



9-512

January 2017

INSTALLATION AND SERVICE MANUAL

High Intensity Gas Fired Infrared Unit Heaters

Model IHR, Control Codes 47, 48, 97, 98, 27, and 67



INSTRUCTIONS APPLY TO:

☐ Installation ☐ Operation ☐ Maintenance

⚠ WARNING ⚠

Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operating, and service/maintenance instructions thoroughly before installing or servicing this equipment.

HAZARD INTENSITY LEVELS

- **DANGER:** Failure to comply will result in severe personal injury or death and property damage
- **WARNING:** Failure to comply could result in severe personal injury or death and/or property damage.
- **CAUTION:** Failure to comply could result in minor personal injury and/or property damage.

⚠ WARNING ⚠

Gas-Fired appliances are not designed for use in hazardous atmospheres containing flammable vapors or combustible dust, or atmospheres containing chlorinated or halogenated hydrocarbons.

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FOR YOUR SAFETY

The use and storage of gasoline or other flammable vapors and liquids in the vicinity of this appliance is hazardous.

These heaters must NOT be used in the following applications:

- Enclosed swimming pool areas
- Areas with contaminated atmospheres.
- Areas requiring explosion-proof equipment.
- Process heating applications.

FOR YOUR SAFETY

If you smell gas:

1. Open Windows.
2. Do not touch electrical Switches.
3. Extinguish any open flame.
4. Immediately call your gas supplier.
5. If gas supplier cannot be reached, call fire department.

ATTENTION

Mount a copy of these instructions adjacent to the heater and retain a copy for future reference.

**FOR INDOOR INSTALLATION ONLY.
NOT FOR RESIDENTIAL USE.**

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1.0 Safety

⚠ WARNING



Improper installation, adjustment, alteration, service, or maintenance can cause property damage, serious injury, or death. Read and understand the installation, operating, and maintenance instructions thoroughly before installing or servicing this equipment. Only trained, qualified gas installation and service personnel may install or service this equipment.

Safety Symbols

Safety is the most important consideration during installation, operation, and maintenance of the infrared heater. You will see the following symbols and signal words when there is a hazard related to safety or property damage.

⚠ WARNING

Warning indicates a potentially hazardous situation which, if not avoided, could result in death or injury.

⚠ CAUTION

Caution indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Notice indicates a potentially hazardous situation which, if not avoided, could result in property damage.

Applications

This is not an explosion proof heater. Consult your local fire marshal, insurance carrier, and other authorities for approval of the proposed installation.

Commercial / Industrial (Indoor Use Only)

Infrared heaters are designed and certified for use in industrial and commercial buildings such as warehouses, manufacturing plants, aircraft hangars, and vehicle maintenance shops. For maximum safety, the building must be evaluated for potential hazards before installing the heater system. A critical safety factor to consider before installation is the clearance to combustibles.

Residential

This heater is **NOT** approved for use in any residential application. This includes, but not limited to, attached garages, living quarters, solariums, etc. Consult the local fire marshal and/or insurance provider if unsure of your application.

⚠ WARNING



Not For Residential Use.

Installation of an infrared heater system in residential indoor spaces, RV's, mobile homes, etc. may result in property damage, asphyxiation, fire, serious injury, or death.

Clearance to Combustibles

⚠ WARNING



Placement of explosive objects, flammable objects, liquids, and vapors close to the heater may result in explosion, fire, property damage, serious injury, or death. Do not store, or use, explosive objects, liquids, and vapor in the vicinity of the heater.

Failure to comply with the published clearances to combustibles could result in personal injury, death, and/or property damage.

⚠ CAUTION



Signs shall be posted specifying the maximum permissible stacking height in order to maintain clearances to combustibles.

Hazards Include:

For maximum safety the building must be evaluated for hazards before installing the heater system. Examples include, but are not limited to:

- Gas and electrical lines
- Combustible and explosive materials
- Chemical storage areas
- Areas of high chemical fume concentrations
- Provisions for accessibility to the heater
- Adequate clearances around air openings
- Combustion and ventilating air supply
- Vehicle parking areas
- Vehicles with lifts or cranes
- Storage areas with stacked materials
- Lights
- Sprinkler heads
- Overhead doors and tracks
- Dirty, contaminated environment

A critical safety factor to consider before installation is the clearances to combustibles. Clearance to combustibles is defined as the minimum distance you must have between the infrared surface, or reflector, and the combustible item. Considerations must also be made for moving objects around the infrared heater. The following is a partial list of items to maintain clearances from:

Combustible Items Include:

- Wood
- Paper
- Fabric
- Chemicals
- Wall or roof insulation

Moving Objects Include:

- Overhead doors
- Vehicles on lifts
- Cranes
- Hoists
- Car wash equipment

The stated clearance to combustibles represents a surface temperature of 90°F (50°C) above room temperature. Building materials with a low heat tolerance (such as plastic, vinyl siding, canvas, tri-ply, etc.) may be subject to degradation at lower temperatures. It is the installer's responsibility to assure that adjacent materials are protected from degradation.

When installing the infrared heater system, the minimum clearances to combustibles must be maintained. These distances are shown in Chart 1.1 and on the heater. If you are unsure of the potential hazards, consult your local fire marshal, fire insurance carrier, or other qualified authorities on the installation of gas fired infrared heaters for approval of the proposed installation.

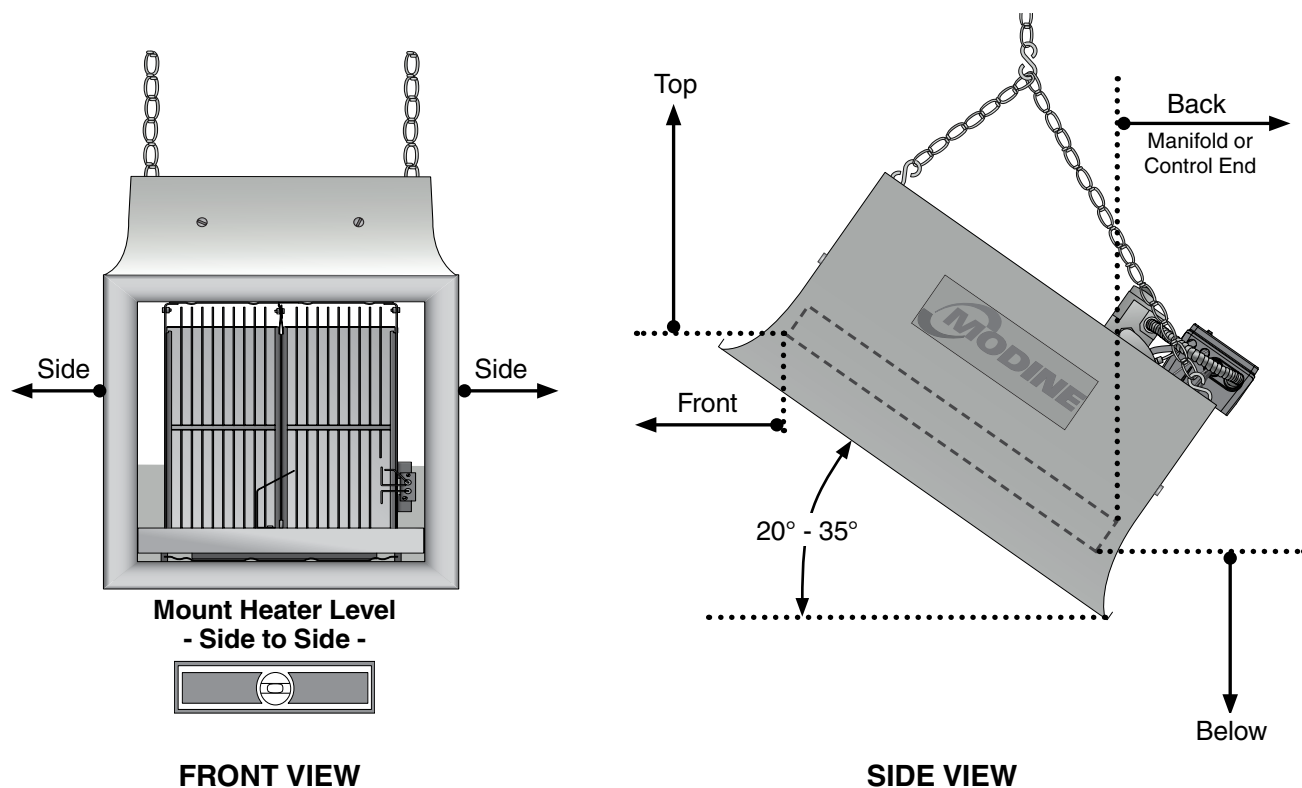
Chart 1.1 • Clearance to Combustibles in Inches (see Figure 1.1)

Model No.	Sides	Back	Top	Below/Front
IHR 30	30	18	28	72
IHR 60	32	18	40	72*
IHR 90	48	30	42	98
IHR 130	48	30	52	120
IHR 160	50	32	60	132

* This clearance is 80 in. when the heater is fitted with a parabolic reflector.

NOTE: If the heater is mounted beneath a non-combustible surface, a 24 in. minimum top clearance must be maintained from the top of the heater to prevent overheating the controls.

Figure 1.1 • Clearance to Combustibles



Gas Connection

⚠ WARNING



An approved connector, suitable for the environment of equipment usage, is required. Visible or excessive swaying, flexing, and vibration of the gas connections **must** be avoided to prevent failure. Neither the gas pipe nor the connector shall be placed in the 'flue discharge area'. In no case shall the gas supply support the weight of the heater.

To ensure your safety, and comply with the terms of the warranty, all units must be installed in accordance with these instructions.

Standards, Certifications and Government Regulations

Installation of this infrared heater must comply with all applicable local, state, and national specifications, regulations and building codes. Contact the local building inspector and/or fire marshal for guidance.

