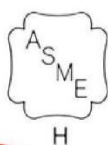


Installation & Service Manual



Low NOx certified to SCAQMD 1146.2



IONIC

WCB

CB 299W-399W-470W-500W

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

- Customer must register unit within thirty (30) days of installation in order to gain warranty coverage. See Warranty Card

- When receiving the Ionic unit, any claims for damage or shortage in shipment must be filed immediately against the transportation company by the consignee.

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

— Do not store or use gasoline or other flammable vapours and liquids 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 neighbour'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.

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.



NOTICE

Customer must register unit within thirty (30) days of installation in order to gain warranty coverage. See Warranty Card for details

Leave all documentation received with appliance with the owner for future reference.



WARNING

WARNING: To maintain the safety & longevity of your appliance, read and follow the maintenance schedule information throughout this manual.

If the information in this manual is not followed exactly, a fire or explosion may result causing substantial property damage, serious injury, or death.

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1 IMPORTANT WARNINGS

1.1 Definitions

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.

1.2 General warnings



WARNING

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



WARNING

Avoid electrical shock when servicing the appliance, by disconnecting the electrical supply prior to performing maintenance. Failure to comply with these instructions will result in substantial property damage, serious injury, or death.



WARNING

Failure to comply with these instructions will result in substantial property damage, serious injury, or death.



WARNING

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.



WARNING

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.



WARNING

Prior to installing this product, the qualified installer must read all instructions included in this manual and all accompanying manuals/ documents with this appliance.

All installation steps required in these manuals must be performed in the proper order given.



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

2 SAFETY GUIDELINES



2.1 English version

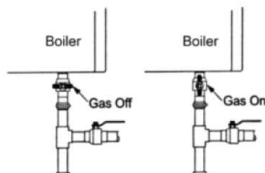
FOR YOUR SAFETY READ BEFORE OPERATING

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


- A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
- B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.
- WHAT TO DO IF YOU SMELL GAS
- Do not try to light any appliance.
 - Do not touch any electric switch; do not use any phone in your building.
 - Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.
- C. Use only your hand to turn the manual shutoff valve. Never use tools. If the manual valve will not turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion
- D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

OPERATING INSTRUCTIONS

1. STOP! Read the safety information above on this label.
2. Set the thermostat to the lowest setting
3. Turn off all electric power to the appliance
4. 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.
5. The manual gas shut off is located beneath the appliance cabinet, in the gas piping.
6. The manual gas shutoff valve is located beneath the appliance cabinet; turn the handle clockwise  to the full OFF position (perpendicular to the gas piping).
7. Wait five (5) minutes to clear out any gas. Then smell for gas including near the floor. If you 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 counterclockwise  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. Set the thermostat to the lowest setting.
2. Turn off all electric power to the appliance if service is to be performed.
3. The manual gas shutoff valve is located beneath the appliance cabinet; turn the handle clockwise  to the full OFF position (perpendicular to the gas piping).

2.2 Version français

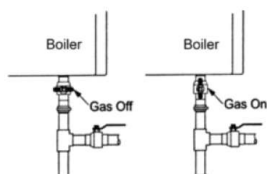
POUR VOTRE SÉCURITÉ LISEZ AVANT DE METTRE EN MARCHÉ

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. N'utilisez que votre main pour tourner la vanne d'arrêt manuelle. N'utilisez jamais d'outils. Si la vanne manuelle ne tourne pas à la main, n'essayez pas de la réparer, appelez un technicien sevice qualifié. La force ou la tentative de réparation peut entraîner un incendie ou une explosion.
- 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 MARCHÉ

1. ARRÊTEZ! Lisez les instructions de sécurité sur la portion supérieure (à gauche) de cette étiquette.
2. **Réglez le thermostat à la température la plus basse**
3. **Coupez l'alimentation électrique de l'appareil**
4. Cette appareil 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 ↻ dans le sens antihoraire 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.

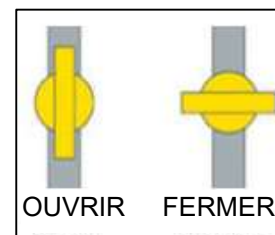
1. **Réglez le thermostat à la température la plus basse**
2. **Coupez l'alimentation électrique de l'appareil s'il faut procéder à l'entretien**
3. L'interrupteur de gaz principal se trouve directement sous la chaudière. Tournez l'interrupteur de gaz principal ↻ dans le sens horaire pour couper l'alimentation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

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 cancérigènes ou pouvant l'être).

Comment couper l'admission de gaz de L'appareil:

1. Réglez le thermostat à la température la plus basse.
2. Coupez l'alimentation électrique de l'appareil s'il faut procéder à l'entretien
3. Le robinet d'arrêt de gaz est situé dessous la chaudière dans la conduite de gaz.
4. Tourner le robinet sens horaire à "OFF"  (fermé) pour arrêter l'alimentation en gaz. Ne pas forcer.



En cas de surchauffe ou si l'admission de gaz ne peut être coupée, ne pas couper ni débrancher l'alimentation électrique de la pompe. Fermer plutôt le robinet d'admission de gaz à l'extérieur de l'appareil.

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. »

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, l'entretien doit être fait pour assurer un fonctionnement sûr et efficace.**
- Les dommages causés par le manque d'entretien ne seront pas couverts par la garantie**

Retrait d'une chaudière existante.

« Au moment du retrait d'une chaudière existante, les mesures suivantes doivent être prises pour chaque appareil toujours raccordé au système d'évacuation commun et qui fonctionne alors que d'autres appareils toujours raccordés au système d'évacuation ne fonctionnent pas :»

« Sceller toutes les ouvertures non utilisées du système d'évacuation. »








« 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.

« Dans la mesure du possible, fermer toutes les portes et les fenêtres du bâtiment et toutes les portes entre l'espace où les appareils toujours raccordés au système d'évacuation sont installés et les autres espaces du bâtiment. Mettre en marche les sècheuses, tous les appareils non raccordés au système d'évacuation commun et tous les ventilateurs d'extraction comme les hottes de cuisinière et les ventilateurs des salles de bain. S'assurer que ces ventilateurs fonctionnent à la vitesse maximale. Ne pas faire fonctionner les ventilateurs d'été. Fermer les registres des cheminées. » « Mettre l'appareil inspecté en marche. Suivre les instructions d'allumage. Régler le thermostat de façon que l'appareil fonctionne de façon continue. »


« Une fois qu'il a été déterminé, selon la méthode indiquée ci-dessus, que chaque appareil raccordé au système d'évacuation est mis à l'air libre de façon adéquate. Remettre les portes et les fenêtres, les ventilateurs, les registres de cheminées et les appareils au gaz à leur position originale.

« Tout mauvais fonctionnement du système d'évacuation commun devrait être corrigé de façon que l'installation soit conforme au National Fuel Gas Code, ANSI Z223.1/NFPA 54 et (où) aux codes d'installation CAN/CSA-B149.1. Si la grosseur d'une section du système d'évacuation doit être modifiée, le système devrait être modifié pour respecter les valeurs minimales des tableaux pertinents de l'appendice F du National Fuel Gas Code, ANSI Z223.1 / NFPA 54 et (où) les codes d'installation CAN/CSA-B149.1. »

2.3 Specific warnings

 CAUTION	<p>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 shall be made to put the boiler back into operation. A qualified service technician must 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.</p>
 DANGER	<p>“Should overheating occur or the gas supply fail to shut off, do not turn off or disconnect the electrical supply to the circulator. Instead, shut off the gas supply at a location external to the appliance.”</p>
 NOTICE	<p>The installer must verify that all the carbon monoxide detectors with alarms have been installed within residential living spaces or the home following the alarm manufacturer’s instructions and applicable local codes before putting the appliance into operation.</p> <p>Triangle Tube requires the installation of a minimum of two (2) carbon monoxide detectors with an alarm and battery back-up if hard wired; one in the mechanical room where the boiler is located and another installed in the area outside each sleeping area for all installations.</p> <p>For systems using common venting an additional carbon monoxide detector must be wired into the safety controls of the boiler see <i>the Ionic Common Vent Installation and Operations Manual</i> for additional information.</p> <p>Consult the local authority having jurisdiction for any additional carbon monoxide detector requirements in your area.</p> <p>See <i>Section 2.4 on page 14</i> for additional carbon monoxide detector requirements in Massachusetts.</p>
 WARNING	 Avertissement
<p>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)</p>	<p>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 cancérigènes ou pouvant l'être).</p>
 WARNING	<p>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.</p>
 WARNING	<p>WARNING: Crystalline Silica - Certain components in the combustion chamber can 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 20 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).</p>

To meet commercial hot water requirements, the tank setpoint is adjustable up to 185°F. However, water temperatures over 125°F can cause severe burns instantly or death from scalds. This is the preferred starting point for setting the control for supplying general purpose hot water.


 WARNING	<p>WARNING: Water temperatures over 125 °F (52 °C) can cause severe burns instantly or death from scalding. The tank temperature is factory set at 140 °F (60 °C) to minimize legionella risk. Before bathing or showering always check the water temperature.</p>
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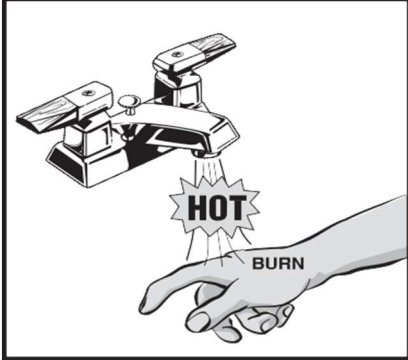
To avoid any potential scald hazard or if codes require specific water temperatures at the hot water faucet, the installer must:

- Install a thermostatic mixing valve at this appliance and ensure it is working properly AND
- Set the domestic hot water temperature to the lowest temperature which satisfies your hot water needs.
- Feel and adjust water temperature before bathing or showering.
- Water drained from the system drain valves may be extremely hot.

TO AVOID INJURY

- Make sure all connections are tight.
- Direct water flow away from any person.
- Failure to comply with these instructions will result in substantial property damage, serious injury, or death.


DANGER



Water temperature over 125°F can cause instant severe burns or death from scalds.

Children, disabled, and elderly are at highest risk of being scalded.

- Never leave them unattended in or near shower, bathtub or sink
- Never allow small children to use a hot water faucet or draw their own bath


Temperature	Time to Produce Serious Burn
120°F	More than 5 minutes
125°F	1-1/2 to 2 minutes
130°F	About 30 seconds
135°F	About 10 seconds
140°F	Less than 5 seconds
145°F	Less than 3 seconds
150°F	About 1-1/2 seconds


Table courtesy of Shriners Burn Institute.

Maximum water temperatures occur just after burner has shut off. To find hot water temperature being delivered, turn on a hot water faucet and place a thermometer in the hot water stream and read the thermometer.

Time/Temperature Relationships in Scalds

The temperature of the water in the storage tank can be regulated by setting the temperature at the boiler. To comply with safety regulations, the setpoint was set at its lowest setting before shipment from the factory.

 CAUTION	<p>Hotter water increases the risk of SCALDING!</p>
---	---

 NOTICE	<p>When this boiler is supplying general purpose hot water for use by individuals, a thermostatically controlled mixing valve for reducing point of use water temperature is recommended to reduce the risk of scald injury. Contact a licensed plumber or the local plumbing authority for further information.</p>
--	--

2.4 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 (2018 Edition) and NFPA 72.
- 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 (2018 Edition) and NFPA 72
 - 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.
- 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 (2018 Edition) and NFPA 72.
- 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 (2018 Edition) and NFPA 72.
- 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.

For installations in Massachusetts, code requires the boiler to be installed by a licensed plumber or gas fitter, and if antifreeze (glycol) is utilized, the installation of a reduced pressure back-flow preventer device is required in the boiler's cold water fill or make up water supply line.

3 INTRODUCTION

This manual is written for the installer and service technician.

Triangle Tube accepts no liability for any damage, injury, or loss of life resulting from incorrect installation, alteration of any factory supplied parts, or the use of parts or fittings not specified by Triangle Tube. If there is a conflict or doubt about the proper installation of the unit or any factory supplied replacement parts, please contact Triangle Tube Technical Support.

Parts must only be replaced with genuine Triangle Tube parts. Do not attempt to carry out any modifications to the appliance without prior written consent from Triangle Tube.

Unauthorized modifications and the use of non-genuine replacement parts can result in minor property damage, injury, or death.

All documentation produced by the manufacturer is subject to copyright law.

This manual is subject to change without notice.

3.1 Explanations.

CB = 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)
299/399/470/500 = Model number of the boiler.

3.2 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.

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

Ce manuel est écrit pour l'installateur et le technicien d'entretien.

Triangle Tube décline toute responsabilité pour tout dommage, blessure ou perte de vie résultant d'une installation incorrecte, d'une modification de toute pièce fournie par l'usine ou de l'utilisation de pièces ou de raccords non spécifiés par Triangle Tube. En cas de conflit ou de doute quant à l'installation correcte de l'unité ou de toute pièce de rechange fournie par l'usine, veuillez contacter le support technique de Triangle Tube.

Les pièces ne doivent être remplacées que par des pièces d'origine Triangle Tube. Ne tentez pas d'apporter des modifications à l'appareil sans le consentement écrit préalable de Triangle Tube.

Les modifications non autorisées et l'utilisation de pièces de rechange non authentiques peuvent entraîner des dommages matériels mineurs, des blessures ou la mort.

Tout documentation produit par le fabricant est sous réserve de la loi sur le droit d'auteur.

Ce manuel est sujet à changement sans préavis.

Explications

CB = 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)
299/399/470/500 = Modèle numéro de chaudière.

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.

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

Make sure to reference the unit's model number and serial number from the rating label when inquiring about service or troubleshooting.

Triangle Tube reserves the right to change the technical characteristics, components and features of its products without prior notice. Check for an updated version of this manual at www.triangletube.com.

4 TECHNICAL DATA IONIC CB BOILERS

4.1 Functional introduction

The Ionic WCB 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 Ionic WCB boiler is factory set for Natural gas.

Fuel used must have Sulphur rates with a maximum annual peak over a short period of time of 110 ppm (150 mg/m³) and an annual average of 22 ppm. (30 mg/m³)

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
- External Ignition coil
- Alarm

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 circulator or diverter valve
- Boiler circulator
- PWM control for boiler circulator.
- System circulator
- External flow switch or external safety device.
- Modbus
- External system sensor
- DHW indirect sensor or aquastat.

4.2 Location of version numbers

Burner Controller Hardware Version

– To be found on the second line of the white sticker located at the side of the burner controller.

v.B = “Version B” for instance

Parameter Version

- To be found on the small sticker on the side of the burner controller.



Figure 4.1

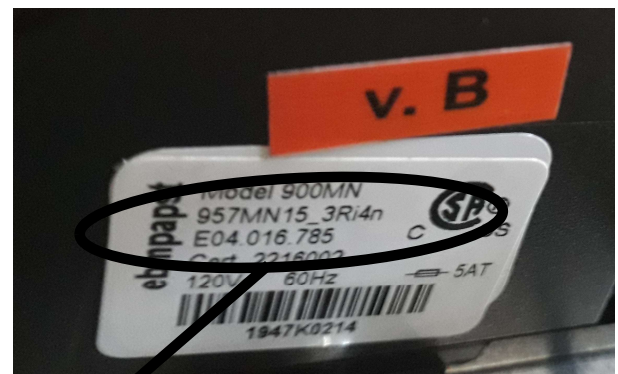



Figure 4.2

957MN15_3Ri4n e.g.

Burner Controller Software Versions

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

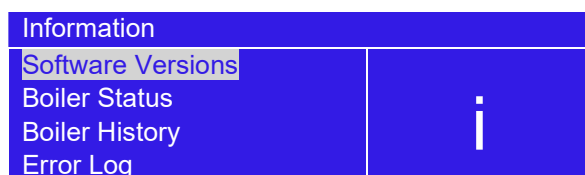


Figure 4.3

Software Versions	
Display	[A910 C219]
Boiler	[59AB 9672]
Device Group	900MN

Figure 4.4

4.3 Technical specifications datasheet

GENERAL						
Boiler category	-		IV, direct vent			
BOILER MODEL			CB 299W	CB 399W	CB 470W	CB 500W
Dimensions (h x w x d)	inch (mm)	33.3 x 17.4 x 21.1 (846 x 442 x 535)				
Water content	Gallon (liter)	1.77 (6.7)	2.19 (8.3)	2.74 (10.4)	2.74 (10.4)	
Weight (empty)	Lbs (kg)	174 (79)	183 (83)	187 (85)	187 (85)	
Flow/return connection	inch	NPT 1 ½"	NPT 1 ½"	NPT 1 ½"	NPT 1 ½"	
Gas connection	inch	NPT 1"	NPT 1"	NPT 1"	NPT 1"	
Flue connection	inch (mm)	4" (100)	4" (100)	6" (150)	6" (150)	
GAS CONSUMPTION						
Natural gas	ft ³ /h m ³ /h	42.8 - 278 1.2- 7.9	67.0 – 371 1.9 - 10.5	72.6 – 437 2.1 – 12.4	77.2 – 465 2.2 – 13.2	
Propane ¹	ft ³ /h m ³ /h	18.4 - 119 0.5 - 3.4	27.6 – 159 0.8 - 4.5	31.6 – 188 0.9 - 5.4	33.6 – 200 1.0 - 5.7	
Gas supply pressure nominal ²	Nat. gas	Inch W.C./ (mbar)	7.0 (17.4)			
	Propane	Inch W.C./ (mbar)	11.0 (27.4)			
EMISSION						
O ₂ flue gas ³ Low fire – High fire	Natural gas	%	4.7 – 4.7		5.3 – 5.3	4.7 – 4.7
	Propane	%	6.4 – 5.0			
CO ₂ flue gas ³ Low fire – High fire	Natural gas	%	9.2 – 9.2		8.8 – 8.8	9.2 – 9.2
	Propane	%	9.5 – 10.4			
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)	29 (8.8)	29 (8.8)
	ΔT = 35 F	ft.head (m.W.C.)	9 (2.7)	10 (3.0)	11 (3.3)	11 (3.3)
Pressure boiler min-max.	psi (bar)	15.0 - 87.0 (1.0 - 6.0)				
Max. supply temperature	°F (°C)	194 (90)				
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)			
³ O ₂ (or CO ₂) of the unit measured/set without the boiler front panel in place. The boiler should be setup utilizing O ₂ values, CO ₂ values are for reference.						
⁴ Maximum allowed combined resistance of flue gas and air supply piping at high fire						

Table 4.1

Model boiler		CB 299W	CB 399W	CB 470W	CB 500W
ELECTRIC					
Maximum power consumption ⁵	W	180	200	280	280
Power supply	V/Hz	120 / 60			
Protection class ⁶	-	IPX4D			
NOTES					
⁵ Power consumption is measured without circulation pump					
⁶ For gas appliances type B23(P) only class IPX4D with special air inlet (see § 6.2 "Accessories"), otherwise the protection class is IP20.					

Table 4.1

For all room air installations an air intake is required. One of the two options either figure 4.5 or 4.6 may be selected.

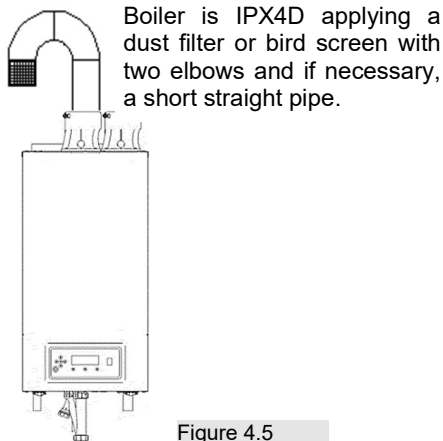


Figure 4.5

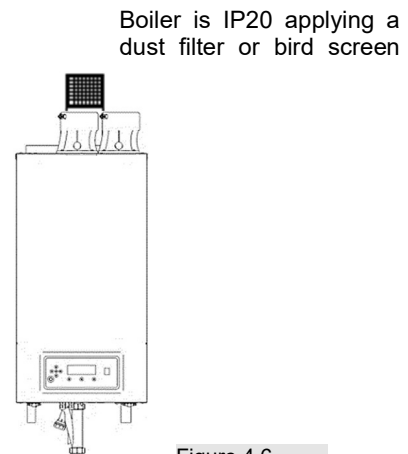


Figure 4.6

4.4 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 can result in property damage, serious injury, or death.

Table 4.2

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 de-rate 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 %

4.5 AHRI Specifications



DOE



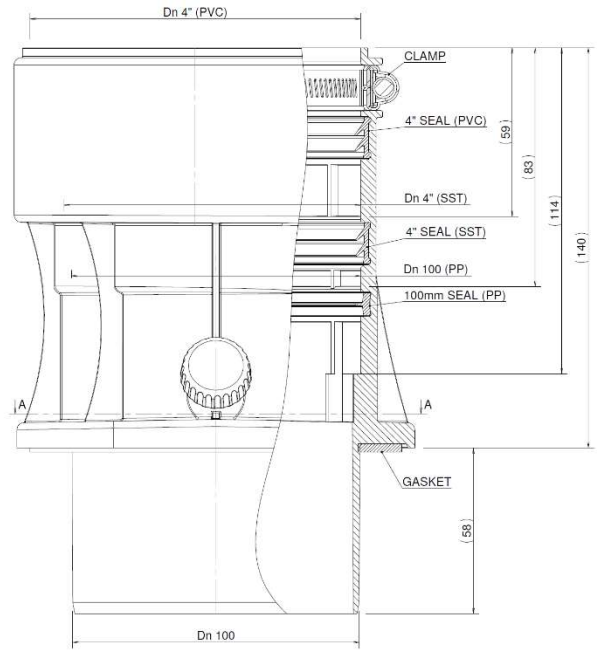
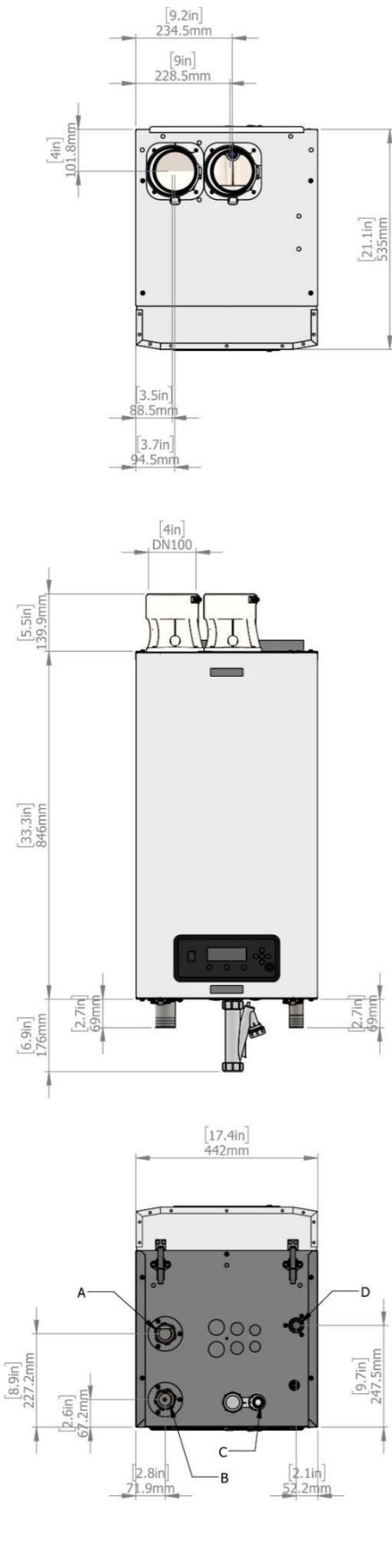
IONIC WCB series 							
Model number	Input, MBH ¹		Output ^{1,2} MBH	AHRI Net Ratings Water, MBH	AFUE %	Thermal Efficiency, %	Combustion Efficiency, %
	Min	Max					
CB 299W	46.0	299	284	238	95.1	NA	NA
CB 399W	72.0	399	381	331	NA	95.5	95.4
CB 470W	83.0	470	449	390	NA	95.6	95.1
CB 500W	83.0	500	476	414	NA	95.1	94.5

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 CB 299W, and 'Gross Output' for CB 399W, CB 470W and CB 500W
 3 Ratings have been confirmed by the Hydronics Section of AHRI.
 4 The ratings and efficiencies are based on standard test procedures and calculation methods as prescribed by the United States Department of Energy.
 5 Triangle Tube has determined that these firing rates meet the ENERGY STAR guidelines for energy efficiency

Table 4.4

5 BOILER DIMENSIONS

5.1 CB 299W



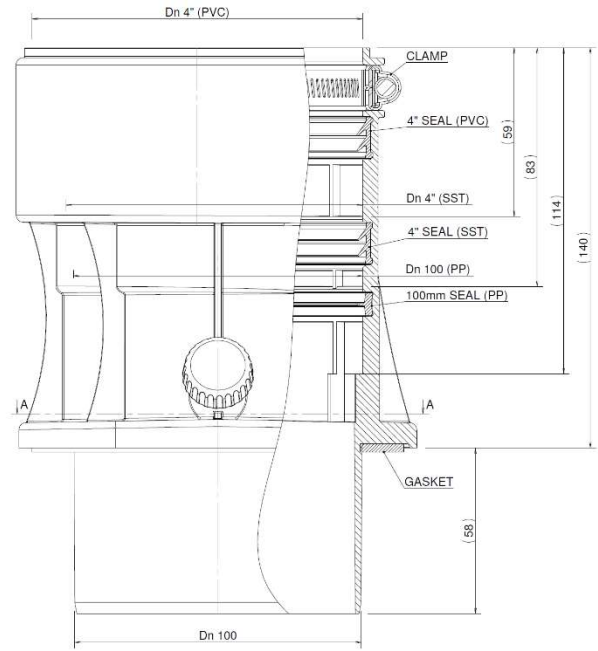
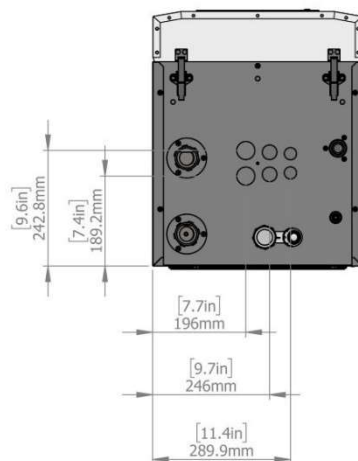
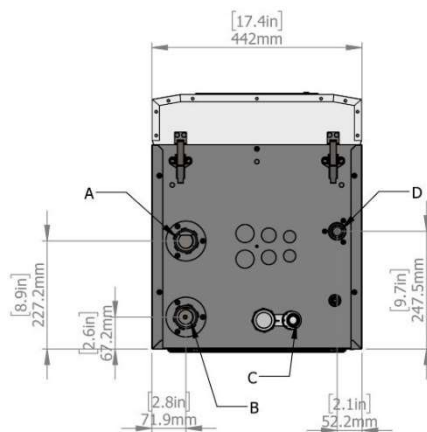
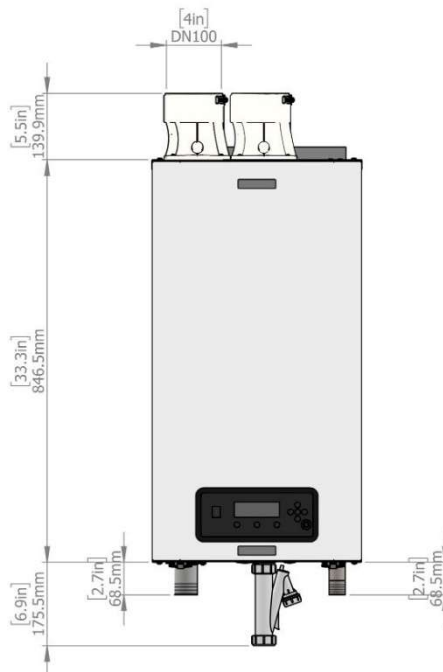
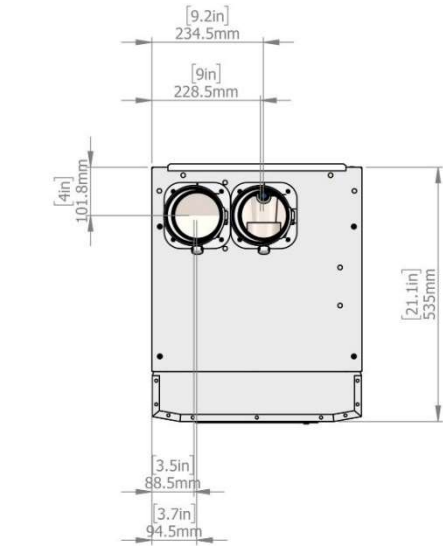
Vent connection

Connections	CB 299W
A Supply	NPT 1½"
B Return	NPT 1½"
C Condensate	Flexible hose Ø 1.06" (26.9 mm)
D Gas	NPT 1"

Table 5.1

Figure 5.1

5.2 CB 399W



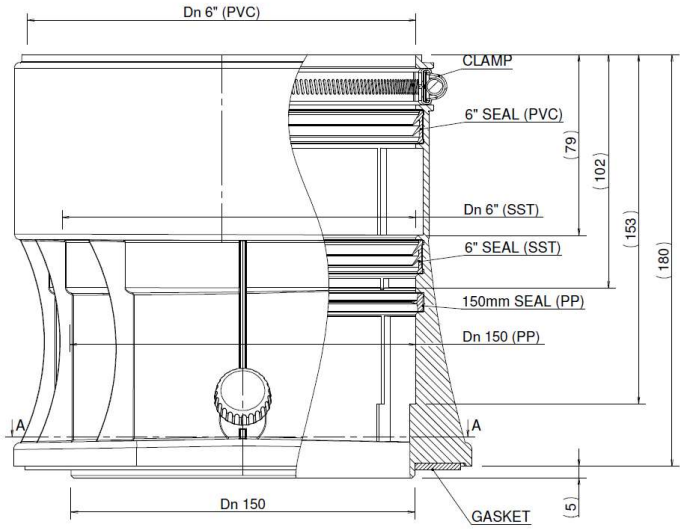
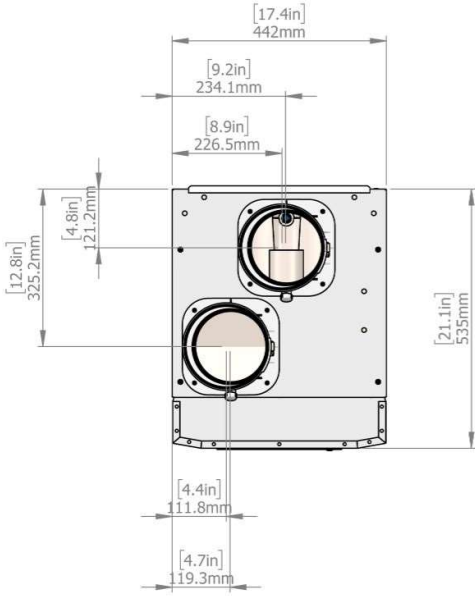
Vent connection

Connections		CB 399W
A	Supply	NPT 1½"
B	Return	NPT 1½"
C	Condensate	Flexible hose Ø 1.06" (26.9 mm)
D	Gas	NPT 1"

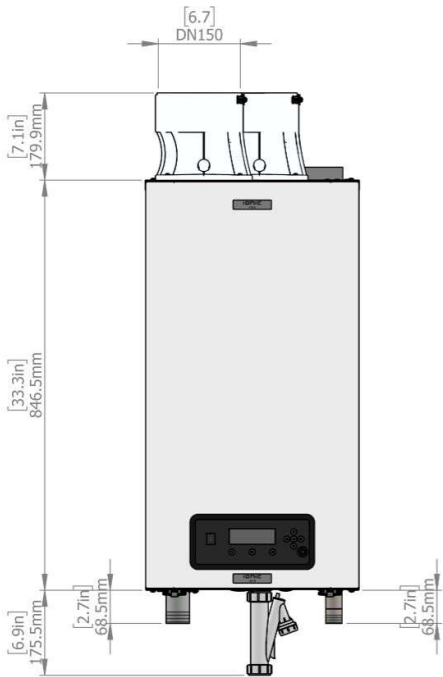
Table 5.2

Figure 5.2

5.3 CB 470W and CB 500W



Vent connection



Connections		CB 470W and CB 500W
A	Supply	NPT 1½"
B	Return	NPT 1½"
C	Condensate	Flexible hose Ø 1.06" (26.9 mm)
D	Gas	NPT 1"

Table 5.3

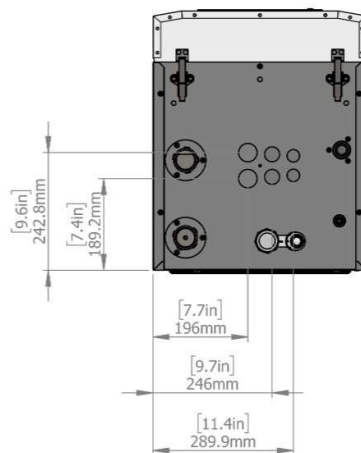
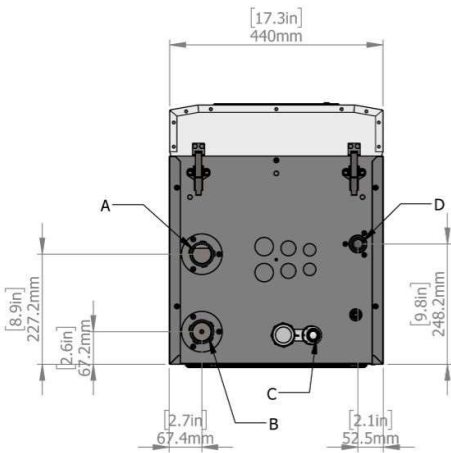


Figure 5.3

6 UNPACKING AND ACCESSORIES

6.1 Unpacking

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

- One "Installation, and service instructions" manual for the installer (inside the boiler, at the sidepanel)
- One User Manual (inside the boiler, at the sidepanel)
- One suspension bracket with locking plate and bolts (on the pallet)
- Spare fuse for the boiler controller (at the burner controller)
- Spare nuts for mounting the burner plate (in a small bag attached to the front of the heat exchanger)
- Bottom part of the condensate trap.
- Outdoor (air) temperature sensor: 10kOhm@25°C -B3977
- Pressure relief valve
- 1" Gas valve
- Tridicator (temperature and pressure gauge)

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.

6.2 Optional 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 N°.
Adhesive kit 04	E364000001
LOCTITE® SI 5366™ 50ml	E364000002
Set. Universal maintenance kit (requires item E364000002 purchased separately)	E153000001
External flow temperature sensor for the low loss header: 10kOhm@25°C - B3977	E361100001
NTC tank sensor (to be mounted in a dry well): 10kOhm@25°C - B3977	E361100002
Software + interface cable for programming the boiler with a computer/laptop	E362100001
Propane conversion kit for VMS Venturi hole Ø 6.2 CB 299W	E368000001
Propane conversion kit for VMS Venturi hole Ø 6.7 CB 399W	E368000002
Propane conversion kit for VMS Venturi hole Ø 7.2 CB 470W and CB 500W	E368000003
IPX4D Air Inlet Kit CB 299W and CB 399W	E369000001
IPX4D Air Inlet Kit CB 470W and CB 500W	E369000002
0-10V output kit PWM output for the boiler pump is available at the burner controller. When the boiler pump needs 0-10V control, this kit converts the PWM output into 0-10V output.	E361100003
Circulator Relay Kit When pumps are over 2 Amps, they cannot be connected directly to the burner controller. This relay set accomodates for 3 circulators until 15 Amps	E361100004
Circulator Relay Kit When pumps are over 2 Amps, they cannot be connected directly to the burner controller. This relay set accomodates for 2 circulators until 15 Amps	E361100005
Circulator Relay Kit When pumps are over 2 Amps, they cannot be connected directly to the burner controller. This relay set accomodates for 1 circulator until 15 Amps	E361100006
Low and High Gas pressure switch kit 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. The kit is factory supplied with the CB-470W and the CB-500W, but available for the other models	E158000005
Condensate neutralizer kit 0-400 MBH	E363100001
Condensate neutralizer kit 500-1000 MBH	E363100002
Condensate neutralizer 1,250-3,000MBH	E363100003
Condensate neutralizer 4,000-7,000MBH	E363100004

UL approved flowswitch	E361100008
24V manual reset LWCO with test function	E361100007
External manual reset high limit	E361100009
ASME CSD-1 kit: 3 parts together, E361100007, E361100008 and E361100009	E361000002
UPS 43-100 F (requires one of the following options: Circulator relay kit for 3 circulators E361100004, Circulator relay kit for 2 circulators E361100005, or Circulator relay kit for 1 circulator E361100006)	CIR01
MAGNA3 40-80 GF (Note: requires E361100003 Modulating circulator signal converter (PWM to 0-10V)) and one of the following options: Circulator relay kit for 3 circulators E361100004, Circulator relay kit for 2 circulators E361100005, or Circulator relay kit for 1 circulator E361100006)	CIR02
MAGNA1 40-120 GF (Note: requires one of the following options: Circulator relay kit for 3 circulators E361100004, Circulator relay kit for 2 circulators E361100005, or Circulator relay kit for 1 circulator E361100006)	CIR03
ALPHA1 26-99 (Note: requires one of the following options: Circulator relay kit for 3 circulators E361100004, Circulator relay kit for 2 circulators E361100005, or Circulator relay kit for 1 circulator E361100006)	CIR04
6mm NTC Storage tank sensor 10K @ 25°C B3977k@25°C/85°C, 3000MM Cable length	E361100010
4" Immersion Well with 1/2" NPT thread and M12 compression fitting	E361100011
Thermal paste for NTC sensor	E364000003
316 Stainless Steel Threaded Low-Pressure, Bushing Adapter, 3/4 Male x 1/2 Female	E365000001
85 psi relief valve 3/4"	E365100006
75 psi relief valve 3/4"	E365100001

Table 6.1

7 INSTALLATION LOCATION OF THE CB

7.1 Installation Clearances

On all sides of the boiler at least 2" of clearance must 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. CB 299W CB 399W CB 470W CB 500W	Clearances to wall, ceiling and floor				
	Distances – inches				
	A: Front	B: Top	C: Sides	D: Back	E: Bottom
Minimum service Clearances	6	14	2	0	10
Recommended Service clearances	25	14	20	0	30
Clearances from combustible materials <ol style="list-style-type: none"> Hot water pipes—at least 1/4" (6 mm) from combustible materials. Vent pipe – at least 1" (25 mm) from combustible materials. 					

Table 7.1

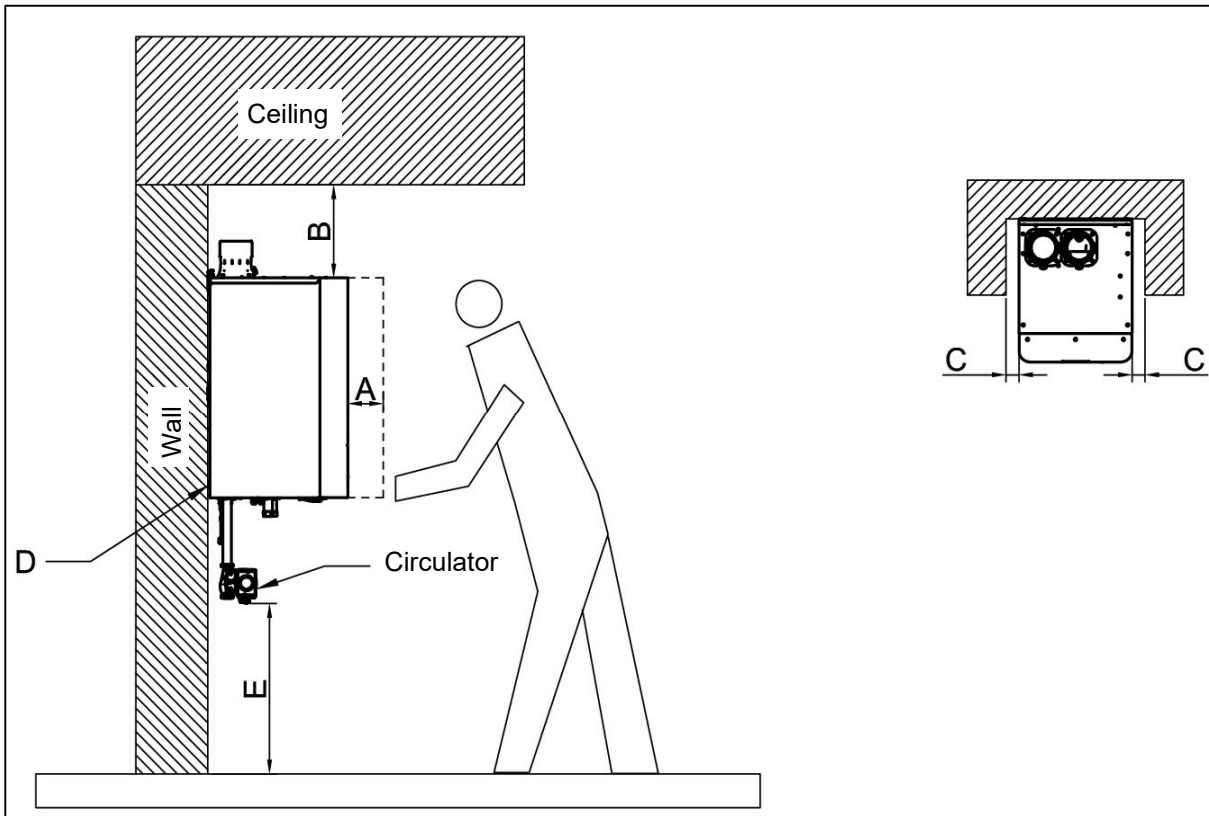


Figure 7.1

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 circulator apply a circuit breaker between 6 and 12 amps.

