ideal HEATING
NORTH AMERICA

Installation & Service Manual

NSF/ANSI/CAN 372

HLW

COMMODORE

W-WH

WH- 299W-399W-470W-499W

Low NOx certified to SCAQMD 1146.2

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.

When receiving the Commodore 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.

E93.1805.034 – E126100006

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	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 Water heater must be installed by a qualified installer, service agency, or the gas supplier or the Warranty is void. Failure to properly install this unit may 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.

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

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.

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

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 water heater if any part has been under water. Immediately call a qualified service technician to inspect the water heater 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.

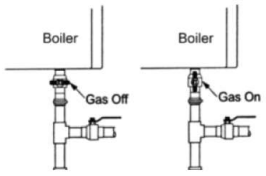
WHAT TO DO IF YOU SMELL GAS
- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

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 sevice 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 MARCHE

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

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

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

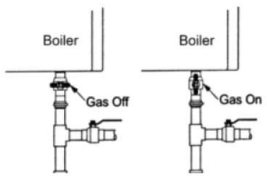
QUE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAZ
- Ne pas tenter d'allumer d'appareil.
- Ne touchez à aucun interrupteur ; ne pas vous servir des téléphones se trouvant dans le bâtiment.
- Appelez immédiatement votre fournisseur de gaz depuis un voisin. Suivez les instructions du fournisseur.
- Si vous ne pouvez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

C. **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 service 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 MARCHE

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 apparell ne comporte pas de veilleuse. Il intègre un dispositif d'allumage automatique du brûleur. N'essayez pas d'allumer manuellement le brûleur.
5. L'interrupteur de gaz principal se trouve directement sous la chaudière, sur la conduit d'alimentation en gaz.
6. L'interrupteur de gaz principal se trouve directement sous la chaudière. Tournez l'interrupteur de gaz principal dans le sens horaire pour couper l'alimentation en gaz.



7. Attendre cinq (5) minutes pour laisser échapper tout le gaz. Reniflez tout autour de l'appareil, y compris près du plancher, pour déceler une odeur de gaz. Si vous sentez une odeur de gaz, ARRÊTEZ ! Passez à l'étape B des instructions de sécurité sur la portion supérieure (à gauche) de cette étiquette. S'il n'y a pas d'odeur de gaz, passez à l'étape suivante.
8. **Tournez la vanne manuelle de contrôle du gaz dans le sens antihoraire en position ON (parallèlle 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 pourcouper l'alimentation en gaz.

2.3 *Specific warnings*

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

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

NOTICE	The installer must verify that all the carbon monoxide detectors with alarms have been installed within residential living space(s) or the home following the alarm manufacturer's instructions and applicable local codes before putting the appliance into operation. Ideal 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 water heater is located and another installed in the area outside each sleeping area for all installations. For systems using common venting an additional carbon monoxide detector must be wired into the safety controls of the water heater see the *Commodore Common Vent Installation and Operations Manual* for additional information. Consult the local authority having jurisdiction for any additional carbon monoxide detector requirements in your area. See *Section 2.4 on page 13* for additional carbon monoxide detector requirements in Massachusetts.

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

WARNING	**Avertissement**
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 water heater. This water heater contains materials that have been identified as carcinogenic, or possibly carcinogenic, to humans)	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 le chauffe-eau et les respecter. Ce chauffe-eau contient des matériaux qui ont été identifiés comme étant cancérogènes ou pouvant l'être).

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

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

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 water heaters, 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 the newest edition of the NFPA 72.
2) **A carbon monoxide detector and alarm shall be located in the room that houses the water heater and/or equipment and shall:**
    a) Be powered by the same electrical circuit as the water heater and/or equipment such that only one service switch services both the water heater and the carbon monoxide detector;
    b) Have battery back-up power;
    c) Meet ANSI/UL 2034 Standards and comply with the newest edition of the NFPA 72; and
    d) Have been approved and listed by a Nationally Recognized Testing Lab as recognized under 527 CMR.
3) A product-approved vent terminal must be used, and if applicable, a product approved air intake must be used. Installation shall be performed in strict compliance with the manufacturer's instructions. A copy of the installation instructions shall remain with the water heater 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 water heaters, mechanical-vent heating water heaters 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 the newest edition of NFPA 72.
2) **A carbon monoxide detector shall:**
    a) Be located in the room where the water heater and/or equipment is located;
    b) Be either hard-wired or battery powered or both; and:
    c) Comply with the newest edition of 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 water heater and/or equipment at the completion of the installation.

For installations in Massachusetts, code requires the water heater to be installed by a licensed plumber or gas fitter.

2.5 *Water heater warnings*

To meet commercial hot water requirements, the water heater setpoint is adjustable up to 185°F (85°C). However, water temperatures over 125°F (52°C) 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.

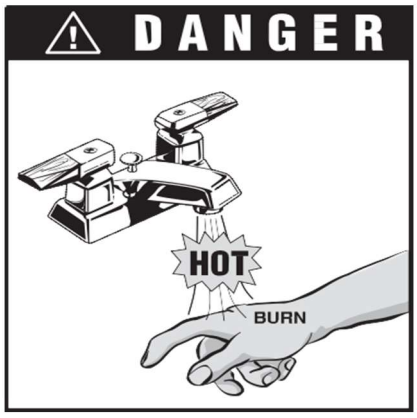
WARNING	WARNING: Water temperatures over 125°F (52°C) can cause severe burns instantly or death from scalding. The water temperature is factory set at 140°F (60°C) to minimize legionella risk. Before bathing or showering always check the water temperature.

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 (on the storage 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.

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.



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 water heater. To comply with safety regulations, the setpoint was set at its lowest setting before shipment from the factory.

CAUTION	Hotter water increases the risk of SCALDING!

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

3 INTRODUCTION

This manual is written for the installer and service technician.
Ideal 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 Ideal. If there is a conflict or doubt about the proper installation of the unit or any factory supplied replacement parts, please contact Ideal Technical Support.
Parts must only be replaced with genuine Ideal parts. Do not attempt to carry out any modifications to the appliance without prior written consent from Ideal.
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.

Ce manuel est écrit pour l'installateur et le technicien d'entretien.
Ideal 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 Ideal. 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 Ideal.
Les pièces ne doivent être remplacées que par des pièces d'origine Ideal. Ne tentez pas d'apporter des modifications à l'appareil sans le consentement écrit préalable de Ideal.
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.

3.1 *Explanations*

WH = Water Heater
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)
299/399/470/499=Model number of the water heater.

Explications

WH = Chauffe-eau.
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)
299/399/470/499 = Modèle numéro de chauffe-eau

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 water heater 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

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 chauffe-eau 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.

Ideal 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.idealheatingna.com.

3.3 *Important technical warnings and guidelines*

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 water heater should be carried out at the following occasions:
- **When a number of similar error codes and/or lockouts appear.**
- **At least every 12 months or every 2000 hours (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

The Ideal Hot Water systems will, for a long period, comfortably meet your requirement of hot water of the right temperature at the right hour, provided that a few important conditions have been fulfilled regarding the installation.
Please follow all instructions and recommendations presented in this manual by Ideal, especially the ones concerning the next important topics:

- Water quality (also see § 8.8 on page 36)

  A first necessary condition is the quality of the water to be heated in the hot water heater.
  Only potable water can be used with this water heater. Do not introduce pool or spa water, or any chemically treated water into the water heater.
  Three values matter: hardness, total amount of dissolved solids and acidity. If water quality does NOT meet the requirements the system may be seriously damaged in time!

  - Water hardness should not exceed 11 gpg (190 ppm $CaCO_3$). If the waterflow (gpm) is increased in accordance with the tables in this manual, a water hardness up to 14 gpg (240 ppm $CaCO_3$) is acceptable. Water hardness leads to scale formation and may affect/damage the water heater. Hard water scaling must be avoided or controlled by proper water treatment.
  - TDS (Total Dissolved Solids) should not exceed 450 ppm
  - Hardness and TDS together may not exceed 450 ppm
  - pH value should be between 6.5 and 7.5, measured cold

  The actual values can be retrieved at your local water supplier.

  If water quality doesn't meet the abovementioned requirements, a water treatment installation must be installed to improve water quality to the required levels.

- Water flow velocity and pump selection

  For a given combination of water heaters and tanks, pump selection is very important with respect to the required flow velocity.

- Water flow velocity and piping diameters and lengths

Following the instructions and recommendations given in the referred paragraphs will highly improve the functioning and considerably lengthen the life time of your Commodore WWH system.

Furthermore, for all Ideal Commodore WWH water heaters the next instructions and recommendations apply:

! *Never use aluminium or aluminium containing flue gas outlet*

! *Always fill the condensate trap before commissioning the water heater*

! *Always setup the correct combustion according to the manual during commissioning the water heater, for the first time and after maintenance and/or installation changes*

! *Never place a valve between the safety valve and the water heater*

! *In a log, keep track of all situations regarding the appliance:*
what, when, by whom, what actions and/or changes, what communication has been performed

Ideal is not liable for any damage caused by inaccurately following these mounting instructions. Only Ideal parts shall be used when carrying out any repair or service works.

Do not use chlorine based products for brazing.
When commissioning the water heater, the running of the water heater pump must be checked before leaving the installation.

Firing the water heater without water flow (but filled with water) will cause a boiling noise.

The outlet and inlet temperature are checked continuously. The temperature difference must not exceed the programmed value belonging to the actual power mode. If it does, the water heater will go into a lock-out.

⚠	The applied DHW pump must be controlled only by the Commodore WWH water heater control. If, for any reason, an external pump control is applied *without written approval of* Ideal, the complete warranty on the WH water heater and all supplied parts will become void.

Minimum water pressure 15 psi.

Fuel used should have sulphur rates that comply with the next values: a maximum annual peak over a short period of time of 110 ppm (150 mg/m^3) and a maximum annual average of 22 ppm (30 mg/m^3).

Combustion air must be free of contents of chlorine, ammonia, alkali agents. The air near a swimming pool, a washing machine or a laundry is containing these a.m. contents.

The water heater must always be installed with the factory supplied pressure relief valve. The storage tank(s) connected to the water heater must always be installed with a field supplied temperature and pressure relief valve. Always follow all applicable installation standards and regulations.

At first installation, the built-in automatic air vent should be open.

LEGIONNAIRES' DISEASE

⚠	An anti-Legionella function is present in the software and is by default turned ON

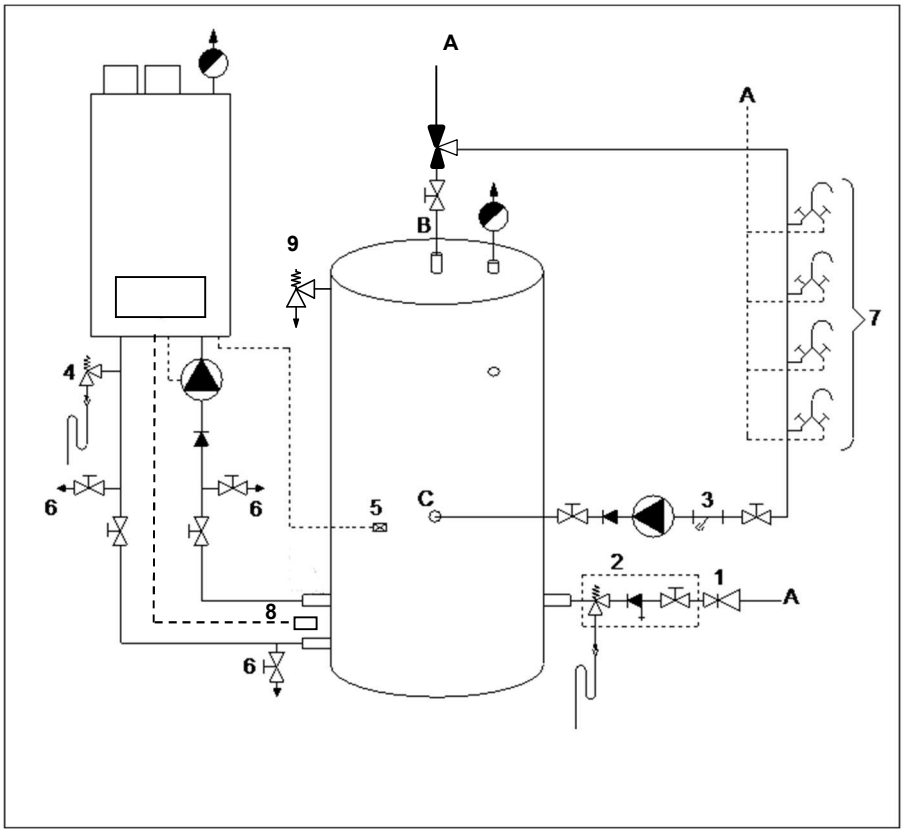
3.4 *Pressure relief valve*

This appliance comes with an approved pressure relief valve, specially selected for these appliances, rated set at 145 psi. An approved pressure relief valve must be installed to the water tank.

- The pressure relief valve must conform to ANSI Z21.22 or CAN 1-4.4 and installation must follow local codes.
- The MBH rating of the relief valve must not be less than the MBH input of the heater
- The pressure relief valve must not exceed the maximum working pressure indicated on the water heater rating plate.
- The discharge piping for the pressure relief valve must be directed so that the hot water cannot splash outward and cause damage or personal injury.
- 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.
- If the pressure relief valve discharges periodically, this may be due to thermal expansion in a closed water supply system, such as one having a backflow preventer in the cold supply line. Means shall be provided to control thermal expansion such as an expansion tank suitable for domestic water.
- Contact the water supplier or a local plumbing professional on how to correct this situation. Do not plug the pressure relief valve.
- The pressure relief valve must be manually operated periodically to check for correct operation.
- Before operating the valve manually, check that it will discharge in a place for secure disposal.
- 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, 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 applicate local code.
- The discharge line shall be installed to allow complete drainage of both the valve and line.

WARNING	Hot water could be released when the pressure relief valve is opened. This can result in severe personal injury. Before operating the pressure relief valve manually, check that it will discharge in a safe place. If water does not flow freely from the end of the discharge pipe, turn the gas supply and power OFF and call a qualified person to determine the cause. Refer to the pressure relief valve manufacturer's instructions for inspection and maintenance requirements.

The water heater and tank should be installed by a skilled installer according to all applicable standards and regulations for potable water installations. For single water heater installations use figure 3.1 as the standard piping schematic, this figure is for representative purposes only. When multiple water heaters and tanks are applied, each water heater has to be equipped with its own temperature and pressure relief valve. This figure is meant to illustrate piping concept only, the installer is responsible for the correct installation of all equipment. The qualified installer must follow all manufacturer's instructions for each component. It is the responsibility of the qualified installer to follow all local applicable codes of the authority having jurisdiction.



	PUMP
	NON- RETURN VALVE
	VALVE
	SAFETY VALVE
	AUTOMATIC VENT

	FILTER
	INLET COMBINATION - Overflow - Controllable return valve - Valve
	PRESSURE REDUCING VALVE

A) Potable water inlet
B) Hot water supply circulation
C) Circulation return

1) Pressure reducing valve (mandatory in case service water pressure is too high)
2) Inlet combination with valve (mandatory)
3) Apply filter if necessary (recommended)
4) A factory supplied pressure relief valve must be mounted near the water heater outlet (mandatory)
   This safety valve must never be isolated from the water heater by means of a closing valve
5) Mount the tank sensor in an immersion bulb into the tank at 1/5 from the bottom of the tank
6) Drain valve (required)
7) Hot and cold-water mixers
8) Strap-on system sensor (necessary)
9) Temperature and pressure relief valve (mandatory)

Figure 3.1

WARNING	**If the installation is constructed in such a way that underpressure (Pabs<1 bar; Patm<0 bar) can occur in the tank, a vacuum breaker must be installed between the inlet combination and the tank, without any valve".**

NOTICE	**SAFETY COMPONENTS** The picture shows an example of a functional installation. ALWAYS have the system installed by a skilled installer. Safety components must be added according to all applicable standards and regulations.

4 TECHNICAL DATA COMMODORE WWH WATER HEATERS

4.1 *Functional introduction*

The Commodore WWH series are water heaters 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 WWH water heater is factory set for Natural gas.
Fuel used should have sulphur rates with a maximum annual peak over a short period of time of 110 ppm (150 mg/m^3) and an annual average of 22 ppm (30 mg/m^3)

Water heater control includes:
- Cascade control for up to sixteen water heaters
- Remote operation and heat demand indication from each water heater
- Anti-Legionnaires' disease function (Only available at DHW mode 1, and cascaded water heaters)
- Direct tank control

Connections for:
- Water heater pump
- PWM control for external water heater pump.
- External flow switch or external safety device.
- DHW sensor.
- System sensor
- Modbus

4.2 *Location of version numbers*

Parameter Version
- To be found on the small sticker on the side of the burner controller. **v.B** = "Version B" e.g

Burner Controller Hardware Version
– To be found on the second line of the white sticker on the side of the burner controller.

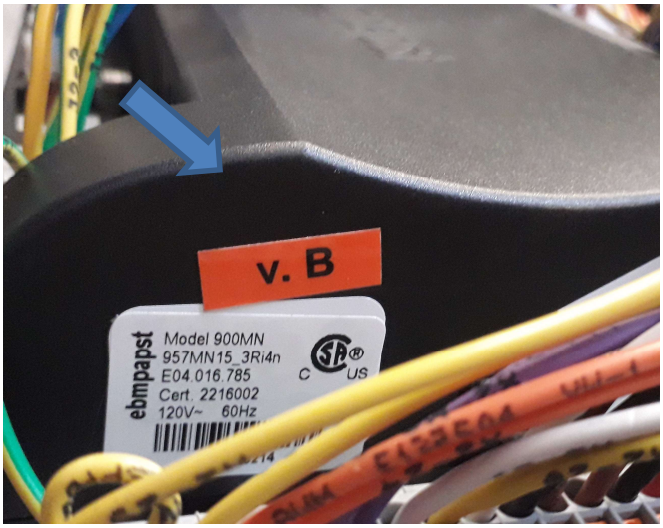


Figure 4.1

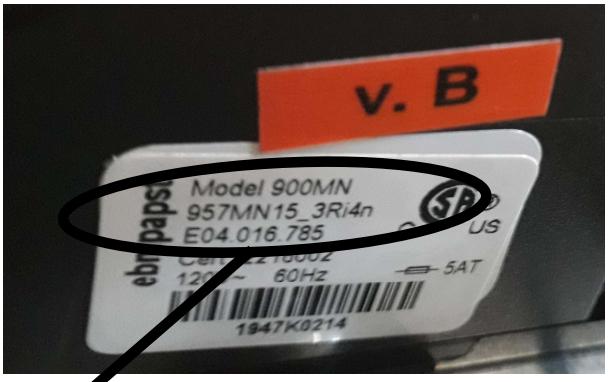


Figure 4.2

957MN15_3Ri4n

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

Information	
Software Versions	i
Boiler Status	
Boiler History	
Error Log	

Figure 4.3

Software Versions	
Display	[BD65 814B]
Boiler	[59AB 9672]
Device Group	900MN

Figure 4.4

4.3 *Technical specifications datasheet*

GENERAL						
Water heater, category		-	IV, direct vent			
WATER HEATER MODEL			**WH 299W**	**WH 399W**	**WH 470W**	**WH 499W**
Dimensions (h x w x d)		inch (mm)	**33.3 x 17.3 x 21.2 (845 x 440 x 539)**			
Water content (estimated)		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)
Supply / return connection (water heater)		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 and air connection		inch (mm)	4" (100)	4" (100)	6" (150)	6" (150)
GAS CONSUMPTION			**Values Low fire - High fire:**			
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 WC (mbar)	7.0 (17.4)			
	Propane	inch WC (mbar)	11.0 (27.4)			
EMISSION			**Values Low fire - High fire:**			
O_2 flue gas [3]	Nat. gas	%	4.7 - 4.7		5.3 - 5.3	4.7 - 4.7
	Propane	%	6.4 - 5.0			
CO_2 flue gas [3]	Nat. 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 WC (Pa)	0.8 (200)			

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 / CO_2 of the unit measured/set without the water heater front panel in place; the water heater should be setup utilizing O_2, CO_2 values are for reference.

[4] Maximum allowed combined resistance of flue gas and air supply piping at high fire

Table 4.1

WATER HEATER MODEL			WH 299W	WH 399W	WH 470W	WH 499W
INSTALLATION						
Resistance water heater	ΔT = 30 °F	ft.head (m.WC)	12 (3.7)	14 (4.3)	14 (4.3)	15 (4.6)
	ΔT = 22.5 °F	ft.head (m.WC)	20 (6.1)	21 (6.4)	21 (6.4)	23 (7.0)
Pressure water heater min-max.		psi (bar)	15 - 145 (1.0 - 10.0)			
Max. supply temperature		°F (°C)	185 (85)			
ELECTRIC						
Maximum power consumption		W	180	200	280	280
Power supply		V/Hz	120/60			
Protection class		-	IPX4D			

Table 4. 2

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.

Water heater is IPX4D applying a dust filter or bird screen with two elbows and if necessary, a short straight pipe.

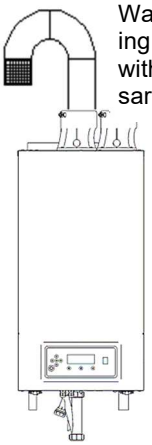


Figure 4.5

Water heater is IP20 applying a dust filter or bird screen only

Figure 4.6

4.4 *High altitude operation.*

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

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

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

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

Table 4.3

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

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

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

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

4.5 *AHRI specifications*

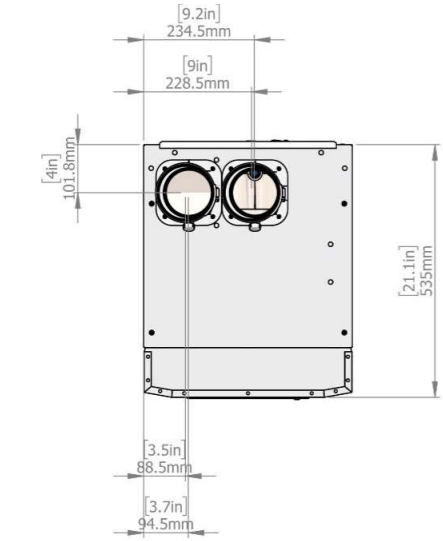
COMMODORE WWH series				
Model number	Input rate [1] MBTU/h		AHRI CERTIFIED	Recovery rate 100ºF (gal/h)
	Min	Max	Thermal efficiency (%)	
WH 299W	46	299	96	340
WH 399W	72	399	96	456
WH 470W	83	470	96	542
WH 499W	83	499	96	576

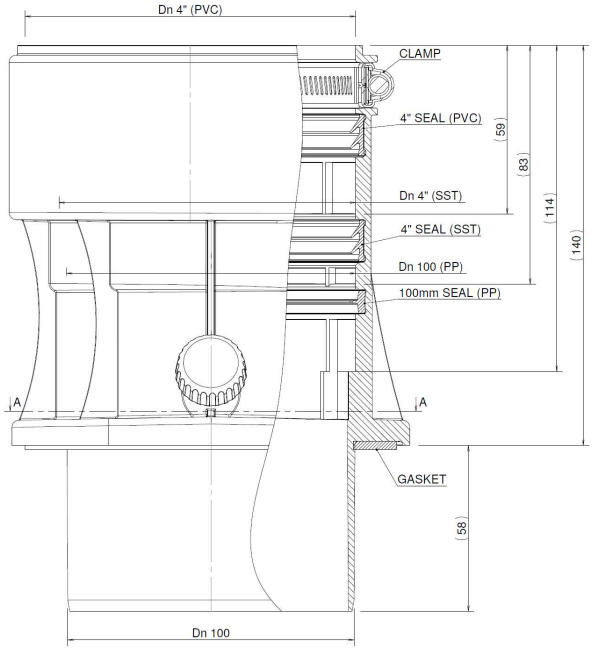
1 Listed Input ratings are at minimum vent lengths at Sea Level. Numbers will be lower with longer venting and/or altitudes greater than 2000 feet [610 m].
2 Ratings have been confirmed by the Hydronics Section of AHRI.
3 The ratings and efficiencies are based on standard test procedures and calculation methods as prescribed by the United States Department of Energy.
4 Ideal has determined that these firing rates meet the ENERGY STAR guidelines for energy efficiency

Table 4.4

5 WATER HEATER DIMENSIONS

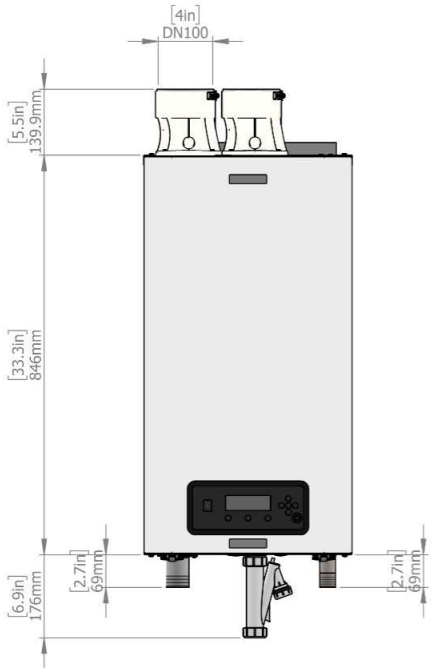
5.1 *WH 299W*





Vent connection

Figure 5.1



	Connections	WH 299W
A	Hot water outlet	NPT 1½”
B	Cold water inlet	NPT 1½”
C	Condensate	Flexible hose Ø 1.06 ” (26.9 mm)
D	Gas	NPT 1”

Table 5.1

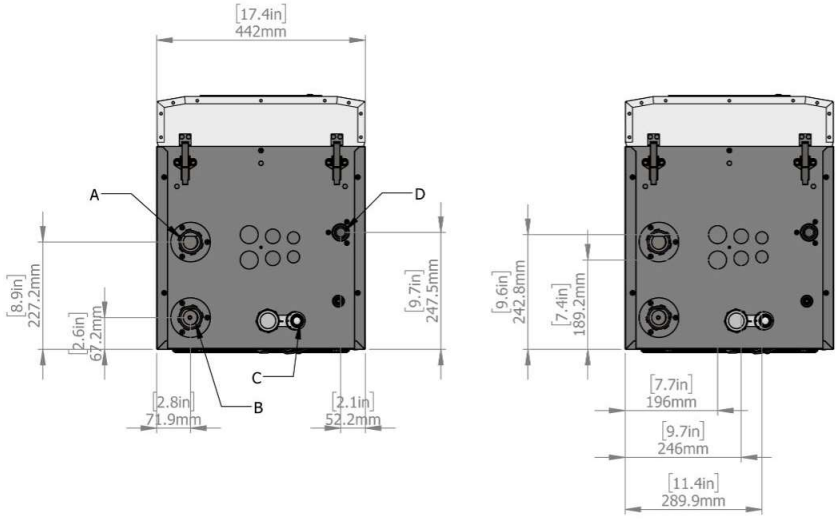
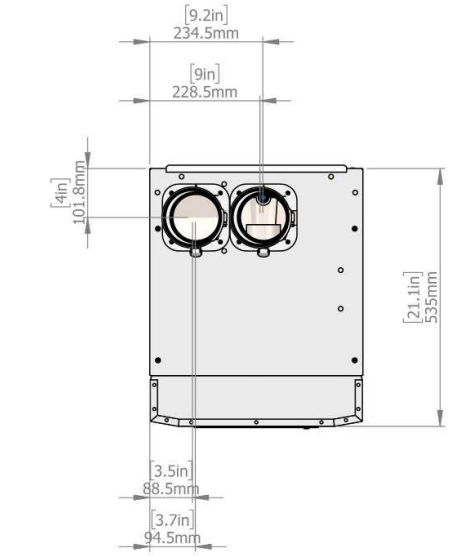
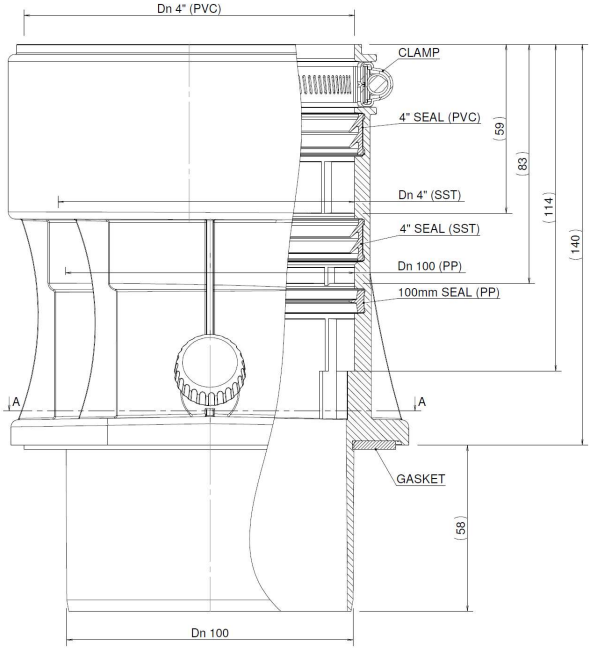


Figure 5.2

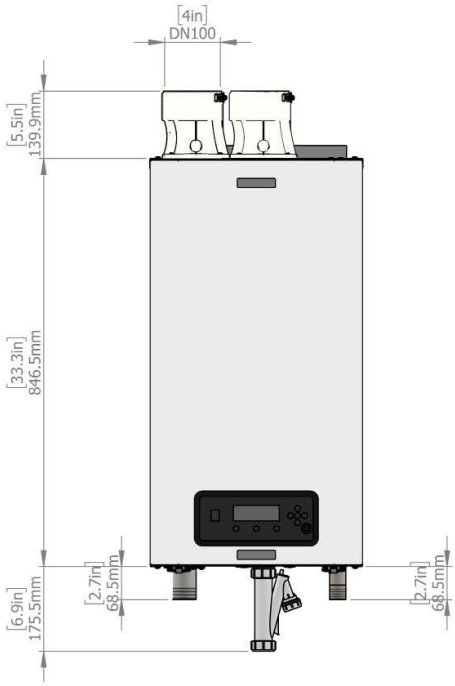
5.2 *WH 399W*





Vent connection

Figure 5.3



	Connections	WH 399W
A	Hot water outlet	NPT 1½”
B	Cold water inlet	NPT 1½”
C	Condensate	Flexible hose Ø 1.06” (26.9 mm)
D	Gas	NPT 1”

Table 5.2

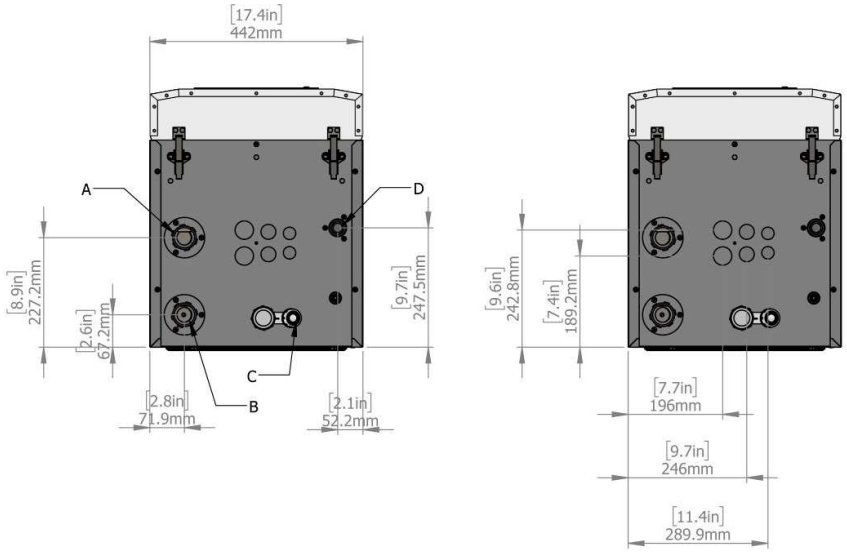
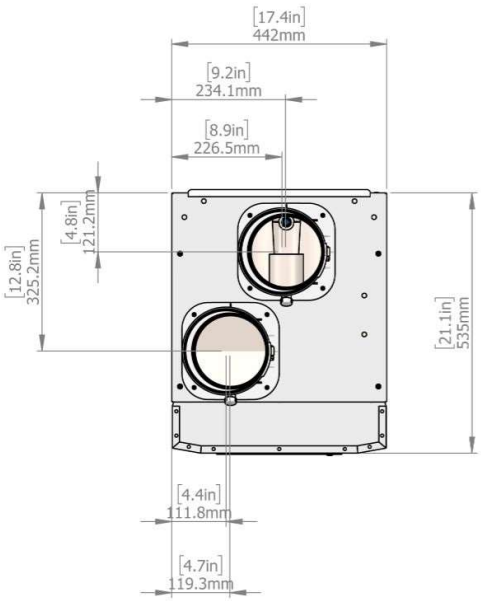
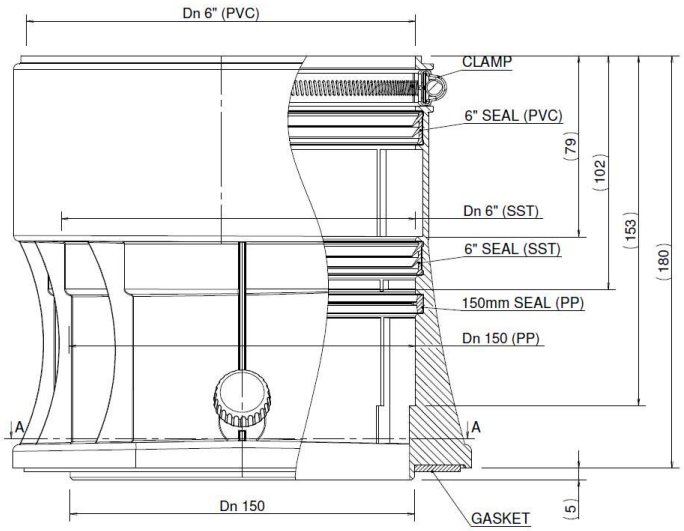


Figure 5.4

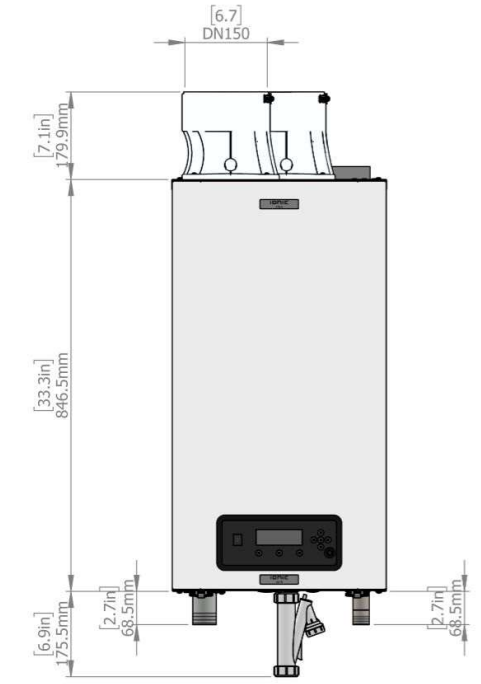
5.3 *WH 470W / WH 499W*





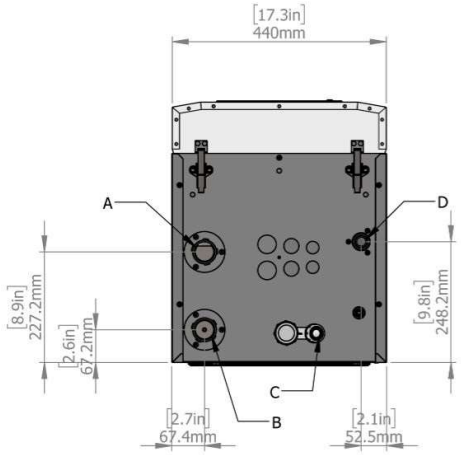
Vent connection

Figure 5.5



Connections		WH 470W / WH 499W
A	Hot water outlet	NPT 1½”
B	Cold water inlet	NPT 1½”
C	Condensate	Flexible hose Ø 1.06” (26.9 mm)
D	Gas	NPT 1”

Table 5.3



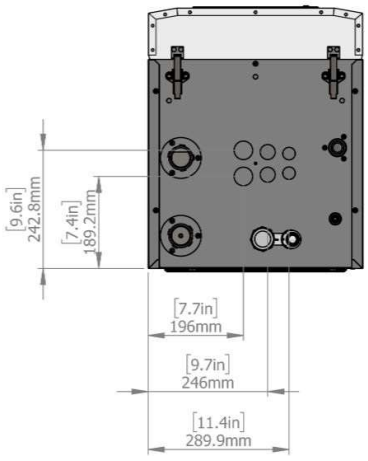


Figure 5.6

6 UNPACKING AND ACCESSORIES

6.1 *Unpacking*

The Commodore WWH water heater will be supplied with the following documents and accessories:

- One “Installation and service instructions” manual for the installer (inside the water heater, at the sidepanel)
- One User Manual (inside the water heater, at the sidepanel)
- One suspension bracket with locking plate and bolts (on the pallet)
- Spare fuse for the burner 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.
- Pressure relief valve 145 psi ¾”
- 1” Gas valve
- Tridicator: Temperature and pressure gauge
- Flow switch
- NTC Tank sensor 10K@25ºC, B3977k@25°C/85°C, 3000MM Cable length
- Thermal paste for tank sensor
- ½” Stainless Steel Tank sensor dry well
- ½” to ¾” Stainless Steel bushing for tank sensor dry well
- NTC Strap-on sensor for supply pipe

NB! A circulator is separately available, it is not included in the water heater supply.

After delivery, always check the water heater 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 sanitary water system and/or the optional use of an direct tank, the following items are available as accessories.

