Rev 6_2023

DT SERIES

INDIRECT GAS-FIRED DUCT FURNACE

Indoor or outdoor installation

INSTALLATION AND OPERATION MANUAL

Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters, And Gas-Fired Duct Furnaces
CSA 2.6 and ANSI Z83.8

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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.

WARNING!

THIS INSTRUCTION MANUAL MUST ALWAYS BE AVAILABLE AND KEPT WITH THE HEATER AT ALL TIMES.

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

	**DANGER!**	Indicates a situation of imminent risk that, if not avoided, will result in death or serious injury.
	**WARNING!**	Indicates a potentially risky situation that, if not avoided, could result in death or serious injury.
	**CAUTION!**	Indicates a potentially risky situation that, if not avoided, can result in bodily injury or property damage.
	**NOTES!**	Indicates special instructions for installation, operation or maintenance that are important but are not related to bodily injury or property damage.

- **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.**
- **DO NOT BYPASS LOCK OR SAFETY SWITCHES UNDER ANY CIRCUMSTANCES.**

PROJECT: _____

ADDRESS: _____

MODEL: _____

SERIAL NUMBER: _____

INSTALLER: _____

ADDRESS: _____

PHONE: _____

EMAIL: _____

INSTALLATION DATE: _____

MANUFACTURER: Nagas Innovation Inc.

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Summary

NOTICE: The features, characteristics, illustrations and description of this document were, to the best of our knowledge, accurate at the time of printing. We reserve the right to modify or stop offering certain features as well as to stop producing a given model without notice or commitment on our part. For more information, please contact your local representative and authorized distributor.

1. CODE AND REGULATION

Indirect gas-fired air heater must be installed according to local installation code for gas equipment, and any provincial or state regulation applying to this category of equipment (CSA B149.1 / ANSI Z223.1 / NFPA-54). All electrical installations must comply with Canadian electrical code or American code (CSA C22.1 / NFPA-70), and other local electrical applicable codes.

Any electrical installation to be done internally or externally to the heater must comply with the electrical wiring diagram supplied with the heater. For more information, refer to start-up instructions, operating sequence, and adjustment instructions.

CAUTION!

CLEARANCES TO COMBUSTIBLE MATERIAL

A minimum clearance of 6 inches between the heater and any combustible material is required on all sides and top, 42 inches in front of the access panel and 18 inches all around the flue vent. No clearance is required under the heater.

Allow sufficient space on both sides of the heater for maintenance and allow sufficient space on the air inlet hood side to prevent snow accumulation and do not block the combustion air inlets.

Clearances to combustible materials	
Position	**Inch [mm]**
Controls	42 [1067]
Top	6 [152]
Back	6 [152]
Flue vent	18 [457]
Floor	Non-combustible

Table 1: Clearances to combustibles

WARNING!

- Installation, modification, adjustment or poor maintenance can cause property damage, injury or death. Read the installation, start-up and maintenance instructions carefully before installing, using or repairing the device.
- Units installed within a building must have fresh air for combustion in sufficient quantity to get a good combustion. Refer to CSA B149.1 installation code for Canada and ANSI Z223.1 for USA for more information and minimum requirements.
- Gas units must be connected to a flue vent properly sized to ensure proper and safe operation and flue evacuation to outdoor.
- The instructions below show the recommended installation and use that we have tested and believe to be safe. If the installer decides not to follow these instructions, it will be the installer's responsibility to test and validate the security and functionality.

2. GENERAL INFORMATION

2.1. INTRODUCTION

This manual has been made to simplify the installation, maintenance, and the operation of this equipment. The strict application of these instructions will ensure the conformity of the installation to **Nagas Innovation Inc.** recommendations.

The application of the instructions given in this manual is one of the conditions of the warranty, however it does not guarantee at any time conformity with the applicable laws, rules, codes, and regulations of the country of destination of the equipment installed.

2.2. LISTED PRODUCT

This equipment has been declared to conform to applicable Canadian and American standards (CSA 2.6 and ANSI Z83.8) and bear the cETLus marking.

This equipment is intended for industrial or commercial use only. The installation must comply with the latest laws and regulation for gas heating units CSA B149.1 / ANSI Z223.1 / NFPA-54, to the electrical code CSA C22.1 / NFPA-70 and to local laws, rules, and regulations. All the electrical installation located inside or outside of this equipment must comply with the unit's electrical diagrams.

The electrical and ratings described on the rating plate appear on the unit. Following these ratings is mandatory for a safe use of the unit. To learn more, read this manual carefully.

2.3. RESPONSABILITIES

This equipment must be used specifically for the purposes for which it was designed and manufactured. Any contractual liability of **Nagas Innovation Inc.** is therefore excluded in the event of injury to persons, animals or damage to the goods, as a result of errors in installation, adjustment, maintenance or improper use.

Nagas Innovation Inc. is responsible for the compliance of the device with the codes and construction standards in force at the time of sale. Knowledge of and compliance with the legal provisions as well as the standards inherent in the design, implantation, installation, commissioning or maintenance are the sole responsibility of the installer or integrator.
Be aware that this manual does not cover all possibilities, situations or contingencies. Regular service is required to ensure the proper functioning and safety of this equipment. If you have any doubts about the performance of these tasks yourself, you need to hire a qualified specialist. Negligence in maintenance may cause equipment failure, property damage and/or damage to building occupants and will void the equipment warranty.

2.4. RECEPTION & STORAGE

Upon receipt of the equipment, check that the packaging and contents have not been damaged during shipping. Inspect the packaging for punctures or other signs of damage. Remove the packaging and check if there is no external damage to the unit.

All units that leave our factory are tested and carefully inspected immediately prior to shipment to ensure they are in good working order at that time. Check the packing slip to ensure that all parts for field installation have been received. If damage is found or parts are missing, please contact your local authorized distributor or representative.

If equipment must be stored before being installed on site, you should observe the following precautions:

- Store in a well-drained and dry area that will not accumulate surface water to prevent damage by moisture from wet ground, dew, or rain.
- Do not store where the equipment could be physically damaged.
- Make sure that all protective coverings that were provided for shipping are not damaged and are properly installed over the equipment.
- The entire perimeter and any full height cross members of the unit must be supported by a level surface and the supporting surface must be adequate for supporting the entire weight of the unit.
- Do not stack split unit sections one over the other for storage purpose.

2.5. LIMITED GENERAL WARRANTY

Subject to the terms and conditions hereof, during the first year after the original installation of the product or eighteen (18) months from date of shipment by **Nagas Innovation Inc**. whichever occurs first, we will supply free of charge any component part(s) of our product found to be defective in material or workmanship (except for the heat exchanger section which carries a 5-year warranty). Any replacement part(s) so supplied will be warranted for the balance of our product's original warranty. The part(s) to be replaced must be available in exchange for the replacement part(s). Any labor, material, transportation, freight or other charges incurred in connection with the performance of this warranty will be the responsibility of the owner at the hourly rates and prices then in force. This limited warranty is only applicable to new and unused products purchased from us or from our authorized distributors, provided that our user instructions contained in our user guide have been adhered to. You recognize and understand that our obligation is limited to replacing the part found to be defective and that you have no further recourse the manufacturer.

THIS WARRANTY DOES NOT COVER:

(a) damages caused by accident, abuse, negligence, misuse, riot, fire, flood or Acts of God (b) damages caused by operating the product in a corrosive atmosphere (c) damages caused by any unauthorized alteration or repair of the system affecting the product's reliability or performance (d) damages caused by improper matching or applications of the product or the product's components (e) damages caused by failing to provide routine and proper maintenance or service to the product (f) expenses incurred for erecting, disconnecting or dismantling the product (g) parts used in connection with normal maintenance, such as filters or belts (h) products no longer

at the site of the original installation (i) products installed or operated other than in accordance with the printed instructions, with the local installation or building codes or with good trade practices (j) products lost or stolen.