 NOTICE	<p>The installation of the Triangle Tube gas appliance must conform to the requirements of this manual, your local authority and the latest edition of ANSI Z223.1/NFPA 54 and/or the CAN/CSA B149.1 Natural gas and propane installation code. Where required by the authority having jurisdiction, the installation must conform to the standard for Controls and Safety Devices for Automatically Fired Boilers ASME CSD-1</p>
	<p>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.</p>

 CAUTION	<p>The boiler must NOT be installed on or near carpeting.</p>
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7.2 Boiler Installation Location Requirements:

- The installation of this boiler when installed using room air must comply to the latest edition of ANSI Z223.1/NFPA 54 and/or the CAN/CSA B149.1 Natural gas and propane installation code.
- The flue gas exhaust 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 must 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 an external low water cut off above the boiler, when the boiler is installed above the system or at the highest point in the installation. An external low water cutoff would be wired to the boiler on the low voltage wiring terminals 22 and 23. The boiler is equipped with a factory installed probe type low water cutoff internally in the boiler.
- 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 must 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 section 10.7.1 tables 10.16 and 10.17
- When considering installation locations consideration must be given to the combustion air supply whether using room 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 section 10.7.1 tables 10.16 and 10.17

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 was trained for this type of boiler.

In the Commonwealth of Massachusetts this boiler must be installed by a licensed Plumber or Gas Fitter.

7.3 Required tools

Required tools for installation, commissioning, and service

- Controls flat head screwdriver
- Open end 55mm wrench or adjustable pipe wrench
- Open end 13mm wrench
- Open end 10mm wrench
- Open end 8mm wrench
- 5mm hex
- 4mm hex
- torque wrench with 1-10Nm range
- #2 Phillips screw driver
- Torx T40 screw driver
- Combustion analyzer
- Digital manometer: capable of measuring differential pressure
- water quality test kit

7.4 Mounting the boiler

Before mounting and installing the boiler the following connections must 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 a power connection positioned above the boiler)
- Gas pipe sizing.
- Automatic Air Vent Connection.



NOTICE

All lines/piping must be mounted free of tension. The weight of the installation components must 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 7.2 below). When the leveling bolts aren't sufficient, fill the gap behind the bolts to get the boiler in position.

The boiler must be angled when mounted on the wall or rack system to lean slightly backwards with an angle of minimum 0.5° to a maximum of 1.5°. This ensures the condensate drains towards the back of the heat exchanger and does not flow towards the refractory insulation on the burner door.

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.

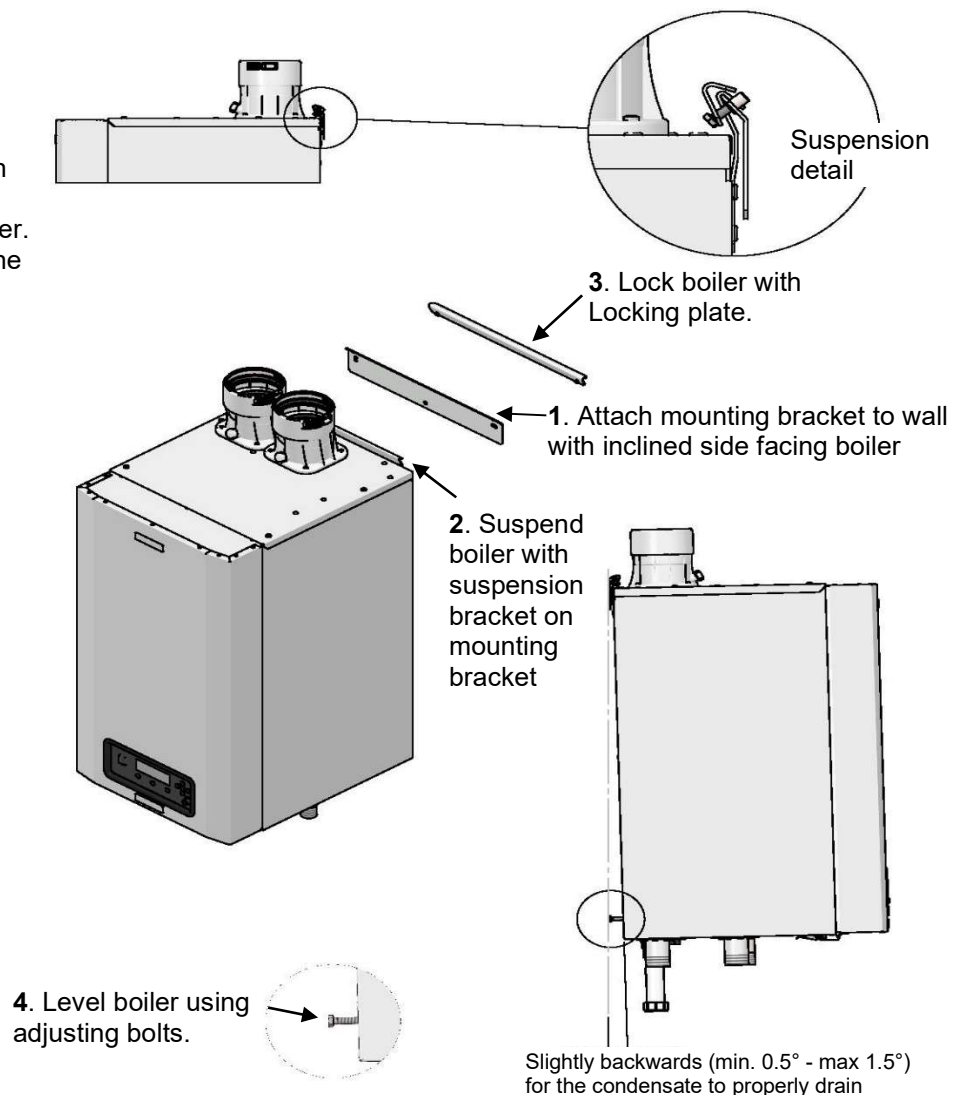


Figure 7.2

8 CONNECTIONS

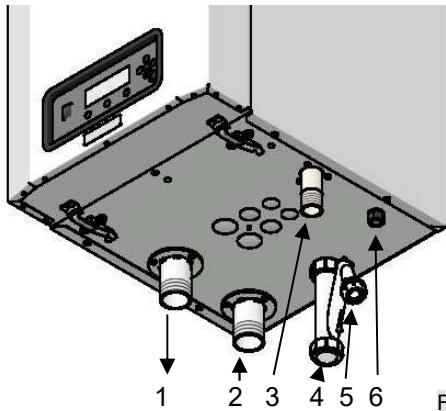


Figure 8.1

8.1 Boiler connections

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

8.2 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 the latest edition of CAN/CSA B149.1 Natural gas and propane installation code, and all 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 building. See table 8.1 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

Table 8.1

8.2.1 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" w.c. as stated in the ANSI Z223.1/NFPA54 or the CAN/CSA B149.1. If you experience a pressure drop of greater than 1" w.c., the regulator or gas line is undersized.

Triangle Tube 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 propane gas, to be available at the boiler gas valve inlet at maximum boiler firing rate. See the 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 at a minimum of 6 ft from the boiler. For Natural Gas install a 100% lockup gas pressure regulator in the gas supply line if inlet pressure can exceed 10.5" W.C. at any time. Adjust the lockup pressure regulator for 10.5" W.C. maximum gas pressure.

For Propane Gas contact the gas supplier to size pipes, tanks, and a 100% lockup gas pressure regulator. The propane gas pressure in the gas supply line cannot exceed 13" W.C. at any time. Adjust the lockup pressure regulator for 10.5" W.C. maximum pressure. The installation of the gas pressure regulator must follow all applicable local and national standards.

Triangle Tube 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. Make sure the gas pressure is within specification during all conditions. Size all gas lines according to ANSI Z223.1 /NFPR 54

Always use a pipe-threading compound, approved for natural gas and/or propane gas. 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

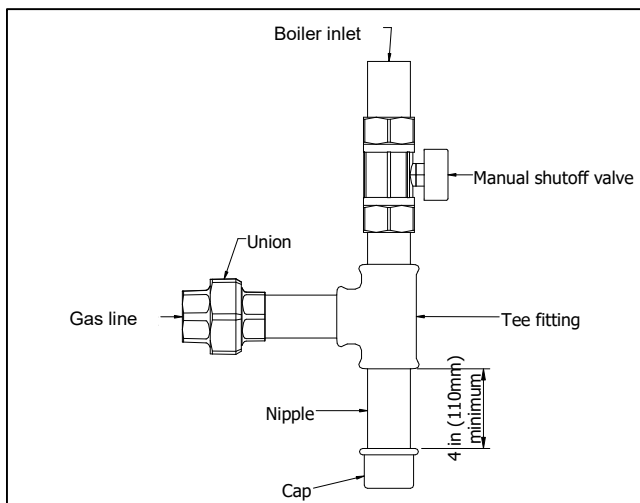


Figure 8.2

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 the appliance into operation for the 1st time;

A sediment trap (drip leg) must be installed directly below the boiler as pictured in Figure 8.2. It must be at least 3 in. long to conform to the National Fuel Gas Code (NFPA 54/ ANSI Z223.1 for U.S. installs and CAN/CSA B149.1 for Canada). This leg is to be installed upstream of the shutoff valve and as close to the appliance as practicable.



WARNING

The appliance and its gas connection must be leak tested before placing the appliance in operation.



WARNING

Strain on the gas valve and fittings can result in vibration, premature component failure and leakage and can 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 could result in fire.

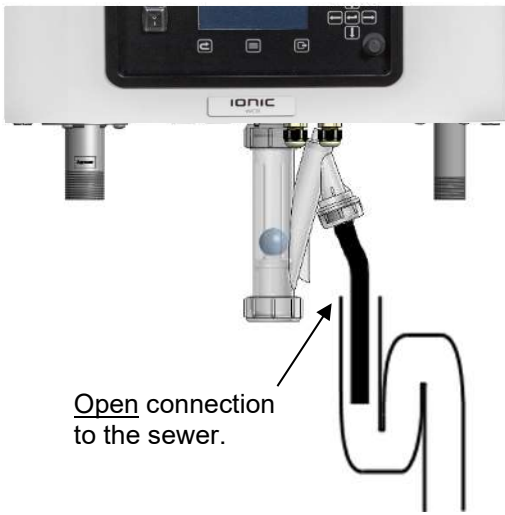
When performing a pressure test on the gas line piping, the following guidelines must be followed.

*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 PSI (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 required 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. This kit is factory installed on all 500 models.



8.3 Condensate drain connection

The condensate drain is placed at the center and at the bottom of the boiler and has a 3/4 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 must be an open connection (air gap) between the condensate hose and the the sewage system. A possible vacuum in the sewage system must never give the opportunity to suck on the boiler's condensate drain hose.

Figure 8.3



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



The condensate the boiler produces is acidic and must 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.

Condensate neutralizers are available as an accessory from Triangle Tube, see the list of optional accessories.

Damage caused by failure to install a neutralizer kit or to adequately treat condensate will not be the manufacturer's responsibility.

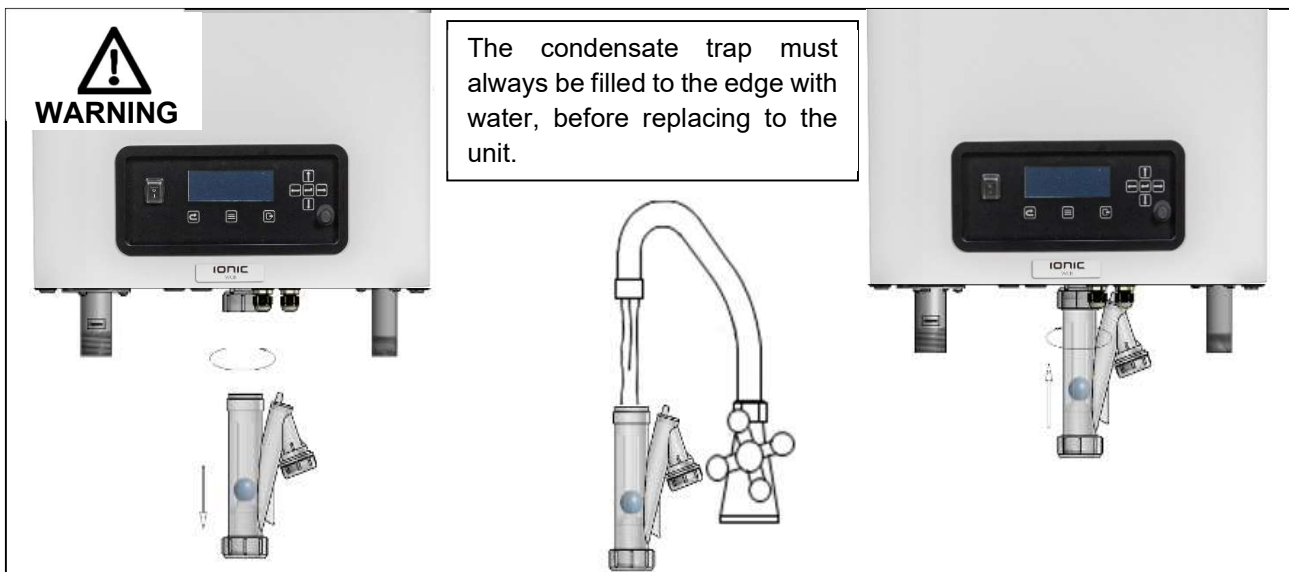


Figure 8.4

8.4 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.

The boiler circulator must 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 as shown in figure 8.5.

8.5 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 8.5

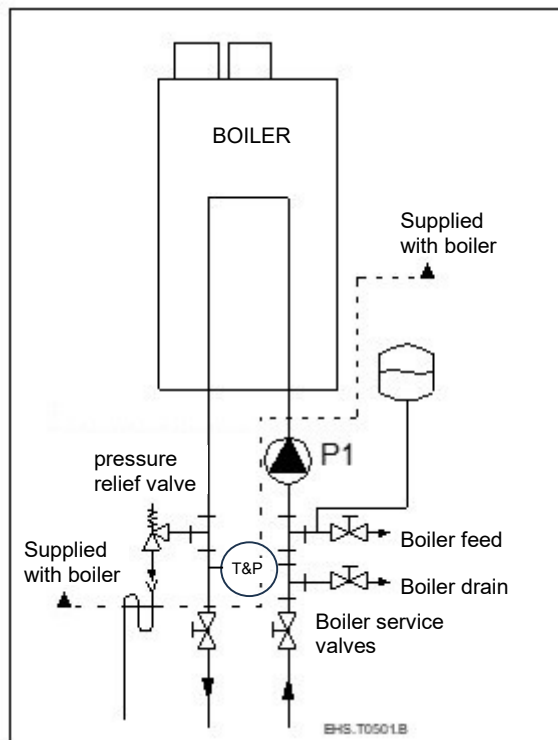


Figure 8.5

8.6 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 must be installed close to the boiler in the supply pipe of the heating system and no shut off valve shall be placed between the pressure relief valve and the boiler. When having a cascade of boilers, each boiler must 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. Terminate the piping in a plain non-threaded end. Always directed away from all persons and downwards towards the floor. Maintain the same outlet diameter for the piping as the supplied pressure relief valve.

Always have an air gap between the pressure relief valve discharge piping and the drain to prevent a vacuum. No valve shall be placed between the relief valve and the discharge line, do not plug or obstruct in any way the pressure relief discharge line. The installation of the pressure relief valve must follow ASME Boiler and Pressure Vessel Code, Section IV, Rules for Construction of Heating Boilers, ASME BPVC-IV, and/or Boiler, Pressure Vessel and Pressure Piping Code, CSA B51 as well as all applicable local code.

Each appliance is factory supplied with a tridicator (temperature and pressure gauge) in the box. The tridicator must be installed between the boiler and the shut off valve on the hot water supply side as shown in figure 8.5.

8.7 NON-Return valve

All Ionic CB 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 losses through the flue of the boiler. This creates a higher thermal efficiency.

The non-return valve has a service life and must be replaced at minimum of every 5 years or sooner dependent on the operating conditions.

8.8 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 tees spaced at minimum 4 pipe diameters apart and at maximum 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 sections must be insulated and/or protected with the help of a heat tracing.

8.9 Chilled Water and Refrigeration Systems

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

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

8.10 Circulator 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 circulator. The burner load automatically decreases when the Return/Supply temperature differential increases too much. In this case, display will show “Ex. Low Flow Protection” or “Heat exchanger Protection active”.

At maximum burner power ΔT is limited to 63°F / 35°C and at low burner power a ΔT above 77°F / 43°C is not allowed. Above these values the boiler modulates down until the temperature difference is between 63°F and 77°F. If ΔT exceeds 86°F / 48°C, the boiler will be temporarily switched off.

8.11 Frost protection

The boiler has a built-in frost protection that is automatically activates the boiler circulator when the boiler return (water) temperature drops below 50°F / 10°C. When the boiler return temperature drops below 41°F / 5°C), the boiler is also ignited. The circulator and/or boiler will shut down as soon as the return temperature has reached 59°F / 15°C. 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	<p>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.</p>
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8.12 Installing a strainer and/or dirt separator

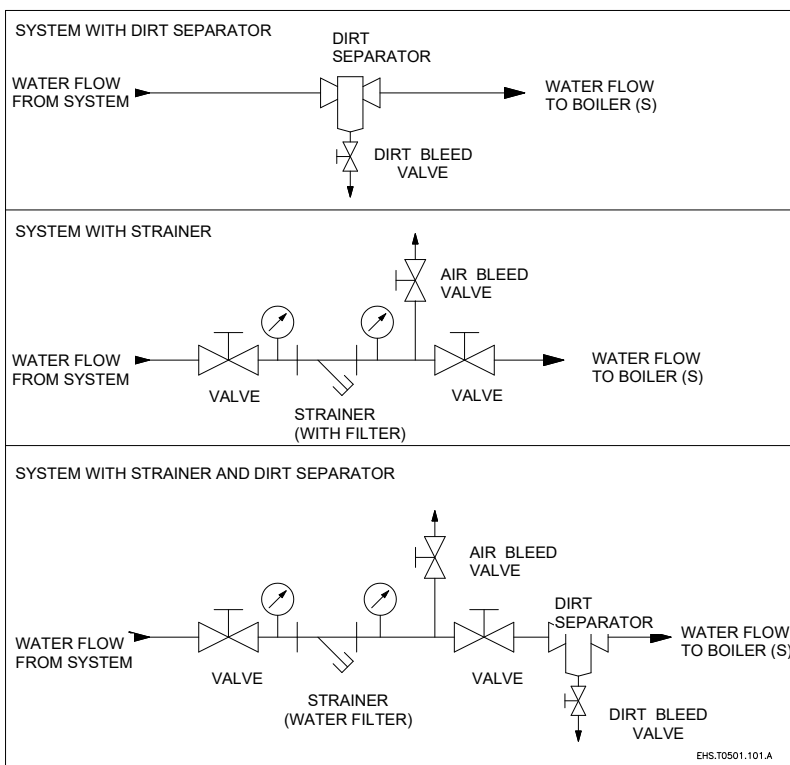


Figure 8.6

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 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 or combination dirt trap magnetic separator is required to be installed.

It is 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.

8.13 Boiler water quality

Contaminant	Maximum allowable level	Units
pH	7.5 to 9.5	
Hardness	50 to 150	ppm CaCo3
	2.9 to 8.8	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 about 7) with fresh water, the water loses its air because of air bleeding operation and heating up (dead water conditions).

Table 8.2

If there is the risk of contamination of the water by any kind of debris/chemicals, a plate heat exchanger must be used to separate the boiler circuit from the heating circuit (see figure 8.7 at page 34).

Fresh oxygenated water might damage the heat exchanger of the boiler and must therefore be prevented from entering the closed loop heating system. Spots where air is most likely to enter the system are: suction gaskets, circulators, air valve working as 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 must 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 8.5 (next page)

Do not use petroleum-based cleaning and sealing compounds in the boilers system as they could damage gaskets.

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 (1 or 2 weeks) 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 maximum values specified in this manual, it must be isolated from the snow melt with a plate heat exchanger.

Readings for initial water quality should be recorded and saved for service and warranty purposes. When using glycol antifreeze or any chemical treatment yearly water quality tests must be done and recorded for service and warranty purposes. Failure to properly document water quality will void the appliances warranty.

8.14 Use of glycol

To prevent the system from freezing, the use of mono propylene glycol can be considered. All materials, used in the boiler, are resistant to mono propylene glycol. Never use Ethylene glycol in a heating system as it is toxic and can damage gaskets.

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 mono propylene glycol, but they have additives added which act against internal corrosion and/or scale formation. An important part of these additives are the "balancers" which are added to the product, to absorb the rise of acidity of the glycol over time.

The chemical compatibility of the specific glycol antifreezes in table 8.3 have been tested by the heat exchanger producer. These products mainly consist of mono propylene glycol next to the described additives. Read the antifreeze suppliers manual for additional information on the glycol antifreeze.

These approved 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
Noble	Noburst-100	Consists of mono propylene glycol next to some additives.
Noble	Noburst-RTU	Premixed to protection temperature concentration

Table 8.3

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 / 11°C Delta T and the following guidelines in the table below must be followed for pump circulator sizing. The only acceptable way to correctly check the concentration of the glycol mix the in the system and/or boiler heating loop is to use a refractometer. **A Refractometer must be used on the initial filling of the system and or boiler loop and during the yearly water quality tests.**

Boiler type	CB 50% glycol maximum @ 20°F ΔT
CB 299W	28 gpm @ 37ft head
CB 399W	38 gpm @ 40ft. head
CB 470W and CB 500W	46 gpm @ 44ft. head

Table 8.4

When using glycol in the boiler it is required to check the pH, conductivity, concentration, 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.

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.

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 or system components in the system is / are galvanized, steel, or black iron.

When using glycol antifreeze in a heating system PVC, CPVC, and galvanized piping is not allowed to be used in any part of the heating system.

8.15 Chemical water treatment

The chemical compatibility of several products for treatment of heating systems and equipment have 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 performing maintenance an inhibitor must 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 heating system and boiler must be within the requirements of table 8.2.


Never mix treatment chemicals from different brands or anti-freezes from different brands as there is no way to ensure they are compatible.

The system cleaner must never be run through the boiler.

Corrosion-/ Scale inhibitors, cleaners and recommended suppliers						
Producers ->	Fernox	Sentinel	Sotin	ADEY	Noble	Rhomar
Inhibitors	Protector F1 / Alphi 11	X100, X500	Sotin 212	MC1+		Boiler Gard 921
Noise reducer		X200				
Cleaner	Restorer	X300		MC3+	Cleaner	Pro-Tek Al
Sludge remover	Protector F1, Cleaner F3	X400	Sotin 212			
Antifreeze	Alphi 11	X500				
Tightness		Leaker Sealer F4		MC4		

Table 8.5

Treatment type	Preventive	Curative
Fernox Protector F1	X	
Fernox Cleaner F3		X
Sentinel X100	X	
Sentinel X200	X	
Sentinel X300		X
Sentinel X400		X
Sentinel X500	X	
Fernox Alphi 11	X	
Sentinel Leaker Sealer F4	X	
Sotin 212		X
Adey MC1+	X	
Adey MC3+		X
Noble Noburst Cleaner		X
Rhomar Boiler Gard 921	X	
Rhomar Pro-Tek Al		X



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.

Table 8.6

8.16 Flush the system with fresh water

The water of the boiler and heating circuit must 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).

8.17 Plastic piping in the heating system

When plastic pipes without oxygen barrier are used in the central heating system, these must 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, circulators 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 will be deemed void.

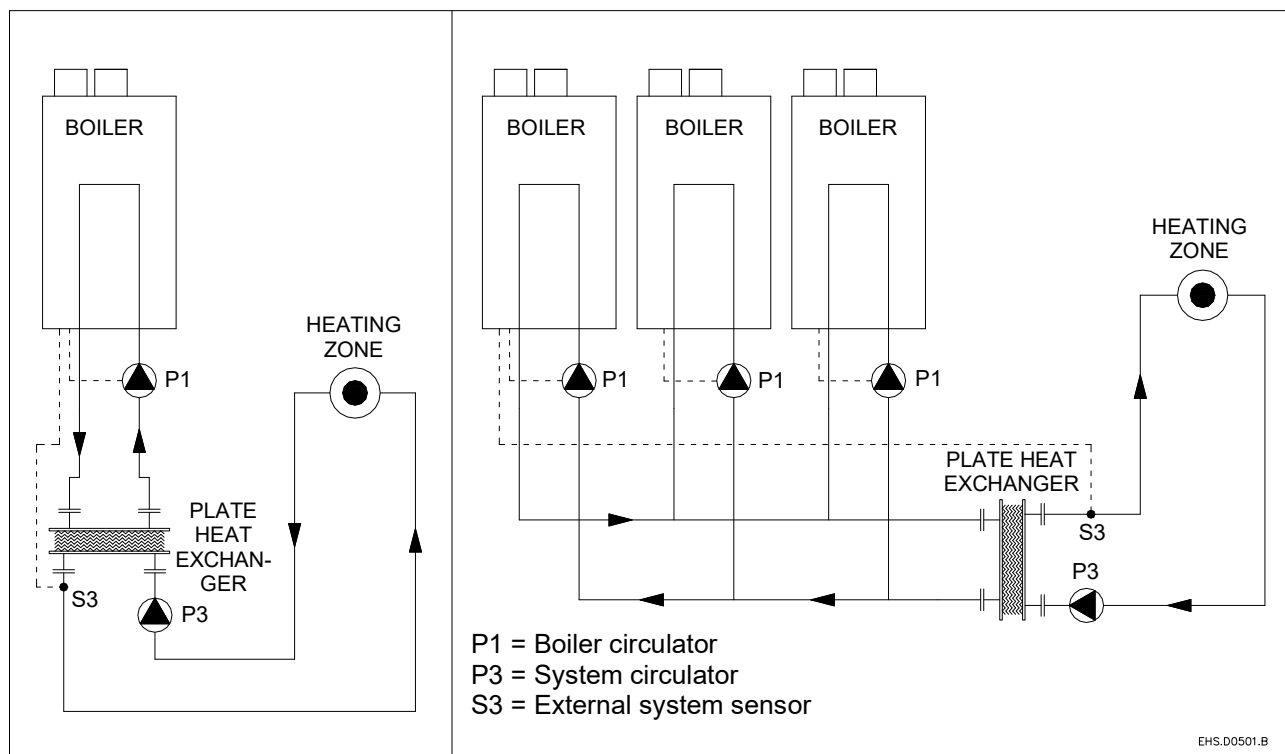


Figure 8.7

8.18 Automatic air purging of the heat exchanger

The De-Air sequence 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 circulator 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 about 14 minutes.

- 1st cycle: The 3 way valve (when attached externally to the boiler) moves to CH position and the general circulator is activated for 10 seconds, deactivated for 10 seconds, activated again for 10 seconds and then deactivated again for 10 seconds (DAir_Repeation_OnOff, 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 way valve is moved to DHW position and repeats the same cycling of the circulator (DAir_Repeation_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 $(10 \times 40) \times 2 = 800$ 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 circulator during one whole cycle of De-Air sequence with a DAir_Repetition_OnOff set to 2.

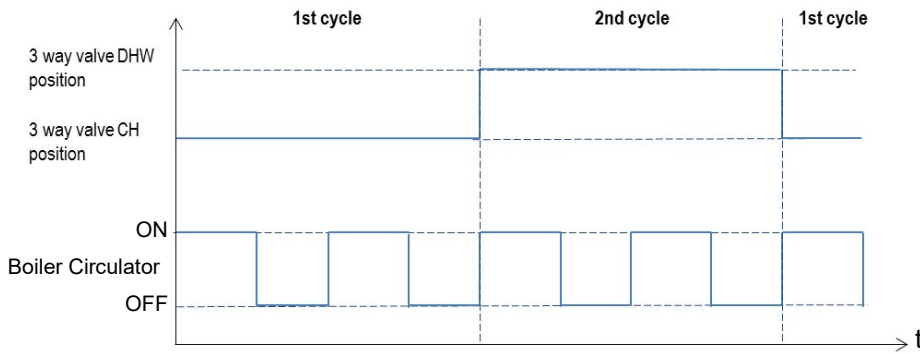


Figure 8.8

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_Repeation_OnOff Number of repeating ON/OFF.	2: Installer	2	0...255
DAir_Number_Cycles Number of DAir cycles.	2: Installer	10	0...255

Table 8.7

8.19 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 1 or 2 weeks following the installation of the boiler into a heating system that the automatic feed valve be closed.

A water meter can be used to detect and eliminate any water leakage as soon as possible.

8.20 Water pressure

The installation must 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 (1 bar) and the maximum pressure is 85 psi (6 bar). The normal water pressure must be between 22 (1.5 bar) and 50 psi (3.5 bar). Or 22 (1.5) and 85 psi (6 bar) 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 (0.7 bar), and starts the boiler firing again when the water pressure reaches above 15 psi (1 bar).

These values shall 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 85 psi (6 bar) 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 85 psi (6 bar). (60 psi (4.5 bar) recommended)

8.21 Installation examples

8.21.1 EXAMPLE OF A SINGLE BOILER HEATING CIRCUIT WITH LOW LOSS HEADER

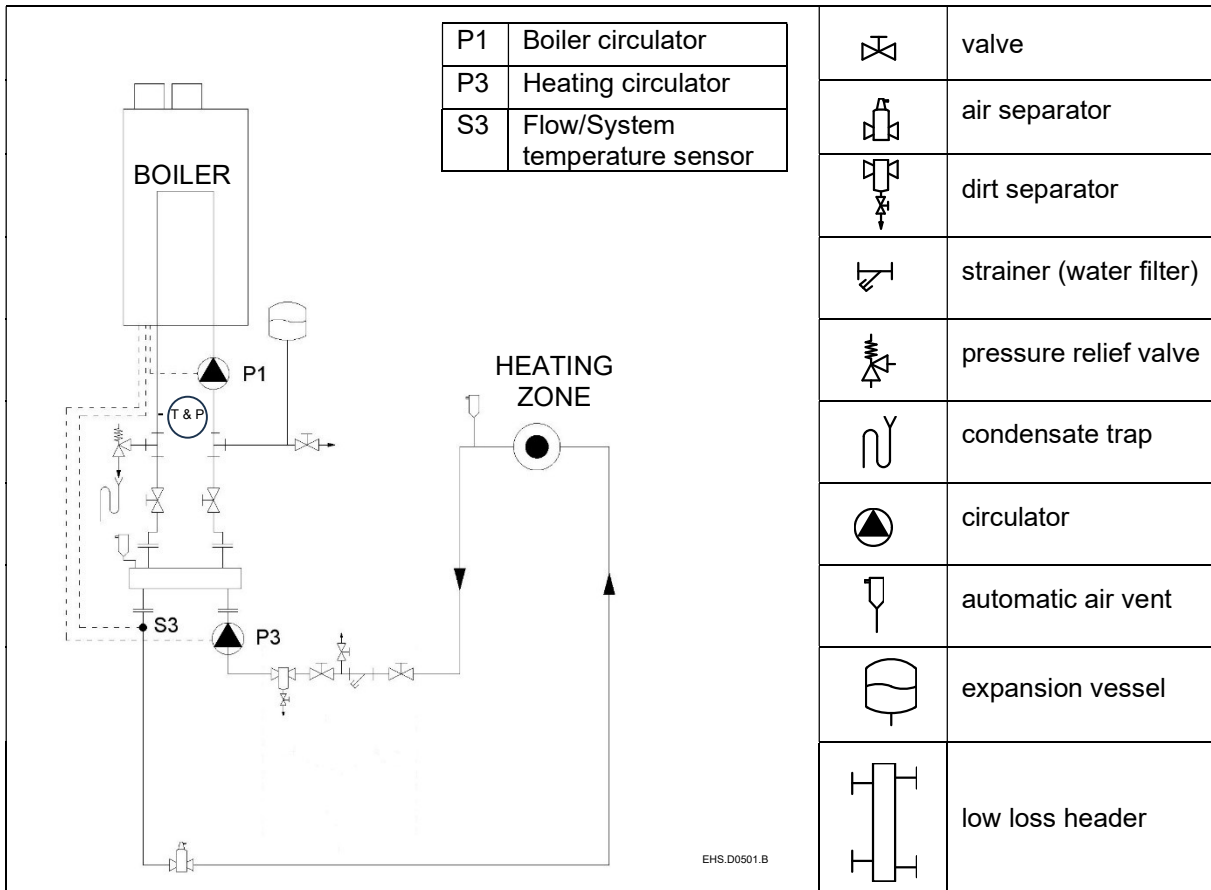


Figure 8.9

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

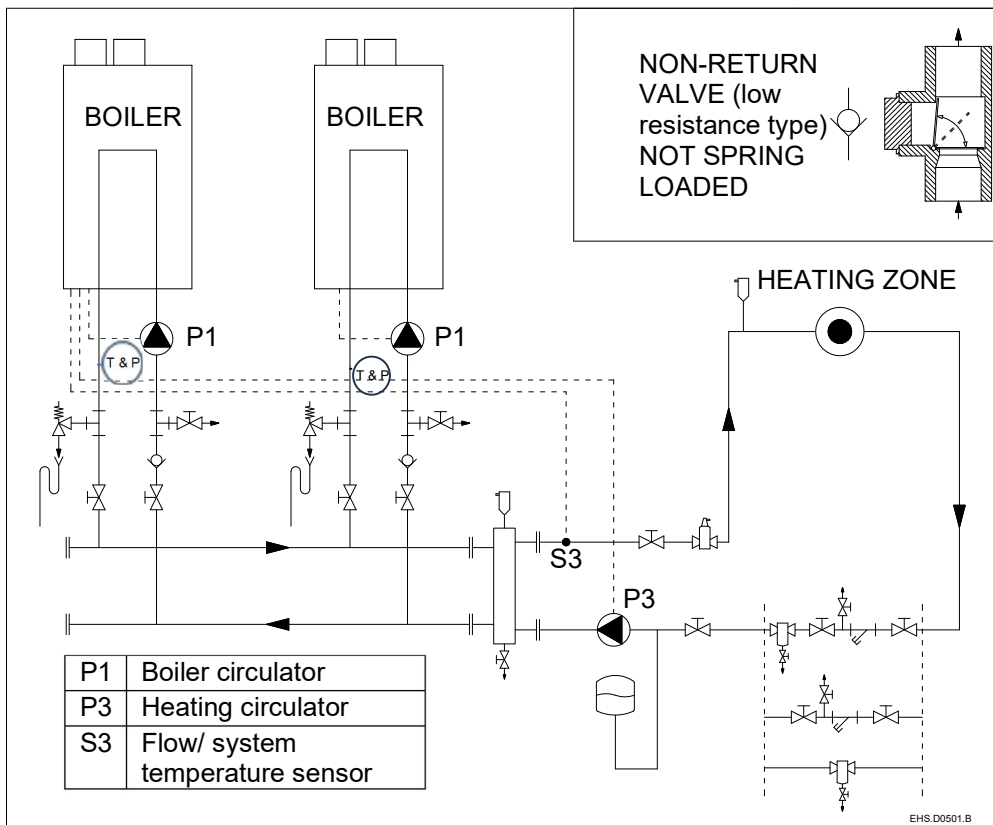


Figure 8.10

9 CIRCULATOR CHARACTERISTICS

9.1 Hydraulic graphs

9.1.1 BOILER RESISTANCE GRAPH CB 299W

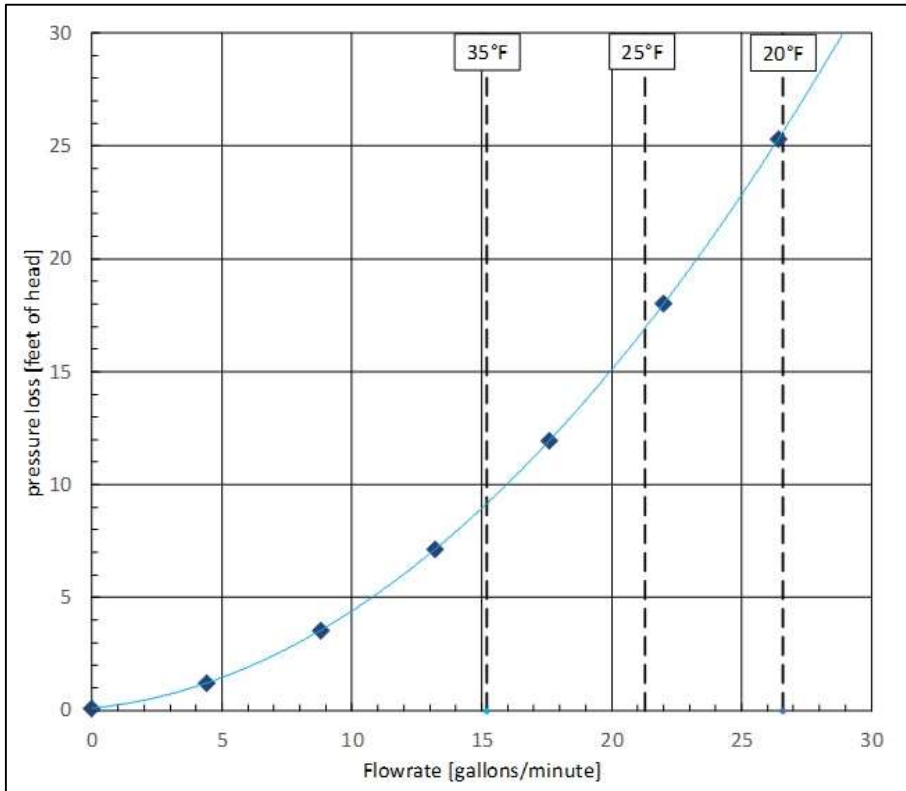


Figure 9.1

9.1.2 BOILER RESISTANCE GRAPH CB 399W

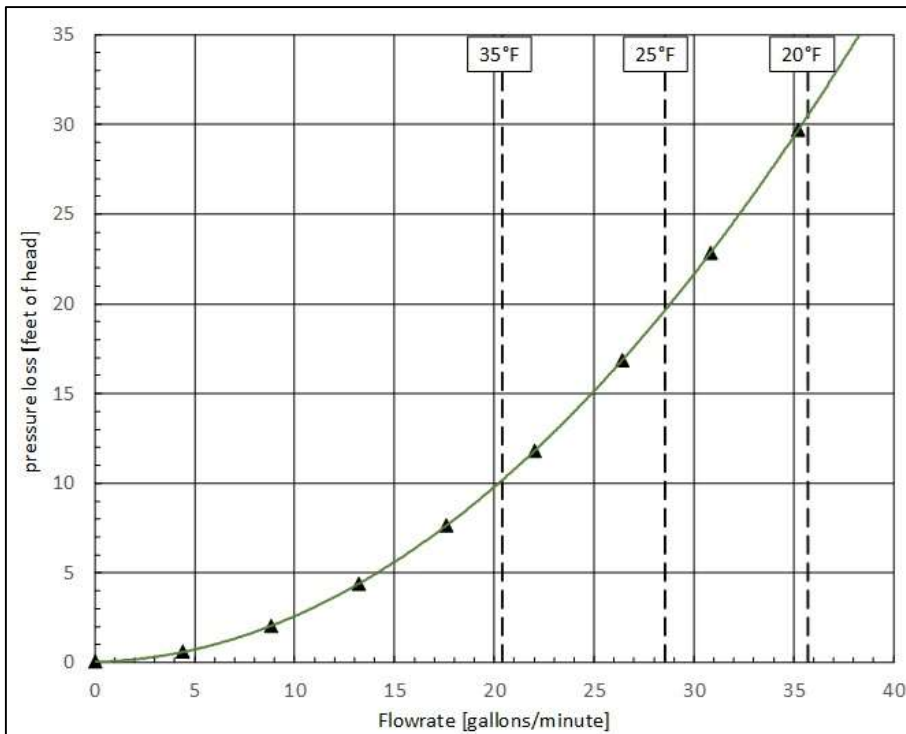


Figure 9.2

9.1.3 **BOILER RESISTANCE GRAPH CB 470W**

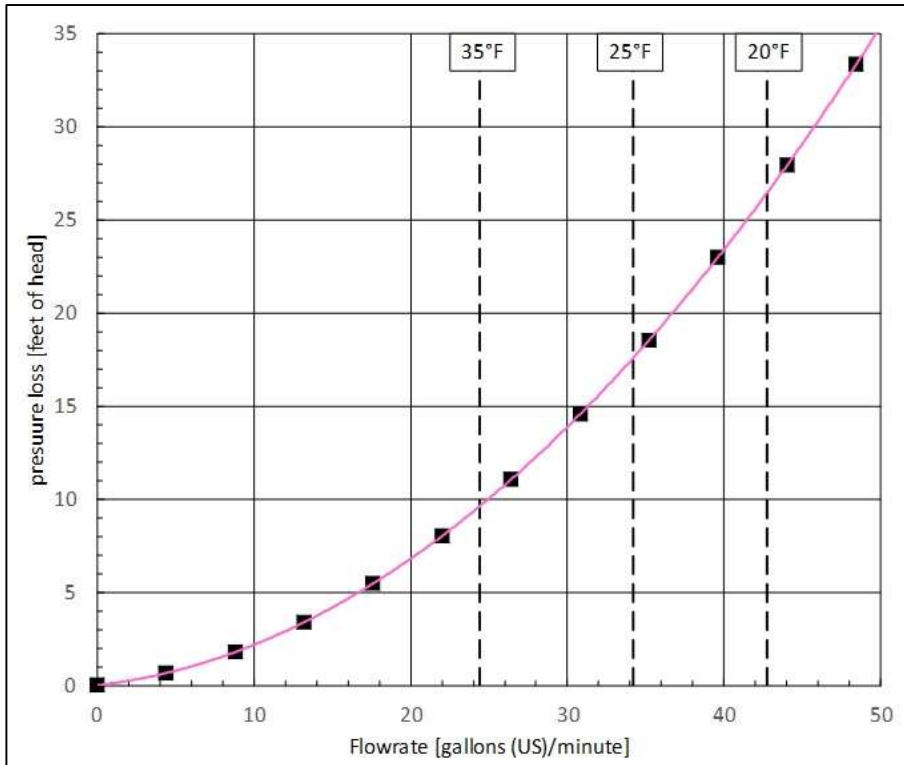


Figure 9.3

9.1.4 **BOILER RESISTANCE GRAPH CB 500W**

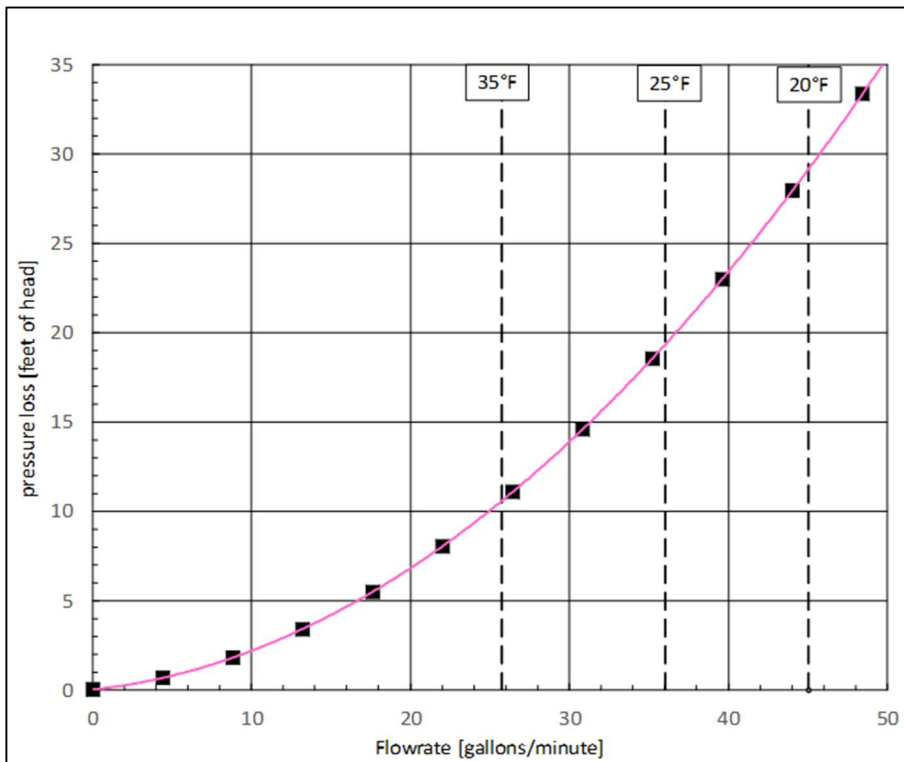



Figure 9.4

9.2 Minimum required circulator head

 NOTICE	<p>The hydraulic graphs presented in §9.1 show the pressure loss of the boiler only. When selecting a circulator, it is important to take also into account the piping to and from the low loss header. Also tees and bends add to the total pressure loss.</p>
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9.3 Grundfos Circulator Sizing

Boiler type / ΔT	20°F ΔT	25°F ΔT	30°F ΔT	35°F ΔT
CB 470W CB 500W	UPS 32-160 or Magna3 40-120	UPS 43-100 or Magna3 40-80	UPS 43-100 or Magna3 40-80	UPS 43-100 or Magna3 32-60
	45 gpm @ 29ft head	36gpm @ 20ft head	33 gpm @ 16ft head	26 gpm @ 11ft head
CB 399W	UPS 32-160 or Magna3 40-120	UPS 43-100 or Magna3 40-80	UPS 43-100 or Magna3 40-80	ALPHA1 26-99 or UPMXL 25-124
	36 gpm @ 31ft. head	29 gpm @ 20ft. head	26 gpm @ 16ft. head	21 gpm 10ft. head
CB 299W	UPS 43-100 or Magna3 40-80	UPS 43-100 or Magna3 40-80	UPS 43-100 or UPMXL 25-124	ALPHA1 26-99 or UPMXL 25-124
	26 gpm @ 26ft. head	22 gpm @ 18ft. head	19 gpm @ 14ft. head	16 gpm @ 9.5ft. head

Table 9.2

Note 1: All the circulators in this table will work with the Cascade rack system with the exception of the 26-99, 32-160, and UPMXL models

Note 2: Magna3 circulators cannot be directly substituted for the same Magna1 circulator as the duty points may not align. i.e. a Magna3 40-80 might need to be substituted with a Magna1 40-120. Please contact Triangle Tube if circulator sizing assistance is needed.