Item	part number
Adhesive kit 04	E364000001
LOCTITE® SI 5366™ 50ml	E364000002
Set. Universal maintenance kit (requires S022.000.002 purchased separately)	E153000001
IPX4D Air inlet kit WH 299W and WH 399W	E369000001
IPX4D Air inlet kit WH 470W	E369000002
Propane conversion kit for Venturi hole Ø 6.2 WH 299W	E368000001
Propane conversion kit for Venturi hole Ø 6.7 WH 399W	E368000002
Propane conversion kit for Venturi hole Ø 7.2 WH 470W and WH 499W	E368000003
Software and interface cable to program the water heater with a computer/laptop	E362100001
0-10V output kit PWM output for the water heater pump is available at the burner controller. When the water heater pump needs 0-10V control, this kit converts the PWM output into 0-10V output.	E361100003
Pump Relay kit When pumps are over 2 Amps, they cannot be connected directly to the burner controller. This relay set accomodates for 1 pump 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 standard supplied with the WH 470W and the WH 499W, 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
External manual reset high limit	E361100009
24V manual reset LWCO with test function	E361100007

MAGNA1 40-80 GF N	CIR14
MAGNA3 40-80 GF N Note: requires E361100003 Modulating circulator signal converter (PWM to 0-10V)	CIR15
MAGNA1 40-120 GF N (Note: requires Circulator relay kit for 1 circulator E361100006)	CIR16
UPS 43-100 SF (Note: requires Circulator relay kit for 1 circulator E361100006)	CIR17
MAGNA3 40-120 GF N (Note: requires E361100003 Modulating circulator signal converter (PWM to 0-10V) and Circulator relay kit for 1 circulator E361100006)	CIR18

Table 6.1

7 INSTALLATION LOCATION OF THE COMMODORE WWH

7.1 *Installation Clearances*

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

All Models	**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 1. Hot water pipes—at least 1/4" (6 mm) from combustible materials. 2. Vent pipe – at least 1" (25 mm) from combustible materials.					

Table 7.1

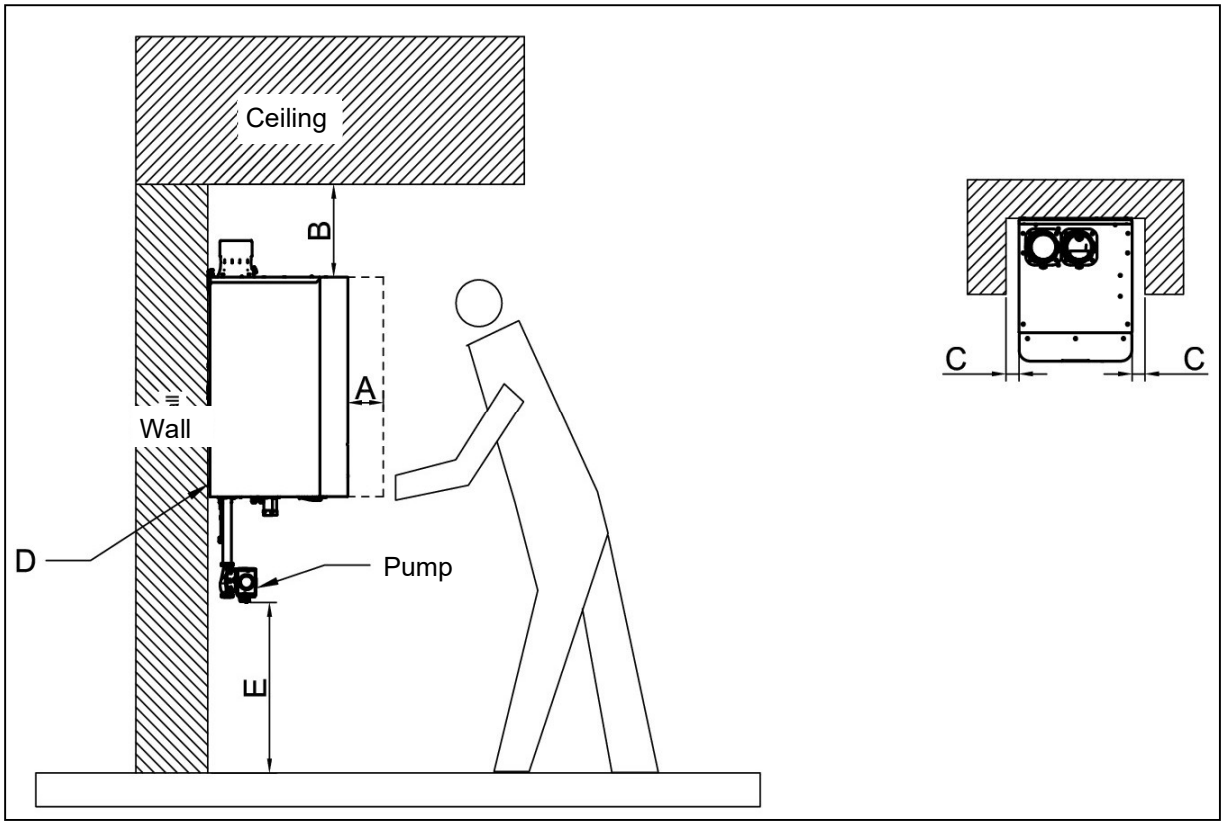


Figure 7.1

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 water heater.
- Depending on the current of the used circulator apply a circuit breaker between 6 and 12 amps

NOTICE	The installation of the Ideal 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
	The wall used for mounting the water heater must be able to hold the weight of the water heater, piping and fittings, and the weight of the water. If not, it is recommended to mount the water heater by means of an (optional) cascade stand.

CAUTION	The water heater must NOT be installed on or near carpeting.

7.2 *Water heater Installation Location Requirements:*

- The installation of this water heater when installed using room air must comply to the latest edition of NFPA 54 / ANSI Z223.1 and / or 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 water heater has a built-in fan that will generate noise, depending on the total heat demand. The water heater location should minimize any disturbance this might cause. Preferably mount the water heater on a solidly constructed wall or stand.
- There must be sufficient lighting available in the water heater room to work safely on the water heater.
- Do not install the water heater in a location where it will be exposed to temperatures 100 °F or higher.
- Do not install the water heater in a location where it will be exposed to high levels of humidity and moisture or where condensation might fall onto the water heater.
- Make sure there is an open connection with the sewer to drain the condensate. This connection should be lower than the condensate drains level of the water heater, if not a condensate pump will be required.
- Do not locate the water heater in an area which contains corrosive or other contaminants as outlined in section 11.7.1 tables 11.16 and 11.17
- 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 11.7.1 tables 11.16 and 11.17.

The water heater 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 water heater must be done by a qualified installer or technician, who was trained for this type of water heater.

In the Commonwealth of Massachusetts this water heater 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 water heater*

Before mounting and installing the water heater the following connections should be considered:

- Flue gas system and the flue gas pipe connections
- Air supply system and connections
- Cold water inlet and hot water outlet pipe connections
- Condensate and pressure relief valve drainage
- Power supply (preferably a power connection positioned above the water heater)
- 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 water heater so there will be no standing forces on the connections. This might influence the mounting position of the water heater.

Determine the position of the water heater 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 water heater 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 water heater in position.

The water heater 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 water heater should not lean forward in the mounted position.

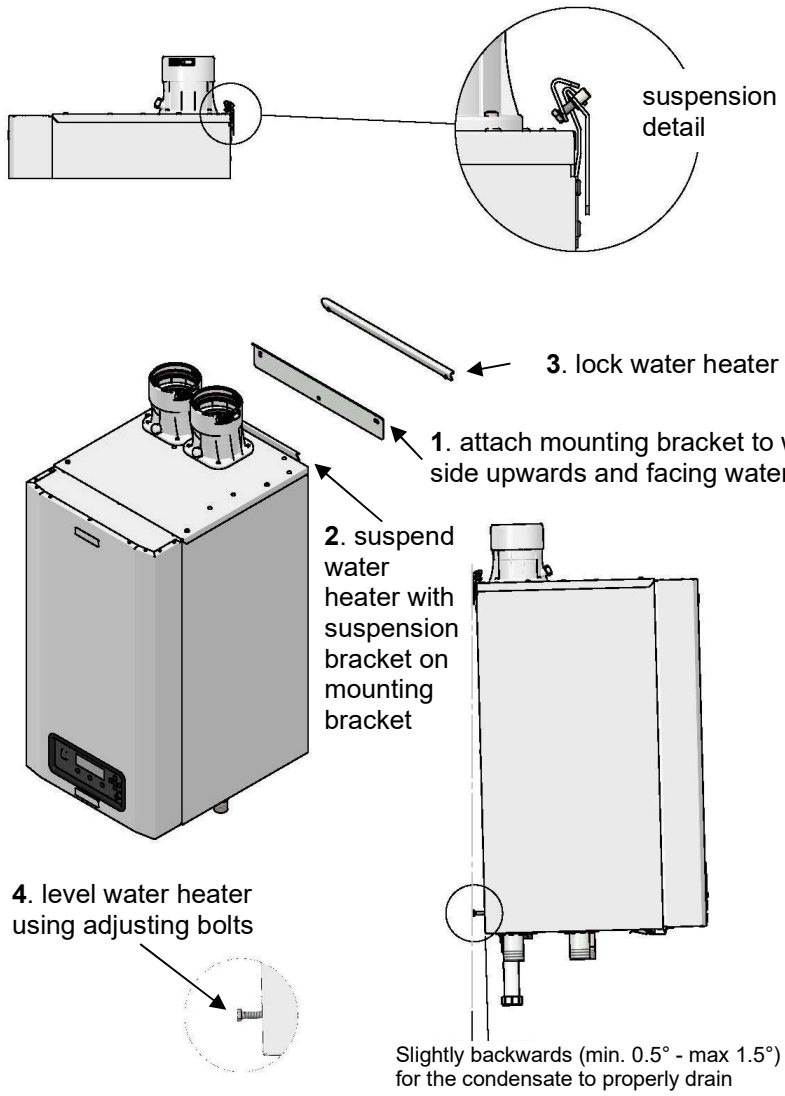


Figure 7.2

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

8 CONNECTIONS

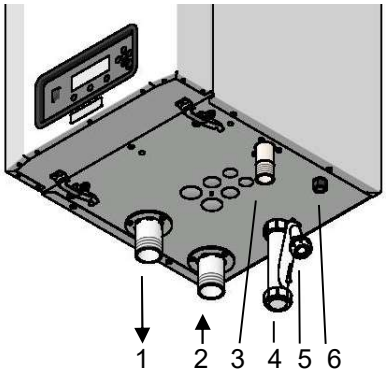


Figure 8.1

8.1 *Water heater 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*

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 the gas sizing table below for help when sizing the gas connection. For information on propane sizing consult your local propane gas supplier.

	Schedule 40 Metallic 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" wc as stated in the ANSI Z223.1/NFPA 54 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.

Ideal 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 water heater gas valve inlet at maximum water heater firing rate. See technical specifications datasheet for minimum and maximum allowed gas pressures.

When an in-line regulator is used to drop gas pressure from 2 psi to 0.5 psi, it must be located at a minimum of 6 ft from the water heater. 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 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.

Ideal requires a minimum 1” diameter flex hose if flex gas hose is going to be used. Ensure that: the gas line connection to the appliance does not apply any weight or pressure to the gas valve.

Create an installation layout such that the piping does not interfere with the vent pipe, or any other serviceable components.

The appliance shall be installed such that the gas ignition system components are protected from water (dripping, spraying, rain etc.) during installation, operation and servicing.

No appreciable drop in line pressure should occur when any unit (or in the instance of a cascade installation when all of the installed units) lights or runs. Use ANSI Z223.1 / CSA B149.1 gas line sizing practices. Make sure the gas pressure is within specification during all conditions.

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

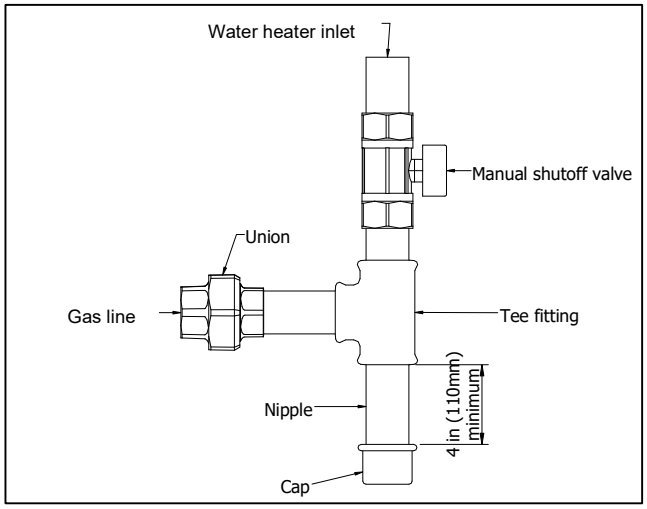


Figure 8.2

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 water heater 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 water heater 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.

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

WARNING

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

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

When performing a pressure test on the gas line piping, the following guidelines must be followed.
* The water heater and its individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 1/2 PSIG (3.45 kPa).
* The water heater 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 as standard equipment on the WH 499W.

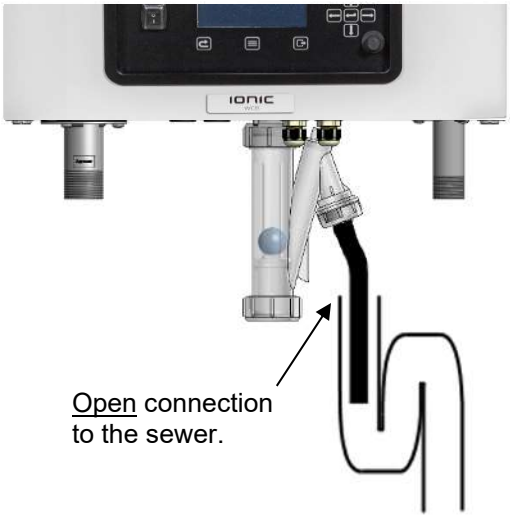


Figure 8.3

8.3 *Condensate drain connection*

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

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

Blockage of this drain might damage the water heater. 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 water heater.

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 water heater's condensate drain hose.

WARNING	The condensate the water heater 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 Ideal, 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.**

WARNING	**Make sure that the condensate trap is filled before operation of the appliance. Failure to fill the condensate trap will allow flue gases to enter the condensate line, resulting in significant injury, or death**

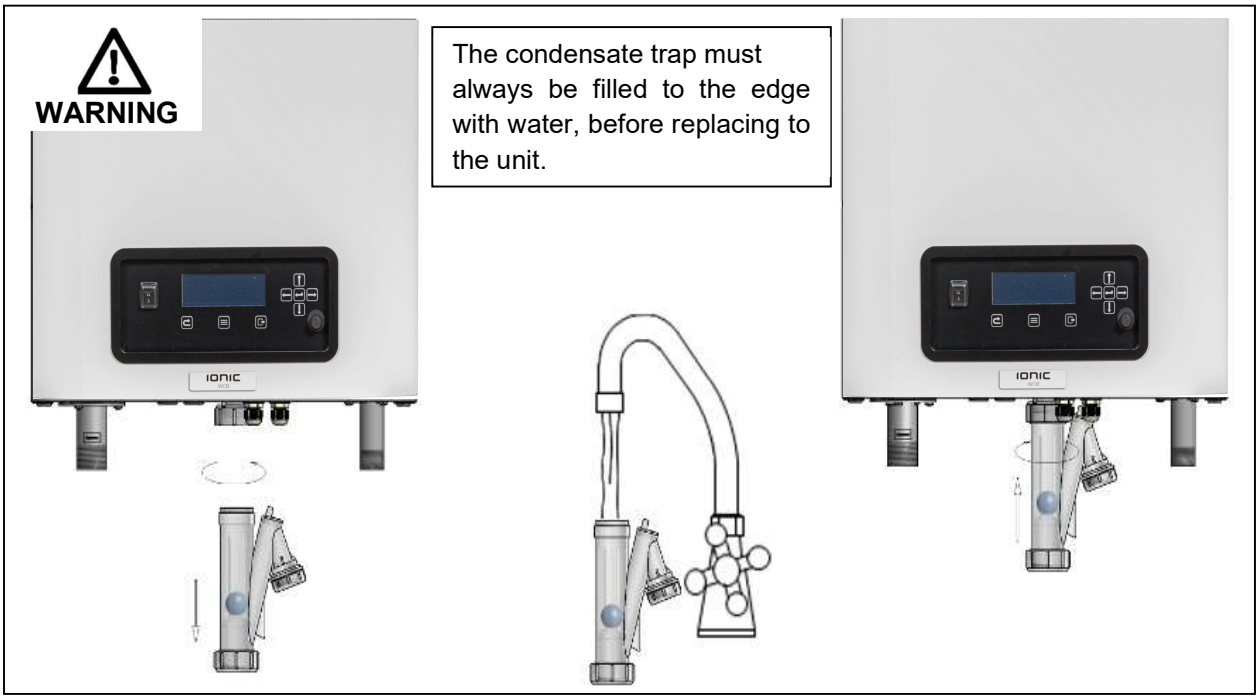


Figure 8.4

8.4 *Pressure relief valve*

The water heater has no internal pressure relief valve, but a relief valve, specially selected for this water heater, is added to the water heater shipment and can be found in the box. This must be installed close to the water heater in the flow pipe of the water heater and no shut off valve shall be placed between the pressure relief valve and the water heater. When having cascaded water heaters, each water heater 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 may 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 applicate local code.

8.5 *NON-Return valve*

All WWH Water heaters 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 water heater. This creates a higher thermal efficiency.

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

8.6 *Circulator functionality*

Delta T monitoring:
A high temperature difference between supply and return of the water heater 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.
At maximum burner power ΔT is limited to 32ºF (18ºC) and at low burner power a ΔT above 47ºF (26ºC) is not allowed. Above these values the water heater modulates down until the temperature difference is between 32ºF (18ºC) and 47ºF (26ºC). If the ΔT exceeds 56ºF (31ºC), the water heater will be temporarily switched off.

8.7 *Frost protection*

The water heater has a built-in frost protection that is automatically activates the water heater pump when the water heater return (water) temperature drops below 50°F / 10°C. When the water heater Inlet temperature drops below 41°F / 5°C, the water heater is also ignited. The pump and/or water heater will shut down as soon as the Inlet temperature has reached 59°F / 15°C. The mentioned temperatures are related to the temperatures measured by the INLET sensor of the water heater. This frost protection function will not fire up the water heater in case of a “general blocking” of the water heater demand.

NOTICE	This “Frost Protection” function is only useable for the water heater and not for the whole sanitary system. Because it concerns a programmable setting, a water heater damaged by frost is not covered under warranty.

8.8 *Water heater water quality*

In direct water heating appliances, the domestic hot water flows directly through the heat exchanger of the water heater. Because all the time fresh water, containing dissolved minerals, is heated, scaling may occur. To prevent this, water quality must meet a number of standards.
The values are the following:

Water temperature max. = 185°F (85°C)
Maximum allowed water hardness is 190 ppm or 190 mg/L $CaCO_3$ (11 gpg)
TDS (total dissolved solids) should not exceed 450 ppm
Water hardness and TDS together should not exceed 450 ppm
Chlorine must not exceed 150 ppm (150 mg/l)
The pH value of the water should not be under 6.5 and not above 7.5 (measured cold)
If water hardness is too high a water softening system is necessary.
If TDS alone or the combined value is higher than the abovementioned, the water should be heated by means of an indirect water heating appliance.
Minimum water hardness = 80 ppm or 80 mg/L $CaCO_3$ (= 4.5°dH or 4.7 gpg)
Minimum TDS = 100 ppm
Water that is under these minimum values normally has a pH value which is aggressive and corrosive.

If water quality doesn't meet the abovementioned requirements, a water treatment installation must be installed to improve water quality to the required levels.

The water pump must be selected according to the water hardness see tables 10.1 and 10.2 in section 10.2 for the minimum pump sizes required for the operation of the water heater. These pumps are sized to take into account a small head loss for piping, larger pumps may be required depending on the piping design.

8.9 *Flush the system with fresh water*

When a water heater is installed in a new system or an existing installation the system must be cleaned before the water heater is installed. The system should then be drained and thoroughly flushed with clean water to remove any debris. The water of the water heater and heating circuit should be free of any particles, debris and pollution.

8.10 *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 (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 water heater pump OFF and ON. The installer/technician can cancel the De-Air sequence by pressing a specific key-button combination from the display.

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

The De-Air sequence consists of cycles.

- The water heater pump cycles in an ON/OFF pattern of 10 second periods. This is repeated for De-Air_Repetition_Cnt times.

When the water pressure is too low, or the pressure sensor is in error, the De-Air sequence will be suspended until the water pressure / sensor pressure is stable again.

The following scheme below shows the behavior of the general pump during one whole cycle of De-Air sequence with a De-Air_Repetition_Cnt set to 2:

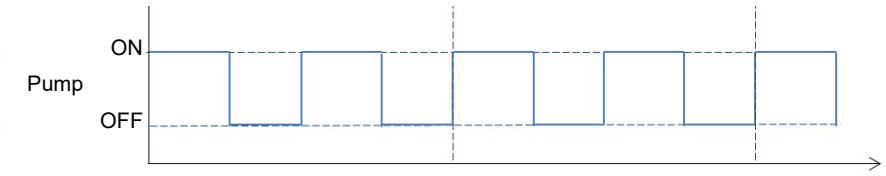


Figure 8.5

Relevant variables:

Specific Parameters	Level	(Default) Value	Range
(139) Dair Active	2: Installer	1	0: 24 hour pump 1: Dair enabled 2: Dair disabled

Table 8.2

De-Air sequence duration
The total duration of the De-Air sequence depends on the selected De-Air settings. With the default settings for De-Air the sequence takes 800 seconds to complete.

De-Air for cascade systems
The de-air function is not available for cascaded systems. It is not possible to generate a burn demand for cascade as long as the de-air cycle is busy. When using a cascaded system it is recommended to configure the de-air function to either 24 hour pump or disabled.

8.11 *Water pressure*

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

Sensor
A water pressure sensor has been built into the water heater. The minimum water pressure in the water heater is 15 psi and the maximum pressure is 145 psi. The pressure sensor will stop the water heater from firing when the water pressure drops below 10 psi and starts the water heater firing again when the water pressure reaches above 15 psi. These values should never be changed in the water heater control settings. The water heater cannot be properly purged of air if the water pressure is less than 15 psi.

Higher pressure systems (e.g. using a water Booster Pump)
If a pressure higher than 145 psi is delivered to the water heating system, you must install a pressure reducing valve.

9 THE HW SANITAIRY SYSTEM: INSTALLATION INSTRUCTIONS

9.1 *The HW system*

The WH water heaters are designed for use with one or more hot water tanks, because the water heater needs a minimum amount of water flow. To get an output temperature of 140°F, the temperature of the return should be within the range 110.3 – 117.5°F. To get an output temperature of 122°F, the temperature of the return should be within the range 92.3 – 99.5°F.

In designing the hot water system there are some points to consider:

- How many water heaters and how many tanks are needed to accommodate the desired domestic hot water flow.
- Water hardness: a high water hardness will lead to calcification of the heat exchanger, especially when water temperatures are high. Calcification can be delayed by increasing the waterflow through the water heater resulting in a smaller temperature difference between in- and output of the water heater:
    - If the water hardness is between 4 and 11 grains per gallon (or between 70 and 190 ppm) the temperature difference between flow and return of the water heater should be 30°F maximum
    - If the water hardness is between 11 and 14 grains per gallon (or between 190 and 240 ppm) the temperature difference between flow and return should be 22.5°F maximum
    - If the water hardness is above 14 grains per gallon (240 ppm) a water softener must be used. Also above 11 gpg (190 ppm) a water softener could be considered, since an installation at 22.5°F temperature difference will need bigger pipes and pumps. After softening, the water hardness should be minimum 4 gpg (70 ppm).
- Pipework is to be made of copper or stainless steel pipes, diameters according or bigger than prescribed below. When using plastic pipes, make sure the inner diameter of the pipes is at least equal to the corresponding copper size.
- If copper is used, pipes of schedule L should be applied.

9.2 *Designing the hot water system*

To calculate tank size for a peak demand, first the total heat demand during the peak must be calculated. Then subtract the amount of hot water that is produced by the water heater during the peak time. Now you have calculated the heat that must be stored in the tank. Depending on the tank temperature, the storage volume can be calculated.

Example: A hotel with 150 rooms with shower. Peak time is between 7 and 8.30 a.m., in this time 60% of the showers will be used for 10 minutes, at 2.0 gpm.

Assumptions: Cold water temperature is 50ºF
Shower temperature is 101ºF
Circulation loss is 25,000 BTU/h

Calculation

90 showers x 10 minutes x 2.0 gpm = 1800 gallon.

Heat calculated from this: 1800 x 8.34 (lb/gallon) x (101 – 50) = 765,600 BTU

This heat must be delivered in 1.5 h, so the power is 765,600 / 1.5 = 510,400 BTU/h

Additional is the circulation loss of 25,000 BTU/h so the total power needed during peak time is 535,400 BTU/h

Suppose we select a WH 499W, with input 499,000 BTU/h and an efficiency of 96%, delivering 479,000 BTU/h

This means we need 535,400 – 479,000 = 56,400 BTU/h in the tank, which should last 1.5 h. The total heat that must be stored is 56,400 x 1.5 = 84,500 BTU

When the tank temperature is 149ºF, one gallon of stored tank volume has 8,34 (lb/gallon) x (149 – 101) = 400 BTU heat stored.

So the needed storage volume is 84,500 / 400 = 211 gallons minimal.

9.3 *Stand-alone set-up*

The basic form of a HW installation is one water heater with one tank.

	WH 299W	WH 399W	WH 470W	WH 499W
Water heater flow at ΔT = 30°F (gpm)	18.0	24.0	28.5	30.0
Nominal pipe size at ΔT = 30°F	1 ½”	1 ½“	2”	2”
Water heater flow at ΔT = 22.5°F (gpm)	25.2	32.0	38.0	40.0
Nominal pipe size at ΔT = 22.5°F	1 ½”	2”	2”	2”

Table 9.1 *: Pipe sizes*

Adding bends or valves to the pipe system influences water resistance and maximum pipe length. In the table below equivalent pipe lengths are given, which should be subtracted from the given maximum pipe length.

Copper pipe Size	Equivalent pipe length 90° bend R = 1 × D	Equivalent pipe length 45° bend R = 1 × D	Equivalent pipe length valve
	ft	*ft*	*ft*
1 ½”	1.6	1	0.3
2”	2.6	1	0.7

Table 9.2 *: Equivalent pipe lengths*

Stand-alone configuration
The setup of the water heater system depends on the type of water tank selected:

- Tanks with a mixing device inside, which mixes cold fresh water with hot water from the tank to provide feed water with the right temperature to the water heater. The setup is shown in § 9.3.1.
- When other tanks are used, it is necessary to mix the cold fresh water with warm water from the tank, outside of the tank. The mixed water will serve as input to the water heater.
  The setup is shown in § 9.3.2.

SAFETY COMPONENTS

The pictures show examples of functional installations. This figure is meant to illustrate the piping concept only, the installer is responsible for the correct installation of all equipment. The qualified installer must follow all manufacturer's instructions for each component. It is the responsibility of the qualified installer to follow all local applicable codes of the authority having jurisdiction.

9.3.1 WH SETUP WITH TANK

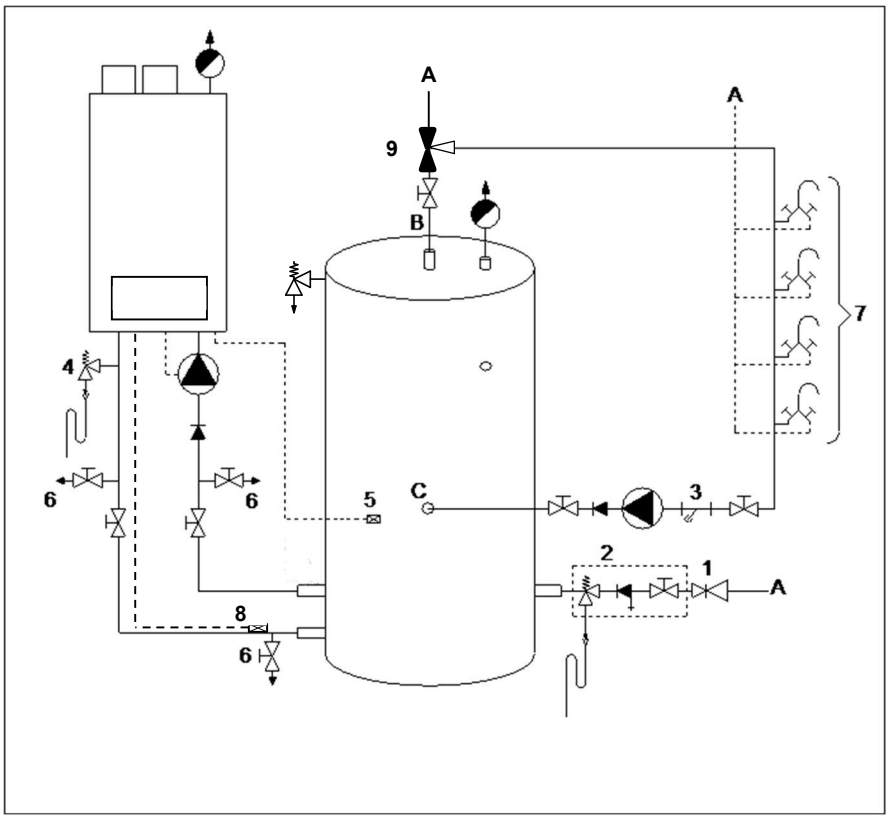


Figure 9.1

Explanation:

1) Pressure reducing valve (mandatory in case service pipe pressure is too high)
2) Inlet combination with valve (mandatory)
3) Apply filter if necessary (recommended)
4) A factory supplied pressure relief valve must be mounted near the water heater (mandatory)
   This safety valve shall never be isolated from the water heater by means of a ball valve
5) The water heater comes with a tank sensor and dry well. Mount them on the tank at 1/5 from the bottom of the tank.
6) Drain valve (required)
7) Hot and cold-water mixers
8) External pipe Strap-on sensor (necessary).
9) Thermostatic mixing valve

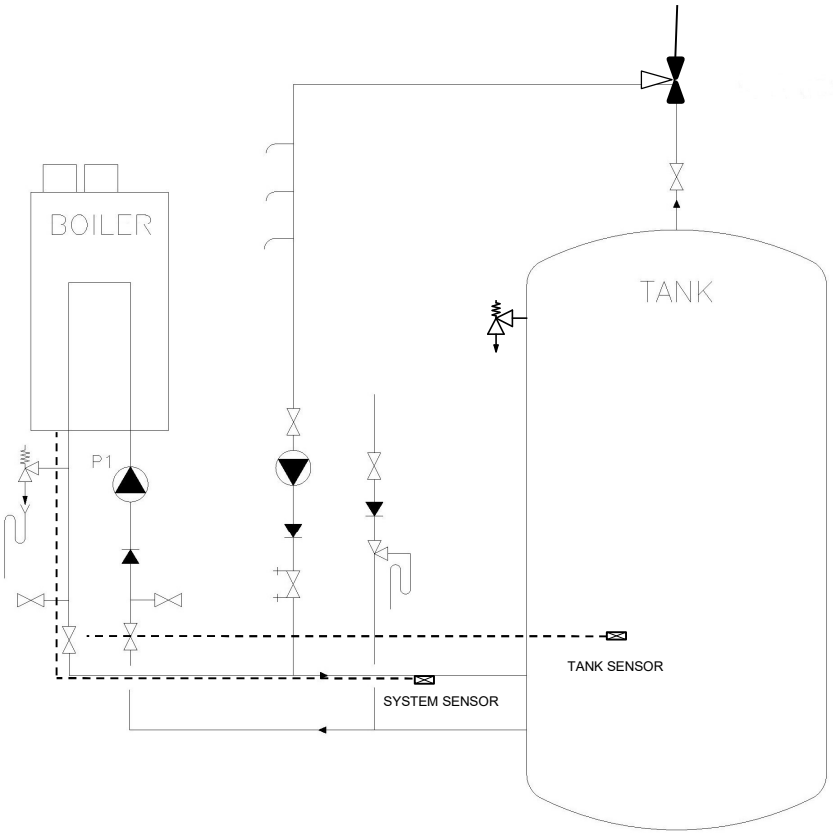
A) Cold water inlet (service pipe)
B) Hot water supply circulation
C) Circulation return

Example of one water heater and one tank

	PUMP		FILTER
	NON- RETURN VALVE		INLET COMBINATION - Overflow - Controllable Inlet valve - Valve
	VALVE		
	SAFETY VALVE		PRESSURE REGULATING VALVE
	AUTOMATIC AIR VENT		

WARNING	**If the installation is constructed in such a way that underpressure can occur in the tank, a vacuum breaker must be installed between the inlet combination and the tank, without any valve".**

9.3.2 ALTERNATIVE SETUP WITH ONE TANK



Example of one water heater and one tank

Figure 9.2

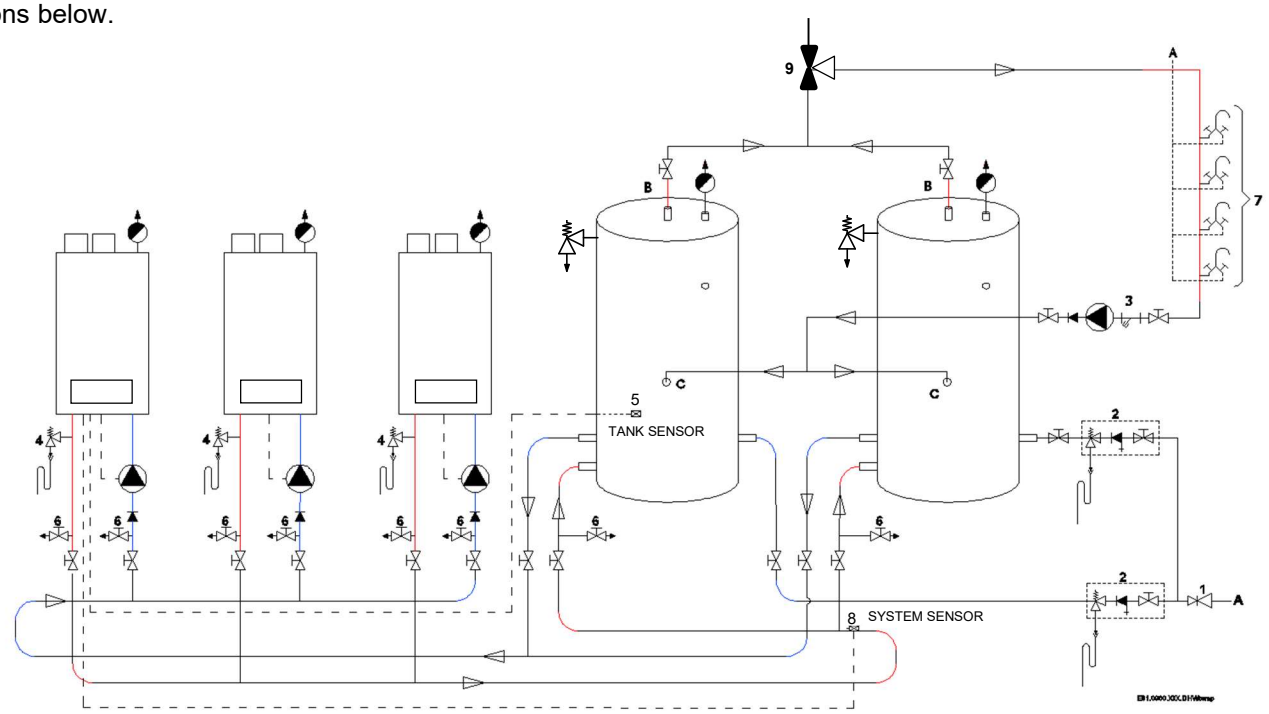
	PUMP
	NON- RETURN VALVE
	VALVE
	SAFETY VALVE
	BALANCING VALVE
	Temperature sensor
	INLET COMBINATION - Overflow - Non return Inlet valve - Valve

Explanation of figure 9.2: hot water recirculation is fed into the pipe from the water heater to the tank. If the tank has a separate connection for re-circulation, use that connection preferably.
Use a tank sensor (mounted into a dry well into the tank at 1/5 from the bottom of the tank) and a strap-on system sensor assembled to the supply pipe to the tank, as close as possible to the tank.

To get a good mix of hot and cold water and therefore a better temperature control of water heater and tank the Supply and Return pipe of the tank should preferably be situated in the bottom 20% of the tank height.

9.4 *Cascade set-up*

HW water heaters and tanks can be installed cascaded in a number of possible combinations according to the instructions below.



