Rev 11_2023

TU & TW SERIES

Gas-Fired Duct Furnace for industrial and commercial use

Indoor and outdoor installation

SERVICE AND INSTALLATION MANUAL

GAS-FIRED
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LISTED
4CP2

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Warning

FIRE OR EXPLOSION HAZARD

- Failure to follow safety warnings exactly, could result in serious injury, death, or property damage.
- Be sure to read and understand the installation, operation, and service instruction in this manual.
- Improper installation, adjustment, alteration, service, or maintenance can cause serious injury, death, or property damages.

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

- **WHAT TO DO IF YOU SMELL GAS**
  - Do not try to light any appliance.
  - Do not touch any electrical switch.
  - Do not use any phone in your building.
  - Leave the building immediately.
  - Immediately call your gas supplier from a phone remote from the building. 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.

Hazard and risk identification is the first step in risk assessment, please read carefully:

- **Before you begin installing the device, read, understand, and follow all the instructions given in this manual, including all safety precautions and warnings.**
- **This device is connected to high voltages and contains parts that can move unexpectedly.**
- **Never open the access doors to the device while it is running.**
- **The unit must be securely and properly grounded.**
- **An electric shock, serious injury or death could occur if the instructions given in this manual are not followed.**
- **Always unplug and lock the power supply before maintaining this equipment. All work must be done by a qualified technician.**
- **<u>DO NOT BYPASS LOCK OR SAFETY SWITCHES UNDER ANY CIRCUMSTANCES.</u>**

SUMMARY

NOTICE: The specifications, illustrations and description in this document were, to the best of our knowledge, accurate at the time they were approved for printing. **Nagas Innovation Inc.** has a policy of continuous product improvement and reserves the right to change design and specifications, discontinue offering certain features, or discontinue production of a given model size without notice. For more information, please contact your local representative and your authorized distributor.

1. WARNINGS

- **Read the installation and service manual completely, before installing this equipment.**
- **Installation and services carried out on this equipment must be executed by competent personnel, who are qualified and able to follow the instructions of this manual, jurisdiction codes as well as all necessary requirements for special applications of this equipment.**
- **Injuries or damaged materials can result from improper installations, adjustments, modifications or poor repair and servicing. Refer to present manual. To obtain help or specific information, consult a competent installer, a service agency, or your gas supplier.**

2. COMBUSTION AIR

The combustion of gas requires a large mass of air to assure complete combustion and a maximum effectiveness of the unit. If in Canada, follow the installation requirements of the exhaust systems and air supply for the devices defined by the current edition if the code CSA-B149.1. If in the United States, follow code ANSI Z 223.1/NFPA 54.

The unit can be supplied with a control cabinet which included an integrated air intake and a screen that is designed for installation outside a building.

Nevertheless, this air supply can be used if the gas device is installed inside an exterior or interior ventilation unit, that foresees; a fresh air opening sufficient to respect code requirements, an all-purpose weather shelter (against wind, rain, ice, etc.). The unit must include the necessary exhaust system of combustion gasses, and includes acceptable access (min. 24'', 609mm) to the controller and to the burner that does not prevent proper functioning of the gas device.

The air inlet must be installed so that the opening faces towards the bottom, in a way rain can not enter. The fresh air opening must NEVER be blocked or impeded by snow or any other object. The air inlet must be positioned at a minimum of 300mm (12") above all surfaces that can accumulate snow. If the region in which the installation is being made has strong annual snow accumulation tendencies, it is preferable to increase this tolerance to the maximum height above the surface in accordance with the installation at hand.

WARNING

NEVER impede the air inlet from combustion or from ventilation. NEVER install a gas device in an area that does not contain exterior air combustion procurement. NEVER install a gas device to a surrounding wall or enclosure that is or can inhibit a negative pressure. A negative pressure may be created by exhaust fans, the air fan supply, air circulation fans, etc. A negative pressure condition causes a lack of combustion air supply in the room where the device is installed. A lack of combustion air supply is dangerous and can be fatal. This can also prevent proper functioning of the device and will result in the warranty being void.

3. BURNERS

These units use inshot venturi type burners. They allow a stable and effective flame with good retention and this without any adjustments. The burners are installed on removable supports to allow an annual inspection of the tubes. The burners must be well aligned with the longitudinal axle of the tubular heat exchanger. A contact of the flame to a non-centered exchanger will cause degradation and even a perforation of the exchanger. The burners are always of the same capacity in a device.

These burners can operate to capacities varying from 100% to 60% of the maximum capacity without changing the airflow rate of the fan exhaust. The maximum capacity for every burner is indicated in **Table 1** and **Table 2**.

To reduce the capacity of the device, verify the operational pressure of the units in **Table 1** and **Table 2**. Be careful not to reduce the capacity to less than 60% of the burner's maximum capacity specified in **Table 1** and **Table 2**. Devices with an S2, Si or SiB codes, already have a reduced capacity and cannot be reduced more nor be increased.

4. BURNER ORIFICES

Each burner uses an orifice that has and opening specified to its normal capacity (see **Figure** 1 and **Figure** 2).

Figure 1 - Orifice

Figure 2 - Burner

Naturel Gaz Option		
	Burner and Orifice Information	
Burner diameter	**2.0 in.**	**2.5 in.**
Burner Capacity	**30 MBH**	**50 MBH**
Orifice number	**#37 (2.64mm)**	**3,40 mm**
Inlet pressure MINIMUM.	**7 in.w.c.**	**7 in.w.c.**
Inlet pressure MAXIMUM.	**10 in.w.c.**	**10 in.w.c.**
Operational Pressure * vs altitude. (Option S1, S2 et Si)**	**High fire pressure 100% (Low fire pressure 60%) In.w.c.**	
0-2000 pieds	**3,5 (1,3) in.w.c.**	**4,2 (1,6) in.w.c.**
2001-4500 pieds	**2,4 (0,9) in.w.c.**	**2,9 (1,1) in.w.c.**

* The gas pressure is measured at the manifold when the burner(s) work at is (their) maximum.

** See appendix for SiB option.

Table 1 – Naturel Gaz Option : Burner and orifice

Propane Option		
	Burner and Orifice Information	
Burner diameter	2.0 in.	2.5 in.
Burner Capacity	30 MBH	50 MBH
Orifice number	#51 (1.70mm)	#45 (2.08mm)
Inlet pressure MINIMUM.	12 in.w.c.	12 in.w.c.
Inlet pressure MAXIMUM.	14 in.w.c.	14 in.w.c.
Operational Pressure * vs altitude. (Option S1, S2 et Si)**	**High fire pressure 100% (Low fire pressure 60%) in.w.c.**	
0-2000 feet	10.0 (3.5) in.w.c	11.0 (4.0) in.w.c
2001-4500 feet	2,4 (0,9) in.w.c	2,9 (1,1) in.w.c

* The gas pressure is measured at the manifold when the burner(s) work at is (their) maximum.

** See appendix for SiB option.

Table 2 – Propane Option : Burner and orifice

As altitude increases, a decrease in combustible oxygen in the air reduces the capacity of a device at an approximate rate of 4% for every 325m (1000') increase in altitude above sea level. Therefore, it is very important to reduce gas pressure according to the information given in **Table 1** and **Table 2**. Failure to do so will result in incomplete combustion and an excessive production of CO (carbon monoxide) will be produced. It is important to know that the net capacity of the device will then be reduced by the same proportions.