No one is authorized to change this WARRANTY or to create for us or on our behalf any other obligation or liability in connection with our product(s). There is no other representation, warranty or condition in any respect, expressed or implied, made by or binding upon us other than the above, nor will we be liable in any way for incidental, consequential, or special damages however caused such as but not limited to: loss of productivity, damages caused by delays, loss of profits and management time.

In order to obtain replacement parts under this product's warranty, contact the dealer or contractor who installed or services our products. Only dealers or contractors who are registered with us are authorized to perform this warranty. Should the dealer or the contractor need assistance, the authorized agent for **Nagas Innovation Inc.** is available for support, and we, at **Nagas Innovation Inc.**, in turn, support our agent's efforts.

RETAIN THIS WARRANTY IN YOUR FILES FOR FUTURE REFERENCE

This warranty is expressly given and accepted in lieu of any and all other warranties, expressed or implied, including without any limitation any warranty of merchantability or fitness for a particular purpose. Some states/provinces do not allow for the disclaimers, limitations and exclusions identified above; as a result, they may not apply to you.

2.6. PARTS, REPAIRS AND MAINTENANCE

Any spare parts must be identical or be an approved alternative to the original part supplied. The spare part must meet the specifications of the original in terms of functionality, including certifications, adjustments, range of operation, accuracy and operation. Failure to replace parts or components with equivalent parts may result in equipment failure, equipment damage, injury or death, and may void the equipment warranty.

When contacting **Nagas Innovation Inc.** Customer Service (or an authorized distributor) for parts, repairs or services, please be prepared to provide the model number, serial number, date of installation and nature of the failure as well as a description of the required parts. Be aware that some parts may not be items in inventory, that these parts must be manufactured or ordered. Variable delays can be expected depending on the nature of the damage to the defective equipment or part.

DANGER!

Always unplug the power supply before working on or near this equipment. Lock and label the disconnect switch or circuit breaker to prevent accidental power on.

When servicing the unit, the internal components may be hot. Allow time for cooling before maintenance.

2.7. NORMAL USAGE

This indirect gas-fired heater is intended for indoor or outdoor installation, in air ducts, or in air handling unit made by original equipment manufacturers (OEM) of listed heating equipment in cabinet. It must be mounted on the positive side of the circulating air blower and may be downstream of refrigeration system. This product is designed to serve as a heating for make-up air or/and recirculated air. The unit must be installed on non-combustible surfaces, duct, or wall, and located in a neutral pressure environment. It can operate with a minimum thermal efficiency of 80 % and use natural or propane gas. The heating output capacities available range from 550 to 5,000 MBH (160 to 1,471 kW) and from 4,244 to 92,593 SCFM (2,003 to 43,690 L/s) of air at temperature differential of 50°F to 120°F (28°C to 67°C). **The maximum discharge temperature is limited to 130°F (55°C) at 3.00 in.w.c. (747 Pa) maximum external static pressure. The discharge temperature high limit protection is factory set at 160°F (71°C).**

3. SPECIFICATIONS

MODEL	INPUT CAPACITY		NET OUTPUT CAPACITY		TURNDOWN RATIO	AIRFLOW			
						CFM		L/S	
	MBTU	KW	MBTU	KW		MIN	MAX	MIN	MAX
55	688	200	550	160	10:1	4244	10185	2003	4808
65	813	237	650	189	10:1	5015	12037	2368	5682
75	938	273	750	219	10:1	5787	13889	2732	6556
85	1063	310	850	248	12:1	6559	15741	3096	7430
100	1250	364	1000	291	12:1	7716	18519	3642	8742
125	1563	455	1250	364	12:1	9645	23148	4553	10927
150	1875	546	1500	437	12:1	11574	27778	5464	13112
175	2188	638	1750	510	17:1	13503	32407	6374	15298
200	2500	729	2000	583	18:1	15432	37037	7285	17483
250	3125	911	2500	729	15:1	19290	46296	9106	21854
300	3750	1093	3000	874	15:1	23148	55556	10927	26225
350	4375	1275	3500	1020	18:1	27006	64815	12748	30596
400	5000	1457	4000	1166	20:1	30864	74074	14569	34966
500	6250	1821	5000	1457	20:1	38580	92593	18212	43708

Table 2: General specifications

NOTES:

- **Net output capacities are based on 80% combustion efficiency for natural gas, some models may have higher efficiency**
- **Airflow is intended for temperature rise of 50°F to 120°F (28°C to 67°C)**
- **1 MBTU: 1000 BTU/ Hr**
- **CFM: Cubic foot per minute**
- **Ratings are based on 1000 Btu/ft^3 for natural gas at sea level**
- **Reduce burner capacity for altitude over 2000ft by 4% for each 1000ft above sea level**
- **Consult factory for turndown ratio for propane gas**

4. INSTALLATION GUIDELINES

4.1. GENERAL

- Install the unit on the positive side of the air-circulating blower (supply side). In other words, the fan must be installed upstream of the duct heater.
- Duct furnace shall be installed with an inlet duct that will provide air distribution equivalent to a straight run of duct having the same cross-sectional area as the inlet connection and not less than 2 equivalent diameters in length.
- Centrifugal twin blower, plenum blower, and centrifugal single blower (with diffuser plate) to provide the airflow required by the duct heater.
- The installation must be adjusted to obtain an air throughput within the range specified on the appliance rating plate.
- Always use a bypass damper for applications where temperature rise is below 50°F through the duct heater.
- The fan motor contact and/or flow proving switch must be wired to the burner safety loop.
- The final air temperature should be controlled by a duct temperature sensor located downstream of the duct heater. The sensor must be installed at a position where it will measure the average duct temperature (field testing may be required to find the optimal position).
- The installation must be adjusted to obtain a temperature rise within the range specified on the unit heater rating plate.
- The appliance shall be adjusted to the manifold pressure specified on the manufacturer's rating plate.
- The ducts connected to the duct furnace shall have removable access panels on both upstream and downstream sides of the duct furnace. These openings shall be accessible when the appliance is installed in service and shall be of such size that smoke or reflected light may be observed inside the casing to indicate the presence of leaks in the heating element. The cover for the opening shall be attached in such a manner as to prevent leaks.
- The air intake must be located and oriented to prevent infiltration of snow, rain, and flammable toxic gas, as well as any other harmful material in the make-up air heater.
- For indoor installation make sure that the minimum airflow required for combustion is sufficient in the room where the duct heater is installed (refer to local code in effect).
- Always make sure that the air used for combustion by the gas burner is clean and free of dust and corrosive particles or it could greatly reduce the service life of the unit.

4.2. TYPICAL ARRANGEMENT

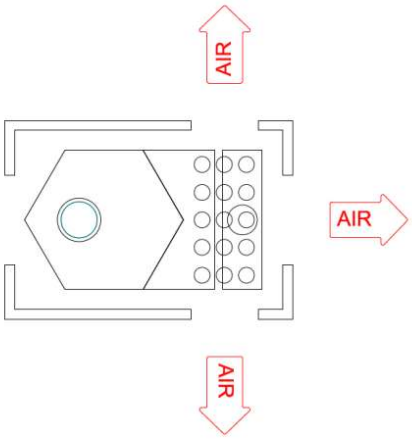


Figure 1: Horizontal (multiple air discharge configuration available)

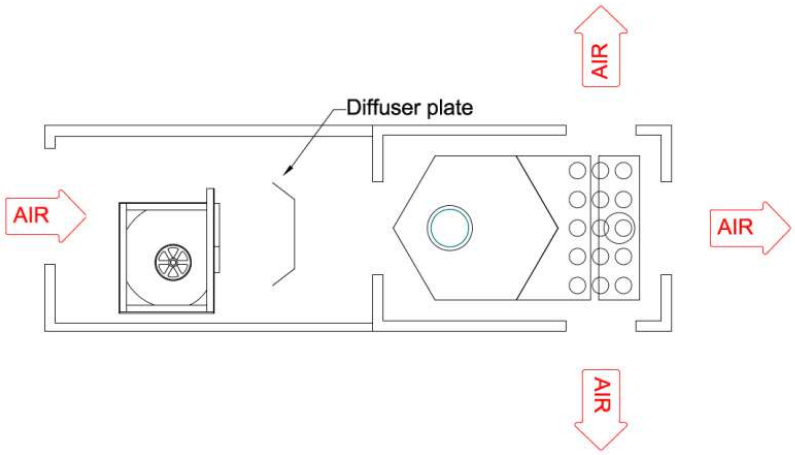


Figure 2: Single or Twin DWDI blowers with diffuser plate and horizontal arrangement (Do not use SWSI blower)