Example of a combination of three water heaters and two tanks

Figure 9.3

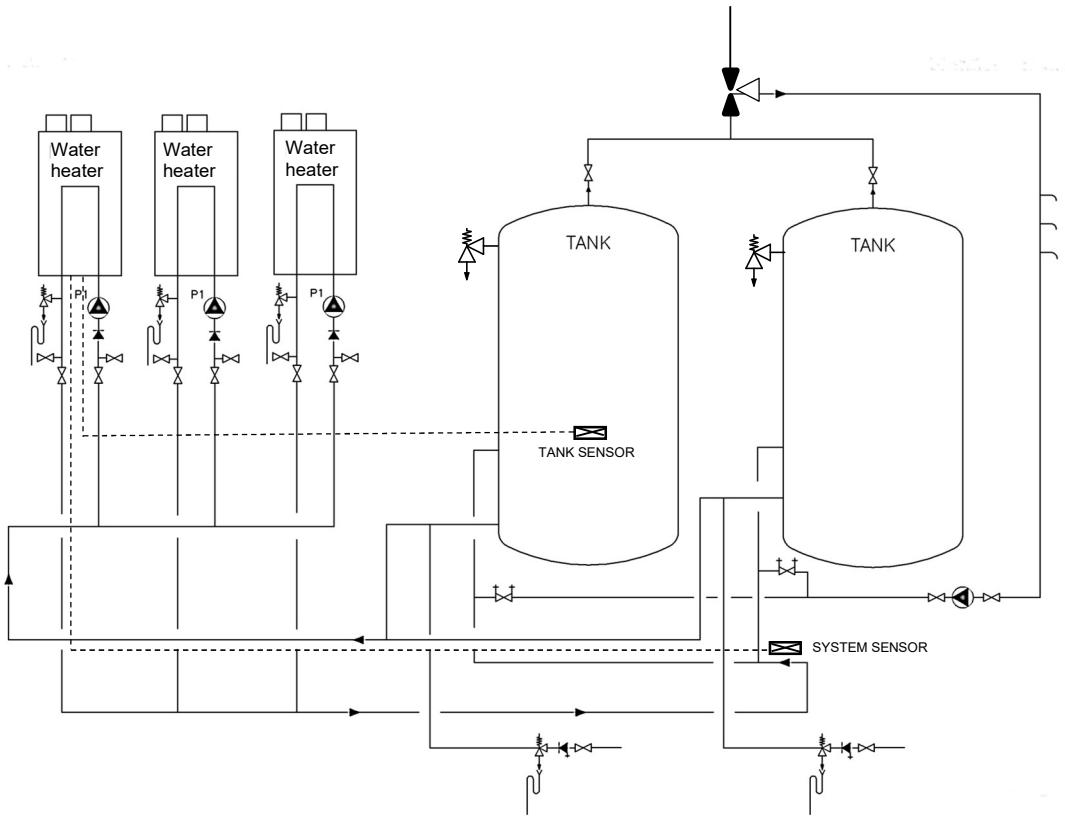
⚠	For the installation of cascaded water heaters and tanks always consult your supplier. All requirements concerning pipe diameters and lengths and pump selection have to be calculated. By doing so you'll improve the operation and the life time of your HW installation. Always use the reverse return (Tichelmann) system to connect multiple water heaters and/or tanks.

	PUMP
	NON- RETURN VALVE
	VALVE
	SAFETY VALVE
	AUTOMATIC AIR VENT
	FILTER
	Tank Bulb temperature sensor and Strap-on temperature sensor
	INLET COMBINATION - Overflow - Non return Inlet valve - Valve
	PRESSURE REGULATING VALVE

Extra explanation:

1) Pressure reducing valve (mandatory in case water pressure is too high)
2) Inlet combination with valve (mandatory)
3) Apply filter if necessary (recommended)
4) A pressure relief valve is factory supplied with each appliance and must be installed near the water heater (mandatory) [1]
   This safety valve must never be isolated from the water heater by means of a (ball) valve
5) Mount the tank sensor in a dry well into the tank at 1/5 from the bottom of the tank [1, 2]
6) Drain valve (required)
7) Hot and cold-water faucets
8) Mount the (strap-on) system sensor to the pipe close to the T-piece of the last tank as shown in the figure
   This sensor measures the supply temperature from both heaters.
9) Thermostatic mixing valve

A) Cold water inlet (service pipe)
B) Hot water supply circulation
C) Circulation return



Example of a combination of three water heaters and two tanks

Figure 9.4

Notes:

- Connections on the water heater side should **always** be executed as reverse return piping (Tichelmann system). This way, the installation of balancing valves can be avoided.
- [1] *Always apply safety components according to all applicable regulations.*
- [2] In case of more than one tank, mount the tank sensor on one of the tank outlets. The temperature of this tank will be assumed to be representative for all, provided that the installation design is correct.
- In the inlet (return) connection of the water heater no check valve is recommended.
- When needed, the water heater control can handle up to sixteen water heaters.
- For large capacity installations consult your supplier.

9.4.1 CASCADE CALCULATIONS

WH water heaters and tanks can be cascaded in a number of possible combinations according to the instructions below. Pipe sizes should be selected conforming to the tables A, B and C below. These are minimum (copper) pipe sizes; selecting smaller pipes will result in a higher water resistance of the system, in higher temperature differences between flow and return of the water heater, and in a higher risk of calcification of the system.

Diameters D1 (= OUTLET and INLET of each water heater)		
	ΔT = 30°F	**ΔT = 22.5°F**
WH 299W	1 ½”	1 ½”
WH 399W		2”
WH 470W	2”	
WH 499W		

Table 9.3

Table**:** *Connections directly on the water heater(s)*

Diameters D_T	(= TANK in- and outlet)					
WH 299W	**number of cascaded water heaters ΔT = 30°F**			**number of cascaded water heaters ΔT = 22.5°F**		
	1	**2**	**3**	**1**	**2**	**3**
1 tank	1 ½"	2"	2 ½"	1 ½"	2"	-
2 tanks	1 ¼"	1 ½"	2"	1 ¼"	1 ½"	2"
WH 399W	**number of cascaded water heaters ΔT = 30°F**			**number of cascaded water heaters ΔT = 22.5°F**		
	1	**2**	**3**	**1**	**2**	**3**
1 tank	1 ½"	2"	-	2"	2 ½"	-
2 tanks	1 ¼"	1 ½"	2"	1 ¼"	2"	2"
WH 470W / WH 499W	**number of cascaded water heaters ΔT = 30°F**			**number of cascaded water heaters ΔT = 22.5°F**		
	1	**2**	**3**	**1**	**2**	**3**
1 tank	2"	2 ½"	-	2"	-	-
2 tanks	1 ¼"	2"	2"	1 ½"	2"	2 ½"

Table: *Connections directly on the water tank(s)*

Table 9.4

NOTICE	For larger systems where more water heaters or tanks are required please contact Ideal.

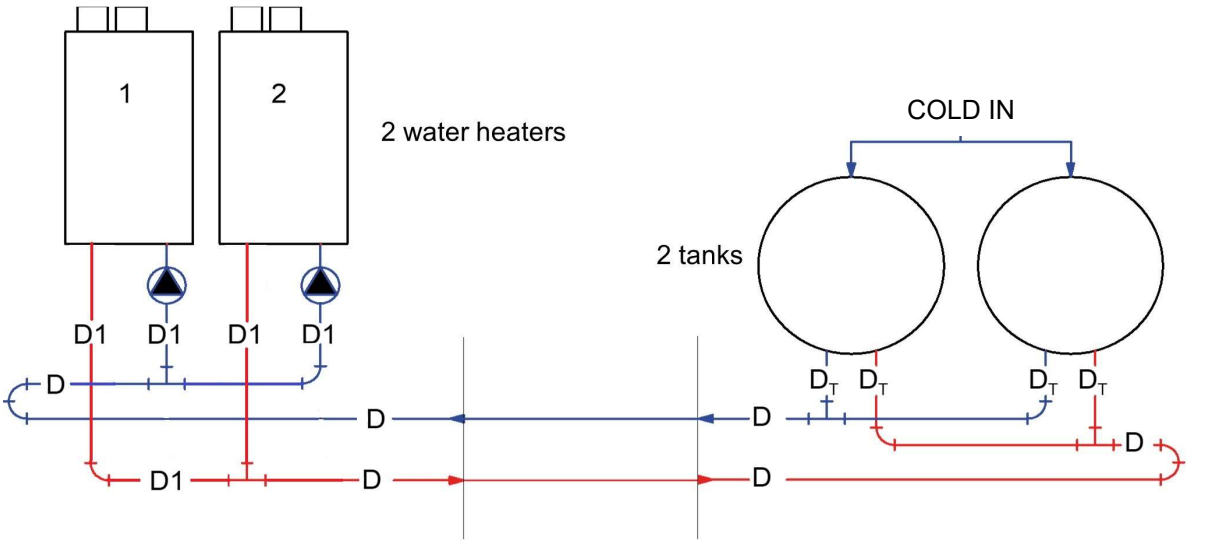


Figure indicating D1, D_T and D

Figure 9.5

Diameters D	(= Connection between water heaters and tank(s))					
WH 299W	**number of cascaded water heaters ΔT = 30°F**			**number of cascaded water heaters ΔT = 22.5°F**		
	1	**2**	**3**	**1**	**2**	**3**
1 tank	1 ½"	2"	2 ½""	1 ½"	2"	-
2 tanks	1 ½"	2"	2 ½""	1 ½"	2"	3"
WH 399W	**number of cascaded water heaters ΔT = 30°F**			**number of cascaded water heaters ΔT = 22.5°F**		
	1	**2**	**3**	**1**	**2**	**3**
1 tank	1 ½"	2"	-	2"	2 ½"	-
2 tanks	1 ½"	2"	3"	2"	2 ½"	3"
WH 470W / WH 499W	**number of cascaded water heaters ΔT = 30°F**			**number of cascaded water heaters ΔT = 22.5°F**		
	1	**2**	**3**	**1**	**2**	**3**
1 tank	2"	-	-	2"	-	-
2 tanks	2"	2 ½"	3"	2"	3"	3 ½"

Table: Connection between water heater(s) and tank(s) Table 9.5

NOTICE	For larger systems where more water heaters or tanks are required please contact Ideal.

Copper pipe diameter *D*	Equivalent pipe length 90° bend R = 1 × D	Equivalent pipe length 45° bend R = 1 × D	Equivalent pipe length valve
Inch	*ft*	*ft*	*ft*
1 ½"	1.6	1	0.3
2"	2.6	1	0.7
2 ½"	3.3	1.3	0.7
3"	3.9	1.6	1

Table E: Equivalent pipe lengths Table 9.6

From the figures 10.1 through 10.4 you can select the resistance value for your water heater at the selected temperature difference (30°F resp. 22.5°F)

9.5 *Examples*

To elaborate the examples in this section, the rules of §§ 9.3 and 9.4 are repeated below:

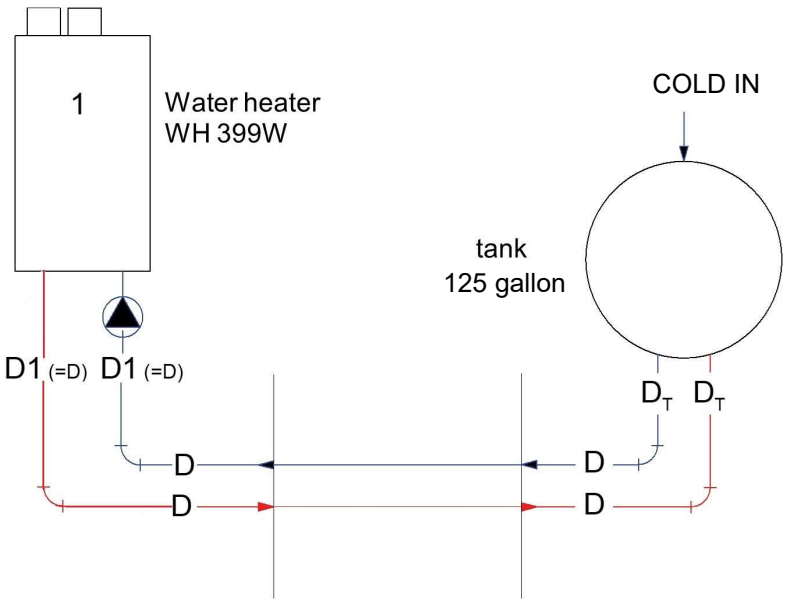
1. **Codes to a one water heater installation:**

– There's only one flow pipe and one return pipe.
For the right diameter value see table 9.1 in § 9.3.

2. **Codes for cascades having two or more water heaters connected:**
Check the tables in § 9.4.1:

– Pipes directly connected to the water heater D1 are selected from table 9.3
– Pipes directly connected to the tank D_T are selected from table 9.4.
– The main pipes D between water heaters and tanks are selected from table 9.5

9.5.1 ONE WH 399W HEATER WITH ONE 125 GALLON TANK



Example 1

Figure 9.6

Water heater and tank connections:
For this system only one pipe size is needed.
No numbering of water heaters, tanks and connections is required.
From table 9.1 in paragraph 9.2 : for 1 water heater HW 399W at ΔT = 30°F is D =D1 = D_T = 1½"

9.5.2 TWO WH 299W WATER HEATERS WITH TWO 125 GALLON TANKS

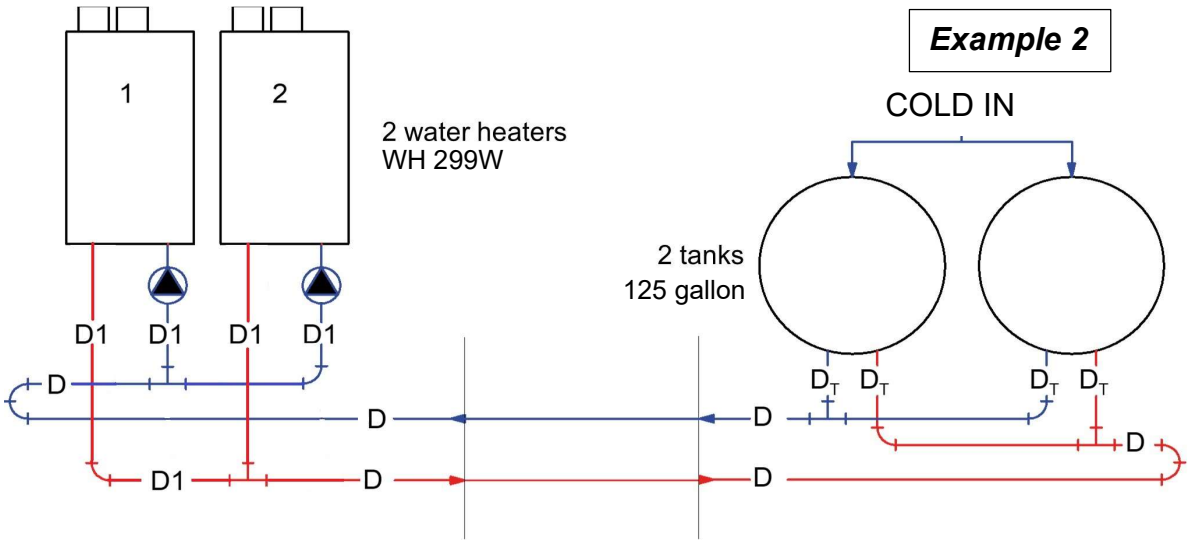


Figure 9.7

Water heater connections, figure 9.7
Number the water heaters: water heater 1 is the water heater furthest from the tank(s)..
Number the connection pipes directly connected to the water heaters: D1.
Number the horizontal connection pipes:

- hot water pipes starting at water heater 1: D1 up to D (= in this example only D1 and D).
- return pipes starting at water heater-last (= water heater 2): D1 up to D (same remark).

Pipe sizes, water heater side:
Selecting ΔT = 30°F, from tables **9.3 and 9.5**, WH 299W:

- All pipes D1 in the picture must measure at least 1 ½" (table **9.3**)
- The pipes D must measure 2" (table **9.5**)

Tank connections:

- From table 9.4, for 2 tanks D_T = 1 ½"

For this system, pipes sized at least 1 ½" are to be applied for all connections directly on water heaters and tanks, and pipes sized at least 2" for the connections between them.

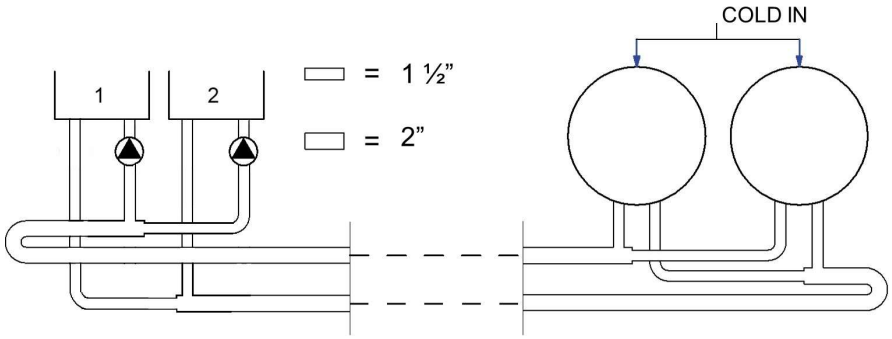


Figure 9.8

9.6 *Pump control*

The applied pump must be a bronze or stainless steel pump and controlled only by the Commodore WWH water heater control. If, for any reason, an external pump control is applied *without written approval of Ideal* then the complete warranty on the WWH water heater and all delivered parts will become void.

9.7 *Sensors*

9.7.1 TANK SENSOR

The tank sensor has to be mounted in a sensor dry well, preferably at 1/5 from the bottom of the tank. So at a tank with a total height of 80 inch the sensor has to be mounted at 16 inches from the bottom. Every water heater is supplied with a stainless steel dry well and matching sensor.

Strap on system sensor.

Tank sensor with sensor dry well

Figure 9.9

Use only Ideal supplied and accessory sensors.

NTC 10K@77 °F (25°C) B3977k 3%@140°F (60°C)

Temperature °F (°C)	Resistance (Ω)	Temperature °F (°C)	Resistance (Ω)	Temperature °F (°C)	Resistance (Ω)	Temperature °F (°C)	Resistance (Ω)
-40 (-40)	334275	50 (10)	19897	122 (50)	3599	212 (100)	674
-22 (-30)	176133	68 (20)	12493	140 (60)	2454	230 (110)	506
-4 (-20)	96761	77 (25)	10000	158 (70)	1748	248 (120)	384
14 (-10)	55218	86 (30)	8056	176 (80)	1252	266 (130)	296
32 (0)	32624	104 (40)	5324	194 (90)	912	284 (140)	230

Table 9.7

9.7.2 SYSTEM SENSOR

Always use a strap-on system sensor besides the tank sensor. This strap-on sensor has to be connected to connections 3-4 “System Sensor” and mounted to the water heater supply line, as depicted in figures 9.1, 9.2, 9.3 and 9.4.

A strap-on system sensor and tank sensor with dry well are part of the water heater delivery.

10 WATER HEATER RESISTANCE GRAPHS

10.1.1 WATER HEATER RESISTANCE GRAPH WH 299W

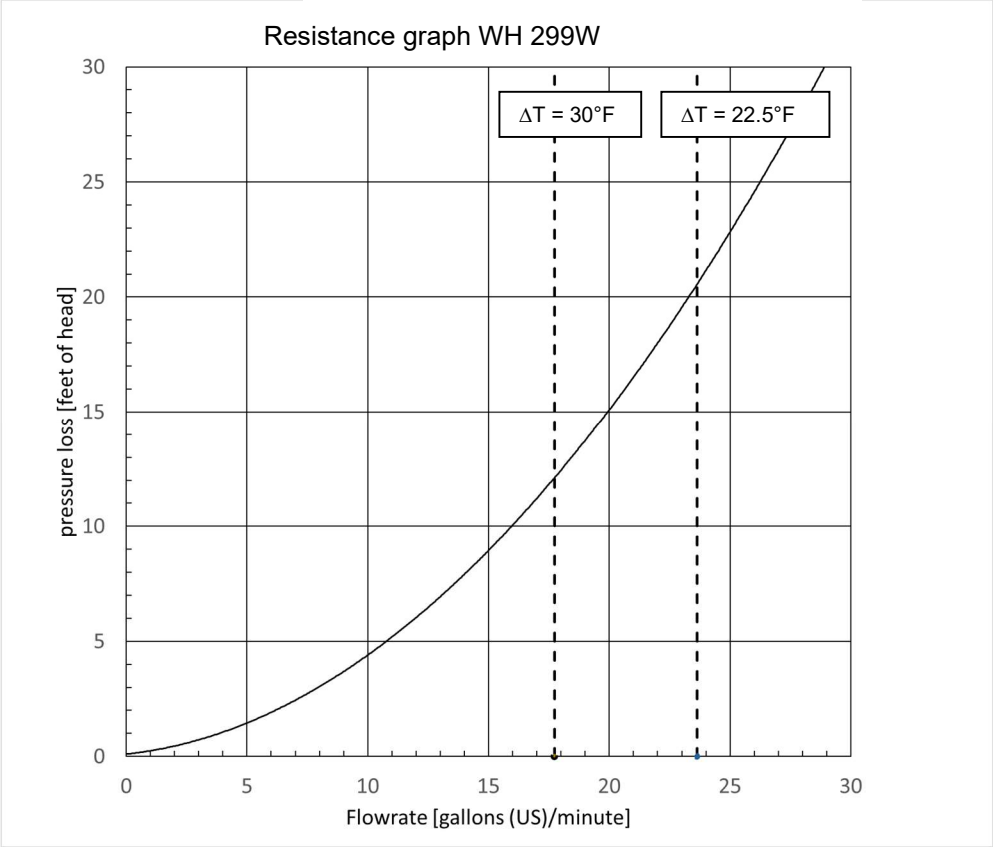


Figure 10.1

10.1.2 WATER HEATER RESISTANCE GRAPH WH 399W

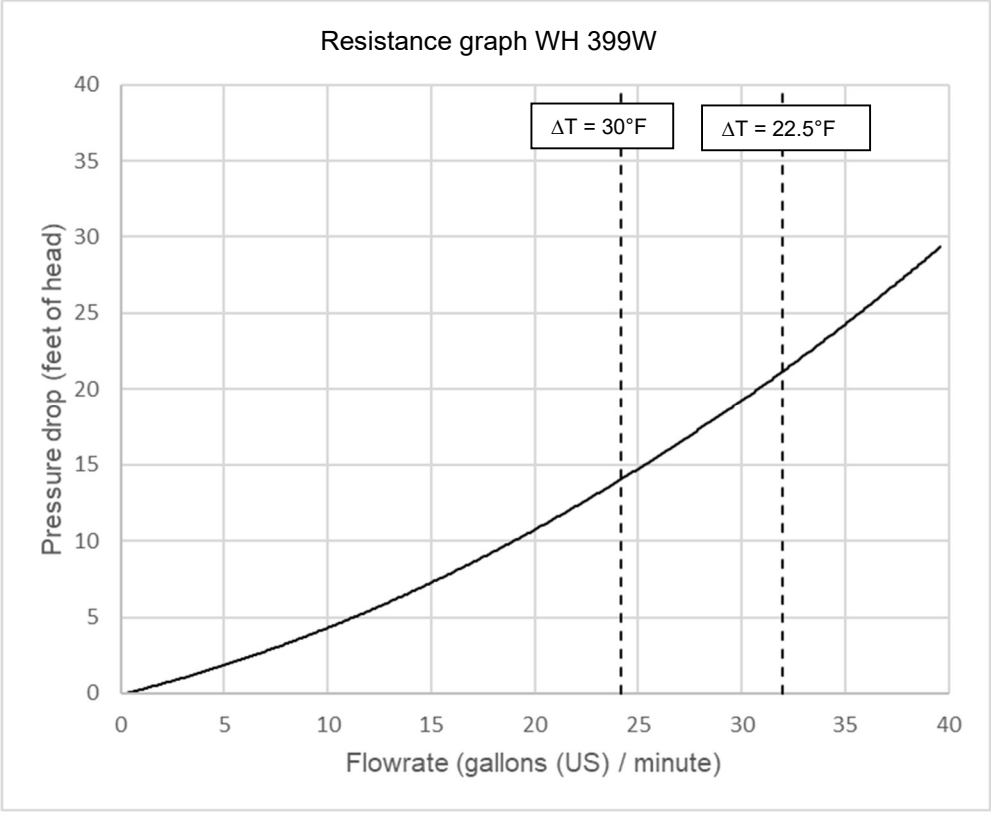


Figure 10.2

10.1.3 WATER HEATER RESISTANCE GRAPH WH 470W

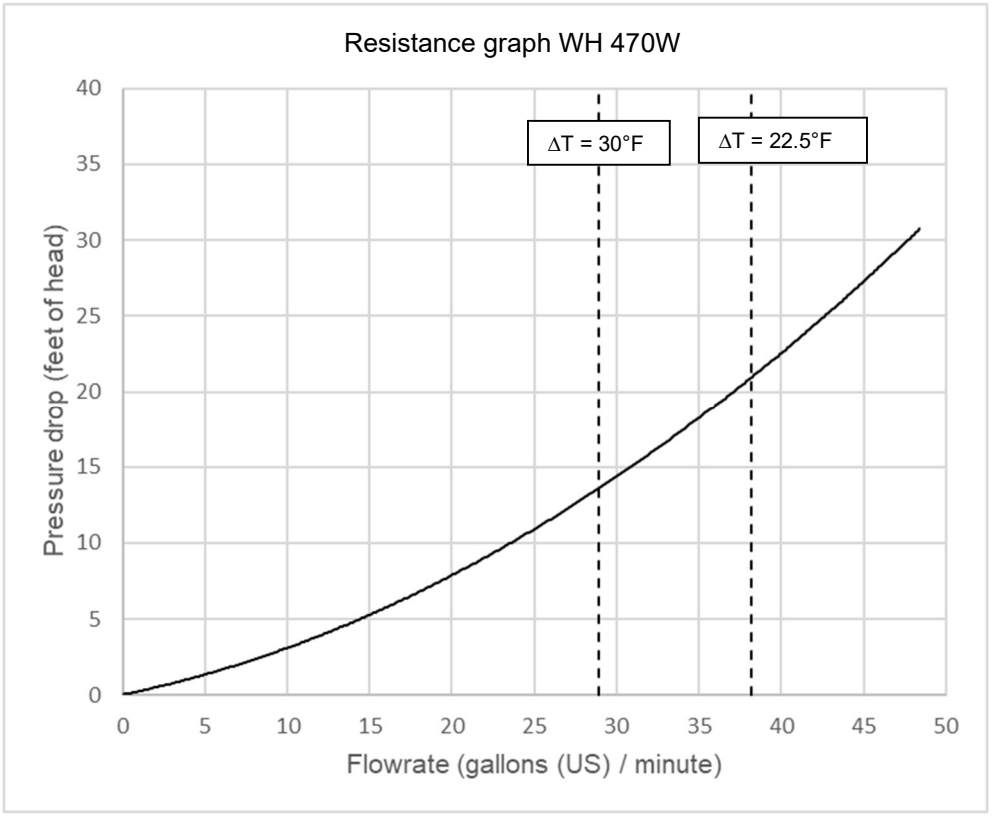


Figure 10.3

10.1.4 WATER HEATER RESISTANCE GRAPH WH 499W

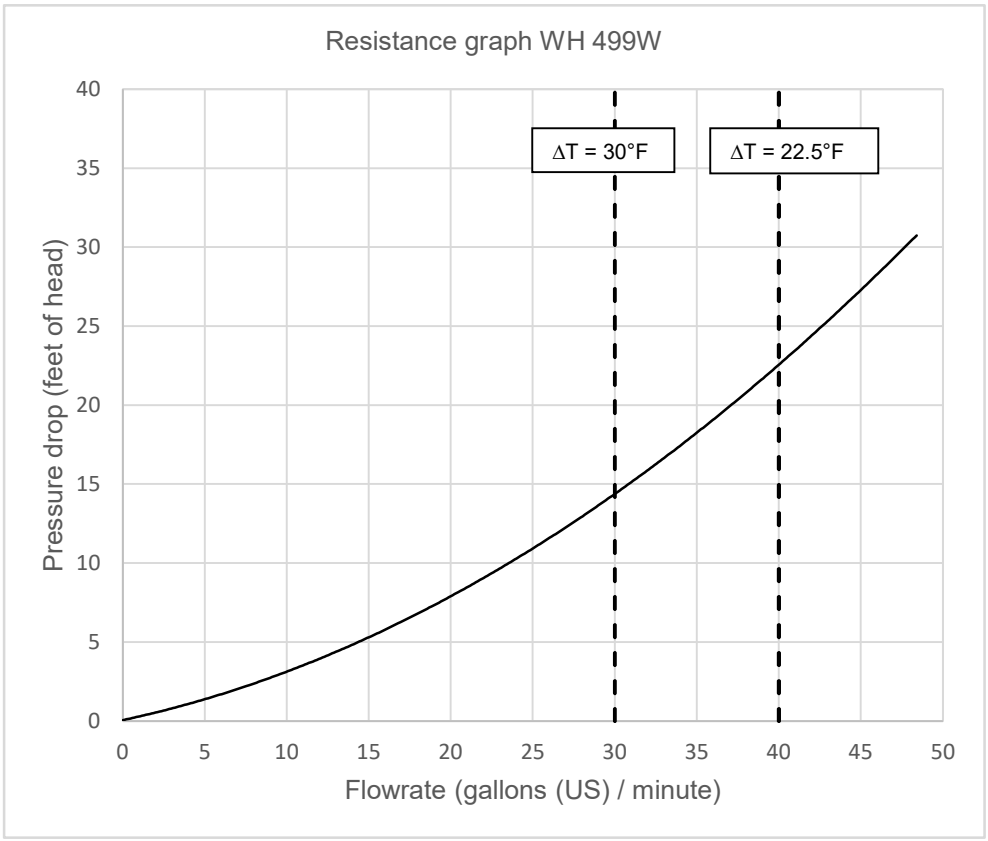


Figure 10.4

10.2 *Minimum required pump head.*

To prevent calcification of the heat exchanger, the flow of the water needs to be high. The design flow of the system should be at a delta T of either 30 or 22.5°F at high fire, depending on the water hardness. To calculate the minimum required pump head, take the resistance of the water heater and add the resistance of the piping and tank to make a good design. Normally, an extra 7 feet of head is sufficient to overcome the resistance of the pipes and tank.

Water heater ΔT = 30°F	at flow rate	min. required head for water heater	min. required head for installation: +7 ft. WC
	[gpm]	[feet]	[feet]
WH 299W	18.0	12.0	19.0
WH 399W	24.0	14.0	21.0
WH 470W	28.5	14.0	21.0
WH 499W	30.0	15.0	22.0

Table 10.1

Water heater ΔT = 22.5°F	at flow rate	min. required head for water heater	min. required head for installation: +7 ft. WC
	[gpm]	[feet]	[feet]
WH 299W	24.0	20.0	27.0
WH 399W	32.0	21.0	28.0
WH 470W	38.0	21.0	28.0
WH 499W	40.0	23.0	31.0

Table 10.2

Grundfos Pump Sizing

Water Heater Model / Water Hardness GPG	**Water Hardness 11-14 Grains Per Gallon**	**Water Hardness 4-10 Grains Per Gallon**
WH 299W, WH 399W, WH 470W, WH 499W	MAGNA1 40-120 GF N or MAGNA3 40-120 GF N	UPS43-100 SF or MAGNA1 40-80 GF N or MAGNA3 40-80 GF N

Table 10.3

The pumps in table 10.3 are available as accessories from Ideal. Please contact Ideal if pump sizing assistance is needed.

10.3 *Pump: 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 water heater loop, DHW, and the system that are connected to the water heater must not exceed 3.5 A. Use separate relays if higher currents are needed. The fan is separately connected to the main supply and has a fuse of 3.15 A slow blow.

Pump P1 - water heater pump.
This circulator is NOT part of the appliance. The maximum combined current for the water heater loop circulator and any additional valves should not exceed 2 A. You can use a relay to accommodate the circulator. A relay kit is available as an accessory, see § 6.2.

Warning (ECM pumps):
When using an ECM circulator, it **CANNOT** be powered directly by the water heater. Use a relay to isolate the water heater from the circulator.

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

WARNING	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, 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. 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. 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. For further information also check the installation manual of the specific pump.

11 FLUE GAS AND AIR SUPPLY SYSTEM

11.1 *General venting.*

The water heater has a positive pressure vent system.
The water heater 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, should be piped to the outdoors. Under no conditions must this appliance vent exhaust gases into a masonry chimney. The internal safety system shuts down the water heater 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	Install all horizontal vent components with a minimum angle of ¼ inch per foot downwards in the direction of the water heater. When not installed accordingly, it may result in condensate building-up in the vent gas tube, eventually causing component failure.
	When using a wall terminal, there is the possible risk of ice building-up on surrounding parts/structures, because the condensate will freeze. This risk should be taken into account during the design phase of the heating installation.
	Because the flue gases can have a low temperature, the water heater needs to have a high efficiency approved stainless steel or plastic vent system. These materials, including the gaskets, should be usable for positive pressure vent gas systems. **These parts must be certified for use at temperatures of minimal 158°F / 70°C** (See also warnings below).

11.1.1 VENT SIZING.

Water heater	Intake Air and Exhaust
WH 299W, WH 399W	4"
WH 470W, WH 499W	6"

Table 11.1

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 and / or as local codes dictate.

Connections vent gas (vent) and air supply:

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

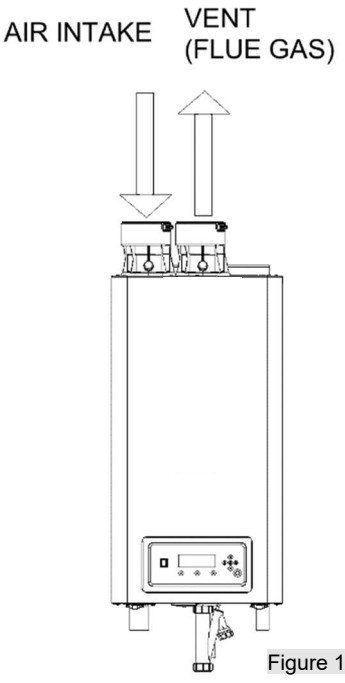


Figure 11.1

11.1.2 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 water heaters
- Maximum venting length: see table below.

Maximum Exhaust Length / Maximum Combustion Air Intake Length			
	WH 299W	WH 399W	WH 470W / WH 499W
3"	60' / 60'	30' / 30'	
4"	200' / 200'	121' / 121'	73' / 73'
5"			200' / 200'
6"			200' / 200'

Table 11.2

NOTICE	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 water heater. Do **NOT** use this table for common vent systems with cascaded water heaters.

Pipe, elbows, tees - equivalent feet: for 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	NA
	Air	45 ft	65 ft		
Concentric wall terminal	Flue	11 ft	13 ft	NA	NA
	Air	45 ft	65 ft		

Table 11.3

11.2 *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 158ºF (70ºC) 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 11.4

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

11.2.1 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 11.4 (paragraph 11.2 (page 53) and comply to local codes and regulations.

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

11.3 *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	If these directions and those of the vent manufacturer differ, follow the more conservative requirements.

Approved PVC/ CPVC vent pipe and fittings:

IPEX – System 636

WATER HEATER	FITTING	PART #
WH 299W WH 399W WH 470W WH 499W	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
WH 470W WH 499W	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 11.6

WARNING	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, and local building codes.
NOTICE	• In Canada, CPVC and PVC vent pipe, fittings and cement/primer must be ULC-S636 certified. • Use only cleaners, primers, and solvents that are approved for the materials which are joined together. • All PVC vent pipes must be glued, properly supported, and the exhaust must be pitched a minimum of a 1/4 inch per foot back to the water heater (to allow drainage of condensate).
NOTICE	The use of bushings to reduce vent sizing is prohibited for both the exhaust venting and intake air venting system.
	Only standard and long sweep PVC elbows are allowed for use in the exhaust venting and intake air venting system.

<table>
<tr><td>⚠
WARNING</td><td>Failure to properly support the vent system can cause the venting system to fail, resulting in substantial property damage, serious injury, or death</td></tr>
<tr><td>NOTICE</td><td>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 11.7. If a fitting (elbow or coupling) is needed it does not count toward the total linear feet.:
<table><tr><td colspan="3">Required CPVC Starter Venting Piece for all PVC venting installations</td></tr><tr><td>WH 299W</td><td>WH 399W</td><td>WH 470W / WH 499W</td></tr><tr><td>0 ft</td><td>4 ft</td><td>2 ft *</td></tr></table>Table 11.7
* 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.</td></tr>
<tr><td>⚠
WARNING</td><td>• The use of cellular core PVC (ASTM F891), cellular core CPVC, or Radel® (polyphenol sulfone) in the exhaust venting system is prohibited. Failure to follow these instructions may result in property damage, personal injury or death.
• The vent connection to the appliance must be made with a starter CPVC pipe section if PVC vent is to be used.
Failure to follow this warning could result in fire, personal injury, or death.
• 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 11.4 that is designated for the selected vent diameter. Use only the vent materials, primer and cement specified in this manual to make the vent connections. Failure to follow this warning could result in fire, personal injury, or death.
• 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.</td></tr>
</table>

11.3.1 INSTRUCTIONS FOR CEMENTING PVC/ CPVC PIPE CONNECTIONS:

1. Work from the water heater to vent or air termination. Do not exceed the equivalent lengths given in this manual for the air or vent piping.
2. Cut pipe to the required lengths and deburr the inside and outside of the pipe ends.
3. Chamfer outside of each pipe end to ensure even cement distribution when joining.
4. Clean all pipe ends and fittings using a clean dry rag. (Moisture will retard curing and dirt, or grease will prevent adhesion.)
5. Dry fit vent or air piping to ensure proper fit up before assembling any joint. The pipe should go a third to two-thirds into the fitting to ensure proper sealing after cement is applied.
6. Priming and Cementing:
   a. Handle fittings and pipes carefully to prevent contamination of surfaces.
   b. Apply a liberal even coat of primer to the fitting socket and to the pipe end to approximately 1/2" beyond the socket depth.
   c. Apply a second primer coat to the fitting socket.
   d. 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 as it will needlessly soften the pipe.

Near water heater PVC/ CPVC venting.

The starter piece must have a minimum length according table 11.7 "PVC Exhaust Venting" (page 54)

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.

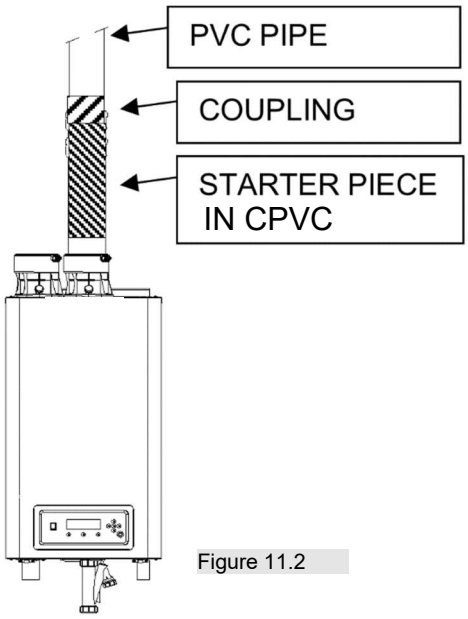


Figure 11.2

11.4 *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.

Preferred polypropylene vent pipe and fittings.