 WARNING	<p>Because the maximum allowed burner controller amperage of 2 amps is exceeded when using the larger on/off circulators like the Grundfos UPS 43-100 and UPS 32-160, an extra relay is required to switch the power to the circulator on and off (connection 6-7-PE). See the accessories list for available relay kits</p> <p>All Grundfos Magna circulators must be permanently connected to the main power supply and must be controlled by a start/stop signal (or optional by a 0-10Vdc signal), in this case an extra module is needed to control the circulator; E361100003). For the Magna circulators an extra relay (connection 6-7-PE) with a potential free contact is needed to activate the start/stop signal of the pump.</p> <p>The PWM signal must be converted to a 0-10Vdc signal to control the Magna circulator and to modulate the signal and so the flow of the circulator.</p> <p>For further information also check the installation manual of the specific pump.</p>
--	---

9.4 Modulating circulator for CH demand

When using a modulating circulator with the boiler it is possible to directly connect a PWM circulator or connect a 0-10Vdc circulator with the signal converter accessory part number E361100003.

Parameter 136 has to be set to modulating (Factory set to on/off circulator) when using a modulating circulator. The boiler circulator is modulated when there is a demand for CH.

During any other demand, the modulating circulator will run at a fixed speed set by the Default Duty cycle parameter. How the circulator is modulated is controlled with the Modulating_Pump_Mode setting.

9.5 Modulating circulator modes

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

Modulating circulator mode	Details
0: Disabled	No circulator 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%.

Table 9.3

9.5.1 DELTA TEMPERATURE MODULATION

The variable speed control is designed to ensure that the delta T across the boiler's heat exchanger matches the set delta T in the boiler control ensuring efficient temperature control and maximizing both electrical energy efficiency and the percentage of time the boiler operates in a condensing mode. This improves the overall boiler efficiency vs a fixed speed circulator, because as the boiler modulates with a fixed speed circulator which is sized for the maximum firing rate of the boiler the delta T drops increasing the return water temperature and therefore reducing the efficiency of the boiler.

When the modulating circulator mode 1, Delta temperature modulation is selected, the circulator 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 circulator 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 circulator speed decreases so there is more time to cool down the heated water. This results in the T_Return temperature decreasing.

9.5.2 PID CALCULATION SCALING

For a better burner modulation, the modulating circulator 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.

9.6 *Circulator: maximum electrical power*

General

- The inrush current of a conventional circulator 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 circulators and valves for the boiler loop, DHW, and the system that are connected to the boiler shall not exceed 3.5 amps. Use separate relays if higher currents are needed. These relays are available as an accessory, see § 6.2.
- The fan is separately connected to the main supply and has a fuse of 3.15 Amps.

Circulator P1 - boiler circulator.

This circulator is NOT part of the appliance. The maximum combined current for the boiler loop pump and any additional valves shall not exceed 2 amps.

Circulator P2 – indirect tank circulator.

Circulator P2 is a DHW indirect tank circulator, meaning it is not part of the appliance. The maximum combined current for the indirect tank pump and any additional valves shall not exceed 2 amps.

3-way valve.


The combined nominal current of circulator P1 and the 3-way valve shall not exceed 2 amps


Circulator P3 - system circulator.

The maximum current of circulator P3 shall not exceed 2 amps.

Warning (ECM circulators):

When using an ECM circulator, it **CANNOT** be powered directly by the boiler. Use a relay to isolate the boiler from the circulator.

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

 NOTICE	Use an external relay if nominal circulator currents exceed 2 Amp A pre-mounted set with 1, 2 or 3 circulator relays is available as an accessory. See § 6.2
--	---

10 FLUE GAS AND AIR SUPPLY SYSTEM


10.1 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 exhaust vent, and if applicable air-intake piping, must be piped to the outdoors. Under no conditions this appliance shall vent exhaust 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 the latest edition of ANSI Z223.1/NFPA 54 and/or the CAN/CSA B149.1 Natural Gas and Propane Installation Code and local requirements.

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

 NOTICE	<ul style="list-style-type: none"> • Install all horizontal vent components with a minimum angle of ¼ inch per foot downwards in the direction of the boiler. When not installed accordingly, it could 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 must 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, must 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).
--	--


10.1.1 VENT SIZING.

Boiler	Intake Air and Exhaust
CB 299W, CB 399W	4"
CB 470W, CB 500W	6"

Table 10.1

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:

 WARNING
<p>Failure to properly support the vent system can cause the venting system to fail, resulting in substantial property damage, serious injury, or death.</p>

AIR INTAKE VENT
(FLUE GAS)

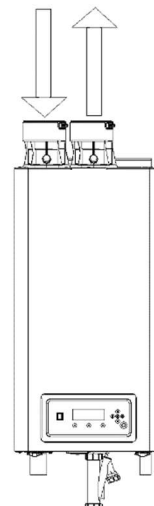


Figure 10.1


10.1.2 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			
	CB 299W	CB 399W	CB 470W / CB 500W
3"	60' / 60'	30' / 30'	
4"	200' / 200'	121' / 121'	73' / 73'
5"			200' / 200'
6"			200' / 200'

Table 10.2

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

Pipe, elbows, tees - equivalent feet (DuraVent PolyPro):

Item \ size	3"	4"	5"	6"
1 ft Vent Pipe	1 ft	1 ft	1 ft	1 ft
1 ft Flex Pipe (same diameter as rigid)	2 ft	2 ft	2 ft	NA
1 ft Flex Pipe (upsized one diameter)	0.6 ft	0.6 ft	NA	NA
45 Elbow	3 ft	7 ft	6 ft	6 ft
90 Elbow	7 ft	12 ft	14 ft	14 ft
(Termination) Tee	12 ft	19 ft	21 ft	22 ft
Concentric roof terminal	Flue	25 ft	36 ft	NA
	Air	45 ft	65 ft	
Concentric wall terminal	Flue	11 ft	13 ft	NA
	Air	45 ft	65 ft	

Table 10.3


10.2 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 may 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 ⁴⁾	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.
- 4 All primers must be colored in a contrasting color so that inspectors can easily verify by the residual color on the pipe near the joints that the primer has been used.

Table 10.4

 WARNING	<p>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 could result in serious injury or death. In Canada, the first piece of vent piping must be readily accessible for inspection.</p> <p>Covering non-metallic vent pipe and fittings with insulation is prohibited. Failure to follow these instructions may result in property damage, personal injury or death.</p>
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10.2.1 APPROVED MANUFACTURERS

CPVC venting:

* IPEX System 636,

Polypropylene venting:

* Duravent - PolyPro


Stainless steel venting:

* Duravent - FasNSeal, FasNSeal W2, FasNSeal Flex, Duraseal DS, DSD, DSID

* Security Chimneys - Secure seal SS/SSD/SSID


* Heat Fab - Saf-T EZ Seal

Other manufacturers are allowed, as long as they comply to table 10.4 (paragraph 10.2 (page 42)) and comply to local codes and regulations.

 NOTICE	<p>READ THE MANUAL PROVIDED BY THE VENT GAS AND AIR SYSTEM SUPPLIER CAREFULLY</p>
--	---

10.3 **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.

 NOTICE	<p>If these directions and those of the vent manufacturer differ, follow the more conservative requirements.</p>
--	--




Approved CPVC vent terminations:







IPEX – System 636

BOILER	FITTING	PART #
CB 299W CB 399W CB 470W CB 500W	4" Concentric Termination CPVC *	197021
	4" FGV 90° Elbow CPVC	197202
	4" FGV Tee CPVC	197489
	4" Termination Vent Screen	196052
	4" Low profile termination kit	196986
CB 470W CB 500W	6" FGV Tee CPVC	197490
	6" FGV 90° Elbow CPVC	197203
	6" Termination Vent Screen	196090

* Concentric termination is for use in vertical installations only.

Table 10.6

 NOTICE	<p>The use of bushings to reduce vent sizing is prohibited for both the exhaust venting and intake air venting system.</p> <p>Only standard and long sweep PVC elbows are allowed for use in the exhaust venting and intake air venting system.</p>
 WARNING	<p>PVC In Canada Safety authorities in some jurisdictions are not allowing PVC venting materials with appliances of any kind, even if the system is ULC S636 certified. Check with the local safety inspector to verify compliance. Canadian installations must comply with the latest edition of the CAN/CSA B149.1 Natural Gas and Propane Installation Code.</p>
 WARNING	<p>The use of cellular core PVC (ASTM F891), cellular core CPVC, ABS, or Radel® (polyphenol sulfone) in the exhaust venting system is prohibited. Failure to follow these instructions could result in property damage, personal injury or death.</p>

 NOTICE	<p>PVC exhaust venting: When using PVC venting, the first part of exhaust venting is required to always be approved CPVC. This starter piece must have a minimum length (in linear feet) according to table 10.7. If a fitting (elbow or coupling) is needed it does not count toward the total linear feet:</p> <table border="1" data-bbox="352 241 826 398"> <tr> <th colspan="3">Required CPVC Starter Venting Piece for all PVC venting installations</th> </tr> <tr> <td>CB 299W</td> <td>CB 399W</td> <td>CB 470W CB 500W</td> </tr> <tr> <td>0 ft</td> <td>4 ft</td> <td>2 ft *</td> </tr> </table> <p>Table 10.7</p> <p>* When reducing to 4" diameter venting the starter 6" section of CPVC and the 6" to 4" CPVC reducer coupling are not included in the 2 feet of straight pipe required. The 2 feet of 4" diameter CPVC venting required start after the reducer coupling.</p>	Required CPVC Starter Venting Piece for all PVC venting installations			CB 299W	CB 399W	CB 470W CB 500W	0 ft	4 ft	2 ft *
Required CPVC Starter Venting Piece for all PVC venting installations										
CB 299W	CB 399W	CB 470W CB 500W								
0 ft	4 ft	2 ft *								
 WARNING	<p>The vent connection to the appliance must be made with a starter CPVC pipe section if PVC/CPVC vent is to be used. Failure to follow this warning could result in fire, personal injury, or death.</p>									
 WARNING	<ul style="list-style-type: none"> Insulation is prohibited for use 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 approved "All Purpose Cement" and Primer listed for use in table 10.4 that is designated for the selected vent diameter. Failure to follow this warning could result in fire, personal injury, or death. 									
 WARNING	<p>venting materials from different systems cannot be mixed. Approved CPVC and PVC are considered the same system. PP venting cannot be mixed with PVC or CPVC venting.</p>									
 NOTICE	<ul style="list-style-type: none"> 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 1/4 inch per foot back to the boiler (to allow drainage of condensate). 									
 WARNING	<p>Failure to properly support the vent system can cause the venting system to fail, resulting in substantial property damage, serious injury, or death</p>									


10.3.1 INSTRUCTIONS FOR CEMENTING PVC/ CPVC PIPE CONNECTIONS:

1. Work from boiler to vent or air termination. Do not exceed equivalent lengths from table 10.2 for 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 fit up before assembling any joint. The pipe must 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 fitting socket and to pipe end to approximately 1/2" beyond socket depth.
 - c. Apply a second primer coat to the fitting socket.
 - d. All primers must be colored in a contrasting color so that inspectors can easily verify by the residual color on the pipe near the joints that the primer has been used.
 - e. 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.
 - f. Apply a second coat of cement to the pipe.
 - g. 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.
 - h. Wipe excess cement from the joint removing ring or beads as it will needlessly soften the pipe.

Near boiler PVC/ CPVC venting.

The starter piece must have a minimum length according to table 10.7 "PVC Exhaust Venting" on page 45.

 WARNING
Never insert a PVC/CPVC street elbow directly into the vent adapter on the appliance, doing so could result in substantial property damage, serious injury, or death.

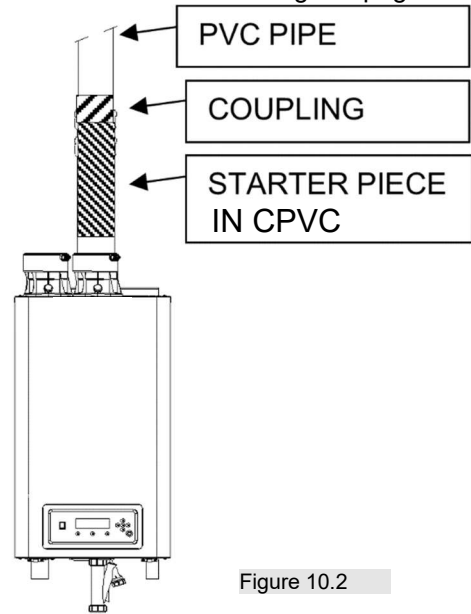



Figure 10.2

10.4 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.

 NOTICE	If these directions and those of the vent manufacturer differ, follow the more conservative requirements.
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Approved polypropylene vent pipe and fittings.

SUPPLIER	TYPE
Duravent	PolyPro


Table 10.8


Approved polypropylene terminations:


Duravent - PolyPro


BOILER	TERMINATION	COLOR:	ORDER #:	STOCK #:
CB 299W CB 399W CB 470W CB 500W	4" UV resistant tee	black	4PPS-TTBL	810014461
	4" Bird guard screen	white	4PPS-BG	810004367
	4" concentric roof	black	4PPS-VKC-N	810014649
		terra-cotta	4PPS-VK-TCC-N	810014650
	4" concentric wall	white	4PPS-HKC-N	810014651
	4" twin pipe termination	black	4PPS HTPC	810014605
CB 470W CB 500W	5" Roof	black	5PPS-VTMC	810014664
	5" Single Pipe Side Wall	Stainless	5PPS-HSTL	810009763
	6" Roof	black	6PPS-VTMC	810014813
	6" Single Pipe Side Wall	Stainless	6PPS-HSTL	810009784
	6" UV resistant tee	black	6PPS-TTBC	810014696

Table 10.9

 WARNING	Never insert a polypropylene street elbow directly into the vent adapter on the appliance, doing so could result in substantial property damage, serious injury, or death.
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 WARNING	Contact approved polypropylene vent manufacturer for a copy of their installation instructions. Read, understand and follow all of the vent manufacturer's instructions before beginning the installation. Contact vent manufacturer if you require any technical support.
---	--

 WARNING	Failure to properly install and support the vent system can cause the venting system to fail, resulting in substantial property damage, serious injury, or death.
---	---

 WARNING	<p>Only the Duravent PolyPro Locking Clamp is approved for use with Triangle Tube appliances when using the PolyPro venting system. This locking clamp is required for use on vent joints in the system.</p> <p>Failure to do so may result in improper installation, property damage, or injury</p>
---	---

- Rigid polypropylene vent pipe must be installed with approved locking band clamps or connector rings and supports (wall strap or clamp, elbow or base, etc.). Consult vent manufacturer for complete list of required parts.
- Maintain 1/4 in. [6 mm] per foot slope back toward appliance on all horizontal runs.
- The use of a wall plate is required to seal rigid polypropylene vent pipe at the entrance of the chimney or chase to prevent mortar or cement from contacting the polypropylene vent pipe.
- Any termination piping external to the building must be UV resistant.
- Plastic venting systems shall not pass through rated fire separations without approved fire stopping installed in accordance with fire stopping manufacturers instructions.
- Prior to assembly of any joints, ensure the joint gasket is present and properly installed. Contact the vent manufacturer if a gasket is missing or damaged. Verify the integrity of joints upon completion of the vent system.

10.4.1 **REDUCER**

If a reduction of the flue gas pipe is needed a reducer is required to make it fit.



Use to transition the vent system to a smaller diameter. Includes 1 adapter connector clamp.
Supplier: Duravent.


Figure 10.3


Boiler	Size		Order #	STOCK#	A
CB 299W CB 399W	4" - 3"	100 – 80 mm	4PPS-R3L	810009746	5" / 130mm
CB 470W	5" - 4"	130 – 100 mm	5PPS-R4L	810009764	7 ⁵ / ₈ " / 193mm
CB 500W	6" - 5"	150 – 130 mm	6PPS-R5L	810009785	7 ³ / ₄ " / 197mm

Table 10.10


10.4.2 **FLEXIBLE POLYPROPYLENE**


For use of flex pipe, it is required 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	<p>Insulation is prohibited from use on all types of plastic venting material: PVC, CPVC, and Polypropylene.</p> <p>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.</p>
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 NOTICE	All vent connections MUST be secured by the vent manufacturer's locking clamp.
	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 flex vent system must adhere to the vent manufacturer's installation instructions supplied with the vent system.

- Approved for vertical installations only, where a clean, structurally sound unused chimney or chase is used as a raceway.
- Vertical offsets must not exceed 45° and are limited to a maximum number of 2.
- Requires rigid polypropylene vent pipe with approved locking band clamps or connector rings and wall straps or support clamps from the appliance to the entrance of the chimney or chase.
- Maintain 1/4 in. [6 mm] per foot slope back toward appliance on all horizontal runs of rigid polypropylene vent pipe.
- The use of a wall plate is required to seal rigid polypropylene vent pipe at the entrance of the chimney or chase to prevent mortar or cement from contacting the polypropylene vent pipe.
- Requires supports (elbow or base, flex chimney and bracket), spacers, chimney cap and end pipe. Consult vent manufacturer for complete list of required parts.
- Any termination piping external to the building must be UV resistant.
- Do not apply insulation directly to vent. Maintain vent manufacturers clearances to combustibles.
- Flex plastic venting systems shall not pass through rated fire separations.
- Prior to assembly of any joints, ensure joint gasket is present and properly installed. Contact vent manufacturer if gasket is missing or damaged. Verify the integrity of joints upon completion of the vent system.

 NOTICE	If these directions and those of the vent manufacturer differ, follow the more conservative requirements.
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 WARNING	<p>A venting system must not be routed into, through, or within any other vent, such as an existing masonry or factory-built chimney flue, unless that vent or chimney is not being used to vent another appliance and is only used as a conduit for the gas-vent system.</p> <p>Failure to do so may result in improper installation, property damage, or injury.</p>
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 WARNING	Do not install PVC, CPVC, or Polypropylene (rigid or flexible) in a multi-flue chimney. Only use an approved and certified metal venting system designed for use as a chimney liner in a multi-flue chimney.
---	--

Approved flexible polypropylene terminations:

Duravent – PolyPro Flex

BOILER	TERMINATION	COLOR:	ORDER #:	STOCK #:
CB 299W CB 399W CB 470W CB 500W	4" Chimney cap	black	4PPS-FCTC	810014617
CB 470W CB 500W	5" Chimney cap	black	5PPS-FCTC	810014665

Table 10.11

10.5 Stainless steel vent.



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

Approved stainless steel vent pipe and fittings.

SUPPLIER	TYPE
Duravent	FasNSeal, FasNSeal W2, FasNSeal Flex, Duraseal DS, DSD and DSID
Security Chimneys	Secure Seal SS/SSD/SSID
Heat Fab	Saf-T EZ Seal / EZ 316

Table 10.12

*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 of the vent system occurs. 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	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 must adhere to the stainless-steel vent manufacturer's installation instructions supplied with the vent system.

Approved Stainless Steel Terminations.

	Duravent	Duravent	Security Chimneys	HeatFab
	FasNSeal, FasNSeal W2	Duraseal DS, DSD, DSID	Secure Seal SS, SSD, SSID	Saf-T EZ Seal/ EZ 316
BOILER	TERMINATION	TERMINATION	TERMINATION	TERMINATION
CB 299W CB 399W CB 470W CB 500W	FSTT4 (termination tee) FSBS4 (bird screen wall) FSRC4 (rain cap roof)	DS(I)(D)4TT (termination tee) DS(I)(D)4STA (screen term.) DS(D)4ST90A (screen term.) DS(I)(D)4RC(B) (rain cap) DS(I)(D)4EC (exit cone)	SS(I)(D)4TT (termination tee) SS(I)(D)4STAU (screen termination) SS(I)(D)4RC (rain cap)	9490TEE (termination tee) 9492 (screen termination) 9414TERM (elbow term.) 9411TERM (elbow term.) 5400CI (rain cap)
CB 470W CB 500W	FSTT5 (termination tee) FSBS5 (bird screen wall) FSRC5 (rain cap roof)	DS(I)(D)5TT (termination tee) DS(I)(D)5STA (screen term.) DS(D)5ST90A (screen term.) DS(I)(D)5RC(B) (rain cap) DS(I)(D)5EC (exit cone)	SS(I)(D)5TT (termination tee) SS(I)(D)5STAU (screen termination) SS(I)(D)5RC (rain cap)	9590TEE (termination tee) 9592 (screen termination) 9514TERM (elbow term.) 5500CI (rain cap)
CB 470W CB 500W	FSTT6 (termination tee) FSBS6 (bird screen wall) FSRC6 (rain cap roof)	DS(I)(D)6TT (termination tee) DS(I)(D)6STA (screen term.) DS(D)6ST90A (screen term.) DS(I)(D)6RC(B) (rain cap) DS(I)(D)6EC (exit cone)	SS(I)(D)6TT (termination tee) SS(I)(D)6STAU (screen termination) SS(I)(D)6RC (rain cap)	9690TEE (termination tee) 9692 (screen termination) 9614TERM (elbow term.) 5600CI (rain cap)

Table 10.13

Approved Flexible Stainless Steel Terminations.

	Duravent FasNSeal Flex		
BOILER	TERMINATION	ORDER #:	STOCK #:
CB 299W CB 399W CB 470W CB 500W	4" FasNSeal Flex Rain Cap	FSFLEXRC4	810013290
CB 470W CB 500W	5" FasNSeal Flex Rain Cap	FSFLEXRC5	810013291
	6" FasNSeal Flex Rain Cap	FSFLEXRC6	810013292

Table 10.14

10.6 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, CPVC, PP or Stainless steel.

10.6.1 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 section 10.7.1 tables 10.16 and 10.17

10.6.2 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.

10.6.3 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 rules in the National Mechanical Code, Section 305, Table 305.4 or as local codes dictate.

Near boiler air piping:

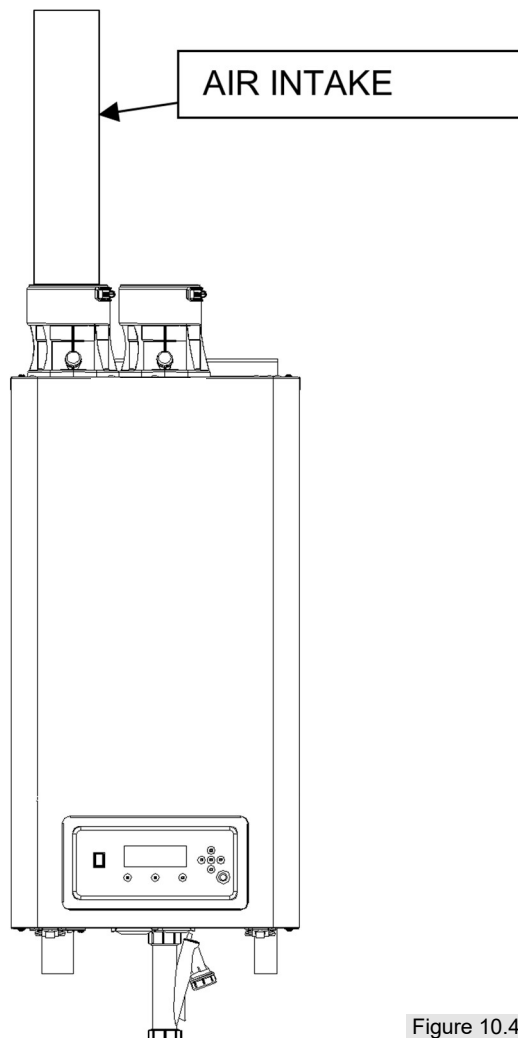




Figure 10.4

10.6.4 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.
- Stainless steel material to be sealed to specification of its manufacturer.

 WARNING	Using air intake materials other than those specified can result in property damage, personal injury or death.
 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 must be cleaned and sealed with the pipe manufacturer’s recommended primers 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.
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10.7 Room air

Commercial applications utilizing the boiler can be installed as a category IV appliance 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 in a positive or neutral pressure room.
- The unit **MUST** be installed with the appropriate room air components (table 10.15).
- The equipment room **MUST** be provided with properly sized openings to assure adequate combustion air. Please refer to instructions provided with the indoor air components.
- 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 10.7.1 "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 with indoor room air, 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 and/or in Canada, the latest edition of CAN/CSA B149.1 Natural Gas and Propane Installation Code, and/or applicable provisions of the local building codes.
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Indoor air components:

Duravent, Polypro / FasnSeal


Boiler	Termination	Color	order	stock
CB 299W CB 399W	4" Termination tee	Stainless	FSTT4	810003175
	4" Rain cap	Stainless	FSRC4	810003185
CB 470W CB 500W	4" Termination tee	black	4PPS-TTBL	810014461
	4" Vertical conc. Term.	black	4PPS-VKC-N	810014649
CB 470W CB 500W	5" Termination tee	Stainless	FSTT5	810003230
	5" Rain cap	Stainless	FSRC5	810003237
	6" Termination tee	Stainless	FSTT6	810003230
	6" Rain cap	Stainless	FSRC6	810003292
	6" Termination tee	black	6PPS-TTBC	810014696
	6" Vertical termination	black	6PPS-VTMC	810014697

Table 10.15

10.7.1 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 on the next page, 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	<ul style="list-style-type: none"> • Do not operate the boiler if the combustion air intake is located near 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: <ul style="list-style-type: none"> ○ remove contaminants permanently. or ○ relocate air inlet and vent terminations to other areas. • Failure to comply with these instructions will result in substantial property damage, serious injury, or death.
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Corrosive Contaminants and Sources

Products to avoid:	Spray cans containing chloral/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

Table 10.16

Areas likely to have contaminants:	Dry cleaning/laundry areas and establishments
	Swimming pools
	Metal fabrication shops
	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.

Table 10.17

10.8 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, and all 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 insulation is prohibited.

For Category IV venting, the venting system shall be installed in accordance with the boiler manufacturer's installation instructions.

Non-combustible supports, designed and approved for the venting system, must be placed a minimum of every 4 feet or less and/or as required by local code and the authority having jurisdiction and following the instructions of the venting manufacturer, on horizontal portions of the venting system to prevent sagging of the venting system. Elbows and Tees are required to be supported by attaching a wall support within 1" to 12" of the pipe joint holding the Elbow or Tee. Vertical portions of the venting system must be support a minimum of every 10 feet or less and/or as required by local code and the authority having jurisdiction and following the instructions of the venting manufacturer.

The supports must allow the boiler to be free from strain and prevent the weight of the venting system from resting on the boiler. The supports must allow for a minimum of 1/4" (6 mm) per foot slope upwards from the boiler to the termination. Follow the venting system manufacturer installation instructions if a larger slope is required. This will prevent the accumulation of condensate and allow it to drain back towards the boiler and reduce the risk of icing at the termination.


 DANGER	<ul style="list-style-type: none"> 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 § 10.11.2 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 could cause severe personal injury or death.
 WARNING	<ul style="list-style-type: none"> This appliance requires a special venting system. Use only approved stainless steel, PVC, CPVC or polypropylene pipe and fittings. Failure to comply could result substantial property damage, severe personal injury or death. DO NOT mix components from different systems. The vent system could fail, causing leakage of flue products into the living space. and will cause severe personal injury or death. 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. Use of PVC is not permitted. Failure to follow this warning could result in fire, substantial property damage, significant injury, and 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 substantial property damage,severe personal injury, or death.
 CAUTION	<p>Improper installation of venting systems could result in flue gas leakage, appliance malfunction, substantial property damage, severe injury, and death</p>
 WARNING	<p>For US installations only, for Category II and Category IV appliances: The vent for this appliance shall not terminate:</p> <ul style="list-style-type: none"> over public walkways; or 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 where condensate vapor could cause damage or could be detrimental to the operation of regulators, relief valves, or other equipment.
 NOTICE	<p>Installation must comply with local requirements and with the National Fuel Gas Code, ANSI Z223.1/NFPA 54 for U.S. installations and/or the latest edition of CAN/CSA B149.1 Natural Gas and Propane Installation Code Follow the instructions in this manual when removing a boiler from an existing vent system.</p>

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 can 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 install air piping from outside to the boiler air intake adapter, unless following the "Room Air" instructions in § 10.7 of this manual.

10.9 Requirements for installation in Canada

- Installations must be made with a vent pipe system certified to ULC-S636.
- The first 3 feet of plastic vent pipe connected to the appliance flue outlet must be readily accessible for visual inspection.
- 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	<p>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, and/or the latest edition of the CAN/CSA B149.1 Natural Gas and Propane Installation Code and all applicable provisions of the local building codes.</p>
	<p>The inlet for combustion air can never be located inside a room storing chemicals or contaminants as listed in section 10.7.1. Avoid installing the boiler in any area with possible contaminants.</p>
	<p>If contaminants are found, you MUST: - remove contaminants permanently. or - relocate the boiler and air intake to an area free from all possible contaminants.</p>

10.10 Direct venting options

Two pipe wall

See § 10.11 for more details.

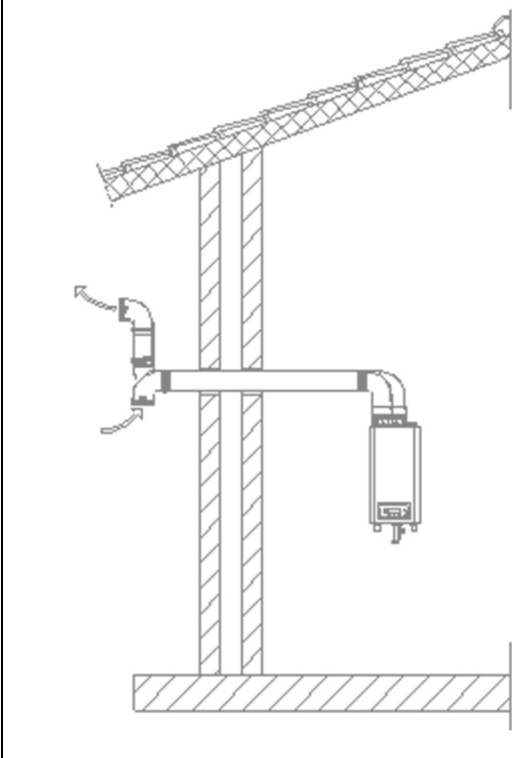


Figure 10.5

Two pipe vertical

See § 10.12 for more details.

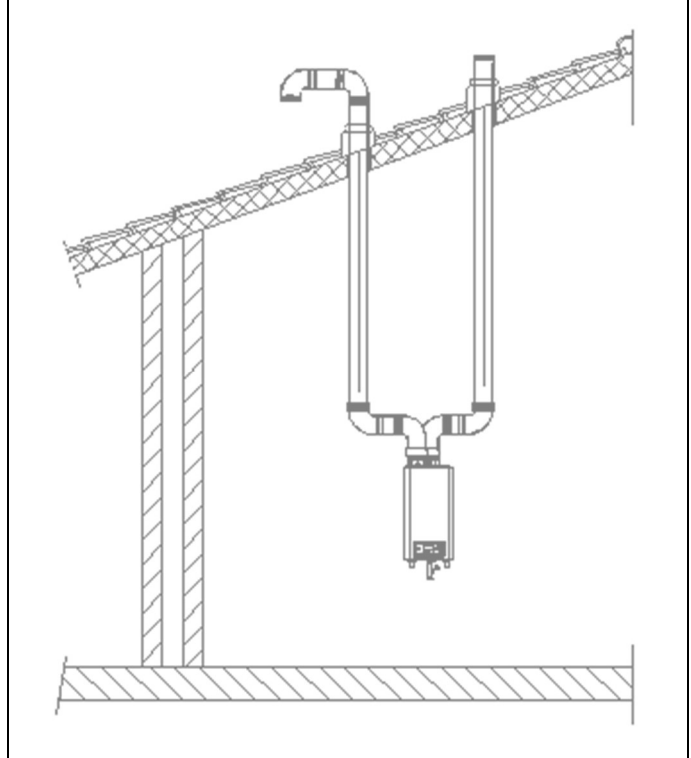


Figure 10.6

Single pipe wall (room air)

See § 10.7 for more details

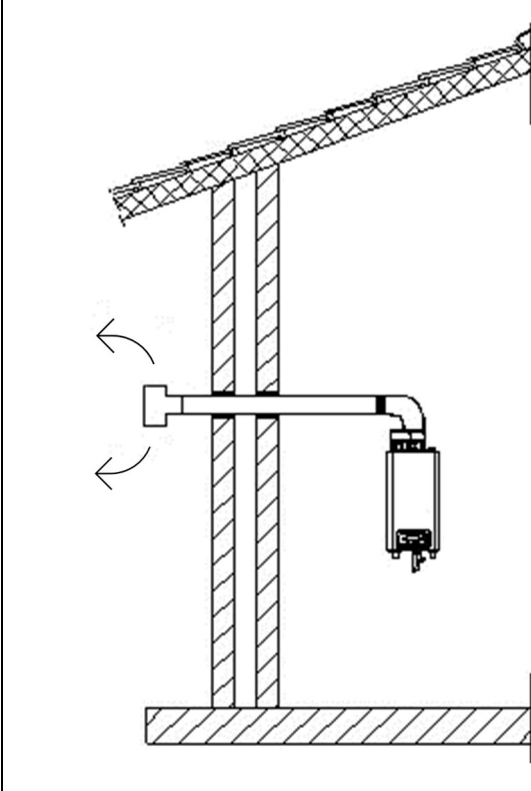


Figure 10.7

Single pipe roof (room air)

See § 10.7 for more details

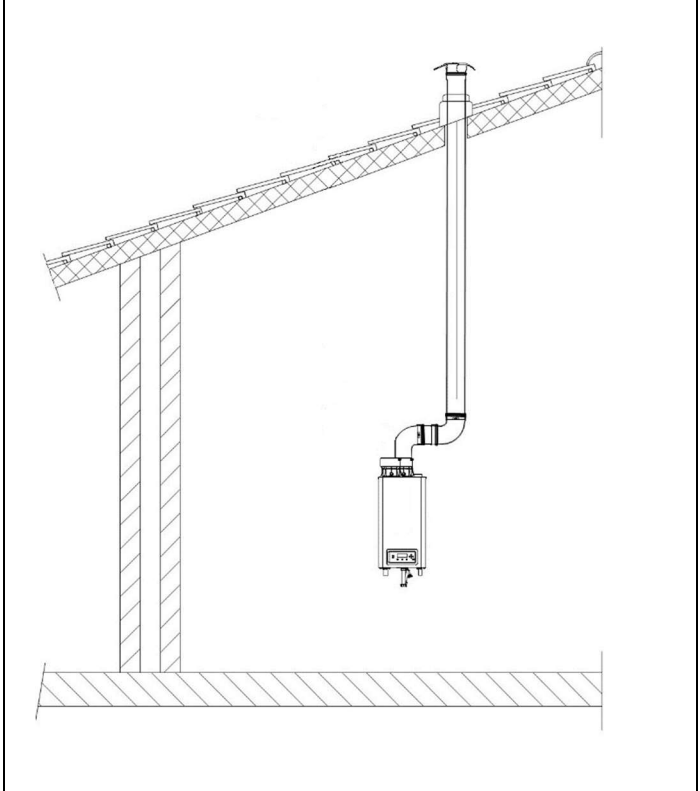


Figure 10.8

Concentric wall - two pipe to boiler
 Boilers CB 299W, CB 399W only.
 See § 10.11 for more details.

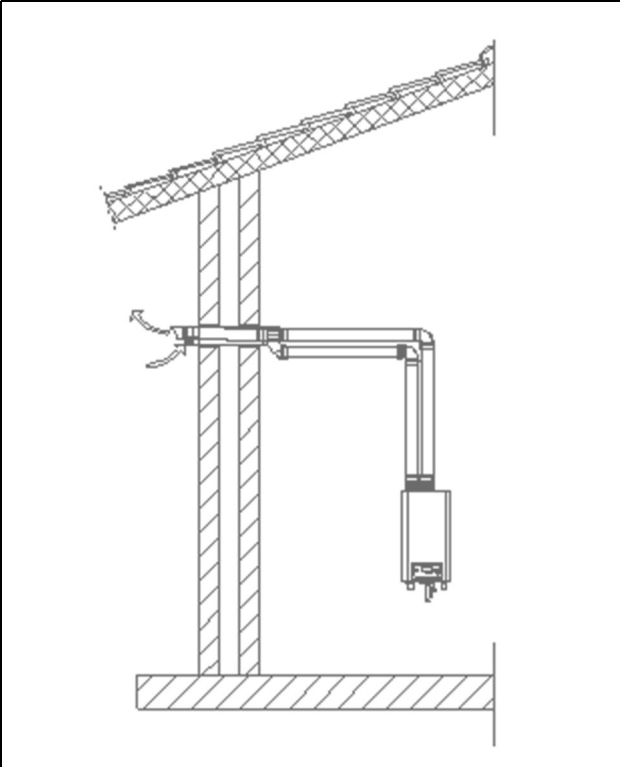


Figure 10.9

Concentric wall - concentric to boiler
 Boilers CB 299W, CB 399W only.
 See § 10.11 for more details.

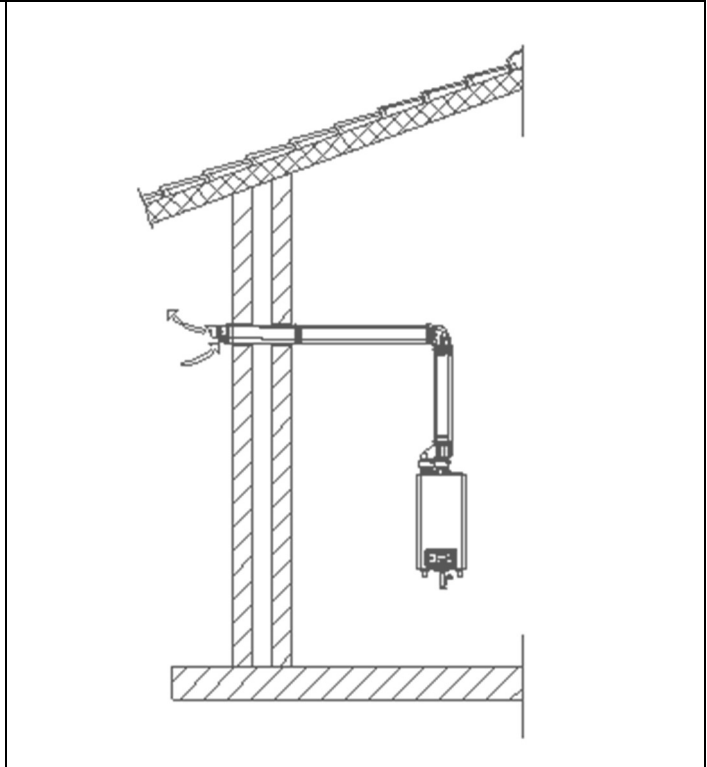


Figure 10.10

Concentric vertical - two pipe to boiler.
 Boilers CH 299W, CH 399W only.
 See § 10.12 for more details

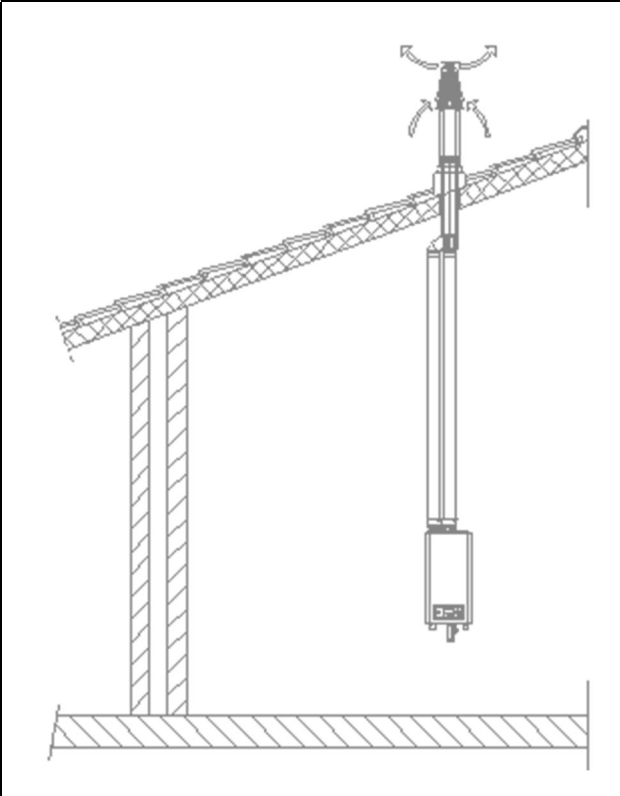


Figure 10.11

Concentric vertical - concentric to boiler
 Boilers CH 299W, CH 399W only.
 See § 10.12 for more details.