Single or multiple plenum blower can be used in any configurations. For application with high air flow. Temperature rises below 60°F to reduce system pressure loss (x = fan wheel diameter)

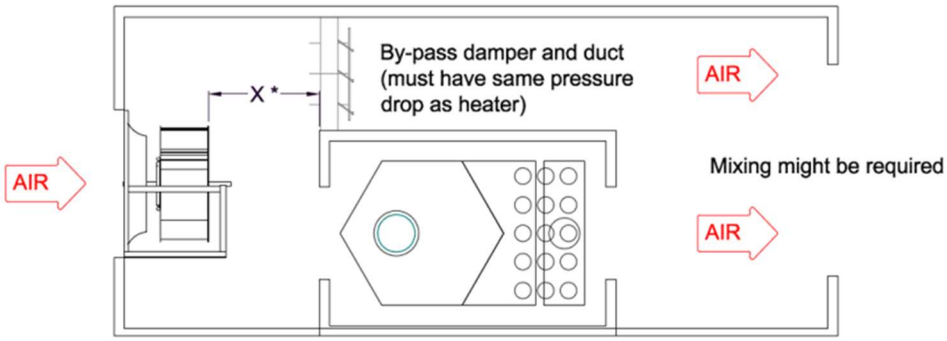


Figure 3: Single or multiple plenum blower with horizontal arrangement

4.3. INSTALLATION

- When the heater is hung over a work area, it must be installed at an adequate height. The installation of a service platform might be required.
- When fire dampers are used in the ducts, they must be equipped with an electric switch wired to the safety control circuit of the unit to shut down the air heater when fire is detected in ducts. These electric switches must be wired to re-activate the safety circuit only when the fire dampers are completely opened.
- To prevent any risk of freeze-up, the installer must install a low temperature switch if not supplied with the unit from the factory.
- Depending on unit size, diameters of the flue gas connection vary between 6 and 14 inches. DT series combustion systems are designed to operate safely against a maximum back pressure of 0.25" water column with positive stock category IV type sealed corrosion resistant single wall or double wall flue vent, either in a vertical arrangement (through the roof) or in a horizontal arrangement (through the wall), or a combination of both.
- The heater should be attached to the roof curb or supporting structure with screws, bolts, or any other appropriate fastening means.
- In some conditions the heater could produce condensate which is a corrosive liquid that must be treated and drain correctly with provision to prevent freezing, or the heater could become flooded and/or cause water damage in the surrounding area.

4.4. LIFTING

The heater is built on a base frame equipped with lifting lugs specifically located to help proper lifting of the unit. Employ the use of spreader bar to maintain a vertical position of the slings and keep them away from the unit casing to prevent *scratches*, surface blemishes or other structural damages. The lifting lugs are designed to be lifted straight up vertically; the maximum angle from a vertical lift which is allowed is 30 degrees. All lifting lugs must be used at to distribute load properly and the equipment must be lifted simultaneously by all the lifting lugs.

NOTICE!

If using a lift truck, ONLY lift using the perimeter base frame. DO NOT allow forks to lift on unit casing or unit floor, it can be easily damaged.

CAUTION!

DO NOT handle the unit by attaching hooks, jacks, slings, or chains to any component or parts protruding outside of the unit casing or base frame (except lifting lugs for vertical lifting only) otherwise it may result in equipment damage, incorrect system operation or personal injury.

WARNING!

Injury or death can result from incorrect rigging and lifting, these maneuvers must be performed by qualified crane operator with proper equipment using appropriate and approved safety precautions.

4.5. MOUNTING

This equipment must be mounted level to the ground to prevent operational issues.

The heater is designed for two types of mounting:

1. Base mounting: The total perimeter base frame structure must be supported level by high density concrete or adequate steel beam. Refer to the shop drawing for mounting information.

2. Roof curb mounting: Roof curbs are fabricated of heavy gauge load bearing, galvanized steel, and must be fully insulated after installation by the installing contractor. Wood nailed strips are provided for easy attachment of roof flashing. A gasket material must be field mounted on the curb to seal the joint between the curb and the unit frame. The curb must be supported along its entire perimeter and any full height cross members as shown on the shop drawing. Point loading of the roof curbs is not acceptable.

NOTICE!

Only use the closed cell foam gasket provided for sealing the curb.

WARNING!

This equipment has not been designed for suspended mounting without special mounting frame. If you intend to suspend this equipment you must provide your own custom base mounting. DO NOT USE lifting lugs to attach hanger rods. This special installation must comply with local codes and applicable OSHA standards/requirements.

4.6. UNPACKAGING

Prior to installation and before you start operating the equipment, you must remove packaging and shipping materials; it may include but are not limited to:

- Protective covers over openings, inlets, outlets, etc.
- Tie-down bolts, corner covers, plastic film, tape, and straps.

Always dispose of shipping and packaging materials according to the respective local regulations in such a way that it may not cause any harm and/or pollution.

Be sure that all shipped-separate accessories for the installation are available. Shipped-separate accessories could include a roof curb, a supply gas regulator, heated drain line, or condensate neutralization kit. Be sure that all necessary equipment, tools, and manpower are available at the installation site.

4.7. ELECTRICAL OR CONTROL SERVICE CONNECTIONS

This equipment is built with unit casing and floors designed to prevent water from penetrating the building through the installed equipment.
All penetrations through the unit walls must be caulked and sealed to prevent air and/or water from entering the unit.

NOTICE!

DO NOT install anything that will interfere with equipment access or the rating labels.

THE FLOOR OF THE UNIT HAS BEEN MADE WATER-RESISTANT. DO NOT CUT OR DRILL HOLES IN THE FLOOR OR USE PENETRATING FASTENERS.

Control voltage is as indicated on the rating label.
Follow the wiring diagram supplied with the equipment.
Field wiring to be done by a qualified electrician is denoted by dotted lines on the wiring diagram, solid lines indicated factory wiring by the manufacturer.

CAUTION!

Screw terminals may become loose during equipment shipment; they should be retightened prior to starting and operating unit.

4.8. ELECTRICAL INSTALLATION

The unit must be electrically grounded, and all wiring must be installed by a qualified electrician in accordance with the National Electrical Code (ANSI/NFPA-70) and/or the Canadian Electric Code (CSA C22.1) and to the approval of the authorities having jurisdiction.

Field wiring diagrams and internal wiring diagrams are included in the control cabinet. The power requirements are indicated on the rating label. See the field wiring diagram for requirements for shielded or twisted pair wire for solid state devices.

NOTICE!

When connecting to a three phases power supply, check for the correct rotation of all motors and fans. If the rotation is incorrect, reverse the rotation at the incoming power only.

All electrical conduit outlets in the control panel must be sealed to prevent moist building air from migrating to the control panel.

All penetrations through the unit walls must be caulked and sealed to prevent air and/or water from entering the unit.

WARNING!

No unspecified and unapproved external load shall be added to the control transformer circuit(s) or to the main power circuit(s) without the written consent from Nagas Innovation Inc. or the warranty will be void.

5. GAS PIPING CONNECTION

For units installed indoor, purge and vent connections must be piped individually towards the outdoor as stated by CSA B149.1 or other local codes in effect.