SUPPLIER	TYPE
Duravent	PolyPro

Table 11.8

Approved polypropylene terminations:

Duravent - PolyPro

WATER HEATER	TERMINATION	COLOR:	ORDER #:	STOCK #:
WH 299W WH 399W WH 470W WH 499W	4” UV resistant tee	black	4PPS-TTBL	810014461
	4” Bird guard screen	Stainless	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
WH 470W WH 499W	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
	6” Bird guard screen	Stainless	6PPS-BG	810004276

Table 11.9

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.

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	Only the Duravent PolyPro Locking Clamp is approved for use with Ideal appliances when using the PolyPro venting system. This locking clamp is required for use on vent joints in the system. **Failure to do so may result in improper installation, property damage, or injury**

- 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 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.

11.4.1 REDUCER

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

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

Figure 11.3

Water Heater	Size		Order #	STOCK#	A
WH 299W WH 399W	4" - 3"	100 – 80 mm	4PPS-R3L	810009746	5" / 130mm
WH 470W WH 499W	5" - 4"	130 – 100 mm	5PPS-R4L	810009764	$7^{5}/_{8}$" / 193mm
	6" - 5"	150 – 130 mm	6PPS-R5L	810009785	$7^{3}/_{4}$" / 197mm

Table 11.10

11.4.2 FLEXIBLE POLYPROPYLENE

For the use of flex pipe, it is recommended to have the vent material in 32°F (0°C) or higher ambient space before bending at installation. No bends should be made to greater than 45° and ONLY installed in vertical or near vertical installations.

DANGER	Insulation is prohibited from use on all types of plastic venting material: PVC, CPVC, and Poly-propylene.
	Use only the adapters and vent system listed. DO NOT mix vent systems of different types or manufacturers. Failure to comply may result in severe personal injury, death, or substantial property damage.

NOTICE	All vent connections MUST be secured by the vent manufacturer's joint connector.
	The installer must use a specific vent starter adapter at the flue collar connection. The adapter is supplied by the vent manufacturer to adapt to its vent system.
	Installations must comply with applicable national, state, and local codes. For Canadian installation, polypropylene vent must be listed as a ULC-S636 approved system.
	Installation of a polypropylene vent system should adhere to the vent manufacturer's installation instructions supplied with the vent system.

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

- 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.

WARNING	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. **Failure to do so may result in improper installation, property damage, or injury.**

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

WATER HEATER	TERMINATION	COLOR	ORDER #:	STOCK #:
WH 299W WH 399W WH 470W WH 499W	4" Chimney cap	Black	4PPS-FCTC	810014617
WH 470W WH 499W	5" Chimney cap	Black	5PPS-FCTC	810014665

Table 11.11

11.5 *Stainless steel*

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

Table 11.12

*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 occurs of the vent system. Connect to the FasNSeal rigid vent using specially designed adapters and sealing method, see manufacturer's instructions.

WARNING	Use only the materials, vent systems, and terminations listed. DO NOT mix vent systems of different types or manufacturers. Failure to comply could result in severe personal injury, death, or substantial property damage.
NOTICE	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
WATER HEATER	TERMINATION	TERMINATION	TERMINATION	TERMINATION
WH 299W WH 399W WH 470W WH 499W	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)
WH 470W WH 499W	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) 9414TERM (elbow term.) 5500CI (rain cap)
	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)D6TT (termination tee) SS(I)(D)6STAU (screen termination) SS6(I)(D)RC (rain cap)	9690TEE (termination tee) 9692 (screen termination) 9614TERM (elbow term.) 5600CI (rain cap)

Table 11.13

Approved flexible Stainless Steel Terminations

	Duravent FasNSeal Flex		
WATER HEATER	**TERMINATION**	**ORDER #:**	**STOCK #:**
WH 299W WH 399W WH 470W WH 499W	4" FasNSeal Flex Rain Cap	FSFLEXRC4	810013290
WH 470W WH 499W	5" FasNSeal Flex Rain Cap	FSFLEXRC5	810013291
	6" FasNSeal Flex Rain Cap	FSFLEXRC6	810013292

Table 11.14

11.6 *Sealed Combustion Air supply*

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

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

11.6.1 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. Check paragraph 11.7.1 (tables 11.16 and 11.17)

11.6.2 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 water heater 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.

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

Near water heater air piping:

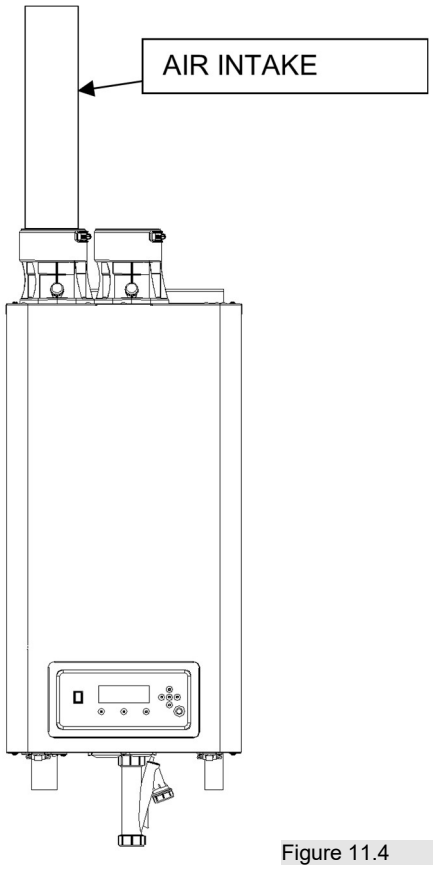


Figure 11.4

11.6.4 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 Aluminium 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.

A PVC or CPVC air inlet pipe should 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.

11.7 *Room air*

Commercial applications utilizing the water heater 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 indoor air kit (table 11.15).
- The equipment room MUST be provided with properly sized openings to assure adequate combustion air. Please refer to instructions provided with the indoor air kit.
- There will be a noticeable increase in the noise level during normal operation from the inlet air opening.
- Using the room air kit makes the unit vulnerable to combustion air contamination from within the building. Please review the section 11.7.1 "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 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 the CAN/CSA B149.1 Natural Gas and Propane Installation Code, or applicable provisions of the local building codes.

Indoor air kit:

Duravent, Polypro / Fasnseal

Water heater	Termination	Color	order	stock
WH 299W WH 399W WH 470W WH 499W	4” Termination tee	Stainless	FSTT4	810003175
	4” Rain cap	Stainless	FSRC4	810003185
	4” Termination tee	black	4PPS-TTBL	810014461
	4” Vertical conc. Term.	black	4PPS-VKC-N	810014649
WH 470W WH 499W	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 11.15

11.7.1 AIR CONTAMINATION

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

WARNING	• Do not operate the water heater 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 water heater or air inlet piping. • If contaminants are found, you MUST: - 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

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 11.16

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 11.17

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

For water heaters 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 thermal insulation is prohibited.
For Category IV venting, the venting system shall be installed in accordance with the water heater 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 should allow the water heater to be free from strain and prevent the weight of the venting system from resting on the water heater. The supports should allow for a minimum 1/4” (6 mm) per foot slope upwards from the water heater 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 water heater and reduce the risk of icing at the termination.

11.9 *Install vent and combustion air piping*

DANGER	• The water heater 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 § 11.11 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	• This appliance requires a special venting system. Use only approved stainless steel, PVC, CPVC or polypropylene pipe and fittings. Failure to comply could result in 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 in the closet/alcove vent structure. 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 water heaters to an existing common vent pipe. Failure to comply could result in substantial property damage, severe personal injury, or death.
CAUTION	Improper installation of venting systems could result in flue gas leakage, appliance malfunction, substantial property damage, sever injury, and death.
WARNING	For US installations only, for Category II and Category IV appliances: The vent for this appliance shall not terminate: • 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	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 water heater from an existing vent system.

The water heater vent and air piping can be installed through the roof or through a wall. Follow the procedures in this manual for the method chosen. Refer to the information in this manual to determine acceptable vent and air piping length. You may use any of the vent/air piping methods covered in this manual. Do not attempt to install the water heater using any other means. You must also install air piping from outside to the water heater air intake adapter, unless following the "Room Air" instructions in § 11.7 of this manual.

11.10 *Requirements for installation in Canada*

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

WARNING	When utilizing the single pipe method, provisions for combustion and ventilation air must be in accordance with Air for Combustion and Ventilation, of the latest edition of the National Fuel Gas Code, ANSI Z223.1/NFPA 54, in Canada, the latest edition of CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment, or applicable provisions of the local building codes.
	The inlet for combustion air shall never be located inside a room storing chemicals or contaminants as listed in section 11.7.1. Avoid installing the water heater in any area with possible contaminants.
	If contaminants are found, you MUST: - remove contaminants permanently. or - relocate the water heater and air intake to an area free from all possible contaminants.

11.11 *Direct venting options*

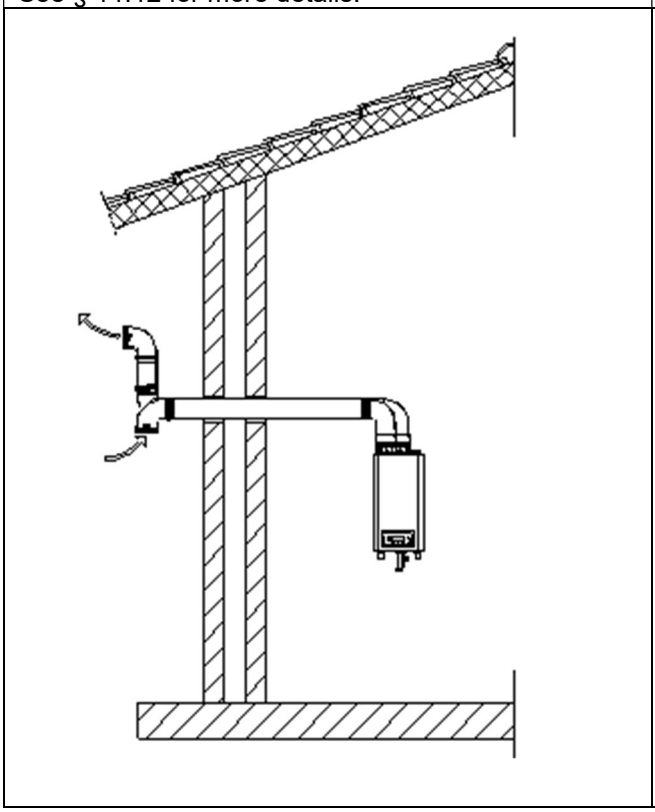
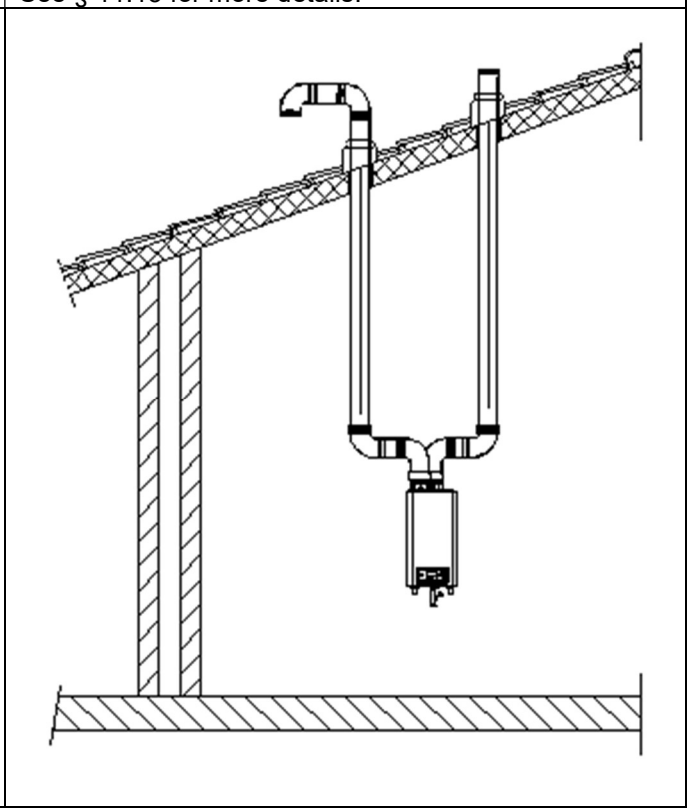
Two pipe wall See § 11.12 for more details.	**Two pipe vertical** See § 11.13 for more details.
	

Figure 11.5

Figure 11.6

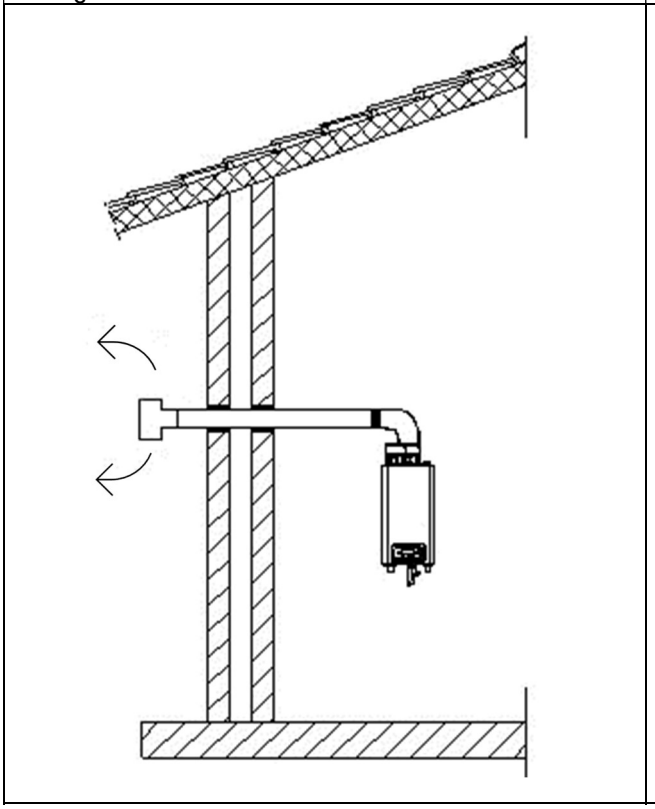
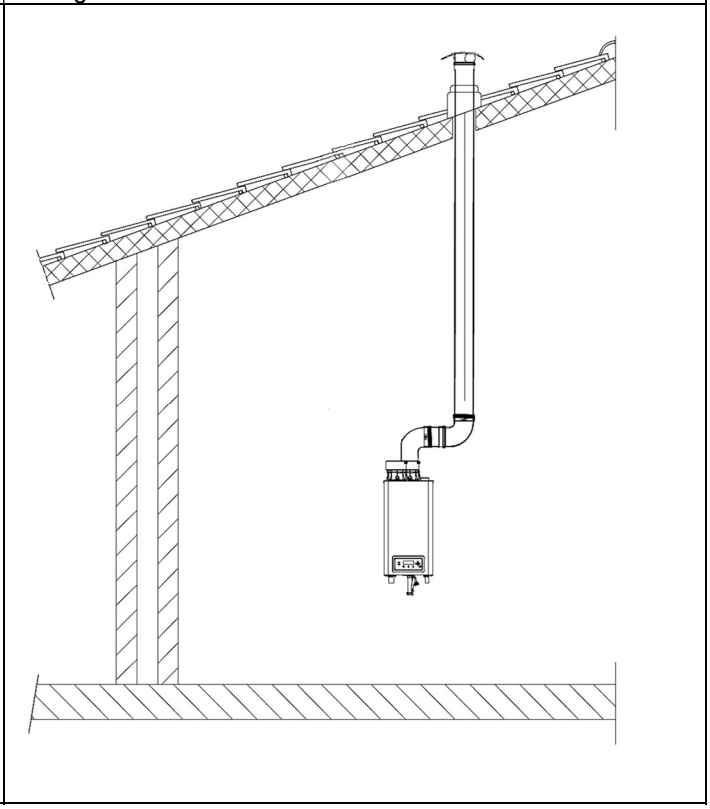
Single pipe wall (room air) See § 11.7 for more details	**Single pipe roof (room air)** See § 11.7 for more details
	

Figure 11.7

Figure 11.8

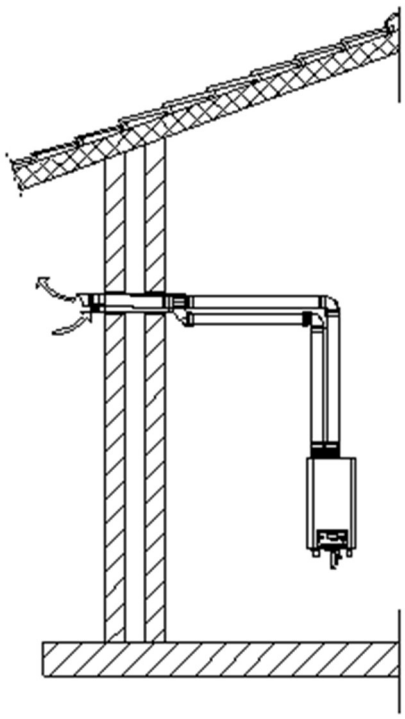
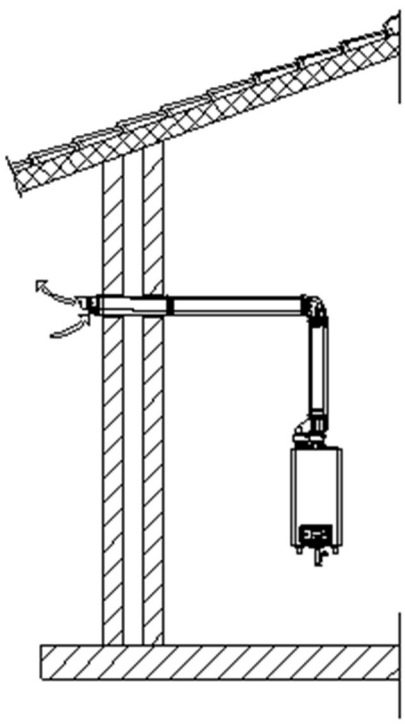
Concentric wall - two pipe to water heater Water heaters WH 299W, WH 399W only. See § 11.12 for more details.	**Concentric wall** - concentric to water heater Water heaters WH 299W, WH 399W only. See § 11.12 for more details.
	

Figure 11.9

Figure 11.10

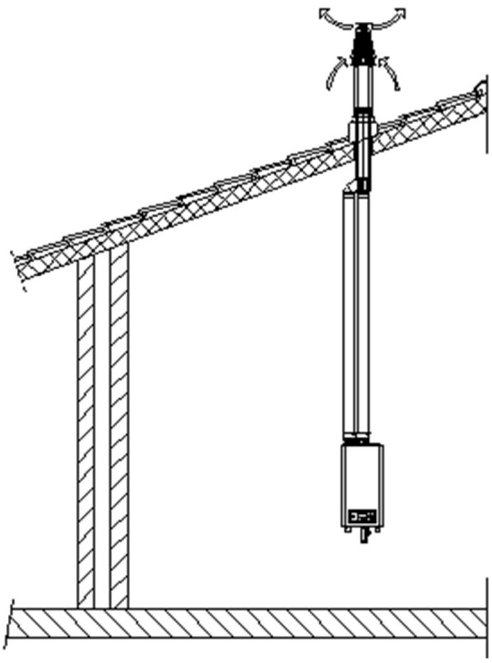
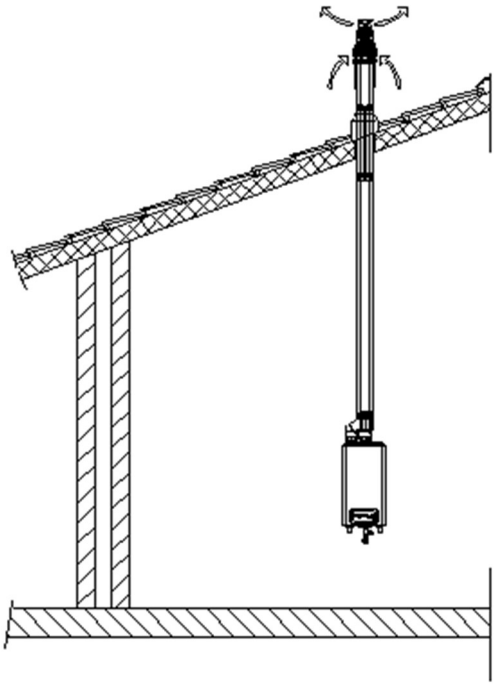
Concentric vertical - two pipe to water heater Water heaters WH 299W, WH 399W only. See § 11.13 for more details	**Concentric vertical** - concentric to water heater Water heaters WH 299W, WH 399W only. See § 11.13 for more details.
	

Figure 11.11

Figure 11.12

11.12 *Wall (Horizontal) direct venting.*

11.12.1 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

11.12.2 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 11.2 in §11.1.2 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 down-turned 90 degree elbow as shown in Figure 11.14 or 11.16. 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 11.14 or 11.16

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 water heater shutdown and possible blocked flue.

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

11.12.3 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 pipe

   When 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 11.13.
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.

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

11.12.4 **POSITIONS**

1. Maintain clearances as stated in this manual.
2. 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.
3. Also maintain the following:

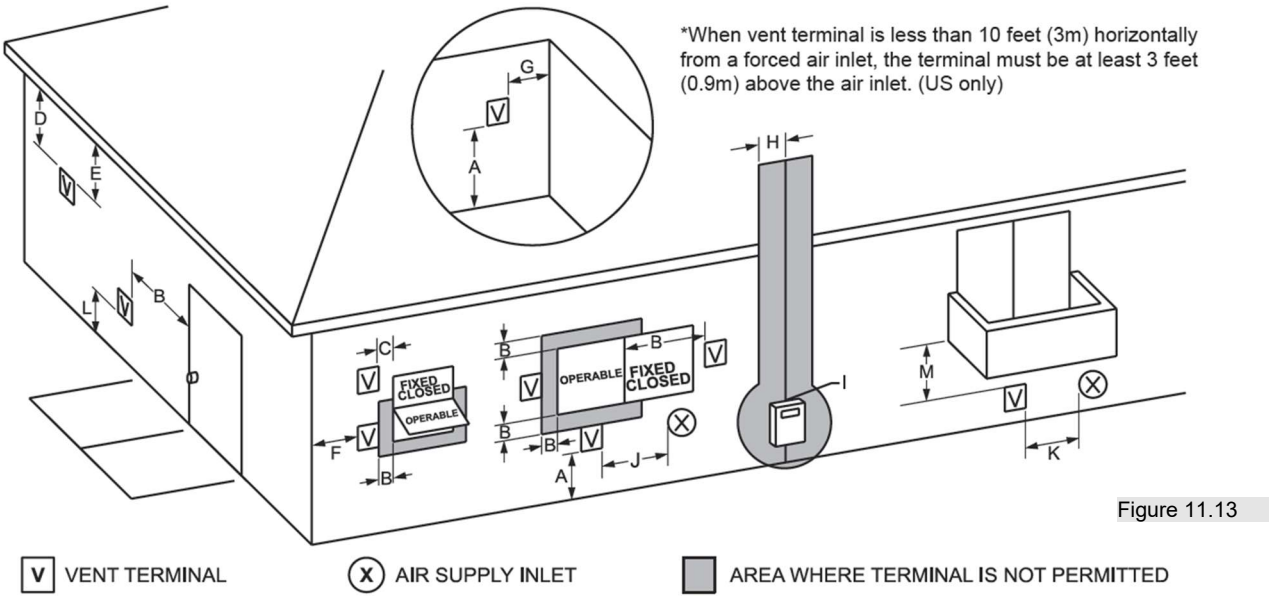


Figure 11.13

Exit terminals of direct-vent venting systems

fig	Clearance Location	Minimum clearances for US installations (ANSI Z223.1/NFPA 54)	Minimum clearances for Canadian installations (CAN/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 meter/regulator assembly	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 (0.3 m) see note 6	12” (0.3 m) see note 6

note 1: In accordance with the current ANSI Z223.1 / NFPA 54 National Fuel Gas Code
note 2: In accordance with the current CAN/CSA-B149.1 Installation Code

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

Table 11.18

Two pipe sidewall termination of air intake and exhaust vent.

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

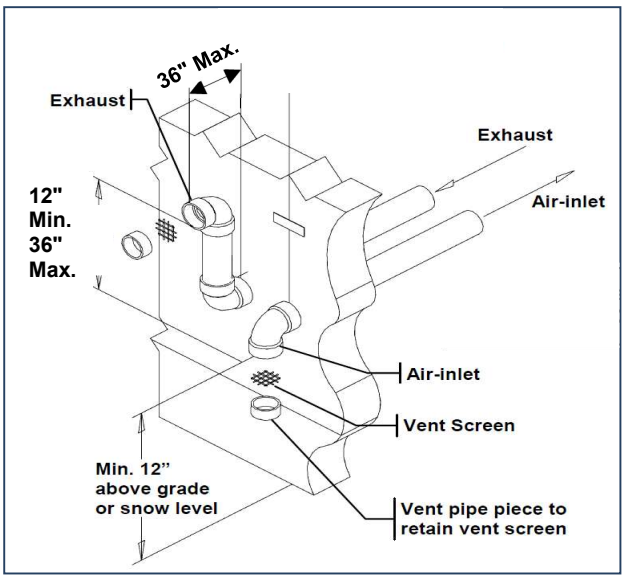


Figure 11.14

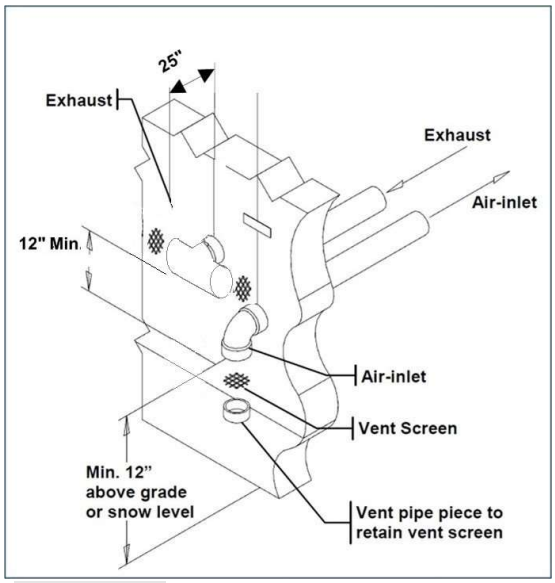


Figure 11.15

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

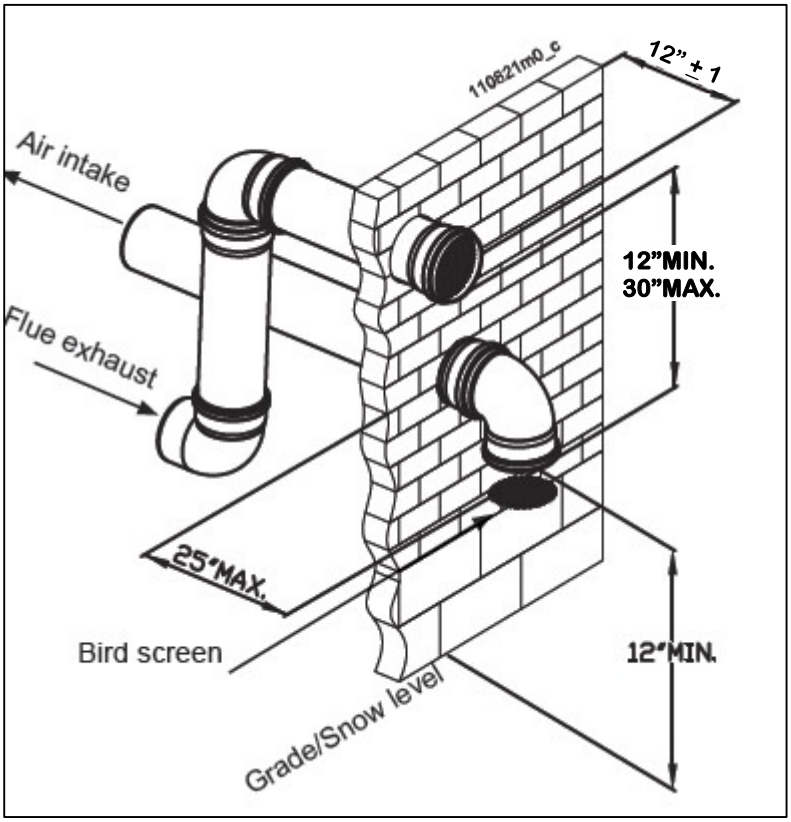


Figure 11.16

WARNING

Do not extend the vent pipe outside the sidewall beyond the dimensions shown in Figures 11.14, 11.15, 11.16, 11.18, 11.19 and 11.20.
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

Two pipe sidewall termination assembly.

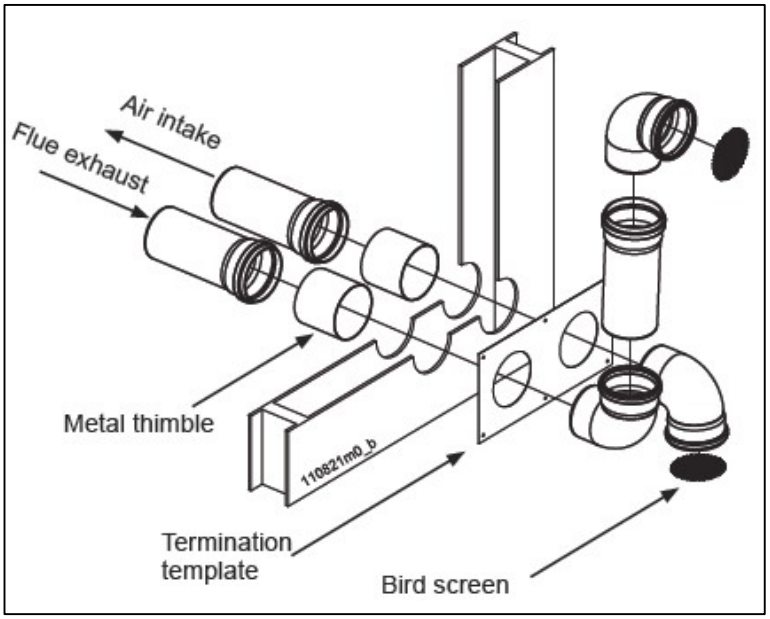


Figure 11.17

Multiple vent/air terminations

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

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

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

Two pipe multiple water heaters vent terminations.

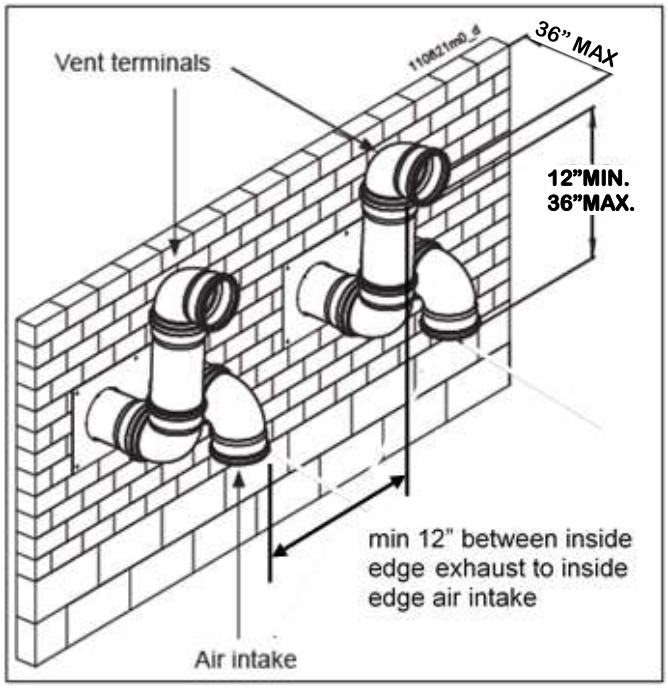


Figure 11.18

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

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 Figures 11.19 and 11.20. The required combustion vent pipe materials are listed in Table 11.4 of this manual.

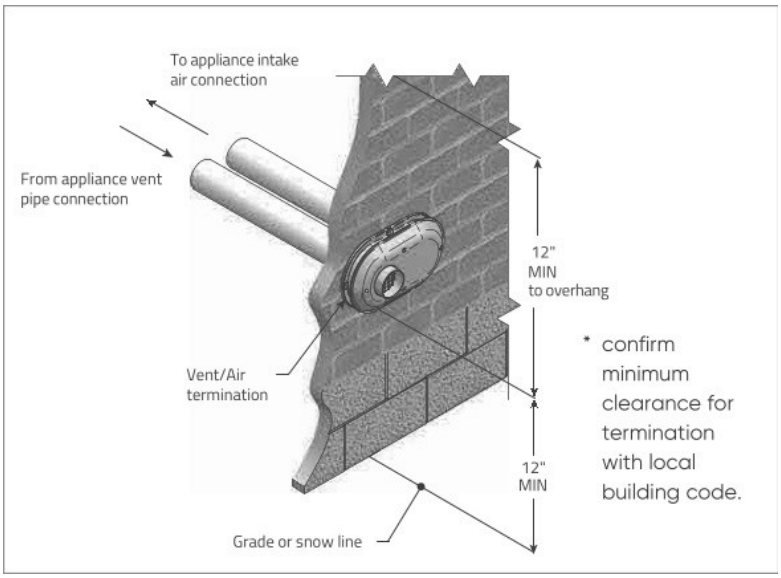


Figure 11.19

Figure 11.20

Wall termination – concentric vent: water heaters WH 299W, WH 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 below. The required combustion vent pipe materials are listed in table 11.4 of this manual.

Concentric sidewall termination clearances: water heaters WH 299W, WH 399W only

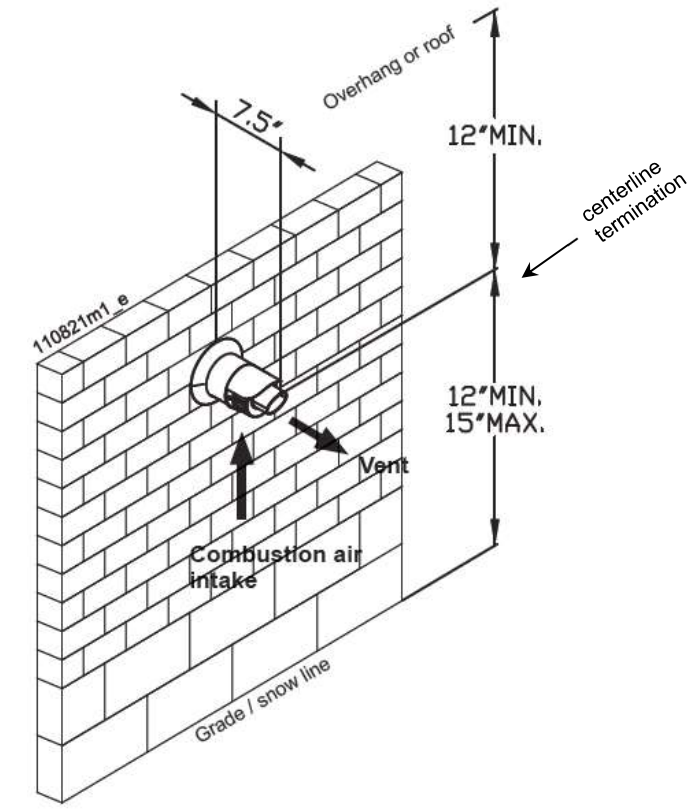


Figure 11.21

Sidewall termination installation:

- Determine the best location for the termination kit (see figure 11.13).
- Reference § 11.12.2 of this manual for general termination considerations.

NOTICE	Ensure termination location clearance dimensions are as shown in figures 11.21 and 11.22
CAUTION	DO NOT use field-supplied couplings to extend concentric terminations. Airflow restriction will occur and may cause intermittent operation.

Multi venting wall terminations
When two (2) or more direct vent appliances are vented near each other, each appliance must be individually vented . NEVER common vent or breach vent this appliance. When two (2) or more direct vent appliances are vented near each other, these must be installed as shown in figures 11.18 or 11.22. It is important that vent terminations be made as shown to avoid recirculation of flue gases.

Concentric sidewall multiple water heaters termination.

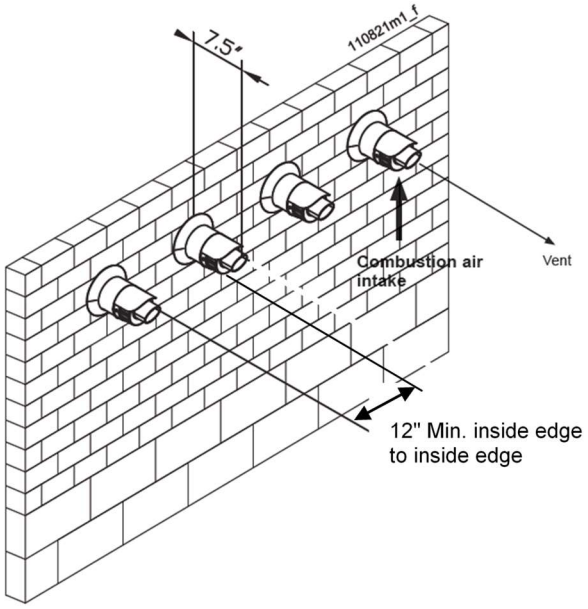


Figure 11.22

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

11.13 *Roof (Vertical) direct venting.*

11.13.1 VENT/AIR TERMINATION – VERTICAL

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

11.13.2 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 §11.1.2 of this manual.
2. Prepare the vent termination and the air intake termination elbow (figure 11.21) 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 11.21
5. The exhaust piping must terminate in a vertical coupling as shown in figure 11.21. 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 11.21.
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.

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

Two pipes vertical termination of air and vent.

