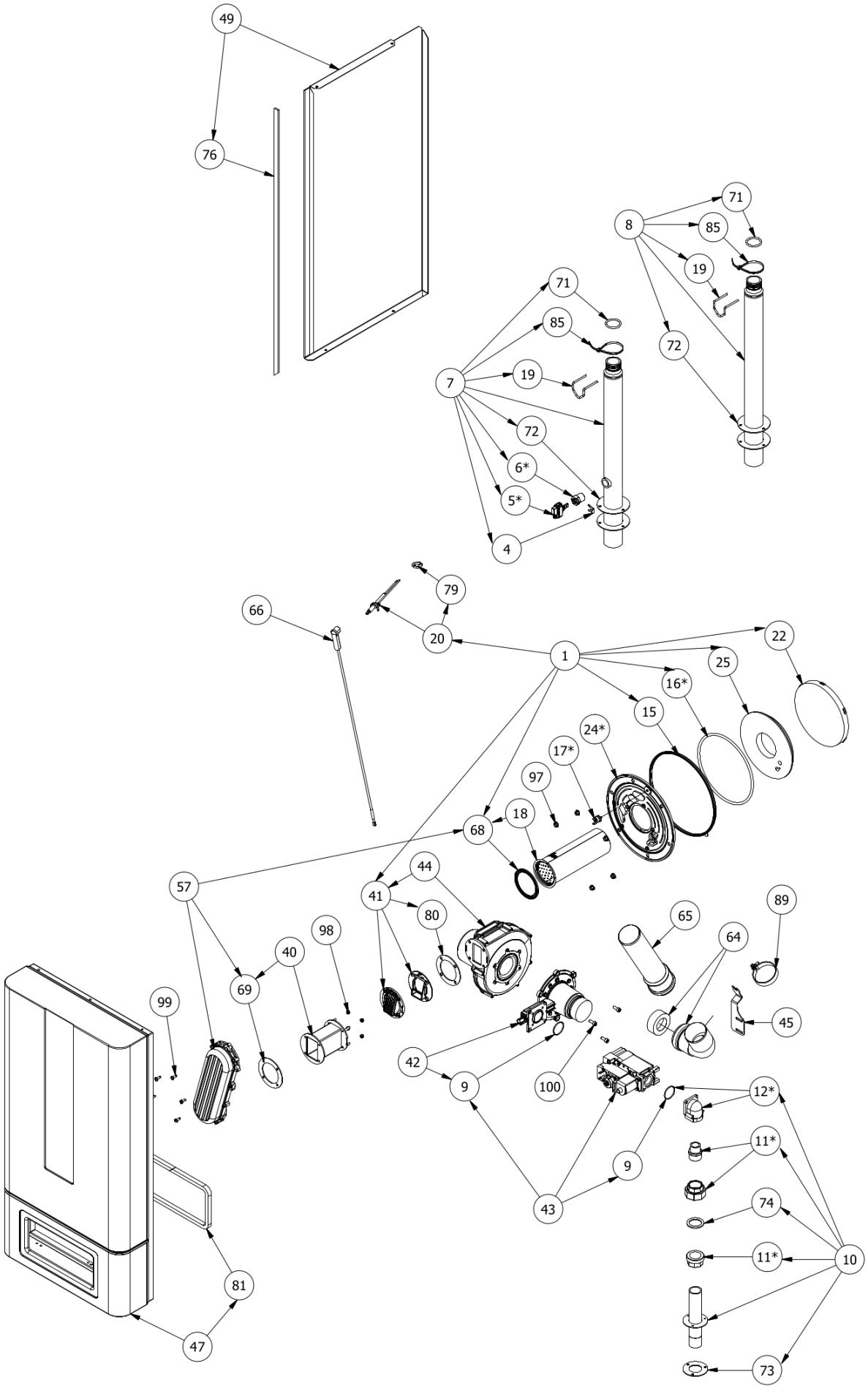
System Example 8

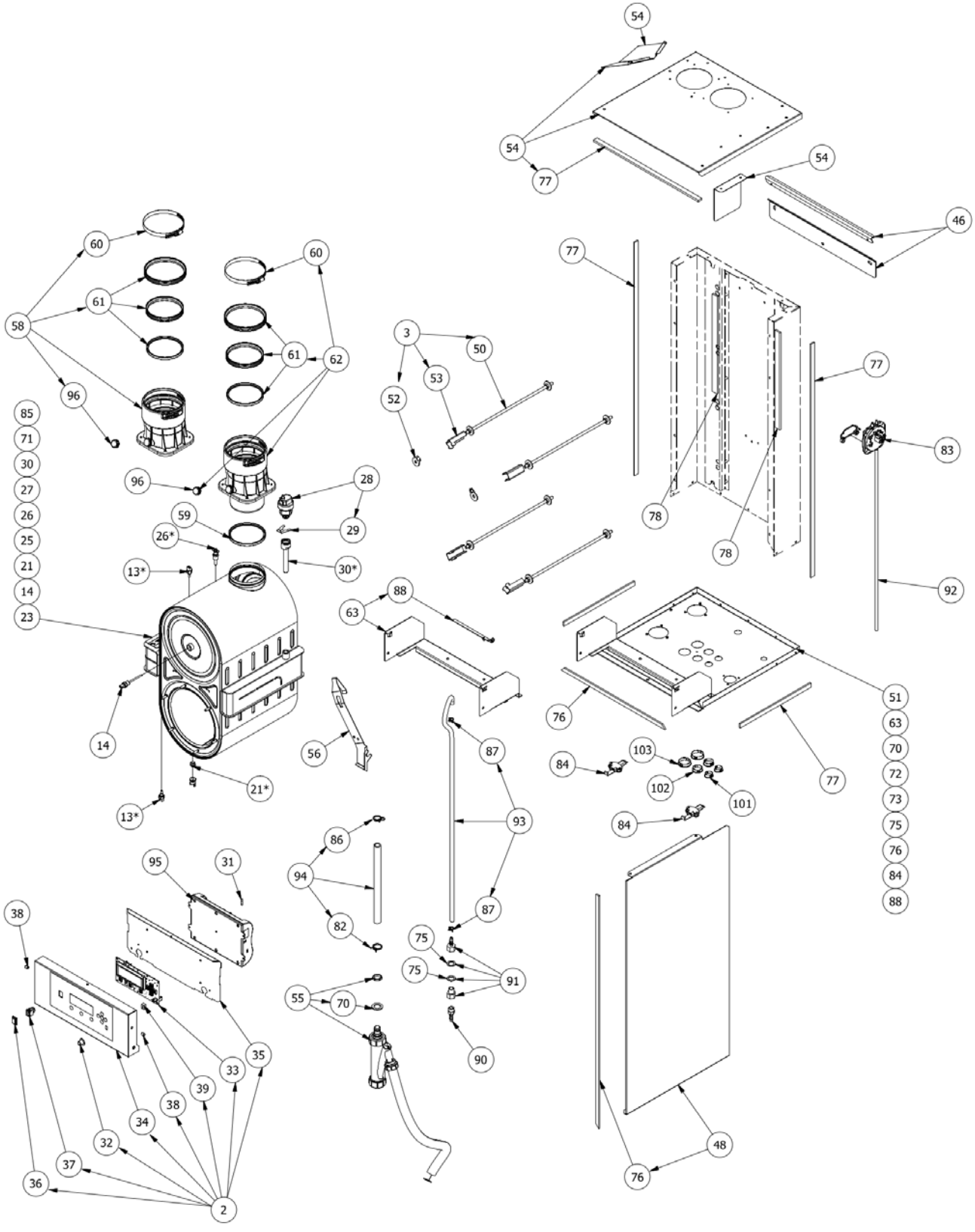


Low Voltage Connections		
	Name	**Wire terminal**
RT	Room thermostat	12-13
OS	outdoor temperature sensor	1-2
FS	System temperature sensor	3-4
ST	Tank thermostat or sensor	5-6
T	DHW indirect Tank	
SNV	non-return valve (low resistance type)	
LLH	low loss header	

Line voltage Connections		
P1	boiler pump	4-PE-5
P2	HWS primary pump	2-3-PE
P3	System heating pump	6-PE-7

22 SPARE PARTS.





Remarks:

All parts are supplied with glued/bonded parts, such as grounding lips, strips, isolation, stickers. Also bolts and nuts are supplied if necessary.

*= installation additions (see sparepart list)