WARNING

Carbon monoxide is an odourless gas and is fatal. A device operating with an improper orifice will produce a high quantity of carbon monoxide in combustion products. This can also prevent proper functioning of the device and will result in the warranty being void. Exposure to this gas is dangerous and can be fatal.

5. ELECTRICAL CONNECTION

When installed, the appliance must be electrically connected and grounded in accordance with local codes, or in the absence of local codes, with the National Electrical Code, ANSI/NFPA 70, and/or the Canadian Electrical Code, CSA C22.1.

Connections must be made to the specified areas in the interior of an electricity panel. Consult the electrical diagram supplied with the device.

WARNING

If the electrical wiring supplied with the device needs to be replaced or wiring needs be added to the device, the cabling must be replaced by the equivalent approved for the application.

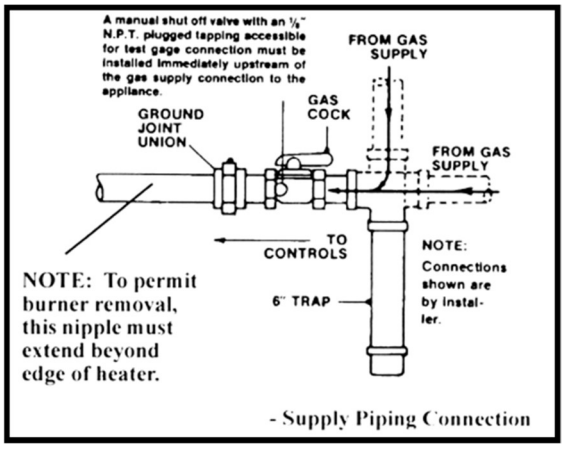
6. GAS CONNECTION

Gas piping must be built according to gas device installation requirements defined by the current edition of the code CSA-B149.1, and ANSI Z 223.1/NFPA 54 for the United States, and that the devices must be installed according to the state of art and must satisfy the requirements of the local codes in force.

The units have been set up to operate with a pressure supply not surpassing 14 in.w.c (½ psi). For a higher network pressure, a high-pressure regulator must be installed. Its capacity must be built to always reduce the pressure supply to a level lower than the maximum prescribed pressure (when stopped or in function). Also, the regulator must be able to maintain a stable pressure supply to a reduced system. The reduced system on these units can be as low as 5 to 10% of its maximum capacity.

The units were built to operate with natural gas having a calorific value of 1007 BTU/FT^3 and 2500 BTU/FT^3 for the LP gas. If the gas distributor does not meet these specifications, contact the manufacturer for proper selection of orifices vs. manifold gas pressure setting.

In proximity and upstream of the unit, a joint union followed by an approved manual valve must be installed (see **Figure 3**). A gas connection must be foreseen to allow a reading of the pressure supply. Verify all the piping joints for gas leaks with a leak detection liquid to detect and seal all gas leaks.



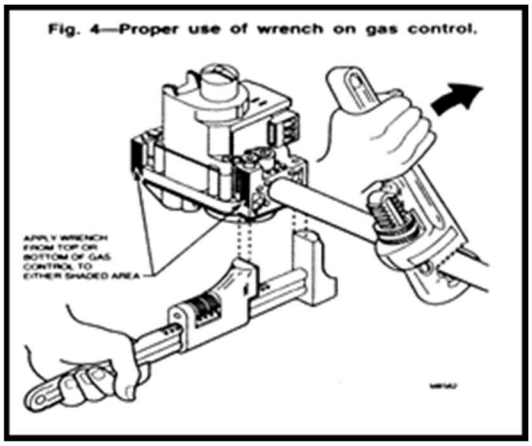


Figure 3 – Gas connection

Carry out a pressure test on all the installations as follows:

For a pressure supply of more than 14 in.w.c. close the manual valve, disconnect the piping, seal the extremities, install the device, and carry out the test. For a pressure supply of 14 in.w.c. and under, close the valve, install the device. Carry out the pressure test while ensuring that the device is of good quality and is well calibrated.

Once the unit is installed and has been prepared for secure functioning, the operating pressure of the piping downstream of the gas control valve must be adjusted to the pressure noted in the **Table 1** and **Table 2**. This procedure is indicated in section 34 « Gas pressure and adjustment ».

To size your gas line piping for the unit supply, refer to the CSA-B149.1 code, and the ANSI Z223.1/NFPA 54 codes if in the United States.

WARNING

All piping joints must be tested before starting up the unit. Never test for gas leaks and drips with an open flame. The pressure supply must be tested and must not exceed a maximum pressure of 14 in.w.c. or ½ psi. Omission to respect any of these requirements is dangerous and can be fatal. This can also prevent proper functioning of the device and will result in the warranty being void.

The appliance and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing of the system at test pressures more than ½ psi (3.5 kPa). The appliance must be isolated from the piping system by closing its individual manual shut-off valve during any pressure testing of the gas supply piping system at test pressures equal to or less than ½ psi (3.5 kPa).

7. AIR CAPACITY

The minimum airflow through the duct heater shall be sufficient to limit the temperature rise of the air below the rated maximum temperature rise (refer to section 40 herein for applicable rating).

The maximum airflow through the duct heater shall be limited to maintain the temperature rise of the air above the rated minimum temperature rise when the burners are functioning at their full capacity (refer to section 40 herein for applicable rating).

If the application requires a temperature rise above rated maximum limit or below rated minimum limit, the installer must contact an authorized distributor or the manufacturer for guidance.

It is very important to have the minimum prescribed airflow rate according to the table in section 40, otherwise the heat exchanger will overheat. If you notice numerous stops and starts in a short period of time, it is possible that the high limit switch locks out and reactivates the circuit. This can be an indication of excessive temperatures often caused by a lack of air capacity or bad air distribution.

In several applications, certain restriction needs a non-linear duct installation upstream or downstream of the heat exchanger. The use of turning vanes is recommended when an elbow or bypass must be installed near the heat exchanger. A good analysis and installation practice in accordance with the state of art is necessary to avoid dead point. A dead point is an area where there is insufficient air to cool the heat exchanger.

If the unit must be installed close to a fan outlet, be sure to install a perforated diffusion plate to force air on each side or to foresee an adequate distance between the exchanger and the fan. Generally, a 45-degree angle transition duct is sufficient to diffuse the air. An access door is necessary upstream and downstream of the exchanger to verify of the tubing's condition.

When starting up the unit, it is very important to balance the system's airflow. The necessary air capacity within the unit can be measured in several ways with at least one of the following instruments: pilot tube, a static pressure sensor, an amperemeter, a tachometer, an air speed sensor, etc.

WARNING

It is the installer's responsibility to ensure that a proper quantity of air is equally distributed on all surfaces of the tubes. A lack of cooling on one or several tubes will cause an accelerated degradation of the non-cooled areas. This can also prevent proper functioning of the device and will result in the warranty being void. This degradation can cause an escape of combustion gasses in the ambient air. An escape of combustion gasses is dangerous and can be fatal.

8. INSTALLATION CODE

The gas type and the capacity of your device, as well as the electrical characteristics are indicated on the nameplate.