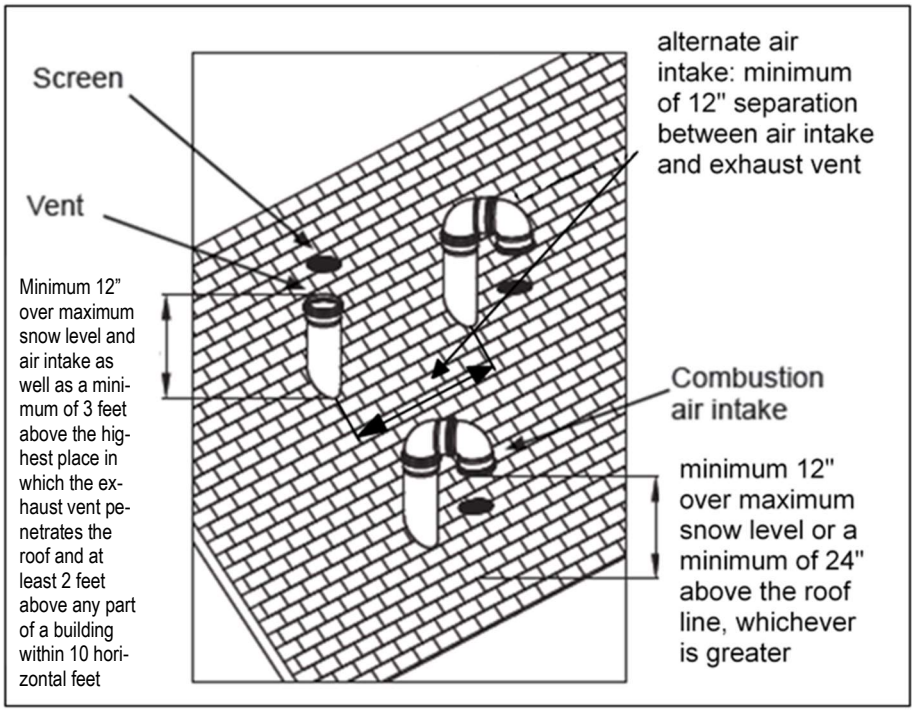


Figure 11.23

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 water heaters, terminate each vent/air connection as described in this manual (figures 11.23, 11.24 and 11.25).

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

2. Place roof penetrations to obtain minimum clearance of 12 inches (305 mm) between outside edge of air intake and exhaust vent of another water heater for U.S. installations (see figure below). 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 water heaters.

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

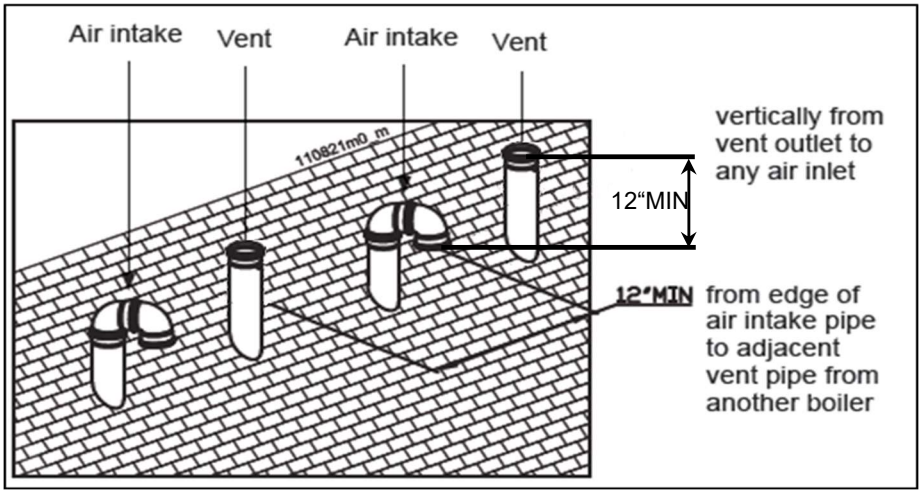


Figure 11.24

Alternate vertical terminations with multiple water heaters.

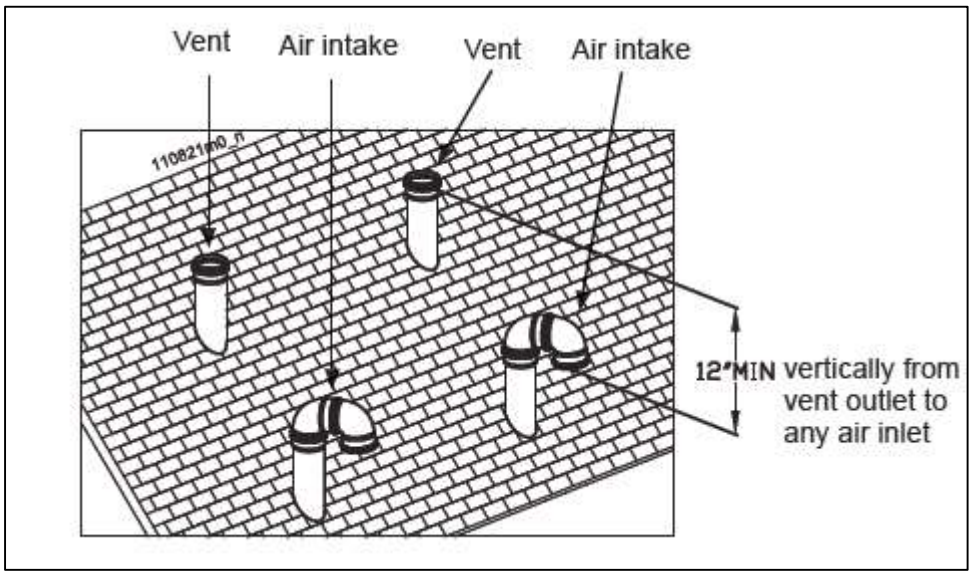


Figure 11.25

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. Water heaters WH 299W and WH 399W only

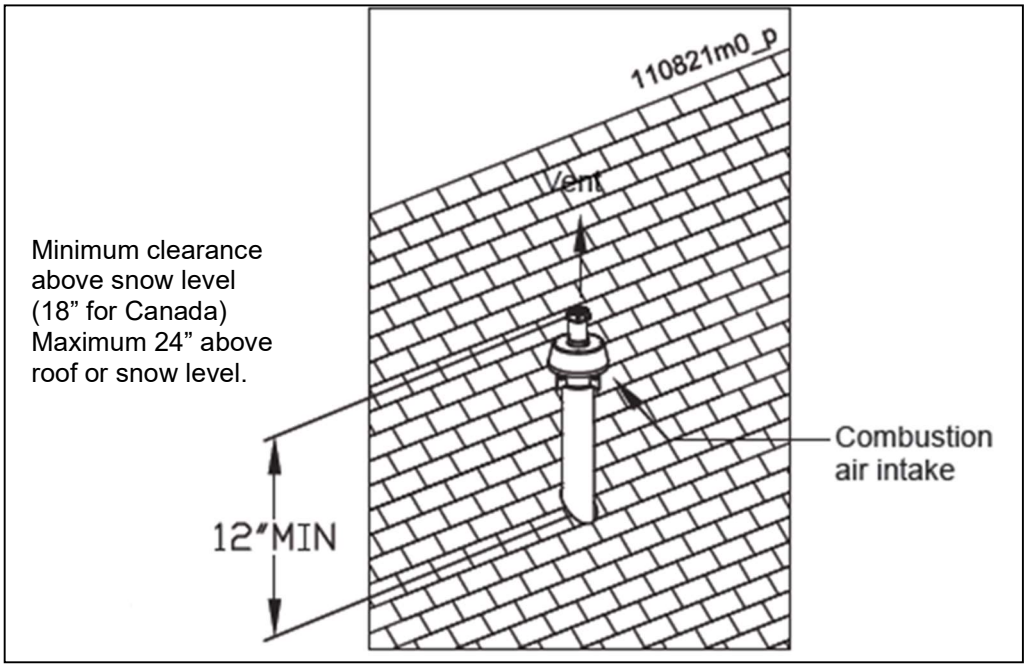


Figure 11.26

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

Figure 11.27

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

Multi venting vertical terminations

When two (2) or more direct vent appliances are vented near each other, each appliance must be individually vented (see figure 11.25, 11.28 or 11.29) or common vented (see Chapter 12). It is important that vent terminations be installed as shown to avoid recirculation of flue gases.

Concentric vent and combustion air vertical termination multiple water heaters.

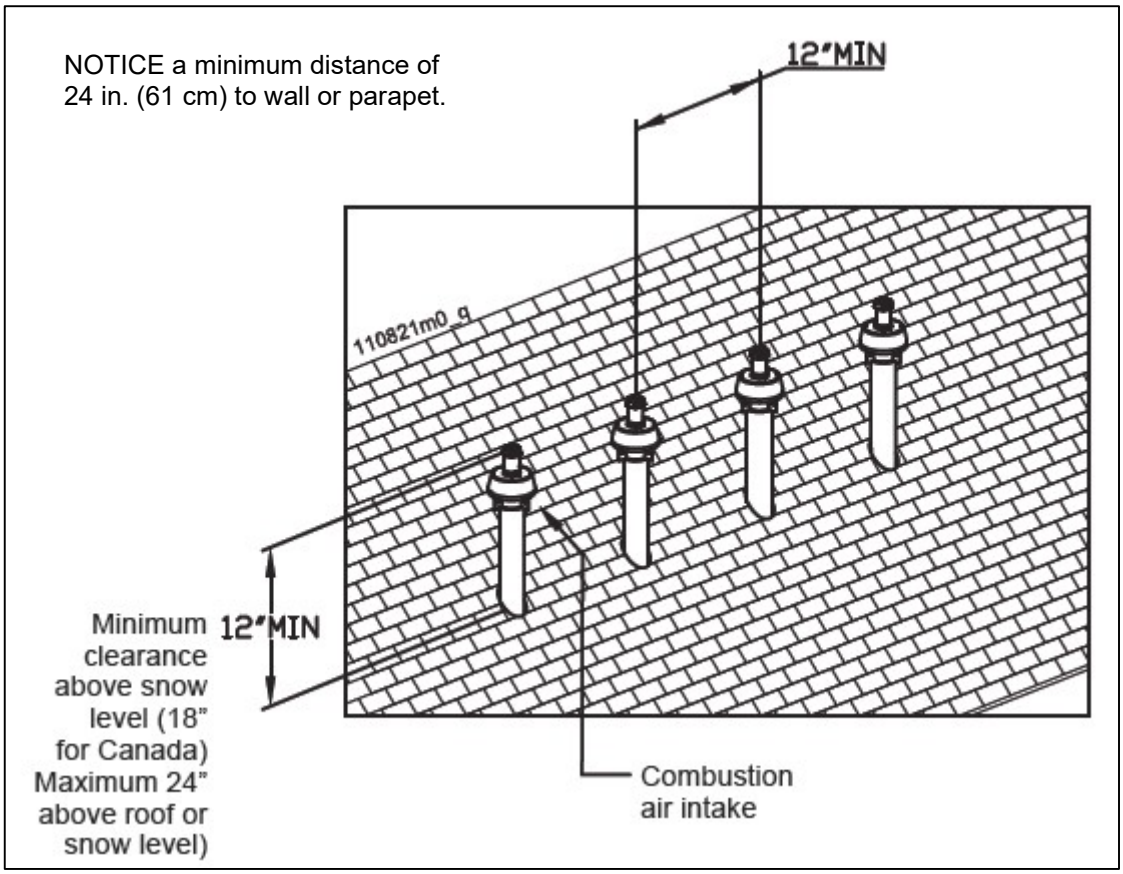


Figure 11.28

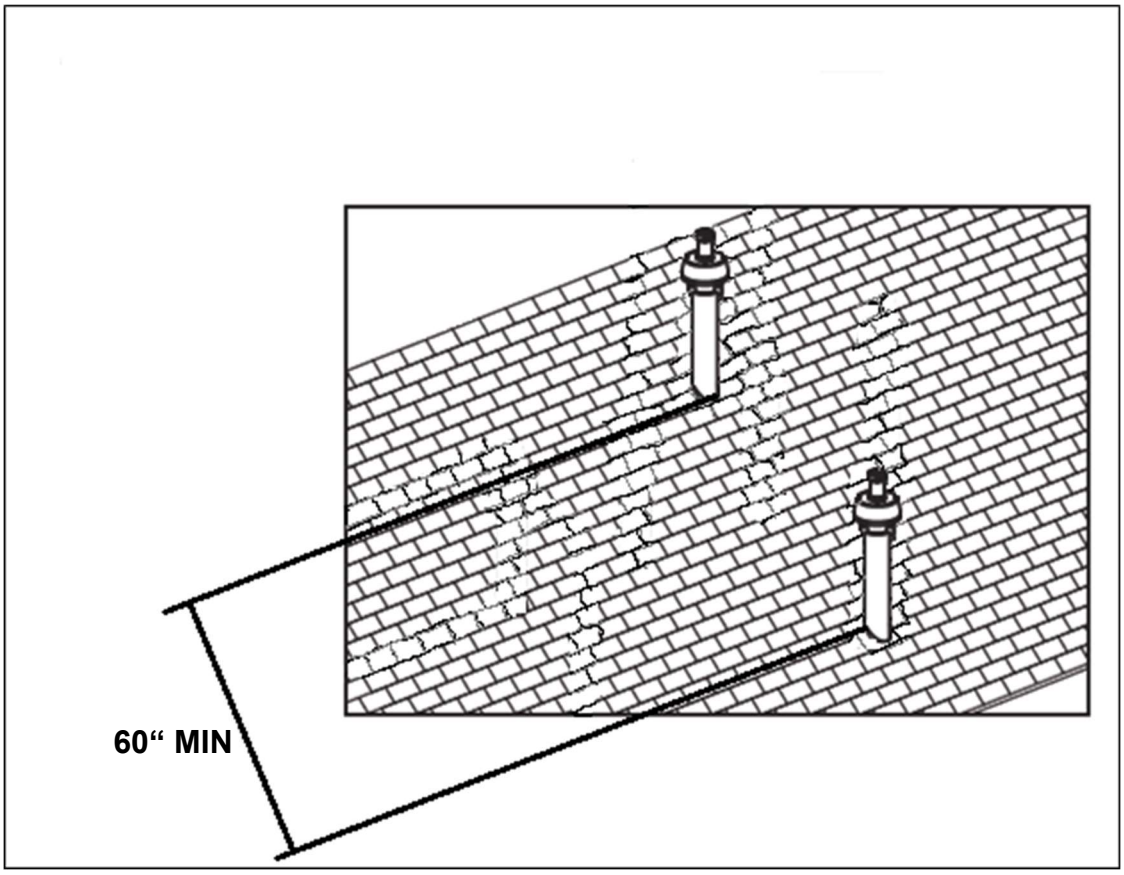
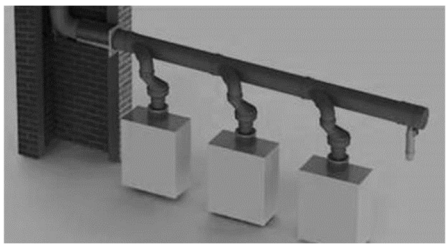


Figure 11.29

12 COMMON VENT CASCADING

12.1 *Introduction*



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

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

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

12.2 *Existing Common Venting Guidelines*

Do not common vent the WWH water heater with the vent pipe of any other water heater or appliance. However, when an existing water heater 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 water heater, 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.

 WARNING	Do not install the Commodore WWH water heater 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.

13 ELECTRICAL INSTALLATION

13.1 *General*

- For operation, the water heater requires a dedicated 120VAC/15A service.
- The water heater mains supply connection is **polarity sensitive**.
- The wiring for the connections should be routed at the bottom of the water heater through the wiring knock-outs.
- **NOTICE: Before starting to work on the water heater, it must be switched off and the power supply to the water heater must be disconnected and the manual gas valve closed.**
- Electrical wiring should be installed according to all applicable standards and regulations.
  In the USA, electrical installation must comply with NFPA 70, National Electrical Code – latest edition, and with any other national, state 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 water heater should only be done by a qualified installer or licensed electrician where required that is skilled in working on electrical installations and according to all applicable standards.
- It is prohibited to make changes or alterations to the 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 water heater, 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 I, in Canada.
- A spare fuse is mounted on the casing of the burner controller.

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

WARNING	**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.**

13.2 *Connection mains 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 voltage and neutral wire.
- The power supply cable must be secured by utilizing a strain relief on in the inside of the water heater cabinet where the wires enter the knockout.
- In case of a flexible cable: use crimp ferrules on each wire end for the terminal connections.
- It is required to use flexible or hard conduit when connecting all line voltage 120V connections to the water heater, for both incoming power to the water heater and outgoing power to any circulators or other accessories.
- use only the knock outs on the bottom of the water heater for making line voltage 120v connections.
- On the high voltage terminal, connect to numbers: 8 = Line voltage; 9 = Neutral; PE = Ground.

13.3 *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 Commodore cabinet and should remain separated inside the Commodore.
- 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 system sensor

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

13.3.1 ADDITIONAL SAFETY LIMITS

The water heater 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:

- external manual reset high limit: part number E361100009
- 24V manual reset LWCO with test function: part number E361100007

A flow switch is part of the delivery and can be found in the box. It must be connected to low voltage connections 16 and 17.

13.4 *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 Interrupteur de sécurité 2		Safety switch 1 Interrupteur de sécurité 1		Gas pressure switch Interrupteur de pression de gaz		LWCO Extern Eau basse coupée à l'extérieur		AL-BUS managing boiler AL-BUS chaudière gérant		Pump control PWM Commande de pompe PWM		Flow switch DHW Interrupteur de débit ECS		DO NOT USE NE PAS UTI-LISER		DO NOT USE NE PAS UTI-LISER		AL-BUS depending boiler AL-BUS chaudière dépendant		Modbus			DHW sensor Capteur ECS		System sensor Capteur de systéme		DO NOT USE NE PAS UTI-LISER	

Figure 13.1

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
MAXIMUM TOTAL OUTPUT 3.5 Amps NOMINAL	DO NOT USE NE PAS UTILISER				DO NOT USE NE PAS UTILISER			GENERAL PUMP Pompe générale MAX 2 Amps			MAINS SUPPLY Alimentation secteur				ALARM Alarme MAX 50W	

Figure 13.2

NOTICE	Read: “circulator” if the word “pump” is used

High power ignitor

A separate connector for an external igniter is located on the cable tree, near the water heater controller and labelled "High power ignitor". The "external ignition transformer is factory installed in all water heater models.

13.5 *Explanation of the low voltage connections.*

1-2	DO NOT USE
Do not connect wires to these terminals	
3-4	**SYSTEM SENSOR**
It is mandatory (single and cascaded heaters) to use a pipe strap-on sensor besides the DHW sensor. This system (Strap-on) sensor has to be connected to connections 3-4 “System Sensor” (Cascaded heaters need one system sensor connected to the managing water heater only.) The system sensor is included in the water heater delivery.	
5-6	**DHW SENSOR**
The DHW/tank sensor can be mounted in a well in the tank. Connect the sensor to connections 5-6 “DHW Sensor”. (Cascaded heaters need one DHW sensor connected to the managing water heater only.) The water heater will now modulate towards the tank setpoint. The DHW sensor with sensor well is part of the delivery and can be found in the box.	
7-8-9	**MODBUS**
Connections for a MODBUS communication signal. 7 = ground, 8 = A, 9 = B (A detailed Modbus bulletin is available at your supplier on request)	
10-11	**AL-BUS DEPENDING**
Cascade connections for the dependent water heaters, 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 water heaters to 20 of the managing water heater, and connections 11 of the dependent water heaters to 21 of the managing water heater.	
12-13	**DO NOT USE**
Do not connect wires to these terminals	
14-15	**DO NOT USE**
Do not connect wires to these terminals	
16-17	**FLOW SWITCH**
Flow switch connection. If a water flow is present, the switch closes, and the DHW circulator is started. PARAMETER: boiler parameter 117, see: § 13.11 "programmable in- and outputs"	
18-19	**PWM**
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 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 connection for the managing water heater. Link connection 20 of the managing water heater to connections 10 of the depending water heaters, and connection 21 of the managing water heater to connections 11 of the depending water heaters.	
22-23	**LWCO EXTERN**
To be used for an extra external Low Water Cut Off. The water heater 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 external gas pressure switch. The water heater goes into a lockout when this contact opens. A gas pressure switch kit part number E361000001 is available for the 299 and 399 models. The kit is standard and factory installed on 470 and 499 models. PARAMETER: water heater parameter 118, see: § 13.11 "programmable in- and outputs"	
26-27	**SAFETY SWITCH 1**
To be used for an extra external safety switch. The water heater goes into a lockout when this contact opens. An external manual reset high limit is available, part number E361100007.	
28-29	**SAFETY SWITCH 2**
To be used for an extra external safety switch. The water heater goes into a lockout when this contact opens	

Table 13.1

13.6 *Explanation of the mains voltage connections.*

1-2-3-PE	**DO NOT USE**
Do not connect wires to these terminals	
4-PE-5	**DO NOT USE**
Do not connect wires to these terminals	
6-PE-7	**GENERAL or WATER HEATER PUMP**
Connections for the power supply of a water heater pump. (P1, see chapter 8.5 for detailed electrical specifications).	
8-9-PE-PE	**MAINS SUPPLY**
The power supply connection of the unit. 8 = Line voltage wire; 9 = Neutral wire, PE = Ground wire	
10-11	**ALARM RELAY**
A semiconductor alarm output. This is a triac output with an active voltage of 120 VAC, it can only handle resistive loads between 5 and 50 Watt. E.g. an incandescent bulb of 10-50 watt can be added to this. Other signals or lights can be applied using a relay. In that case a resistor must be added. This alarm will be activated 60 seconds after an error has occurred. There are a few exceptions: - Alarm output will not be activated for a service warning; - Alarm output will not be activated for warning 202 (Appliance selection). 10 = Line wire; 11 = Neutral wire ATTENTION: The Neutral of the alarm output is connected to the water heater Mains Neutral. Only use this neutral connection with a single water heater and a single alarm. PARAMETER: water heater parameter 127, see: § 13.11 "programmable in- and outputs"	
X1-X2-X3	**HIGH POWER IGNITER (external igniter)**
A connector for an external igniter is located on the cable tree, near the water heater controller and labelled "High power ignitor". This is the connection for the external ignition transformer which is factory installed in all water heater models.	

Table 13.2

NOTICE	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.

13.7 *Ladder / Logic diagram*

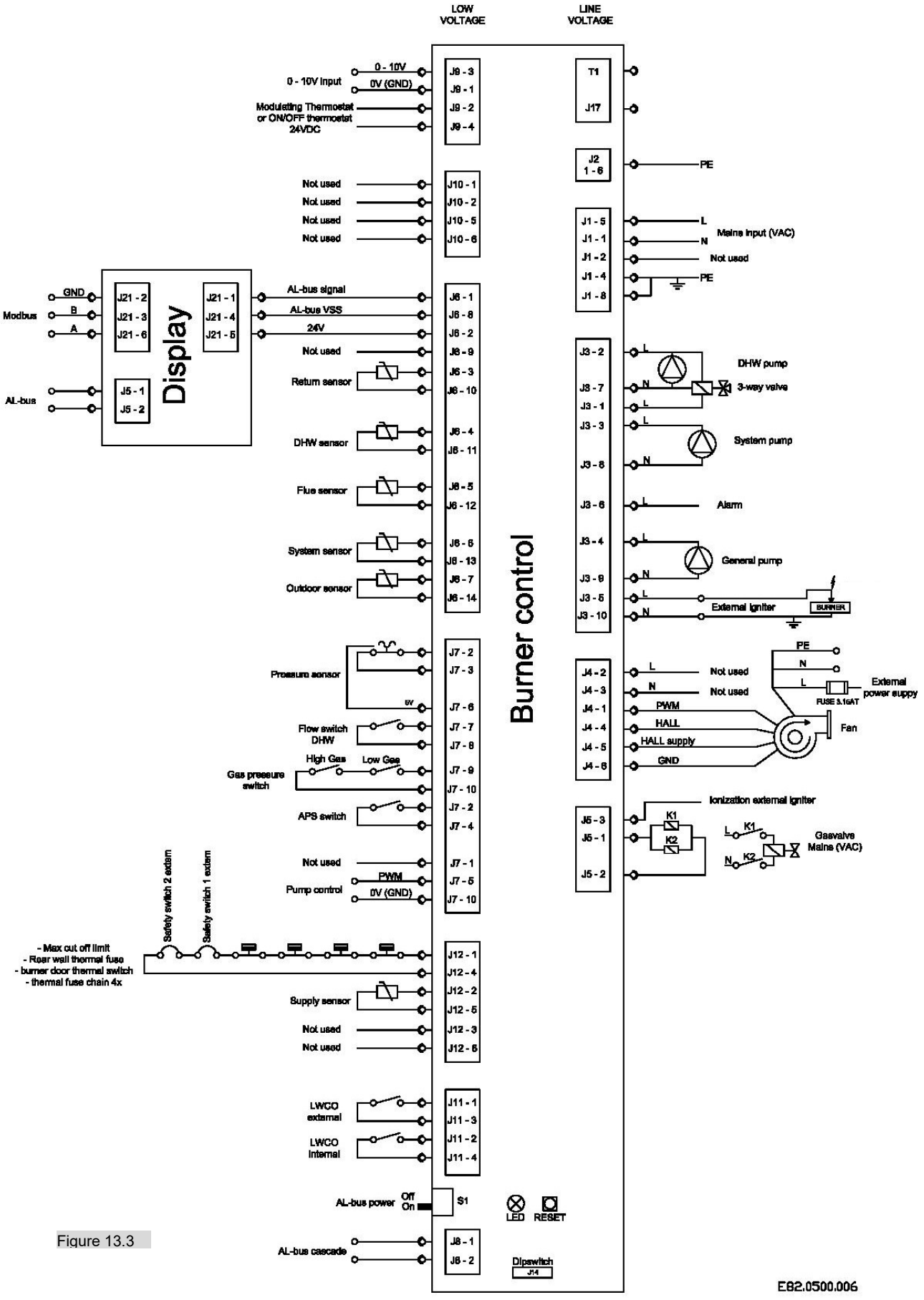


Figure 13.3

13.8 *Electrical schematics*

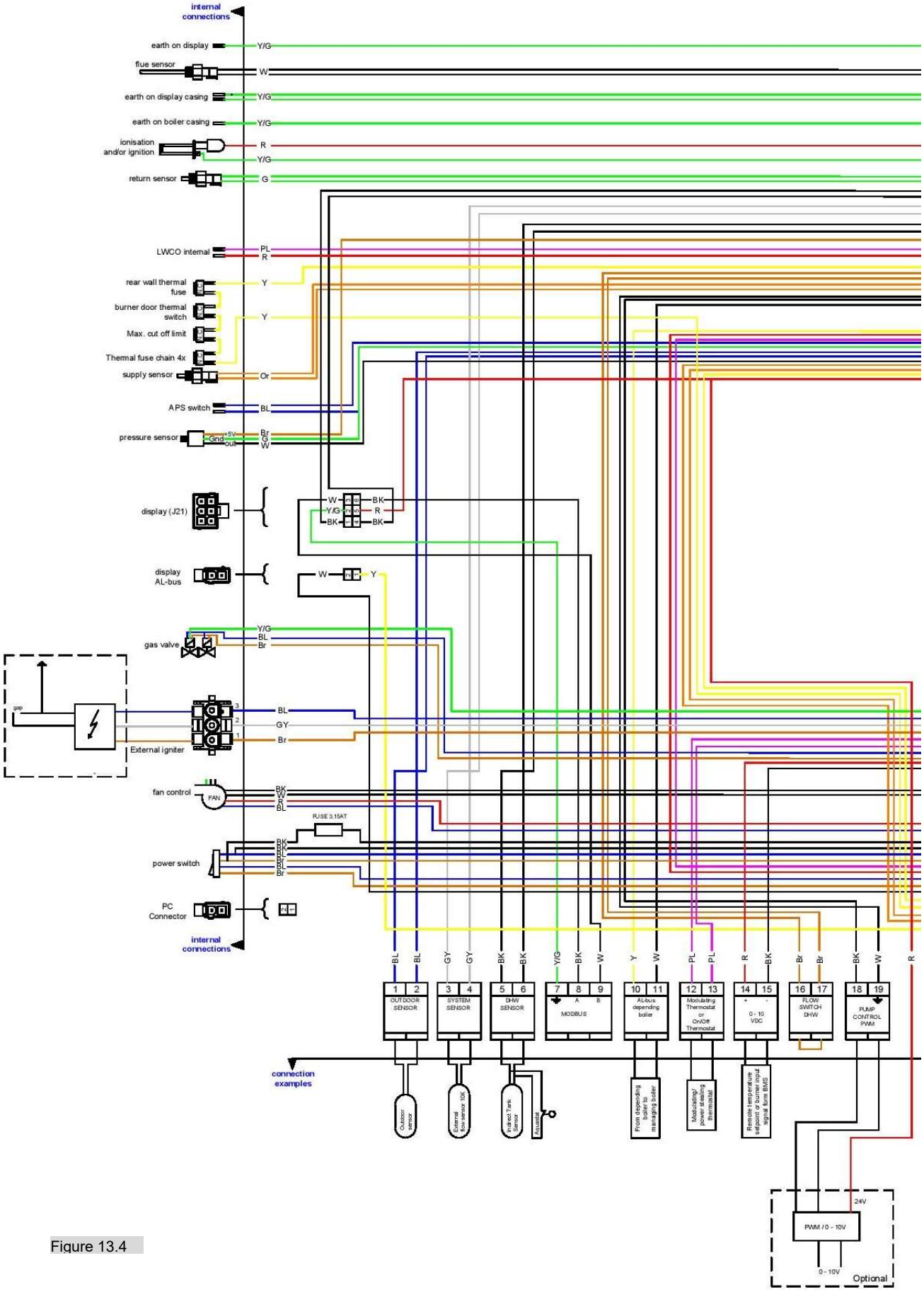


Figure 13.4

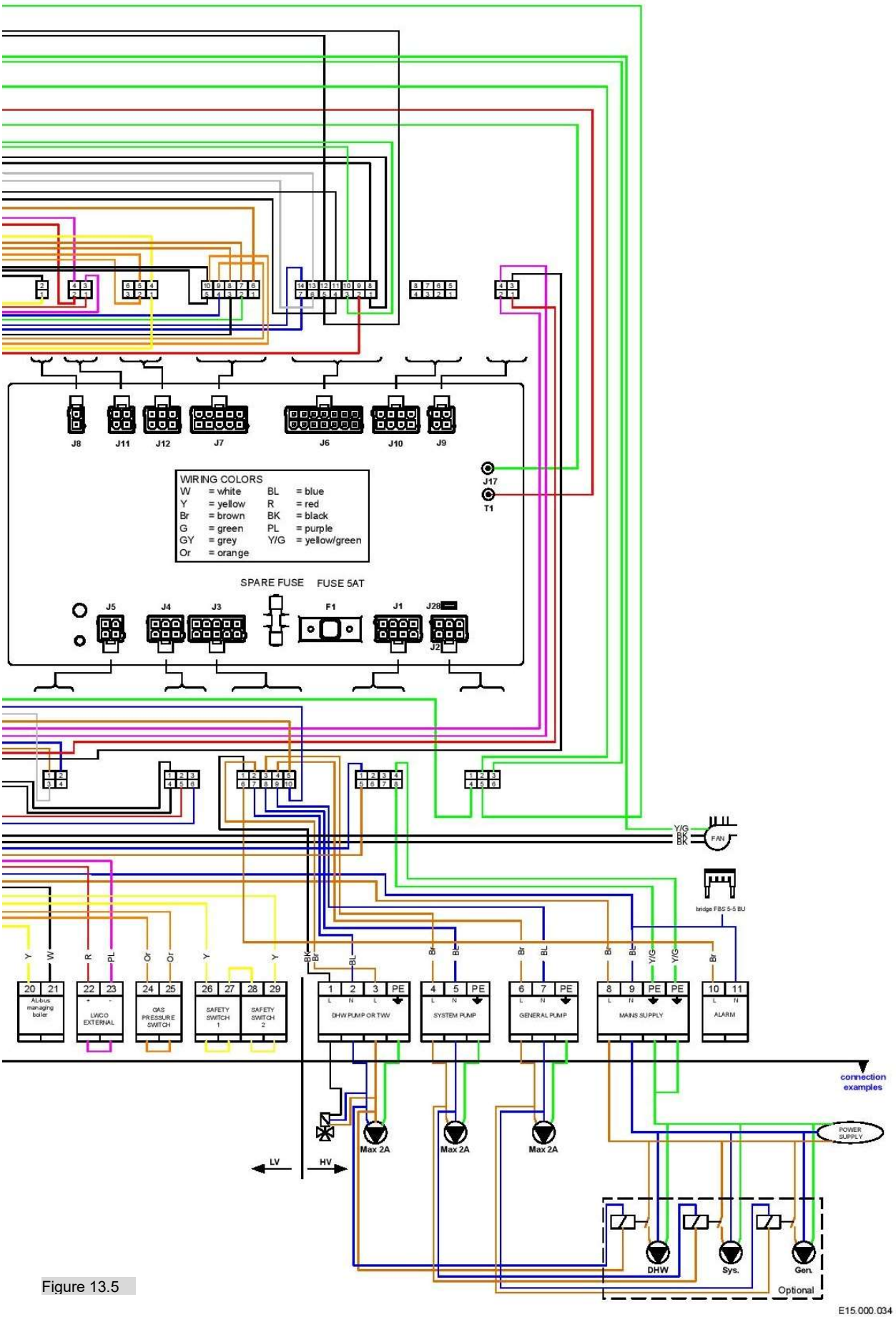

J8
J11
J12
J7
J6
J10
J9
J17
T1
WIRING COLORS
W = white
Y = yellow
Br = brown
G = green
GY = grey
Or = orange
BL = blue
R = red
BK = black
PL = purple
Y/G = yellow/green
SPARE FUSE
FUSE 5AT
J5
J4
J3
F1
J1
J28
J2
FAN
bridge FBS 5-5 BU
20 21 AL-bus managing boiler
22 23 LWCO EXTERNAL
24 25 GAS PRESSURE SWITCH
26 27 28 29 SAFETY SWITCH 1 SAFETY SWITCH 2
1 2 3 PE DHW PUMP OR TWV
4 5 PE SYSTEM PUMP
6 7 PE GENERAL PUMP
8 9 PE PE MAINS SUPPLY
10 11 ALARM
connection examples
POWER SUPPLY
Max 2A
Max 2A
Max 2A
LV
HV
DHW
Sys.
Gen.
Optional
E15.000.034

Figure 13.5

13.9 *Sensor availability*

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

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

Table 13.3

DHW mode 0 – Do not use
DHW mode 1 – Single and cascaded Water Heaters.
DHW mode 2 to 8 – Do not use.

13.10 *NTC sensor curve*

All NTC sensors are according to this characteristic: NTC 10K@77 °F (25°C) B3977k 3%@140°F (60°C)

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 13.4

A system sensor and a tank sensor with sensor well are provided in the box with every Commodore WWH water heater.

13.11 *Programmable in- and outputs*

It is possible to re-program some in- and outputs to other functions. To do this use below list and go to: Menu\settings\boiler settings\"1122" (installer password) \boiler parameters. Several IO's are already in use and cannot be changed. These IO's are signed with N.A.

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

Table 13.5

NOTICE

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

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

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

Remarks:
1) Prog. output 2: An external igniter is connected to a separate connector on the cable tree, the pin in the middle is for ionization, it has no PE connection.
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.

Table 13.6

14 WATER HEATER DISPLAY AND BUTTONS.

Figure 14.1

14.1 *Explanation of the buttons*

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

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 14.2

14.2 *Display configuration*

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

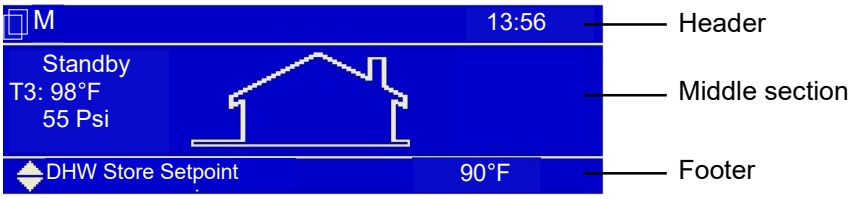


Figure 14.3

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): ▪ 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 (water heater 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
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.

14.3 *Starting the water heater.*

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

Figure 14.4

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 14.5

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 cancelled by pressing the Enter button for over 5 seconds.
After completion or manual ending the “De-Air” sequence one of the following Status overview screens appears:

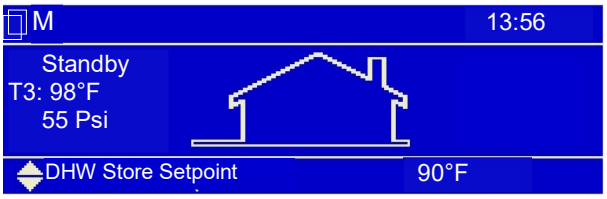


Figure 14.6

A single water heater is set as Managing (M)

14.3.1 CHANGING THE DHW SETPOINT

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

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

14.3.2 ENTERING THE MENU

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

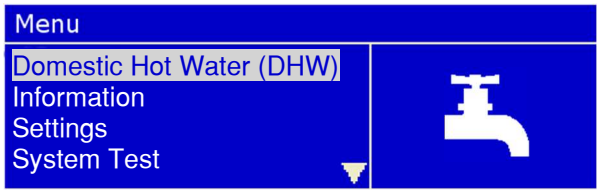


Figure 14.7

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

Figure 14.8

Use “DHW Store Setpoint” to set the warm water temperature

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

14.3.3 PROTECTED MENU ITEMS

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

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

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

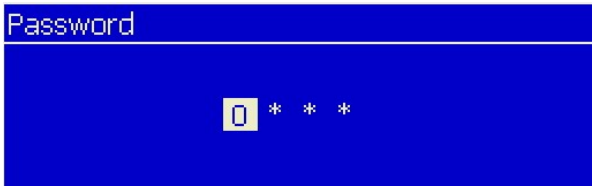


Figure 14.9

Users are only allowed to change parameters not needing a password. Installers have to contact their supplier for the password because of safety.