In the absence of local codes, the installation must conform to the latest edition of:

United States: National Fuel Gas Code, ANSI Z223.1 (NFPA 54).

Canada: CAN/CGA B149.1 and .2, Canadian Electrical Code C22.1

Copies of these standards can be viewed or purchased at www.nfpa.org or www.scc.ca.

Chart 1.2 • Standards and Code Installation Guidelines • Building Aspect

Building Aspect	Codes and Guidelines
Electrical	The heater must be electrically grounded in accordance with the following codes:
	United States: Refer to National Electrical Code®, ANSI/NFPA 70 (latest edition). Wiring must conform to the latest edition of National Electrical Code®, local ordinances, and any special diagrams furnished. Canada: Refer to Canadian Electrical Code CSA C22.1 Part 1 (latest edition).
Venting	Venting must comply with the requirements within this manual and the following codes:
	United States: Refer to NFPA54/ANSI Z223.1 (latest edition), the National Fuel Gas Code. Canada: Refer to CAN/CGA B149.1 Installation Codes for Gas Burning Appliances.

Chart 1.3 • Standards and Code Installation Guidelines • Building Type

Building Aspect	Codes and Guidelines
Public Garages	Installation of this infrared heater in public garages must conform to the following codes:
	United States: Standard for Parking Structures NFPA 88A (latest edition) or the Code for Motor Fuel Dispensing Facilities and Repair Garages NFPA 30A (latest edition). Canada: Refer to CAN/CGA B149.1 and B149.2: Installation Codes for Gas Burning Appliances.
	Guidelines:
	• Heaters must not be installed less than 8 ft. (2.4 m) above the floor. Minimum clearances to combustibles must be maintained from vehicles parked below the heater. • When installed over hoists, minimum clearances to combustibles must be maintained from the upper most point of objects on the hoist.
Aircraft Hangars	Installation of this infrared heater in aircraft hangars must be in accordance with the following codes:
	United States: Refer to Standard for Aircraft Hangars, ANSI/NFPA 409 (latest edition). In Canada: Refer to Standard CAN/CGA B149.1 and B149.2.
	Guidelines:
	• In aircraft storage and servicing areas, heaters shall be installed at least 10 ft. (3 m) from above the upper surface of wings or of the engine enclosures of the highest aircraft that may be housed in the hangar. The measurement shall be made from the wing or engine enclosure, whichever is higher from the floor, to the bottom of the heater. • In areas adjoining the aircraft storage area (e.g., shops, offices) the bottom of heaters shall be installed no less than 8 ft. (2.4 m) above the floor. • Suspended or elevated heaters shall be located in spaces where they shall not be subject to damage by aircraft, cranes, movable scaffolding, or other objects. Provisions shall be made to assure accessibility to suspended infrared heaters for recurrent maintenance purposes.

Applicable authorities governing the manufacturing or installation of this heater include (but are not limited to) the following organizations:

In the United States:

- NFPA 54/ANSI Z223.1 - National Fuel Gas Code.
- ANSI Z83.19/C2.35 - Gas-fired High Intensity Infrared Heaters.
- ANSI/NFPA 70 - National Electric Code.
- IRSC.

In Canada:

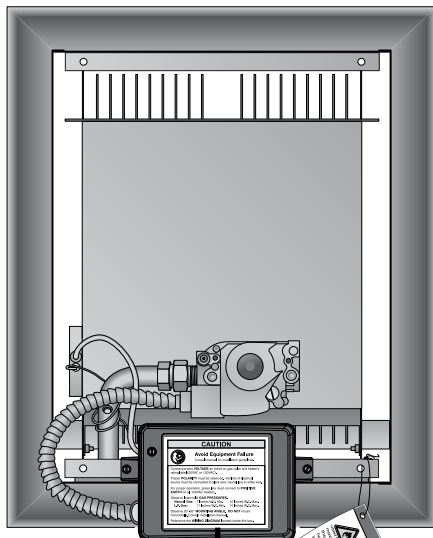
- CAN/CGA B149.1-10 - Natural Gas and Propane Installation Code.
- ANSI Z83.19/C2.35 - Gas-fired High Intensity Infrared Heaters.
- C22.1 Part 1 - Canadian Electrical Code.

Safety Signs and Labels

It is important to provide warnings to alert individuals to potential hazards and safety actions. ANSI Z83.19 and the National Fuel Gas Code require you to post a sign “specifying the maximum permissible stacking height to maintain the required clearances from the heater to the combustibles” near the heater’s thermostat or in absence of such thermostats in a conspicuous location. Signs should state the hazards for the particular application and be legible to the building occupants. Consult the factory or a factory representative for additional information on signage compliance.

Safety warning labels must be maintained on the infrared heater. Illustrations of the safety labels, and their locations, are pictured below.

Back View



⚠ DANGER

Avoid Serious Injury, Death or Property Damage.
Maintain Clearances to Combustible to Prevent the Risk of Fire.

Clearance to combustibles must be maintained at all times in order to prevent the ignition of combustible materials. In locations used for the storage of combustible materials, signs must be posted to specify the maximum permissible stacking height to maintain the required clearances from the heater to the combustibles. Signs must either be posted adjacent to the heater's thermostats or in the absence of such thermostats, in a conspicuous location. Clearances are provided on the heater's safety label and in the heater's Installation, Operation and Maintenance manual. Product installation and operation must comply with applicable standards, codes and regulations. Post this tag adjacent to the heater's thermostat or controls before operating the heater.

• INSTALLER: READ AND POST THIS NOTICE •

F/N: LL01 - Clearance
Safety Tag
(Affix adjacent to
heater's thermostat)

CAUTION

Avoid Equipment Failure
Consult manual for installation guidelines.

Connect proper **VOLTAGE** as noted on gas valve and heater's rating label (25VAC or 120VAC).

Proper **POLARITY** must be observed. Hot line of electrical source must be connected to black wire; neutral line to white wire.

For proper operation, green line must connect to **POSITIVE EARTH** on all 120VAC heaters.

Observe listed inlet **GAS PRESSURES**.
Natural Gas: 7 Inches W.C. Min. 14 Inches W.C. Max.
L.P. Gas: 11 Inches W.C. Min. 14 Inches W.C. Max.

Observe **20°-35° MOUNTING ANGLE**. **DO NOT** mount horizontally. Consult installation manual.

Reference the **WIRING DIAGRAM** located inside this box.

F/N: LLDL002

MODINE UNVENTED GAS RADIANT HEATER
FOR INDOOR (Non-Residential) INSTALLATION ONLY.
High - Intensity Infrared Heater
Class IIIA Permanent Label

MODEL NO. IHR 60S 47	INPUT BTU/H 60,000	VERSION 05/97	FOR USE WITH Natural Gas
VOLTS AC: 120V - 60Hz	HEATER TYPE: C1	MIN. INLET PRESSURE FOR PURPOSE OF ADJUSTMENT 11.0 INCHES W.C.	
AMPS - STARTING: 0.1	MANIFOLD PRESSURE: 10.0 INCHES W.C.	MIN. MOUNTING ANGLE 20 DEGREES	
AMPS - RUNNING: 0.1	MAX. INLET PRESSURE: 14.0 INCHES W.C.	MAX. MOUNTING ANGLE 35 DEGREES	

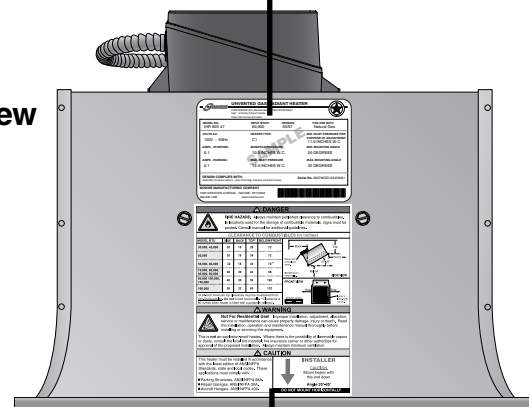
DESIGN COMPLIES WITH:
ANSI Z83.19 (latest edition) - Gas Fired High Intensity Infra-Red Heater

Serial No. 0807MOD123456001

MODINE MANUFACTURING COMPANY
1500 DEKOVEN AVENUE - RACINE, WI 53403
1.800.828.4328 (HEAT) www.modinehvac.com

Rating Plate

Bottom View



⚠ DANGER

FIRE HAZARD. Always maintain published clearance to combustibles. In locations used for the storage of combustible materials, signs must be posted. Consult manual for additional guidelines.

CLEARANCE TO COMBUSTIBLES (in inches)

MODEL BTU	SIDE	BACK	TOP*	BELOW/FRONT
30,000, 45,000	30	18	28	72
50,000	30	18	34	72
55,000, 60,000	32	18	40	72**
75,000, 80,000, 85,000, 90,000	48	30	42	98
95,000, 100,000, 130,000	48	30	52	120
160,000	50	32	60	132

*A 24-inch minimum top clearance must be maintained from non-combustibles. Do not mount horizontally. **Clearance is 80 inches when heater is fitted with a parabolic reflector.

⚠ WARNING

Not For Residential Use! Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operation and maintenance manual thoroughly before installing or servicing this equipment.

This is **not** an explosion-proof heater. Where there is the possibility of flammable vapors or dusts, consult the local fire marshal, fire insurance carrier or other authorities for approval of the proposed installation. Always maintain minimum ventilation.

⚠ CAUTION

This heater must be installed in accordance with the latest edition of ANSI/NFPA Standards, state and local codes. These applications must comply with:

- Parking Structures, ANSI/NFPA 88A.
- Repair Garages, ANSI/NFPA 30A.
- Aircraft Hangars, ANSI/NFPA 409.

INSTALLER

CAUTION
Mount heater with this end down
Angle 20°-35°
DO NOT MOUNT HORIZONTALLY

F/N: LLDCL002

Clearance to Combustibles Label

2.0 Installation

⚠ WARNING



Read and understand, the installation, operating, and maintenance instructions thoroughly before installing or servicing this equipment.