67 → Wiring harness

POS.	DESCRIPTION	Part Number	RC-300	RC-400	RC-500
1	Set. Universal maintenance kit ***2)**	GS000.500.001	X	X	X
2	Set. Electronics holder	GS000.500.002	X	X	X
3	Set. Anchoring bar RC-300	GS000.500.008	X	NA	NA
3	Set. Anchoring bar RC-400	GS000.500.009	NA	X	NA
3	Set. Anchoring bar RC-500	GS000.500.010	NA	NA	X
4	Clip for WPS 10bar	GS001.500.003	X	X	X
5	Water pressure sensor 10bar	GS001.500.004	X	X	X
6	Nipple for RPS D15 ***1)**	GS001.500.005	X	X	X
7	Flow pipe RC-300, 400	GS001.500.001	X	X	NA
7	Flow pipe RC-500	GS001.500.002	NA	NA	X
8	Return pipe RC-300, 400	GS002.500.001	X	X	NA
8	Return pipe RC-500	GS002.500.002	NA	NA	X
9	O-ring gas valve connection	GS003.100.007	X	X	X
10	Gas pipe RC-300, 400	GS003.500.008	X	X	NA
10	Gas pipe RC-500	GS003.500.009	NA	NA	X
11	Union flat seat Rp1 x Rp1 (4408) ***1)**	GS003.500.010	X	X	X
12	Hooked gas valve VR4615 con. ***1)**	GS003.500.006	X	X	X
13	NTC sensor 1/8" SS ***1)**	GS004.100.018	X	X	X
14	NTC flue gas sensor ¼" 10 KOHM = R25 B=3977K t2	GS004.100.019	X	X	X
15	Seal Burner door	GS004.200.004	X	X	X
16	Insulation fiber braid burner door ***2)**	GS004.200.008	X	X	X
17	Burner door thermost. 260° C (M5) ***1)**	GS004.200.009	X	X	X
18	Burner RC-300	GS004.200.010	X	NA	NA
18	Burner RC-400	GS004.200.011	NA	X	NA
18	Burner RC-500	GS004.500.020	NA	NA	X
19	Spring fastconnection RC-300, 400	GS004.200.012	X	X	NA
19	Spring fastconnection RC-500	GS004.200.013	NA	NA	X
20	Electrode	GS004.500.002	X	X	X
21	Reducing coupling G¼ x M5 ***1)**	GS004.500.003	X	X	X
22	Backwall isolation 16mm	GS004.500.004	X	X	X
23	Heat exchanger RC-400 ***2)**	GS004.500.005	NA	X	NA
23	Heat exchanger RC-500 ***2)**	GS004.500.006	NA	NA	X
23	Heat exchanger RC-300 ***2)**	GS004.500.007	X	NA	NA
24	Burner door right sided ignition (metal sheet burner) ***2)**	GS004.500.013	X	X	X
25	Burner door isolation right sided ignition hole Ø70,5	GS004.500.014	X	X	X
26	Sensor LWCO ***1)**	GS004.500.015	X	X	X
27	Temperature switch 90° C	GS004.500.016	X	X	X
28	Automatic air vent with clip connection ***1)**	GS005.500.002	X	X	X
29	Locking clip air vent	GS005.500.003	X	X	X
30	Extension pipe air vent	GS005.500.004	X	X	X
31	Box 10pcs Fuse 5 AT	GS006.200.001	X	X	X
32	Rubber plug Ø13	GS006.200.004	X	X	X
33	Pixel Button Display	GS006.500.001	X	X	X
34	Display front panel	GS006.500.002	X	X	X
35	Mounting plate burner control	GS006.500.003	X	X	X