WARNING	Changing protected/safety parameters should only be conducted by experienced, licensed water heater operators and mechanics. Hazardous burner conditions can happen with improper operations that could result in SUBSTANTIAL PROPERTY LOSS, SERIOUS PHYSICAL INJURY, or DEATH.

Enter the password with the following steps:

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

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

The following menu items also require a password*:

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

14.3.4 DE-AERATION SEQUENCE

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

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

The De-Air sequence can be cancelled by the user by pressing the OK button for min. 5 seconds.

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

14.3.5 LANGUAGE SETTINGS

The display supports the following languages:

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

Table 14.1

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

14.3.6 CHANGE LANGUAGE VIA THE MENU

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

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

Table 14.2

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

14.3.7 CHANGE THE LANGUAGE VIA THE MENU ICONS

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

1. From the Status overview, press the MENU button once.
   Scroll down until the SETTINGS  icon appears on the right-side of the display (and press ENTER):

   In the following menu, press the SETTINGS icon  again (and press ENTER):

   In the following menu screen, select the LANGUAGE icon  (and press ENTER to access the Language menu):

2. 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.

14.4 *Water heater history*

The history found in the information menu displays several history counters that keep track of the water heater usage. The history cannot be erased and will continue for the burner controller life cycle. The following 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).
Operation Days	Number of days 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 14.3

14.5 *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 water heater(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 water heater ID of the water heater on which the error was detected.
The error log can be viewed from the error log menu, which is located in the information menu.

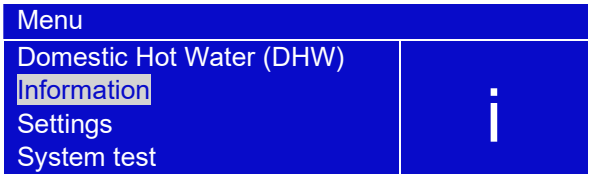


Figure 14.10

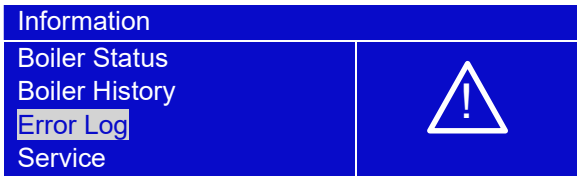


Figure 14.11

Figure 14.12

(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 Water heater ID (Cascade	Filter errors based on Water heater ID (Managing, Dep 1, Dep 2, etc.)
Clear Error Log	Clear the error log (protected by password)

Table 14.4

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 14.13

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

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

14.6 *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 water heater keeps running, but maintenance must be done before resetting this message.

14.6.1 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.

14.6.2 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" go to: menu/ Information/ Service/ "Reset service reminder". Enter the installer password 1122, the "Reset service reminder" can be set to "YES" for resetting the service reminder. The overdue time is recorded in the service history.

14.6.3 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 14.5

14.7 *General*

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

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

Table 14.6

14.7.1 PUMP STARTS EVERY 24 HOURS

To protect the pump from getting stuck at a certain position it is forced to run for 10 seconds every 24 hours. This is done only for the water heater loop pump.

14.7.2 FROST PROTECTION

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

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

When the demand for Frost protection is ended the pumps will post-circulate for DHW_Pump_Overrun.
Parameters are factory set: FP_Start_Pump is set at 50°F (10°C) and FP_Start_Burn is set at 41°F (5°C)

14.7.3 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.
Water heater power limitation:
All water heaters have a flue gas sensor. The control will limit the water heater power when the flue gas temperature reaches the set Max_Flue_Gas_Temp. The maximum water heater power is linearly limited when the flue gas temperature is within Max_Flue_Gas_Temp minus 9 ºF (5 ºC) and Max_Flue_Gas_Temp.
Parameters are factory set

⚠ **WARNING**	Repeated flue gas errors could indicate an issue with the water heater or the exhaust flue venting. If repeated errors occur check the water heater 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 substanial property damage, serious injury, or death.

14.8 *Ignition cycle*

During the ignition cycle multiple safety checks are active

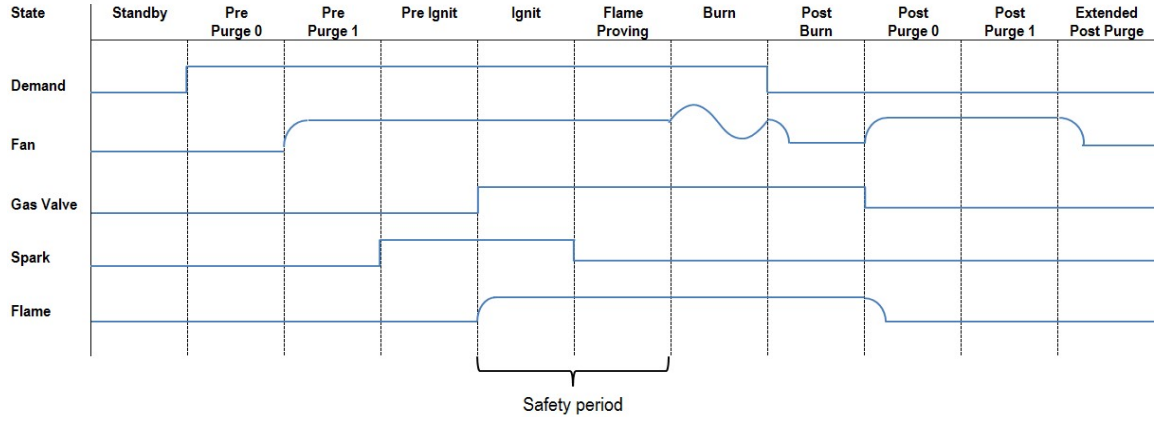


Figure 14.14

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

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

Table 14.7

During the ignition cycle multiple safety checks are active; none of the timing settings are adjustable at the water heater:

False flame detection	If flame is detected at the end of the pre-spark period (*Pre_Ignit*) a lockout error will occur.
Re-ignition	If at the end of the safety period no flame is detected the control will go to *Post_Purge* to remove any unburned gas. After this a re-ignition attempt is started following the same cycle. The number of re-ignition attempts is limited to *Max_Ignit_Trials* after which a lockout occurs.
Flame establishing time	Sparking stops in the *Flame_Proving* state to allow for ionization detection. The *Flame_Proving* state takes *Safety_Period – Ignit_Period*.
Flame out too late	If at the end of the *Post_Purge* 0 state the flame is still detected a lockout follows.
Flame loss	When a flame is lost during a burn cycle the control will restart the burner. The number of restarts is limited by the *Max_Flame_Trials* setting.
Fan supervision	The fan speed is continuously monitored. The following conditions for the fan speed are checked: ▪ The actual fan speed must be within 300 RPM 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 14.8

14.8.1 CONTROL FUNCTIONS

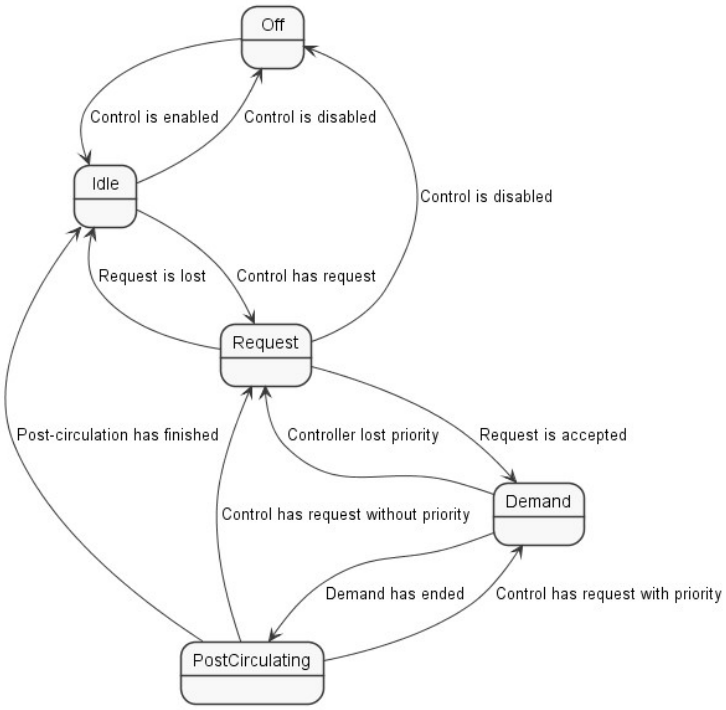


Figure 14.15

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

The demand controls all work according to a defined state machine. The diagram below shows how the controller states are implemented

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

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

Table 14.9

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

900MN

Figure 14.16

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.

14.8.3 FLAME DETECTION

When the water heater is firing, and the flame is not detected anymore, the gas valve will be closed, and the control will perform a post-purge, after which a restart will take place.
When the flame disappears 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. When a flame is present, the free electrons in the flame flow from the flame rod to the earth. This flow of electrons is the flame current.The flame current is measured by the control as ionization in micro amps (µA).

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

14.8.4 FLAME RECOVERY

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

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

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

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

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

Table 14.10

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

14.9 *Demand for Domestic Hot Water*

WARNING

HOT WATER CAN SCALD!

Water temperature over 125ºF 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 on the tank outlet 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.

14.9.1 DHW STORAGE WITH DRY WELL AND SENSOR; DHW MODE 1 (FACTORY DEFAULT SETTING)

Only use DHW mode 1 for a standalone water heater and for a cascaded water heater. Do not use another DHW mode because the water heater will not work properly. Also, the water heater is programmed as managing, and a system sensor is needed besides a DHW sensor. The system sensor is a strap-on sensor connected to the supply pipe close to the storage vessel and the DHW sensor is a tank sensor with dry well in the storage vessel.

When installing the water heater always check what the local water hardness is. Default the water heater is set for a water hardness between 4 and 11 gpg the temperature difference between flow and return of the heater should be maximum 30°F (16.5°C).

The selected pump must have enough pressure to result in a delta T setpoint of maximum 30°F (16.5°C). This shall give the water heater extra efficiency because the water heater stays in the condensing zone of the heat-exchanger if the setpoint storage vessel is below 149°F (65^0C).

Principles to design water heater system:

- If the water hardness is between 4 and 11 gpg (or between 68 and 188 mg/l) the temperature difference between flow and return of the heater should be maximum 30°F (16.5°C)
- If the water hardness is between 11 and 14 gpg (or between 188 and 240 mg/l) the temperature difference between flow and return should be maximum 22.5°F (12.5°C)
- If the water hardness is above 14 gpg (240 mg/l) use a water softener. Also above 11 gpg (188 mg/l) a water softener could be considered, since an installation at 22.5°F (12.5°C) temperature difference will need larger pipes and pumps. After softening, the water hardness should be minimum 4 gpg.

⚠	Notice: the warranty will void if these design requirements are not followed.

It is possible to check if the flow over the heat-exchanger is according to the following:

1. This can be done by changing parameter (136) “Mod. Pump Mode” from “Modulating” to “Fixed 100%” the pump will run now at 100% speed.
2. Open a tapping point for hot water and be sure that the water heater is running at 100% power, now the delta T should be 30°F (16.5°C) or lower for water hardness below 11 gpg and 22.5°F (12.5°C) or lower for above 11 gpg. For determining the delta T read out in the Information menu by selecting heater status. Check the “Flow temperature” minus the “Return Temperature”.
3. If the delta T is within limits change back parameter 136 to “Modulating” if it is not within limit’s replace pump with a larger pump or check if there are any obstructions between the water heater and the storage vessel. Or use a water softener when having a water hardness above 11 gpg. Standard pumps are offered as accessories from Ideal.
4. When using a delta T below 22.5°F (12.5°C) also change parameter (133) “Mod. Pump dT” from 30°F (16.5 °C) to 22.5°F (12.5°C). Also change parameter (137) “Mod. Pump Min Pwr” from 45% to 75%.
5. Check if the water heater works correctly by opening a faucet and flowing a large flow and a small flow.

6. When using a DHW store setpoint above 158°F (70°C) use a fixed setpoint for the pump because the water heater will not condensate at high temperatures. Repeat point 1 and 2 and lower the % until delta T is above 30°F (16.5°C) or 22.5°F (12.5°C) now increase the fixed setpoint by one step (10%). The delta T should be 30°F (16.5°C) or 22.5°F (12.5°C) or smaller depending on water hardness below or above 11 gpg.

	Notice: the warranty will void if these design requirements are not followed.

DHW Mode 1 is also used when cascading water heaters. Set the cascade parameters according to chapter "**17 cascade**". Connect the Dependent water heater(s) and the managing water heater. Attach the strap on sensor (system sensor) to the combined supply of the water heaters and connect this to the managing water heater, also connect the DHW sensor which measures the temperature in the tank to the managing heater.

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 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 water heater is started as well. When the water heater is ON, the power is PID-modulated so T_System is regulated towards DHW_Store_Setpoint plus DHW_Tank_Supply_Extra.

DHW_Tank_Supply_Extra is default set to 0ºF / 0°C because in a direct system the supply temperature of the water is almost the same as the tank temperature.

The water heater 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.

Store warm hold function
Because of the presence of the indirect tank sensor (*T_Store*) the control can detect demand for holding the tank hot. If T_Store drops below (115) DHW_Store_Setpoint minus DHW_Store_Hold_Warm the heater starts at minimum power. DHW_Store_Hold_Warm is factory set at 5.5ºF / 3ºC

If there is a consumption of hot water and the sensor drops below DHW_Store_Setpoint minus DHW_Tank_Hyst_Down the water heater will increase its power and the normal control will be active.

Parameters	Parameter number	Level	Default value	Range
DHW Mode	35	2: Installer	1	0 - 8
DHW Store Setpoint	115	2: Installer	140°F (60°C)	32 - 194°F (0 - 90°C)
DHW Tank Hyst. Down	36	2: Installer	3.5°F (2°C)	0 - 18°F (0 - 10°C)
DHW Tank Hyst. Up	37	2: Installer	5.5°F (3°C)	0 - 18°F (0 - 10°C)
DHW Tank Supply Extra	38	2: Installer	0°F (0°C)	0 - 54°F (0 - 30°C)
DHW Tank Supp Hyst Dn	39	2: Installer	3.5°F (2°C)	0 - 36°F (0 - 20°C)
DHW Tank Supp Hyst Up	40	2: Installer	36°F (20°C)	0 - 36°F (0 - 20°C)
DHW Tank Hold Warm	41	2: installer	5.5°F (3°C)	0 - 18°F (0 - 10°C)
DHW Pump Overrun	44	2: Installer	20 s	0 – 900 s

Table 14.11

Relevant variables

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

Table 14.12

14.9.2 ANTI-LEGIONELLA PROTECTION

Anti-Legionella protection is enabled for DHW modes with an external tank with a sensor. To prevent legionella a special function is implemented in the software.

The Anti-Legionella protection will be checked on the tank 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 heater is forced to heat-up the system for Anti-Legionella. When the tank sensor temperature is below Anti_Legionella_Setpoint the control switches ON the circulators, when the tank sensor temperature is above Anti_Legionella_Setpoint plus 9°F (plus 5°C) the control stops the circulators.

The heater setpoint will be Anti_Legionella_Setpoint plus DHW_Tank_Supply_Extra.

If the supply temperature drops below the heater setpoint the heater is started. The heater is PID controlled towards the Anti_Legionella_Setpoint. When the supply temperature rises above Anti_Legionella_Setpoint plus DHW_Tank_Supp_Hysterese_Up the heater is switched OFF.

When the tank sensor has been above Anti_Legionella_Setpoint minus 5.5°F (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 a temperature of Anti_Legionella_Setpoint (for Anti_Legionella_Burn_Time) within 2 hours, otherwise the heater 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 schedule the next Anti-Legionella cycle.

The Anti-Legionella demand has priority over any DHW 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 DHW demand will be accepted as normal. Below parameters can be set by the installer.

Parameter for installer

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

Table 14.13

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

Parameter	Factory Setting.
Anti_Legionella_Setpoint	158 ºF (60 ºC)
Anti_Legionella_Burn_Time	30 Min.
Anti_Legionella_Wait_Time Wait time for Anti-Legionella demand.	120 min after cold start, 168 h after first successful Anti-Legionella demand

Table 14.14

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 Water temperature < *Anti_Legionella_Setpoint – 5.5°F.*
  - Anti-legionella wait time initialized to 120 [min].
- Anti-legionella enabled AND Water temperature >= *Anti_Legionella_Setpoint – 5.5°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.

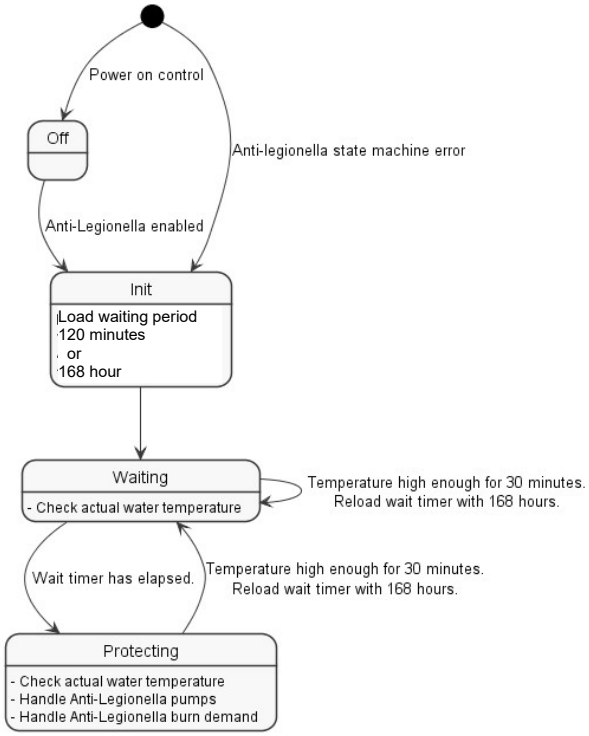


Figure 14.17

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.

⚠ **WARNING**	**Bacteria can develop in the domestic water system if certain minimum water temperatures are not maintained. Failure to maintain at least 140°F [60°C] domestic hot water temperature or use the Antilegionella function can result in bacteria development, which can result in serious injury, or death.**

14.10 *Display menu structure*

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

1. Central Heating (CH)	**min.**	**max.**	**De-fault**	**unit**	**Access level**	**Description:**
1.1 CH Setpoint (par 3)	68 (20)	194 (90)	180 (82)	°F (°C)	User	Set the CH setpoint if CH mode is 0
1.2 Outdoor Reset					Installer	Enter the Outdoor Reset menu if CH mode is 1

1.2 Outdoor reset	**min.**	**max.**	**De-fault**	**unit**	**Access level**	**Description:**
Design Supply Temp. (par. 19)	68 (20)	194 (90)	180 (82)	°F (°C)	Installer	Set CH setpoint when outdoor temperature equals Design Outdoor Temp.
Baseline Supply Temp. (par 21)	68 (20)	194 (90)	120 (49)	°F (°C)	Installer	Set CH setpoint when outdoor temperature equals Baseline Outdoor Temp.
Warm Weather Shutdn (par 25)	32 (0)	95 (35)	95 (35)	°F (°C)	Installer	Set outdoor temperature above which CH demand is locked.
Design Outdoor Temp. (par 20)	-13 (-25)	77 (25)	20 (-7)	°F (°C)	Installer	Set the outdoor temperature at which CH setpoint is set to Design Supply Temp.
Baseline Outdoor Temp. (par 22)	32 (0)	86 (30)	68 (20)	°F (°C)	Installer	Set the outdoor temperature at which CH setpoint is set to Baseline Supply Temp.

2. Domestic Hot Water (DHW)	**min.**	**max.**	**De-fault**	**unit**	**Access level**	**Description:**
DHW Setpoint (par 48)	104 (40)	160 (71)	140 (60)	°F (°C)	Installer	Set the DHW setpoint
DHW Store Setpoint (115)	104 (40)	160 (71)	140 (60)	°F (°C)	User	Set the DHW store setpoint for DHW mode 1 and 2

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

3.1 Software versions	**min.**	**max.**	**De-fault**	**unit**	**Access level**	**Description:**
Display				xxxx xxxx	User	Display the software checksum
Boiler				xxxx xxxx	User	Display the boiler software checksum
Device Group				xxxM N	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					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
Cascade Temperature				°F (°C)	User	Actual casc. flow/supply temp.
0-10 V Input				V	User	Actual 0-10 V input value
Flowrate				l/min	User	Actual DHW flowrate
Gas Pr Sw				open/close	User	Gas pressure switch input
Flow Switch				open/close	User	CH/DHW) Flow switch input
Air Fl Sw				open/close	User	Air pressure switch input
Water Pressure				Bar	User	Actual CH water pressure
Fan Speed				rpm	User	Actual fan speed
Ionization				uA	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	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	Hours remaining until next service
Operation Days				days.	User	Display the total time in operation

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

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

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

4.1.2 unit type	min.	max.	Default	unit	Access level	Description:
Metric (˚C, bar)			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			UTC +00:00		User	Set the time zone correction
Daylight Savings Time			Disabled		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 Digits	1 or 2 dig.	User	Select how the day of month is displayed
Month			Short text		User	Select how the month is displayed
Year			4	2 or 4 dig.	User	Select how the year is displayed
Date Separation Character			“-“		User	Select the date separation character
Day of Week			Short text		User	Select how the day of week is displayed
Seconds			no	yes/no	User	Select if seconds are displayed

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

4.1.5 Other settings	min.	max.	Default	unit	Access level	Description:
Status Overview Settings					User	Configure which information is shown on the Status overview
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			On	Off/On	User	Enable/disable the CH water pressure
State			On	Off/On	User	Enable/disable the burner state
Temperature selection ID			On		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:	Dis-play no:
CH mode	0	5	0	#	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)	122 (50)	68 (20)	°F (°C)	Installer	Set the minimum CH setpoint (0-10V modes)	110
CH Max Setpoint	122 (50)	194 (90)	185 (85)	°F (°C)	Installer	Set the maximum CH setpoint (0-10V modes)	111
Boiler Pump Overrun	0	900	20	sec.	Installer	Set the post-circulation time for the boiler/CH pump	5
CH Hysteresis Up	0 (0)	36 (20)	36 (20)	°F (°C)	Installer	Set the CH hysteresis up	7
CH Hysteresis Down	0 (0)	36 (20)	9 (5)	°F (°C)	Installer	Set the CH hysteresis down	112
Anti-Cycle Period	10	900	10	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 maximum CH burner power	14
Min. Power CH	1	100	1	%	Installer	Set the minimum CH burner power	15
CH PID P	0	1275	20		Installer	Set the PID P factor for CH	16
CH PID I	0	1275	180		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 temp. at which CH setpoint is set to Design Supply T.	20
Baseline Supply Temp	68 (20)	194 (90)	120 (49)	°F (°C)	Installer	Set CH setpoint when outdoor temperature equals Baseline Outd. T.	21
Baseline Outdoor Temp	32 (0)	86 (30)	68 (20)	°F (°C)	Installer	Set the outdoor temp. at which CH setpoint is set to Baseline Supply T.	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	80.6 (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 temp. 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	0	120	30	min.	Installer	The setp. boost function delay time	27
Night Setback Temp.	0 (0)	54 (30)	18 (10)	°F (°C)	Installer	Set the CH night setback temp.	28
DHW Mode	0	8	1	#	Installer	Set the DHW mode	35
DHW Tank Hyst. Down	0 (0)	36 (20)	3.6 (2)	°F (°C)	Installer	Set the DHW tank hysteresis down	36
DHW Tank Hyst. Up	0 (0)	36 (20)	5.4 (3)	°F (°C)	Installer	Set the DHW tank hysteresis up	37
DHW Tank Supply Extra	0 (0)	54 (30)	0 (0)	°F (°C)	Installer	Set the DHW tank supply setpoint offset	38
DHW Tank Supp Hyst Dn	0 (0)	36 (20)	3.6 (2)	°F (°C)	Installer	Set the DHW tank supply hysteresis down	39
DHW Tank Supp Hyst Up	0 (0)	36 (20)	36 (20)	°F (°C)	Installer	Set the DHW tank supply hysteresis up	40
DHW Tank Hold Warm	0 (0)	18 (10)	5 (3)	ºF (ºC)	Installer	Set the Tank Hold Warm offset down	41
DHW Priority	0	2	On	0-2	Installer	Set the DHW priority mode	42
DHW Max. Priority Time	1	255	60	min.	Installer	Set the maximum DHW priority time	43
DHW Pump Overrun	0	900	20	sec.	Installer	Set the DHW post-circulation time	44
DHW Tank PID P	0	1275	60		Installer	Set the DHW tank PID P factor	45
DHW Tank PID I	0	1275	180		Installer	Set the DHW tank PID I factor	46

cont.: 4.2.1 Boiler parameters	min.	max.	Default	unit	Access level	Description:	Dis-play no:
DHW Setpoint	102 (39)	158 (70)	140 (60)	°F (°C)	Installer	Set the DHW setpoint	48
DHW Store Setpoint	32 (0)	194 (90)	140 (60)	°F (°C)	Installer	Set the DHW storage setpoint	115
DHW Hysteresis Down	0 (0)	36 (20)	5.4 (3)	°F (°C)	Installer	Set the DHW hysteresis down	49
DHW Hysteresis Up	3.6 (2)	36 (20)	5.4 (3)	°F (°C)	Installer	Set the DHW hysteresis up	50
DHW Instant PID P	0	1275	400		Installer	DHW instantaneous PID P factor	51
DHW Instant PID I	0	1275	1200		Installer	DHW instantaneous PID I factor	52
DHW On Off Period	10	60	10	sec.	Installer	Set the on/off modulation period	63
PreHeat mode	on	off	off	-	User	Set the PreHeat Eco mode	64
PreHeat Eco Setpoint	32 (0)	176 (80)	86 (30)	°F (°C)	Installer	Set the PreHeat Eco setpoint	65
DHW Max. Limit	32 (0)	194 (90)	185 (85)	°F (°C)	Installer	Limiting DHW setpoint max.	91
DHW Min. Limit	68 (20)	122 (50)	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)	28.8 (16)	°F (°C)	Installer	Set the modulating pump target delta temperature	133
Mod. Pump Start Time	0	255	60	sec.	Installer	Modulating pump start up time	134
Mod. Pump Type			Linear in-verse		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			30	%	Installer	Set the modulating pump mini-mum duty cycle	137
Appliance Type	50	55	dep unit	#	Installer	Set the appliance type	138
Dair active	0	2	1: Enable	-	Installer	Enable/disable 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-le-gionella cycle	107
Anti Legionella Hour	0	23	0	hrs.	Installer	Select the time for the anti-le-gionella cycle	108
Frost Protection			Enabled	Ena/Dis	Installer	Switch Frost protection on/off	205
Anti Legionella			Enabled	Ena/Dis	Installer	Anti Legionella protection on/off	206
DHW Detection Delay	0	255	0		Installer	Sets the detection delay.	207

4.2.2 Module Cascade Settings	min.	max.	Default	unit	Access level	Description:	Display no:
Burner Address			Managing		Installer	Set the cascade burner address	184
Permit Emergency Mode			Yes	Yes/No	Installer	Enable/disable the cascade emergency mode	72
Emergency Setpoint	68 (20)	194 (90)	122 (50)	°F (°C)	Installer	Set the emergency mode setpoint	74
Delay Per Start Next Mod.	0	1275	60	sec.	Installer	Set the delay time before the next module is started	75
Delay Per Stop Next Mod.	0	1275	30	sec.	Installer	Set the delay time before the next module is stopped	76
Delay Quick Start Next	0	1275	30	sec.	Installer	Set the fast delay time before the next module is started	142
Delay Quick Stop Next	0	1275	15	sec.	Installer	Set the fast delay time before the next module is stopped	143
Hyst. Down Start Module	0 (0)	72 (40)	9 (5)	°F (°C)	Installer	Set the hysteresis down after which a module is started	77
Hyst. Up Stop Module	0 (0)	72 (40)	21.6 (12)	°F (°C)	Installer	Set the hysteresis up after which a module is stopped	78
Hyst. Down Quick Start	0 (0)	72 (40)	14.4 (8)	°F (°C)	Installer	Set the fast hysteresis down after which a module is started	144
Hyst. Up Quick Stop	0 (0)	72 (40)	25.2 (14)	°F (°C)	Installer	Set the fast hysteresis up after which a module is stopped	145
Hyst. Up Stop All	0 (0)	108 (60)	28.8 (16)	°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	1	#	Installer	Set the power mode	148
Max. Setp. Offset Down	0 (0)	36 (20)	2 (1)	°F (°C)	Installer	Set the maximum setpoint offset down	79
Max. Setp. Offset Up	0 (0)	36 (20)	2 (1)	°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	10	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 min. 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

⚠	Parameters for cascading are found in the **Module Cascade Settings** menu, submenu of the Boiler settings menu**.** Parameters in the **Boiler Cascade Settings** menu should **not** be used.

4.2.3 Boiler Cascade Settings	min.	max.	Default	unit	Access level	Description:	Dis-play no:
Boiler Address			stand alone		Installer	Set the cascade boiler address	73
Permit Emergency Mode	0	1	yes	Yes/No	Installer	Enable/disable the cascade emergency mode	156
Emergency Setpoint	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)	7.2 (4)	°F (°C)	Installer	Set the fast hysteresis up after which a boiler is stopped	165
Hyst. Up Stop All	0 (0)	108 (60)	14.4 (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 ex-pected 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 to min. 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 CO2 level's)
Fan speed			xxxx	rpm	installer	read out fan speed
Ionization			x.x	µA	installer	read out flame signal

Table 14.15

15 TEMPERATURE PROTECTION

The difference between Supply temperature and Inlet Temperature is continuously monitored. Too large of a difference can indicate a defective pump or a clogged heat exchanger. To protect the water heater, the burner controller reduces the input when the temperature difference ΔT becomes too high:

At maximum water heater input ΔT is limited to 32°F (18°C) = (*Hx_Diff_DeltaT_Max)*

In between 32°F (18°C) and 47°F (26°C) water heater input modulates between minimum and maximum.

At minimum water heater input ΔT is limited to 47°F (26°C)

Above ΔT = 56°F (31°C), the water heater is blocked until ΔT is smaller than *Hx_Diff_DeltaT_Max* again.

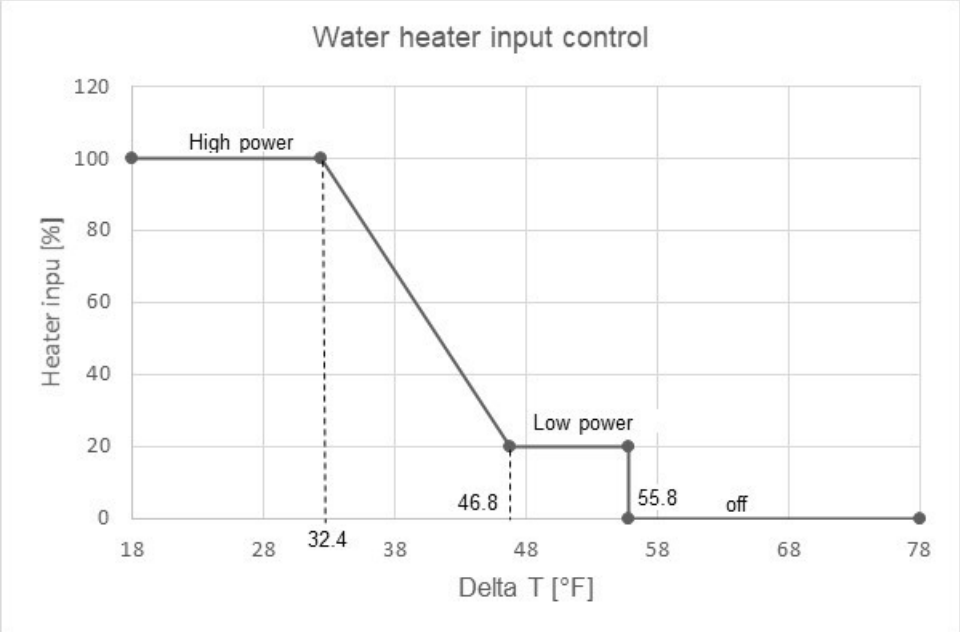


Figure 15.1

16 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 the error is gone)
• Warnings (will disappear when the warning is gone, not stored in the BCU)

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

16.1 *Water heater history.*

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

- Successful ignitions
- Failed Ignitions
- Flame Failures
- Anti-legionella count
- Total system run time
- CH Burner Hours
- DHW Burner Hours

16.2 *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, faulty position igniter	check gas supply and adjust gas valve, reset BCU, check distance between igniter and burner
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	out dated 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 pump and waterflow and replace pump 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.
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 water heater
22	Too Many Flame Failures	Three time flame lost during 1 demand	bad gas supply or O_2 level is not correct or bad ignition rod	check gas supply pressure, check O_2 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 to many filing attempts	Check if there is a leak in the central heating system or if the water heater it self is leaking also check expansion vessel on internal leak
28	Fill Time Error	Filling takes too long	If output is programmed as filing valve and filling takes more than 10 minutes	Check if there is a leak in the central heating system or if the water heater it self is leaking also check expansion vessel on internal leak
29	PSM Error	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and / or display unit
30	Register Error	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and / or display unit
32	T. Exchange Diff Error	The 2nd 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 or wire bridge loose	Check if gas pressure is in limits of the gas pressure switch. If no switch check wire bridge..

Table 16.1

16.3 *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 over heat exchanger	Check functioning of the pump. Check/open all valves that might restrict the water flow through the unit. Check for an external system pump that influences flow through the unit. Check if the system resistance exceeds the spare capacity of the unit pump.
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 water heater	Check earthing of BCU and water heater
116	Low Water Pressure Sensor	Low water pressure, generated when the pressure drops below minimal_Pressure, or when the pressure drops below 0.3 bar / 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	wrongly 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 Or Cascade System: Depending water heaters parameter 35 “DHW Mode” not changed to 0	malfunctioning DHW sensor or not connected	check connection to BCU or check resistance NTC sensor OR Modify parameter 35 (DHW Mode) to 0 of depending water heaters only
123	T Flue Open	Flue sensor open	malfunctioning flue sensor or not connected	check connection to BCU or check resistance NTC sensor

Blocking code	Error	Description	Cause	Solving
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 too many times by user or installer	wait or disconnect and reconnect power supply
136	T_Exchange Block Error	Exchange temperature exceeded 194 ºF (90 ºC).	water temperature is above 194 ºF (90 °C).	Check pump functioning. Check/open all valves that might restrict water flow through the unit. Check external system pump(s) that influences flow through the unit. Check if the system resistance exceeds the spare capacity of the unit pump.
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 pump. Check/open all valves that might restrict the water flow through the unit. Check for an external system pump that influences flow through the unit. Check if the system resistance exceeds the spare capacity of the unit pump.
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	Defect sensor or bad cabling	Check sensors and cables

Table 16.2

16.4 *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 water heaters is interrupted or wiring is broken	Check wiring between water heater or distance between water heaters is too big. Check cascade parameter 147 at the managing water heater.
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 water heaters is interrupted or wiring is broken	Check wiring between water heater or distance between water heaters is to big. Check cascade parameters at the water heaters.
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	ΔT (T_Supply – T_Return) is too high	Check if the pump is running, and check heat exchanger for dark coloured coils

Table 16.3

17 CASCADING

17.1 *System setup*

NOTE: for proper functioning of the system, some settings have to be changed, see § 17.5.2 "Emergency mode".

The water heater controller can control multiple water heaters in a cascade setup.
The sensors (DHW sensor and system sensor) are equal to a stand alone water heater and should only be connected to the managing water heater.
Each unit needs its own separate pump, so no additional pumps are needed. The system sensor is connected to the managing water heater and calculates the domestic hot water setpoint for the cascade system.

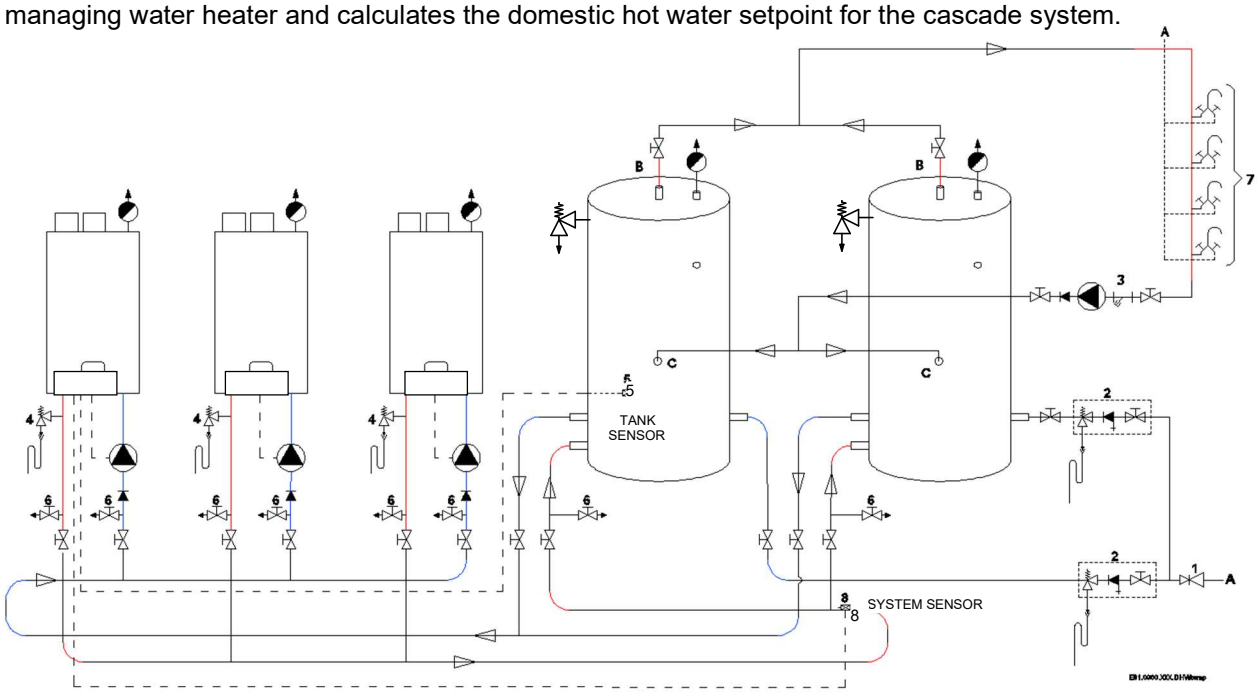


Figure 17.1

	PUMP
	NON- RETURN VALVE
	VALVE
	PRESSURE RELIEF VALVE
	AUTOMATIC AIR VENT
	FILTER
4	INLET COMBINATION - Overflow - Controllable return valve - Valve
	PRESSURE REDUCING VALVE

Explanation:

1) Pressure reducing valve (mandatory in case water pressure is too high)
2) Inlet combination with valve (mandatory)
3) Apply filter if necessary (recommended)
4) A pressure relief valve is supplied by the factory with every water heater. It must be mounted on the hot water outlet(supply) side of the water heater.
   This relief valve shall never be isolated from the water heater by means of a ball valve
5) Mount the tank sensor in the factory supplied dry well into the tank at 1/5 from the bottom of the tank and mount the system sensor onto the supply pipe as shown in the figure. [2, 3]
6) Drain valve (required for service of the appliance)
7) Hot and cold-water faucets
8) Mount the (strap-on) system sensor to the pipe close to the T-piece of the last tank as shown in the figure. This sensor measures the supply temperature from the cascade of water heaters.