Only trained, qualified gas installation and service personnel may install or service this equipment.

⚠ CAUTION

This heater cannot be used in a building with an uninsulated roof or condensation problems can occur.

Design

To ensure a safe, properly designed heating system, a layout should be developed for the correct placement of the infrared heater(s). Aside from safety factors such as clearance to combustibles (see Chart 1.1 on page 5), you should take also into consideration the environment (e.g., cold/drafty, average, protected), heat coverage (sq. ft.) needed, heater centers, the distance behind a person or work station(s) and exhaust path. Also, the effective infrared surface temperature of a person or object may be diminished with wind above 5 mph. Wind barrier(s) may be required. Most importantly, clearance to combustibles **must** always be maintained! Refer to hazards on page 4.

This installation manual, along with national, state, provincial, and local codes, address these issues. It is critical that you read, understand, and follow all guidelines and instructions. Always inspect and evaluate the mounting conditions, space for exhaust, gas supply and wiring.

Perimeter mounting of infrared heaters provides the most effective distribution of heat. The recommended spacing between the heaters is shown in Chart 2.1. Add additional heaters in the center of the space when heaters are spaced farther than the recommended distance (see Figure 2.1).

When heated, materials high in hydrocarbons (solvents, paint thinner, mineral spirits, formaldehydes, etc.) can evaporate. This may result in odors or fumes being emitted into the environment. To correct this problem, clean the area and/or introduce additional ventilation. Heaters installed and serviced in accordance with the installation manual do not emit foul odors into the environment.

IMPORTANT: Fire sprinkler heads must be located at an appropriate distance from the heater. This distance may exceed the published clearance to combustibles. Certain applications will require the use of high temperature sprinkler heads or relocation of the heaters.

Sprinkler systems containing propylene glycol or other flammable substances are not to be used in conjunction with this heater without careful consideration for, and avoidance of, potential fire or explosion hazards. For further information, consult NFPA 13. Always observe applicable state and local codes.

Chart 2.1 • Recommended Mounting Heights and Distances for “Total Area” Heating

Model No.	Mounting Heights Dim. A 30° Angle Standard Reflector (ft.)	Mounting Heights Dim. A 30° Angle Parabolic Reflector (ft.)	Distance Between Heaters Dim. B (ft.)	Distance Between Heater Rows Dim. C (ft.)	Distance Between Heater and Wall (ft.)
IHR 30	12-14	12-15	8-24	15-40	4-8
IHR 60	14-16	18-21	12-36	15-55	6-12
IHR 90	16-18	21-25	16-48	20-70	6-12
IHR 130	21-24	26-32	20-60	25-85	8-14
IHR 160	24-28	29-35	24-65	30-100	8-14

Factory recommended mounting heights are listed as a guideline. If infrared heaters are mounted too low or too high, they may result in discomfort or lack of heat. Modine Manufacturing Company generally recommends observing the recommended mounting heights to optimize comfort conditions. However, certain applications such as spot heating, freeze protection, outdoor patio heating or very high ceilings may result in the heaters being mounted outside of the recommended mounting heights.

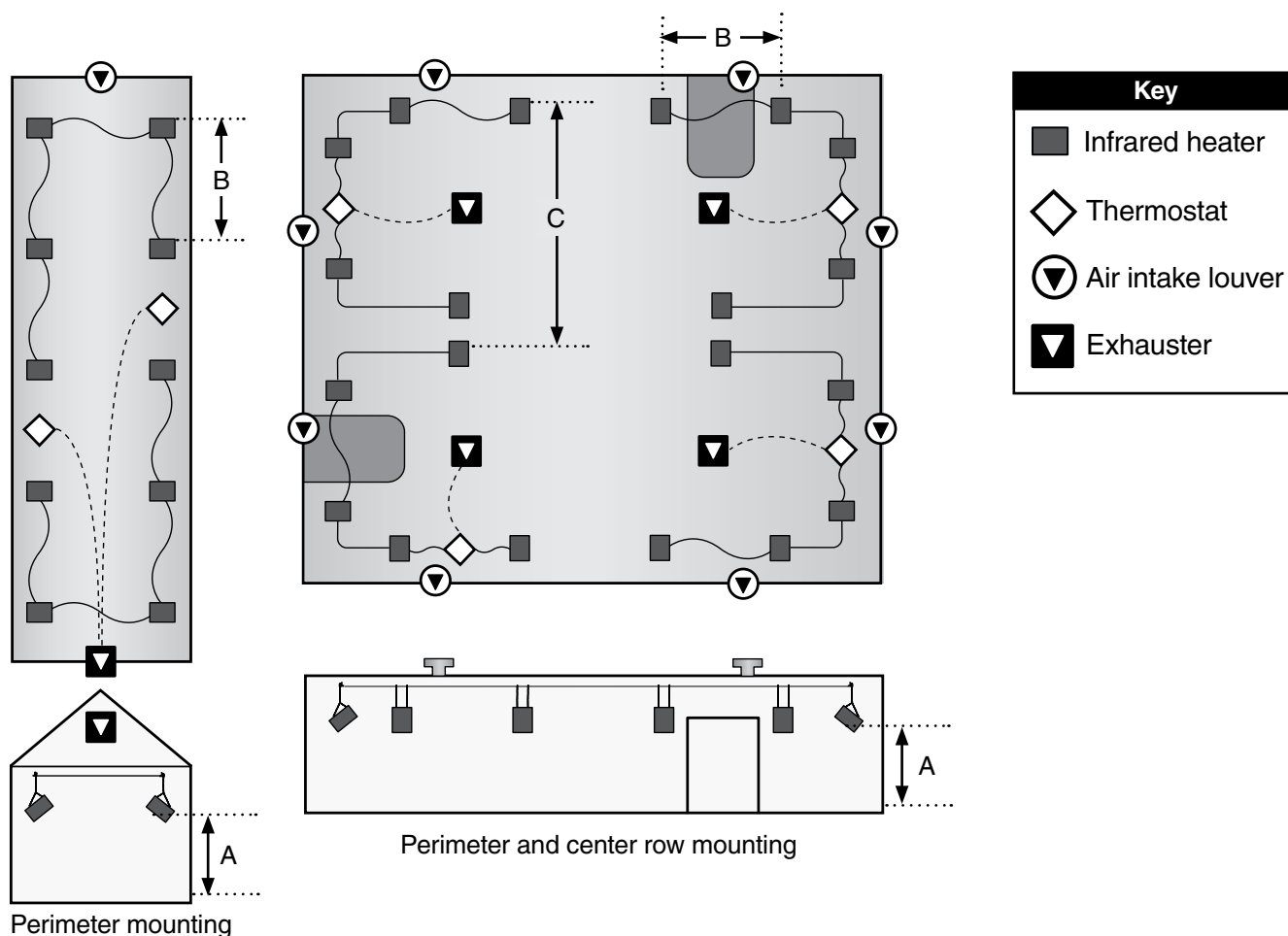
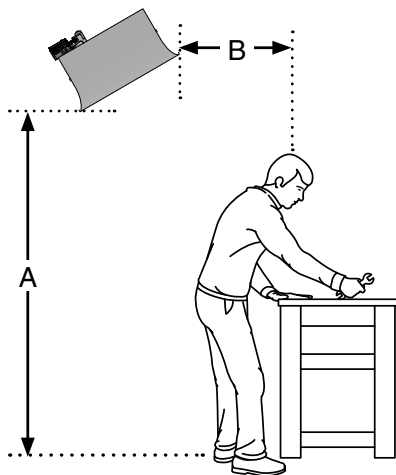
Figure 2.1 • Total Area Heating Sample Layout

Chart 2.2 • Recommended Mounting Heights and Distances for “Spot” Heating

Model & Input	Type of Area (Surroundings)	Approx. Area Covered	Approx. Coverage (sq. ft.)	Recommended Mounting Height Stnd. Reflector (Dim. A)	Distance Behind Person or Work Station (Dim. B)	Centers for Full Coverage (Spot & Area) Htg. Only
IHR 30 30,000 BTU/h	Cold/Drafty	10' x 10'	100	9' to 10'	4'	10'
	Average	12' x 12'	144	10' to 12'	5'	12'
	Protected/Insul.	14' x 14'	196	12' to 14'	6'	14'
IHR 60 60,000 BTU/h	Cold/Drafty	16' x 16'	256	12' to 14'	6'	16'
	Average	18' x 18'	324	14' to 16'	7'	18'
	Protected/Insul.	20' x 20'	400	16' to 18'	8'	20'
IHR 90 90,000 BTU/h	Cold/Drafty	20' x 20'	400	16' to 18'	9'	20'
	Average	24' x 24'	576	18' to 20'	10'	24'
	Protected/Insul.	28' x 28'	784	20' to 22'	11'	26'
IHR 130 130,000 BTU/h	Cold/Drafty	26' x 26'	676	18' to 20'	11'	26'
	Average	30' x 30'	900	18' to 20'	12'	28'
	Protected/Insul.	35' x 35'	1225	20' to 22'	13'	32'
IHR 160 160,000 BTU/h	Cold/Drafty	28' x 28'	784	20' to 22'	12'	28'
	Average	35' x 35'	1225	24' to 26'	16'	32'
	Protected/Insul.	40' x 40'	1600	28' to 30'	20'	35'

Figure 2.2 • Spot Heater Heights

Heater Mounting



Improper suspension of the infrared heater may result in collapse and being crushed. Always suspend from a permanent part of the building structure that can support the total force and weight of the heater.



Failure to maintain minimum clearance to combustibles may result in fire and/or explosion, property damage, serious injury, or death. Always maintain minimum clearances and post signs or provided tags (F/N: LL01) where needed. Signs should state the hazards for the particular application and be legible to the building occupants. Consult the factory or a factory representative for additional information on signage compliance.