GAS CONNECTIONS PIPE SIZES (NPT)	
MODEL	GAS CONNECTION 1/2 PSIG (14 in.w.c.)
	National pipe thread
55 to 75	1'' NPT
85 to 175	1-1/2'' NPT
200 to 350	2'' NPT
400 to 500	3'' NPT

Table 3: Gas connection pipe sizes

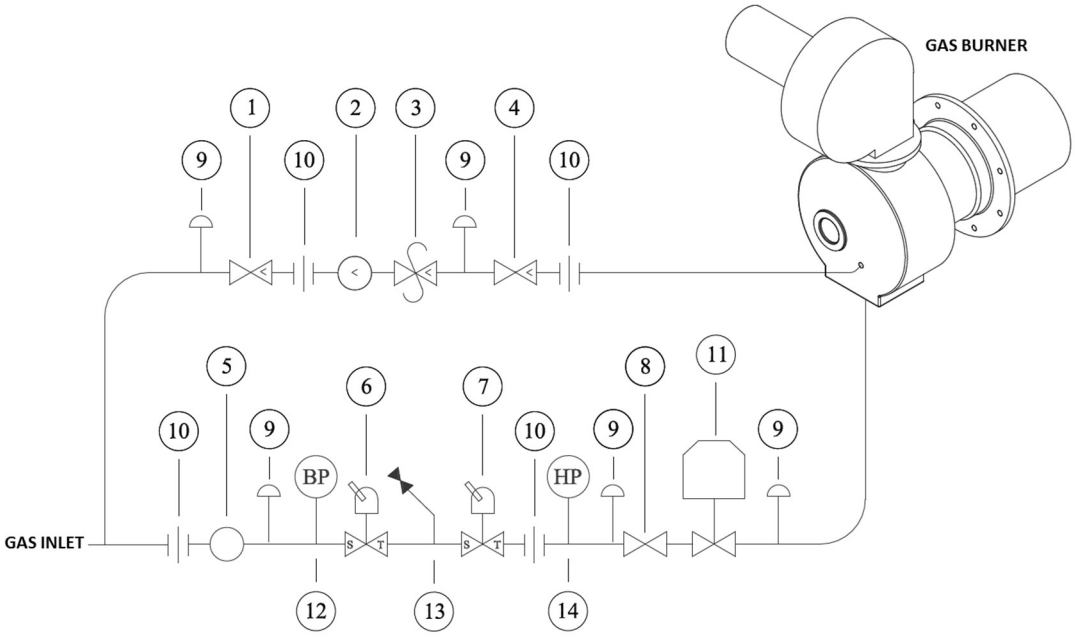
VENT SIZES (NPT)		
MODEL	REGULATOR	PURGE VALVE (OPTIONNAL)
	National pipe thread	
55 to 75	N/A*	3/4'' NPT
85 to 175	N/A*	3/4'' NPT
200 to 350	1/2'' NPT	1'' NPT)
400 to 500	3/4'' NPT	1-1/2'' NPT

Table 4: Vent sizes

NOTES:

1. **Table 3 should not be used to size the gas supply line.**
2. **If gas pressure exceeds 1/2 psig (14 inches w.c.), a high-pressure regulator must be installed at gas piping inlet.**
3. **The regulator must be suitable for modulation in a ratio of 20:1, to properly regulate gas pressure at low fire.**
4. **The regulator vents and purge (IRI option) must be piped separately towards the outdoor as stated by CSA B149.1 for Canada and ANSI Z223 for USA and local codes.**
5. ***Vent limiter factory installed. To be used in ventilated space only. In other case the regulator vent must be piped to outdoor. Use ½'' NPT pipe tubing.**

6. TYPICAL GAS TRAIN



ITEM #	DESCRIPTION
	PILOT PIPING
1	Manual shut-off valve
2	Gas pressure regulator
3	Automatic shut-off valve
4	Manual ignition cock
	MAIN BURNER PIPING
5	Pressure regulator
6	Automatic safety shut-off valve
7	Automatic safety shut-off valve
8	Manual ignition cock
9	1/8'' NPT diameter test port
10	Piping union
11	Modulating valve
	OPTIONS
12	Low gas pressure switch (required for FM, IRI and pressure more than 1/2 psig)
13	Normally open automatic vent valve (required for IRI)
14	High gas pressure switch (required for FM, IRI and pressure more than 1/2 psig)

Table 5: Typical gas train components

7. INLET GAS PRESSURE

Model	Natural Gas			
	Dynamic supply pressure		Nominal Manifold pressure	Pilot pressure
	Minimum In.w.c [kPa]	Maximum In.w.c [kPa]	At maximum capacity In.w.c [kPa]	In.w.c [kPa]
55	10” [2.5]	14” [3.5]	(Consult rating plate or factory)	3.5” [0.87]
65				
75				
85				
100				
125				
150				
175				
200				
250				
300				
350				
400				

Table 6: Inlet gas pressure

Note: Consult factory or rating plate for propane gas inlet and manifold pressures

8. HEATER SHUTDOWN

8.1. EXTENDED SHUTDOWN

When the heater is shut down for a long period of time, it is recommended to shut off gas and electric power. Before turning ON the heater after an extended shutdown, make sure all the air is purged from the gas piping, and that gas pressure is adequate. A complete installation and unit inspection is recommended to make sure that everything is in order.

8.2. EMERGENCY SHUTDOWN

When the heater shuts down in emergency, main electrical disconnect should be turned OFF, and gas supply closed by shutting off the manual gas valve located in the supply gas line, out of the unit.

8.3. HEATER ON AFTER A FLAME FAILURE ALARM

After a flame failure alarm, perform the following checks:

BURNER

1. Ensure that all gas supply manual valves are opened;
2. Check status of the flame safeguard relay (For problems, refer to troubleshooting section);
3. Check pilot flame rod and spark igniter;
4. Place main electrical disconnect to ON position;
5. Press the reset button of the flame safeguard relay;
6. Ensure that the blower motor is operating;
7. Ensure that the pilot ignites properly;
8. Fix all problems and repeat the start-up procedure.

9. FLUE VENT & COMBUSTION AIR INTAKE

Depending on the model, the flue vent connector diameter ranges from 6 to 14 inches. The heater is designed to operate effectively and safely (against a positive pressure of 0.25 in.w.c) with a **positive stack (category IV) type** corrosion resistant single wall or double wall sealed flue vent **listed** for this application, with minimum continuous temperature of at least **550°F**, whether it is for vertical arrangement, horizontal arrangement, or a combination of both.

The minimum diameter of all sections must be identical to the connection diameter found on the heater or greater. **Do not mix different listed vent system parts from different manufacturers in the same venting system. Do not connect vent pipe in a common manifold with another device. It is required that each heater be vented individually.**

A listed vent cap or termination with (at least) the same diameter as the exhaust pipe of the heater must be used at the end of the ducting located outside of the building. See **Figure *4*** to **Figure *6*** showing the recommended end cap and configurations.

The exhaust pipe must end outside of the building and comply (at least but not limited to) the following clearances:

Structure	Minimum Vent Terminal Clearances
Motorized 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') above and 1.8m (6') to the side
Door, openable window, revolving door, 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 from another service	0.9m (3')
Building or adjacent wall or parapet	1.8m (6') (might have to be increased for horizontal discharge)
Sidewalk or parking lot	2.1m (7') above
Ground vent	0.3m (1') above snow level
Wall of vent outlet	0.3m (1') minimum
Roof of vent outlet	0.9m (3') minimum and 0.6m (2') above all obstacles within less than 3m (10')

Table 7: Minimum clearances for vent terminals

NOTES:

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

- **Vent installations shall conform with local codes or, in the absence of local codes, with the National Fuel Gas Code, ANSI Z223.1/NFPA 54, or the Natural Gas and Propane Installation Code, CSA B149.1. Local codes always supersede the above provisions.**
- **Take all necessary precautions to avoid the installation of vent outlets where snow accumulation can occur naturally or due to roof snow slides or snow removal dumps. In the case of a horizontal**

exhaust, a secure distance of 3m (10') must be added to the distance found in the Table 7 for horizontal direction, measured from the mechanical or gravity air intakes.