A) Cold water inlet (service pipe)
B) DHW supply
C) DHW recirculation

Notes:

- Connections on the water heater side should **always** be executed as drawn in the picture above.
- [1] *Always apply safety components according to all applicable regulations.*
- [3] In case of more than one tank, mount the tank sensor in one of the tanks. The temperature of this tank will be assumed to be representative for all, provided that the installation design is correct.
- In the inlet (return) connection of the water heater no check valve is recommended.
- If needed, the water heater control can handle up to sixteen water heaters.
- For large capacity installations consult your supplier.

17.2 *Quick-guide cascade set-up*

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

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

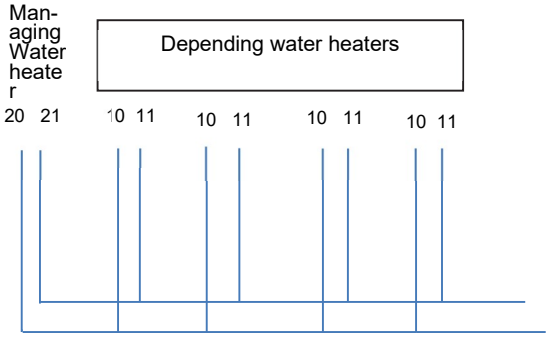


Figure 17.2

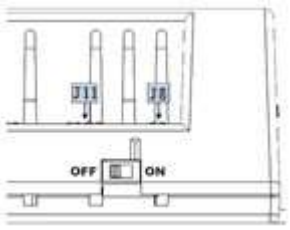


Figure 17.3

2. **Set the switch “bus power on” at the side of the water heater control to the off position.**
   Note the line of the bottom of the water heater control on above picture to determine the off position.

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

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

5. **Change parameter 35 “DHW Mode” of depending water heaters only.**
   Parameter: Menu - Settings - Boiler settings – Boiler Parameters - Parameter 35 (DHW Mode)
   Check that DHW Mode is 1 for the managing water heater. Set Mode to 0 for depending water heaters only. This causes a crossed-out tap symbol at the normal display of the dependents. If this setting is forgotten the message MN:DHW Sensor Open appears.

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

7. **Switch all water heaters off. After that, start them all up again**
   To activate the communication between managing and dependent heaters these need to be restarted.

8. **Deactivate de-air on managing water heater only after de-airing the water heater and system**
   Parameter: Menu - Settings - Boiler settings - Boiler parameters - Parameter 139 (Dair active)
   On managing water heater: set to 0 (Disable)

17.3 *Water heater cascade communication setup.*

In order for the system to work for cascade the communication busses must be parallel linked together. The managing water heater uses the AL-bus connection 20-21 for the cascade. The depending water heaters must be connected to the managing water heater on the 10-11 connection terminals.
It is important that the power on the 10-11 connection terminals on all dependent water heaters is switched to the OFF position. (see also §16.2.1) All water heaters in the cascade system must have a unique address selected. Before commissioning a cascade installation, a number of parameters have to be changed.
These parameters can be programmed on the unit itself.

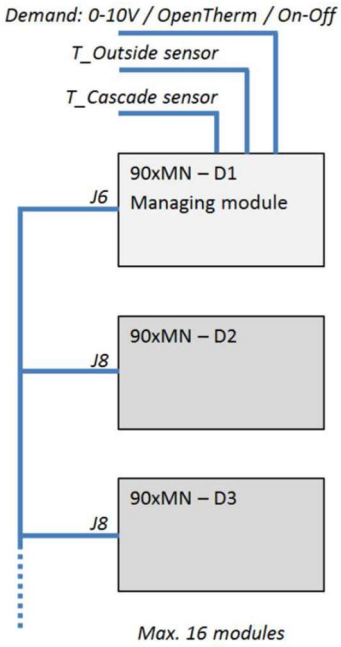


Figure 17.4

WARNING	Changes in parameter may only be carried out by a skilled commissioning/service engineer, who has had specific training for setting up the HW range water heaters. 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 should **NOT** be used.

17.3.1 SETTING THE WATER HEATER ADDRESS

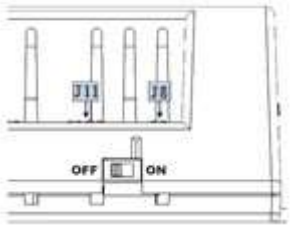
NOTICE

Address rules

The cascade managing address (parameter 184) must be set to 'Managing' on the managing water heater.
The cascade depending addresses (parameter 184) must be set in a logical numbered order from 1= Dep. 2, 2= Dep. 3 etc. on the depending water heaters.
The total number of water heaters in the cascade must be stored in parameter 147 on the managing water heater.

When the number of water heaters 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 water heater 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 water heaters are all parallel connected on terminals 10-11 to the managing water heater communication bus.



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

Figure 17.5

17.3.2 SETTING 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.

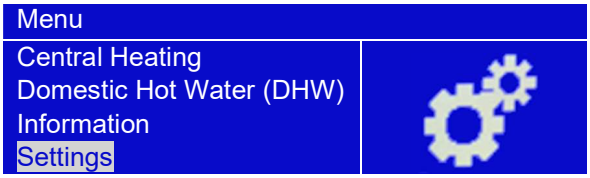


Figure 17.6

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

Figure 17.7

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

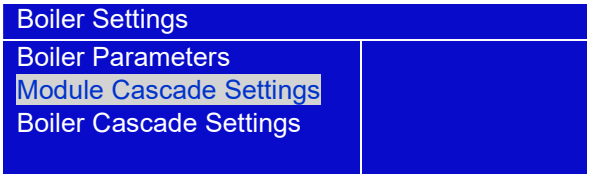


Figure 17.8

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

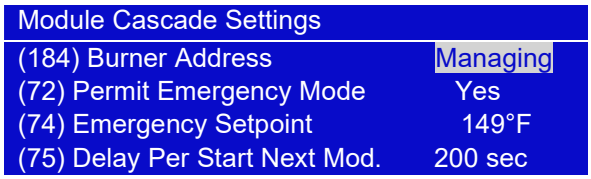


Figure 17.9

Heater address	Heater Operation	Function of sensor input terminal 3-4 No func-
Stand-alone	Not possible	tion
Managing	1st water heater (**managing**)	System sensor
2	2nd water heater (depending)	No function
3	3rd water heater (depending)	No function
4	4th water heater (depending)	No function
↓	↓	
16	16th water heater (depending)	No function

Table 17.1

Select never “Stand alone” with a water heater. The water heater will not function right. A single water heater must be configured to Managing.

5. Now select in parameter 147 of the managing water heater how many water heaters (units) are in the cascade

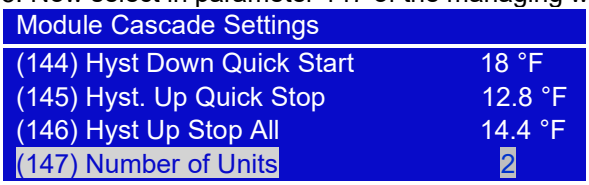


Figure 17.10

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

17.3.3 CASCADE – WATER HEATERS

Managing water heater
When a water heater is set as Managing (Address = 1), the controller of this water heater will control the cascade. The DHW mode of this managing water heater applies to all other water heaters. The DHW mode of the managing water heater is factory set at 1, and must not be changed.

- The system sensor (T_System) connected to the managing water heater will be the control sensor for the cascade supply temperature.

Based on the system temperature (T_System) and the requested Cascade_Setpoint the managing water heater calculates a required water heater setpoint, to achieve the requested Cascade_Setpoint.

The managing water heater provides the calculated setpoint to all dependent water heaters. The modulating power of the dependent water heaters is PID controlled based on the calculated setpoint and dependent water heater supply temperature.

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

Dependent Water Heater
The DHW mode for the cascade is defined by the setting of the managing boiler. DHW 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.
SET parameter 35 to Mode 0 of depending water heaters only, “Menu-Settings-Boiler Settings-Boiler Parameters- Parameter “35 DHW Mode” This causes a crossed-out tap symbol at the display screen. If this setting is forgotten the message MN:DHW Sensor Open appears.

Water heater input Rates
A cascade system operates most effective and efficiently when all of the water heaters in the system are the same type. (so all WH 299W e.g.)

17.3.4 CASCADE – START/STOP SEQUENCE

The managing water heater sends the calculated Cascade_Setpoint to the dependent water heaters. The power of the water heaters is PID controlled based on the Calculated_Setpoint and T_Supply. Depending on the temperature difference between T_System and Cascade_Setpoint the dependent water heaters will start or stop using different algorithms.

Quick Starting and Stopping Water heaters
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.

17.3.5 CASCADE – POWER BALANCE MODE

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

17.4 *Cascade – Water heater rotation*

The water heater rotation function can change the start/stop sequence for the cascade water heaters.
The parameter Module_Rotation_Interval sets the number of days after which the sequence is updated. When Module_Rotation_Interval is set to 0 water heater rotation is disabled.
When the parameter Module_Rotation_Interval is updated the water heater 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 water heater):

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 17.2

With parameter First_Module_To_Start the current water heater that is first to start in the sequence is selected.
When the water heaters are rotated the parameter First_Module_To_Start is automatically updated to the next water heater. When water heater 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.

17.4.1 FIRST MODULE TO START SELECTION

When the cascade 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 depending control is available when the control is present on the communication bus and the control is not blocked by an error.

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

Relevant variables

Specific Parameters	Parameter no.	Level	(Default) Value	Range
Module_Rotation_Interval	Module cascade settings: 84	2: Installer	5	0…30 (0: Disabled)
First_Module_To_Start	Module cascade settings: 149	2: Installer	1	1…8/16

Table 17.3

17.5 *Cascade Error handling*

17.5.1 CASCADE FROST PROTECTION

Frost protection on a cascade is active on two levels

1. Frost protection for cascade

The 'frost protection' function for a cascade is related to the water heater sensor temperatures.
When the supply / Inlet temperatures of the managing water heater are below:

Spec. Parameter	Parameter no.		Default value	Range
Frost Protection	Module cascade settings: 155		50ºF (10°C)	50 - 86ºF (10 - 30°C)
Frost Protection minus 9°F (5°C)		Cascade heat demand is activated; the pumps of all the cascaded water heaters will be started.	50 minus 9 = 41°F	

Table 17.4

2. Frost protection on water heater

As a last level of protection the controllers for the water heaters can force themselves to burn.

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

Specific Parameters	Parameter no.	Level	(Default) Value	Range
Frost protection Temperature for frost protection	Boiler settings Parameter 205	2: Installer	Enable	Enable / Disable

Table 17.5

17.5.2 EMERGENCY MODE

Managing water heater error
When the managing water heater is in error mode, the depending water heaters 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 water heaters start burning on this setpoint.

NOTE: the default setting is 122°F (50°C)! Make sure the right temperature is set.

Specific Parameters	Parameter no.	Level	(Default) Value	Range
Permit Emergency Mode	Module Cascade parameter 72	Installer	Yes	Yes/No
Emergency Setpoint	Module Cascade parameter 74	Installer	122 ºF (50ºC)	68 - 194°F (20 - 90°C)
Dair active	Boiler parameter 139	Installer	1	0 - 2

Table 17.6

For proper functioning of this emergency mode, the following settings are necessary in the managing water heater (installer password required):
- Module Cascade parameter no. 72: "Permit_Emergency_Mode" has to be set on "yes".
- Module Cascade parameter no. 74: "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 water heaters!

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

17.5.3 LOSS OF CASCADE COMMUNICATION

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

17.5.4 MANAGING WATER HEATER ERROR

When the managing water heater is in error mode this water heater is not used anymore for the cascade system. However depending on the error code, the pumps connected to the managing water heater still can be active for the cascade system. When the managing unit is reset from lockout state, the cascade controllers are re-initialized.

18 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 water heater can be started without CH or DHW demand 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 water heater
2	Low power	The water heater starts and after the ignition period has finished the water heater stays at low power
3	Ignition power	The water heater starts and stays at ignition power
4	High power	The water heater starts and after the ignition period has finished the water heater stays at high power
5	High power limited	The water heater starts and after the ignition period has finished the water heater stays at high power limited by the parameter *CH_ max_ power*
6	High limit error test	Simulates the *Max_Temp_Error*
7	Low water cut off 1 error test	Simulates the *LWCO_1_ Error*
8	Low water cut off 2 error test	Simulates the *LWCO_2_ Error*

Table 18.1

Figure 18.1

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

During the system test the water heater and system pump will be ON.
As the water heater 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. When the system test mode is set to zero, the system will continue with normal demand handling.

WARNING	During the system test ensure any faucet or drain that is open is monitored and not left unattended. Ensure any hoses that are used to drain the hot water are rated for temperatures of 200F. Do not use standard garden hoses to drain hot water. Water temperatures over 125ºF (52ºC) can cause severe burns instantly or death from scalds

19 COMMISSIONING THE WATER HEATER

19.1 *First: flushing the water heater with water*

After installation of the water heater the first step, before commissioning, is to flush the water heater and the whole installation with fresh water to remove pollution, debris and other materials that might cause a blocking. This must also be done with installations, where only the water heater is replaced.

19.2 *Second: filling & venting the water heater and the system*

After flushing the water heater and the installation the system can be filled with fresh water.
The water heater has an automatic air vent situated inside the water heater. 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 no water can enter the water heater and make contact with the electrical parts.

NOTICE	Make sure the water quality complies with the water quality section of the manual § 8.8

19.3 *Third: check the water flow*

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

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

19.4 *Mounting Condensate Trap*

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

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

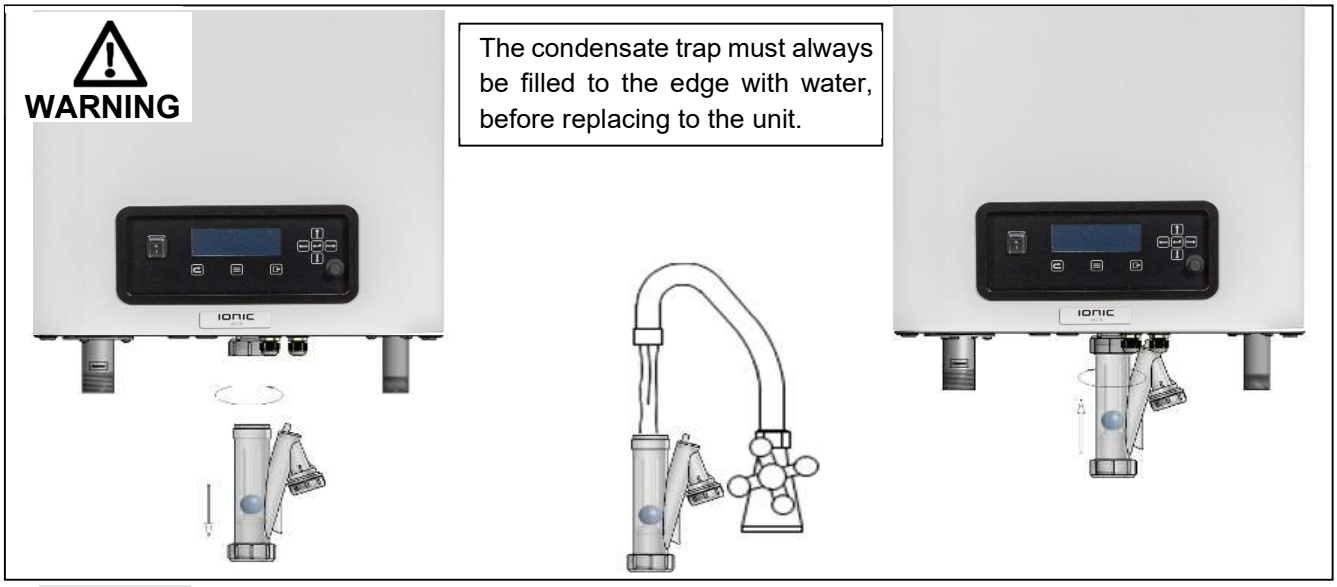


Figure 19.1

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

19.5 *Checking gas pressure*

Check the gas pressure available at the gas connection pipe of the water heater. Use the pressure nipple [3] of the gas safety valve for this measurement. Figure 20.1 shows the position of the pressure nipple [3]

Min. and max. gas supply pressures:

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

Table 19.1

19.6 *Firing for the first time*

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

Figure 19.2

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 19.3

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 8 minutes to complete. It can be cancelled by pressing the Enter button for over 5 seconds.

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

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

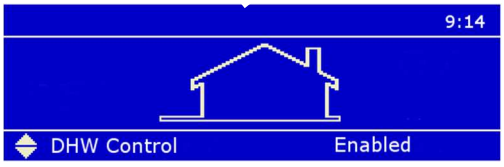


Figure 19.4

The display describes:

- The actual operation for hot water
- The temperature setting

20 ADJUSTING AND SETTING THE WATER HEATER

WARNING	Before carrying out any adjusting of the burner, carefully read this complete chapter. The initial lighting of the appliance must be performed by a licensed Gas Technician. Failure to follow these instructions may result in property damage, serious injury or death. As soon as the appliance has been fully installed (with regard to hydraulics, filling and de-aeration of installation, gas, flue gas, air intake, wiring etc.) according to the preliminary installation instructions, the water heater may then be wired to an electrically grounded power supply source. The water heater should always be connected to a disconnect or external power shut off. The water heater must be electrically bonded to the ground in accordance with the requirements of the local authority having jurisdiction or, in the absence of such requirements, the National Electrical Code, ANSI/NFPA 70, and or/the Canadian Electrical Code Part I, CSA C22.1 Electrical Code. **The water heater should be adjusted using O_2 values. CO_2 values are only used as a reference**

20.1 *Introduction*

The water heater must always be adjusted in the next situations:

- A new water heater is installed
- As part of a service/maintenance check, in case the O_2 values turns out to be incorrect.
- The gas valve has been (re)placed.
- Gas conversion to propane. Prior to adjustments, follow the procedure in 20.5
- The venturi has been replaced. Prior to adjustments, follow the procedure in 20.4
- The fan has been replaced
- The flue gas check valve has been replaced

In any of the cases described, always check the gas/air ratio of the combustion (O_2 / CO_2) at maximum and minimum input. **First set the water heater 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 tables 20.1 or 20.2. A drawing of the gas valve(s) and setting screws is given in § 20.1.3. In § 20.2 a general procedure, conform which the adjustments must be carried out, is presented. § 20.4 describes the specific adjustments to be made when the venturi is replaced, and § 20.5 describes the changes needed when the gas type is set to propane.

20.1.1 COMBUSTION TABLE

Table: O_2 / CO_2 values for maximum and minimum load. [1)]

Gas type	Water heater type	O_2 / CO_2 [%]	O_2 / CO_2 [%]
		High Fire	Low Fire
natural gas	WH 299W, WH 399W, WH 499W	4.7 / 9.2	4.7 / 9.2
	WH 470W[2)]	5.3 / 8.8	5.3 / 8.8
propane[2)3)]	WH 299W, WH 399W, WH 470W, WH 499W	5.0 / 10.4	6.4 / 9.5
Allowed tolerances are O_2 ± 0.2 and CO_2 ± 0.1 1) All values measured without front door. 2) The WH 470W has NOx values < 20 ppm at 3%O_2 with these settings. 3) For propane gas: a conversion kit (orifice) has to be mounted, see § 20.5 4) For propane gas: Parameter 92 and 93 (fan speed) must be changed, see § 20.5			

Table 20.1

WARNING	During the system test ensure any faucet or drain that is open is monitored and not left unattended. Ensure any hoses that are used to drain the hot water are rated for temperatures of 200F. Do not use standard garden hoses to drain hot water. Water temperatures over 125ºF (52ºC) can cause severe burns instantly or death from scalds

20.1.2 COMBUSTION TABLE LOW NOX

Table: O_2 / CO_2 values for maximum and minimum load, where NOx values are less than 20 ppm at 3% O_2. [1)]

gas type	Water heater type	O_2 / CO_2 [%]	O_2 / CO_2 [%]
		High Fire	Low Fire
natural gas	WH 299W, WH 399W	5.3 / 8.8	5.3 / 8.8

Allowed tolerances are O_2 ± 0.2 and CO_2 ± 0.1
1) All values measured without front door.

REMARK: The water heaters will be derated with these settings. To compensate, maximum fan speed can be set to a higher value. The minimum fanspeed does not deed to be changed for Low NOx.

Table 20.2

20.1.3 SETTING SCREWS VENTURI- AND GAS VALVES: DRAWINGS

Location of the setting screws:

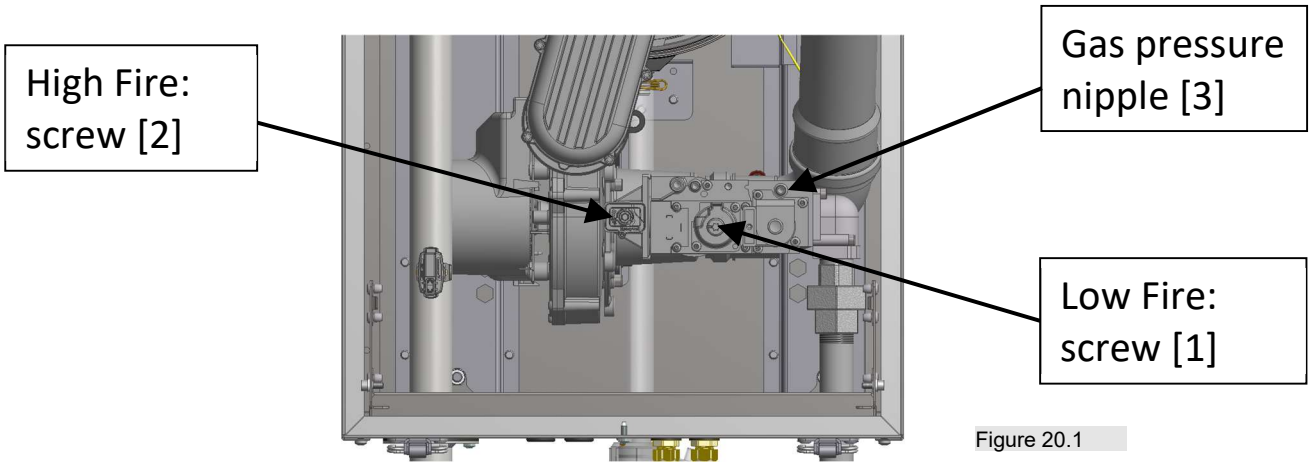


Figure 20.1

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

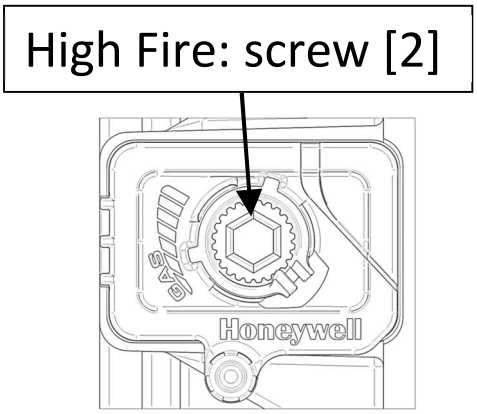


Figure 20.2

Low Fire: gas valve adjustment screw: Torx T40.

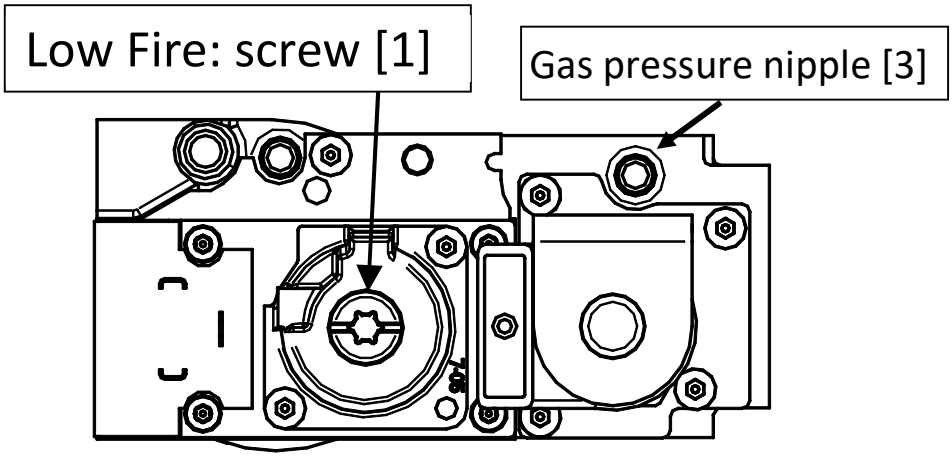


Figure 20.3

20.2 *O_2 Adjustment procedures*

Procedure 1: adjust at High Fire

Carry out the next steps:

1. From status screen, press MENU ☰ .→"Central Heating/ Information/ Settings/ System Test"
2. Press UP/DOWN ↑↓ to select "System Test" Press CONFIRM ↵
3. Password needed to continue
4. Press CONFIRM ↵ to activate the test state. → "Test State: **Off**"
5. Press UP/DOWN ↑↓ multiple times to select "High Power" → "Test State: **High Power**".
   The water heater becomes active, after about 10 seconds, the water heater burns at high fire.
   If the water heater doesn't start, open screw [2] two turns extra - clockwise
   Note: once test state is active, it is not necessary to press a button, selecting the desired power is sufficient.
   Wait a moment for the water heater to stabilize before taking combustion readings between changes and adjustments to the combustion. For your information, "Fan speed" and "Ionization" are displayed.
6. Measure the O_2 percentage at the flue gas test port on the vent connection.
7. By setting screw [2], adjust the gas valve to obtain the O_2 value of table 20.1 or 20.2.
8. To return to the status screen, and stop the water heater, press ESCAPE ⎋ or MENU ☰ 3 times, or RESET ↺ once.

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

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

Procedure 2: adjust at Low Fire

Carry out the next steps:

1. Press UP/DOWN ↑↓ multiple times to select "Low Power" → "Test State: **Low Power**".
   After about 10 seconds, the water heater burns at low fire.
2. Wait a moment for the water heater to stabilize before taking combustion readings.
3. Measure the O_2 percentage at the flue gas test port on the vent connection.
4. By setting screw [1], adjust the gas valve to obtain the O_2 value of table 20.1 or 20.2.

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

5. To return to the status screen, and stop the water heater, 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 20.1 or 20.2 values best

20.3 *Safety shutoff test*

The standard requires testing of the ignition system safety shutoff device. To do this, put the water heater in operation. Now remove the ignition plug that is connected to the igniter. Once removed the water heater 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 water heater controller will now reset to be ready for operation.

Figure 20.4

20.4 *Venturi Replacement Adjustment*

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

- 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:

Water heater type	Number of turns ↶
WH 299W	56
WH 399W	40
WH 470W/WH 499W	36

Table 20.3

After this, perform adjustments according to § 20.2.

20.5 *Conversion from natural gas to propane gas*

⚠ **WARNING**	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. Before starting conversion: close the gas supply and switch off the electrical power!

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

Required parts: (see § 6.2 Accessories)
Propane kit for VMS Venturi hole Ø 6.2 WH 299W
Propane kit for VMS Venturi hole Ø 6.7 WH 399W
Propane kit for VMS Venturi hole Ø 7.2 WH 470W / WH 499W

Table 20.4

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

1. Mount the orifice
2. Set parameter 92 and 93 (fan speed)
3. Check the gas pressure
4. Adjust the O_2 / CO_2 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 an orifice between gas valve and venturi. By using the correct orifice size (see table), the measured O_2 percentage in the flue gas will already be close to the desired value.

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

1. Close the external gas shutoff valve and disconnect the electrical power before opening the water heater.
2. Use a wrench to open the coupling in the gas line in the water heater. The three screws, with which the venturi is mounted onto the fan, can now be removed.
3. Venturi and gas valve can now be separated. The orifice is to be placed between venturi and gas valve. The rounded side of the orifice must be on the side of the gas valve. The orifice must be mounted into the gas entrance of the venturi and secured with the rubber gasket.
4. Venturi and gas valve can now be reconnected.
5. Remount the gas valve and the venturi onto the fan. Reassemble the coupling in the internal gas line.
6. 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.

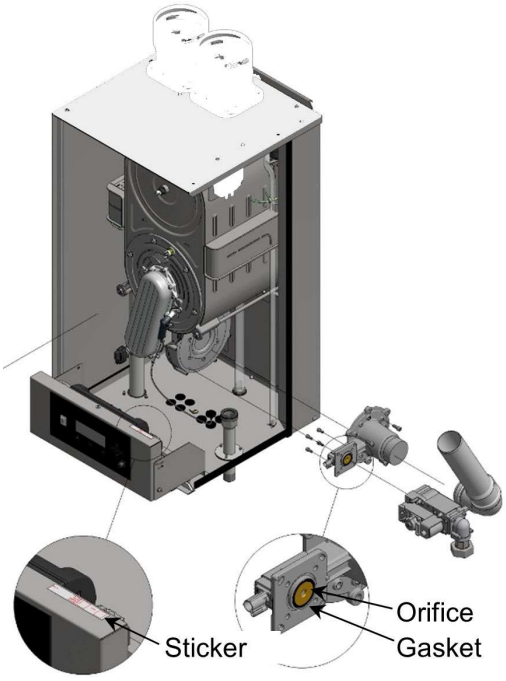


Figure 20.5

2. Set fan speed

The fan speed must be changed in the software of the water heater according to the tables below:.

Water heater type	fan speed high fire parameter 92		Fan speed low fire parameter 93	
	Propane	Nat. gas	Propane	Nat. gas
WH 299W	5950	6200	1450	1450
WH 399W	6450	6600	1550	1550
WH 470W	7250	7400	1750	1650
WH 499W	7850	8000	1750	1650

Table 20.5

1. From status screen, press MENU button once.
2. Press UP/DOWN ↑ ↓ to select "Settings" and press ENTER ↵
3. Press UP/DOWN ↑ ↓ to select "Water heater Settings" and press ENTER ↵
4. Enter installer password '1122' by pressing UP/DOWN ↑ ↓ and LEFT ← / RIGHT →.
5. Press UP/DOWN ↑ ↓ to select "Water heater parameters" and press ENTER ↵
6. Press UP/DOWN ↑ ↓ to select parameter "(92) Fan Speed Maximum" and press ENTER ↵
7. Press UP/DOWN ↑ ↓ to adapt the fan speed according to the table and press ENTER ↵
8. Press UP/DOWN ↑ ↓ to select parameter "(93) Fan Speed Minimum" and press ENTER ↵
9. Press UP/DOWN ↑ ↓ to adapt the fan speed according to the table and press ENTER ↵

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

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

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

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 gas appliances in the room the gas pressure should be checked on the appliance at the end of the gas line, with all appliances burning at high fire. If the gas pressure is too low, check gas lines, reducers and propane tank.

4. Adjust the O_2 / CO_2 percentage

Perform O_2 / CO_2 adjustments according to the procedures in § 20.2, using the values in table 20.1.

5. Confirmation

When finished:
- Apply the corresponding sticker at the appropriate position in the heater.
- Mark the box "Propane" for the used gas type.
- Mark the box "Type", indicating that the correct parameter values have been set for this heater type.

Figure 20.6

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

20.6 *Start Up Checklist*

Installation/start-up checklist

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

Site information	
Site name	
Site contact (owner/end user)	
Address	
Postal code	
City	
State/province	
Phone number	

Water heater information	
Model	
Serial number	
Installation date	
New water heater or replacement	
Cascade installation (Y/N)	(YES / NO)
Number of water heaters	
Type of water heaters in cascade	

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

Ideal North America
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 water heater)		
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 water heater)		

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 water heater 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 water heater & 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)

Figure 20.7

Gas supply	
Type of Gas from installation	
Is gas isolation valve installed under water heater 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 water heater?	(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
O2 level at high fire …%		%
O2 level on low fire …%		%
Flue pressure @ O2 measuring point at high fire		Pa
Flue pressure @ O2 measuring point at low fire		Pa
If cascaded with a common flue system; run all appliances, measure the flue pressure at low- and at high fire.		Pa
Ignition Device Safety Shutoff test (§ 20.3)	(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 (Hot to Neutral)		V
Voltage incoming (Hot to Neutral)		V
Voltage measured between Ground and Neutral		V
Total of amperage switched by the Water heater Control is below 3.5 A or 400 W		A

Additives	
Used descaling products	
Water hardness	

Table 20.6

21 INSPECTION, MAINTENANCE AND SERVICE.

21.1 *General*

For a good, safe and long-time operation of the water heater and to maintain warranty it is mandatory to carry out inspection, maintenance and service on the water heater at least once a year.

Inspection, maintenance and service of the water heater should also be carried out on the next occasion

- **When a number of similar error codes and/or lockouts 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 water heater is once a year and/or after 2000 burning hours maximum, whichever comes first. Every service interval the water heater should be cleaned and checked, according to the maintenance procedures. If there is doubt whether the water heater 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.

CAUTION	Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. “Verify proper operation after operation servicing.”

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

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

21.2 *Safety instructions Crystalline Silica*

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

Refractory Ceramic Fibers (RFC)

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

Potential Carcinogen - Use of *Refractory Ceramic Fibers* in high temperature applications (above 1805 °F) can result in the formation of Crystalline Silica (cristobalite), a respirable silica dust. Repeated airborne exposure to crystalline silica dust may result in chronic lung infections, acute respiratory illness, or death. Crystalline silica is listed as a (potential) occupational carcinogen by the following regulatory organizations: International Agency for Research on Cancer (IARC), Canadian Centre for Occupational Health and Safety (CCOHS), Occupational Safety and Health Administration (OSHA), and National Institute for Occupational Safety and Health (NIOSH). Failure to comply with handling instructions in the table 21.1 on page 136 may result in serious injury or death.

Crystalline Silica - Certain components in the combustion chamber may contain this potential carcinogen. Read warnings and handling instructions pertaining to Refractory Ceramic Fibers before commencing service work in the combustion chamber. Take all necessary precautions and use recommended personal protective equipment as required see the table 21.1 on this page. 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 water heater. Improper installation, adjustment, alteration, service or maintenance can cause property damage, serious injury (exposure to hazardous materials) or death.

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

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

Table 21.1

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.

21.3 *Inspection, maintenance and service.*

Inspection, maintenance and service including the replacement of water heater 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 water heater 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.
- O_2 / CO_2 % at high and low fire
- Gas Pressure at high and low fire
- pH of the water in the system
- name of service company
- date of service

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

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

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

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

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

Figure 21.1

Water leakage
The water pressure of the installation should be more than 15 psi (1.0 bar) and at a maximum of 145 psi (10.0 bar) in normal operation. When the water pressure drops below the minimum occasionally, there might be a water leak. Check the water heater 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 water heater 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 should be checked for a correct functioning. Any gas pipe or fitting that have been opened or adjusted should be checked for leaks.

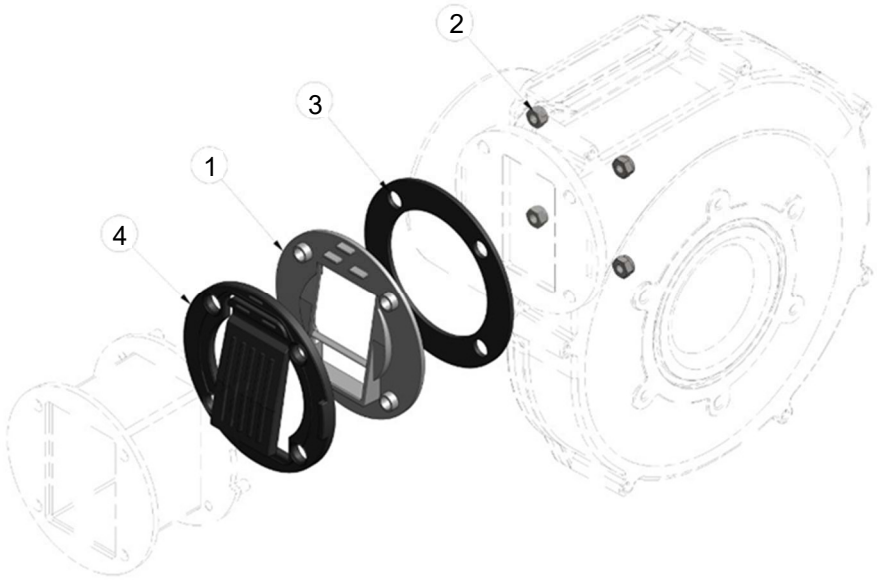
Dismount complete burner unit
The complete burner unit consists of the fan, venturi, gas valve, the burner plate and the internal burner. To make more space to transport the burner unit pull down the burner controller unit.

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 water heater 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.