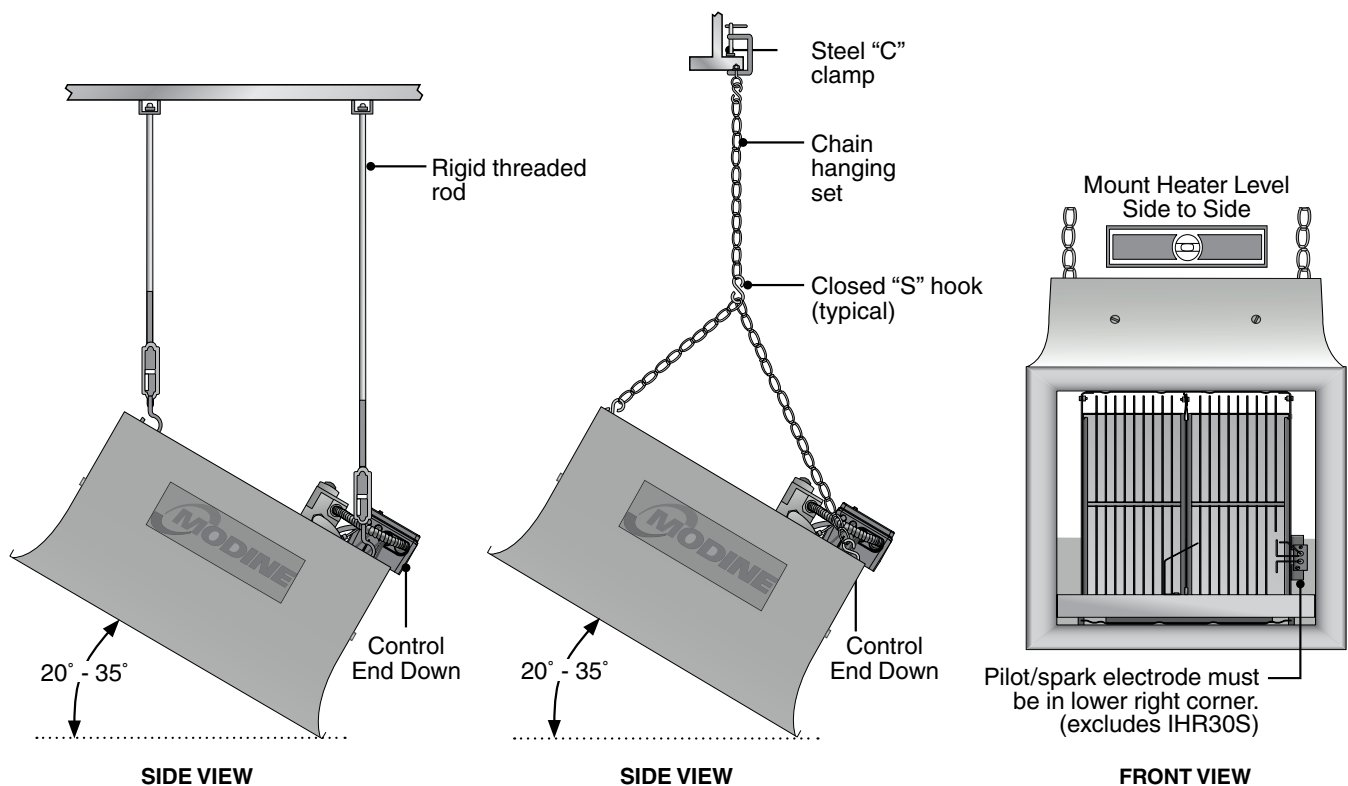


An approved connector, suitable for the environment of equipment usage, is required. Visible or excessive swaying, flexing, and vibration of the gas connections **must** be avoided to prevent failure. Neither the gas pipe nor the connector shall be placed in the 'flue discharge area'. In no case shall the gas supply support the weight of the heater.

The heater can be suspended with chains or rigid threaded rod. Local codes or conditions that would cause the unit to move (e.g., wind drafts, blowers, crane rails, etc.) may require rigid threaded rod. Consult all applicable codes before installation.

The heater must be level from side to side and between 20° and 35° from horizontal. The pilot burner or ignitor, manifold, and controls must be located on the lower end. Refer to Figure 2.3.

Figure 2.3 • Heater Mounting and Orientation



Ventilation

⚠ WARNING



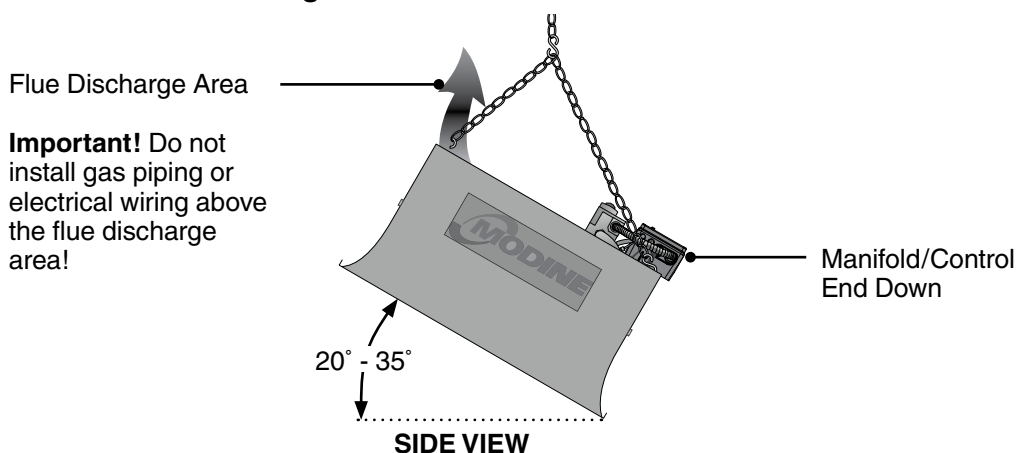
Insufficient ventilation may result in health problems, carbon monoxide poisoning, or death. Vent enclosed spaces and buildings according to national, state, provincial, and local codes.

Improper venting may result in asphyxiation, fire, explosion, injury, or death.

It is required that the levels where heaters are mounted be properly ventilated to supply combustion air to the heaters and to sufficiently dilute the products of combustion. It is also required that the flue discharge area is kept clear of gas piping and electrical wiring (see Figure 2.4).

This infrared heater must be vented in accordance with national, state, provincial, and local codes and the guidelines in this manual. In the United States refer to the latest edition of ANSI Z223.1 (NFPA 54) and in Canada refer to the latest edition of the CAN/CGA B149.1 & B149.2 Standard.

Figure 2.4 • Hot Flue Discharge



Provisions must also be made to provide sufficient fresh air intake area and exhaust air outlet area. For proper ventilation, a positive air displacement of 4 CFM/1,000 BTU/h of gas consumed must be provided.

Where insufficient air movement exists, induced air displacement is required. A balanced system is essential to avoid negative building pressure which causes excessive infiltration, unfavorable drafts, and affects combustion efficiency.

Air displacement may be accomplished by either natural or mechanical means. Mechanical exhausters are preferred and typically mounted at high points on the roof where stagnant air accumulates inside the building. For a flat roof, considerations of prevailing winds, high and low pressure areas, and distribution of air movement must be taken into consideration when locating exhausters.

Best air distribution is accomplished by using a number of small exhausters versus one large exhauster. Provide a minimum of one square inch of inlet area per 1,000 BTU/h for combustion air supply. Inlet opening in the building should be well distributed (see Figure 2.1) high in the sidewalls and should direct incoming air upward to dilute products of combustion while preventing drafts at lower levels. Inlets are typically 1 to 3 sq. ft.

Local codes may require that mechanical exhaust systems be interlocked with heaters to enable both to function simultaneously (see page 17, Figure 2.6) or allow control of exhausters with a ceiling mounted humidistat.

Gas Supply

⚠ WARNING



Improperly connected gas lines may result in fire, explosion, poisonous fumes, toxic gases, asphyxiation, or death. Connect gas lines in accordance to national, state, provincial, and local codes.

The gas supply to the infrared heater must be connected and tested in accordance with national, state, provincial, and local codes along with the guidelines in the Modine Manufacturing Company IHR Series manual. In the United States refer to the latest edition of the ANSI Z223.1 (NFPA 54) Standard and in Canada refer to the latest edition of the CAN/CGA B149.2 Standard.

Important! Before connecting the gas supply to the infrared heater(s):

- Check that the gas piping and service has the capacity to handle the load of all heaters being installed, as well as any other gas appliances being connected to the supply line.
- Check that the main gas supply line is of proper diameter to supply the required fuel pressures.
- If utilizing used pipe, verify that its condition is clean and comparable to a new pipe. Test all gas supply lines in accordance with local codes.
- Test and confirm that inlet pressures are correct. Refer to the rating plate for required minimum and maximum pressures (see Chart 2.3). The gas supply pipe must be of sufficient size to provide the required capacity and inlet pressure to the heater (if necessary, consult the local gas company).

Chart 2.3 • Manifold Pressure

Type of Gas	Required Manifold Pressure	Minimum Inlet Pressure	Maximum Inlet Pressure
Natural	6.0 Inches W.C.	7.0 Inches W.C.	14.0 Inches W.C.
Propane	10.0 Inches W.C.	11.0 Inches W.C.	14.0 Inches W.C.

Note: Check manifold pressure at the tap located either at the outlet of the gas valve or on the gas manifold pipe. Readings will be above atmospheric pressure during operation.

Pressure Equivalents: 1 inch W.C. equals .058 oz/sq. in. equals 2.49 Mbar.

To connect the gas:**⚠ WARNING**

Failure to install, operate, or service this appliance in the approved manner may result in property damage, injury, or death.

An approved connector, suitable for the environment of equipment usage, is required. Visible or excessive swaying, flexing, and vibration of the gas connections **must** be avoided to prevent failure. Neither the gas pipe nor the connector shall be placed in the 'flue discharge area'. In no case shall the gas supply support the weight of the heater.