- **Improperly sized venting system could result in formation of condensate, leakage, and/or spillage.**
- **Always follow manufacturer's installation instructions.**

A double-wall corrosion resistant pipe section is required to pass through the external walls of the building. Make sure to have provision for combustion testing port close to the unit for verifications and adjustments.

The flue vent joints must be sealed so that it will not allow leakage of the combustion product into the room.

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

Flue vent size must be at least the same size as the heater outlet connections and have a **maximum calculated equivalent length of 100 ft**. The equivalent length is calculated by adding the lengths of straight sections of the flue vent, to the equivalent length of all the elbow pipes used. A 90 degree elbow pipes has an equivalent length of 3m (10') and a 45 degree angle elbow pipes has an equivalent length of 1.5m (5').

Model	Flue Vent diameter (minimum)		Combustion Air intake diameter (minimum)	
	Inches	mm	Inches	mm
DT 55	6	152.4	8	203.2
DT 65-175	8	203.2	10	254.0
DT 200-400	10	254.0	12	304.8
DT 500	14	355.6	14	355.6

Table 8: Separated combustion vent sizes

A slope of at least 48:1 (1/4" per feet) must be maintained on the entire length of the horizontal sections to prevent accumulation of condensation in a horizontal exhaust pipe. If a horizontal section is followed by a vertical section, a "T" section with drain can be added where the condensation may accumulate.

Cover the flue vent on its entire length with thermal liner material to prevent condensation formation while the burner is operating. If the room temperature is maintained below 10°C (50°F) 1/2 inch thick fiberglass insulation should be sufficient.

It is very important not to position the vent outlet towards a fresh air duct, another device's combustion air intake, or any other opening of a building. It is possible that the clearances indicated in table above, from the vent cap, are not suitable because of the horizontal release of the combustion products. Special attention must be taken for 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 combustion flue gas 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 flue vent extension.

CAUTION!

In some conditions the heater can produce condensate. This corrosive liquid must be treated and drain correctly with provision to prevent freezing.

WARNING!

The thermal liner material is used it must be able to withstand temperature of at least 288°C (550°F). The vent pipe may be very hot when the burner is operating.

WARNING!

Two or several units installed in a common or independent ventilation 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.

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

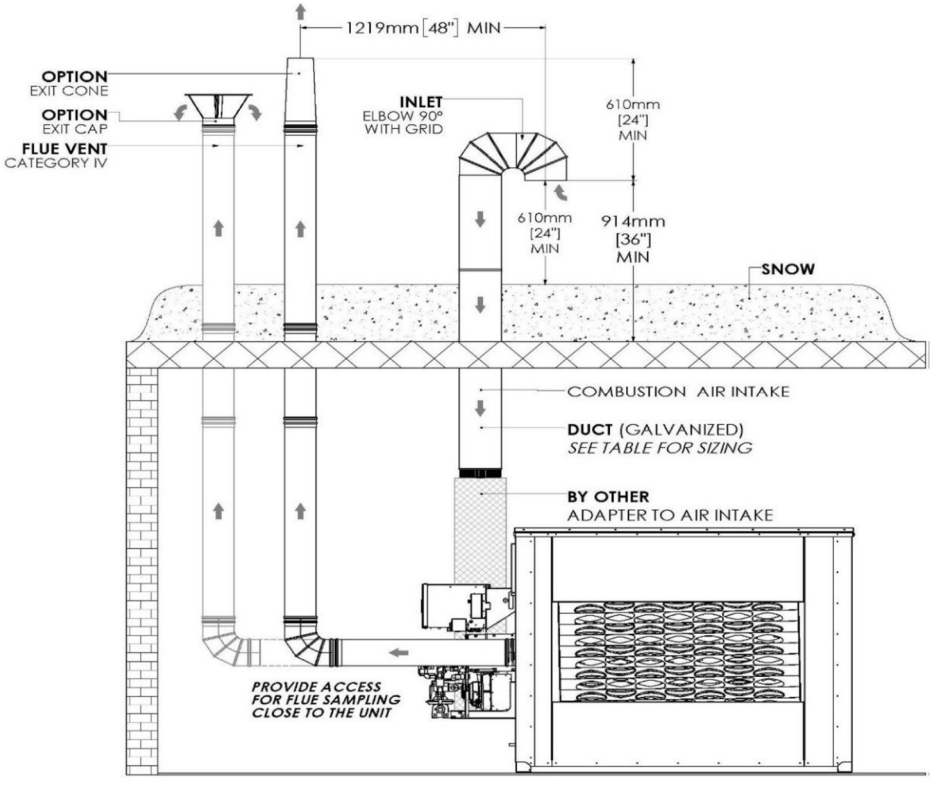


Figure 4: Recommended roof top Flue Vent Exhaust and/or Combustion Air Duct

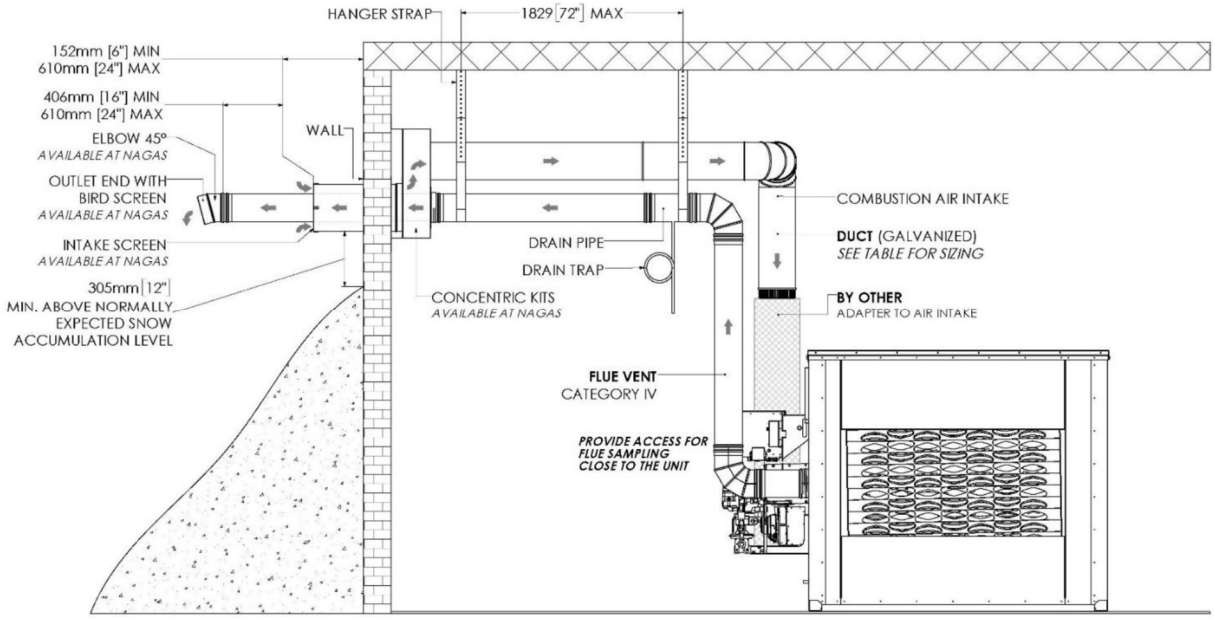


Figure 5: Recommended wall horizontal Flue Vent Exhaust and Combustion Air Duct – Concentric kit