In addition to following the instructions in this manual, you must ensure that all installations of these devices meets all the installation requirements of gas devices defined by the current edition of CSA-B149.1 code, and for the United States the ANSI Z 223.1/NFPA 54 code. The device must be installed according to the rule of the art and must satisfy the requirements of the current local installation code.

In the United States, installation in an aircraft hangar should be in accordance with NFPA No. 409 (latest edition), Standard for Aircraft Hangars; in public garages in accordance with NFPA No. 88A (latest edition), Standard for Parking Structures; and in repair garages in accordance with NFPA No. 88B (latest edition), Standard for Repair Garages. In Canada, installations in aircraft hangars, parking garages, and repair garages should be in accordance with the requirements of the enforcing authorities and with CSA B149.1 code.

9. CONDENSATION

Combustion produces enormous quantities of water vapours. These water vapours are retained in the device's combustion gases and can condense if its temperature drops below the dew point. The condensation produced is corrosive. It must be verified and controlled by taking appropriate measures to avoid its initiation. It can be settled in the tubes, the collector, the fan, and the exhaust system. To avoid their corrosive effects, take the following precautions:

- Follow the installation recommendations specified in the exhaust section of this manual.
- Isolate the flue vent if the room temperature is below 10°C (50°F),
- Install a condensation drain on the combustion collector with a ''P trap'',
- Use a stainless-steel exchanger if the temperature of the air inlet is below 5°C (40°F), or if there is a temperature increase of 22°C (40°F) or lower at the exchanger.

To avoid condensation accumulation in the combustion gas collector, it is possible to add a drain to the gas collector. This can be linked to an open drain. It requires the use of a loop or a swan neck to stop the evacuation of undesired gas.

WARNING

For security and effectiveness, it is necessary to inspect adequately and regularly the exhaust system. A malfunctioning exhausts system or with a gas leak is dangerous and can be fatal. It can also prevent proper functioning of the device and will result in the warranty being void.

10. INSTALLATION DOWNSTREAM FOM REFRIGERATION SYSTEMS

When the appliance is to be installed downstream from evaporative coolers, air washers or cooling units of refrigerating systems, the heat exchanger shall be built from stainless steel and the condensate drain shall be installed on the appliance.

11. IGNITION CONTROL

Ignition system verification procedures when starting up the unit:

- Verify the spacing of the igniter. It should be of 4.17mm (0.164’’);
- Verify the grounding;
- Ensure that the electrical supply and that gas supply are opened;
- Carry out a heating request and verify the igniter’s spark. (The spark will occur for a maximum of 7 seconds.);
- In case of non-ignition, a manual reset is necessary;
- Ensure that once the unit has been lit, the gas control valve is completely open, that the burners are on, and that the igniter does not make any sparks.

12. HIGH LIMIT SWITCH

All the devices use a high limit switch that is installed to detect a high level of temperature throughout the unit.

It is not adjustable and must only be replaced by a compatible component, installed at the same place and with the same temperature setting (160-40F that can be cut at 160 and reconnected at 120F).

Given the variety of ways in which these devices can be used, it is possible that a second high-limit switch may be necessary. A second high-limit switch is recommended, if there is a possibility that there can be a lack of air of the ventilation system (for example if there are two fans or a double duct at the outlet).

The additional high limit switch must be installed in a strategic place where the burner would cut off if the temperature is at an undesirable level for that area. At the time of servicing a qualified technician must ensure good functioning of this high limit switch.

A lack of colling air can be caused by one of the following situations:

- Exchanger is installed too close from an elbow;
- Inappropriate air diffusion;
- Exchanger is installed too close to the fan;
- Air conduit is too small;
- Exchanger is installed too close to an obstacle;
- Insufficient airflow;
- Broken fan, strap, or damper;
- Dirty filters;
- Gas capacity is too high, etc.

WARNING

It is the installer's responsibility to ensure that a proper quantity of air is equally distributed on all surfaces of the tubes. A lack of cooling on one or several tubes will cause an accelerated degradation of the non-cooled areas. This can also prevent proper functioning of the device and will result in the warranty being void. This degradation can cause combustion gas leak in the air. A combustion gas leak is dangerous and can be fatal.

13. STAGES CONTROL

13.1. SINGLE STAGE (S1 Option)

The standard devices are delivered with a single stage gas control valve using a 24V power supply. The gas control valve is either closed (0%) or opened at 100% of the device's capacity.

13.2. SINGLE STAGE (S2 Option)

In cases where heating smaller rooms or rooms where there must be a high comfort level (classrooms, large office spaces, shopping centres, show rooms, etc.), the use of a double-stage gas control valve is required. It must be operated by a well-placed two-step, 24V thermostat or by two DDC system dry contacts.

The redundant gas control valves used are adjusted by the manufacturers to maintain a capacity of 100% at maximum fire and of 60% at a low fire. The valve is designed to maintain a stable outlet pressure when the inlet pressure is in the range of 7 in.w.c. to 10 in.w.c. (natural gas).

13.3. MULTIPLE STAGES (Si Option)

A multiple stage device is constructed with one solenoid valves per burner and a main valve that supplies the gas to the manifold. Each of the solenoids is independently controlled from one another. This allows a decrease in the total capacity of the unit, according to the number of lit tubes.

13.4. MULTIPLE STAGES (SiB Option)

A multiple stage device is constructed with one solenoid valves per burner, a two stages gas valve (low capacity) that supplies the burner #1 and a main two stages gas valve (high capacity) that supplies the gas to the manifold for other burners. Each of the solenoids is independently controlled from one another. This allows a decrease in the total capacity of the unit, according to the number of lit tubes.

14. CORROSION

Corrosion can occur in the exhaust ducts and in the exchanger if the combustion air contains chemical vapours that, at high temperatures, transform themselves into acids. The chlorine-based products are most encountered. In the combustion process, chlorine molecules transform themselves into hydrochloric acids, which are very aggressive on metals, even on the 300 stainless steel series. Such corrosion can induce a very quick degradation of the exchanger.

The following products are examples of corrosion sources: aerosols, cleaning solvents, refrigerant gas, chemical products for swimming pools, calcium and chloride sodium, wax, glue etc. In the presence of these products, the heat exchanger and vent system may, in one heating season, be damaged enough to need replacing. Such products should not be stored in such a way that their vapors can contaminate the combustion air or come into contact with the gas appliance.

WARNING

Failure to meet these requirements is dangerous and can cause death. It can also prevent proper operation of the device and void the warranty.

15. UNPACKING AND PREPARATION

This device has passed its manufacturer's security and functioning tests and checks before having been packed. Contact your distributor if the device has been damaged.

Verify that the nameplate indicates the required model number, the proper capacity, the correct voltage and that the gas supply is compatible. Read and familiarise yourself with all the instructions in this installation manual before undertaking the installation and communicate with local authorities that may have installation requirements for this type of device. If you have any questions, contact the manufacturer by calling 1-800-514-8007.

Verify that the device is delivered with one or several separate options that require an on-site installation. For example; modulating duct probe, signal amplifier, room thermostat, air flow switch, waterproof joint, combustion air intake, gas regulator, manual gas control valve, etc.