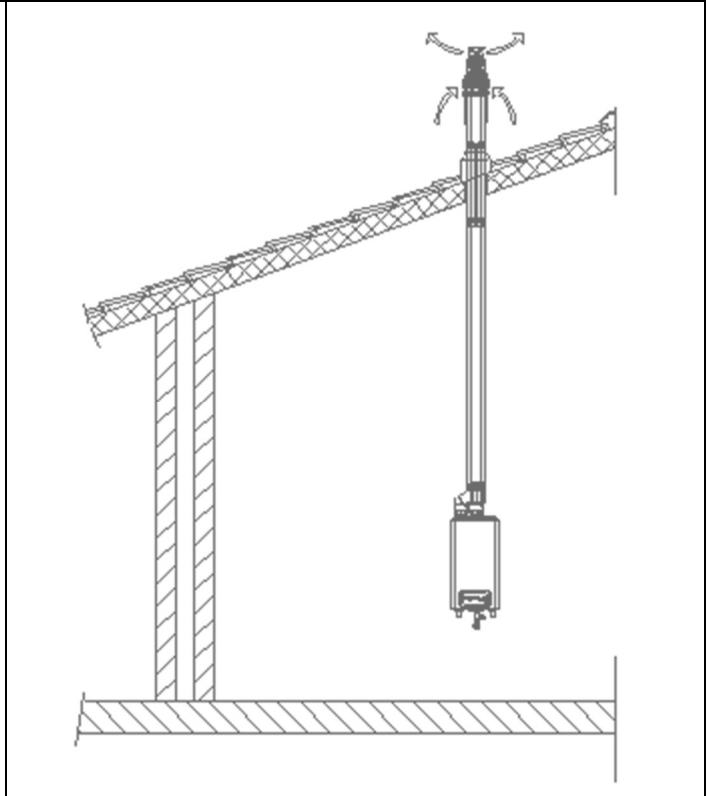




Figure 10.12

10.11 Wall (Horizontal) direct venting.

10.11.1 VENT/AIR TERMINATION - WALL


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

10.11.2 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 table 10.2 (§ 10.1.2) 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 90 degree down-turned elbow as shown in Figure 10.14 or 10.16. 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 Figure 10.14 or 10.16

 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 as air intake pipe material
--	--

10.11.3 SIDE WALL PENETRATION

1. Vent pipe penetration through combustible or non-combustible wall material must maintain a minimum 1/2" [13 mm] clearance for PVC/CPVC vent. The diameter of the penetration hole must be:
 - 5½ inch hole (140 mm) for 4 inch (102 mm) vent pipe
 - 7½ inch hole (191 mm) for 6 inch (152 mm) vent pipeWhen using Polypropylene or AL29-4C® Stainless Steel Vent, refer to the vent manufacturer's Installation Instructions for clearances.
2. Locate the vent pipe penetration to provide clearances as described in Figure 10.13.
3. The installer must use a galvanized metal thimble for the vent pipe penetration and properly seal the PVC/CPVC vent pipe to the vent termination plate using silicone sealant.

- Properly support the PVC/CPVC using pipe metal strap hangers or equivalent pipe hangers suitable for plastic pipe.
- The installer must comply with all local codes for isolating the vent pipe as it passes through floors and walls.
- The installer must seal all exterior openings around penetration with an exterior silicon caulk

10.11.4 POSITIONS

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

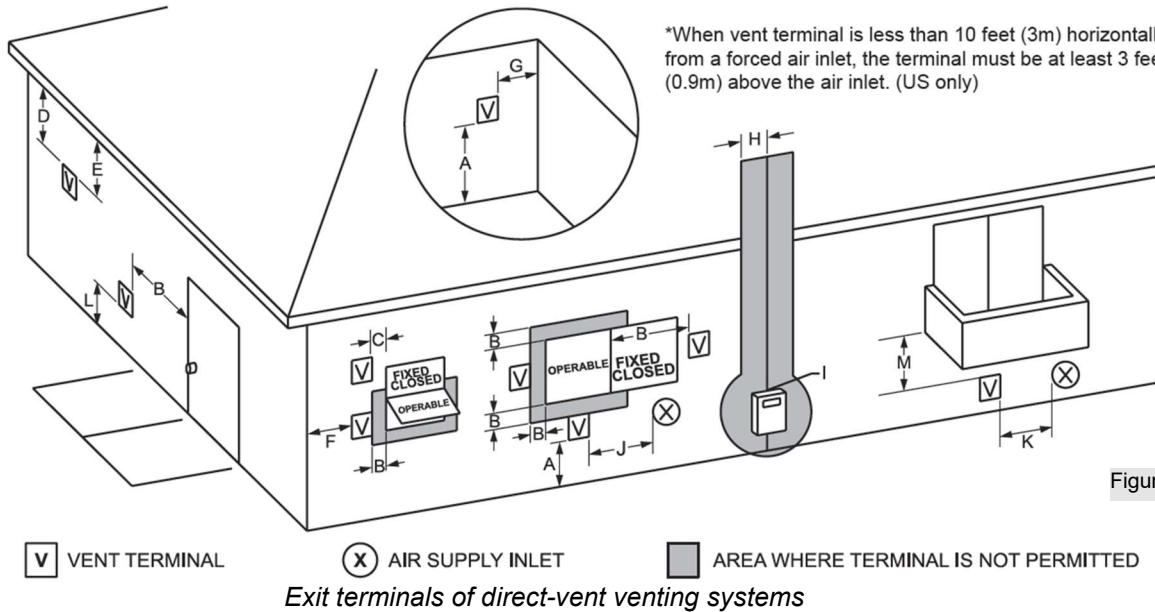


Figure 10.13

fig	Location	Minimum clearances for US installations (ANSI Z223.1/NFPA 54)	Minimum clearances for Canadian installations (CSA B149.1)
A	Clearance above finished grade level, 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	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 (non-openable) 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 of building	see note 4	see note 5
G	Clearance to inside corner of building	see note 4	see note 5
H	Clearance to each side of center line extended above gas meter/regulator assembly/electric meter and relief equipment	4 ft	4 ft
I	Clearance to service regulator vent outlet	4 ft	4 ft
J	Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	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	10 ft horizontally from inlet or 3 ft above inlet	6 ft (1.83 m)
L	Clearance above paved sidewalk or paved driveway located on public property	7 ft (2.1 m) see note 7	7 ft (2.1 m) see note 7 and 8
M	Clearance underside of veranda, porch, deck, or balcony	12 inch, see note 6	12" (30 cm) see note 6

Table 10.18

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-B149.1, clearance is in accordance with local installation codes and the requirements of the gas supplier
note 6: Permitted only where the area beneath the veranda, porch, deck, or balcony is open on not less than two sides. The vent terminal is prohibited in this location where only one side is open.
note 7: Not located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard
note 8: A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings

Two pipe sidewall termination of air intake and exhaust vent.

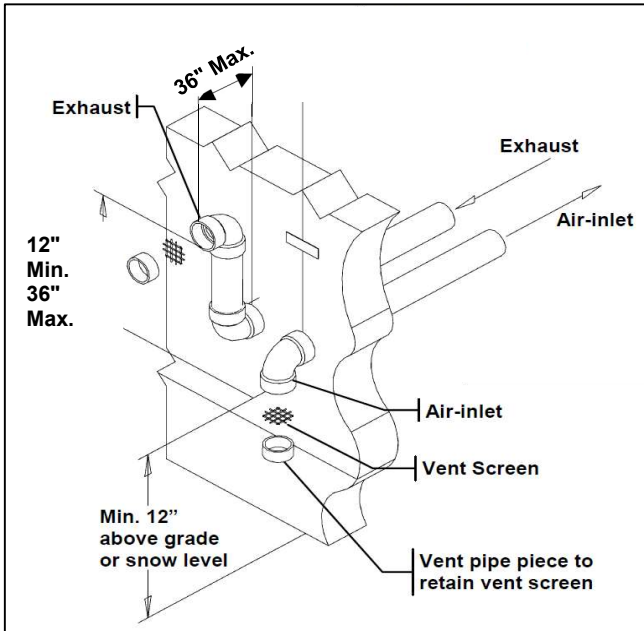


Figure 10.14

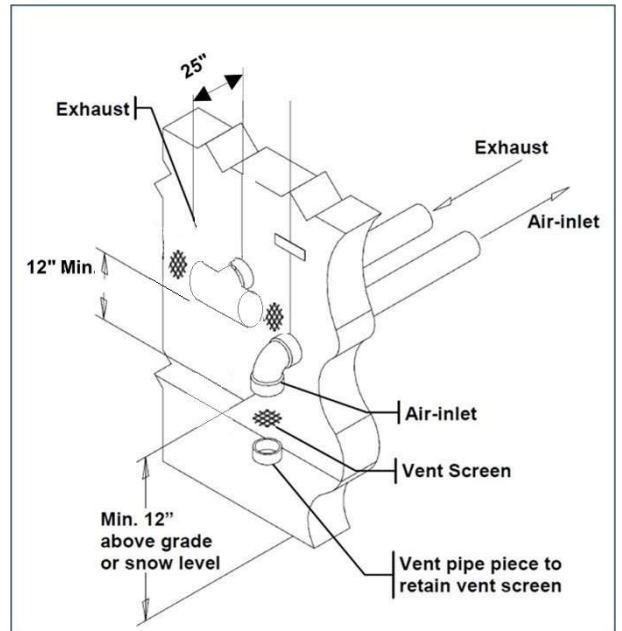


Figure 10.15

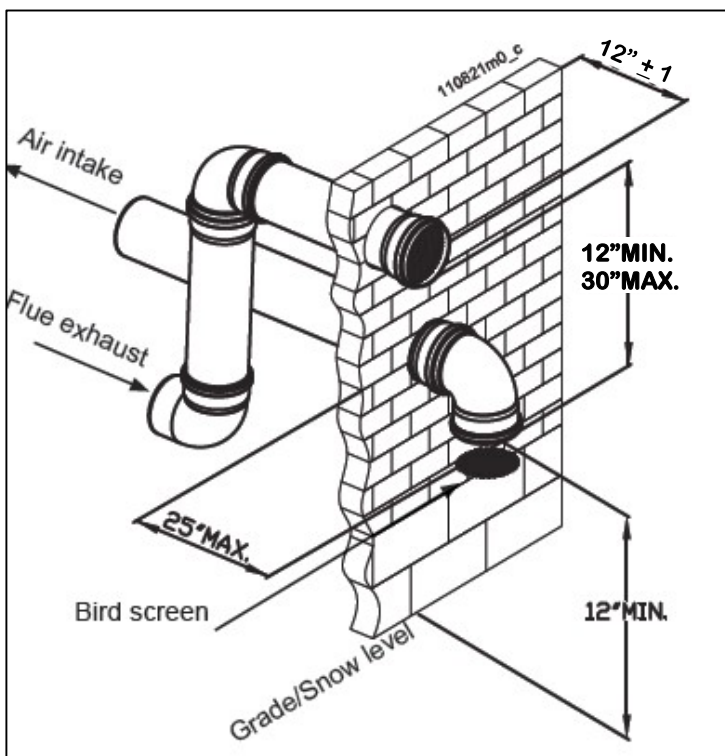



Figure 10.16

Two pipe sidewall termination assembly.



Manual




WARNING

Do not extend the vent pipe outside the sidewall beyond the dimensions shown in Figures 10.14, 10.15, 10.16, 10.18, 10.19 and 10.20. Extended exposure of the vent pipe could cause condensate to freeze and block the vent pipe, resulting in substantial property damage, serious injury, or death

Figure 10.17

Multiple vent/air terminations

1. When terminating multiple boilers, terminate each vent/air connection as described in this manual (Figure 10.18).

 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 below Figure 10.18 for U.S. installations. For Canadian installations, provide clearances required by the latest edition of the CAN/CSA B149.1 Natural Gas and Propane 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.

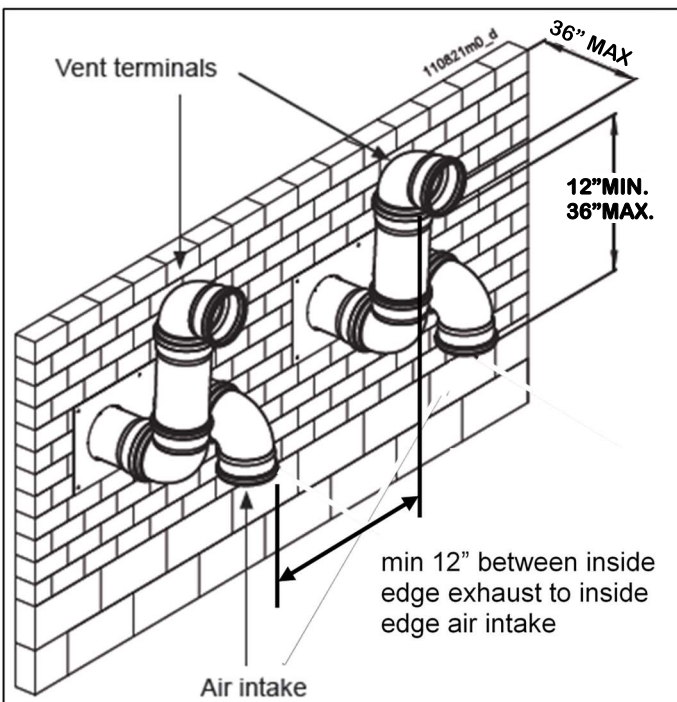


Figure 10.18

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

Wall termination – low profile

Description and usage: Two 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 10.19. The required combustion vent pipe materials are listed in Table 10.4 of this manual.

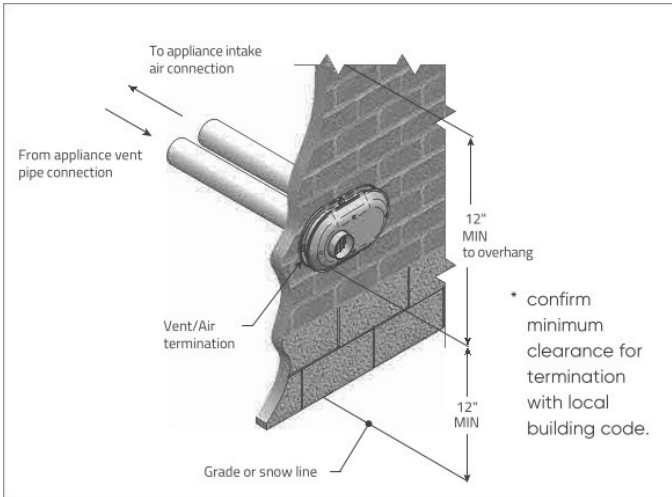


Figure 10.19



Figure 10.20

Wall termination – concentric vent: boilers CB 299W and CB 399W 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 10.21. The required combustion vent pipe materials are listed in Table 10.4 of this manual.

Concentric sidewall termination clearances: boilers CB 299W and CB 399W only

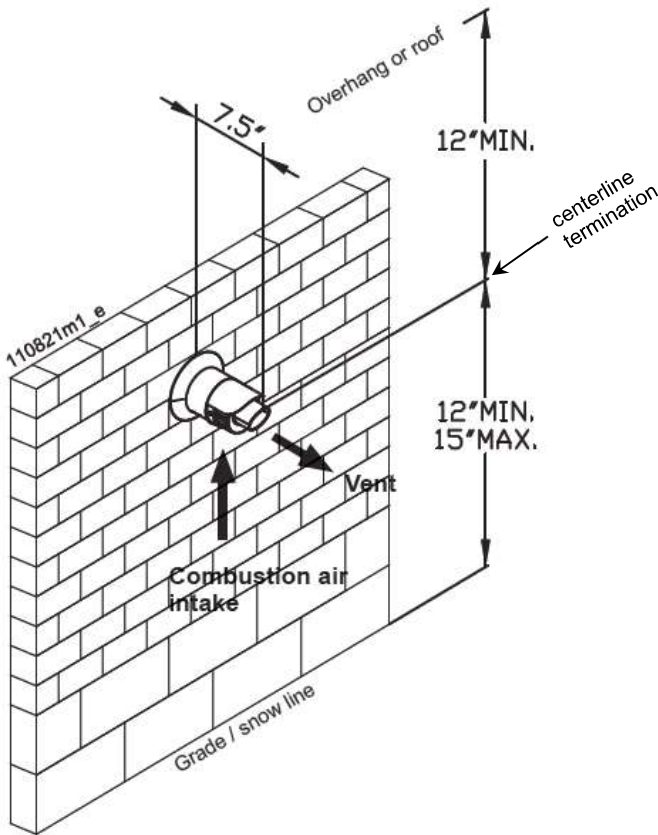




Figure 10.21

Sidewall termination installation:

- Determine the best location for the termination kit (see Figure 10.13).
- Reference § 10.11.2 of this manual for general termination considerations.

 NOTICE	Ensure termination location clearance dimensions are as shown in Figure 10.21 or 10.22.
 CAUTION	DO NOT use field-supplied couplings to extend concentric terminations. Airflow restriction will occur and could 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. 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 should be installed as shown in figures 10.18 or 10.22. It is important that vent terminations be made as shown to avoid recirculation of flue gases.

Concentric sidewall multiple boilers termination.

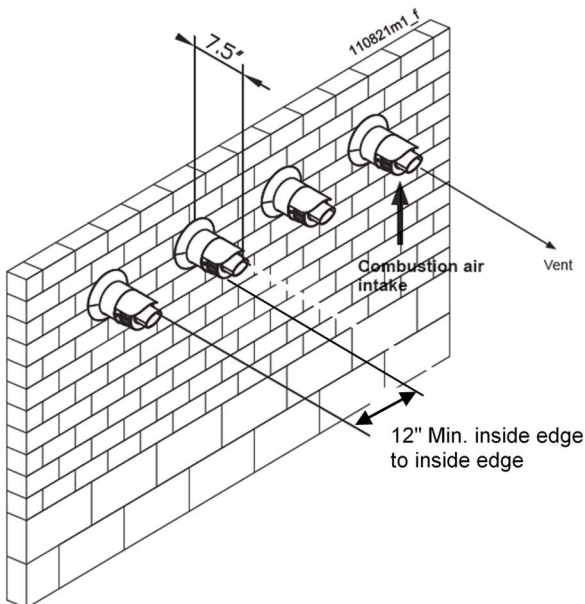



Figure 10.22

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

10.12 Roof (Vertical) direct venting.


10.12.1 VENT/AIR TERMINATION – VERTICAL


 WARNING	Follow instructions below when determining vent location to avoid possibility of severe personal injury, death or substantial property damage.
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10.12.2 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 § 10.1.2 of this manual.
2. Prepare the vent termination and the air intake termination elbow (Figure 10.21) 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 10.21
5. The exhaust piping must terminate in a vertical coupling as shown in Figure 10.21. 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 10.23.
7. Make sure the exhaust vent does not end under an overhang or other building structure that could be damaged when flue gas is conveyed against it.

 WARNING	Do not extend the vent pipe above the roof beyond the dimensions shown in in this document. Extended exposure of the vent pipe could cause condensate to freeze and block the vent pipe, resulting in substantial property damage, serious injury, or death.
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 WARNING	Rooftop exhaust vent and air intake inlet terminations must terminate in the same pressure zone.
---	--

Two pipes vertical termination of air and vent.

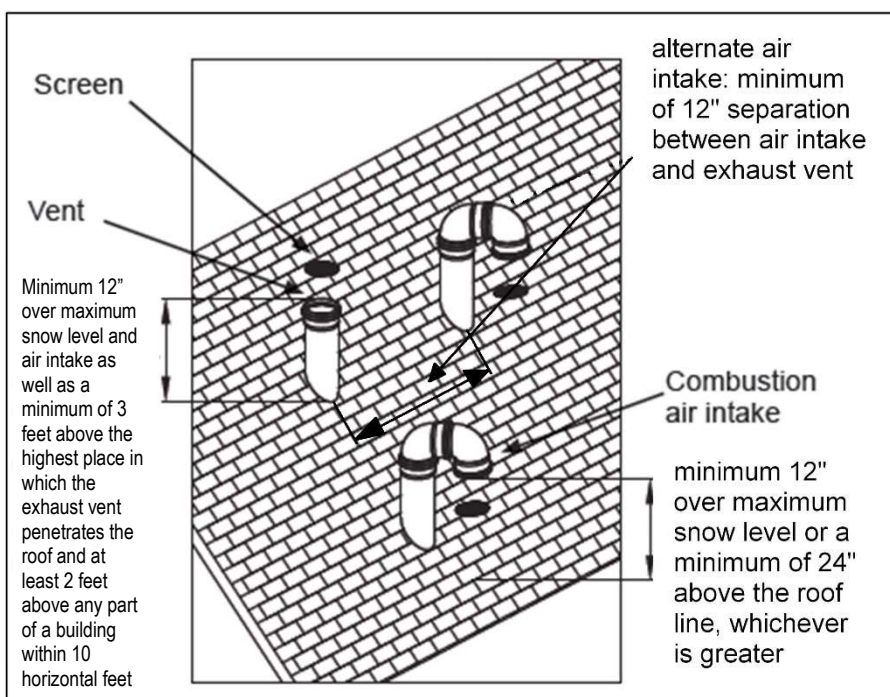



Figure 10.23

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 (figures 10.23, 10.24 and 10.25).

	<p>Terminate all exhaust vent pipes at the same height and all air intake pipes at the same height to avoid recirculation of flue products. Failure to comply with the requirements can result in substantial property damage, serious injury, or death.</p>
---	--

2. Place roof penetrations to obtain minimum clearance of 12 inches (305 mm) between outside edge of air intake and exhaust vent of another boiler for U.S. installations (see Figure 10.24). For Canadian installations, provide clearances required by the latest edition of the CAN/CSA B149.1 Natural Gas and Propane 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 screens.

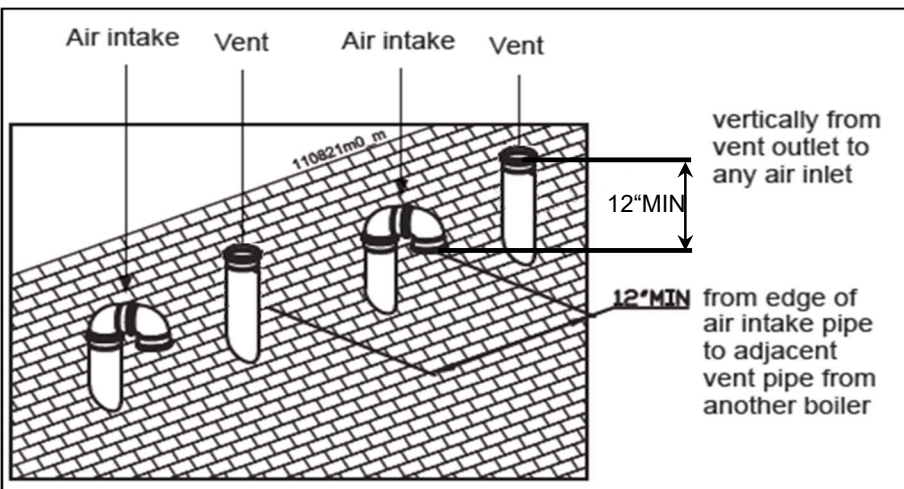


Figure 10.24

Alternate vertical terminations with multiple boilers.

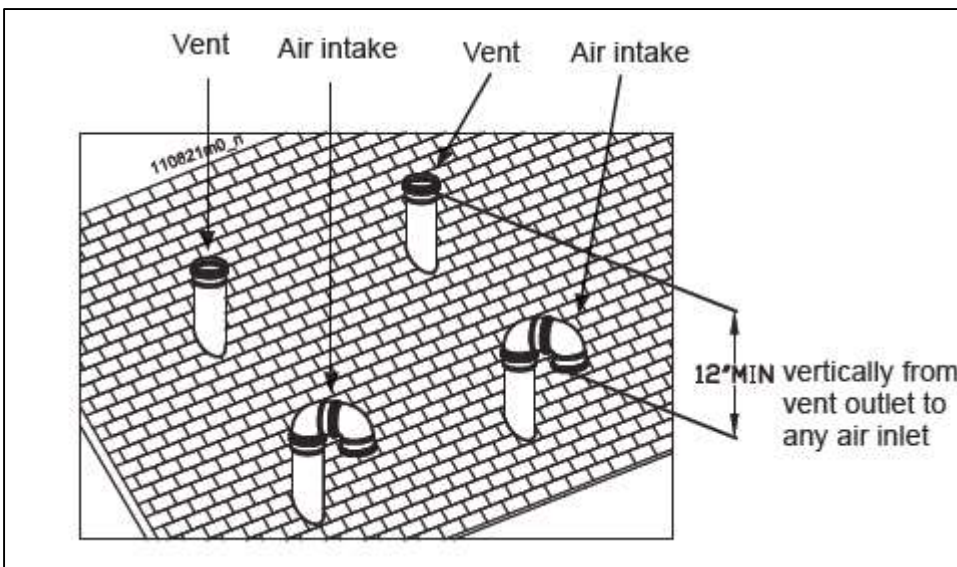


Figure 10.25

Note: keep the terminals at a minimum of 12" above grade or snow line. Provide vent and air intake with bird screens.

Concentric Vertical Termination: boilers CB 299W and CB 399W only

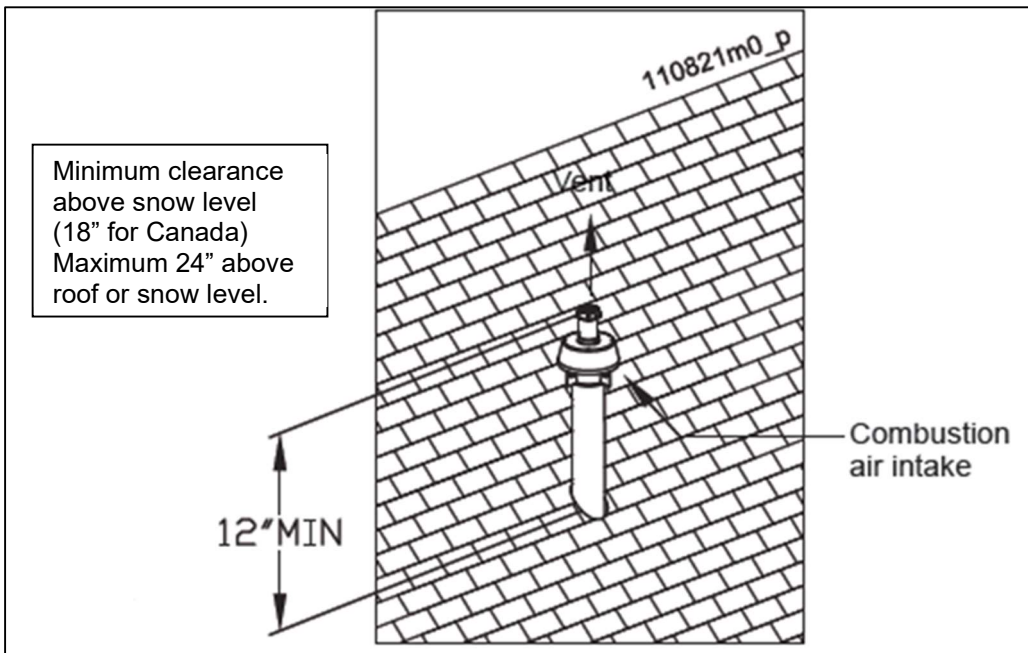


Figure 10.26

Do Not Install U-Bend or elbow on a concentric termination



Figure 10.27

 WARNING	<p>Do not operate the appliance with the rain cap removed on the concentric terminations or recirculation of combustion products can 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 substantial property damage, serious injury, or death.</p>
 NOTICE	<p>Do not allow insulation or other materials to accumulate inside the pipe assembly when installing through the hole.</p> <p>Ensure termination height is above the roof surface or anticipated snow level (a minimum of 12 inches (305 mm) in U.S.A. or 18 inches (457 mm) in Canada) as shown in Figure 10.24.</p>
 CAUTION	<p>DO NOT use field-supplied couplings to extend concentric terminations. Airflow restriction will occur.</p>

Multi venting vertical terminations

When two (2) or more direct vent appliances are vented near each other, each appliance must be individually vented (see figures 10.23, 10.24, 10.27 or 10.28) or common vented (see Chapter 11). 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.

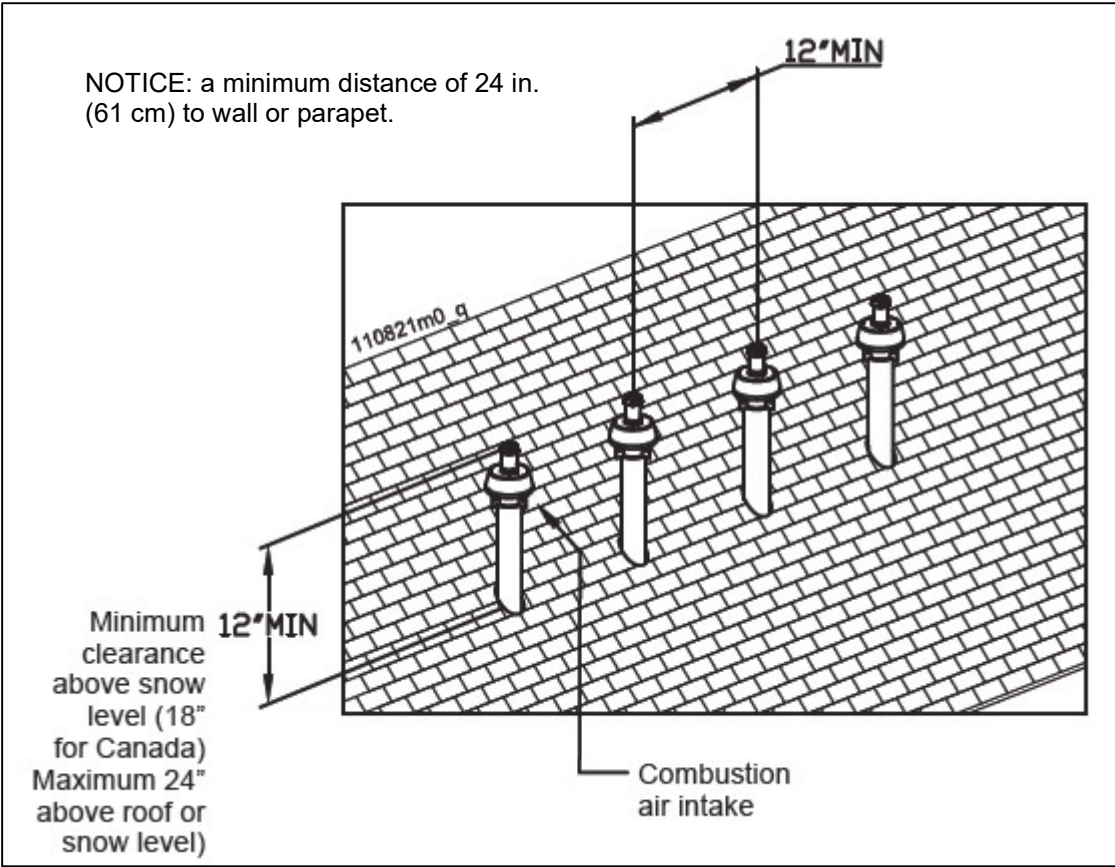


Figure 10.28

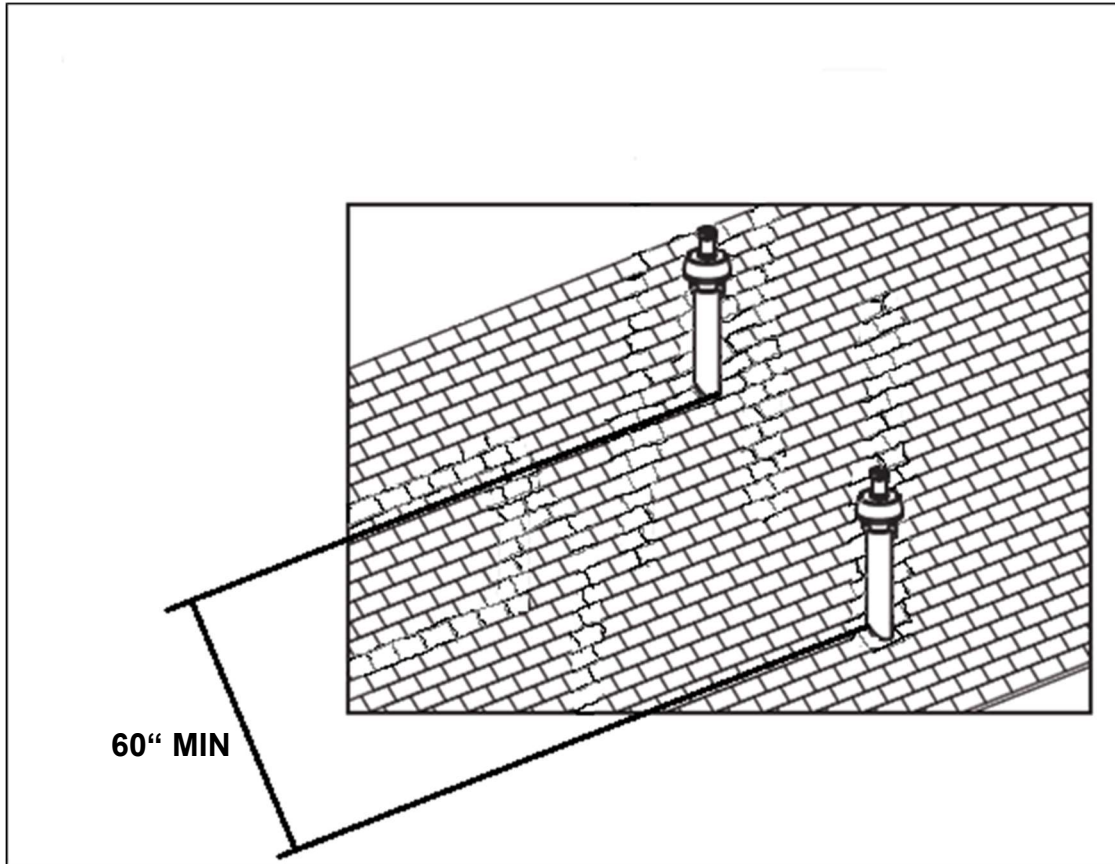


Figure 10.29

11 COMMON VENT CASCADING

11.1 Introduction

All CB boilers have an internal flue gas valve for a positive pressure category IV common vent. This device is needed to prevent recirculation of the flue gases.

If common venting is required contact Triangle Tube. Triangle Tube offers a factory supplied certified common venting system designed by Duravent to work with the boilers. The system is available in both Stainless Steel and PolyPro.

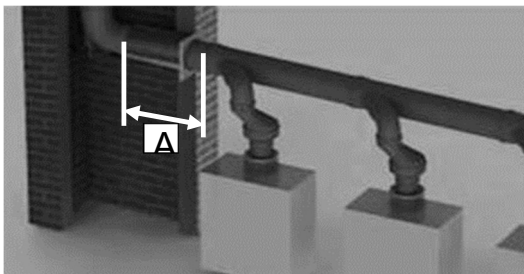


Figure 11.1



For common vent installation and information please see the Ionic Common Vent Installation and Operations Manual.

11.2 Existing Common Venting Guidelines.

Do not common vent the WCB boiler with the vent pipe of any other boiler or appliance. However, when an existing boiler 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 in the US and the Natural Gas and Propane Installation Code, CSA B149.1 in Canada. 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 the National Fuel Gas Code, ANSI Z223.1/NFPA 54 in the US and the Natural Gas and Propane Installation Code, CSA B149.1 in Canada.



Do not install the Ionic WCB boiler into a common vent with any other appliance. Failure to follow all these requirements will result in severe personal injury, death, or substantial property damage.

12 ELECTRICAL INSTALLATION

12.1 General

- For operation, the boiler needs a dedicated 120 VAC / 15A service.
- The boiler mains supply connection is **polarity sensitive**.
- The wiring for the connections should be routed 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 and the manual gas valve closed.**
- Electrical wiring must 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 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 provincial or local codes and regulations.
- Wiring the boiler must 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 prohibited to make changes or alterations to the internal wiring fitted by the manufacturer.
- the installer line voltage terminals are locate on the left side of the control panel.
- the installer low voltage terminals are locate on the right side of the control panel.
- The boiler, when installed, must be electrically bonded to ground in accordance with the requirements of the authority having jurisdiction or, in the absence of such requirements, with the National Electrical Code, NFPA 70, in the US and the Canadian Electrical Code CSA C22.1 Part 1, in Canada.
- A spare fuse is mounted on the casing of the burner controller.



If local electrical codes require an additional service switch, the installer must provide and install a fused disconnect or minimum 15 amp service switch.



ELECTRICAL SHOCK HAZARD. For your safety, disconnect electrical power supply to the unit before servicing or making any electrical connections to avoid possible electric shock hazard. Failure to do so can cause serious injury, or death.

12.2 Connection power supply

- It is advised to use a flexible cable between the cabinet entry (knockout at the bottom) and the connection terminals.
- The earth wire has to be longer than the line and neutral wire.
- The power supply cable must be secured by utilizing a strain relief on in the inside of the boiler cabinet where the wires enter the knockout.
- 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 = Line voltage; 9 = Neutral; PE = Ground.
- It is required to use flexible or hard conduit when connecting all line voltage 120V connections to the boiler, for both incoming power to the boiler and outgoing power to any circulators or other accessories.
- use only the knock outs on the bottom of the boiler for making line voltage 120v connections.

12.3 Low Voltage wiring

- Line and Low Voltage wiring should be separated to prevent possible electrical noise on the low voltage circuits. Line and Low Voltage wiring should use separate electrical knockouts on the Ionic cabinet and should remain separated inside the Ionic.
- all low voltage wiring should be secured using a strain relief.
- If the sensor wires are located in an area with sources of electromagnetic interference (EMI), the sensor wires should be shielded or the wires should be run in a grounded metal conduit. If using shielded cable, the shielding should be connected to the common ground of the unit.
- use 18 AWG wiring 2 wire cable to wire the outdoor sensor



CH call connections to the Ionic require a dry contact with no external voltage present. Ensure no external voltage is present on each set of wires before connecting to the Ionic. If external voltage is present, the use of an isolation relay is required to prevent damage to the boiler management module.

12.3.1 ADDITIONAL SAFETY LIMITS

The boiler has low voltage connections for three external safety limits that can be field wired, LWCO Extern, Safety Switch 1, and Safety Switch 2. All three create manual reset lockouts in the control. The following accessory safety limits are available from the factory:

- UL approved flow switch: part number E361100008
- external manual reset high limit: part number E361100009
- 24V manual reset LWCO with test function: part number E361100007

A set which includes these three safety limits is available with part number E361000002

12.4 *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	Safety switch 1	Gas pressure switch	LWCO Extern	AL-BUS managing boiler	Pump control PWM	Flow switch DHW	0-10 Vdc	On/Off thermostat or modulating thermostat	AL-BUS depending boiler	Modbus	DHW sensor	System sensor	Outdoor sensor	Sécurité passer 2	Sécurité passer 1	Gas la pression passer	Eau basse coupée à l'extérieur	AL-BUS chaudière gérant	Commande de pompe PWM	Interrupteur de débit ECS	0-10 Vcc	Régulateur marche/ arrêt ou régulateur modulant	AL-BUS chaudière dépendant	Capteur DHW	Capteur de système	Capteur extérieur			

Figure 12.1



LINE 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
	DHW PUMP				SYSTEM PUMP			GENERAL PUMP			MAINS SUPPLY				ALARM	
MAXIMUM TOTAL OUTPUT 3.5 Amps NOMINAL	DHW TWV (3-WAY) VALVE Vanne ECS (3 voies) MAX 2 Amps				Pompe du système MAX 2 Amps			Pompe générale MAX 2 Amps			Alimentation secteur				Alarme	

Figure 12.2

 NOTICE	Read: "circulator" if the word "pump" is used
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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 is factory installed in all boiler models.