This heater must be installed and serviced by trained gas installation and service personnel only.

The installation of this heater must conform with local building codes or, in the absence of such codes, the National Fuel Code (NFPA 54).

The gas outlet must be in the same room as the appliance and accessible. It may not be concealed within or run through any wall, floor or partition.

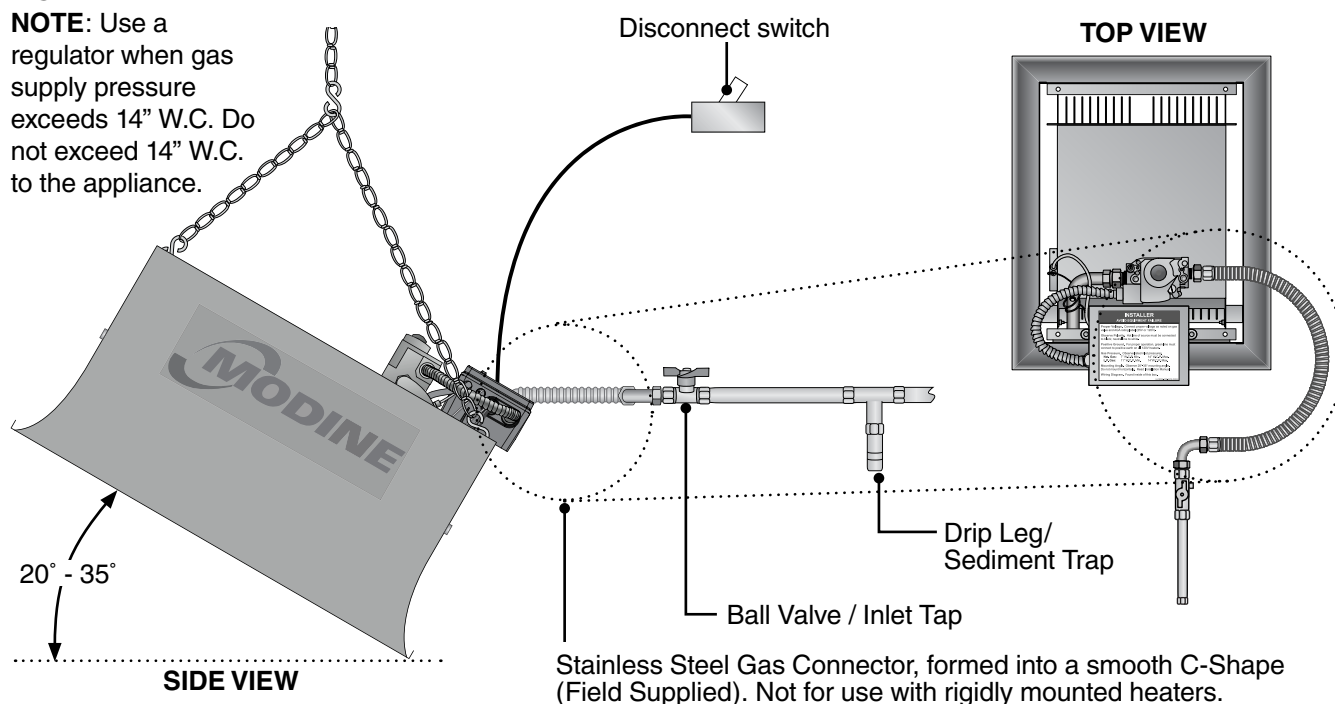
- ❶ The IHR Series heater is equipped to receive a gas supply line nipple of 1/2" NPT Schedule 40 metallic pipe. All piping must be installed in accordance with the requirements outlined in the National Fuel Gas Code ANSI/Z223.1 (latest edition) or CSA B149.2. Support all gas supply with pipe hangers, metal strapping, or other suitable material. Do not rely on the heater to support the gas pipe.
- ❷ Form the stainless steel flexible connector (field supplied) into a smooth C-shape allowing 12 in. between the flexible connector's end nuts. Figure 2.5 on page 16. **NOTE:** Not for use on rigidly mounted heaters.
- ❸ Install a ground joint union with a brass seat and a manual shut off valve adjacent to the unit for emergency shut off and easy servicing of controls. A 1/8" NPT plugged tap that is accessible for a test gauge connection is also recommended.
- ❹ A sediment trap must be installed in the supply line in the lowest spot prior to connecting to the heater. The trap length shall be at least three inches long. Ideally, the trap would be installed as close as possible to the shut off.
- ❺ When connecting piping to the unit, the use of a thread joint compound is required. The thread compound (pipe dope) shall be resistant to the action of propane gas or any other chemical constituents of the gas to be conducted through the piping. Use of Teflon[®] tape is not permitted.

⚠ WARNING

Always use two (2) opposing wrenches to tighten mating pipe connections to prevent excessive torque on the gas valve and manifold pipe. Excessive torque can damage the valve and/or misalign the orifice, resulting in fire, explosion, serious injury, or death.

Figure 2.5 • Gas Connection

NOTE: Use a regulator when gas supply pressure exceeds 14" W.C. Do not exceed 14" W.C. to the appliance.



Leak Testing

⚠ WARNING



Use a soap solution or equivalent for leak testing. Never test for leak with an open flame. Failure to comply could result in personal injury, property damage, or death.

Always leak test final gas assembly for gas leaks according to the procedures outlined in NFPA 54 and all local codes and/or Standards.

For leak testing on pressures below ½" PSI

Before leak testing, close the field installed manual shut off valve shown on Figure 2.5 on the supply line to isolate the gas valve from the pressure.

NOTE: All factory installed gas connections have passed an approved leak test.

For leak testing on pressures above ½" PSI

When leak testing with pressures above ½" PSI (14 inches W.C.), the unit must be isolated from the supply pipe. Close the field installed manual shut off valve, disconnect the supply line to the unit, and temporarily cap the supply line for testing purposes.

⚠ WARNING



Gas pressures to the appliance controls must never exceed 14 inches W.C. (1/2" PSI). Supply pressures greater than 14" W.C. can damage the controls, resulting in personal injury, property damage, or death.

Electrical Requirements and Wiring Diagrams

⚠ WARNING



Shock hazard. Disconnect power supply before making wiring connections to prevent electrical shock and equipment damage. Any original factory wiring that requires replacement must be replaced with wiring material having a temperature rating of at least 105°C.

All field installed wiring to the unit heater must be done in accordance with the national, state, provincial, local codes, and to the guidelines in this manual. In the United States, refer to the most current revisions to the Electrical Code ANSI/NFPA 70 and in Canada refer to the most current revisions to the Canadian Electrical Code CSA C22.1 Part 1. The unit must be electrically grounded according to these codes. Line polarity must be observed when making field connections.

⚠ CAUTION

The power supply to the heater must be within +/- 5% of the voltage rating as indicated on the rating plate of the appliance. If input power does not meet these specifications, contact your utility company.

Before proceeding with electrical connections, ensure that the supply voltage, frequency, phase and current capacity meet the requirements specified on the rating plate. A dedicated line voltage supply with properly sized wire should run directly from the main electrical panel to the heater. The power to the unit must be protected with a circuit breaker appropriate for the load. The unit must be electrically grounded in accordance with local codes, or in their absence, with the latest edition of the National Electrical Code, ANSI / NFPA 70 and/or the Canadian Electrical Code CSA C22.1, latest edition.

Control systems are initiated by either 120 VAC, 24 VAC or millivolt energy. The 120 VAC systems can be used directly from a 120 VAC line. On 24 VAC systems, transformers **must** be used to supply power of sufficient VA rating for single or multiple connected installations.

Millivolt systems require NO external power, as energy needed to operate the valve is developed by the power-pile generator. Do not use multiple connections, as one thermostat may only control one heater.

For wiring of controls on the unit, see the Figure 2.6 below. It is recommended that the thermostat be installed on the hot side of a fused supply line and have sufficient ampere capacity rating for the heater(s) it will control. The ventilation system may not be controlled separately from the heating system (consult local codes) by the use of a humidistat that closes then the humidity rises. The humidistat control should be installed at roof level. For summer ventilation, a simple on/off switch can be installed at the occupant level.