16. CLEARANCES

Devices must be installed in a manner that will respect the clearances of the combustible materials as indicated in the following table

Side	15cm (6 in)
Top	15cm (6 in)
Below (H)	7.5cm (3 in)
Behind	15cm (6 in)
Vent Piping	15cm (6 in)
Front (service and inspection)	46cm (18 in)

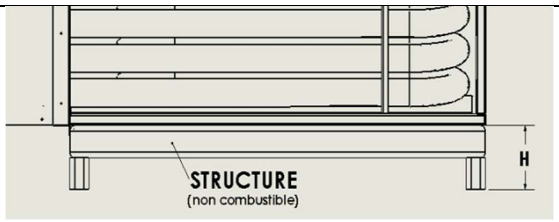


Table 3 - Clearances

If the device is installed in a garage, it shall be installed with a minimum clearance above the floor of 18 in (457mm)

17. ELECTRICAL DIAGRAM

The electrical diagram is located on the interior of the access panel and/or inside the envelope supplied upon delivery of the appliance.

18. DIMENSION

Given the multitude of dimensions and the variety of ways, in which these devices can be assembled, we do not present any dimension drawings in this manual. Refer to the specifications manual or to the unit drawings supplied with the device.

19. SUPPLY DIRECTION

The airflow can be rising, descending or at an angle of 0 to 90 degrees. However, it is suggested to direct it in counter stream to the hot gasses to maximise thermal efficiency. This means that the air should pass on the portion of the tube that is coldest, towards the hottest portion of the tube. If work-site conditions do not allow for this type of installation, the device will not undergo any damage if it is installed in the reverse direction. The air pressure loss will be the same.

20. HEAT EXCHANGER

The heat exchanger is of a tubular type. The tubes must be in horizontal or vertical positions according to specified configuration. The tubes can be made of three types of stainless steel: 409HP, 304L or 316L.

In a fresh air system, condensation from combustion products may appear. This condensation is slightly corrosive thus a stainless-steel heat exchanger is necessary. If the temperature rise exceeds the rated maximum temperature rise, the installer must contact an authorized distributor or the manufacturer for guidance (refer to section 40 herein for applicable rating).

As it was mentioned, the heat exchanger products specified above do not withstand corrosion of hydrochloric acid caused by a chlorine presence in combustion air. Annual inspection and cleaning of the exchanger must be performed. The use of a cylindrical- shaped stainless-steel brush is suggested to reach all the internal surfaces of the tubes, and an ordinary brush is sufficient for the exterior of the tubing. It is not necessary to use a stainless-steel brush if the surface dirt can be cleaned with a humid rag or an air pressure hose.

21. MAINTENANCE

The maintenance and installation instructions found in this manual are constructed to help qualified technicians. To assure an optimum level of performance and security, all gas equipment must be well inspected and maintained regularly. Here is a list of maintenance tasks to be performed annually, preferably at the beginning of the heating season:

- Cleaning of the combustion air inlets;
- Verification of the exhaust system and of the pressure switch;
- Cleaning of the burners and orifices;
- Cleaning of the interior and exterior of the exchanger, remove surface rust, dust, etc;
- Cleaning of the condensate collection and disposal system as applicable;
- Verification of the electric wiring;
- Verification of the overall installation (environment change, or equipment additions, temperature rise, etc.);
- Verification of the control sequence and of the ignition;
- Clean the flame detection probe and verifying that it light correctly;
- Verification of the manifold gas pressure for all operation set point;
- Checking the safety shut-off valve for gas tightness.

For dismantling and assembling components refer to the appropriate section. Always follow the activation steps described in the activation section 30 « Start-up » before igniting any gas equipment.
In the case of overheating or failure of the gas control systems, close the manual gas valve of the unit before closing the power supply.

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

WARNING

If you close the power on the device, close the manual gas valve too.

WARNING

If ambient air contains large amounts of dust, a second cleaning could be required during the heating season. Omission to clean a gas device is dangerous and can be fatal. This can also prevent proper functioning of the device and will cause cancellation of its warranty.

22. SMALL AREAS

In large buildings, natural and mechanical ventilation systems are generally sufficient to provide combustion air supply. The installer must ensure that the installations of these devices meet all the gas device requirements defined by the current edition if the code CSA-B149.1, and for the United States: ANSI Z 223.1/NFPA 54 code, and that the devices must be installed according to the state of the art and must satisfy the requirements of current local installation code. Consult with competent authorities before performing the installation.

23. EXHAUST

The exhaust system of a gas appliance is very important for proper operation and safety of people. It is imperative to: follow the instructions in this manual, ensure that the installation of these devices meet all the installation requirements defined by the current edition if the code CSA-B149.1, and for the United States: ANSI Z 223.1/NFPA 54 code, and that the devices must be installed according to the state of the art and must satisfy the requirements of the current local installation code. Consult with competent authorities before performing the installation.

WARNING

Before installation ensure that the model number indicates option I for an inside device and E for an outside device. Use of such a device requires the proper type of exhaust system. Otherwise, usage can be dangerous and can be fatal. This can also prevent proper functioning of the device and will result in the warranty being void.

24. EXHAUST SYSTEM INDOOR UNITS

This unit is equipped with a combustion gas exhaust fan to ensure effective and secure functioning. This same fan also draws in the flame through the burner and the tubular heat exchanger. It also is constructed to evacuate combustion gas in a horizontal or vertical flue vent that terminates at a roof or at a wall. A vent cap of the same diameter as the exhaust pipe must be used at the extremities located at the exterior of the building. The exhaust pipe must end at the exterior of the building while respecting the following clearances:

STRUCTURE	Minimum Vent Terminals Clearance***
Motorised air intake less than 1.8m (6')	0.9m (3') above and 1.8m (6') to the side
Combustion air intake from another device	1.8m (6')
Door, openable window, revolving air intake or all other openings	1.8m (6') to the side
	0.9m (3') above
Electrical or gas meter, regulator, and relief equipment *	1.8m (6') to the side (Canadian standards)
	1.2m (4') to the side (U.S.A. standards)
Vent outlet	0.9m (3')
Building or adjacent wall or parapet	1.8m (6')
Sidewalk or parking lot	2.1m (7') above
Ground	0.3m (1') above snow level
Wall of pipe outlet	0.3m (1') minimum
Roof of pipe outlet	0.9m (3') minimum and 0.6m (2') above all obstacles less than 3m (10')

* Never install a flue vent outlet above a service regulator or a gas meter

** Local codes may supersede the above provisions.

*** Take all necessary precautions to avoid the installation of vent outlets where snow accumulation can occur due to roof snow slides or snow removal dumps

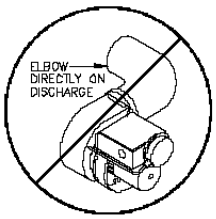
Table 4 – Clearance for vent terminals ** (as an indicator only. Refer to the codes for official information)

S1, S2, Si and SiB units require categories III venting. The flue vent must be built using a single-wall or double-wall galvanised steel (or stainless steel) pipe having a minimum thickness of 24awg, in the interior of the building. However, a double-wall galvanised (or stainless steel), steel pipe is required to cross the external walls of the building to the vent cap.