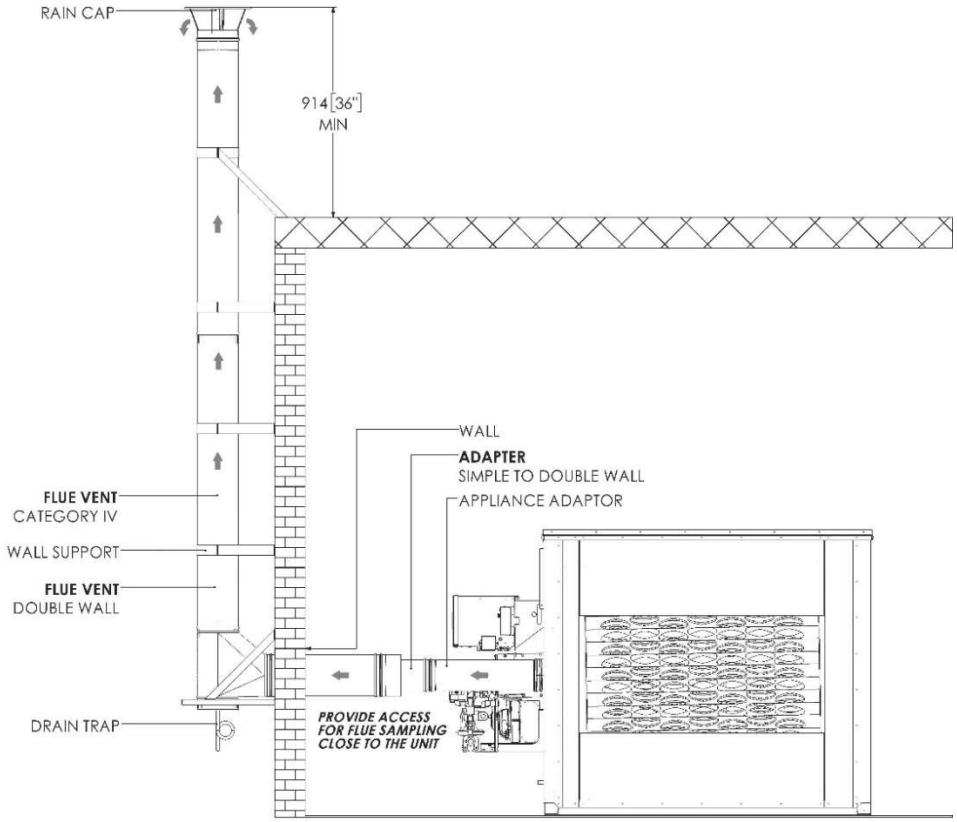


Figure 6: Recommended wall vertical Flue Vent Exhaust

10. START-UP INSTRUCTIONS

WARNING!

DO NOT SMOKE during gas heater start-up

The following information should only be used by a qualified technician for gas equipment installation (with qualification cards) with knowledge in electricity and ventilation.

This unit is connected to high voltages and contains moving parts that can start unexpectedly. Electrical shock, severe injury or death could occur if instructions given in this manual are not followed. Always disconnect and lock out power before servicing this equipment. All work should be done by a qualified technician. DO NOT bypass any interlock or safety switches under any circumstances.

Proper commissioning of this equipment is the responsibility of the installing contractor. It is recommended that an air balance be completed before the unit start up by a certified air balancing contractor to ensure that the air volume being sent downstream of the unit into the ventilation system matches the unit rating label. Failure to perform a proper air balance can cause injury or death, damage to the equipment, property damage, system operational problems, or be a cause of poor indoor air quality. Moisture carries over can also result from improper air flow.

10.1. RECOMMENDED TOOLS

Voltmeter
Ammeter
Air temperature reading device
Tachometer (Fan & motor [rpm])
Pressure gauge
  0 - 5 in. w.c.
  0 - 20 in. w.c.
Combustion analyzer
Flat and Philips Screwdrivers
Hex Wrenches

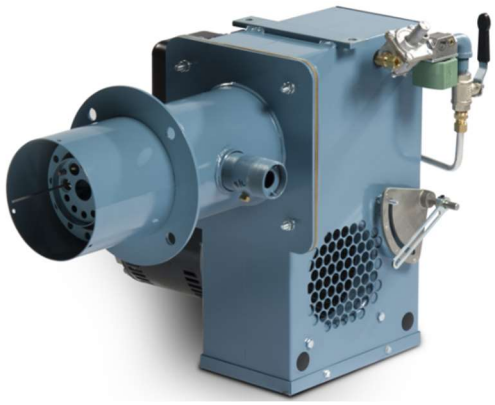


Figure 7: Typical model "C" gas burner from GP Combustion

10.2. BURNER ADJUSTMENT

- Make sure that all vents and bleed valves are piped adequately.
- Make sure that combustion air openings are operational and not blocked.
- Install a pressure gauge (0-20 in. w.c.) on gas piping inlet on the test port located upstream of the low-pressure regulator.
- Make sure that the gas inlet pressure complies with values found in **Table *6***.
- Install the (0-5 in.w.c.) pressure gauge on the test port located at burner inlet, downstream of the modulating valve (butterfly valve) see **Figure *8***.

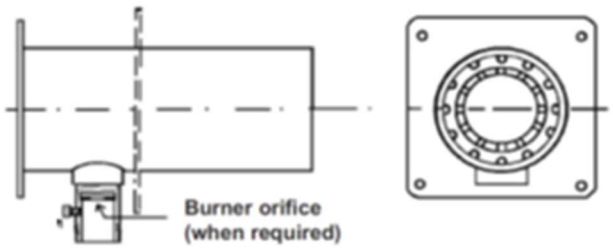


Figure 8: Burner pressure test port location Model "C"

- Ensure that all the air is completely purged from gas piping.

NOTE: For this test, turn OFF the main electrical disconnect

- Check burner fan rotation and modify electrical connections if required.
- Ensure that the contactor overload relays are set according to the full load amperage (FLA) as indicated on burner motor name plate.
- Check spark igniter electrode adjustment; check pilot flame rod adjustment.
- Spark ignition electrode must be positioned and oriented as shown in **Figure *9*** and **Figure *10***.

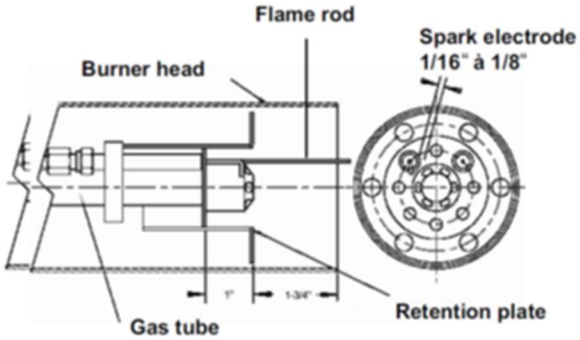


Figure 9: "C4" model only

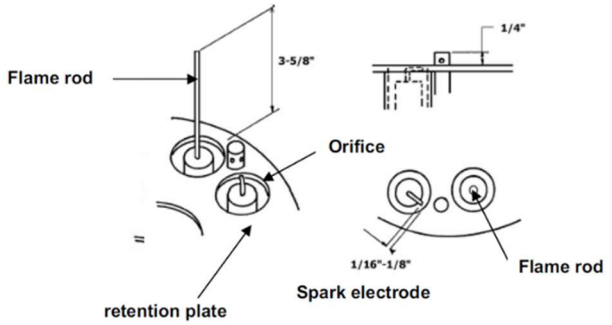


Figure 10: "C6" to "C12" models

- The horizontal portion of the electrode must be aligned with the top face of the retention plate.
- Electrode gap must be adjusted between 1/16" and 1/8"
- For model C4, this gap is the distance between electrode tip and the burner nozzle. For burner models C6 to C12, the gap is the distance between the electrode tip and the edge of the orifice in the retention plate.

NOTE: The flame detector illustrated is a flame rod. It could be replaced by a « UV » type flame detector. In that case, the UV tube must be placed in the same support used to install the flame rod.

10.3. PILOT ADJUSTMENT

- Turn ON main electrical disconnect and turn control panel selector to BURNER position.
- Close the manual burner gas valve located upstream of the electric valves. Open pilot manual gas valve.
- Ensure that there is no heat demand to gas modulating valve (low fire position).

- Check pilot lighting sequence. Take a reading of the flame signal (5-10 VDC), and adjust the signal corresponding to gas pressure available, after the pilot pressure regulator, to get the optimum signal.