12.5 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. An outdoor sensor is provided with every boiler from the factory.	
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 at the system side, close to the low loss header. NOTICE: This sensor (See figure 8.9 or 8.10 in § 8.21) must be used when boilers are cascaded with the internal cascade manager. A system sensor accessory part number E361100001 is available. PARAMETER: boiler parameter 122, see § 12.11 "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 must 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. A DHW sensor accessory part number E361100002 is available.	
7-8-9	MODBUS
Connections for a MODBUS communication signal 7 = ground, 8 = A, 9 = B (A detailed Modbus manual 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 boilers, 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: § 12.11 "programmable in- and outputs"	
14-15	0-10 VDC CONTROL SIGNAL
These terminals are used for an external 0-10 VDC control input signal, used in heating modes 4 and 5. 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 circulator is started. The temperature of the DHW is set with DHW_Setpoint. PARAMETER: boiler parameter 117, see § 12.11 "programmable in- and outputs"	
18-19	PWM – CIRCULATOR CONTROL
PWM pump signal, use this to control a PWM pump. The PWM signal determines the speed of the circulator, when there is a heat demand. 18 = Signal (PWM input), 19 = Ground (signal ref). It is also possible to convert the PWM signal to a 0-10V signal, see § 6.2 for the accessory. Parameter 136 has to be set to modulating (Factory set to on/off circulator) when using a modulating circulator.	
20-21	AL-BUS MANAGING / CASCADE
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. An accessory external LWCO manual reset with a test function is available, part number E361100007.	
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 § 12.12 "programmable in- and outputs". A gas pressure switch kit part number E361000001 is available for the 299 and 399 models. The kit is factory installed on 500 models.	
26-27	SAFETY SWITCH 1
To be used for an extra external safety switch. The boiler goes into a lockout when this contact opens. An ASME CSD-1 kit part number E361000002 is available as an accessory which includes an external flow switch , a LWCO manual reset and an external manual reset high.	
28-29	SAFETY SWITCH 2
To be used for an extra external safety switch. The boiler goes into a lockout when this contact opens	

Table 12.1

12.6 Explanation of the mains voltage connections.

1-2-3-PE	DIVERTER VALVE DHW indirect tank / DHW PUMP
<p>If an indirect domestic hot water tank is installed, a 3-way valve or a circulator (P2) can be used to divert hot water to the heating coil of the tank. This 3-way valve will open, or circulator will power on, when the indirect tank has a heat demand.</p> <p>PARAMETER: boiler parameter 128, see § 12.11 "programmable in- and outputs" 1 = L1 wire (heating position); 2 = Neutral wire; 3 = L2 (hot water position); PE = Ground.</p> <p>The inrush current of the 3-way valve or circulator must not exceed 8 Amps, see § 9.5 for detailed electrical specifications.</p>	
4-5-PE	SYSTEM CIRCULATOR / DHW CIRCULATOR / CH CIRCULATOR
<p>Connections for the power supply of a central heating system circulator (P3, see § 9.5 for detailed electrical specifications).</p> <p>4 = Line voltage; 5 = Neutral wire; PE = Ground</p> <p>PARAMETER: boiler parameter 125, see § 12.11 "programmable in- and outputs"</p>	
6-7-PE	BOILER CIRCULATOR
<p>Connections for the power supply of a boiler circulator. (P1, see § 9.5 for detailed electrical specifications).</p>	
8-9-PE-PE	MAINS SUPPLY
<p>The power supply connection of the unit. 8 = Line voltage wire; 9 = Neutral wire, PE = Ground wire</p>	
10-11	ALARM RELAY
<p>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. Alternatively, a relay can be used. In that case a resistor must be added to the circuit.</p> <p>The alarm will be activated 60 seconds after an error has occurred.</p> <p>There are a few exceptions:</p> <ul style="list-style-type: none"> - Alarm output will not be activated for a service warning; - Alarm output will not be activated for warning 202 (Appliance selection). <p>10 = Line wire; 11 = Neutral wire</p> <p>ATTENTION: <u>The neutral wire is connected to the neutral connection of the boiler.</u></p> <p>Only use this neutral connection with a single boiler and a single alarm.</p> <p>PARAMETER: boiler parameter 127, see § 12.11 "programmable in- and outputs"</p>	
X1-X2-X3	HIGH POWER IGNITER (external igniter)
<p>A separate connector for an external igniter is located on the cable tree, near the boiler controller and labelled "High power ignitor". This is the line voltage connection for the external ignition transformer, which is factory installed in all boiler models.</p>	

Table 12.1

 NOTICE	<p>To all outputs the following applies: maximum current 2 Amps for each output. Total output of all currents combined maximum 3.5 Amps. The inrush current of the 3-way valve and/or circulators is maximum 8 Amps. If pumps with higher amperage are selected, use a relay, see § 6.2 Accessories.</p>
--	---

12.7 Electrical schematics

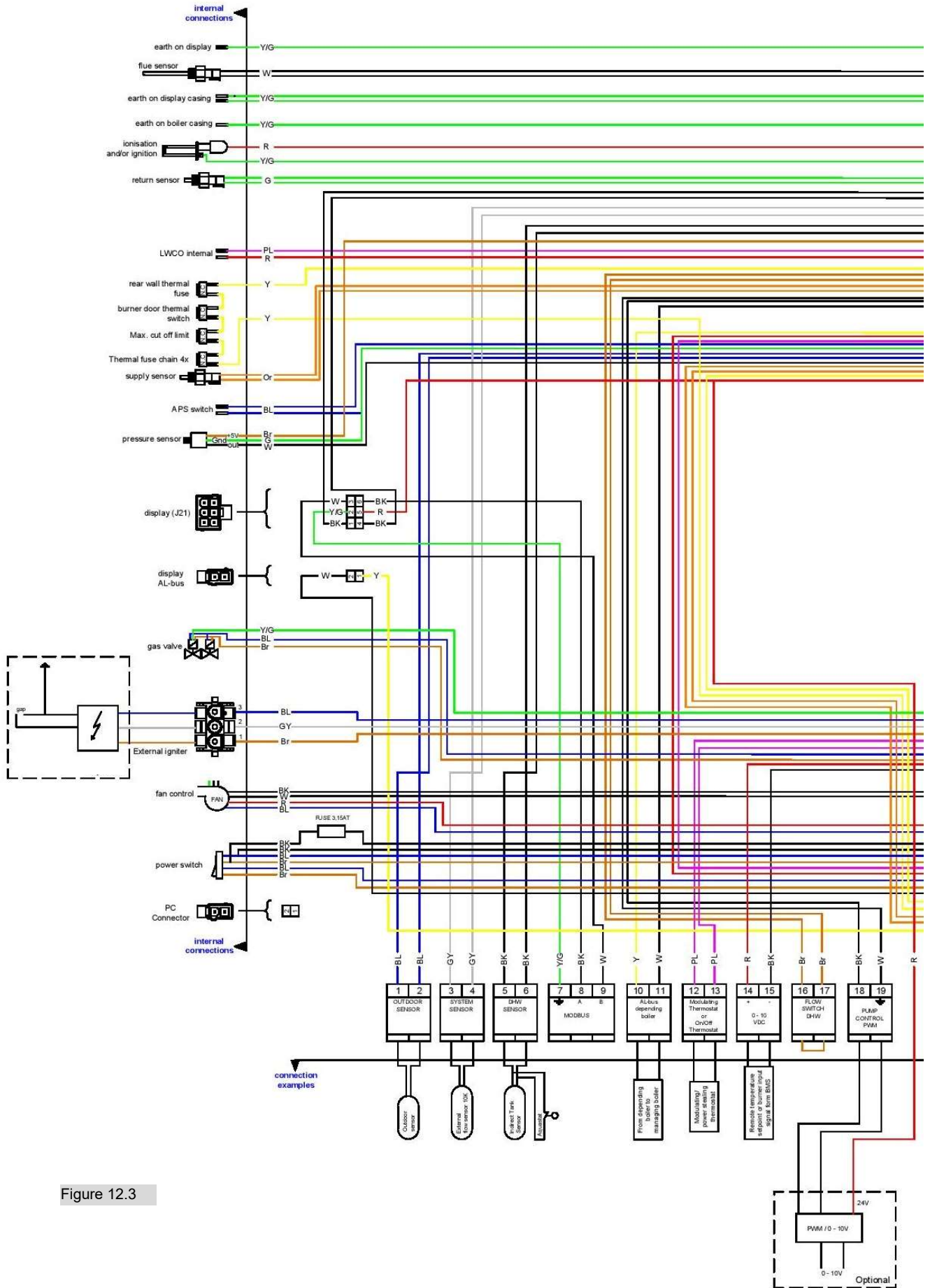


Figure 12.3

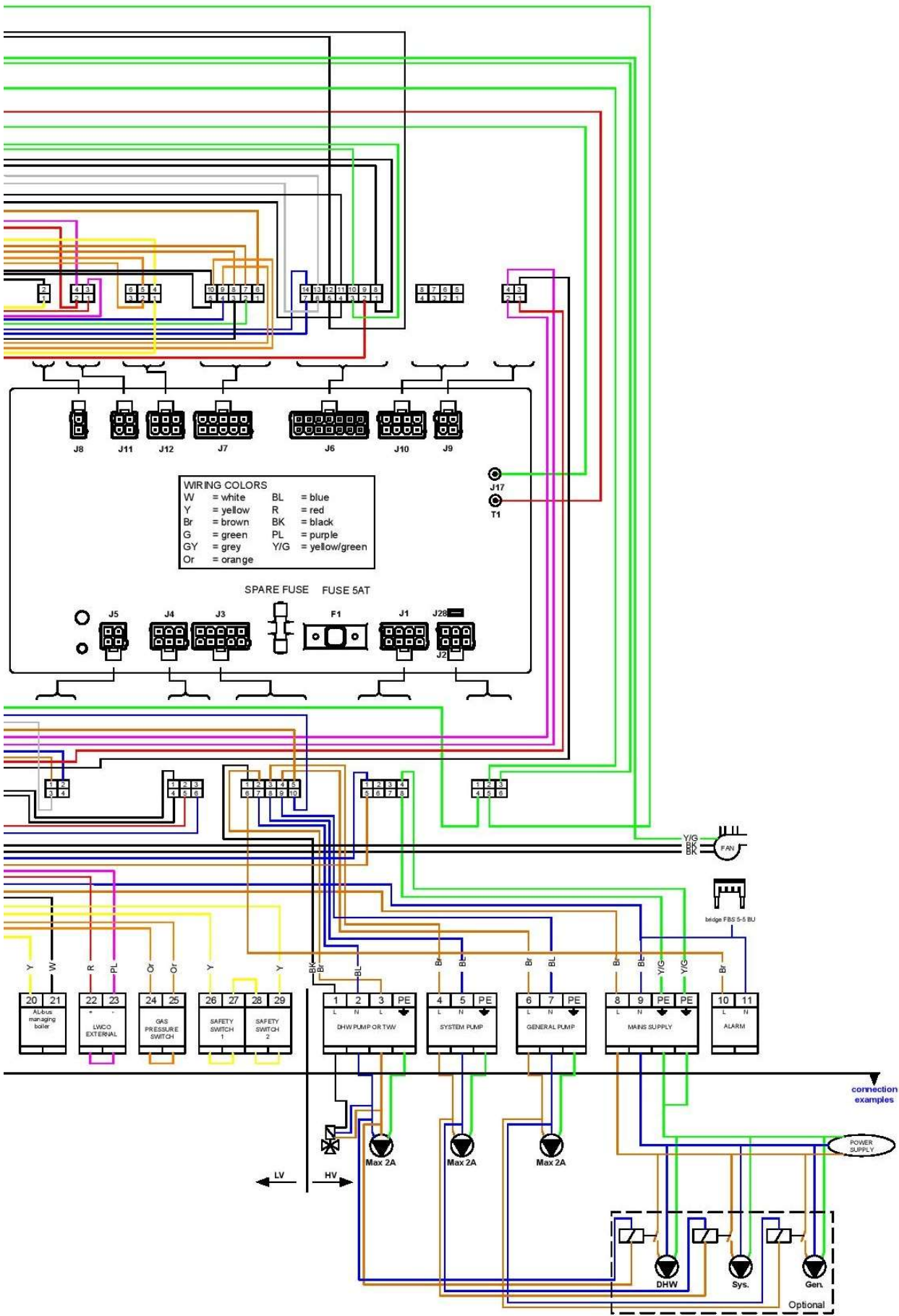


Figure 12.4

E15.000.034

12.8 Ladder / logic diagram

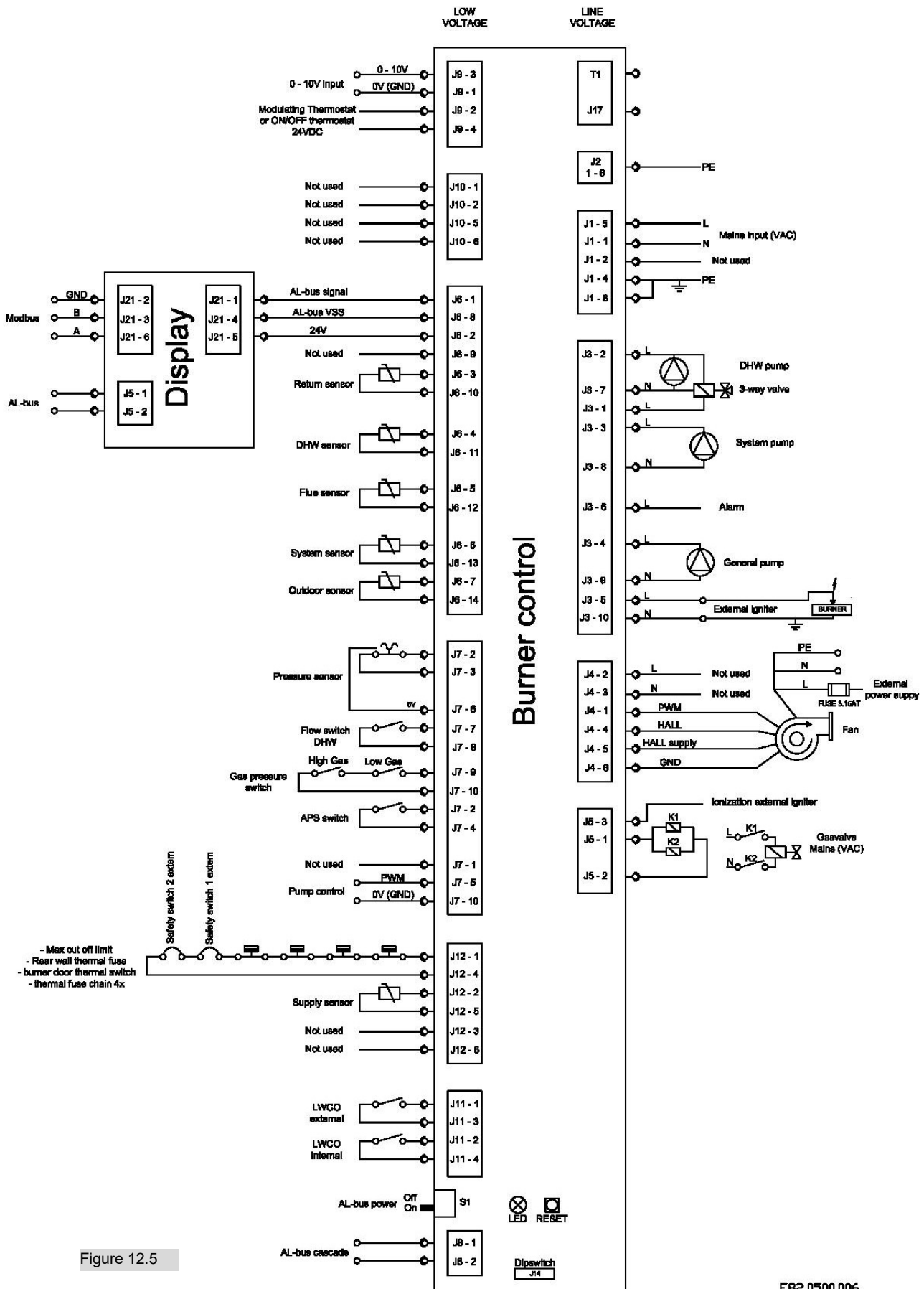


Figure 12.5

E82.0500.006

12.9 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.

Table 12.3

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	4	5	6	7	8	
					N.A.	N.A.	N.A.	N.A.	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.

Table 12.4

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
 DHW mode 4 to 8 N.A.

12.10 NTC sensor curve

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

Temperature		Resistance	Temperature		Resistance	Temperature		Resistance	Temperature		Resistance
°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

Table 12.5


An outdoor sensor is provided in the box with every Ionic CB boiler. The DHW and System sensor are available as an accessory. See chapter 6.2

12.11 Programmable in- and outputs

It is possible to re-program some in- and outputs to other functions. To do this use list below 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 on	LV 12-13
(125)	Prog. Output 1.	2	CH circulator	HV 4-5-PE
(126)	Prog. Output 2.	9	Ext. Igniter	separate connector
(127)	Prog. Output 3.	6	Alarm semi-conductor output.	HV 10-11
(128)	Prog. Output 4.	3	3-way Valve DHW circulator	HV 3-2-1

Table 12.6

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

parameter	Display:	INPUTS:	re-mark	parameter	Display:	OUTPUTS:	re-mark
(117)	Prog. Input 2.	0 Disabled		(127)	Prog. Output 3.	0 Disabled	
		1 DHW flow sensor	N.A.			1 Module pump	N.A.
		2 DHW flow switch				2 CH pump	N.A.
		3 CH flow sensor	N.A.			3 DHW pump	N.A.
(118)	Prog. Input 3.	4 CH flow switch				4 System pump	N.A.
		0 Disabled				5 Cascade pump	N.A.
		1 Drain switch				6 Alarm relay	2)
(122)	Prog. Input 7.	2 Gas pressure switch				7 Filling valve	2)
		0 Disabled				8 LPG tank	2)
		1 T_Flue_2 sensor	N.A.			9 Ext. Igniter	2)
		2 Disabled	N.A.			10 Air damper	2)
		3 Cascade sensor					
(124)	Prog. Input RT.	4 Blocked Flue switch	N.A.	(128)	Prog. Output 4.	0 Disabled	
		5 CH Sensor				1 Module pump	
	Display:	0 room thermostat off				2 CH pump	
		1 room thermostat on				3 DHW pump	
(125)	Prog. Output 1.	4 System pump				4 System pump	
		5 Cascade pump				5 Cascade pump	
		6 Alarm relay				6 Alarm relay	
		7 Filling valve				7 Filling valve	
		8 LPG tank				8 LPG tank	
		9 Ext. Igniter				9 Ext. Igniter	
		10 Air damper				10 Air damper	
		11 empty				11 empty	
		12 empty				12 empty	
		13 empty				13 empty	
(126)	Prog. Output 2.	14 empty				14 empty	
		15 empty				15 empty	
		16 empty				16 empty	
		17 3-way Valve CH				17 3-way Valve CH	
		18 3-way Valve DHW				18 3-way Valve DHW	
		19 3-way Valve CH (power when idle)				19 3-way Valve CH (power when idle)	
		20 3-way Valve DHW (power when idle)				20 3-way Valve DHW (power when idle)	
		1 Module pump	1)			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.	
		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)						

Table 12.7

13 BOILER CONTROLLER AND DISPLAY.

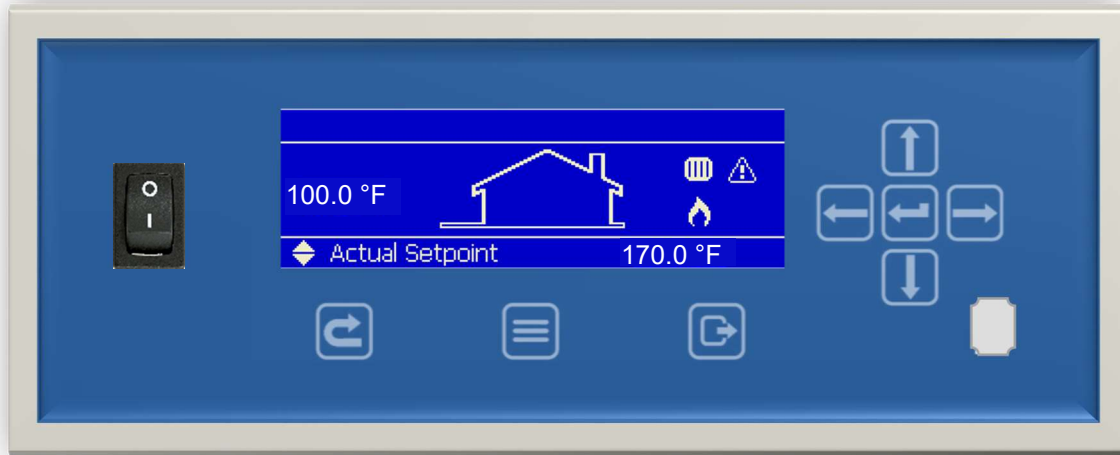


Figure 13.1

13.1 Explanation of the 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

Figure 13.2

13.2 Display configuration.

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

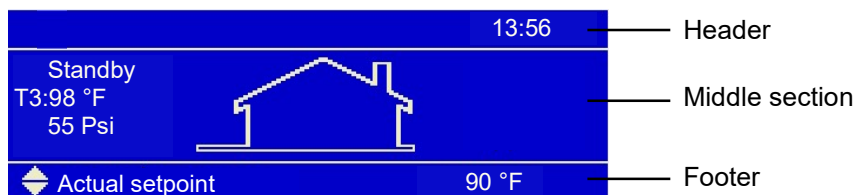


Figure 13.3

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): <ul style="list-style-type: none"> ▪ 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 level
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.

13.3 Starting the boiler

If the boiler is not on make sure the gas valve beneath the boiler is open and the power is wired into the mains, use the on/off button to switch the boiler on. The following screen will occur:

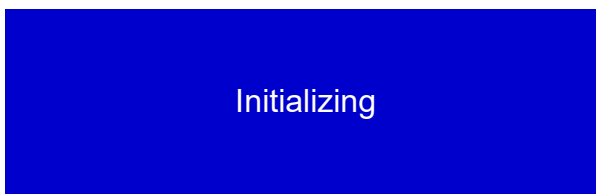


Figure 13.4

This screen is active during power up until communication with the main Control has been established. After communication has been established the Dair mode is running and the following screen appears:

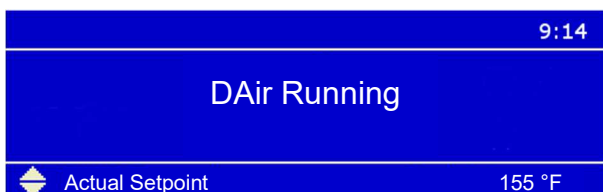



Figure 13.5

The "De-Air" sequence is a safety function that starts at every power-up and is used to remove the air from the heat exchanger. The De-Air sequence takes around 14 minutes to complete. It can be canceled by pressing the Enter button for over 5 seconds.

 CAUTION	Do not bypass the Dair function upon initial startup of the boiler or when water has been added to the boiler/system. Bypassing the Dair function may cause damage to the heat exchanger which could cause the boiler to fail. Bypassing the Dair function could lead to overheating or under heating resulting in property damage.
---	---

After completion or manual ending the "De-Air" sequence one of the following Status overview screens appears:

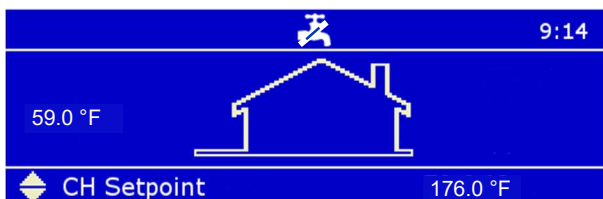


Figure 13.6

This screen shows on the bottom the "CH setpoint" temperature. On the middle left the outdoor temperature (if sensor is connected).

13.3.1 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 $\uparrow\downarrow$ to select the mode, then press CONFIRM \leftarrow or RIGHT \rightarrow to confirm the mode and the Actual/DHW setpoint becomes directly settable. Use UP \uparrow or DOWN \downarrow to increase/decrease the setpoint. Press CONFIRM \leftarrow or RIGHT \rightarrow to confirm your alteration or press ESC $\boxed{\text{C}}$ or LEFT \leftarrow 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.

13.3.2 SET THE SETPOINT BY THE MENU BUTTON

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.

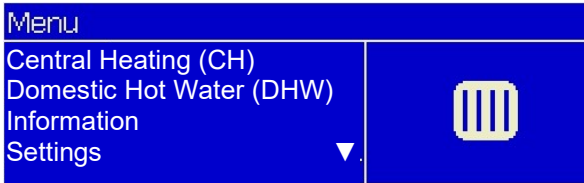




Figure 13.7

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 go back one step in the menu press MENU  or ESC .



Figure 13.8

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:

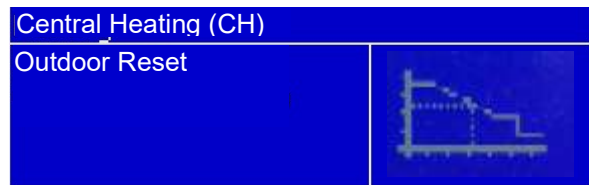


Figure 13.9



Enter a menu item by pressing CONFIRM  or RIGHT .

The header shows your location inside the menu, as seen in the following image:



Figure 13.10

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 go back one step in the menu press MENU  or ESC .


13.3.3 PROTECTED MENU ITEMS

Some menu items are protected and only accessible via a password* The following password screen will appear:



Figure 13.11

Users are only allowed to change parameters not needing a password. Installers have to use the password 1122 to change parameters protected by a password.

 WARNING	<p>Changing protected/safety parameters should only be conducted by experienced, licensed boiler operators, qualified installer, service agency, or the gas supplier. Hazardous burner conditions can happen with improper operations that could result in SUBSTANTIAL PROPERTY LOSS, SERIOUS PHYSICAL INJURY, or DEATH.</p>
---	---

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.

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 in the top bar, the associated number indicates which user-level is unlocked (1:Installer, 2:Factory).

menu items	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

13.3.4 LANGUAGE SETTINGS

The display supports the following languages:


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

Table 13.2

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

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

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

Table 13.3

13.3.6 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.

13.4 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

Table 13.4

13.5 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.

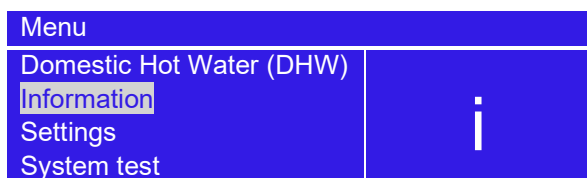


Figure 13.12

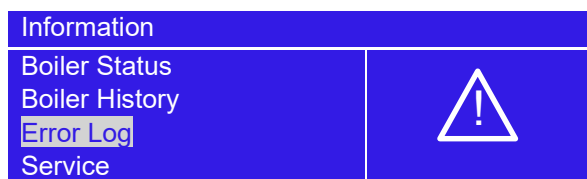


Figure 13.13

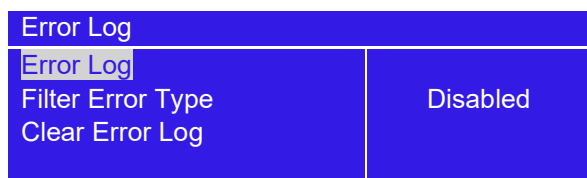


Figure 13.14

(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, Dep2, etc.)
Clear Error Log	Clear the error log (protected by password)

Table 13.5

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.



Figure 13.15

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 figure 13.15 on page 83.
 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.

13.6 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.

13.6.1 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.

13.6.2 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.

13.6.3 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.
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.

Table 13.6

13.7 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.

Fuses	Line 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	1.0 µA	
	Start-detection	1.5 µA	
Cable length AL-BUS ¹		AWG	(mm ²)
		23	(0.25)
		20	(0.5)
		18	(0.75)
		17	(1.0)
		15	(1.5)
		Cable length (m)	
			328.1 ft (100)
			656.2 ft (200)
			984.3 ft (300)
			1312.3 ft (400)
			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.

Table 13.7

13.7.1 CIRCULATOR START EVERY 24 HOURS

To protect the circulator 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 circulator.

13.7.2 FROST PROTECTION

The Frost protection function protects the boiler and boiler loop from freezing.

The T_Supply and T_Return sensors are checked for generating a Frost protection demand.

- When any of the sensors drop below FP_Start_Circulator the boiler loop circulator 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 circulators continue circulating the boiler loop for Boiler_Pump_Overrun (settable)

13.7.3 FLUE TEMPERATURE PROTECTION

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


- When the T_Flue sensor measures above the Max_Flue_Gas_Temp, 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°C) and Max_Flue_Gas_Temp.

Parameters are factory set

	<p>Repeated flue gas errors could indicate an issue with the boiler or the exhaust flue venting. If repeated errors occur check the boiler to ensure it is running correctly, has sufficient flow, and that the heat exchanger has been serviced and cleaned at the required maintenance intervals. Check to ensure there are no blockages in the venting or terminations. Failure to follow these instructions could result in substantial property damage, serious injury, or death</p>
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13.8 Ignition cycle

During the ignition cycle multiple safety checks are active

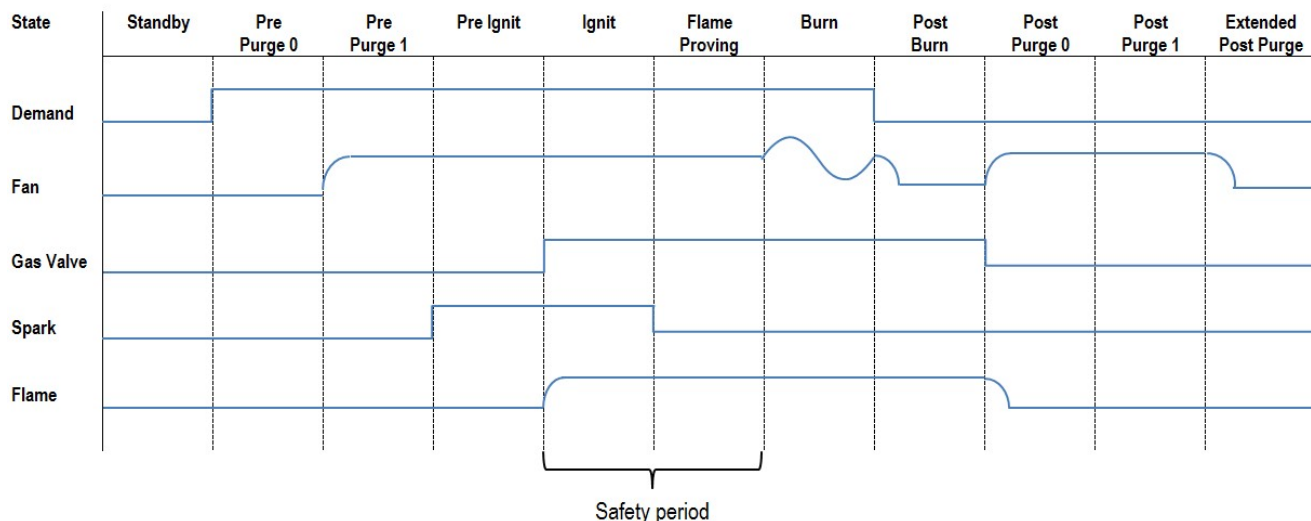


Figure 13.16

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

#	Burner state	Actions
0	INIT	<ul style="list-style-type: none"> Controller initialization
1	RESET	<ul style="list-style-type: none"> Software reset (and initialization)
2	STANDBY	<ul style="list-style-type: none"> Standby (waiting for demand)
3	PRE_PURGE_0	<ul style="list-style-type: none"> Fan is not running When an APS is enabled the APS position is checked Circulator starts Air damper check is performed
4	PRE_PURGE_1	<ul style="list-style-type: none"> Fan starts at ignition speed When an APS is enabled the APS position is checked
5	PRE_IGNIT	<ul style="list-style-type: none"> Fan stays at ignition speed Igniter is started When a LPG tank is selected, the tank valve is opened
6	IGNIT	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Fan is set to minimum speed The gas valve stays opened
10	POST_PURGE_0	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Fan stays at ignition speed When an APS is enabled the APS position is checked
12	ERROR_CHECK	<ul style="list-style-type: none"> Blocking error is set Checking if blocking error can be removed (error situation is solved)
13	ALARM	<ul style="list-style-type: none"> Lockout error is set User must reset the lockout error (and the controller will reboot)
14	BURNER_BOOT	<ul style="list-style-type: none"> Finalize processes and reboot the control

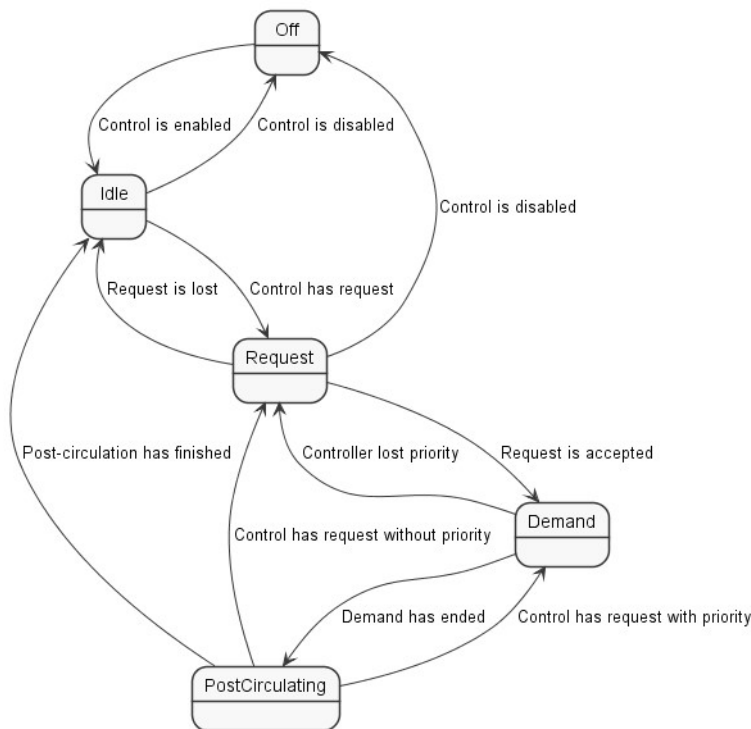
Table 13.8

During the ignition cycle multiple safety checks are active, none of the initiation timing settings are adjustable:

False flame detection	If a flame is detected at the end of the pre-spark period (<i>Pre_Ignit</i>) a lockout will occur.
Re-ignition	If at the end of the safety period no flame is detected the control will go to <i>Post_Purge</i> to remove any unburnt gas. After this a re-ignition attempt is started following the same cycle. The number of re-ignition attempts is limited to <i>Max_Ignit_Trials</i> after which a lockout occurs.
Flame establishing time	Sparking stops in the <i>Flame_Proving</i> state to allow for ionization detection. The <i>Flame_Proving</i> state takes <i>Safety_Period - Ignit_Period</i> .
Flame out too late	If at the end of the <i>Post_Purge</i> 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 <i>Max_Flame_Trials</i> setting.
Fan supervision	The fan speed is continuously monitored. The following conditions for the fan speed are checked: <ul style="list-style-type: none"> ▪ The actual fan speed must be within 300RPM of the target fan speed ▪ When the fan speed duty cycle is within the lower/upper 5% of the PWM duty cycle range no errors will be generated since the fan is in the limits of its working range.

Table 13.9

13.8.1 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.

Figure 13.17

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.

Table 13.10

13.8.2 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 (reset) and a 2 color (red/green) LED. These are used to indicate basic status information about the control.

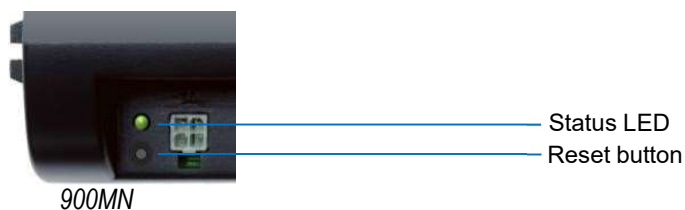


Figure 13.18

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.

13.8.3 FLAME DETECTION

When the boiler is firing, and the flame is not detected anymore, the gas valve will be closed, and the controller will perform a post-purge, after which a restart will take place.

When the flame disappears three times within one heat demand, the controller will lockout.

The presence of a flame is measured through the flame rod that points into the flame. Between this flame rod and earth an electromagnetic field is present. When a flame is present, the free electrons in the flame flow from the rod to the earth. This flow of electrons is the flame current.

The flame current is measured by the controller as ionization in micro Amperes (μA).

When the flame current is above $\text{Flamerod_Setpoint} + \text{Flamerod_Hysteresis}$ ($1.0 \mu\text{A} + 0.5 \mu\text{A}$) a flame will be regarded as present. When the flame current is below Flamerod_Setpoint ($1.0 \mu\text{A}$) the flame will not be present.

13.8.4 FLAME RECOVERY

When the ionization current at minimum fanspeed is too low, the system responds by increasing the minimal fan speed, in order to keep the flame present.

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 $\text{Flamerod_Setpoint} + \text{Flamerod_Delta}$ ($1.0 \mu\text{A} + 0.2 \mu\text{A}$) the minimal fan speed will be increased.
- When the flame current is above $\text{Flamerod_Setpoint} + \text{Flamerod_Delta} + \text{Flamerod_Delta} * 2$ ($1.0 \mu\text{A} + 0.2 \mu\text{A} + 0.4 \mu\text{A}$) 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

Table 13.11

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

13.9 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.

13.9.1 CH WITH ROOM THERMOSTAT ONLY; CH MODE 0

For this mode no outdoor sensor is needed.

If the room thermostat closes, the boiler and system circulators are switched ON. When the supply temperature drops CH_Hysteresis_Down below the CH_Setpoint (settable via the menu) the boiler is switched ON. The power for the boiler is regulated between T_Supply and the CH_Setpoint using the PI parameters for Central Heating. If the supply temperature reaches a temperature CH_Hysteresis_Up above the CH_Setpoint the boiler is switched OFF. However, if CH_Setpoint + CH_Hysteresis_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 circulators run ON for Boiler_Pump_Overrun.

Anti-cycling time

(This function is also applicable to all other CH modes) When the boiler is switched OFF because the supply temperature reaches CH_Setpoint + CH_Hysteresis_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 short cycling ON and OFF of the boiler. However, when during the anti-cycle wait time the differential between setpoint and supply temperature gets greater than Anti_Cycle_Temp_Diff, anti-cycle will be aborted, and the boiler is allowed to start.

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 Max._Power_CH

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 Min._Power_CH

Adjustable Set Point Heating Parameters

Specific Parameters	Parameter no.	Level	Default Value	Range
CH Mode	1	2: Installer	1	Mode 0-5
CH Setpoint Sets the required supply temperature.	3	1: User	180°F (82°C)	68.....194°F (20.....90°C)
Boiler Pump Overrun	5	2: Installer	120 sec.	10.....900 sec
Anti-Cycle Period	9	2: Installer	180 sec	10.....900 sec
Anti-Cycle Temp. Diff Aborts anti-cycle time when setpoint – actual supply temp > Anti_Cycle_T_Diff.	10	2: Installer	29°F (16°C)	0.....36°F (0.....20°C)
Max. Power CH Maximum boiler power for CH operation	14	2: Installer	100 %	1.....100 %
Min. Power CH Minimum boiler power for CH operation	15	2: Installer	1 %	1.....50 %

Table 13.12

13.9.2 CH WITH AN OUTDOOR TEMPERATURE RESET AND THERMOSTAT; CH MODE 1 (FACTORY DEFAULT SETTING)

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 not connected, the boiler automatically uses Design_Supply_Max._Limit (par. 24) as setpoint. 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 § 13.9.1).

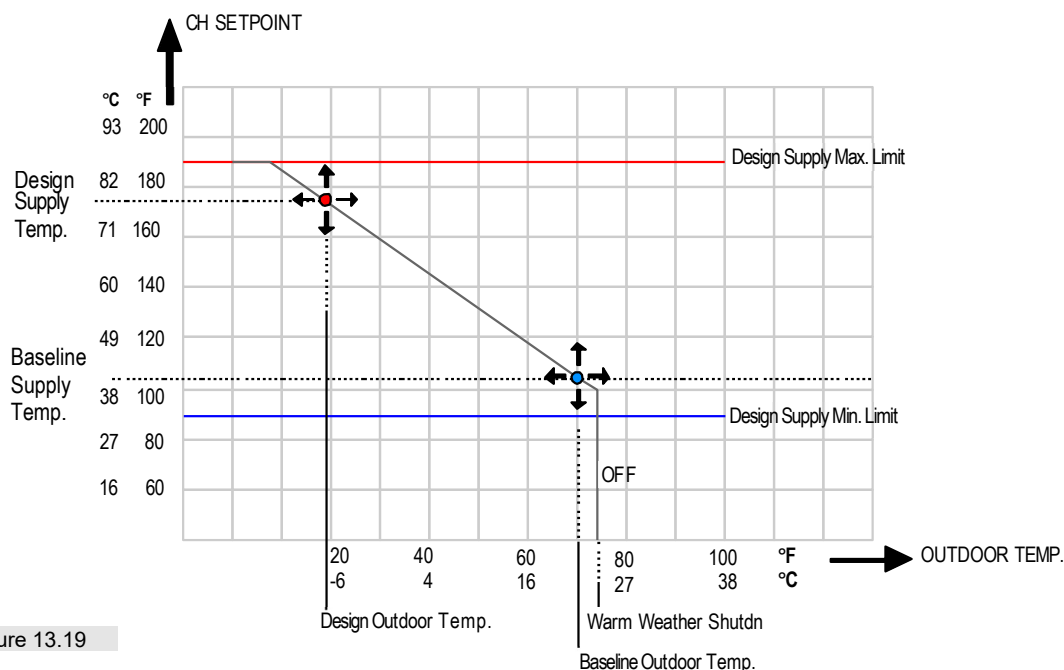


Figure 13.19

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 Design_Supply_Temp. and Baseline_Supply_Temp.

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 Design_Supply_Temp.

Shutdown temperature

When the outdoor temperature rises above Warm_Weather_Shutdn, the call for heat is blocked and the circulators are stopped. There is a fixed hysteresis of 2°F (1 °C) around the Warm_Weather_Shutdn setting. This means that the demand is stopped when the outdoor temperature has risen above Warm_Weather_Shutdn plus 2°F (1°C). When the outdoor temperature drops below Warm_Weather_Shutdn minus 2°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_Temp_Increment) if a call for heat continues beyond the pre-set time limit (Boost_Time_Delay).

Boiler Parameters		
(25) Warm Weather Shutdn	95°F	▲
(26) Boost Temp increment	0°F	
(27) Boost Time Delay	30 min	
(28) Night Setback Temp.	18°F	▼

Figure 13.20

Parameters 26 Boost Temp Increment and 27 Boost Time Delay have default values of 0°F (0°C) and 30 min. This means that 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.