The vent connections must be set up with a minimum of three screws made of a non-corrosive substance and must be sealed with an adhesive tape able to withstand temperatures of 288°C (550°F). The joints must be sealed in a manner that will not allow leakage of the combustion product into the room.

The horizontal conduit sections should be supported every six feet with non-combustible products such as, chains or steel belts. Do not use the unit or the vertical conduit section as a support.

The connection to the device must be made by a section of pipe with a minimum length of 30cm (12'') before installing the first elbow. Do not install an elbow pipe directly to the device discharge (see **Figure 4**).



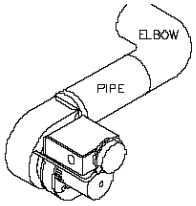


Figure 4 – Vent Connection

Piping dimensions must respect the diameters and maximum equivalent lengths shown in the following **Table 5**. The equivalent length is calculated by adding the straight lengths of the flue vent, to the equivalent length of all the elbow pipes used. A 90-degree elbow pipes have an equivalent length of 3m (10') and of 1.5m (5') 45-degree angle elbow pipes.

Models	Tjernlund Model	Capacity (MBH)	Flue Vent Diameter (inches)	Maximum Equivalent Length (ft)
50 à 125 MBH	HST-J	50 à 100	4	75
	HST-J	101 à 125	4	20
150 à 300 MBH	HST-1	150 to 210	4	50
	HST-1	211 to 240	4	20
	HST-1	241 to 250	4	10
	HST-1	150 to 250	6*	75
	HST-1	251 to 270	6*	60
300 à 400 MBH	HST-2	271 to 402	6	75

* Diameter increase from unit 4'' discharge to 6'' flue vent.

Table 5 – Equivalent Lengths

To avoid accumulation and backflow of condensation in a horizontal exhaust pipe, a slope of at least 48:1 (1/4'' per foot) must be maintained on the entire length of the horizontal sections, headed towards the exterior. If a horizontal section is followed by a vertical section, a condensation sleeve can be added where the condensation may accumulate at the beginning and at the end of every cycle. The condensation sleeve must be placed in a way to avoid to the return of condensation into the device.

To avoid condensation formation while the burner is functioning, it is suggested to isolate the flue vent on its entire length, if the room temperature is maintained below 10°C (50°F). We can then isolate the flue vent by using a 0.5'' (minimum) thick fibreglass insulator, able to withstand temperatures of 288°C (550°F).

WARNING

Two or several units installed in a common or independent heating system requires an installation of a separate, independent-exhaust system for each unit. The installation of two units onto one same exhaust system is forbidden and dangerous. A repression of combustion gas of one of the devices could migrate towards the second and cause combustion gas exhaust to drift into the room.

The horizontal portions of category III venting systems shall be supported to prevent sagging. Typical methods and recommended intervals for support are shown below.

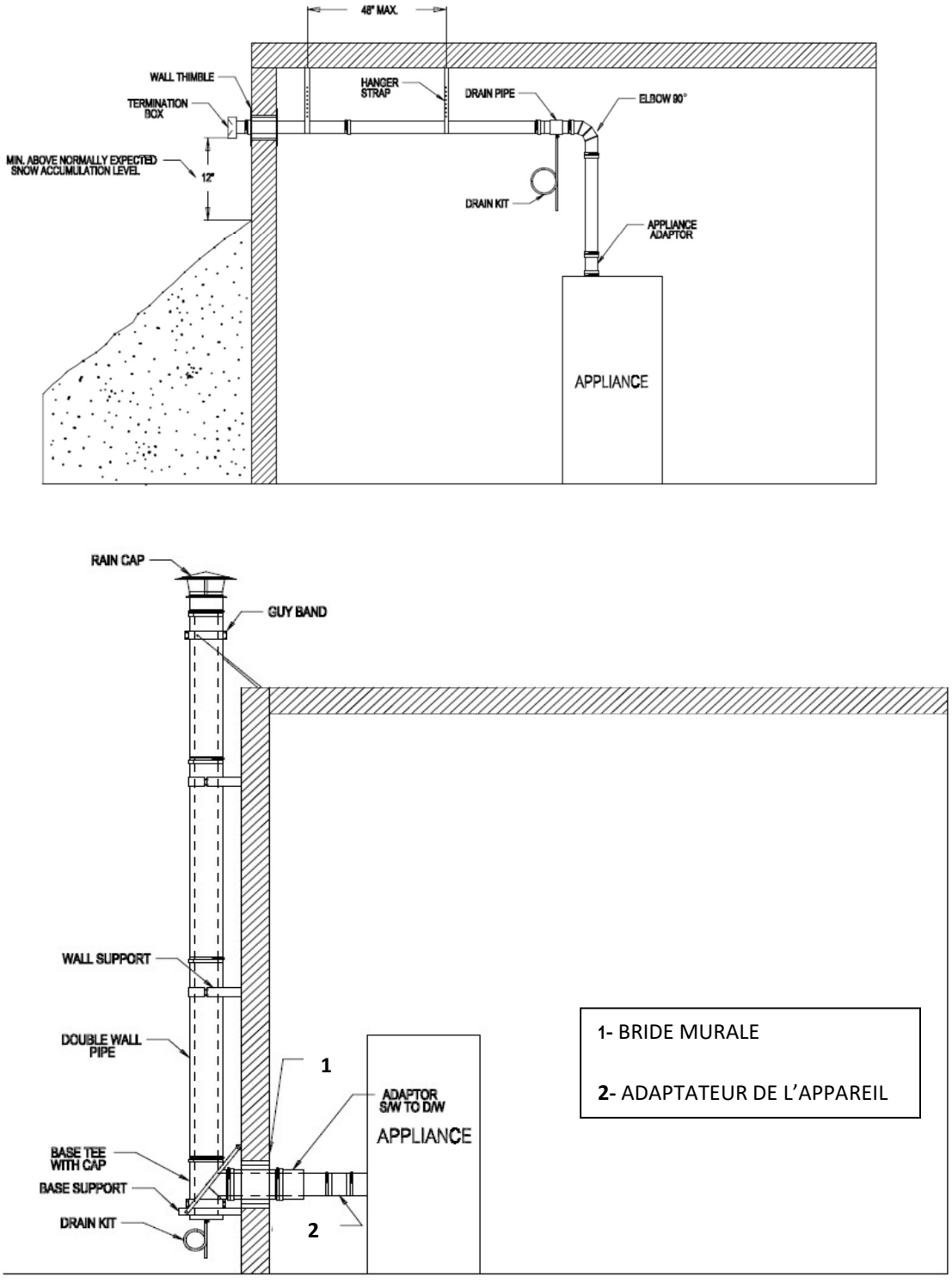


Figure 5 - Typical methods and recommended intervals for support

25. EXHAUST SYSTEM OUTDOOR UNITS

These devices, just as the internal models, are supplied with a combustion gas exhaust fan for effective and secure functioning. This same fan also serves to draw in the flame through the burner and the tubular heat exchanger.

It is very important not to orient this outlet towards a fresh air duct, another device combustion air intake, or any other opening of a building. It is possible that the exhaust indicated in the table of exhausts, from the vent cap, are not suitable because of the horizontal release of the combustion products. Special attention must be taken to each application. In the case of a horizontal exhaust, a secure distance of 3m (10') must be added to the distance found in the table for horizontal direction, measured from the mechanical or gravity air intakes.