Figure 2.6 • Typical Field Wiring

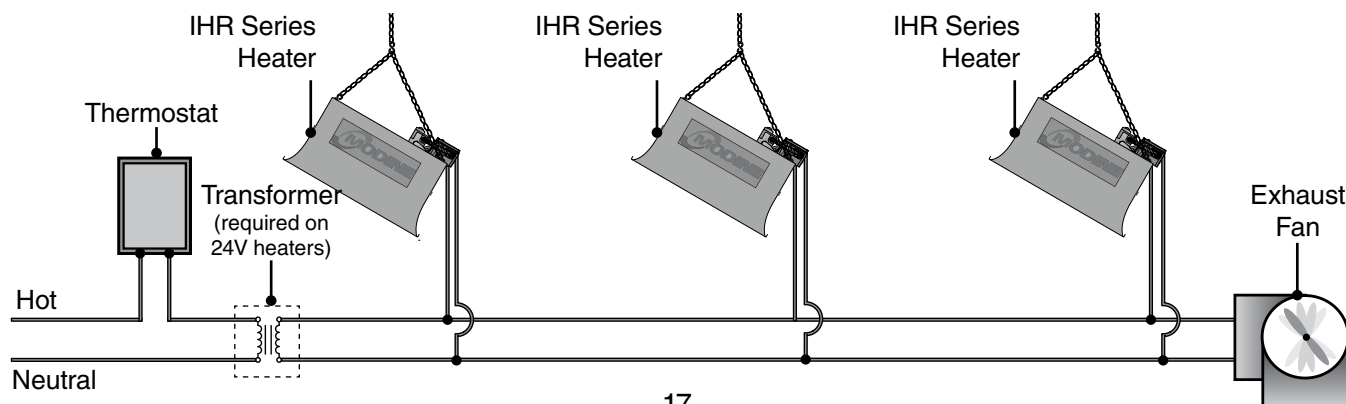
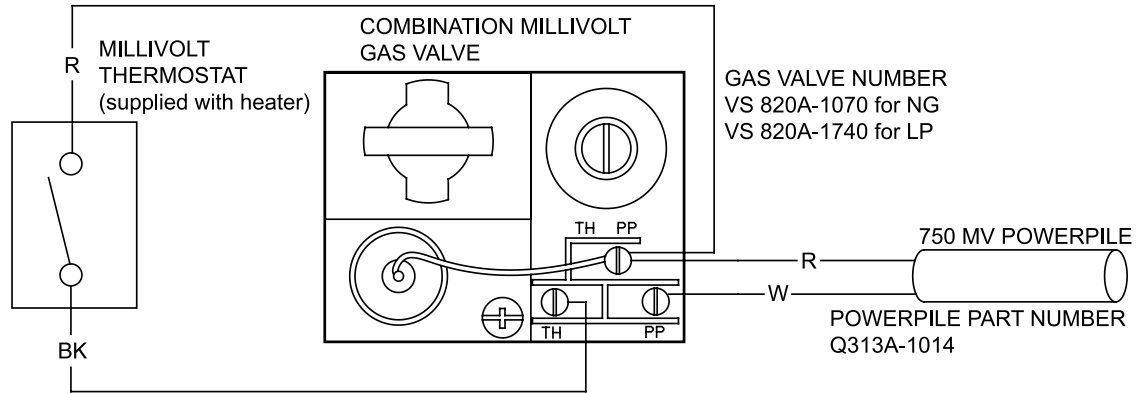
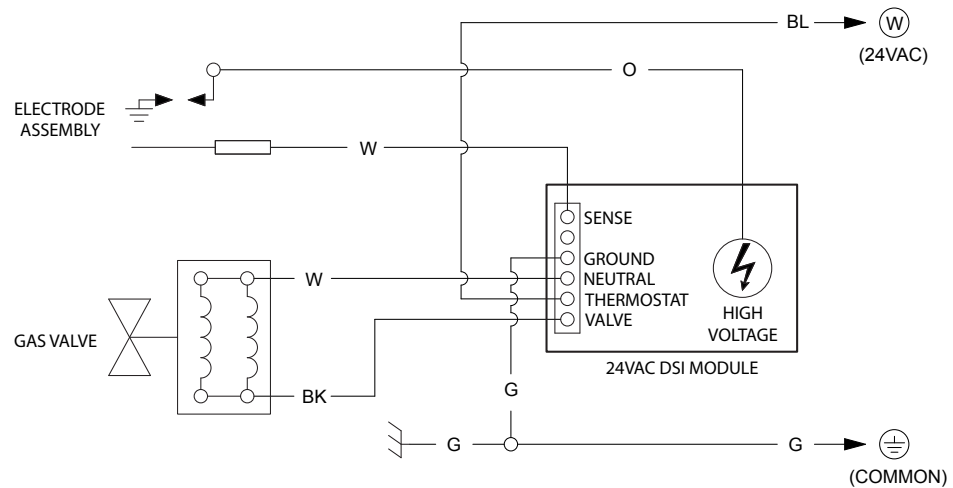


Figure 2.7 • Millivolt • 750 Schematic

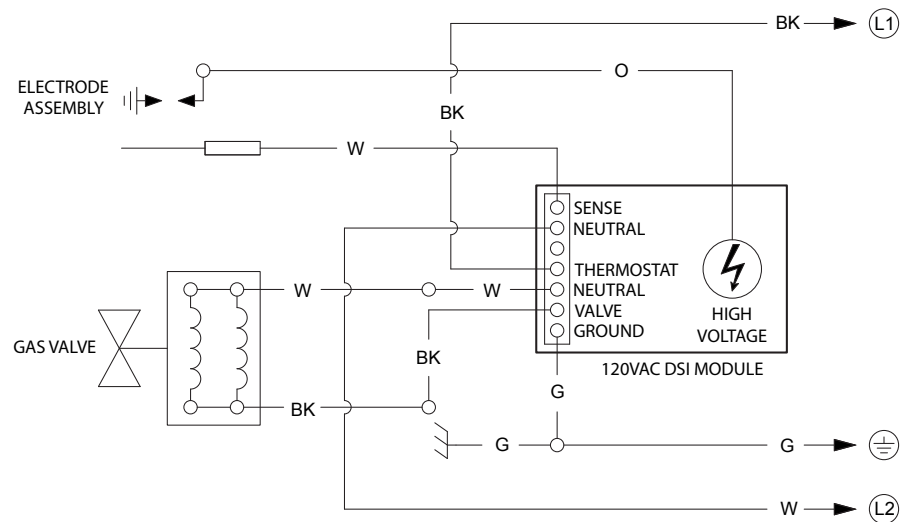
• Millivolt Control

**Figure 2.8 • 24V Schematic**

- Direct Spark Ignition
- VA Draw: 12
- Amps: .48
- Potted Circuit Board

**Figure 2.9 • 120V Schematic**

- Direct Spark Ignition
- VA Draw: 12
- Amps: .10
- Potted Circuit Board



3.0 Operation

⚠ WARNING



Do not attempt to ignite a direct spark ignition heater by hand. Failure to comply could result in personal injury, property damage, explosion, fire, or death.

Upon satisfactory completion of the electrical supply and purging of the gas supply line to the heater(s), follow the lighting instructions on the heater's rating label to put the heater into operation.

Direct Spark Ignition

Lighting Instructions

- ① Rotate the heater's valve knob to the "ON" position.
- ② Close electrical circuit (typically the thermostat).
- ③ If the heater fails to light, turn off gas, open electrical circuit and wait 5 minutes before repeating the above steps.

Shutdown Instructions

- ① Open electrical circuit.
- ② Rotate the heater's valve knob to the "OFF" position.

Sequence of Operation

Starting Circuit: Upon a call for heat, voltage is applied to L1 and Neutral. After a pre-purge, the spark electrode is energized and the gas valve opens. The trial for ignition is 15 seconds. If flame is not sensed, the heater will attempt two more times to reignite.

Running Circuit: After ignition, the sensing electrode monitors the burner flame. If sense of flame is lost, the control immediately acts to reignite the gas-air mixture. If flame sense is not established within 15 seconds, the heater will attempt two additional ignition sequences before proceeding to hard lockout. The control can be reset by briefly interrupting the power source.

Millivolt

Lighting Instructions

- ① Purge main gas supply line.
- ② Slightly depress and rotate the heater's manual gas valve knob COUNTERCLOCKWISE from the "OFF" position to the "PILOT" position.
- ③ Fully depress the manual gas valve knob and light the pilot burner. Continue to depress for 30 seconds and then release.
- ④ Rotate the heater's valve knob to the "ON" position.
- ⑤ Close the control circuit. If the heater fails to light, turn off the gas, open control circuit and wait 5 minutes before repeating the above steps.

Shutdown Instructions

- ① Open the control circuit.
- ② Rotate the heater's valve knob to the "PILOT" position, depress slightly and rotate to the "OFF" position.

Sequence of Operation

Starting Circuit: After manually lighting the pilot (see lighting instructions), upon a call for heat, the main burner solenoid is energized. The gas valve opens and the pilot lights the main burner.

Running Circuit: After ignition, the powerpile monitors the pilot flame. If the pilot flame is lost, the powerpile cools and closes the valve within 180 seconds. See lighting instructions to relight the heater.

4.0 Maintenance

It is recommended that the following become a standard yearly procedure to obtain maximum operating efficiency and trouble free operation.

During long periods of non-usage, remove or cover heater with a polyethylene bag and shut off gas supply. If further service to the heater is desired, contact your representative or the factory.

Main Burner

- 1 Gently use an air hose to blow any accumulated dust and/or dirt off the heater. Air hose pressure **must not exceed 30 psig**.
- 2 Gently pass the air hose over the entire exposed area of the ceramic. A distance of 2' to 4' from the unit is recommended.
NOTE: Blowing out the gasket material will permanently damage the rayhead.
- 3 Gently place the air hose outlet into each venturi tube and allow the air to flow for approximately one minute.
- 4 See troubleshooting chart (page 21) if there are any signs of burner malfunction. Replace if necessary.

Pilot Burner

- 1 Remove pilot access door.
- 2 Use an air hose and gently blow the pilot burner free of dust or debris.

Gas Supply

- 1 Periodically inspect the gas supply for signs of corrosion or failure. Replace if necessary.

⚠ WARNING



Use protective glasses when cleaning the heater.



Disconnect power to heater before servicing.



Do not operate unit if repairs are necessary. Do not operate unit showing any signs of burner malfunction. Call a professional for assistance.

⚠ CAUTION



Avoid Equipment Failure.

Do not blow out heating elements with high pressure air.