10.4. COMBUSTIONS ADJUSTMENT

For the combustion test, it is recommended to use a (0-10 VDC) manual potentiometer to simulate full modulation range of the burner.

Step 1: Full fire adjustment

Run the burner to its maximum position (high fire). Adjust the burner capacity in accordance with Table 2.

Table 2 data correspond to the values established by the manufacturer during a factory test and represents those for the required burner capacity.

These data correspond to the desired pressure readings at main gas inlet connection and at burner, to get the right unit capacity.

Calibration specified in Table 2 is obtained by adjusting the gas pressure regulator of the burner.

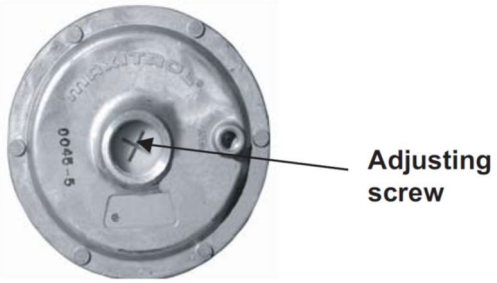


Figure 11: Gas pressure regulator

NOTE:

- Turning the adjustment screw clockwise increases the gas pressure and burner capacity.
- Turning the adjustment screw counterclockwise decreases the gas pressure and burner capacity.

Factory final adjustments	
Serial No.	
Inlet pressure - burner off	
Inlet pressure - high fire	
Pressure at burner - high fire	

Table 9: Burner section factory test data

Step 2: Combustion readings

Take O_2 and CO readings. Ideally O_2 shall be around 5% at high fire with CO not exceeding 0.04% (400 ppm).

If required, to increase or decrease O_2 concentration, proceed as follow:

- Position burner at HIGH FIRE

- Mark the actual position on the adjustment quadrant (or circular variable inlet vane*)
- Stop the burner
- Unscrew adjustment rod ball joint
- Slightly slide the ball joint in lever arm slot to the desired position. Mark the new position
- Re-open gas and repeat high fire test

*DT-500 burner only

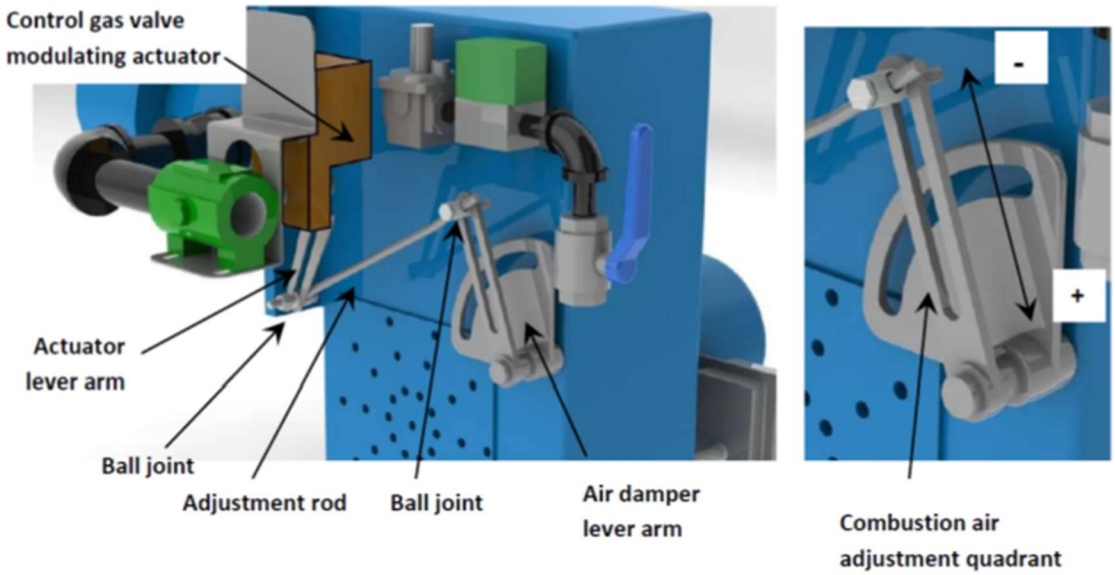


Figure 12: Burner linkage details

Step 3: Low fire adjustment

Run burner to LOW FIRE position. Take combustion readings and adjust to measure 0.04% CO (400 ppm) maximum.

NOTE: It is normal to have high O_2 reading. Mark the position.

Make adjustments for the complete range of modulation between both high and low fire marks. Take combustion readings over all the modulation range of the burner. Don't forget to tighten all adjusting screws and to complete the start-up report.

WARNING!

Do not adjust burner flame only visually. Using a combustion analyzer and combustion instruments is the only recommended method to adequately adjust burner combustion.

11. CONTROL SEQUENCE

STARTING UP THE BURNER

1. Create a heating demand.
2. Burner combustion air fan starts.
3. Combustion air damper opens completely to perform a complete purge of the heat exchanger and returns to low fire position.
4. Pilot operation is allowed when burner fan pressure switch and high temperature limit switches are closed. Pilot ignites and is proven.
5. The main burner operates and modulates according to an external signal (0-10 volts or 4-20 mA).
6. When demand for heating is satisfied, the post purge sequence maintains the burner in operation with the combustion air fully opened to exhaust all remaining flue gas from the heat exchanger.
7. Burner stops and is now ready for a new heat demand.

Note: For general guidance purpose only, always refer to the control sequence and wiring diagram provided with the heater.

12. TROUBLESHOOTING

12.1. FIREYE NORMAL OPERATING SEQUENCE

The ***FIREYE*** flame safeguard relay includes five lights to indicate that the operating sequence is normal and also to indicate burner malfunction.

1. The (OPR CTRL) light is on when there is a heating demand and terminal 7 is energized.
2. The (AIR FLOW) light comes on when all safety devices as well as the low and high air pressure switches, and high temperature switch are closed and terminal 6 is energized.
3. The (PTFI) light is on during pilot ignition sequence.
4. The (FLAME) light is on only when flame safeguard relay detects a good flame signal and is not in alarm mode.
5. The (ALARM) light flashes when a malfunction is detected.

NOTES:

1. During an alarm, the ALARM light that corresponds to the malfunction flashes at 1 second intervals. The status of the other four lights indicates the type of malfunction (see **Table *10***).
2. Pressing down the reset button brings back the flame safeguard relay to its normal operating mode.
3. The last 6 alarm codes are stored in the relay's memory. A plug-in display is required to read them.

12.2. STATUS OF WARNING LIGHTS (FIREYE)

The table below lists the most common and important codes concerning unit operation.

(Refer to manufacturer for other codes not listed in this table).

NOTE: A complete troubleshooting list is shown in **Table *11***

TROUBLE CODE	TROUBLE DESCRIPTION (ALARMS)	OPR CTRL	AIR FLOW	PTFI	FLAME	ALARM
6	FREQUENCY NOISE	●	O	O	●	*
7	PILOT FLAME FAILURE (PTFI)	O	●	●	●	*
19	BURNER FLAME FAILURE (MTFI)	O	O	●	●	*
21	OPEN AIR PRESSURE SWITCH	●	●	●	O	*
54	GROUND FAULT	O	O	O	●	*
55	FAULTY PROGRAMMER	O	O	●	O	*
56	FAULTY AMPLIFIER	●	O	O	O	*

Table 10: Status warning lights (Fireye)

WARNING LIGHTS:
● = OFF

O = ON

* = FLASHING

Figure 13: FIREYE flame safeguard relay

12.3. HONEYWELL NORMAL OPERATING SEQUENCE

The HONEYWELL flame safeguard relay has five (5) lights that show that the operating sequence is normal and also to indicate burner malfunctions. When flashing the ALARM light indicates a burner malfunction. To identify the anomaly, use the HONEYWELL S8700 keyboard display module.