If the air combustion outlet is too close to a building's opening or to where the direction of gasses is undesirable, it is possible to add a vertical exhaust kit.

WARNING

A secure and effective operation requires a sufficient exhaust of combustion gas. An exhaust system that is broken or that has a gas leak is dangerous and can be fatal. This can also prevent proper functioning of the device and will result in the warranty being void.

26. WARRANTY

26.1. EXCHANGER

If, in the five (5) years that follows the initial installation of the device, the guarantor states that the heat exchanger perforated for reasons of improper assembly or of manufacturing defects, it will be replaced or repaired under the terms of the warranty.

26.2. PARTS

If, in the year that follows the initial installation of the device, the guarantor states that any given part presents an assembly or manufacturing defect, it will be replaced or repaired under the terms of the warranty.

26.3. TERMS

This warranty only applies if the devices are installed in accordance with the requirements of the codes in force, to the local regulations in force, to the industry rules, to the printed instructions furnished with the devices, as well as to the device's installation manual.

The warranty does not apply if the unit is used:

1. In temperatures that surpasses the minimum and maximum prescribed temperatures;
2. With gas pressures surpassing the conditions stated in this installation manual;
3. Is exposed to a corrosive or contaminated atmosphere;
4. Is exposed to abusive or improper applications;
5. After having been damaged;
6. After having been modified on a worksite;
7. In an installation that does not respect the state of the art

26.4. MAINTENANCE OR REPAIR EXPENSES

In the terms presented in the limited warranty, the guarantor does not commit to replace defective parts or perforated exchangers. All other expenses are the owner's responsibility.

These expenses can include:

1. Service charge for the repair or the reinstallation of parts or of a new device;
2. Shipping and delivery costs, handling and administration delivery costs made by the distributor nearest to you for a new unit or replacement parts for the unit;
3. All necessary or incidental expense for all materials or permits needed for the installation of the device or a replacement part.

26.5. RESPONSABILITY DISCLAIMERS

No other explicit warranty has been nor will be made in the name of the warranty related to the device or its installation, its functioning, its repair, or replacement. The guarantor will not be held responsible for any damages caused by the device, any inconveniences any losses or damages to personal property, or any other resulting damages.

The guarantor will not be held responsible, by virtue of the present warranty or otherwise, by damages to any persons or to property, be direct or indirect, and that results in a contractual clause or a civil offence.

27. INSTALLATION AND LOCATION

These devices are constructed to be installed inside ducts furnace, inside rooftop air conditioning and heating devices, and inside ventilation units manufactured in plants or on worksites. They can be used in heating applications that re-circulate air, fresh air, or a mixture of the two. They can also be used in more specialized applications such as a variable volume air heater, etc. In addition, they can be installed before or after a cooling coil.

Each of the mentioned applications requires technical knowledge relative to each case. If you need help or for more detailed information, contact the manufacturer or a representative in your area.

These units must be installed on the positive side of the fan supply and must never be installed in a conduit where the pressure is lower than the atmospheric pressure. In case of a perforated heat exchanger, if the pressure is higher in the air conduit, then in the interior of the exchanger, the combustion gasses will not escape the combustion room.

Certain units are designated for an interior installation and others for an exterior installation. Verify the nameplate before installing yours (I = Interior and E= Exterior).

These devices are constructed to be installed in a rising, descending, horizontal or all angled airflow rate. However, it is advantageous to orient the airflow in the opposite direction (against the current) to the combustion gas airflow. In other words, the air should travel from the cold area of the exchanger towards the hot area of the exchanger (the section closest to the burner is the hottest area). The goal of this is to maximise the unit's thermal exchange. However, it is possible to install the airflow in the other direction without compromising the secure functioning of the unit. The device is delivered with a label indicating the airflow direction.

28. PRESSURE SWITCH

The pressure-sensitive switch is used to ensure proper functioning of the combustion gas exhaust fan that evacuates burned gasses and allows combustion air to enter the burner. The switch closes the circuit by using a negative pressure of -0.53 ±0.03 in w.c. and opens the circuit if the pressure increases to more than –0.40 ±0.03 in w.c. This contact is linked to the ignition control to ensure proper functioning.

If the exhaust conduit is blocked, too long, too small, or if there is an elbow pipe that is placed too close to the fan vent, it is normal that the switch does not make the contact shutting off the burner. It is also possible that the switch produces a contact when the gasses are cold and does not when the gasses are hot. This indicates a problem that must be corrected immediately.

WARNING

A secure and effective functioning requires a sufficient combustion gas discharge. Disabling a security device such as a pressure-sensitive switch on a gas device is dangerous and can be fatal. This can also prevent proper functioning of the device and will result in the warranty being void.

29. AIR PRESSURE SWITCH

The air proving pressure detector is used to ensure proper functioning of the HVAC system's supply air fan. Therefore, it is not necessary to use an air pressure-sensitive switch. Nevertheless, it will protect and will extend the exchanger's life span against motor and pulley breakage, broken or slippery straps, fan shaft breakage, clogged filters, obstructed conduits, and all other situations impeding the device's air supply.

The switch is activated by a differential pressure via the exchanger on the air side. Typically, it is normally opened with a simple contact that is sequentially linked to a thermostat or to a contact of the temperature controller, thus not allowing it to function if there is breakage.

The adjustment should be of a pressure of at least ±30% of the device's pressure loss (see name plate) and should be connected to the boundaries indicating a normally open contact. Its location is very important and requires special attention to ensure proper functioning.

30. START-UP

It is very important to ensure that all the instructions in this manual are respected. You must ensure that installation of these devices meet all gas device installation requirements defined by the current edition if the code CSA-B149.1, and for the United States: ANSI Z 223.1/NFPA 54 code, and that the devices must be installed according to the state of the art and must satisfy the requirements of the local codes in force. If necessary, consult competent authorities before operating the device.

30.1. ADDITIONAL SUGGESTED CHECKLIST BEFORE STARTING THE DEVICE :

1. Verify the rigidity of the installation, the unit must be well supported and level;
2. Verify the clearances specified in this manual and ensure that they are respected;
3. Verify the combustion air supply, if it is mechanical verify that it is functioning properly and has been electrically wired with an interlocked proving switch;
4. Verify the exhaust system and ensure that it respects the requirements prescribed in this manual.
5. Verify the gas pipes for leaks and pressure supply;
6. Verify the electrical wiring, ensure that the wiring used, circuit breakers and fuses are all the proper capacity;
7. Verify that there is good air supply throughout the device;
8. Verify the location of the temperature sensor and the control sequence.

30.2. IGNITION PROCEDURE :

1. Adjust the thermostat to the off position;
2. Open the manual gas valve;
3. Turn on the device's electrical power;
4. Adjust the thermostat or controller to the desired temperature;
5. The combustion gas fan evacuator should start-up;
6. The pressure-sensitive switch closes the contact;
7. A 30 second purge delay will occur;
8. Ignition is made, the gas control valve opens and the burner lights instantly.