***1) Install with GS022.000.001**
***2) Install with GS022.000.002**

POS.	DESCRIPTION	Part Number	RC-300	RC-400	RC-500
36	Dustcover ON/OFF switch	GS006.500.004	X	X	X
37	Main switch	GS006.500.005	X	X	X
38	Spring plunger 8mm	GS006.500.006	X	X	X
39	EPDM sealing for EBM 957	GS006.500.007	X	X	X
40	Offset piece RC-400	GS008.500.006	NA	X	NA
40	Offset piece RC-500	GS008.500.007	NA	NA	X
40	Offset piece RC-300	GS008.500.010	X	NA	NA
41	Check valve + seat	GS008.500.002	X	X	X
42	Venturi RC-300	GS008.500.004	X	NA	NA
42	Venturi RC-400	GS008.500.008	NA	X	NA
42	Venturi RC-500	GS008.500.009	NA	NA	X
43	Modulating gas valve VR4615 (120VAC)	GS008.500.005	X	X	X
44	Radial Blower RG148/300W (120VAC)	GS008.500.024	X	X	X
45	Mounting plate silencer	GS008.500.019	X	X	X
46	Wall mounting plate	GS009.100.001	X	X	X
47	Frontpanel	GS010.500.001	X	X	X
48	Side panel right	GS011.500.001	X	X	X
49	Side panel left	GS011.500.002	X	X	X
50	Anchoring bar RC-400	GS011.500.003	NA	X	NA
50	Anchoring bar RC-300	GS011.500.004	X	NA	NA
50	Anchoring bar RC-500	GS011.500.005	NA	NA	X
51	Bottom panel RC-500	GS011.500.018	NA	NA	X
51	Bottom panel RC-300, 400	GS011.500.019	X	X	NA
52	Special washer heat exchanger	GS011.500.013	X	X	X
53	Clamping bracket heat exchanger	SG011.500.014	X	X	X
54	Top panel RC-300, 400	GS011.500.015	X	X	NA
54	Top panel RC-500	GS011.500.016	NA	NA	X
55	Condensate drain assembly l=800	GS012.200.002	X	X	X
56	Backwall clixon	GS013.100.002	X	X	X
57	Gas-air mixing pipe	GS014.500.001	X	X	X
58	Boiler air connector RC-300, 400	GS015.500.001	X	X	NA
58	Boiler air connector RC-500	GS015.500.002	NA	NA	X
59	Seal EPDM RC-300, 400	GS016.100.011	X	X	NA
59	Seal EPDM RC-500	GS016.500.003	NA	NA	X
60	Clamp galvanised RC-300, 400	GS016.500.008	X	X	NA
60	Clamp galvanised RC-500	GS016.500.009	NA	NA	X
61	Set. Seal EPDM Adapter RC-300 400	GS016.500.010	X	X	NA
61	Set. Seal EPDM Adapter RC-500	GS016.500.011	NA	NA	X
62	Boiler flue gas connector RC-300, 400	GS016.500.012	X	X	NA
62	Boiler flue gas connector RC-500	GS016.500.014	NA	NA	X
63	Connection bar display holder	GS021.500.001	X	X	X
64	Elbow silencer RC-500	GS024.500.001	NA	NA	X
64	Elbow silencer RC-300	GS024.500.002	X	NA	NA
64	Elbow silencer RC-400	GS024.500.003	NA	X	NA
65	Extension pipe silencer	GS024.500.004	X	X	X
66	Ignition cable	GS031.200.001	X	X	X
67	Harness HV/LV	GS031.500.001	X	X	X
68	Gasket Burner & gas/air inlet pipe	GS032.200.001	X	X	X
69	Gasket gas/air inlet pipe & fan	GS032.200.002	X	X	X
70	Gasket siphon/bottom plate	GS032.200.003	X	X	X
71	O-ring flow/return pipe RC-500	GS032.200.005	NA	NA	X
71	O-ring flow/return pipe RC-300, 400	GS032.200.007	X	X	NA

POS.	DESCRIPTION	Part Number	RC-300	RC-400	RC-500
72	Gasket flow/return pipe 1½"	GS032.500.001	X	X	X
73	Gasket gas pipe	GS032.500.002	X	X	X
74	Gasket malleable coupling 12+6	GS032.500.018	X	X	X
75	Gasket Condensate drain/bottom plate	GS032.500.006	X	X	X
76	Silicone seal 13x5 self adhesive L=10m	GS032.500.008	X	X	X
77	EPDM seal 15x6 self adhesive L=5m	GS032.500.009	X	X	X
78	EPDM seal 20x5 self adhesive L=5m	GS032.500.010	X	X	X
79	Gasket electrode	GS032.500.011	X	X	X
80	Gasket gas/air mixing	GS032.500.012	X	X	X
81	EPDM seal 10x12 self adhesive L=5m	GS032.500.013	X	X	X
82	Hose clamp Ø23,83 (DW15)	GS033.500.001	X	X	X
83	Air pressure switch DL 2 ET with S-clip (US)	GS011.500.007	X	X	X
84	Quick-action clamp	GS033.500.003	X	X	X
85	Ty-Rap Hitte bestendig 3,5x200 mm	GS033.500.006	X	X	X
86	Hose clamp Ø20,62 (DW13)	GS033.500.007	X	X	X
87	Hose clamp Ø11,6-12,3	GS033.500.008	X	X	X
88	Cable tie with rivet	GS033.500.009	X	X	X
89	PVC bracket Ø60	GS033.500.010	X	X	X
90	NPT Male Connector 3/8	GS033.500.012	X	X	X
91	NPT Female Connector 3/8	GS033.500.013	X	X	X
92	Hose pressure switch	GS034.500.001	X	X	X
93	Hose air vent	GS034.500.002	X	X	X
94	Hose condensate trap RC-300, 400	GS034.500.003	X	X	NA
94	Hose condensate trap RC-500	GS034.500.004	NA	NA	X
95	Burner control RC-300, 400, 500	GS165020	X	X	X
96	Measuring Cap M20x2 Ral-9011	GS016.500.002	X	X	X
97	10x Flanging head nut M6	GS004.200.005	X	X	X
98	4x Nut M5 DIN985	GS008.500.003	X	X	X
99	5x Screw M5x14 DIN7500C	GS014.500.003	X	X	X
100	3x Screw M6x16 DIN912 (Venturi)	GS008.500.021	X	X	X
101	Knock Out Seal ½" nylon	GS011.600.004	X	X	X
102	Knock Out Seal ¾" nylon	GS011.600.005	X	X	X
103	Knock Out Seal 1" nylon	GS011.600.006	X	X	X

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