Chart 4.1 Troubleshooting Guide

Symptom	Code	Possible Cause	Corrective Action
Burning of gas-air mixture inside plenum (flashback).	A, B A, B A, B A, B A, B	• Heater mounted at incorrect angle. • Excessive drafts. • Gas leaking or blocked orifice/venturi. • Separation of ceramic grids. • Ceramic grids cracked.	• Mounting angle 20°-35° from horizontal. • Relocate or shield from draft. • Do not operate. Check with leak detector solution. • Do not operate. Replace rayhead. • Do not operate. Replace rayhead.
Delayed ignition.	A A, B A, B A, B A, B	• Electrode out of specification. • Low gas pressure. • Partially blocked orifice. • Improper orifice size. • Incorrect gas.	• See Figure 4.3. • See Gas Supply section. • Clean or replace. • Consult dealer. • Do not operate. See nameplate. Correct immediately.
Low ceramic surface temperature, excessive rollout or soot on rods.	A, B A, B A, B A, B A, B A, B A, B A, B	• Dirty or plugged rayhead ceramics. • Partially blocked orifice. • Low inlet gas pressure. • Low manifold gas pressure. • High manifold pressure. • Foreign matter in venturi tube. • Gas supply piping too small. • Incorrect gas.	• See maintenance instructions. • Remove and clean. • See Gas Supply section. • Adjust main valve regulator for 6" W.C. natural gas, 10" W.C. propane. • Adjust main valve regulator for 6" W.C. natural gas, 10" W.C. propane. • See Maintenance Section. • Increase inlet pressure or replace. • Do not operate. See nameplate. Correct immediately.
Control system overheating.	A, B A, B	• Heater not mounted correctly. • Heater mounted too close to ceiling.	• Mounting angle 20°-35° from horizontal. • Observe clearance to combustibles safety chart located on heater reflector. Do not operate.
Gas odor.	A, B B	• Loose pipe connection. • Pilot not lit.	• Check all connections with leak-detector solution, tighten as necessary. • Cycle thermostat or manually light.
Heater cycles repeatedly.	A, B A A, B A, B B	• Heater located in drafty area. • Low gas pressure. • Thermostat located in drafty area. • Weak pilot flame. • Defective flame detector.	• Relocate or shield from draft. • See Gas Supply section for propane. • Replace thermostat. • Clean or adjust pilot. • Replace.
Pilot on, no gas to main burner.	B	• Weak pilot flame. • No electrical power to unit. • Pilot sensor element not located in pilot flame. • Defective main valve solenoid. • Defective pilot generator or thermocouple. • Excessive thermostat wire length with millivolt system. • Manual valve off.	• Clean or adjust pilot. • Check thermostat, manual switch or circuit breaker. • Locate upper 3/4 of element in pilot flame. • Isolate. Measure resistance, replace if "0". • Replace. • Wire not to exceed length provided by factory. • Turn to "ON" position.
No spark; no ignition.	A A A A A A A	• Lack of 120V or 24V incoming voltage. • Open high voltage wire. • Improper electrode gap. • Loose or open wire connection. • Poor or no equipment ground. • Unit in "safety lockout" mode. • Defective "gas lighter" control.	• Proper voltage needed or repair wire. • Isolate and measure resistance, replace if "0". • See Figure 4.3. • Check all wires, tighten or replace. • Trace ground wire for complete circuit back to equipment ground from control. • Interrupt power source, repeat trial for ignition. • Verify proper voltage. Replace.
Heater lights, and "locks out" after approximately 10 seconds.	A A A A A	• Poor or no equipment ground. • Polarity is reversed. • Low gas pressure. • Electrode not sensing. • Heater mounted at incorrect angle.	• Check all connections, provide positive earth ground. • 120V to black, neutral to white. • See Gas Supply section. • Relocate or replace if defective. • Mounting angle 20°-35° from horizontal.
Spark is present. No main gas operation. Unit "locks out".	A A A	• Gas valve in "Off" position. • Defective main valve solenoid. • Defective "Gas lighter" control.	• Turn to "On" position. • Isolate and check for resistance. Replace if "0". • Verify proper voltage. Replace.
Heater will not shut off.	A, B A, B A, B	• Defective thermostat or wiring. • Gas valve stuck open. • High gas pressure.	• Replace or repair. • Replace. • See Gas Supply section.

Code: **A** - Direct Spark Ignition (24V/120V) **B** - Standing Pilot (Millivolt)

Heater Assembly Components

NOTE: Replacement burners are called “rayheads” with rod inserts. Ceramic grids are not sold separately.

Figure 4.1 • Heater Assembly Components (side view)

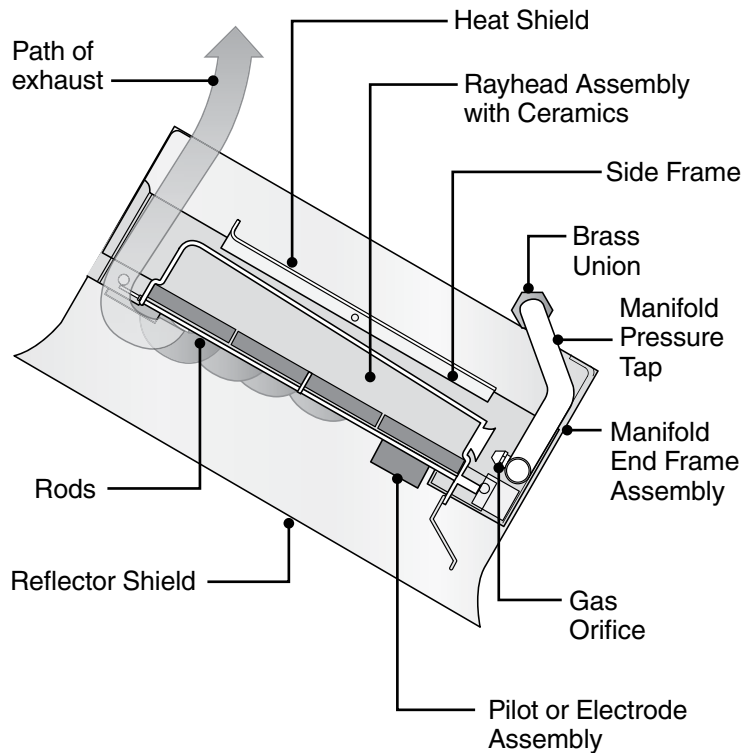


Figure 4.2 • Heater Assembly Components (rear view of Direct Spark)

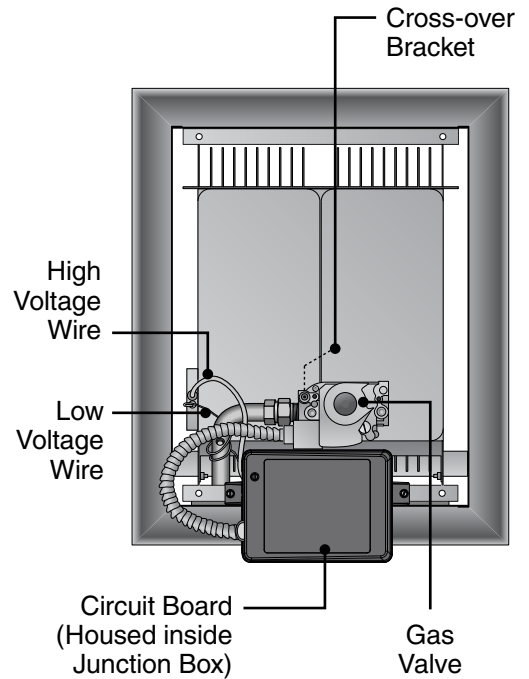


Figure 4.3 • Spark Electrode Side View (Direct Spark) Side View

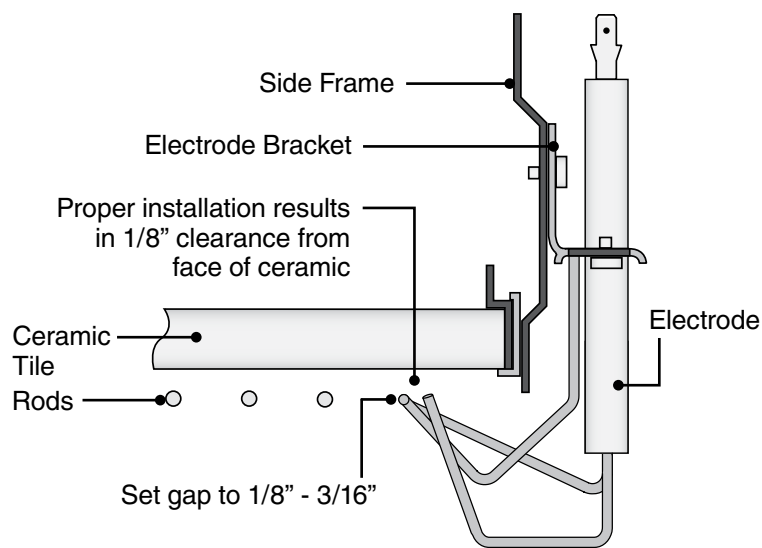
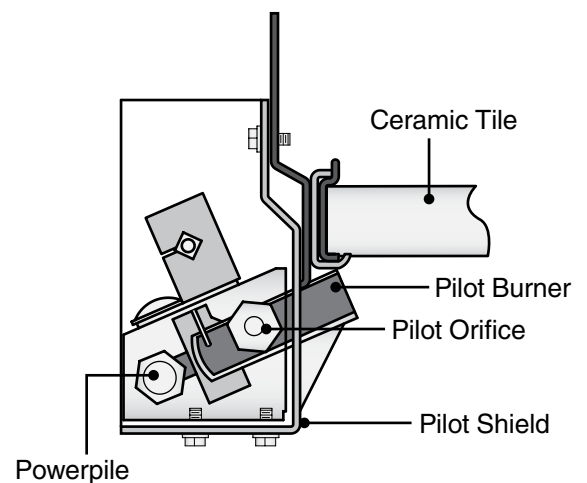


Figure 4.4 • Pilot Assembly Side View (Millivolt)



Parts Listing

IMPORTANT: Contact factory for conversion assistance. Note: Gas type conversions require gas valve and gas orifice among other changes. Conversion may also require burner and crossover changes.