30.3. SUGGESTED ADDITIONAL CHECKLIST AFTER RESTART

1. While the burner is functioning, measure the tubing gas pressure. The pressure at its full operation should be in accordance with **Table 1** and **Table 2**;
2. Turn the device on and off waiting 1 minute between each cycle to ensure that ignition is gentle and without spillage. On modulated systems or stage systems ensure that all heating systems work properly;
3. Observe the flame at its full operation and ensure good combustion. A yellow flame indicates an excess of combustion air, however a blue flame with a yellow tip indicates an excess of gas. A combustion analyser should be used to complete this verification;
4. Verify the high limit switch while cutting out the air supply. It should stop the burner in about 1 minute and should start the burner again once it has cooled;
5. Verify the exhaust system for combustion gas leaks;
6. Leave a copy of this manual in a secure place close to the unit

WARNING

For a secure operation of a gas device, it is very important that the ignition sequence is verified to ensure a proper ignition. A gas device that has an incorrect ignition sequence is dangerous and can be fatal. This can also prevent proper functioning of the device and will result in the guarantee being void.

31. AIR PRESSURE LOST

Every restriction in an air pipe produces a static pressure loss. The pressure loss for a tubular heat exchanger must be considered in the system's design and fan selection.

32. REMPLACEMENT PARTS

Given the numerous types of models and the variety of configurations of these devices, we do not publish any parts lists in this manual. Refer to the parts lists furnished with the device or contact the manufacturer.

33. NAMEPLATE

The nameplate indicates several important gas device characteristics and installation details. The serial number is coded and contains pertinent information for maintenance or servicing. The nameplate identification codes are indicated on the last page of this manual.

Example : Model : CTW-150-N-5-2.00-19H-34L-30E-E-S2-115-1234

Four-pass model with a capacity of 150,000 BTU/hrs from natural gas having five burners of 2'' diameter s capacity each with a height of 19'', a width of 34'' and a length of 30''. The unit have a control cabinet and a 115V/1/60 power supply. It is used for exterior installations and has a two-stage gas control valve.

The nameplate also indicates the manufacturing date coded in a serial number: PVA file# - date code – sequential#.

Example : 11336 – IAJ - 0898

34. GAZ PRESSURE AND ADJUSTMENT

The pressure adjustment is set at the plant and does not require any modification. However, the tubular pressure **MUST BE VERIFIED** and if required must be adjusted as follows:

1. Install a 0-10 in.w.c. gas manometer to the exit gas control valve plug;
2. Turn on the unit to its full capacity;
3. Remove the screw cap located on the gas control valve;
4. Using a screwdriver, increase the pressure by turning it in a clockwise direction or in a counterclockwise direction to reduce the pressure;
5. Re-install the screw cap on the gas control valve.

35. COMBUSTION AIR ADJUSTMENT

The adjustment of the combustion air is possible but not recommended. The unit is factory adjusted to operating limits. This adjustment requires a qualified technician.

36. IGNITION SYSTEM

This unit is equipped with a direct ignition system that monitors the flame and controls the ignition and the gas control valve. This ignition system uses a combination of an igniter and a flame probe detector. The flame is detected using a method of rectification that functions operate as follows: a weak electrical signal isolated from ground is applied to the probe detector by the ignition controller. When a flame is present it acts as a conductor to the ground. The flame rectifies itself and completes the DC circuit, which is in turn automatically detected by the ignition controller.

The ignition sequence is simple but must be well understood before taking on a modification on a defective or new device. On a thermostat's request a secondary- 24Volt circuit supplies a relay. This relay makes a contact that starts up the exhaust fan that is powered by the current from the 110 Volt primary circuits. In return, the exhaust fan applies pressure on the pressure-sensitive switch that closes the secondary circuit and supplies the ignition controller, following a 30 second delay of the stalled relay that is integrated in the ignition module. In series with the pressure switch there are two high temperature limits, if one of the three is opened the circuit remains open and ignition will not be made. Next the ignition controller produces a spark to the igniter and opens the gas control valve simultaneously. It will wait for a maximum of 7 seconds for a flame to be detected at the opposite end, before closing the valve. The controller does not try to ignite the burner a second time if ignition fails.

For the proper functioning of the flame probe detector, a minimum signal of 1.5 microampers is required. It can be measured with a microampers. The distance between the igniter stem and the grounding stem must be 0.134'' (4.17mm). The igniter must be well connected and grounded while assuring continuity between itself, the burner, and the ignition controller.

For more complete details on the ignition controller, refer to the manufacturer's controller operation and installation manual.

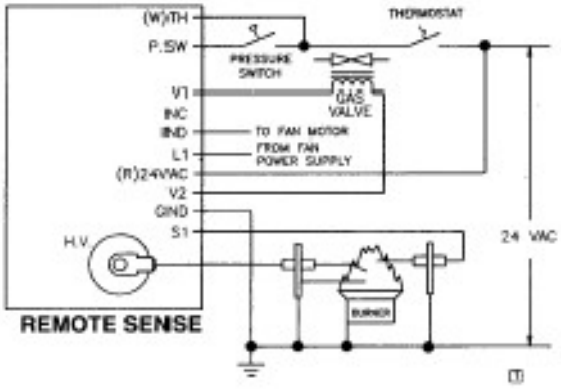


Figure 6 - Ignition Controller

WARNING

The ignition system works on high voltage. For secure manipulation, disconnect the current before handling ignition components.

37. THERMOSTAT

A 24Volt thermostat is not an integral part of the device but its usage is required. The thermostat must be installed according to the manufacturer's recommendations while paying special attention to its placement. Ensure that the adjustment of the heat anticipator is to the level indicated on the electrical diagram. A DDC system can be used with this device.

Consult the electrical diagram supplied with the device or refer to the typical diagram in this manual. The connection of the thermostat must be made at the location prescribed in the interior of the electrical control panel.

38. GAS CONTROL VALVE

The gas control valve is supplied with 24Volts coming from the ignition controller. The primary function of the gas control valve is to cut the burner's gas supply on the ignition controller's request. Its secondary function is to reduce the inlet pressure to the tubing's necessary operational pressure. It uses a diaphragm-type regulator, and the pressure is adjustable with an adjustment screw that is situated underneath the removable threaded protective lid. (See section 34 «Gaz pressure and the adjustment»).

WARNING

The valve is the only way to ensure an automatic shutdown of gas flow. It is therefore very important of to ensure that the gas supply tubes are clean and do not contain any metal leaks or drips. An incomplete closing of the valve is dangerous and can be fatal. This can also prevent proper functioning of the device and will result in the guarantee being void.

39. EXHAUST FAN

The combustion gas exhaust fan motor is permanently lubricated. Clean its surface as needed. It works on a tension of 110V/1/60. Verify the motor's nameplate and the device while ensuring proper voltage supply.

If it is necessary to replace one of the following parts: motor, fan, or squirrel cage, it is very important to replace them by original parts only.

WARNING

The exhaust fan is the only way to ensure that combustion gas evacuates towards the exterior. It is therefore very important to ensure that it is in good working condition and is well connected. An insufficient evacuation is dangerous and can be fatal. This can also prevent proper functioning of the device and will result in the guarantee being void.