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°C). The CH setpoint limits (Design_Supply_Min._Limit and Design_Supply_Max._Limit) are respected while adjusting the setpoint.

Apart from the calculated setpoint the functionality is the same as described in § 13.9.1.

Adjustable Outdoor Reset parameters

Parameters	number	Level	Default Value	Range
CH Mode	1	2: Installer	1	Mode 0-5
Design Supply Temp. Sets high boiler CH setpoint when outdoor temp. is equal to <i>Design Outdoor Temp.</i>	19	2: Installer	180°F (82°C)	68.....194°F (20.....90°C)
Design Outdoor Temp. Sets the outdoor temp at which the boiler setpoint must be high as set by <i>Design Supply Temp.</i>	20	2: Installer	20°F (-7°C)	-13.....77°F (-25.....25°C)
Baseline Supply Temp. Sets low boiler CH setpoint when outdoor temp. is equal to <i>Baseline Outdoor Temp.</i>	21	2: Installer	120°F (49°C)	68.....194°F (20.....90°C)
Baseline Outdoor Temp. Sets the outdoor temp at which the boiler setpoint must be low as set by <i>Baseline Supply Temp.</i>	22	2: Installer	68°F (20°C)	32.....86°F (0.....30°C)
Design Supply Min. Limit Sets the lower limit for the CH setpoint (minimum).	23	2: Installer	68°F (20°C)	68.....194°F (20.....90°C)
Design Supply Max. Limit Sets the upper limit for the CH setpoint (maximum).	24	2: Installer	194°F (90°C)	68.....194°F (20.....90°C)
Warm Weather Shutdn Set max. outdoor temp. Above this temperature heat demand is blocked.	25	2: Installer	95°F (35°C)	32.....95°F (0.....35°C)
Boost Temp Increment CH setpoint increment when heat demand remains beyond <i>Boost_Time_Delay</i> .	26	2: Installer	0°F (0°C)	0.....36°F (0.....20°C)
Boost Time Delay	27	2: Installer	20 min.	1 – 120 min.
CH_Setpoint_Diff Adjusts the calculated CH setpoint.	-	1: User	0°F (0°C)	-18.....+18°F (-10.....+10°C)

Table 13.13

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

Table 13.14

13.9.3 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 § 13.9.2.

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_Shutdn (settable) CH demand is created.

When the RT input opens CH_Setpoint will be decreased with Night_Setback_Temp. The RT input does not influence the CH demand directly!

Switching the CH_Setpoint 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 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 18°F / 10°C.

Boiler Parameters		
(25) Warm Weather Shutdn	95°F	▲
(26) Boost Temp increment	0°F	
(27) Boost Time Delay	30 min	
(28) Night Setback Temp	18°F	▼

Figure 13.21

Adjustable constant Circulation Parameters

Parameters	Number	Level	(Default) Value	Settable
CH Mode	1	2: Installer	1	Mode 0 - 5
Warm Weather Shutdn Set max. outdoor temp. above which heat demand is blocked.	25	2: installer	95°F (35°C)	32.....95 °F (0.....35 °C)
Night Setback Temp Decreasing setpoint when RT input is open	28	2: Installer	18°F (10°C)	0...54°F (0...30°C)

Table 13.1

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

With CH_Mode 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 paragraph 13.9.1.

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

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

Parameters	Number	Level	(Default) Value	Settable
CH Mode	1	2: Installer	1	Mode 0 - 5
CH Setpoint	3	1:User	180°F (82°C)	68.....194°F (20.....90°C)

Table 13.2

13.9.5 CH WITH ANALOG INPUT CONTROL OF SETPOINT; CH MODE 4

In mode 4 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_Min_Setpoint and the CH_Max_Setpoint settings.

The minimum analog input signal will correspond to the CH_Min_Setpoint parameter and the maximum analog input signal will correspond to the CH_Max_Setpoint 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 the signal is rising faster than the boiler can regulate that the boiler will slow down to prevent overshoot in temperature.

The CH_Min_Setpoint and CH_Max_Setpoint 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.

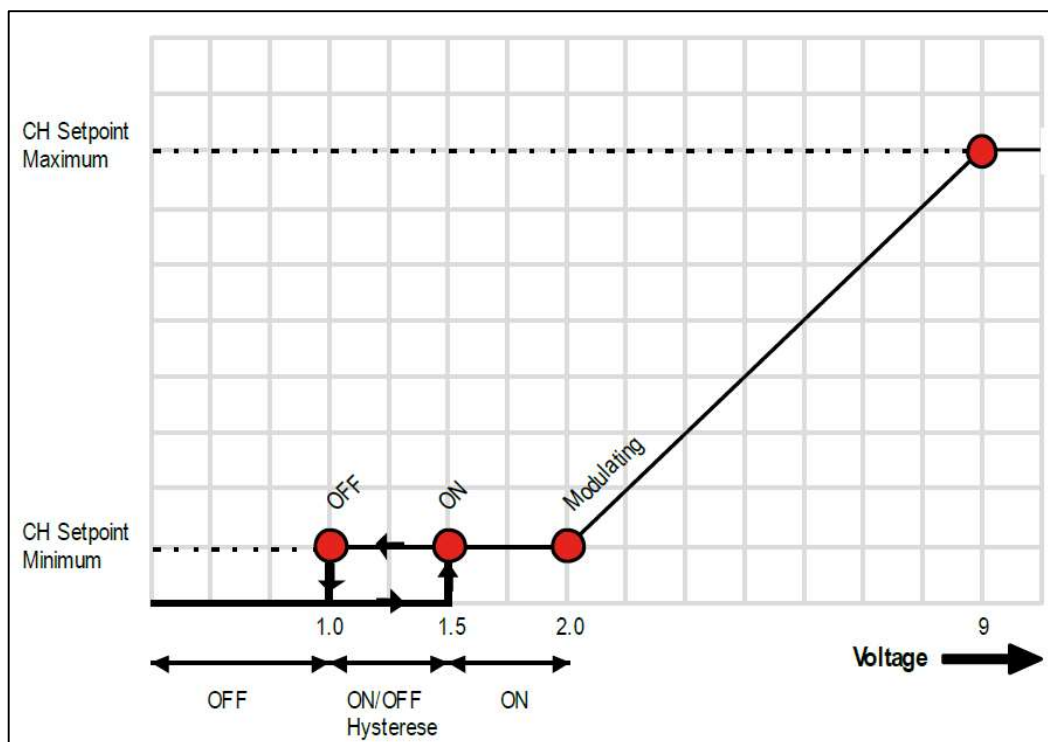


Figure 13.22

- Room Thermostat input (Low Voltage connections 12-13) must be bridged to generate heat demand.
- Min/Max CH power setting is limiting 0-10V range.

Parameters	Number	Level	(Default) Value	Settable
CH_Mode	1	2: Installer	1	Mode 0, 1, 2, 3, 4, 5
CH Min Setpoint	110	2: Installer	68°F (20°C)	68...122°F (20...50°C)
CH Max Setpoint	111	2: Installer	185°F (85°C)	122...194°F (50...90°C)

Table 13.3

13.9.6 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 203°F (95°C) the boiler switches off and shows the blocking code “High Temp Error” (105) When the temperature has dropped to 194°F (90°C) the boiler will start again. So the external controller needs to reduce the 0-10V signal or switch the boiler off before it reaches 203°F (95°C)

When connecting the 0-10V signal the room thermostat signal needs to be bridged to activate the signal.

CH Mode 5 will not work in cascade.

When using a modulating pump on pwm signal the pump will only run on a fixed pwm signal. This signal can be changed in parameter(136) Mod. Pump Mode. The pump 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.

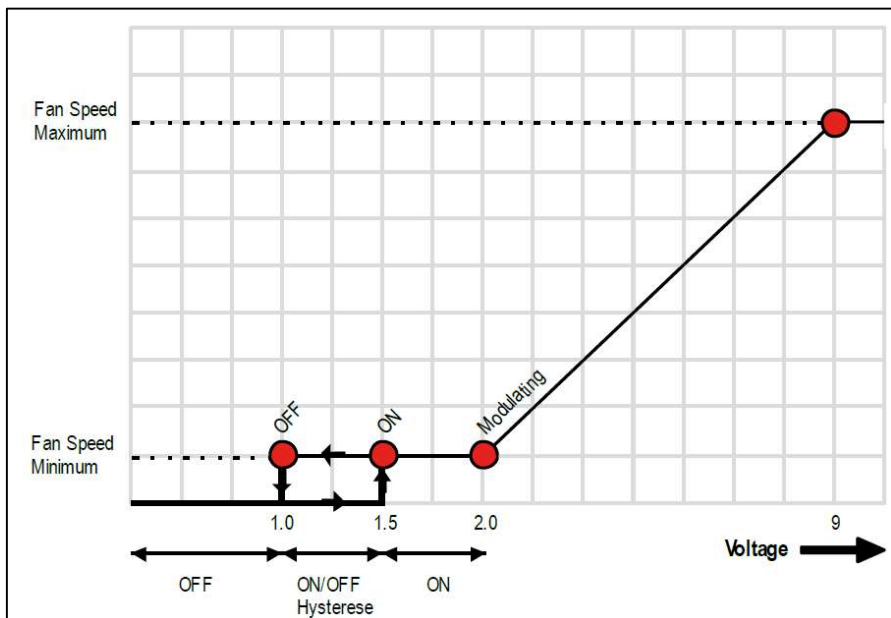


Figure 13.23

- CH mode 5 will work without sensors.
- The room thermostat input (Low Voltage connections 12-13) needs to be bridged to generate heat demand

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

Table 13.18

13.10 Demand for Domestic Hot Water



HOT WATER CAN SCALD!

Water temperature over 125°F can cause severe burns instantly or death from scalds.

- Children, disabled and elderly are at highest risk of being scalded.
- Never leave them unattended in or near shower, bathtub or sink.
- Never allow small children to use a hot water faucet or draw their own bath.

To avoid any potential scald hazard or if codes require specific water temperatures at the hot water faucet, the installer must:

- Install a thermostatic mixing valve at on the indirect tank and ensure it is working properly AND
- Set the domestic hot water temperature to the lowest temperature which satisfies your hot water needs.
- Feel and adjust water temperature before bathing or showering.
- Water drained from the system drain valves may be extremely hot.

13.10.1 NO DOMESTIC HOT WATER; DHW MODE 0 (FACTORY DEFAULT SETTING)

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

13.10.2 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_Tank_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_Tank_Supply_Extra minus DHW_Tank_Supp_Hyst_Dn 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_Tank_Supply_Extra.

The boiler is stopped when the supply temperature rises above DHW_Store_Setpoint plus DHW_Tank_Supply_Extra plus DHW_Tank_Supp_Hyst_Up.

The demand for the tank is ended when the tank sensor rises above DHW_Store_Setpoint plus DHW_Tank_Hyst_Up. The circulator continues DHW_Pump_Overrun.

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.

Parameters	Parameter number	Level	Default value	Range
DHW Priority	42	2: Installer	0	0 - 2
DHW Max. Priority Time	43	2: Installer	60 minutes	0-255 minutes

Table 13.19

Different DHW Priority types can be chosen:

DHW priority	Description
0 → Time	DHW has priority to CH during <i>DHW_Max_Priority_Time</i>
1 → OFF	CH always has priority to DHW
2 → ON	DHW always has priority to CH

Default *DHW_Priority* is set to 2.

Table 13.20

Store warm hold function

Because of the presence of the tank sensor (T_{Store}) the control can detect demand for holding the indirect tank hot. If the tank sensor drops below $DHW_Store_Setpoint$ minus $DHW_Tank_Hold_Warm$ the boiler starts at minimum power. The boiler stops if the tank sensor is higher than $DHW_Store_Setpoint$ plus $DHW_Tank_Hyst_Up$.

Relevant variables

Parameters	Parameter number	Level	Default value	Range
DHW Mode	35	2: Installer	0	0 - 8
DHW Store Setpoint	115	2: Installer	149°F (65°C)	32 - 194°F (0 - 90°C)
DHW Tank Hyst. Down	36	2: Installer	9°F (5°C)	0 - 18°F (0 - 10°C)
DHW Tank Hyst. Up	37	2: Installer	9°F (5°C)	0 - 18°F (0 - 10°C)
DHW Tank Supply Extra	38	2: Installer	27°F (15°C)	0 - 54°F (0 - 30°C)
DHW Tank Supp Hyst Dn	39	2: Installer	9°F (5°C)	0 - 36°F (0 - 20°C)
DHW Tank Supp Hyst Up	40	2: Installer	9°F (5°C)	0 - 36°F (0 - 20°C)
DHW Tank Hold Warm	41	2: Installer	9°F (5°C)	0 - 18°F (0 - 10°C)
DHW Pump Overrun	44	2: Installer	20 s	0 - 900 s

Table 13.21

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

Table 13.22

13.10.3 DHW STORAGE WITH THERMOSTAT; DHW MODE 2

In this mode DHW is prepared by warming up an indirect tank. Either a DHW circulator 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 must 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 circulator.

If the supply temperature T_{Supply} drops below $DHW_Store_Setpoint$ minus $DHW_Tank_Supp_Hyst_Dn$ 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 $DHW_Tank_Supp_Hyst_Up$.

The demand for DHW ends when the indirect tank thermostat/aquastat opens. The circulator continues $DHW_Pump_Overrun$ after the DHW demand has stopped.

DHW priority

See paragraph 13.10.2 – DHW Mode 1 – Storage with sensor

13.10.4 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 $DHW_Hysteresis_Down$ 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 $DHW_Hysteresis_Up$. When the flow switch opens the demand for the tapping is ended and the burner stops. The pump continues $DHW_Pump_Overrun$.

It is possible to keep the heat exchanger warm, which results in a faster reaction to a hot water demand. This function can be enabled with parameter 64 (PreHeat Mode):

Preheat mode	
0: Off	Preheat mode is disabled
1: Anti-frost	The heat exchanger is kept at the Anti-Frost setpoint
2: Eco mode	The heat exchanger is kept at the Eco setpoint
3: Comfort mode	The heat exchanger is kept at DHW setpoint - 9°F-Pre_Heat_Hyst_Down

Table 13.23

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)
CB 299W	1.1	5.3
CB 399W	1.4	7.1
CB 470W CB 500W	1.8	9.0

Table 13.24

Relevant variables

Parameters	Parameter no.	Level	Default value	Range
DHW Setpoint	48	2: Installer	140°F (60°C)	104 - 160°F (40 - 71°C)
DHW Hysteresis Down	49	2: Installer	7°F (4°C)	0 - 36°F (0 - 20 °C)
DHW Hysteresis Up	50	2: Installer	7°F (4°C)	0 - 36°F (0 - 20 °C)
DHW Pump Overrun	44	2: Installer	20 s	0 - 900 s
PreHeat Mode	64	2: Installer	0: Off	0 - 3
PreHeat Eco Setpoint	65	2: installer	104°F (40°C)	68 - 140°F (20 - 60°C)

Table 13.25

13.10.5 **ANTI-LEGIONELLA PROTECTION**

Anti-Legionella protection can be enabled for DHW mode 1 (external tank with a sensor).

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 tank sensor (= Anti_Legionella_Sensor) At least once every 168 hours (7 days) the tank 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 tank temperature is below Anti_Legionella_Setpoint the control switches ON the circulators, when the tank 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_Tank_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_Tank_Supply_Hyst_Up the boiler is switched OFF.

When the T_Store sensor has been above Anti_Legionella_Setpoint minus 5°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 tank sensor temperature must reach and maintain 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 tank 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	Parameter no.	Factory Setting.
Anti Legionella Day	107	Sunday
Anti Legionella Hour	108	0 hrs
Anti Legionella	206	Disable

Table 13.26

Following parameters are factory set

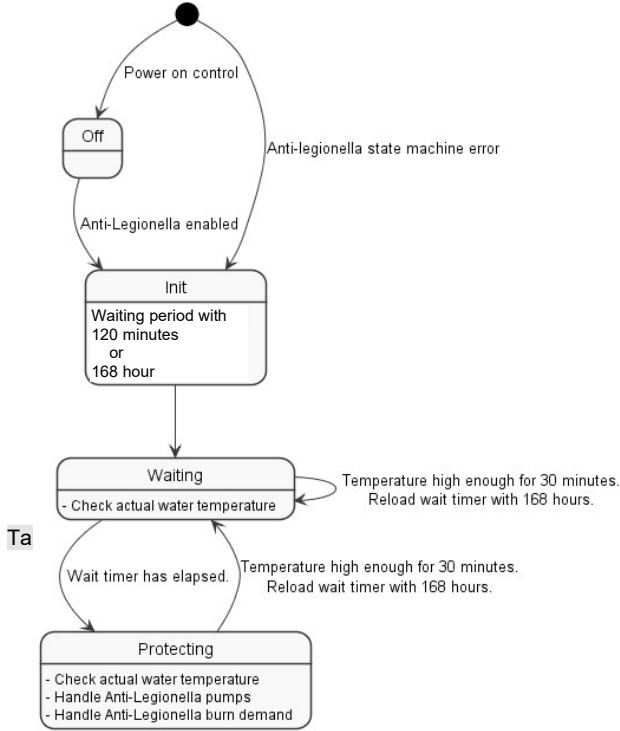
Parameter	Factory Setting.
Anti_Legionella_Setpoint Setpoint for Anti-Legionella demand	140°F (60°C)
Anti_Legionella_Burn_Time	30 Min.
Anti_Legionella_Wait_Time Wait time for Anti-Legionella demand.	120 min after cold start, 168 h after first successful Anti-Legionella demand

Table 13.27

When the control is powered the anti-legionella algorithm will be initialized when enabled. The initial wait time before an anti-legionella cycle is started is initialized as following:

- Anti-legionella enabled AND $T_{Store} < \text{Anti_Legionella_Setpoint} - 5^{\circ}\text{F}$.
 - Anti-legionella wait time initialized to 120 [min].
- Anti-legionella enabled AND $T_{Store} \geq \text{Anti_Legionella_Setpoint} - 5^{\circ}\text{F}$.
 - Anti-legionella wait time initialized to 48 [h].
- Anti-legionella enabled AND *Anti_Legionella_At_Boot* disabled.
 - Anti-legionella wait time initialized to $168 + 2$ [h].

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.

Figure 13.24

 WARNING	<p>Bacteria can develop in the domestic water system if certain minimum water temperatures are not maintained.</p> <p>Failure to maintain at least 140°F [60°C] domestic hot water temperature or not using the Antilegionella function can result in bacteria development, which can result in serious injury, or death.</p>
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13.10.6 **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.	Default	unit	Access level	Description:
1.1 CH Setpoint	68 (20)	194 (90)	180 (82)	°F (°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 or 2

1.2 Outdoor reset	min.	max.	Default	unit	Access level	Description:
Design Supply Temp.	68 (20)	194 (90)	180 (82)	°F (°C)	Installer	Set CH setpoint when outdoor temperature equals Design Outdoor Temp.
Baseline Supply Temp.	68 (20)	194 (90)	120 (49)	°F (°C)	Installer	Set CH setpoint when outdoor temperature equals Baseline Outdoor Temp.
Warm Weather Shutdn	32 (0)	95 (35)	95 (35)	°F (°C)	Installer	Set outdoor temperature above which CH demand is locked.
Baseline Outdoor Temp.	32 (0)	86 (30)	68 (20)	°F (°C)	Installer	Set the outdoor temperature at which CH setpoint is set to Baseline Supply Temp.
Design Outdoor Temp.	-13 (-25)	77 (25)	20 (-7)	°F (°C)	Installer	Set the outdoor temperature at which CH setpoint is set to Design Supply Temp.

2. Domestic Hot Water (DHW)	min.	max.	Default	unit	Access level	Description:
DHW Setpoint	104 (40)	160 (71)	140 (60)	°F (°C)	Installer	Set the DHW setpoint
DHW Store Setpoint	86 (30)	185 (85)	149 (65)	°F (°C)	Installer	Set the DHW store setpoint for DHW mode 1 and 2

3. Information	min.	max.	Default	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.	Default	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				°F (°C)	User	Actual supply flow temperature
Flow 2 Temperature				°F (°C)	User	Actual supply 2 flow temperature
Return Temperature				°F (°C)	User	Actual return temperature
DHW Temperature				°F (°C)	User	Actual DHW temperature
DCW Temperature				°F (°C)	User	Actual DCW temperature
Outside Temperature				°F (°C)	User	Actual outside temperature
Flue Temp				°F (°C)	User	Actual flue gas temperature
Flue 2 Temp				°F (°C)	User	Actual flue gas 2 temperature
System Temperature				°F (°C)	User	Actual system temperature
0-10 V Input				V	User	Actual input voltage
Flowrate				l/min	User	Actual DHW flowrate
RT Input				open/clos	User	Actual RT input status
Gas Pressure Switch				open/clos	User	Gas pressure switch input
Flow Switch				open/clos	User	CH/DHW) Flow switch input
Air Pressure Switch				open/clos	User	Air pressure switch input
Water Pressure				psi (bar)	User	Actual CH water pressure
Fan Speed				rpm	User	Actual fan speed
Ionization				µA	User	Actual ionization current
State					User	Actual burner state
Error				#	User	Actual internal error code
Calculated Setpoint				°F (°C)	User	Actual CH setpoint
Module Setpoint				°F (°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
Reset Service Reminder	Yes	No	No	-	Installer	Reset the service reminder

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)			x	°C/bar	User	Select Metric units
Imperial (°F, psi)			°F/psi	°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			DMY		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	-	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:
Status overview settings					User	Select the status overview settings menu
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.	Default	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
4.2.4 Service					Installer	Enter the Service menu

4.2.1 Boiler parameters	min.	max.	Default	unit	Access level	Description:	Display no:
CH mode	0	5	1	#	Installer	Set the CH mode	1
CH Setpoint	68 (20)	194 (90)	180 (82)	°F (°C)	Installer	Set the CH setpoint	3
Calc. Setp. Offset	-18 (-10)	18 (10)	0 (0)	°F (°C)	Installer	Set the offset for CH mode 1 / 2 calculated setpoint	109
CH Min Setpoint	68 (20)	194 (90)	68 (20)	°F (°C)	Installer	Set the minimum CH setpoint (0-10V modes)	110
CH Max Setpoint	68 (20)	194 (90)	185 (85)	°F (°C)	Installer	Set the maximum CH setpoint (0-10V modes)	111
Boiler Pump Overrun	0	900	120	sec.	Installer	Set the post-circulation time for the boiler/CH pump	5
CH Hysteresis Up	0 (0)	36 (20)	12.5 (7)	°F (°C)	Installer	Set the CH hysteresis up	7
CH Hysteresis Down	0 (0)	36 (20)	9 (15)	°F (°C)	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 (0)	36 (20)	29 (16)	°F (°C)	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	40		Installer	Set the PID P factor for CH	16
CH PID I	0	1275	400		Installer	Set the PID I factor for CH	17
Design Supply Temp.	68 (20)	194 (90)	180 (82)	°F (°C)	Installer	Set CH setpoint when outdoor temperature equals Design Outdoor T.	19
Design Outdoor Temp.	-13 (-25)	77 (25)	20 (-7)	°F (°C)	Installer	Set the outdoor temperature at which CH setpoint is set to Design Supply Temp.	20
Baseline Supply Temp	68 (20)	194 (90)	120 (49)	°F (°C)	Installer	Set CH setpoint when outdoor temperature equals Baseline Outdoor T.	21
Baseline Outdoor Temp	32 (0)	86 (30)	68 (20)	°F (°C)	Installer	Set the outdoor temperature at which CH setpoint is set to Baseline Supply Temp.	22
Design Supply Min. Limit	39 (4)	180 (82)	68 (20)	°F (°C)	Installer	Set the outdoor reset curve minimum setpoint	23
Design Supply Max. Limit	81 (27)	194 (90)	194 (90)	°F (°C)	Installer	Set the outdoor reset curve maximum setpoint	24
Warm Weather Shutdn	32 (0)	95 (35)	95 (35)	°F (°C)	Installer	Set outdoor temperature above which CH demand is blocked	25
Boost Temp Increment	0 (0)	54 (30)	0 (0)	°F (°C)	Installer	Set the setpoint boost function temperature increment	26
Boost Time Delay	1	120	30	min.	Installer	Set the setpoint boost function delay time	27
Night Setback Temp.	0 (0)	54 (30)	18 (10)	°F (°C)	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 (0)	36 (20)	9 (5)	°F (°C)	Installer	Set the DHW tank hysteresis down	36
DHW Tank Hyst. Up	0 (0)	36 (20)	9 (5)	°F (°C)	Installer	Set the DHW tank hysteresis up	37
DHW Tank Supply Extra	0 (0)	54 (30)	27 (15)	°F (°C)	Installer	Set the DHW tank supply setpoint offset	38
DHW Tank Supp Hyst Dn	0 (0)	36 (20)	9 (5)	°F (°C)	Installer	Set the DHW tank supply hysteresis down	39
DHW Tank Supp Hyst Up	0 (0)	36 (20)	9 (5)	°F (°C)	Installer	Set the DHW tank supply hysteresis up	40
DHW Tank Hold Warm	0 (0)	18 (10)	9 (5)	°F (°C)	Installer	Set the Tank Hold Warm offset down	41
DHW Priority	On/ Parallel/ Time/ Off		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

cont: 4.2.1 Boiler parameters	min.	max.	Default	unit	Access level	Description:	Display no:
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
DHW Setpoint	68 (20)	176 (80)	140 (60)	°F (°C)	Installer	Set the DHW setpoint	48
DHW Store Setpoint	86 (30)	185 (85)	149 (65)	°F (°C)	Installer	Set the DHW storage setpoint	115
DHW Hysteresis Down	0 (0)	36 (20)	7.2 (4)	°F (°C)	Installer	Set the DHW hysteresis down	49
DHW Hysteresis Up	0 (0)	36 (20)	7.2 (4)	°F (°C)	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	68 (20)	140 (60)	104 (40)	°F (°C)	Installer	Set the PreHeat Eco setpoint	65
DHW Max. Limit	68 (20)	194 (90)	176 (80)	°F (°C)	Installer	Limiting DHW setpoint max.	91
DHW Min. Limit	68 (20)	194 (90)	86 (30)	°F (°C)	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 programmable input 1	116
Prog. Input 2.	0	4	2	#	Installer	Select the function for programmable input 2	117
Prog. Input 3.	0	2	2	#	Installer	Select the function for programmable input 3	118
Prog. Input 7.	0	5	3	#	Installer	Select the function for programmable input 7	122
Prog. Input RT.	0	1	1	#	Installer	Select the function for the programmable RT input	124
Prog. Output 1.	0	10	2	#	Installer	Select the function for programmable output 1	125
Prog. Output 2.	0	10	9	#	Installer	Select the function for programmable output 2	126
Prog. Output 3.	0	10	6	#	Installer	Select the function for programmable output 3	127
Prog. Output 4.	0	20	3	#	Installer	Select the function for programmable output 4	128
Mod. Pump dT	9 (5)	72 (40)	36 (20)	°F (°C)	Installer	Set the modulating pump target delta temperature	133
Mod. Pump Start Time	0	255	60	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	on/off	on/off or mod.	Installer	Set the modulating pump mode	136
Mod. Pump Min Pwr	0	100	35	%	Installer	Set the modulating pump minimum duty cycle	137
Appliance Type	50	55	dep. unit	#	Installer	Set the appliance type	138
Dair active	Yes	No	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-legionella cycle	107
Anti Legionella Hour	0	23	0	hrs.	Installer	Select the time for the anti-legionella cycle	108
Frost Protection			Enabled	Ena/Dis	Installer	Switch Frost protection on/off	205
Anti Legionella			Disabled	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	32 (0)	194 (90)	158 (70)	°F (°C)	Installer	Set the emergency mode setpoint	74
Delay Per Start Next Mod.	25	1275	90	sec.	Installer	Set the delay time before the next module is started	75
Delay Per Stop Next Mod.	25	1275	60	sec.	Installer	Set the delay time before the next module is stopped	76
Delay Quick Start Next	0	1275	20	sec.	Installer	Set the fast delay time before the next module is started	142
Delay Quick Stop Next	0	1275	10	sec.	Installer	Set the fast delay time before the next module is stopped	143
Hyst. Down Start Module	0 (0)	72 (40)	14.5 (8)	°F (°C)	Installer	Set the hysteresis down after which a module is started	77
Hyst. Up Stop Module	0 (0)	72 (40)	9 (5)	°F (°C)	Installer	Set the hysteresis up after which a module is stopped	78
Hyst. Down Quick Start	0 (0)	72 (40)	22 (12)	°F (°C)	Installer	Set the fast hysteresis down after which a module is started	144
Hyst. Up Quick Stop	0 (0)	72 (40)	12.6 (7)	°F (°C)	Installer	Set the fast hysteresis up after which a module is stopped	145
Hyst. Up Stop All	0 (0)	108 (60)	18 (10)	°F (°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	2	#	Installer	Set the power mode	148
Max. Setp. Offset Down	0 (0)	36 (20)	4 (2)	°F (°C)	Installer	Set the maximum setpoint offset down	79
Max. Setp. Offset Up	0 (0)	36 (20)	18 (10)	°F (°C)	Installer	Set the maximum setpoint offset up	80
Start Mod. Delay Fact.	0	60	0	min.	Installer	Set the setpoint modulation delay time	81
Next Module Start Rate	0	100	85	%	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
PwrMode2 Min Power	0	100	20	%	Installer	Set the power mode 2 minimum power	152
PwrMode2 Hysteresis	0	100	10	%	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	50 (10)	86 (30)	50 (10)	°F (°C)	Installer	Set the frost-protection setpoint	155



NOTICE

Parameters for cascade operation are found in the Module cascade settings menu, located in the Boiler settings menu.

Parameters in the below **Boiler cascade settings** menu must **not** be used.

4.2.3 Boiler Cascade Settings	min.	max.	Default	unit	Access level	Description:	Display 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	68 (20)	194 (90)	158 (70)	°F (°C)	Installer	Set the emergency mode setpoint	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 (0)	72 (40)	9 (5)	°F (°C)	Installer	Set the hysteresis down after which a boiler is started	162
Hyst. Up Stop Boiler	0 (0)	72 (40)	4 (2)	°F (°C)	Installer	Set the hysteresis up after which a boiler is stopped	163
Hyst. Down Quick Start	0 (0)	72 (40)	18 (10)	°F (°C)	Installer	Set the fast hysteresis down after which a boiler is started	164
Hyst. Up Quick Stop	0 (0)	72 (40)	7 (4)	°F (°C)	Installer	Set the fast hysteresis up after which a boiler is stopped	165
Hyst. Up Stop All	0 (0)	108 (60)	14 (8)	°F (°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 expected in the cascade system	167
Power Mode	0	3	2	#	Installer	Set the power mode	168
Max. Setp. Offset Down	0 (0)	36 (20)	0 (0)	°F (°C)	Installer	Set the maximum setpoint offset down	169
Max. Setp. Offset Up	0 (0)	36 (20)	36 (20)	°F (°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
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

4.2.4 Service	min.	max.	Default	unit	Access level	Description:
Service Interval	Off	25500	2000	hours	Installer	Set burning hours till service reminder
Reset Service Reminder	no	yes	no	yes/no	Installer	Reset the service history

5 System test	min.	max.	Default	unit	Access level	Description:
Test State			off		installer	set test state (for adjusting O ₂ levels)
Fan speed			xxxx	rpm	installer	read out fan speed
Ionization			x.x	µA	installer	read out flame signal

Table 13.28

14 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 this temperature difference ΔT becomes too high:

At maximum boiler input ΔT is limited to 63°F (35°C) ($Hx_Diff_DeltaT_Max$).

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

At minimum boiler input ΔT is limited to 77°F (43°C).

Above $\Delta T = 86^\circ\text{F}$ (48°C), the boiler is blocked until ΔT is smaller than $Hx_Diff_DeltaT_Max$ again.

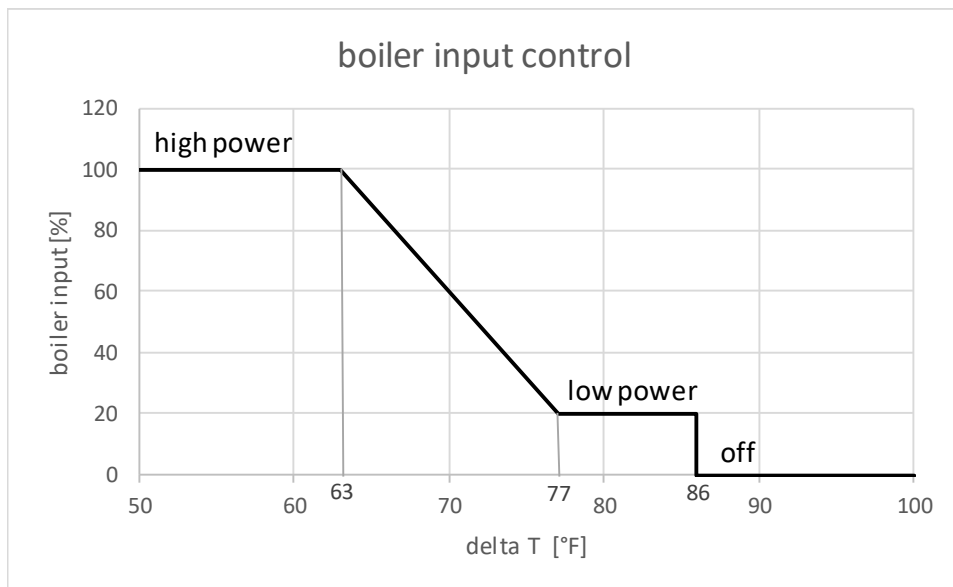


Figure 14.1

15 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 circulator 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 circulator will not be running, also see the error tables in this chapter for more details.

15.1 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

15.2 Lockout codes

Lock out code	Error	Description	Cause	Solving
0	EEPROM Read Error	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
1	Ignition Error	Five unsuccessful ignition attempts in a row	no gas, wrongly adjusted gas valve	check gas supply and adjust gas valve, reset BCU
2	GasValve 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 Error	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 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 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 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	outdated E2prom	reset BCU or replace BCU
10	EEPROM 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	Air Switch 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	Air Switch Not Closed	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. Thermostat Lock 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 burner door gasket and replace burner door gasket and reset clixon on burner door or check circulator and waterflow and replace circulator or increase water flow check also if valves are closed or check if rear wall fuse is broken if so replace and also replace rear wall insulation disc (combustion chamber).
16	Max. Flue Lock 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 too low increase waterflow. Clean the heat exchanger.
17	Stack Error	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit

Lock out code	Error	Description	Cause	Solving
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 Error	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 Ignition	Flame is detected before ignition	wrong earthing of BCU and boiler	Check earthing of BCU and boiler
22	Too Many Flame Failures	Three times 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 Number	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 too many filing attempts	Check if there is a leak in the central heating system or if the boiler itself 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 itself 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 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/Air intake block	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	Air Switch Not Closed	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; loose cabling on terminal	Check if gas pressure is in limits of the gas pressure switch; check cable bridge between connections 24-25 (low voltage connections)

Table 15.1

15.3 Blocking codes

Blocking code	Error	Description	Cause	Solving
100	WD Error Ram	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and / or display unit
101	WD Error Rom	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and / or display unit
102	WD Error Stack	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and / or display unit
103	WD Error Register	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and / or display unit
104	WD Error Xrl	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and / or display unit
105	High Temp Error	T_Supply sensor measures over Stay_Burning_Temp for a period of Max_Value_Period.	not enough waterflow overheat exchanger	Check functioning of the circulator. Check/open all valves that might restrict the water flow through the unit. Check for an external system circulator that influences flow through the unit. Check if the system resistance exceeds the spare capacity of the unit circulator.
106	Refhi Too Hi Error	Internal hardware error	wrongly programmed BCU or PB	reset BCU or replace BCU and / or display unit
107	Refhi Too Lo Error	Internal hardware error	wrongly programmed BCU or PB	reset BCU or replace BCU and / or display unit
108	Reflo Too Hi Error	Internal hardware error	wrongly programmed BCU or PB	reset BCU or replace BCU and / or display unit
109	Reflo Too Lo Error	Internal hardware error	wrongly programmed BCU or PB	reset BCU or replace BCU and / or display unit
110	Refhi2 Too Hi Error	Internal hardware error	wrongly programmed BCU or PB	reset BCU or replace BCU and / or display unit
111	Refhi2 Too Lo Error	Internal hardware error	wrongly programmed BCU or PB	reset BCU or replace BCU and / or display unit
112	Reflo2 Too Hi Error	Internal hardware error	wrongly programmed BCU or PB	reset BCU or replace BCU and / or display unit
113	Reflo2 Too Lo Error	Internal hardware error	wrongly programmed 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 allowed to be seen	wrong earthing of BCU and boiler	Check earthing of BCU and boiler
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 Communication Error	Watchdog communication error	wrong programmed BCU or PB	reset BCU or replace BCU and / or display unit
119	T Return Open	Return sensor open	malfunctioning return sensor or not connected	check connection to BCU or check resistance NTC sensor
120	T Supply Open	Supply sensor open	malfunctioning supply sensor or not connected	check connection to BCU or check resistance NTC sensor
122	T DHW Open	DHW sensor open	malfunctioning DHW sensor or not connected	check connection to BCU or check resistance NTC sensor

Lockout code	Error	Description	Cause	Solving
123	T Flue Open	Flue sensor open	malfunctioning flue sensor or not connected	check connection to BCU or check resistance NTC sensor
125	T 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	T Return Shorted	Return sensor shorted	malfunctioning return sensor or short circuiting	check connection to BCU or check resistance NTC sensor
127	T Supply Shorted	Supply sensor shorted	malfunctioning supply sensor or short circuiting	check connection to BCU or check resistance NTC sensor
129	T DHW Shorted	DHW sensor shorted	malfunctioning DHW sensor or short circuiting	check connection to BCU or check resistance NTC sensor
130	T Flue Shorted	Flue sensor shorted	malfunctioning Flue sensor or short circuiting	check connection to BCU or check resistance NTC sensor
132	T Outdoor Shorted	Outdoor sensor shorted	malfunctioning Outdoor sensor or short circuiting	check connection to BCU or check resistance NTC sensor
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
136	T_Exchange Block Error	Exchange temperature exceeded 194 °F (90 °C).	water temperature is above 194 °F (90 °C).	Check circulator functioning. Check/open all valves that might restrict water flow through the unit. Check external system circulator(s) that influences flow through the unit. Check if the system resistance exceeds the spare capacity of the unit circulator.
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	Ex. Low Flow 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 circulator. Check/open all valves that might restrict the water flow through the unit. Check for an external system circulator that influences flow through the unit. Check if the system resistance exceeds the spare capacity of the unit circulator.
167	Low Gas Pressure	The low gas pressure switch input is detected as Open	Gas pressure is outside settings or wire bridge is missing	Check gas pressure Check gas pressure switch Check wire bridge
168	Flue Temperature Too High	The flue temperature exceeded the maximum flue temperature	Dirty combustion chamber.	Clean combustion chamber, especially the spaces between the coils.
169	ADC Unstable	ADC measurements detected too many unstable measurements	Defective sensor or unstable 0-10V input	Check sensors and 0-10V input

Table 15.2

15.4 Warnings

Error no.	Error	Description	Cause	Solving
200	Comm. Lost with module	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 too big Check cascade parameter 147 at the managing boiler.
202	App. Selection Error	Unknown appliance model selected	wrongly programmed parameters	replace BCU
203	Comm. Lost with boiler	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 too big Check cascade parameters at the boilers.
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 BOILER cascade settings used, set para 73 to standalone and use MODULE cascade settings for cascading
207	Heat-Exchanger protection active	The heat-exchanger protection function is actively blocking the burn demand	$\Delta T (T_{Supply} - T_{Return})$ is too high	Check pump, check heat exchanger for dark coloured coils

Table 15.3

16 CASCADING

16.1 System setup

NOTE: for proper functioning of the system, some settings have to be changed, see § 16.5.2 "Emergency mode".

The boiler controller can control multiple boilers in a cascade setup.

A system sensor is necessary to measure the cascade system supply temperature. The sensor is connected to the boiler controller. 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.

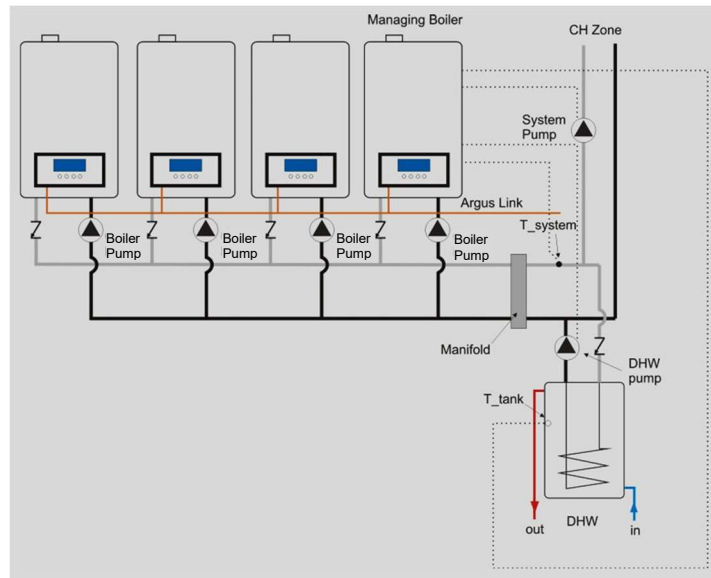


Figure 16.1

Cascade boiler pump 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

16.2 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.

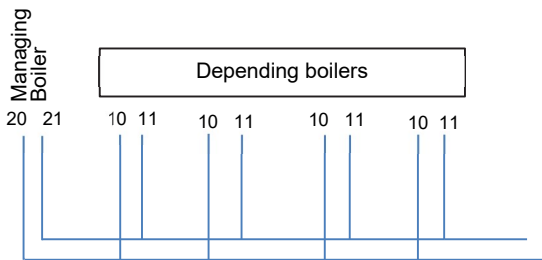


Figure 16.2

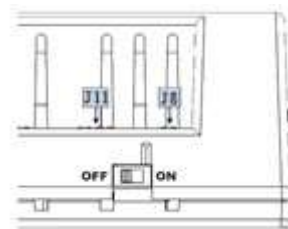


Figure 16.3

2. Set the switch "bus power on" at the side of the boiler control to the off position (ALL boilers).

Note the line of the bottom of the boiler control on above picture to determine the off position.