Chart 4.2 • Direct Spark Control Components

Part No.	Description	Voltage
78636	Combination gas valve, natural gas	25V
78637	Combination gas valve, natural gas	120V
78638	Combination gas valve, propane gas	25V
78639	Combination gas valve, propane gas	120V
78640	Main burner electrode	25V, 120V
78641	25V circuit board	25V
78642	Wiring harness for Mark 10DX-24 circuit board	25V
78643	120V circuit board	120V
78644	Wiring harness for Mark 10DX-117 circuit board	120V
78645	High voltage ignition wire	25V, 120V
78646	Low voltage ignition wire	25V, 120V

Chart 4.3 • Millivolt Control Components

Part No.	Description
78647	Combination gas valve, natural gas
78648	Combination gas valve, propane gas
78649	Pilot flame detector powerpile
78650	Pilot burner
78651	Pilot orifice, natural gas
78652	Pilot orifice, propane gas
78653	Pilot regulator, natural gas
78654	Pilot regulator, propane gas
78655	Millivolt Thermostat
78656	35' Thermostat Wire

Chart 4.4 • Miscellaneous Core Components

Part No.	Description	Part No.	Description
78657	Manifold	78675	Electrode mounting bracket (Direct Spark)
78658	Upper frame (*specify 1-5)	78676	Red Rubber Spark Boot (Direct Spark)
78659	Heat shield (*specify 1-5)	78677	Low volt black wire grommet (Direct Spark)
78660	Flash shield (*specify 1-5)	78678	High volt black wire heyco grommet (Direct Spark)
78661	Reflector End (*specify 1-5)	78679	JB-0514 metal junction box (Direct Spark)
78662	Full Reflector Assembly (*specify 1-5)	78680	#8 x 1/2" common sheet metal screw
78663	Side frame	78681	1/4 - 20 x 1/2" machine screw (IHR Bolt)
78664	Side frame insert	78682	1/4 - 20 hex nut (mates to IHR bolt)
78665	Embossed reflector sides	78683	1/4 - 20 x 1/2" self-tap IHR bolt
78666	Rayhead with center support	78684	1/4 - 10 short electrode mounting screw
78667	Rayhead no center support (IHR30 LP models only)	78685	#8 x 1/2" sheet metal self-tap screw
78668	Cross-over bracket	78686	Pilot access door with zip screw (Millivolt)
78669	Long rayhead rod	78687	Pilot shield for F10-1 pilot burner (Millivolt)
78670	Short rayhead rod	78688	Pilot line for IHR 30 (Millivolt)
78671	Union fitting, 3-piece	78689	Pilot line (Millivolt)
78672	Brass gas orifice (specify model #)	78690	Plastic junction box (Top)
78673	3/8" flex conduit (Direct Spark)	78691	Plastic Junction Box (Bottom)
78674	3/8" conduit attachment fitting (NFS-2/PFS-2)		

*Reference proper part number when ordering these parts: 1=IHR30; 2=IHR60; 3=IHR90; 4=IHR130; 5=IHR160

5.0 Limited Warranty

Seller warrants its products to be free from defects in material and workmanship, EXCLUSIVE, HOWEVER, of failures attributable to the use of materials substituted under emergency conditions for materials normally employed. This warranty covers replacement of any parts furnished from the factory of Seller, but does not cover labor of any kind and materials not furnished by Seller, or any charges for any such labor or materials, whether such labor, materials, or charges thereon are due to replacement of parts, adjustments, repairs, or any other work done. This warranty does not apply to any equipment which shall have been repaired or altered outside the factory of Seller in any way so as, in the judgement of Seller, to affect its stability, nor which has been subjected to misuse, negligence, or operating conditions in excess of those for which such equipment was designed. This warranty does not cover the effects of physical or chemical properties of water or steam or other liquids or gases used in the equipment.

BUYER AGREES THAT SELLER'S WARRANTY OF ITS PRODUCTS TO BE FREE FROM DEFECT IN MATERIAL AND WORKMANSHIP, AS LIMITED HEREIN, SHALL BE IN LIEU OF AN EXCLUSIVE OF ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, WHETHER ARISING FROM LAW, COURSE OF DEALING, USAGE OF TRADE, OR OTHERWISE, **THERE ARE NO OTHER WARRANTIES, INCLUDING WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE, WHICH EXTEND BEYOND THE PRODUCT DESCRIPTION CONFIRMED BY BUYER AND SELLER AS OF THE DATE OF FINAL AGREEMENT.**

This warranty is void if the input to the product exceeds the rated input as indicated on the product serial plate by more than 5% on gas-fired and oil-fired units, or if the product, in the judgement of the SELLER, has been installed in a corrosive atmosphere, or subjected to corrosive fluids or gases, been subjected to misuse, negligence, accident, excessive thermal shock, excessive humidity, physical damage, impact, abrasion, unauthorized alterations, or operation contrary to SELLER'S printed instructions, or if the serial number has been altered, defaced, or removed.

BUYER AGREES THAT IN NO EVENT WILL SELLER BE LIABLE FOR COSTS OF PROCESSING, LOST PROFITS, INJURY TO GOODWILL, OR ANY OTHER CONSEQUENTIAL OR INCIDENTAL DAMAGES OF ANY KIND RESULTING FROM THE ORDER OR USE OF ITS PRODUCT, WHETHER ARISING FROM BREACH OF WARRANTY, NONCONFORMITY TO ORDERED SPECIFICATIONS, DELAY IN DELIVERY, OR ANY LOSS SUSTAINED BY THE BUYER.

Component Applicable Models	"APPLICABLE WARRANTY PERIOD"
Heat Exchangers Gas-Fired Units	TEN YEARS FROM DATE OF FIRST BENEFICIAL USE BY BUYER OR ANY OTHER USER, WITHIN TEN YEARS FROM DATE OF RESALE BY BUYER OR ANY OTHER USER, WITHIN TEN YEARS FROM DATE OF RESALE BY BUYER IN ANY UNCHANGED CONDITION, OR WITHIN ONE HUNDRED TWENTY-SIX MONTHS FROM DATE OF SHIPMENT FROM SELLER, WHICHEVER OCCURS FIRST.
Heat Exchangers Low Intensity Infrared Units Compressors Condensing Units for Cassettes	FIVE YEARS FROM DATE OF FIRST BENEFICIAL USE BY BUYER OR ANY OTHER USER, WITHIN FIVE YEARS FROM DATE OF RESALE BY BUYER OR ANY OTHER USER, WITHIN FIVE YEARS FROM DATE OF RESALE BY BUYER IN ANY UNCHANGED CONDITION, OR WITHIN SIXTY-SIX MONTHS FROM DATE OF SHIPMENT FROM SELLER, WHICHEVER OCCURS FIRST.
Burners Low Intensity Infrared Units Other Components excluding Heat Exchangers, Coils, Condensers, Burners, Sheet Metal	TWO YEARS FROM DATE OF FIRST BENEFICIAL USE BY BUYER OR ANY OTHER USER, WITHIN TWO YEARS FROM DATE OF RESALE BY BUYER IN ANY UNCHANGED CONDITION, OR WITHIN THIRTY MONTHS FROM DATE OF SHIPMENT FROM SELLER, WHICHEVER OCCURS FIRST.
Heat Exchangers/Coils Indoor and Outdoor Duct Furnaces and System Units, Steam/Hot Water Units, Oil-Fired Units, Electric Units, Cassettes, Vertical Unit Ventilators, Geothermal Units Compressors Vertical Unit Ventilators, Geothermal Units Burners High Intensity Infrared Units Sheet Metal Parts All Products	ONE YEAR FROM DATE OF FIRST BENEFICIAL USE BY BUYER OR ANY OTHER USER, WITHIN ONE YEAR FROM DATE OF RESALE BY BUYER IN ANY UNCHANGED CONDITION, OR WITHIN EIGHTEEN MONTHS FROM DATE OF SHIPMENT FROM SELLER, WHICHEVER OCCURS FIRST.

As Modine Manufacturing Company has a continuous product improvement program, it reserves the right to change design and specifications without notice.



BUYER'S REMEDY FOR BREATCH OR WARRANTY, EXCLUSIVE OF ALL OTHER REMEDIES PROVIDED BY LAW, IS LIMITED TO REPAIR OR REPLACEMENT AT THE FACTORY OF SELLER, ANY COMPONENT WHICH SHALL, WITHIN THE APPLICABLE WARRANTY PERIOD DEFINED HEREIN AND UPON PRIOR WRITTEN APPROVAL, BE RETURNED TO SELLER WITH TRANSPORTATION CHARGES PREPAID AND WHICH THE EXAMINATION OF SELLER DISCLOSE TO HAVE BEEN DEFECTIVE; EXCEPT THAT WHEN THE PRODUCT IS TO BE USED BY BUYER AS A COMPONENT PART OF EQUIPMENT MANUFACTURED BY BUYER, BUYER'S REMEDY FOR BREACH, AS LIMITED HEREIN, SHALL BE LIMITED TO ONE YEAR FROM DATE OF SHIPMENT FROM SELLER, FOR GAS-FIRED PRODUCTS INSTALLED IN HIGH HUMIDITY APPLICATIONS AND UTILIZING STAINLESS STEEL HEAT EXCHANGERS, BUYER'S REMEDY FOR BREACH, AS LIMITED HEREIN, SHALL BE LIMITED TO TEN YEARS FROM DATE OF SHIPMENT FROM SELLER.

These warranties are issued only to the original owner-user and cannot be transferred or assigned. No provision is made in these warranties for any labor allowance or field labor participation. Seller will not honor any expenses incurred in its behalf with regard to repairs to any of Seller's products. No credit shall be issued for any defective part returned without proper written authorization (including, but not limited to, model number, serial number, date of failure, etc.) and freight prepaid.

OPTIONAL SUPPLEMENTAL WARRANTY

Provided a supplemental warranty has been purchased, Seller extends the warranty herein for an additional four (4) years on certain compressors. Provided a supplemental warranty has been purchased, Seller extends the warranty herein for an additional four (4) years or nine (9) years on certain heat exchangers.

EXCLUSION OF CONSUMABLES & CONDITIONS BEYOND SELLER'S CONTROL

This warranty shall not be applicable to any of the following items: refrigerant, gas, belts, filters, fuses, and other items consumed or worn out by normal wear and tear or conditions beyond Seller's control, including (without limitation as to generality) polluted or contaminated or foreign matter contained in the air or water utilized for heat exchanger (condenser) cooling or if the failure of the part is caused by improper air or water supply, or improper or incorrect sizing of power supply.

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