40. MAXIMUM AND MINIMUM TEMPERATURE RISE RATING

Heater's series	Rated Maximum Temperature Rise	Rated Minimum Temperature Rise
2.5" dia. Tubes series	55.5°C (100°F)	17°C (30°F)
2.0" dia. Tubes series	55.5°C (100°F)	17°C (30°F)

Table 6 – Temperature rise

41. APPENDIX – ADDITIONAL INFORMATION FOR SiB OPTION

LOW PILOT BURNER CAPACITY STABLE MODULATION RANGE (SMR)

OPTION **SiB** (Gas Control; Suffix 16)

INFORMATION SUPPLEMENT

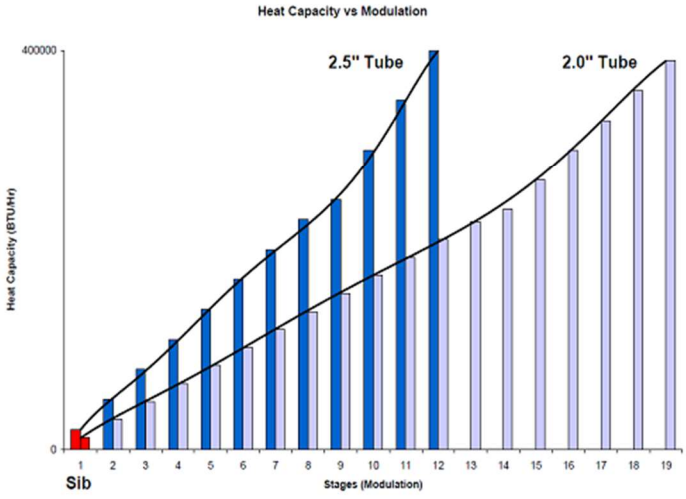
TO SERVICE AND INSTALLATION MANUAL FOR TU, CTU, TW and CTW

This NAGAS option is designed for models TU, CTU, TW and CTW with option SiB.

This NAGAS option is similar as Si option but with a low pilot burner capacity. (Reduces the low fired burner capacity from 60% to 40% at the first burner only).

The principle is that the first burner is equipped with an independent 2 stages gas valve allowing the reduction for the low outlet gas pressure to fire 40% of its maximum capacity.

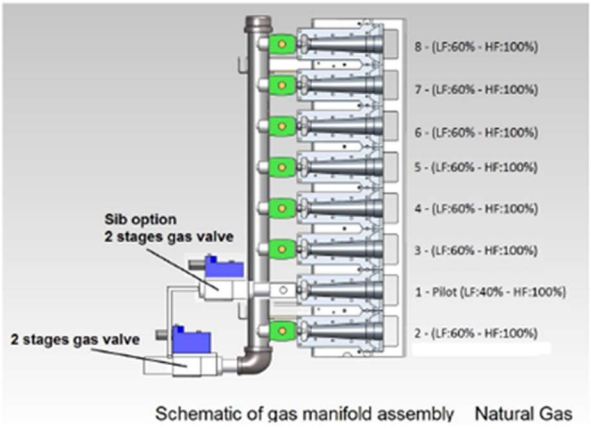
The second stage is use for the normal operation of the appliance when all the burners are set to the maximum high fired burner capacity.



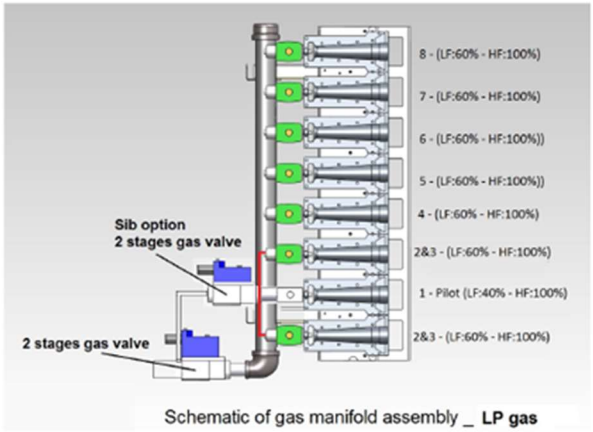
SMR graphic sample (Natural gas SiB option)

NAGAS low pilot burner capacity provides the benefits of a stable extent modulation over the entire range (SMR).

Type of gas: Natural gas and LP gas



Schematic of gas manifold assembly Natural Gas



Schematic of gas manifold assembly _ **LP gas**

Nagas_SiB option 1 V5_2023

Pressure regulation setting: (pressure will be factory-adjusted)

***Natural Gas* pressure regulator specification table** (Pressure in W.C. / kPa)

	Nominal inlet pressure	**Nominal regulator outlet pressure** (white Stern)			
		Sib – Burner orifice Burner #1		Burner's orifices All others	
Burner Capacity	In.w.c. (kPa)	Low fire (40%) In.w.c. (kPa)	High fire (100%) In.w.c. (kPa)	Low fire (60%) In.w.c. (kPa)	High fire (100%) In.w.c. (kPa)
2.0" Tube diameter	7.0 (1,75)	12 MBH / 3.5 kW 0.9 (0.23)	29 MBH / 8.5 kW 5.0 (1.25)	18 MBH / 5.3 kW 1.3 (0,32)	30 MBH / 8.8 kW 3.5 (0,87)
Orifice Size / Decimal / mm		#42 / 0.0935" / 2.37mm		#37 / 0.1040" / 2.64mm	
2.5" Tube diameter	7.0 (1,75)	20 MBH / 5.9 kW 1.0 (0,25)	43 MBH / 12.6 kW 5.0 (1.25)	30 MBH / 8.8 kW 1.6 (0,40)	50 MBH / 14.7 kW 4.2 (1.05)
Orifice Size / Decimal / mm		#32 / 0.1160" / 2.95mm		# -- / 0.1337" / 3,40mm	

For natural gas appliance, the maximum modulation capacity range is **33:1** (for 30MBH burners with 2" tube diameter) or **20:1** (for 50MBH burners with 2.5" tube diameter).

***LP Gas* pressure regulator specification table** (Pressure in W.C. / kPa)

	Nominal inlet pressure	**Nominal regulator outlet pressure** (black Stern) *			
		Sib – Burner orifice Burner #1		Burner's orifices All others	
Burner Capacity	In.w.c. (kPa)	Low fire (80%) ** In.w.c. (kPa)	High fire (100%) In.w.c. (kPa)	Low fire (60%) In.w.c. (kPa)	High fire (100%) In.w.c. (kPa)
2.0" Tube diameter	N/A	N/A		N/A	
Orifice Size / Decimal / mm					
2.5" Tube diameter	12.0 to 14.0 (3,3 to 3,9)	40 MBH / 11.7 kW 7.0 (1.75)	50 MBH / 14.7 kW 11.0 (2.5)	30 MBH / 8.8 kW*** 4.0 (1.00)	50 MBH / 14.7 kW 11.0 (2.5)
Orifice Size / Decimal / mm		#45 / 0.0820" / 2,08mm			

*Used appropriate conversion kit for two-stage combination gas Controls.
**Minimum regulation for LP gas is limited at 40,000 Btuh for two-stage combination gas control.
***Minimum of 2 burners at low fired (2 x 30MBH = 60MBH)

For LP gas appliance, the maximum modulation capacity range is **10:1** (for 50MBH burners with 2.5" tube diameter).

Refer to installation manual or contact your NAGAS Representative at 1-888-514-8007 for more information.