3. Change the burner address on every boiler that is part of the cascade

Parameter: Menu - Settings - Boiler settings - **Module Cascade Settings** - Parameter 184 (Burner Address)

On managing boiler: set as manager.

On dependent boilers: set as dep 2, dep 3, etc.

(DO NOT USE Boiler Cascade Settings)

4. Change number of units on manager boiler only

Parameter: Menu - Settings - Boiler settings - **Module Cascade Settings** - Parameter 147 (Number of units)

On manager boiler: set total amount of units that are part of the cascade (= managing + 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 is not possible in cascade.

6. Connect required sensors to the managing boiler only

Outdoor sensor required (CH modes 1 and 2) at Low voltage connections 1 and 2.

System temperature sensor required at Low voltage connections 3 and 4.

DHW (tank) temperature sensor is required (DHW mode 1) at Low voltage connections 5 and 6.

7. Switch all boilers off. After that, start them all up again

To activate the communication between managing and dependent boilers these need to be restarted.

8. 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 0 (disable)

16.3 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 depending boilers must be connected to the managing boiler on the 10-11 connection terminals.

It is important that the power on the 10-11 connection terminals on all boilers is switched to the OFF position.

All boilers in the cascade system must have an unique address selected (see also § 16.3.2 "Setting of cascade parameters").

Before commissioning a cascade installation, a number of parameters have to be changed.

These parameters can be programmed on the display of the unit.

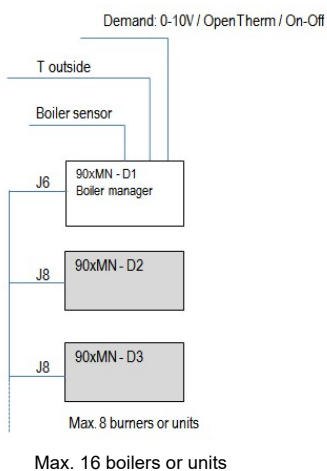


Figure 16.4

16.3.1 SET THE BOILER ADDRESS



WARNING

Changes in parameter should only be carried out by a skilled commissioning/service engineer, who has had specific training for setting up the CB 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 must not be used.**



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: Dep. 2, Dep. 3 etc. on the depending boilers.

The total number of boilers in the cascade must be stored in parameter 147 on the managing boiler.

Example: 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 2, 3 and 4 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.

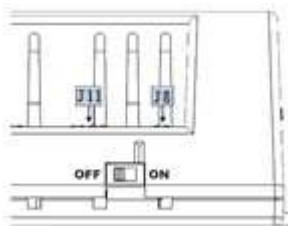


Figure 16.5

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

16.3.2 SETTING OF THE CASCADE PARAMETERS

1. 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.
2. Now select Boiler Settings and enter the right password to continue.

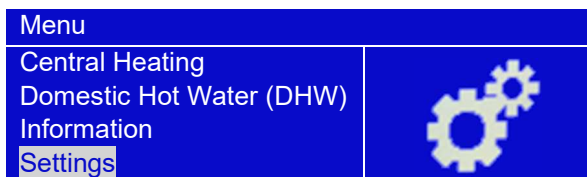


Figure 16.6



Figure 16.7

3. Select the **Module Cascade Settings** and NOT Boiler Cascade Settings

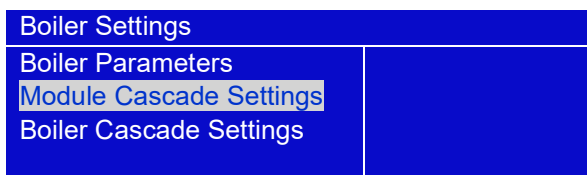


Figure 16.8

4. Change burner address into Managing or Dependent with the correct sequence number. (Dep2 is the first depending boiler)

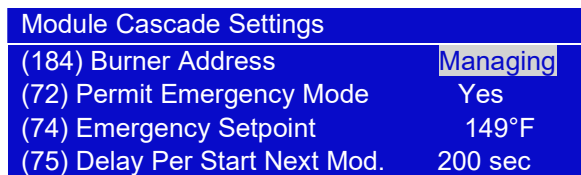


Figure 16.9

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

Table 16.1

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

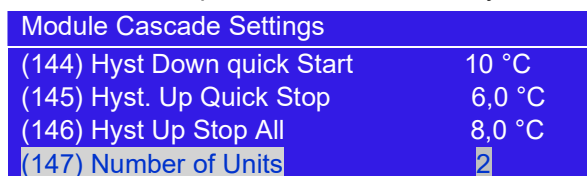


Figure 16.10

6. Connect sensors to the managing boiler
7. After setting the cascade parameters all cascaded boilers must be switched off. After that, they can be switched on again. This is to activate the communication between the managing boiler and the dependents.
8. After de-airing set Dair (parameter 139) to 0 on the managing boiler

16.3.3 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" (parameter 184: "Burner address") the setpoint is always provided by the managing boiler.

The modulating power of 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 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.

16.3.4 CASCADE – DOMESTIC HOT WATER SETTINGS

In the installer DHW menu of the managing boiler controller the DHW_Mode must be set.

DHW temperature sensor is required at Low voltage connections 5 and 6.

The only available DHW mode in cascade is mode 1 = sensor (see § 13.10 "Demand for Domestic Hot Water").

Dependent Boiler

In case a boiler is set as dependent (parameter 184: "Burner address") 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.

16.3.5 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

Table 16.2

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.

Table 16.3

16.3.6 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.

16.3.7 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.

16.4 Cascade – Boiler rotation

The boiler rotation function can change the start/stop sequence for the cascade boilers.

The parameter Module_Rotation_Interval sets the number of days after which the sequence is updated. When Module_Rotation_Interval is set to 0 boiler rotation is disabled.

When the parameter Module_Rotation_Interval is updated the boiler rotation days left will be initialized to the new Module_Rotation_Interval setting.

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

Days	Start/Stop sequence
Day 0-5	1-2-3-4-5-6..x
Day 5-10	2-3-4-5-6..x-1
Day 10-15	3-4-5-6..x-1-2
Day 15-20	4-5-6..x-1-2-3
Day 20-25	5-6..x-1-2-3-4

Table 16.4

With parameter First_Module_To_Start the current boiler that is first to start in the sequence is selected.

When the boilers are rotated the parameter First_Module_To_Start is automatically updated to the next boiler.

When boiler rotation is disabled the parameter First_Module_To_Start is reset to 0.

When the First_Module_To_Start is manually changed the control will clear all demand of the cascade control.

After this it will start cascade demand generation with the new selection for First_Module_To_Start.

16.4.1 FIRST MODULE TO START SELECTION

When Module_Rotation_Interval has passed the control will perform the cascade rotation. At this moment the next available control based on the current First_Module_To_Start is selected.

A 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_Module_To_Start.

Relevant variables

Specific Parameters	Parameter	Level	(Default) Value	Range
Module Rotation Interval	Module cascade settings no. 84	2: Installer	5	0...30 (0: Disabled)
First Module To Start	Module cascade settings no. 149	2: Installer	1	1...8/16

Table 16.5

16.5 Cascade Error handling

16.5.1 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 module cascade is related to the system sensor temperature. When the sensor value is below:

Spec. Parameter	Parameter no.		Default value	Range
Frost Protection	Module cascade settings: 155		50°F (10°C)	50 – 86 °F (10 - 30°C)
Frost Protection plus 9°F (5°C)		The Cascade pump (system pump) is started	50 plus 9 =59°F (10 plus 5 = 15°C)	
Frost Protection minus 9°F (5°C)		Cascade heat demand is activated; the general pumps of all the cascaded boilers will be started.	50 minus 9 = 41°F (10 minus 5 = 5°C)	

Table 16.6

2. Frost protection on boiler

As a last level of 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 Parameter	Parameter no.	Level	(Default) Value	Range
Frost protection Temperature for frost protection	Boiler settings parameter 205	2: Installer	Enable	Enable / Disable

Table 16.7

16.5.2 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	Parameter no.	Level	(Default) Value	Range
Permit Emergency Mode	Module Cascade parameter 72	2: Installer	Yes	Yes/No
Emergency Setpoint	Module Cascade parameter 74	2: Installer	158 °F (70 °C)	68 - 194 °F (20 - 90 °C)
Dair active	Boiler parameter 139	2: Installer	Yes	Yes/No

Table 16.8

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 to 0 (disable)

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.

16.5.3 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.

16.5.4 MANAGING BOILER ERROR

When the managing boiler is in error mode this boiler is not used anymore for the cascade system.

However depending on the error code, the pumps connected by the managing boiler still can be active for the cascade system. When the managing unit is reset from lockout state, the cascade controllers are re-initialized.

17 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 <i>CH_max_power</i>
6	High limit error test	Simulates the <i>Max_Temp_Error</i>
7	Low water cut off 1 error test	Simulates the <i>LWCO_1_Error</i>
8	Low water cut off 2 error test	Simulates the <i>LWCO_2_Error</i>

Table 17.1

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 °F (95 °C). When this temperature is reached the boiler will switch OFF. When the supply temperature cools down to 194 °F (90 °C) the boiler will start again.

During the system test the boiler and system circulator 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.

18 COMMISSIONING THE BOILER

18.1 *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 § 8.15. 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 in the system for longer than recommended by the manufacturer of the cleaner. NEVER put system cleaner inside the boilers heat exchanger.



Make sure the cleaners comply with the Chemical water treatment section of the manual § 8.15.

18.2 *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 20 and 50 psi (1.5 and 3.4 bar) – see § 8.20 "Water pressure". Shortly after putting the boiler into operation, check the water pressure and add or remove some water to obtain the required pressure.



Make sure the water quality and all system additives comply with the water quality section of the manual § 8.13

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.

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

18.3 *Third: check the water flow*

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



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

18.4 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.



Figure 18.1

This is a condensing appliance and the condensate it produces is acidic. A condensate neutralizer should be installed to raise the pH of the condensate neutralizing it before it is disposed of down a drain. If the condensate is not neutralized it has the potential to damage piping. Condensate neutralizers are available as an accessory, see the list of optional accessories in table 6.2 for part numbers.

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

18.5 Checking gas pressure

Check the gas pressure available at the gas connection pipe of the boiler. Use the pressure nipple [3] of the gas valve for this measurement. Figures 19.1 and 19.3 (section 19.1.3) show 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

Table 18.1

18.6 Firing for the first time

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



Figure 18.2

This screen is active during power up until communication with the main Control has been established. After communication has been established the Dair mode is running and the following screen appears:



Figure 18.3

The “De-Air” sequence is a safety function that starts at every power-up and is used to remove the air from the heat exchanger. The De-Air sequence takes around 4 minutes to complete. It can be cancelled by pressing the Enter button for over 5 seconds.

 CAUTION	<p>Do not bypass the Dair function upon initial startup of the boiler or when water has been added to the boiler/system. Bypassing the Dair function may cause damage to the heat exchanger which could cause the boiler to fail. Bypassing the Dair function could lead to overheating or under heating resulting in property damage.</p>
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After completion or manual ending the “De-Air” sequence one of the following Status overview screens appears:

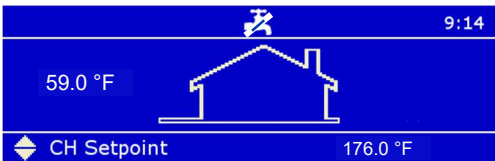


Figure 18.4 Central Heating only

OR

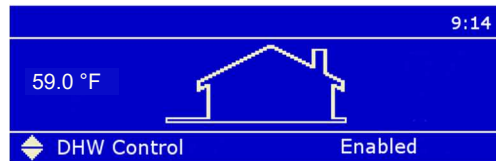



Figure 18.5 Central Heating AND Domestic Hot Water

The display describes:

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

19 ADJUSTING AND SETTING THE BOILER

 WARNING	<p>Before carrying out any adjusting of the burner, carefully read this complete chapter.</p> <p>The initial lighting of the appliance must be performed by a licensed Gas Technician. Failure to follow these instructions can result in property damage, serious injury or death.</p> <p>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 can then be wired to an electrically grounded power supply source. The boiler must 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</p> <p>The boiler should be adjusted using O₂ values. CO₂ values are only used as a reference</p>
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19.1 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 O₂ / CO₂ values turns out to be incorrect.
- The gas valve has been (re)placed.
- Gas conversion to propane. Prior to adjustments, follow the procedure in 19.5
- The venturi has been replaced. Prior to adjustments, follow the procedure in 19.4
- The fan has been replaced
- The burner 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 (O₂) 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 combustion tables 19.1 and 19.2. A drawing of the gas valve(s) and setting screws is given in § 19.1.3. In § 19.2 a general procedure, conform which the adjustments must be carried out, is presented. § 19.4 describes the specific adjustments to be made when the venturi is replaced, and § 19.5 describes the changes needed when the gas type is set to propane.

19.1.1 COMBUSTION TABLE

Table 1: O₂ and CO₂ values for maximum and minimum load. ¹⁾

gas type	boiler type	O ₂ / CO ₂ [%]	
		High Fire	Low Fire
natural gas	CB 299W, CB 399W, CB 500W	4.7 / 9.2	4.7 / 9.2
	CB 470W ²⁾	5.3 / 8.8	5.3 / 8.8
Propane ³⁾⁴⁾	CB 299W, CB 399W, CB 470W, CB 500W	5.0 / 10.4	6.4 / 9.5

Allowed tolerances are O₂ ± 0.2 and CO₂ ± 0.1

1) All values measured without front door.

2) The CB 470 has NO_x emissions < 20 ppm at 3% O₂ with these settings.

3) For propane: a conversion kit (orifice) has to be mounted, see 19.4.

4) For propane: fan speeds must be changed, see 19.4

Table 19.1

19.1.2 **COMBUSTION TABLE LOW NOx**

Table 2: O₂ and CO₂ values for maximum and minimum load, where NO_x values are less than 20 ppm at 3% O₂.

gas type	boiler type	O ₂ / CO ₂ [%]	
		High Fire	Low Fire
natural gas	CB 299W, CB 399W	5.3 / 8.8	5.3 / 8.8
<p>Allowed tolerances are O₂ ± 0.2 and CO₂ ± 0.1</p> <p>All values measured without front door.</p> <p>REMARK 1: Appliances will be derated with these settings. To compensate, maximum fan speed can be set to a higher value. The minimum fan speed does not need to be changed for Low NOx.</p>			

Table 19.2

19.1.3 **SETTING SCREWS VENTURI- AND GAS VALVES: DRAWINGS**

Location of the setting screws:

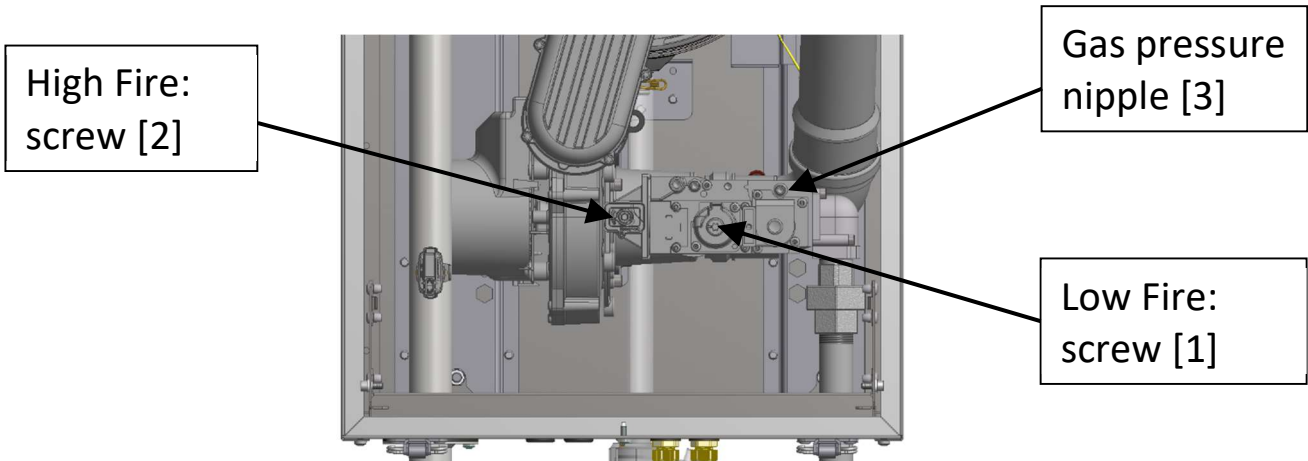


Figure 19.1

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

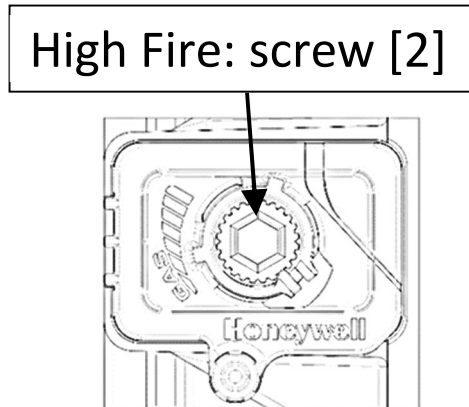


Figure 19.2

Low Fire: gas valve adjustment screw: Torx T40.

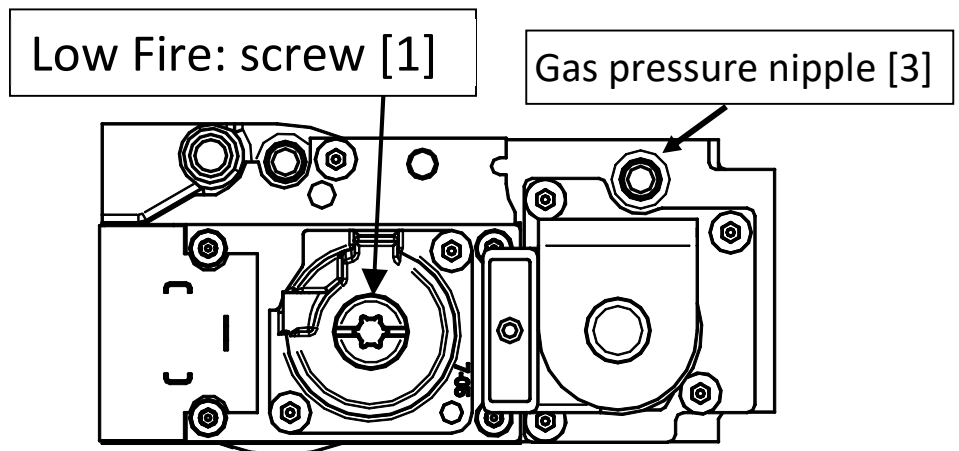














Figure 19.3


19.2 O₂ Adjustment procedures

Procedure 1: adjust at High Fire

Carry out the next steps:

1. From status screen, press MENU . Menu options are Central Heating / Information / Settings / System Test
2. Press UP/DOWN  to select "System Test"
3. Press CONFIRM  to activate the system test.
4. Enter the password '1122' by pressing UP/DOWN  and LEFT  / RIGHT  →
5. After entering the last number press CONFIRM  → "Test State: Off"
6. 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, check if air has been removed from the gas line. Open screw [2] two turns extra – clockwise and try to start again.
Note: once the test state is active, it is not necessary to press a button, selecting the desired power is sufficient. Wait 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.
7. Measure the O₂/CO₂ percentage at the flue gas test port on the vent connection.
8. By setting screw [2], adjust the gas valve to obtain the O₂/CO₂ value of table 19.1 or table 19.2.
9. To return to the status screen, and stop the boiler, press ESCAPE  or MENU  3 times, or RESET  once.


Decrease O₂  Turn screw [2] right (clockwise)


Increase O₂  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 O₂/CO₂ percentage at the flue gas test port on the vent connection.
3. By setting screw [1], adjust the gas valve to obtain the O₂/CO₂ value of table 19.1 or table 19.2.

Decrease O₂  Turn screw [1] right (clockwise)

Increase O₂  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 19.1 / 19.2 values best.

19.3 Safety shutoff test

The standard requires testing of the ignition system safety shutoff device. To do this, put the boiler in operation. Now remove the ignition plug that is connected to the igniter. Once removed the boiler should stop, and present the error:

MN : Too Many Flame Failures

on the bottom line of the screen. Now reconnect the igniter plug and press RESET during 5 seconds. The burner controller will now reset to be ready for operation.

Figure 19.4



19.4 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 fully open, *do not try to turn the screw any further.*
- Now turn screw [2] counterclockwise:

Boiler type	Number of turns ↻
CB 299W	56
CB 399W	40
CB 470W / CB 500W	36

Table 19.3

After this, perform adjustments according to § 19.2.

19.5 Conversion from natural gas to propane

 WARNING	<p>Conversion of the heater 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.</p> <p>Before starting conversion: close the gas supply and switch off the electrical power!</p>
---	--

Use only parts/conversion kits obtained from Triangle Tube and intended to be used with this particular boiler. Every conversion kit is provided with instructions how to assemble the kit to the boiler.

Required parts: (see § 6.2 Accessories)
Propane kit for Venturi hole Ø 6.2 CB 299W
Propane kit for Venturi hole Ø 6.7 CB 399W
Propane kit for Venturi hole Ø 7.2 CB 470W / CB 500W

Table 19.4

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

1. Mount the orifice
2. Set parameter 92 and 93
3. Check the gas pressure
4. Adjust the O₂ / CO₂ percentage
5. Confirmation: apply the propane sticker and mark the boxes

1. Mount the orifice:

Converting the water heater to propane is done by placing a propane orifice between gas valve and venturi. By using the correct orifice size (see table), the measured O₂ (CO₂) 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. When in operation, check again for gas leaks on all parts that have been apart.

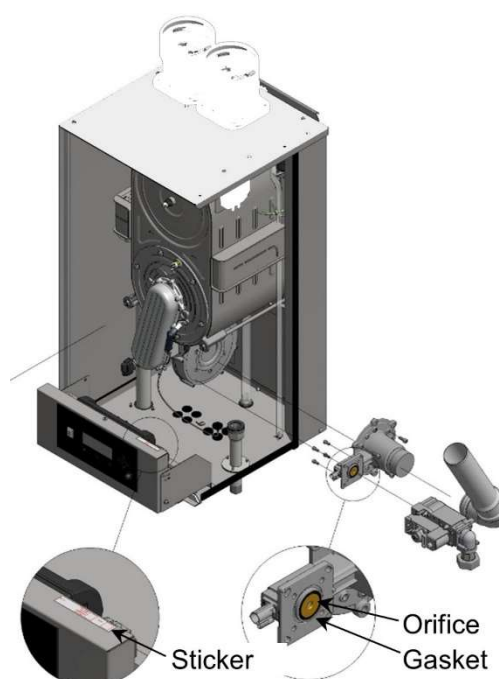


Figure 19.5


2. Set fan speed


The fan speed must be changed in the software of the boiler according to table 19.5:

Water heater type	fan speed high fire parameter 92		Fan speed low fire parameter 93	
	Propane G31	Nat. gas	Propane G31	Nat. gas
CB 299W	5950	6200	1450	1450
CB 399W	6450	6600	1550	1550
CB 470W	7250	7400	1750	1650
CB 500W	7850	8000	1750	1650

Table 19.5

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 '1122' 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 table 19.5 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	<p>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 !</p>
---	---

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

3. Check the gas pressure

Measure the gas pressure at high fire. The dynamic pressure should be at least 8.0 inch w.c. (20 mbar). If there are more boilers in the boiler room the gas pressure should be checked on the boiler at the end of the gas line, with all boilers burning at high fire. If the gas pressure is too low, check gas lines, reducers and propane tank.

4. Adjust the O₂ / CO₂ percentage

Perform O₂ / CO₂ adjustments according to the procedures in § 19.2, using the values in table 19.1.

5. 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 this boiler type.



E73.1628.901



Figure 19.6

 WARNING	<p>Please ensure the boiler is clearly labelled if operating on propane supply!</p>
---	---

19.6 Installation/start-up checklist

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

Site information	
Site name	
Site contact (owner/end-user)	
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	



After filling in form please
send a copy by e-mail to:
info@triangletube.com or
send a copy to address:

Triangle Tube
1240 Forest Parkway, Suite 100
West Deptford NJ 08066

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 of elbows 90°		
Number of elbows 60°		
Number of elbows 45°		
Number of 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 drainpipe ?	(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

Picture 18. 7

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 must 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
O ₂ / CO ₂ level at high fire ...%		%
O ₂ / CO ₂ level on low fire ...%		%
Flue pressure @ CO ₂ measuring point at high fire		Pa
Flue pressure @ CO ₂ measuring point at low fire		Pa
If cascaded with common flue system; run all appliances at HIGH fire and measure the flue pressure.		Pa
If cascaded with common flue system; run all appliances at LOW fire and measure the flue pressure.		Pa
Ignition Device Safety Shutoff test (§ 19.3)	(OK / NOT OK)	

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 (Live to Neutral)		V
Voltage incoming (Live to Ground)		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	

Table 19.6

20 INSPECTION, MAINTENANCE AND SERVICE.

20.1 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 must 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 must 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.



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.”

20.2 Safety instructions Crystalline Silica



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 must 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 must 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 (RCF)

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 must never be handled without personal protective equipment. When disturbed as a result of servicing, these substances become airborne and, if inhaled, could 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 could 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 Table 20.1 on page 133 can result in serious injury or death.

Crystalline Silica - Certain components in the combustion chamber can 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 Table 20.1. 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 may 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 (20.1) below:

Avoid the Following	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Wear long-sleeved shirt and pants, gloves, and safety goggles • Wear a respirator with a N95 rated filter efficiency or better. ¹
Working Environment	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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.

Table 20.1

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>.

20.3 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.
- O₂ / 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 parts of the boiler in bold listed below must be checked and inspected.

NOTICE: Before starting to work on the boiler:

- Switch off the electrical power to the boiler (use 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 must 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 ▼

Figure 20.1

Water leakage

The water pressure of the heating installation must be more than 21 psi (1.0 bar) and at a maximum of 85 psi (6.0 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.

Flue gas & air supply

- The flue gas pipes and the air supply pipes must be checked to ensure they are properly sealed.
- 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 for any blockages, debris, or damage to the vent piping intake and exhaust venting as well as the terminations.
- Check that all intake and exhaust venting has been properly reassembled and sealed before leaving the job site
- Check for any flammable, items, liquids, and/ or vapors near the combustion air intake and/or vent terminations.
- Check for any products listed in Section 10.7.1 in the area surrounding the appliance, removing any that are present.
- Check and clean the intake and exhaust vent termination screens.

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 must be checked for a correct functioning. Any gas pipe or fitting that has been opened or adjusted must be checked for leaks.

Dismount complete burner unit

The complete burner unit consists of the fan, venturi, gas valve, the burner plate and the internal burner. To make more space to transport the burner unit pull down the burner controller unit.

To dismount this part for an internal heat exchanger check: remove the six M6 nuts, the ignition cable, the thermal fuse cables and the gas valve cable. Disconnect the gas switches (if applicable) Remove the ignition transformer. Loosen the gas union by untighten the swivel joint under the gas valve. Remove the air intake pipe from the venturi.

After this, take out the burner unit by moving it forward out of the boiler housing. The unit must be tilted a little to move the fan past the waterpipes. NOTICE: Watch out not to damage the burner door insulation during this operation.

While removing the burner unit unplug both of the electrical and controlling cables of the fan. After all this remove the venturi on the suction side of the fan and check the blade wheel of the fan.

 WARNING	Warning Crystalline Silica – Read instructions of § 20.2 carefully
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Checking Non-return Valve (NRV)

The non-return valve is placed directly after the fan and has to be replaced every five years 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 gasket, 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 4 of the check valve every fifth year.

Needed tools: Wrench 55, 10 and 8 mm, Hex key 5 mm

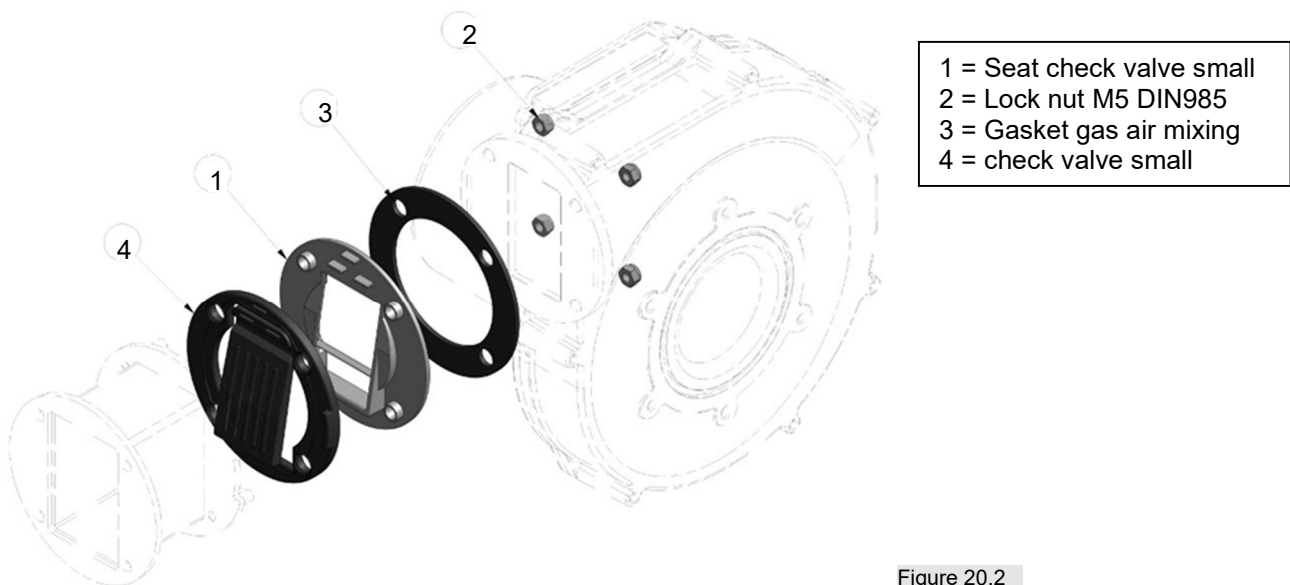



Figure 20.2

 WARNING	Always check gaskets on non-return valve for air/gas leakage!!
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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 burner unit 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 must 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.

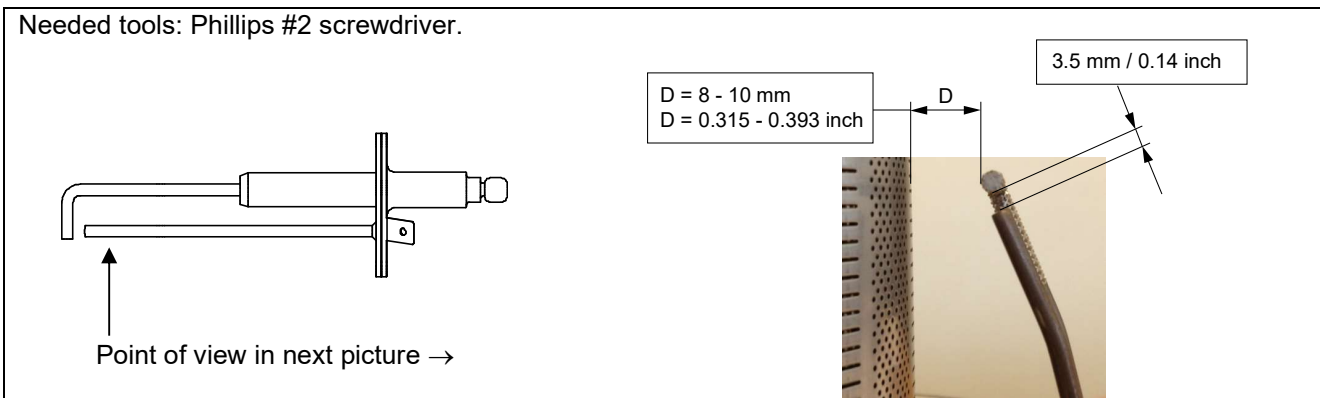


Figure 20.3



Warning

Crystalline Silica – Read instructions of § 20.2 carefully

Burner door clixon

Needed tool: Wrench 16 mm.

This clixon (maximum thermostat) is activated if the temperature of the burner door has been too high. It can be reset by pressing the central button. When it is defect, it has to be replaced (spare part).

Replacement:

- Disconnect the wiring and remove the thermostat.
- Mount the new thermostat by hand
- Tighten the burner door's thermostat with a torque of 2 Nm.
- Reconnect the wiring.



Figure 20.4

Burner door gasket

If any part of the gasket has discolored, changed texture, or hardened, 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:



Figure 20.5

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

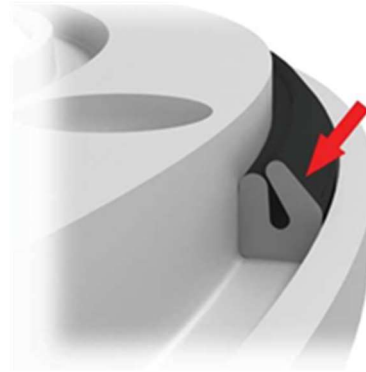


Figure 20.6

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 fixed by silicone glue.

- 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.



Figure 20.7



Figure 20.8

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

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

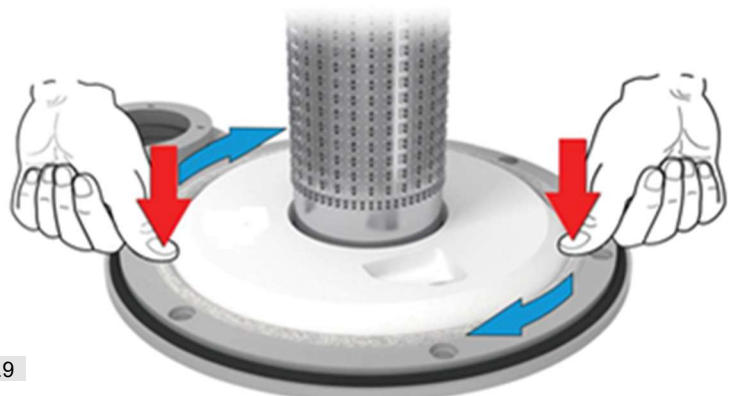


Figure 20.9



WARNING

Warning

Crystalline Silica – Read instructions of § 20.2 carefully

Rear wall insulation disk

If the insulation disk has been degraded or damaged, it has to be replaced.

- be sure the heat exchanger has cooled down, wait a few hours after burning. In this way, the protective film on the new insulation disk will not stick to the rear side of the heat exchanger.
- make the insulation wet, by spraying water over it. This in order to keep airborne dust to a minimum.
- place a piece of paper in the heat exchanger to catch the insulation remnants.
- 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

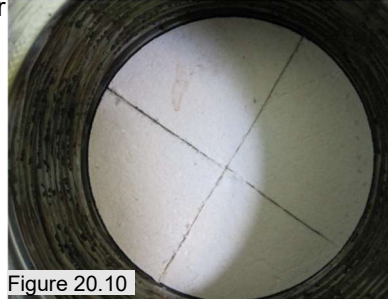


Figure 20.10



Figure 20.11

The new disc has the clip on the back.

- do **NOT** remove the protective film from 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.



Figure 20.12

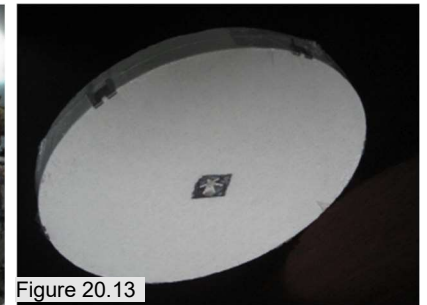


Figure 20.13

Burner door insulation disk

If the insulation disk is damaged, it must be replaced.

Removal of the insulation:

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

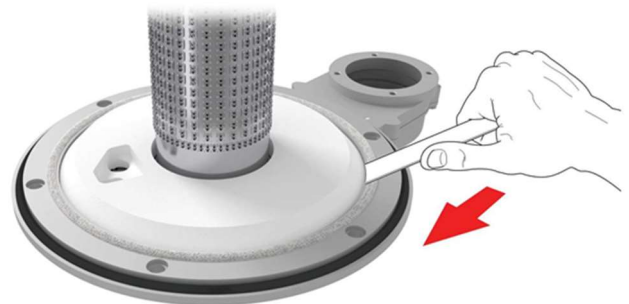


Figure 20.14

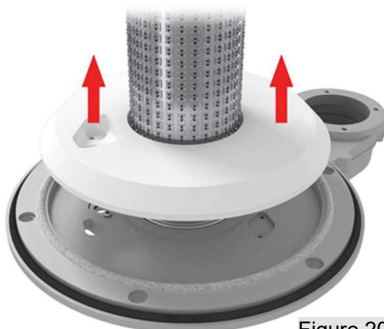


Figure 20.15

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

Install the new insulation:

- make sure that the burner is in proper condition, remove any possible insulation residues on the burner
- put two dots of temperature-resistant silicone glue according to the location indicated in figure 20.16. Use only either Loctite 5366 or Ottoseal S17.
- engage the insulation carefully and place it in contact with the two dots of silicone glue
- check the condition of the electrode, if necessary replace it
- reinstall the electrode.

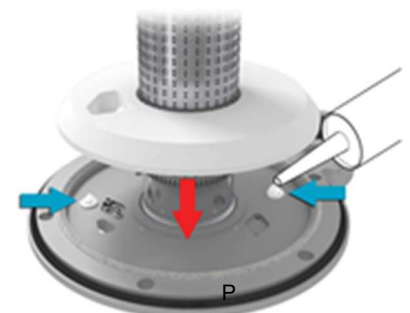


Figure 20.16


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. If 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: do not wet the rear wall insulation.

Check to make sure the condensate neutralizer is draining correctly and that there is sufficient media in it to neutralize the condensate.

 WARNING	When mounting the bottom part of the condensate trap, before commissioning the boiler and/or after maintenance, the condensate trap must ALWAYS be <u>completely</u> 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.
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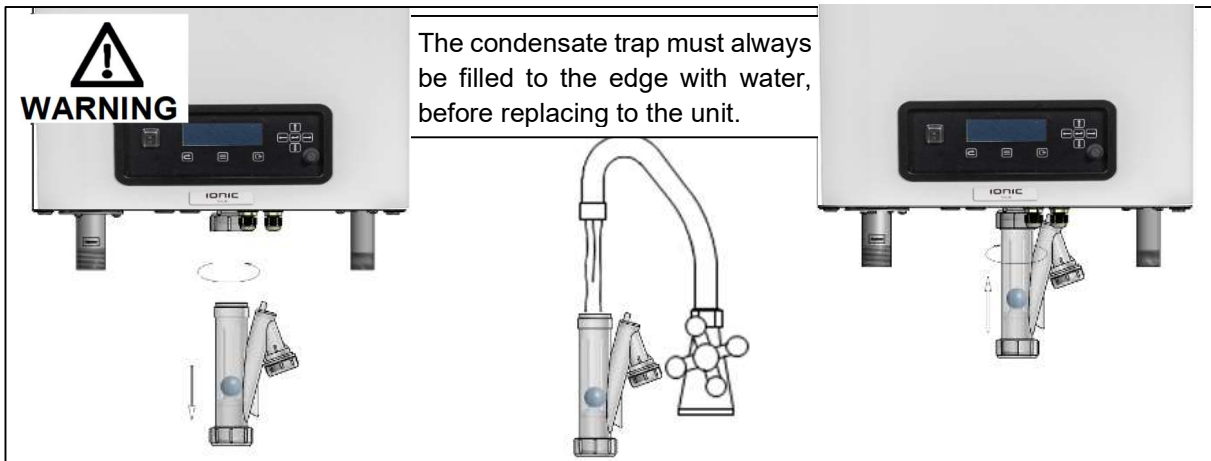


Figure 20.17

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.


Do not use acid or alkali products for cleaning, except for white vinegar with max. 7% acetic acid. Always rinse with fresh water afterwards, while keeping the insulation dry.

Gas/air ratio

With every service check and/or maintenance of the boiler always check the gas/air ratio by measuring the O₂ / CO₂ 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 19.

Circulator (supplied separated from the boiler)

Check the electrical parts and the motor of the circulator for a correct functioning. The circulator must generate a sufficient water flow over the (heat exchanger of) the boiler. When the circulator produces noise, is operational for more than five years or has signs of water leakage it is recommended to replace the circulator 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 must be reported to the owner/end-user of the installation. Also the owner/end-user must be advised how to fix these faults and these faults must 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, except for white vinegar with max. 7% acetic acid.
---	---

20.3.1 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:

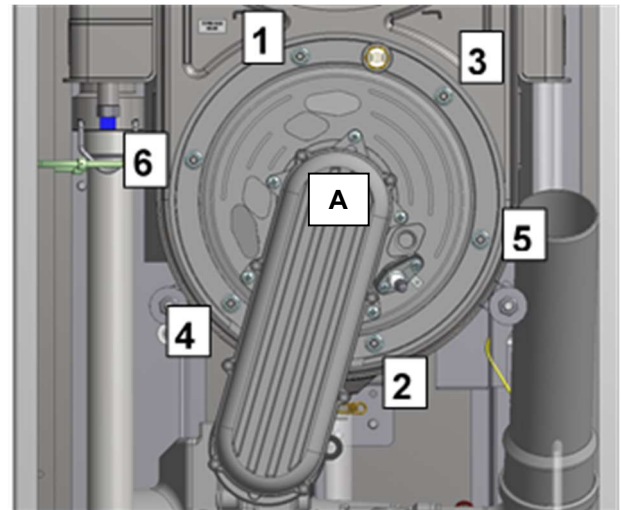
Place the burner door with its holes over the six threaded studs. Tilt it a little to get the fan motor past the waterpipes. Mind also the gas connection.

- 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 with the attached thermal fuse bracket 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 mixing pipe (point A).
- Hand tighten the flange nuts with the other hand as far as possible onto the threaded studs.
- Fasten the gas connection using a new gasket.

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)


Figure 20.18

After reconnecting all cables, silencer and ignition transformer, the electrical and gas supply can be restored. Check if the boiler ignites properly and check for gas leaks on the parts that have been apart. Check O₂/CO₂ settings on low and high fire.

20.3.2 BOILER ROOM CHECK

- Check the space where the boiler is installed for possible contaminants
- Do a check for any flammable items, liquids, or vapours in the area surrounding the appliance
- Do a check for any products listed in section 10.7.1 in the area surrounding the appliance, removing any that are present.