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

WARNING	**Warning** **Crystalline Silica – Read instructions of § 21.2 carefully**

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 gaskets, NRV seat, lock nuts, and non-return valve. Do not reuse any of the old parts. Reassemble the Non-return valve to the burner unit be sure that the nuts are tightened again so no air/gas mixture is leaking into the cabinet. Check during startup of the water heater to ensure no gas mixture is leaking on these gaskets near the non-return valve.
Replace parts 1 to 4 of the check valve once every five years.
Needed tools: Wrench 55, 10 and 8 mm, Hex key 5 mm



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

Figure 21.2

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

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

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

Needed tools: Phillips #2 screwdriver.

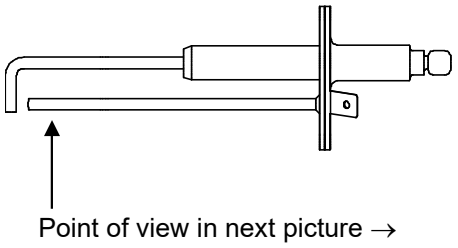


Figure 21.3

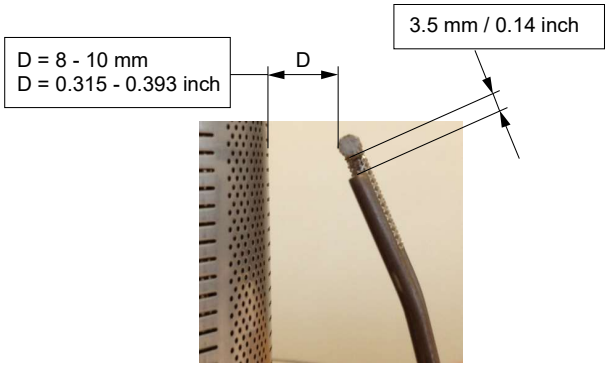


Figure 21.4

WARNING	**Warning** **Crystalline Silica – Read instructions of § 21.2 carefully**

Burner door thermostat
Needed tool: Wrench 16 mm.
This thermostat is activated if the temperature of the burner door has been too high. 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 21.5

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

Burner door gasket replacement:

Figure 21.6

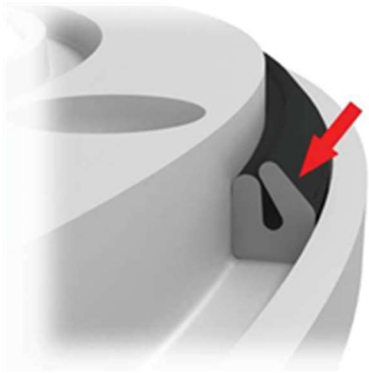


Figure 21.7

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

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

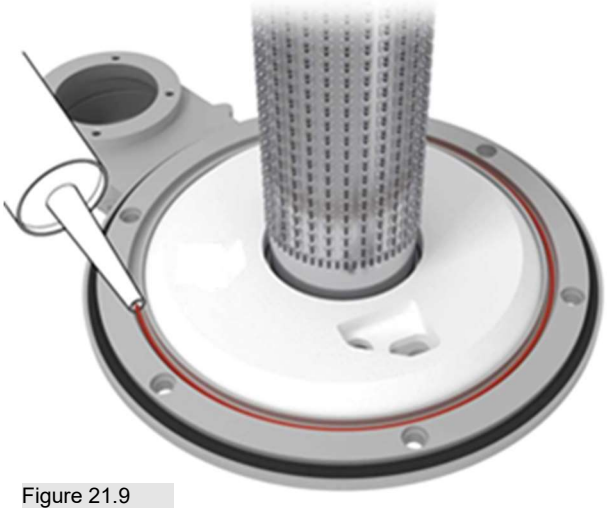


Figure 21.9

Figure 21.8

- 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 and place it in contact of the glue and press the braids.

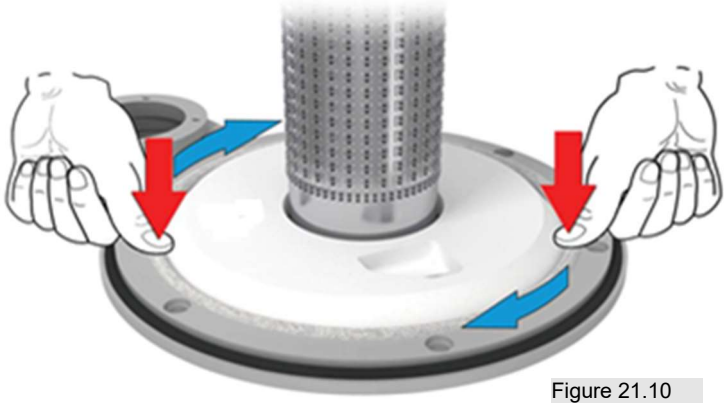


Figure 21.10

WARNING	**Warning** **Crystalline Silica – Read instructions of § 21.2 carefully**

Rear wall insulation disk

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

- let the heat exchanger cool down, wait a few hours after burning. In this way, the protective film of the new insulation disc will not stick to the rear wall of the heat exchanger.
- make the insulation wet, by spraying water over it. This in order to keep airborne dust to a minimum.
- put a piece of paper in the heat exchanger to catch the remnants of the insulation.
- with a knife, cut a cross in the insulation disk, avoiding the central insert (on the back, not visible)

- make a square cut around the central insert

- remove the segments

- remove the central insert

The new disc has the clip on the back.

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

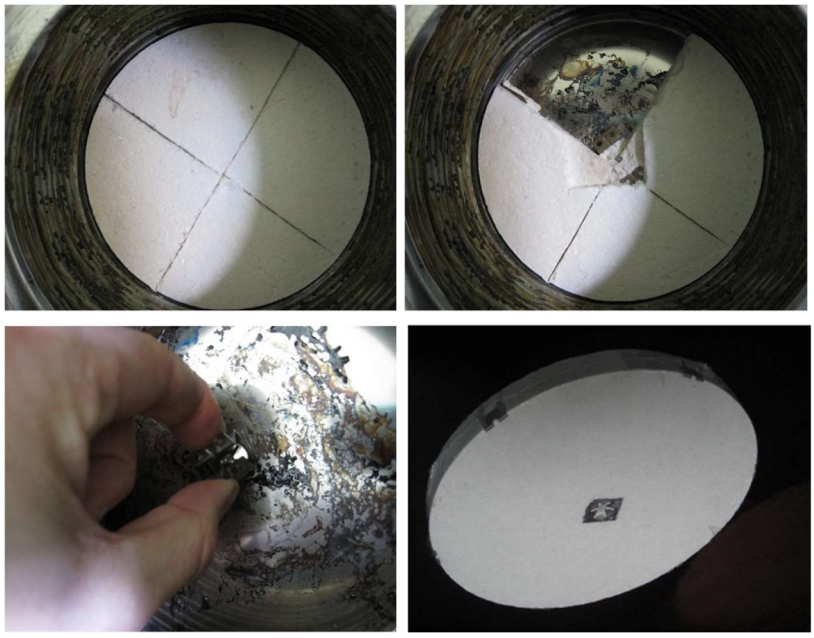


Figure 21.11

Burner door insulation disk

If the insulation disk is damaged, it has to 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.

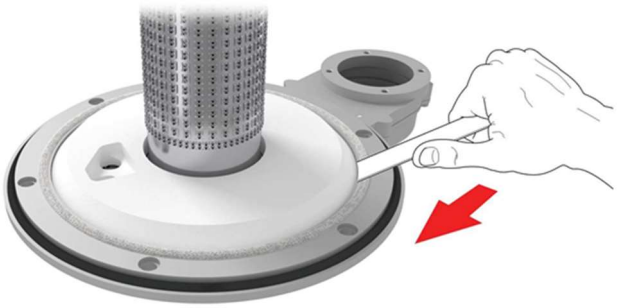


Figure 21.12

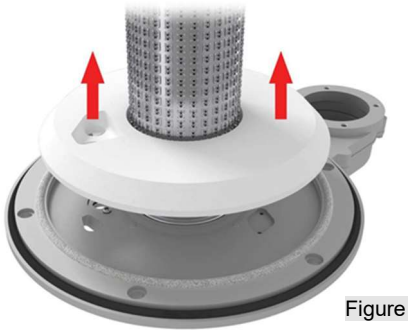


Figure 21.13

- 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 21.14. 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

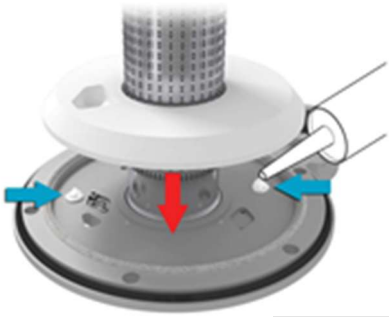


Figure 21.14

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 damage. When in doubt always replace the fan of the water heater.

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 potable water in the water heater combustion chamber (when the burner door is removed). This water will exit the heat exchanger by the condensate trap. Be careful not wetting the rear wall insulation.

WARNING

When mounting the bottom part of the condensate trap, before commissioning the water heater 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.

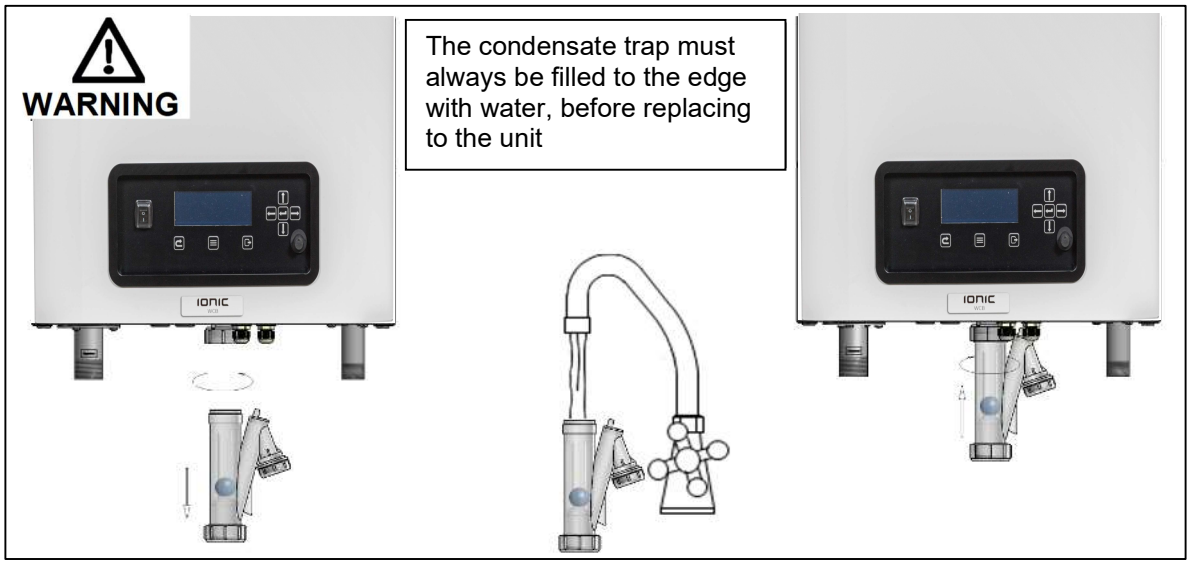


Figure 21.15

Heat exchanger and water heater combustion chamber
After the removal of the 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 water heater combustion chamber with water. Never expose the refractory insulation in the back of the combustion chamber to water or get it wet. Don't forget afterwards to clean the condensate trap once again.

Gas/air ratio
With every service check and/or maintenance of the water heater always check the gas/air ratio by measuring the O_2 percentage (flue gas) at the maximum and minimum load of the water heater. If necessary, adjust these values. See for information chapter "Adjusting and setting the water heater" chapter 20.

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

WARNING	When faults and abnormalities are found by the service technician during service and maintenance and these are not repairable, this information should be reported to the owner/end-user of the installation. Also, the owner/end-user should be advised how to fix these faults and these faults should be reported in the service report / log file of the water heater. 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 water heater again. Cleaning the combustion chamber and heat exchanger with acid or alkali products is prohibited.

21.3.1 DECALCIFYING OF THE HEAT EXCHANGER

Cleaning the heat exchanger (Every 2-year maintenance or as needed based on water quality)
The heat exchanger should be cleaned at the service interval every 2 years. Failure to flush the heat exchanger will cause damage to it. Follow the procedure below for cleaning the heat exchanger.

1. Turn off the DHW function on the water heater.
2. Check if pump P1 is resistant to the detergent
3. Close the shutoff valves on both the hot water and cold-water lines (V3 and V4).
4. Connect pump outlet hose (H1) to the hot water line at service valve (V1).
5. Connect drain hose (H3) to service valve (V2).
6. Pour approximately 5 gallons liter of virgin, food grade, white vinegar or citric acid into pail.
7. Place the drain hose (H3) and the hose (H2) to the pump (CP) inlet into the cleaning solution.
8. Open both service valves (V1 and V2) on the hot water and cold-water lines.
9. Operate the pump (CP) and allow the cleaning solution to circulate through the heat exchanger for at least 45 minutes.
10. Turn off the pump (CP).
11. Rinse the cleaning solution from the heat exchanger as follows:
    - Remove the free end of the drain hose (H3) from the pail
    - Close service valve, (V2), and open shutoff valve, (V4). Do not open shutoff valve, (V3).
    - Disconnect both H1 and H3 from the service valves
    - Connect H3 to V1 and place the end of the hose in a drain
    - Allow water to flow through the heat exchanger for 5 minutes
    - Close service valve, (V1), and open shutoff valve, (V3).
12. Disconnect all hoses.

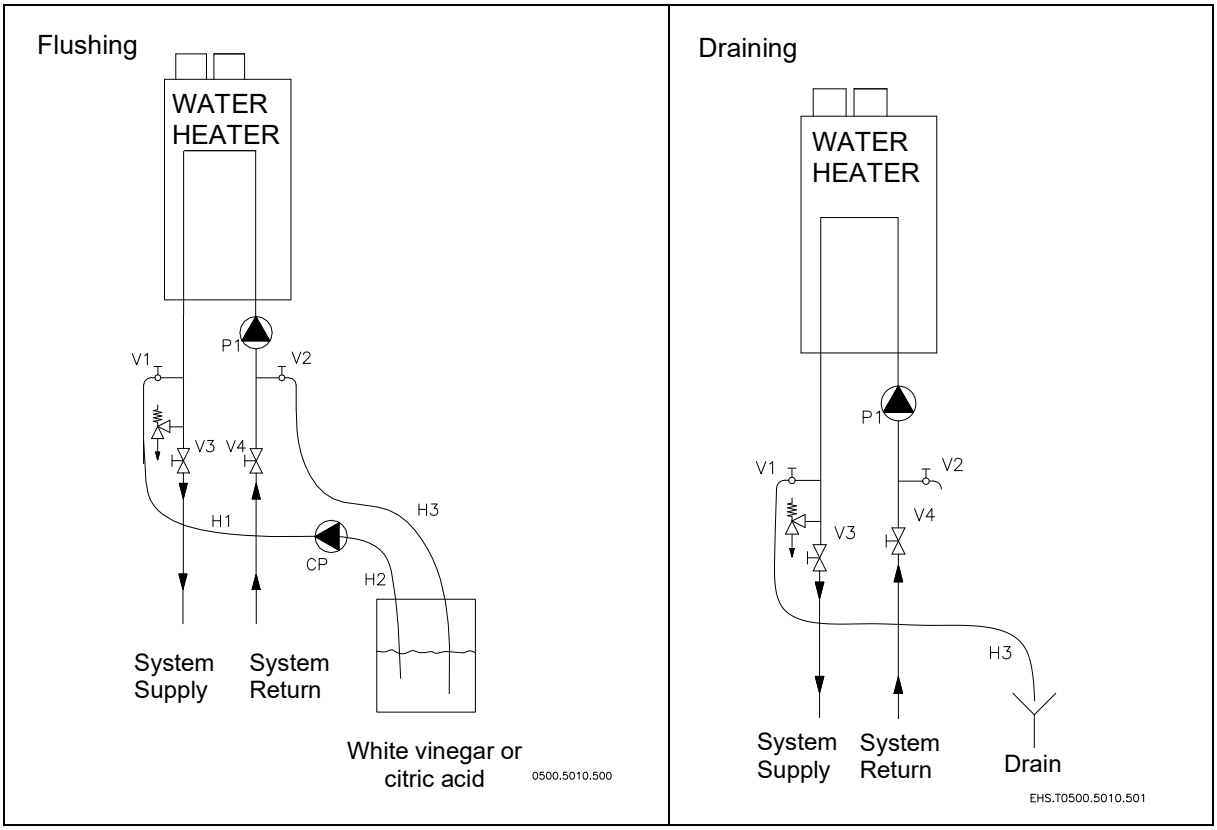


Figure 21.16

21.3.2 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 unit must be mounted back on the heat exchanger as follows:
- Place the burner door with its holes over the six threaded studs. Tilt 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 middle at 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 value = 70.8-inch lbs. (8 Nm)**

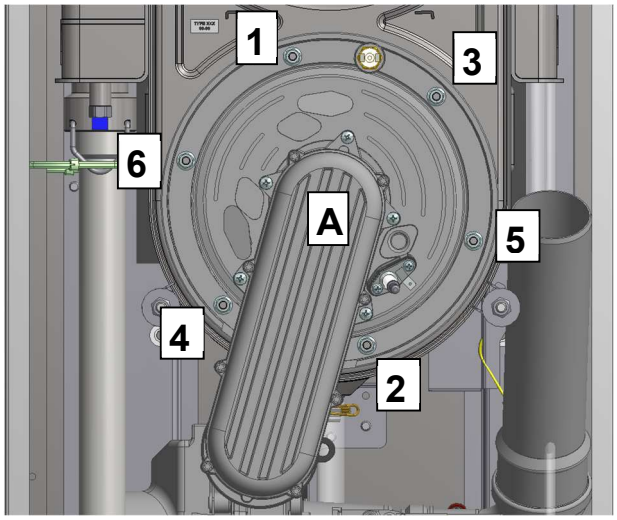


Figure 21.17

After reconnecting all cables, and after mounting the silencer and the external igniter, the electrical and gas supply can be restored. Check if the water heater ignites properly and check on gas leaks on the parts that have been apart. Check O_2/CO_2 settings on low and high fire.

21.3.3 WATER HEATER ROOM CHECK

- Check the space where the water heater is installed for possible contaminates
- Do a check for any flammable items, liquids, or and/ or vapors in the area surrounding the appliance
- Do a check for any products listed in manual section 11.7.1 in the area surrounding the appliance, removing any that are present.

21.4 *Instructions for the user.*

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

21.5 *Maintenance Checklist*

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

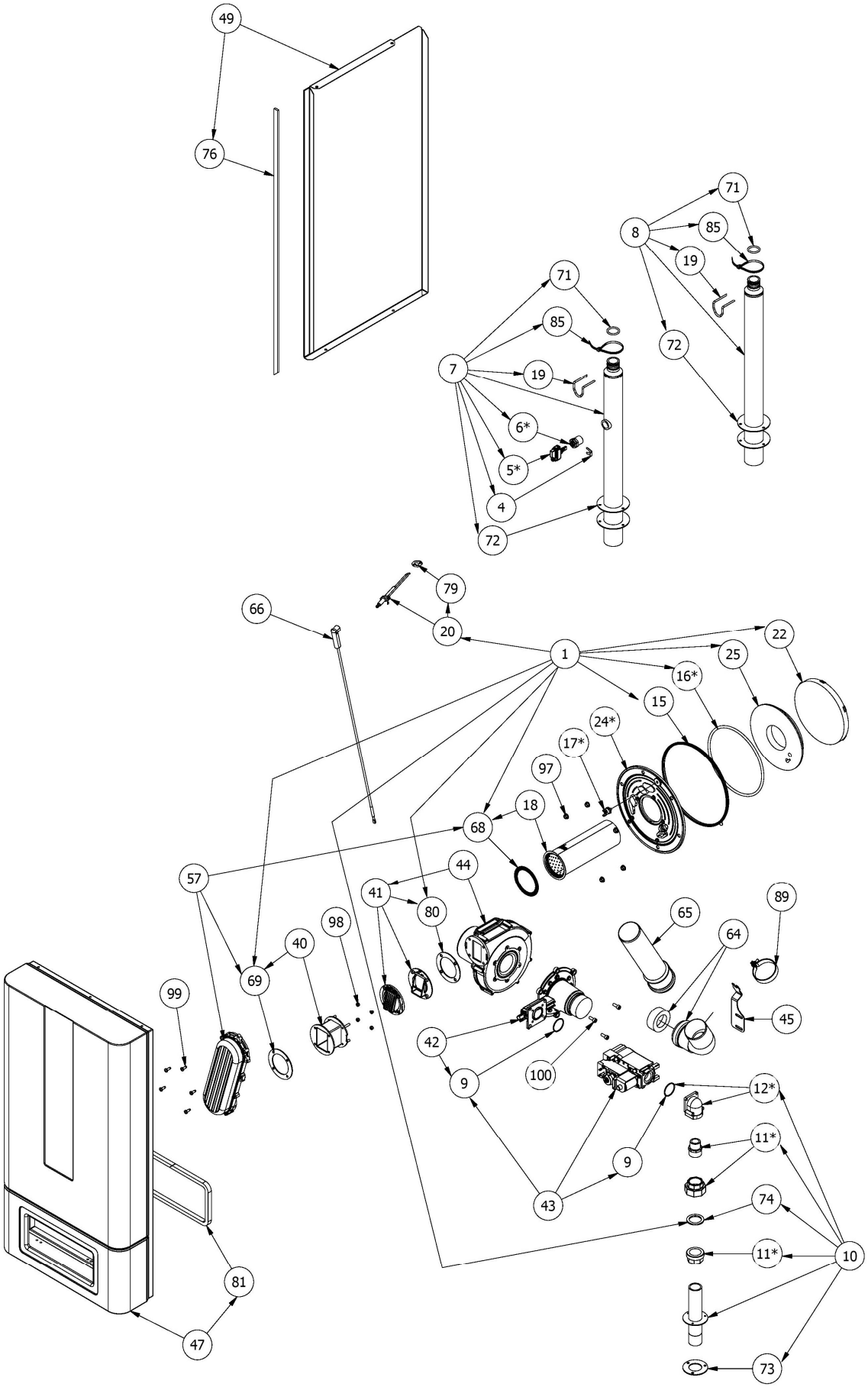
Periodic maintenance should be performed once a year by a qualified service technician to assure that all the equipment is operating safely and efficiently. The owner should make necessary arrangements with a qualified heating contractor for periodic maintenance of the heater. The technician must also inform the owner that the lack of proper care and maintenance of the water heater may result in a hazardous condition.

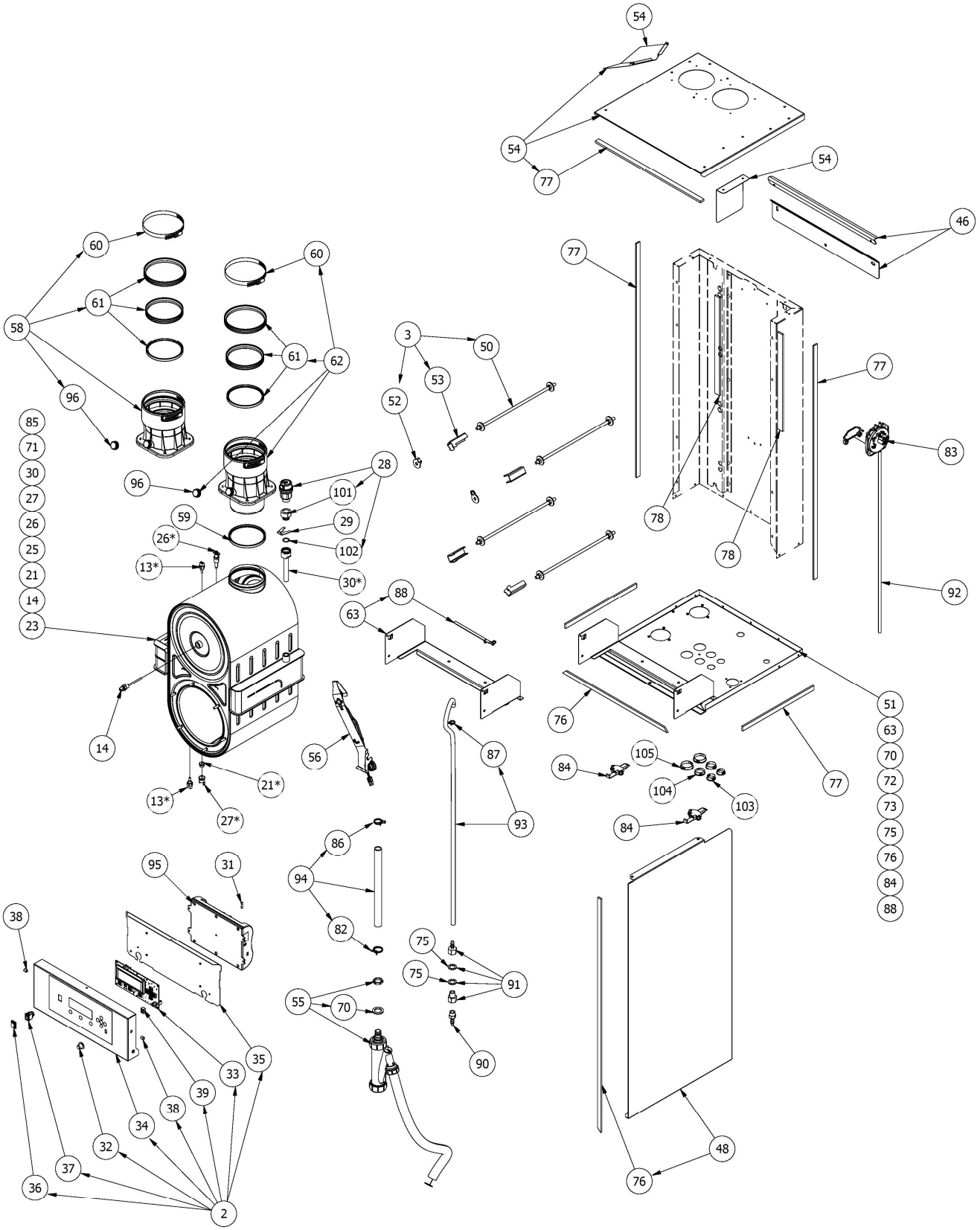
Maintenance Table

Inspection Activities		**Date Last Completed**			
		1st Year	2nd Year	3rd Year	4th Year
Near water heater piping	Check system and water heater piping for any sign of leakage. Take off water heater cover and inspect connections in water heater 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 O_2 at high and low fire				
Visual and Temperature	Do visual inspection of all system components and verify programmed temperature settings				
Connections	Check wire connections and make sure they are tight				
Combustion chamber	Check burner tube and combustion chamber coils. Clean with nylon brush and vacuum. Avoid touching white ceramic fiber. Also see maintenance section of manual				
Spark igniter	Ensure spacing of igniter prongs are aligned properly.				
Replace NRV	Replace non-return valve every fifth year. And be sure it is not leaking gas after reassembling.				
Condensate trap	Disconnect condensate hose and trap. Ensure no blockage, rinse and clean out. Fill completely again with fresh water and re-install				
Relief Valve	Check to make sure it is not weeping				
Pump and Fan	Listen to the sound of the pump and fan. If either makes noise during operation, it is recommended to replace the part.				
Low water cut-off	Check the LWCO is not leaking and check for right pressure value by draining the water from the water heater and comparing the value with a calibrated meter equipment				
Homeowner	Question homeowner before maintenance if they have any issues and after done, confirm activities you performed during maintenance visit				
Used descaling products	Check the descaling products				
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 21.2

22 SPARE PARTS.





Remarks:

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

*= installation additions (see sparepart list)

22.1 *Part numbers*

POS.	DESCRIPTION	Part Number	*	WH 299W	WH 399W	WH 470W	WH 499W
1	Set. Universal maintenance kit	E153000001	2	X	X	X	X
2	Set. Electronics holder	E144000001		X	X	X	X
3	Set. Anchoring bar WH 299W	E111000001		X	NA	NA	NA
3	Set. Anchoring bar WH 399W	E111000003		NA	X	NA	NA
3	Set. Anchoring bar WH 470W, WH 499W	E111000004		NA	NA	X	X
4	Clip for WPS 10bar	E115100001		X	X	X	X
5	WPS 10bar (HW) + EPDM o-ring	E141100002		X	X	X	X
6	Nipple for RPS D15	E133100001	1	X	X	X	X
7	Flow pipe WH 299W, 399W	E131000003		X	X	NA	NA
7	Flow pipe WH 470W, WH 499W	E131000005		NA	NA	X	X
8	Return pipe WH 299W, 399W	E131000008		X	X	NA	NA
8	Return pipe WH 470W, WH 499W	E131000009		NA	NA	X	X
9	O-ring gas valve connection	E153100001		X	X	X	X
10	Gas pipe WH 299W, WH 399W	E158000001		X	X	NA	NA
10	Gas pipe WH 470W, WH 499W	E158000002		NA	NA	X	X
11	Union flat seat Rp1 x Rp1 (4408)	E158000003	1	X	X	X	X
12	Hooked gas valve VR4615 connection	E158100001	1	X	X	X	X
13	NTC sensor 1/8" SS	E141100003	1	X	X	X	X
14	NTC flue gas sensor ¼" 10 B=3977K t2	E141100004		X	X	X	X
15	Seal Burner door	E153100005		X	X	X	X
16	Insulation fibre braid burner door	E153100004	2	X	X	X	X
17	Burner door thermostat 260° C (M5)	E141100005	1	X	X	X	X
18	Burner WH 299W	E151000001		X	NA	NA	NA
18	Burner WH 399W	E151000002		NA	X	NA	NA
18	Burner WH 470W, WH 499W	E151000003		NA	NA	X	X
19	Spring fastconnection WH 299, 399	E115100003		X	X	NA	NA
19	Spring fastconnection WH 470W, WH 499W	E115100004		NA	NA	X	X
20	Electrode	E155000001		X	X	X	X
21	Reducing coupling G¼ x M5	E135100001	1	X	X	X	X
22	Backwall isolation 16mm	E153100002		X	X	X	X
23	Heat exchanger WH 299W	E134000002	2	X	NA	NA	NA
23	Heat exchanger WH 399W	E134000005	2	NA	X	NA	NA
23	Heat exchanger WH 470W, WH 499W	E134000006	2	NA	NA	X	X
24	Burner door right sided ignition	E153100006	2	X	X	X	X
25	Burner door isolation right sided ignition	E153100003		X	X	X	X
26	Sensor LWCO	E141100006	1	X	X	X	X
27	Temperature switch 90° C	E141100007		X	X	X	X
28	Automatic air vent with adapter	E134000007		X	X	X	X
29	Locking clip air vent	E115100005		X	X	X	X
30	Extension pipe air vent	E131100001	1	X	X	X	X
31	Box 10pcs Fuse 5 AT	E145100001		X	X	X	X
32	Rubber plug Ø13	E144100003		X	X	X	X
33	Pixel Button Display	E144100004		X	X	X	X
34	Display front panel	E144100005		X	X	X	X
35	Mounting plate burner control	E142100001		X	X	X	X
36	Dustcover ON/OFF switch	E144100006		X	X	X	X
37	Main switch	E141100008		X	X	X	X
38	Spring plunger 8mm	E144100007		X	X	X	X
39	EPDM sealing for EBM 957	E144100008		X	X	X	X
40	Offset piece WH 299W	E152000004		X	NA	NA	NA
40	Offset piece WH 399W	E152000005		NA	X	NA	NA
40	Offset piece WH 470W, WH 499W	E152000006		NA	NA	x	x

*1) Install with S022.000.001

*2) Install with S022.000.002

POS.	DESCRIPTION	Part Number		WH 299W	WH 399W	WH 470W	WH 499W
41	Check valve + seat	E152000008		X	X	X	X
42	Venturi WH 299W	E158100002		X	NA	NA	NA
42	Venturi WH 399W	E158100003		NA	x	NA	NA
42	Venturi WH 470W, WH 499W	E158100004		NA	NA	X	X
43	Modulating gas valve VR4615 (120VAC)	E158000004		X	X	X	X
44	Radial Blower RG148/300W (120VAC)	E152000002		X	X	X	X
45	Mounting plate silencer	E114100001		X	X	X	X
46	Wall mounting plate	E114000002		X	X	X	X
47	Frontpanel	E121000001		X	X	X	X
48	Side panel right	E121000002		X	X	X	X
49	Side panel left	E121000003		X	X	X	X
50	Anchoring bar WH 299W	E111100001		X	NA	NA	NA
50	Anchoring bar WH 399	E111100003		NA	X	NA	NA
50	Anchoring bar WH 470W, WH 499W	E111100004		NA	NA	X	X
51	Bottom panel WH 299W, WH 399W	E121000004		X	X	NA	NA
51	Bottom panel WH 470W, WH 499W	E121000005		NA	NA	X	X
52	Special washer heat exchanger	E113100001		X	X	X	X
53	Clamping bracket heat exchanger	E114100002		X	X	X	X
54	Top panel WH 299W, WH 399W	E121000006		X	X	NA	NA
54	Top panel WH 470W, WH 499W	E121000007		NA	NA	X	X
55	Condensate drain assembly l=800	E137000001		X	X	X	X
56	Backwall clixon	E141100009		X	X	X	X
57	Gas-air mixing pipe	E152000009		X	X	X	X
58	Boiler air connector WH 299W, WH 399W	E157000001		X	X	NA	NA
58	Boiler air connector WH 470W, WH 499W	E157000002		NA	NA	X	X
59	Seal EPDM WH 299W, WH 399W	E157100001		X	X	NA	NA
59	Seal EPDM WH 470W, WH 499W	E157100002		NA	NA	X	X
60	Clamp galvanised WH 299W, WH 399W	E157100003		X	X	NA	NA
60	Clamp galvanised WH 470W, WH 499W	E157100004		NA	NA	X	X
61	Set. Seal EPDM Adapter WH 299W, WH 399W	E157000003		X	X	NA	NA
61	Set. Seal EPDM Adapter WH 470W, WH 499W	E157000004		NA	NA	X	X
62	Boiler flue gas connector WH 299W, WH 399W	E157000005		X	X	NA	NA
62	Boiler flue gas connector WH 470W, WH 499W	E157000006		NA	NA	X	X
63	Connection bar display holder	E114000003		X	X	X	X
64	Elbow silencer	E155100001		X	X	X	X
65	Extension pipe silencer WH 299W, WH 399W	E143000001		X	X	NA	NA
65	Extension pipe silencer WH 470W, WH 499W	E151100001		NA	NA	X	X
66	Ignition cable	E152100002		X	X	X	X
67	Harness HV/LV	E137100001		X	X	X	X
68	Gasket Burner & gas/air inlet pipe	E155100001		X	X	X	X
69	Gasket gas/air inlet pipe & fan	E143000001		X	X	X	X
70	Gasket siphon/bottom plate	E151100001		X	X	X	X
71	O-ring flow/return pipe WH 299W, WH 399W	E133100003		X	X	NA	NA
71	O-ring flow/return pipe WH 470W, WH 499W	E133100004		NA	NA	X	X
72	Gasket flow/return pipe 1½"	E133100005		X	X	X	X
73	Gasket gas pipe 1"	E153100007		X	X	X	X
74	Gasket malleable coupling	E153100008		X	X	X	X
75	Gasket Condensate drain/bottom plate	E137100002		X	X	X	X
76	Silicone seal 13x5 self adhesive L=10m	E123100001		X	X	X	X
77	EPDM seal 15x6 self adhesive L=5m	E123100002		X	X	X	X
78	EPDM seal 20x5 self adhesive L=5m	E123100003		X	X	X	X
79	Gasket electrode	E155100002		X	X	X	X
80	Gasket gas/air mixing	E152100003		X	X	X	X

POS.	DESCRIPTION	Part Number		WH 299W	WH 399W	WH 470W	WH 499W
81	EPDM seal 10x12 self adhesive L=5m	E123100004		X	X	X	X
82	Hose clamp Ø23,83 (DW15)	E137100003		X	X	X	X
83	Air pressure switch DL 2 ET with S-clip (US)	E141100010		X	X	X	X
84	Quick-action clamp	E115100006		X	X	X	X
85	Ty-Rap Hitte bestendig 3,5x200 mm	E115100007		X	X	X	X
86	Hose clamp Ø20,62 (DW13)	E137100004		X	X	X	X
87	Hose clamp Ø12,7 DW8)	E115100008		X	X	X	X
88	Cable tie with rivet	E115100009		X	X	X	X
89	PVC bracket Ø60	E114100003		X	X	X	X
90	NPT Male Connector 3/8	E116100001		X	X	X	X
91	NPT Female Connector 3/8	E116000001		X	X	X	X
92	Hose pressure switch	E138100001		X	X	X	X
93	Hose air vent	E138100002		X	X	X	X
94	Hose condensate trap WH 299W, WH 399W	E138100003		X	X	NA	NA
94	Hose condensate trap WH 470W, WH 499W	E138100004		NA	NA	X	X
95	Burner control WH 299W, WH 399W, WH 470W, WH 499W	E142100003		X	X	X	X
96	Measuring Cap M20x2 Ral-9011	E157100005		X	X	X	X
97	10x Flanging head nut M6	E112100001		X	X	X	X
98	4x Nut M5 DIN985	E112100002		X	X	X	X
99	5x screw M5x14 DIN7500C	E116100002		X	X	X	X
100	3x Screw M6x16 DIN912 (Venturi)	E116100003		X	X	X	X
101	Air vent coupling G1/2" with clip connection	E135100002		X	X	X	X
102	O-ring Ø15x2,5	E133100005		X	X	X	X
103	Knock Out Seal ½" nylon	E123100001		X	X	X	X
104	Knock Out Seal ¾" nylon	E123100002		X	X	X	X
105	Knock Out Seal 1" nylon	E123100003		X	X	X	X
106	Thermal fuse protection burner door	E141100011		X	X	X	X
107	CSD kit gas pressure	E158000005		NA	NA	X	X
108	External ignition transformer	E146100001		X	X	X	X

COMMODORE

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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