1. The (POWER) light flashes to indicate that the flame safeguard is energized and that there is no heating demand.
2. The (PILOT) light is ON when there is a heating demand and the pilot control valve coil as well as the ignition transformer is energized.
3. The (FLAME) light is ON when the flame safeguard relay detects a pilot flame signal for 10 seconds.
4. The (MAIN) light is ON when the flame safeguard relay detects a stable flame signal for 10 seconds and all safety devices, low and high air pressure as well as high temperature limit switches is closed between terminals 6 and 7.
5. The (ALARM) lights flashes when a malfunction is detected. Refer to the troubleshooting check list to establish diagnostic.

NOTE: Pressing the reset button brings the flame safeguard relay back to its normal operating mode and burner will restart.

Figure 14: Honeywell flame safeguard relay and keyboard module

12.4. TROUBLESHOOTING CHECK LIST

NOTE: Refer to the normal operating sequence and service check list below to identify possible causes of problems.

The ***Honeywell S7800A*** keyboard module displays the following trouble codes which are the most important regarding the operation of the heater. (Refer to the manufacturer for any code not listed below).

FIREYE AND HONEYWELL TROUBLESHOOTING CHECK LIST		
SYMPTOMS	**CORRECTIVE ACTION**	
✓ The burner is off.	1. Turn ON main disconnect switch 2. Check for heat request command 3. Check line voltage 4. Check secondary circuit fuse (120 volts) 5. If ALARM light of the flame safeguard relay (FIREYE or HONEYWELL) flashes, press the reset button 6. Check adjustment of the overload relay of the fan motor; re-adjust if necessary 7. Check if flue vent or combustion air intake are blocked or if there is too much restriction in the ducting 8. Check if heat exchanger or condensate drain are blocked 9. Check if pressure switches are defective 10. Consult factory	
✓ Frequency noise CODE (6) FIREYE	1. Check for a high voltage source close to the flame safeguard relay 2. Check electrical wiring between building distribution panel and the heater 3. Consult factory	
✓ Flame failure (PTFI) CODE (7) FIREYE CODE (28) HONEYWELL NOTE: The flame safeguard relay goes into alarm mode during the pilot ignition cycle.	1. Check pilot gas supply 2. Check pilot ignition transformer 3. Check flame signal intensity (pilot only: it should range between 5 and 10 VDC for Fireye or between 3 and 5 VDC for Honeywell) 4. Check if manual and electric pilot gas supply valves are opened 5. Check condition of the flame rod ceramic; replace if necessary 6. Check the flame safeguard amplifier; replace if necessary 7. Refer to the manufacturer	
✓ Flame failure (MTFI) CODE (19) FIREYE CODE (17) HONEYWELL NOTE: The flame safeguard relay goes into alarm mode during the pilot ignition cycle.	1. Check if a gas interruption has occurred during heater operation 2. With burner in operation, check gas pressure at burner manifold 3. Check flame signal intensity (pilot only: it should range between 5 and 10 VDC for Fireye or between 3 and 5 VDC for Honeywell over the entire modulation range) 4. Perform a combustion test 5. Consult factory	
✓ Flame failure CODE (19) HONEYWELL NOTE: The flame safeguard relay goes into alarm mode during the burner ignition cycle.	1. Check burner gas piping and burner electrical connections 2. Check condition of the flame rod ceramic; replace if necessary 3. Check flame signal intensity (between 5 and 10 VDC for Fireye or between 3 and 5 VDC for Honeywell) 4. Perform a combustion test over the entire capacity range of the burner	
✓ Air pressure switch opened CODE (21) FIREYE CODE (32) HONEYWELL NOTE: While the heater is in operation, safety contact between 6 and 8 terminals for Fireye and 6 and 7 for Honeywell relay must be closed.	There are two safety devices connected in series between terminals 6 and 7 of the ***Honeywell*** flame safeguard, and 6 and 8 terminals for the ***Fireye*** flame safeguard relay.	
	Burner pressure switch The burner pressure switch proved that the burner is in operation. (Adjusted between 0.5''-1'' w.c.)	1. Check burner fan rotation. 2. Check for obstruction in chimney. 3. Check for obstruction at combustion air intake. 4. Check sampling tubes of the pressure switch (installation and adjustment). 5. Replace pressure switch if defective. 6. Consult factory

	Safety high temperature limit switch (set at 160 °F) This contact is normally closed (N.C.) and open when air temperature exceeds 160°F downstream of the heat exchanger	<u>At startup or when heater is in operation</u> 1. Check temperature upstream of the heater (Safety high temperature limit switch opens when air temperature exceeds 160°F) 2. Check burner modulation, all controls, and temperature control signal 3. Check gas pressure at burner manifold for maximum fire 4. If required, replace the temperature switch. 5. Consult factory
✓ Ground fault CODE (54) FIREYE	1. Check grounding of the heater frame and flame safeguard relay 2. Check for ground default in electrical wiring between the heater and main distribution panel 3. Consult factory	
✓ Faulty programmer CODE (55) FIREYE	1. Replace the programmer 2. Consult factory	
✓ Faulty amplifier CODE (56) FIREYE	1. Replace amplifier 2. Consult factory	
✓ Voltage drop CODE (5) HONEYWELL	1. Check voltage at relay while heater is in operation 2. Check relay electrical connections and installation 3. Consult factory	
✓ Ground fault CODE (109) HONEYWELL	1. Check relay grounding 2. Main current and neutral wires are inverted 3. Consult factory	

Table 11: Fireye and Honeywell troubleshooting check list

13. HEATER MAINTENANCE

CHECK LIST	*MAINTENANCE FREQUENCY*			
	WEEKLY	*MONTHLY*	*1/2 YEAR*	*YEARLY*
Ensure that no flammable material is stored near the heater	•			
Ensure that nothing obstructs the air inlet and outlet of the heater	•			
Check combustion and flame quality		•		
Check that all safety controls are operational			•	
Check the operation of the high temperature limit thermostat				•
Ensure that there are no gas leaks in piping (fittings & valves)				•
Inspect all electrical connections				•
Ensure that burner motor is firmly fastened				•
Inspect the flame detector and pilot igniters electrode change if necessary				•
Clean burner fan wheel				•
Check burner installation and tighten screws and bolts if required				•

Table 12: Heater maintenance check list

14. START-UP REPORT

Unit Tag: _____

Company: _____ Project: _____

Technician: _____ Project manager: _____

Contractor: _____ Address: _____

Phone: _____ Email: _____

MANUFACTURER INFOS

Model number: _____ Serial number: _____

Burner model: _____ # Serial Burner: _____

INSPECTION

Unit casing: ☐ Combustion air proving switch: ☐ Air flow switch (by others): ☐

Gas leak: ☐ Control panel installed (by others): ☐ Gas vent (if applicable): ☐

Combustion air openings ☐ High limit adjustment: ☐ Flue vent: ☐

Top air baffle installed: ☐ Condensate drain: ☐ Neutralizer kit: ☐

Note: _____

START-UP

Flame signal: _____ VDC Unit CFM: _____ Natural gas: ☐ Propane gas: ☐

Gas inlet pressure: _____ _____ _____

Gas manifold pressure: _____ _____

	STOP	LOW FIRE	HIGH FIRE

ADJUSTMENTS

Inlet duct thermostat: _____ ºF Pre-purge delay: _____ sec.

Low limit stat (freezestat): _____ ºF Delay when starting on low fire: _____ sec.

High limit thermostat: _____ ºF Low limit delay: _____ sec.

Start-up completed: ☐ If no, why? (or others):

_____

_____

_____

_____

COMBUSTION AIR ANALYSIS

Ambient temperature: _____ ºF

Signal	% CO_2	% Oxygen	Gas Temp. °F	Ambient Temp °F	% Efficiency	% Air Excess	*PPM CO (Air free)	Manifold
0%								
20%								
40%								
60%								
80%								
100%								

* This value must be as low as possible and must never exceed 400 ppm.

Note:

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Signature: _____ Date: _____