20.4 Maintenance Checklist

 WARNING	<p>Allowing the boiler to operate with a dirty combustion chamber will affect 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.</p>
---	---

Periodic maintenance must be performed once a year by a qualified service technician to assure that all the equipment is operating safely and efficiently. The owner must make necessary arrangements with a qualified heating contractor for periodic maintenance of the boiler. The technician must also inform the owner that the lack of proper care and maintenance of the boiler can 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 the white ceramic insulation. Also see the maintenance section of manual				
Spark igniter	Ensure spacing of igniter prongs are aligned properly.				
Replace NRV	Replace non-return valve every 5 years. And be sure it is not leaking gas after reassembling.				
Condensate trap	Disconnect the condensate trap. Ensure there is 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				
Circulator and Fan	Listen to the sound of the circulator 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.				
Glycol	Check the mixing ratio and the acidity				
Condensate Neutralizer	Check to make sure the condensate neutralizer is draining correctly and that there is sufficient media in it to neutralize the condensate.				

Table 20.2


21 USER INSTRUCTIONS

After installing and commissioning of the boiler, the installer is obliged to do the following:

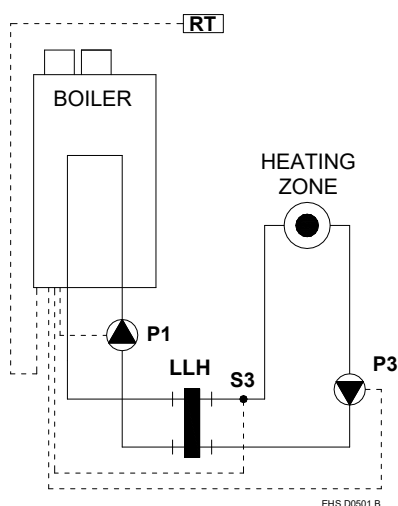
- Demonstrate the operation of the entire heating system to the end-user;
- Make the user familiar with all safety precautions of the boiler and the installation
- Instruct the user that service and maintenance of the boiler is required at least once every twelve months regular service and maintenance are essential for a safe and proper operation of the boiler.
- Hand over the user manual and all other documents supplied with the boiler to the end-user.

22 INSTALLATION EXAMPLES

The following schematics present several examples of heating installations:

 WARNING	<p>All schematics are purely functional.</p> <p>Safety components, bypass, control devices and so on must be added conform all applicable standards and regulations.</p>
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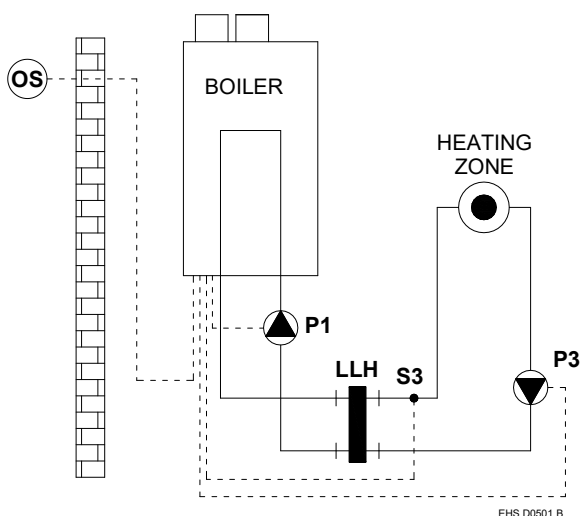
System Example 1



Low Voltage Connections		
	Name	Wire terminal
RT	Room thermostat	12-13
S3	System temperature sensor	3-4
LLH	Low loss header	
Line voltage Connections		
P1	Boiler circulator	6-7-PE
P3	System heating circulator	4-5-PE

Figure 22.1

System Example 2



Low Voltage Connections		
	Name	Wire terminal
OS	Outdoor temperature sensor	1-2
S3	System temperature sensor	3-4
LLH	Low loss header	
Line voltage Connections		
P1	Boiler circulator	6-7-PE
P3	System heating circulator	4-5-PE

Figure 22.2

System Example 3

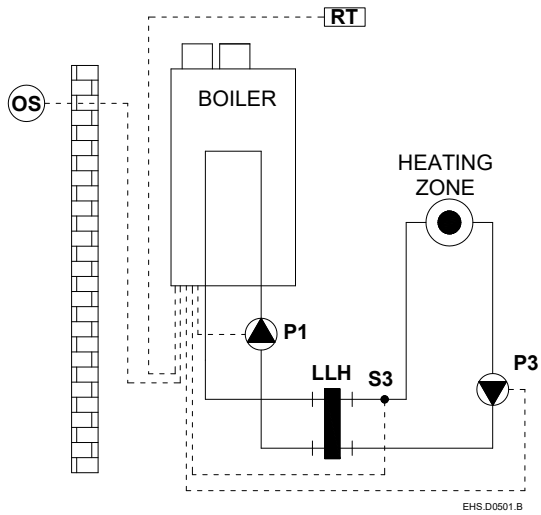


Figure 22.3

Low Voltage Connections		
	Name	Wire terminal
RT	Room thermostat	12-13
OS	Outdoor temperature sensor	1-2
S3	System temperature sensor	3-4
LLH	Low loss header	
Line voltage Connections		
P1	Boiler circulator	6-7-PE
P3	System heating circulator	4-5-PE

System Example 4

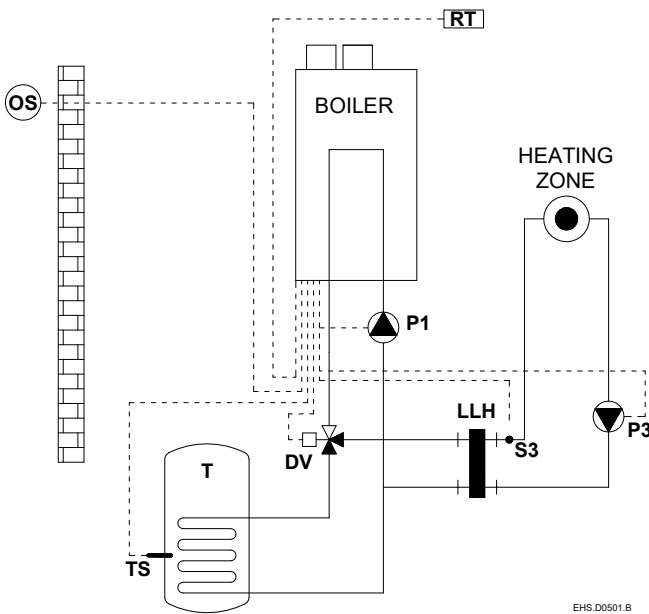
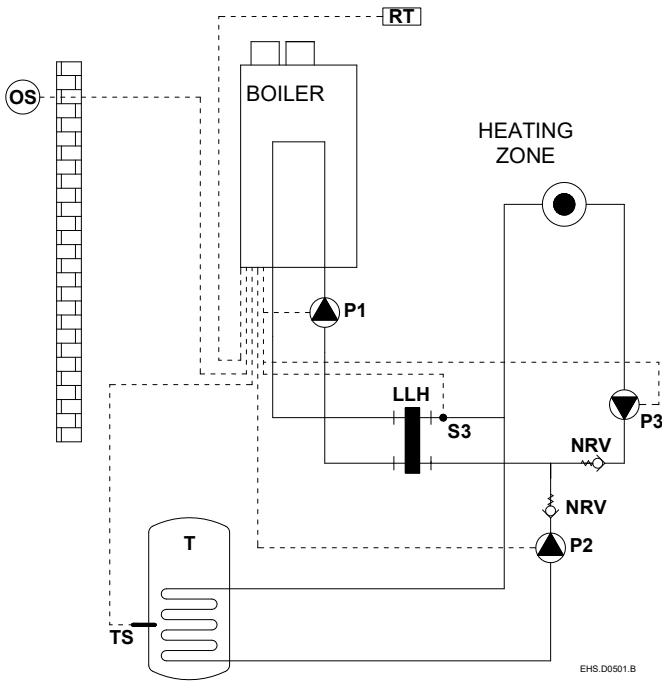


Figure 22.4

Low Voltage Connections		
	Name	Wire terminal
RT	Room thermostat	12-13
S3	System temperature sensor	3-4
OS	Outdoor temperature sensor	1-2
TS	DHW Tank thermostat or sensor	5-6
LLH	Low loss header	
T	DHW indirect Tank	
Line voltage Connections		
P1	Boiler circulator	6-7-PE
P3	System heating circulator	4-5-PE
DV	Diverter valve (3-way-valve)	1-2-3-PE

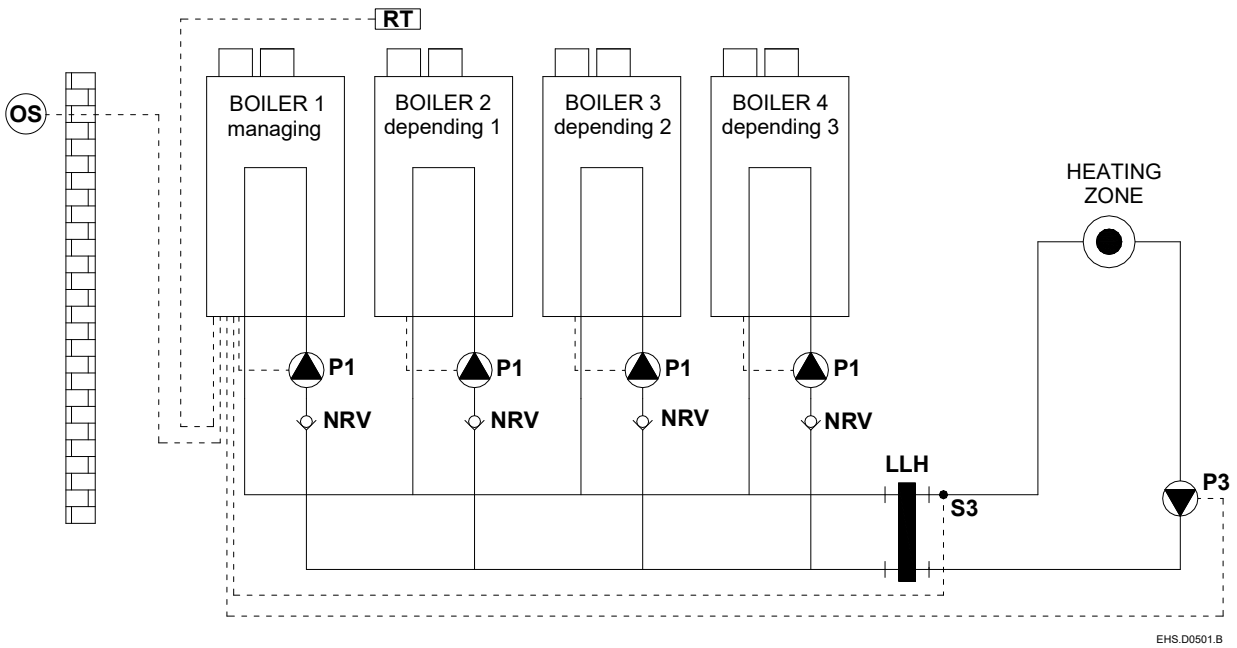
System Example 5



Low Voltage Connections		
	Name	Wire terminal
RT	Room thermostat	12-13
S3	System temperature sensor	3-4
OS	Outdoor temperature sensor	1-2
TS	DHW Tank thermostat or sensor	5-6
LLH	Low loss header	
T	DHW indirect Tank	
NRV	Non-return valve (low resistance type)	
Line voltage Connections		
P1	Boiler circulator	6-7-PE
P2	DHW primary circulator	2-3-PE
P3	System heating circulator	4-5-PE

Figure 22.5

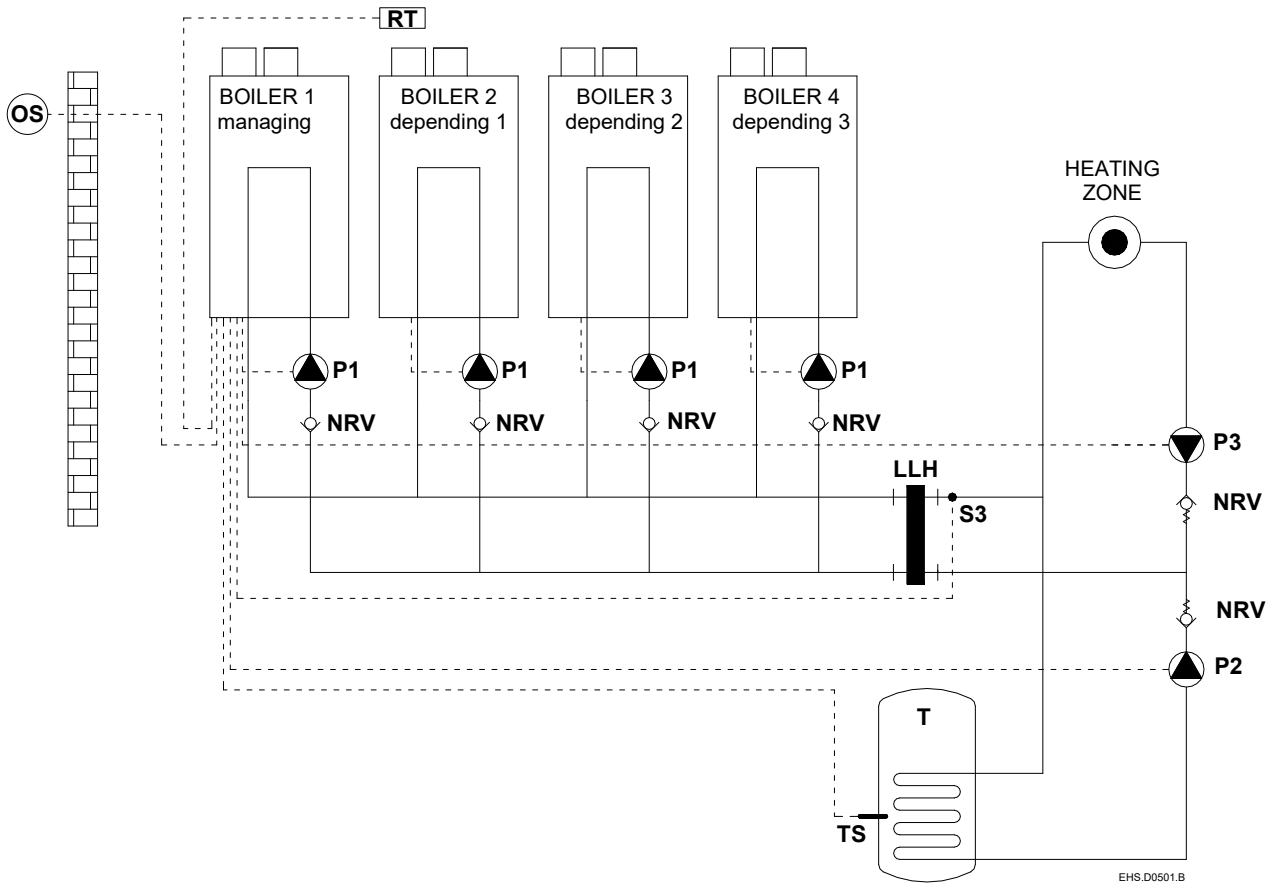
System Example 6



Low Voltage Connections		
	Name	Wire terminal
RT	Room thermostat	12-13
OS	Outdoor temperature sensor	1-2
S3	System temperature sensor	3-4
NRV	Non-return valve (low resistance type)	
LLH	Low loss header	
Line voltage Connections		
P1	Boiler circulator	6-7-PE
P3	System heating circulator	4-5-PE

Figure 22.6

System Example 7



Low Voltage Connections		
	Name	Wire terminal
RT	Room thermostat	12-13
OS	Outdoor temperature sensor	1-2
S3	System temperature sensor	3-4
TS	DHW Tank thermostat or sensor	5-6
T	DHW indirect Tank	
NRV	Non-return valve (low resistance type)	
LLH	Low loss header	
Line voltage Connections		
P1	Boiler circulator	6-7-PE
P2	DHW primary circulator	2-3-PE
P3	System heating circulator	4-5-PE

Figure 22.6

23 SPARE PARTS.

23.1 CB 299W and CB 399W

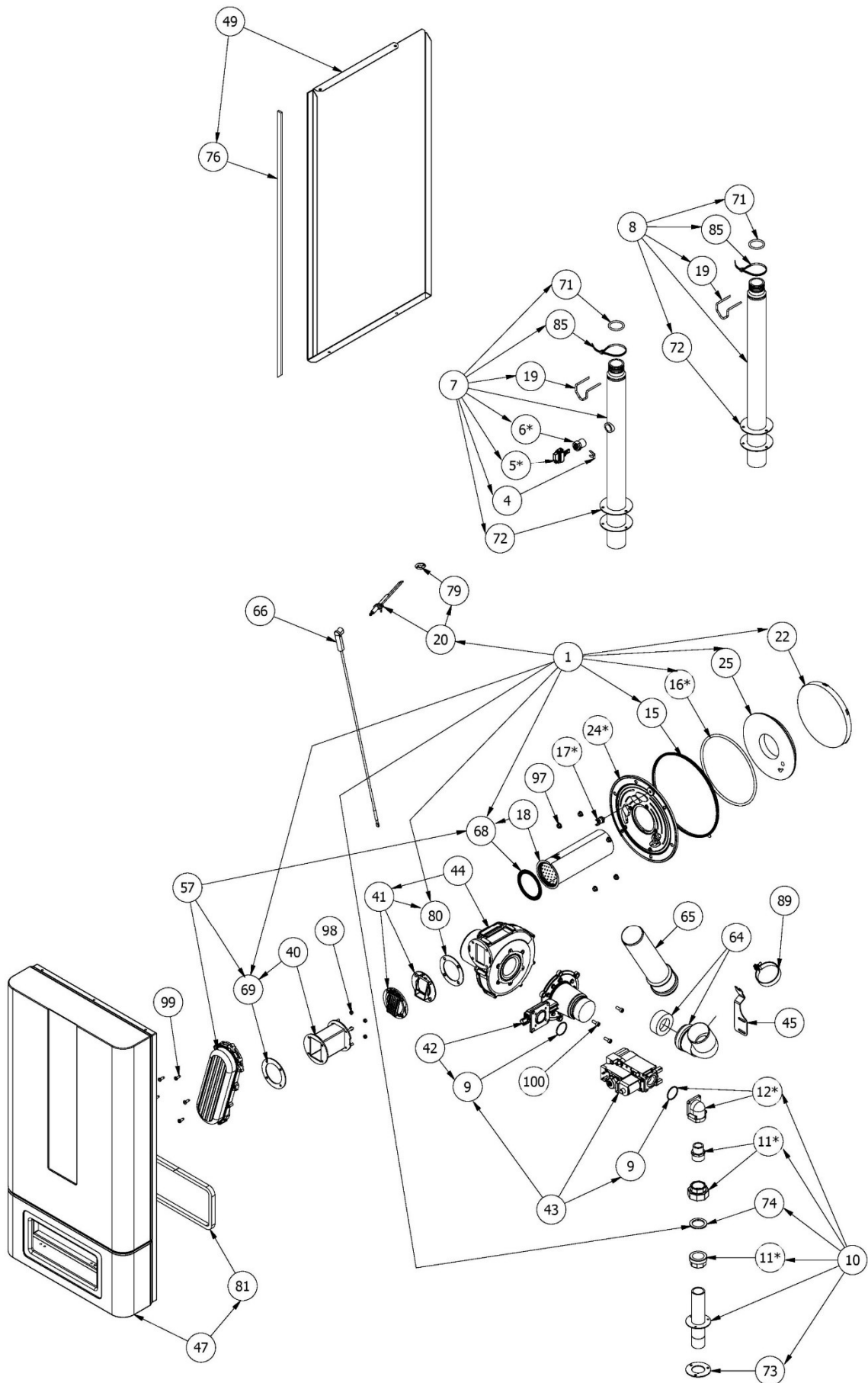
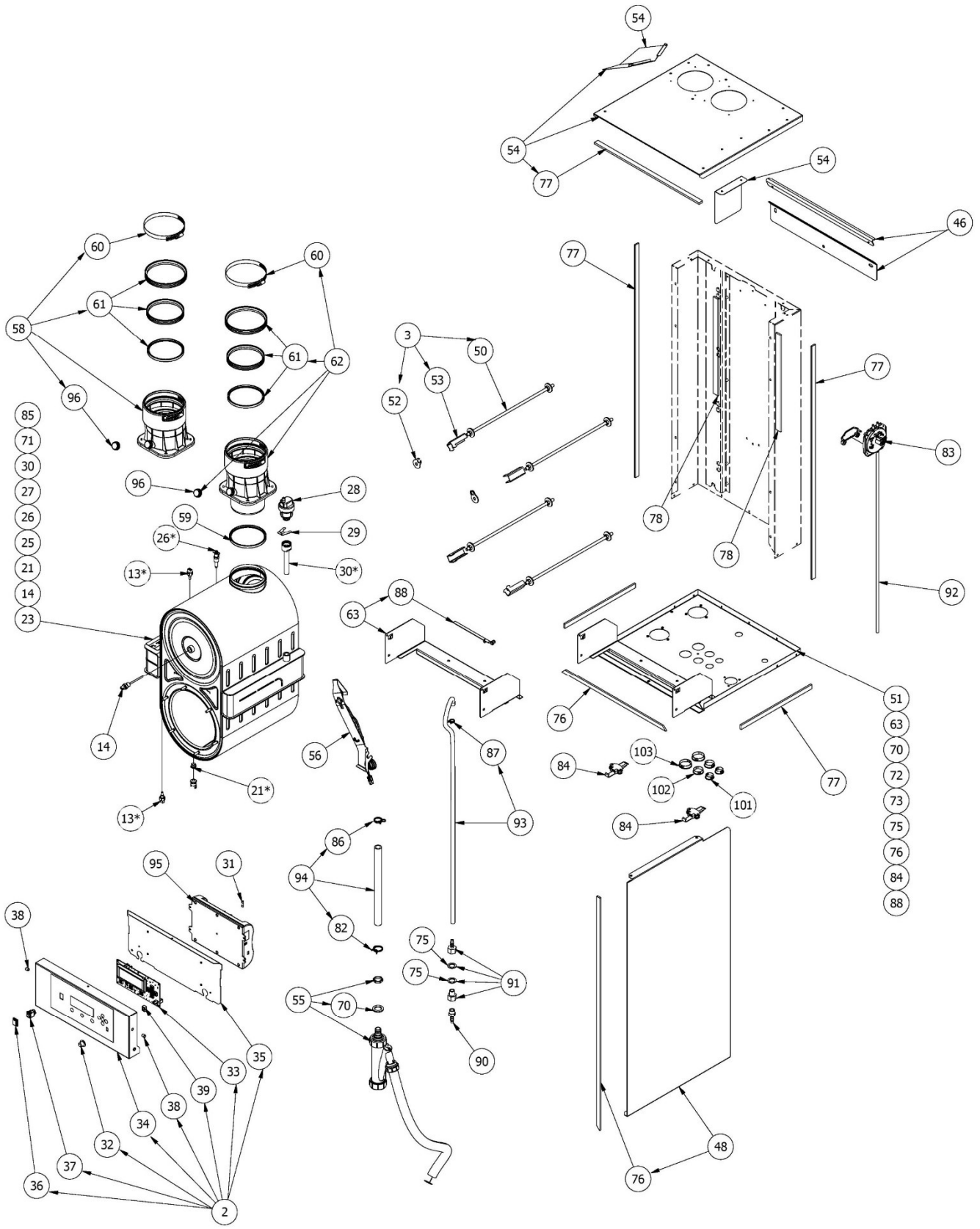


Figure 23.1



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

Figure 23.2

23.2 CB 470W and CB 500W

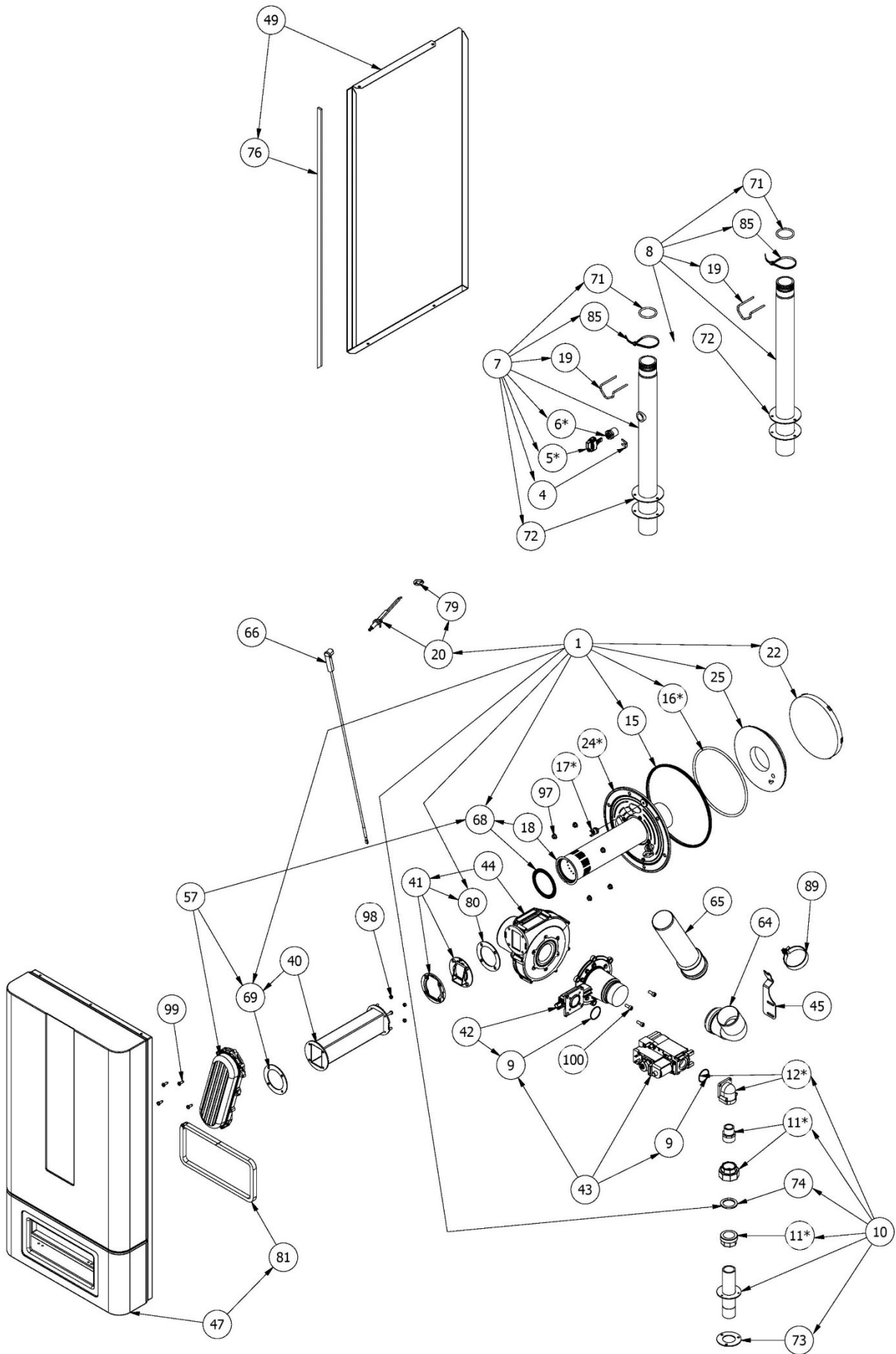
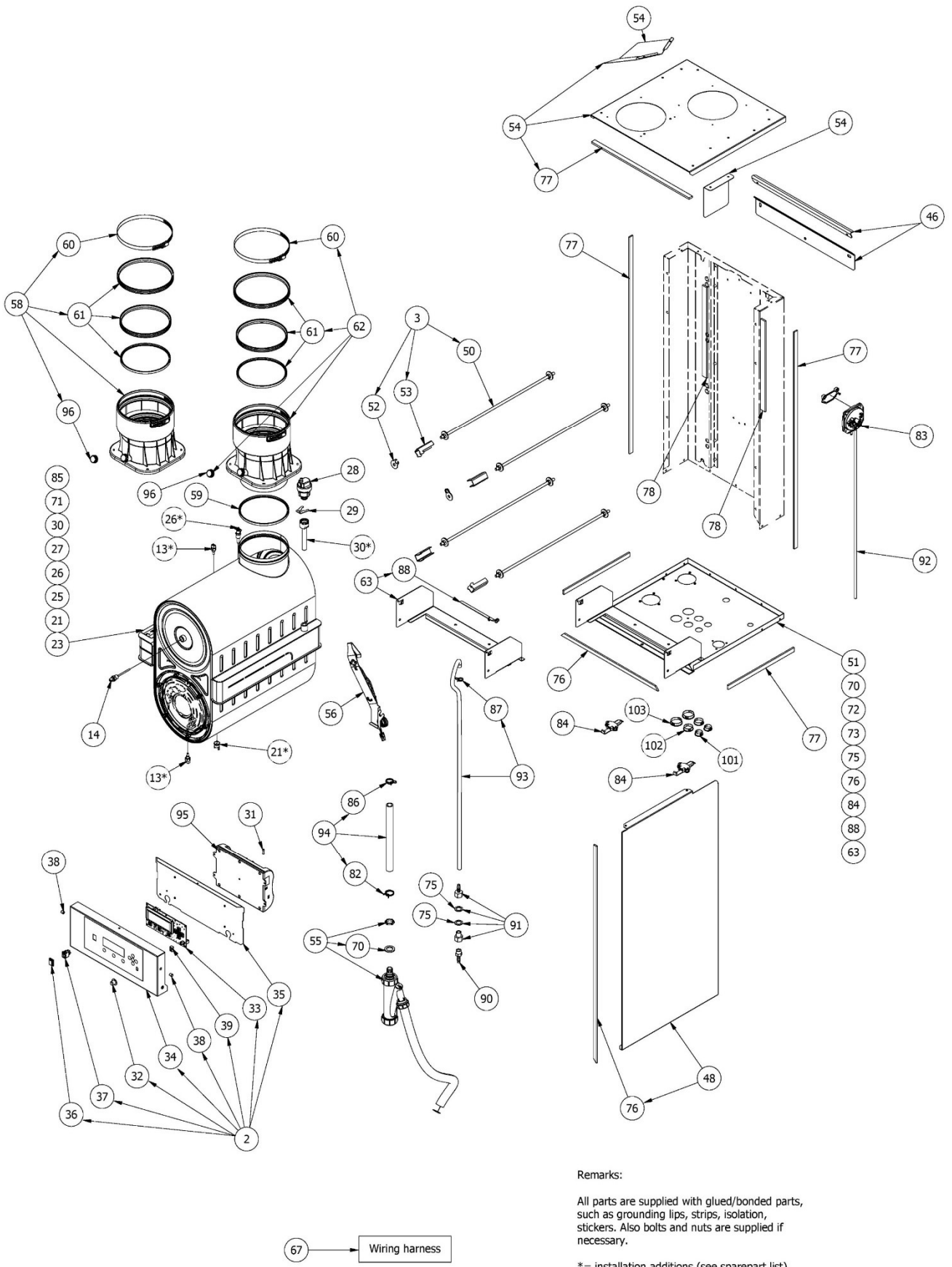


Figure 23.3



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)

Figure 23.4

23.3 Part numbers

POS.	DESCRIPTION	Part Number	CB 299W	CB 399W	CB 470W CB 500W
1	Set. Universal maintenance kit *2)	E153000001	X	X	X
2	Set. Electronics holder	E144000001	X	X	X
3	Set. Anchoring bar CB 299W	E111000001	X	NA	NA
3	Set. Anchoring bar CB 399W	E111000003	NA	X	NA
3	Set. Anchoring bar CB 470W & CB 500W	E111000004	NA	NA	X
4	Clip for WPS 10bar	E115100001	X	X	X
5	Water pressure sensor 10bar	E141100001	X	X	X
6	Nipple for RPS D15	E133100001	X	X	X
7	Flow pipe CB 299W & CB 399W	E131000001	X	X	NA
7	Flow pipe CB 470W & CB 500W	E131000004	NA	NA	X
8	Return pipe CB 299W & CB 399W	E131000006	X	X	NA
8	Return pipe CB 470W & CB 500W	E131000010	NA	NA	X
9	O-ring gas valve connection	E153100001	X	X	X
10	Gas pipe CB 299W & CB 399W	E158000001	X	X	NA
10	Gas pipe CB 470W & CB 500W	E158000002	NA	NA	X
11	Union flat seat Rp1 x Rp1 (4408) *1)	E158000003	X	X	X
12	Hooked gas valve VR4615 connection *1)	E158100001	X	X	X
13	NTC sensor 1/8" SS *1)	E141100003	X	X	X
14	NTC flue sensor 1/4" 10 KOHM = R25 B=3977K t2	E141100004	X	X	X
15	Seal Burner door	E153100005	X	X	X
16	Insulation fibre braid burner door *2)	E153100004	X	X	X
17	Burner door thermostat 160° C (M5)	E141100005	X	X	X
18	Burner CB 299W	E151000001	X	NA	NA
18	Burner CB 399W	E151000002	NA	X	NA
18	Burner CB 470W & CB 500W	E151000003	NA	NA	X
19	Spring fast connection CB 299W & CB 399W	E115100003	X	X	NA
19	Spring fast connection CB 470W & CB 500W	E115100004	NA	NA	X
20	Electrode	E155000001	X	X	X
21	Reducing coupling G1/4 x M5 *1)	E135100001	X	X	X
22	Backwall isolation 16mm	E153100002	X	X	X
23	Heat exchanger CB 299W *2)	E134000001	X	NA	NA
23	Heat exchanger CB 399W *2)	E134000003	NA	X	NA
23	Heat exchanger CB 470W & CB 500W *2)	E134000004	NA	NA	X
24	Burner door right sided ignition (metal sheet burner) *2)	E153100006	X	X	X
25	Burner door isolation right sided ignition hole Ø70,5 *2)	E153100003	X	X	X
26	Sensor LWCO *1)	E141100006	X	X	X
27	Temperature switch 90° C	E141100007	X	X	X
28	Automatic air vent with clip connection	E134000006	X	X	X
29	Locking clip air vent	E115100005	X	X	X
30	Extension pipe air vent	E131100001	X	X	X
31	Box 10pcs Fuse 5 AT	E145100001	X	X	X
32	Rubber plug Ø13	E144100003	X	X	X
33	Pixel Button Display	E144100004	X	X	X
34	Display front panel	E144100005	X	X	X
35	Mounting plate burner control	E142100001	X	X	X
36	Dustcover ON/OFF switch	E144100006	X	X	X
37	Main switch	E141100008	X	X	X
38	Spring plunger 8mm	E144100007	X	X	X
39	EPDM sealing for EBM 957	E144100008	X	X	X
40	Offset piece CB 299W	E152000004	X	NA	NA
40	Offset piece CB 399W	E152000005	NA	X	NA
40	Offset piece CB 470W & CB 500W	E152000006	NA	NA	X
41	Check valve + seat	E152000008	X	X	X

*1) Install with E364000001

*2) Install with E364000002

POS.	DESCRIPTION	Part Number	CB 299W	CB 399W	CB 470W CB 500W
42	Venturi CB 299W	E158100002	X	NA	NA
42	Venturi CB 399W	E158100003	NA	X	NA
42	Venturi CB 470W & CB 500W	E158100004	NA	NA	X
43	Modulating gas valve VR4615 (120VAC)	E158000004	X	X	X
44	Radial Blower RG148/300W (120VAC)	E152000002	X	X	NA
45	Mounting plate silencer	E114100001	X	X	X
46	Wall mounting plate	E114000002	X	X	X
47	Front panel	E121000001	X	X	X
48	Side panel right	E121000002	X	X	X
49	Side panel left	E121000003	X	X	X
50	Anchoring bar CB 299W	E111100001	X	NA	NA
50	Anchoring bar CB 399W	E111100003	NA	X	NA
50	Anchoring bar CB 470W & CB 500W	E111100004	NA	NA	X
51	Bottom panel CB 299W & CB 399W	E121000004	X	X	NA
51	Bottom panel CB 470W & CB 500W	E121000005	NA	NA	X
52	Special washer heat exchanger	E113100001	X	X	X
53	Clamping bracket heat exchanger	E114100002	X	X	X
54	Top panel CB 299W & CB 399W	E121000006	X	X	NA
54	Top panel CB 470W & CB 500 W	E121000007	NA	NA	X
55	Condensate drain assembly l=800	E137000001	X	X	X
56	Backwall clixon	E141100009	X	X	X
57	Gas-air mixing pipe	E152000009	X	X	X
58	Boiler air connector CB 299W & CB 399W	E157100001	X	X	NA
58	Boiler air connector CB 470W & CB 500W	E157100002	NA	NA	X
59	Seal EPDM CB 299W & CB 399W	E157100003	X	X	NA
59	Seal EPDM CB 470W & CB 500W	E157100004	NA	NA	X
60	Clamp galvanized CB 299W & CB 399W	E157000003	X	X	NA
60	Clamp galvanized CB 470W & CB 500W	E157000004	NA	NA	X
61	Set. Seal EPDM Adapter CB 299W & CB 399W	E157100001	X	X	NA
61	Set. Seal EPDM Adapter CB 470W & CB 500W	E157100002	NA	NA	X
62	Boiler flue gas connector CB 299W & CB 399W	E157000005	X	X	NA
62	Boiler flue gas connector CB 470W & CB 500W	E157000006	NA	NA	X
63	Connection bar display holder	E114000003	X	X	X
64	Elbow silencer	E156000004	X	X	X
65	Extension pipe silencer CB 299W & CB 399W	E156100001	X	X	NA
65	Extension pipe silencer CB 470W & CB 500W	E156100001	NA	NA	X
66	Ignition cable	E155100001	X	X	X
67	Cable Harness HV/LV	E143000001	X	X	X
68	Gasket Burner & gas/air inlet pipe	E151100001	X	X	X
69	Gasket gas/air inlet pipe & fan	E152100002	X	X	X
70	Gasket siphon/bottom plate	E137100001	X	X	X
71	O-ring flow/return pipe CB 299W & CB 399W	E133100003	X	X	NA
71	O-ring flow/return pipe CB 470W & CB 500W	E133100004	NA	NA	X
72	Gasket flow/return pipe 1½"	E133100005	X	X	X
73	Gasket gas pipe	E153100007	X	X	X
74	Gasket malleable coupling 12+6	E153100008	X	X	X
75	Gasket Condensate drain/bottom plate	E137100002	X	X	X
76	Silicone seal 13x5 self adhesive L=10m	E123100001	X	X	X
77	EPDM seal 15x6 self adhesive L=5m	E123100002	X	X	X
78	EPDM seal 20x5 self adhesive L=5m	E123100003	X	X	X
79	Gasket electrode	E155100002	X	X	X
80	Gasket gas/air mixing	E152100003	X	X	X
81	EPDM seal 10x12 self adhesive L=5m	E123100004	X	X	X
82	Hose clamp Ø23,83 (DW15)	E137100003	X	X	X
83	Air pressure switch DL 2 ET with S-clip (US)	E141100010	X	X	X
84	Quick-action clamp	E115100006	X	X	X

POS.	DESCRIPTION	Part Number	CB 299W	CB 399W	CB 470W CB 500W
85	Ty-Rap Heat resistant 3,5x200 mm	E115100007	X	X	X
86	Hose clamp Ø20,62 (DW13)	E137100004	X	X	X
87	Hose clamp Ø11,6-12,3	E115100008	X	X	X
88	Cable tie with rivet	E115100009	X	X	X
89	PVC bracket Ø60	E114100003	X	X	X
90	NPT Male Connector 3/8	E116100001	X	X	X
91	NPT Female Connector 3/8	E116000001	X	X	X
92	Hose pressure switch	E138100001	X	X	X
93	Hose air vent	E138100002	X	X	X
94	Hose condensate trap CB 299W & CB 399W	E138100003	X	X	NA
94	Hose condensate trap CB 470W & CB 500W	E138100004	NA	NA	X
95	Burner control CB 299W, CB 399W, CB 470W, CB 500W	E142100002	X	X	X
96	Measuring Cap M20x2 Ral-9011	E157100005	X	X	X
97	10x Flanging head nut M6	E112100001	X	X	X
98	4x Nut M5 DIN985	E112100002	X	X	X
99	5x Screw M5x14 DIN7500C	E116100002	X	X	X
100	3x Screw M6x16 DIN912 (Venturi)	E116100003	X	X	X
101	Knock Out Seal 1/2" nylon	E123100001	X	X	X
102	Knock Out Seal 3/4" nylon	E123100002	X	X	X
103	Knock Out Seal 1" nylon	E123100003	X	X	X
104	Thermal fuse protection burner door	E141100011	X	X	X
105	CSD kit gas pressure	E158000005	NA	NA	X
106	External ignition transformer (120V)	E146100001	X	X	X

Table 23.1

IONIC

CASCADE

Rack System



Racks systems to ensure smallest footprint to maximize the BTU/square feet delivered by Wall Mounted Boilers.

Models # Rack System	# of Boilers	Total Input MBH	Total Output MBH	Rack and LLH		
				Depth	Width	Weight (lbs)
RS0600BL2D3	(2) 299	598	578	27"	58"	410
RS0800BL2D3	(2) 399	798	762	27"	58"	410
RS0900BL3D3	(3) 299	897	867	27"	80"	560
RS1000BL2D3	(2) 500	1,000	936	27"	58"	410
RS1200BL4D3	(4) 299	1,196	1,156	27"	101"	735
RS1200BL3D3	(3) 399	1,197	1,143	27"	80"	560
RS1500BL5D3	(5) 299	1,495	1,445	27"	123"	885
RS1500BL3D3	(3) 500	1,500	1,404	27"	80"	560
RS1600BL4D3	(4) 399	1,596	1,524	27"	101"	885
RS1800BL6D3	(6) 299	1,794	1,734	27"	145"	1,245
RS2000BL5D3	(5) 399	1,995	1,905	28"	123"	1,065
RS2000BL4D4	(4) 500	2,000	1,872	28"	101"	885
RS2400BL6D4	(6) 399	2,394	2,286	28"	145"	1,245
RS2500BL5D4	(5) 500	2,500	2,340	28"	123"	1,065
RS3000BL6D4	(6) 500	3,000	2,808	28"	145"	1,810

* Height of Rack is 66 inches



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E126100001