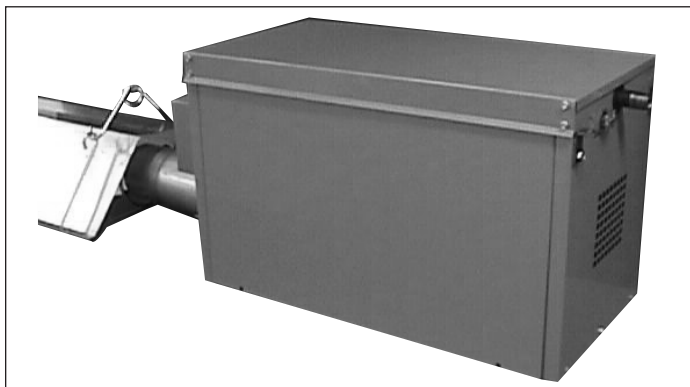


INSTALLATION AND SERVICE MANUAL

low intensity gas-fired pressurized infrared heaters

model TLP



WARNING

1. Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death, and could cause exposure to substances which have been determined by various state agencies to cause cancer, birth defects, or other reproductive harm. Read the installation, operating, and maintenance instructions thoroughly before installing or servicing this equipment.
2. Do not locate ANY gas-fired units in areas where chlorinated, halogenated, or acidic vapors are present in the atmosphere. These substances can cause premature heat exchanger failure due to corrosion which can cause property damage, serious injury or death.

CAUTION

As with all infrared equipment, clearances to combustible materials are critical. Be sure all units have reflectors installed along the entire length of the tube, and that they are not mounted at an angle greater than 45° from the horizontal plane. In locations used for storage of combustible materials, signs shall be clearly posted in the vicinity of the heater where readily apparent to material handlers to specify the maximum permissible stacking height to maintain required clearances from the heater to the combustibles.



FOR YOUR SAFETY

IF YOU SMELL GAS:

1. Open windows (indoor installation only).
2. Do not touch electrical switches.
3. Extinguish any open flame.
4. Immediately call your gas supplier.

FOR YOUR SAFETY

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

IMPORTANT

The use of this manual is specifically intended for a qualified installation and service agency. A qualified installation and service agency must perform all installation and service of these appliances.

Inspection upon Arrival

1. Inspect unit upon arrival. In case of damage, report it immediately to transportation company and your local Modine Sales Representative.
2. Check rating plate on unit to verify that power supply meets available electric power at the point of installation.
3. Inspect unit upon arrival for conformance with description of product ordered (including specifications where applicable).

SPECIAL PRECAUTIONS

SPECIAL PRECAUTIONS

THE INSTALLATION AND MAINTENANCE INSTRUCTIONS IN THIS MANUAL MUST BE FOLLOWED TO PROVIDE SAFE, EFFICIENT AND TROUBLE-FREE OPERATION. IN ADDITION, PARTICULAR CARE MUST BE EXERCISED REGARDING THE SPECIAL PRECAUTIONS LISTED BELOW. FAILURE TO PROPERLY ADDRESS THESE CRITICAL AREAS COULD RESULT IN PROPERTY DAMAGE OR LOSS, PERSONAL INJURY, OR DEATH. THESE INSTRUCTIONS ARE SUBJECT TO ANY MORE RESTRICTIVE LOCAL OR NATIONAL CODES.

HAZARD INTENSITY LEVELS

1. **DANGER:** Indicates an imminently hazardous situation which, if not avoided, WILL result in death or serious injury.
2. **WARNING:** Indicates a potentially hazardous situation which, if not avoided, COULD result in death or serious injury.
3. **CAUTION:** Indicates a potentially hazardous situation which, if not avoided, MAY result in minor or moderate injury.
4. **IMPORTANT:** Indicates a situation which, if not avoided, MAY result in a potential safety concern.

DANGER

Appliances must not be installed where they may be exposed to a potentially explosive or flammable atmosphere.

WARNING

1. Do not locate ANY gas-fired units in areas where chlorinated, halogenated, or acidic vapors are present in the atmosphere. These substances can cause premature heat exchanger failure due to corrosion which can cause property damage, serious injury or death.
2. To prevent risk of fire or improper unit operation, radiant tube baffle must be properly selected from Table 10.1 according to fuel type, burner input, and tube system length and it must also be properly assembled and installed.
3. To prevent tube sections from separating during unit operation, tube clamps must be centered over the joints of adjoining tube sections and tightened to 50 ft. - lb. and the clamp fastened to the tubes using (2) self-tapping screws. Failure to do so may result in separation of tube sections which could fall and result in death or serious injury.
4. All field gas piping must be pressure/leak tested prior to operation. Never use an open flame. Use a soap solution or equivalent for testing.
5. Gas pressure to appliance controls must never exceed 14" W.C. (1/2 psi).
6. Do not join two sections of Type B double wall vent pipe within the vent system. A compromised pipe joint/liner pipe may or not be detected, resulting in serious injury or death.
7. A built-in combustion air blower is provided – additional external draft hoods (diverters) or power exhausters are not required or permitted.
8. To reduce the opportunity for condensation, the minimum sea level input to the appliance, as indicated on the serial plate, must not be less than 5% below the rated input.
9. A certified flexible connector must be used (local codes permitting) as a the method of connecting the heaters to the gas supply to avoid placing stress on the gas supply line due to the expansion of the low intensity infrared tubes during operation.
10. Disconnect power supply before making wiring connections to prevent electrical shock and equipment damage.
11. All appliances must be wired strictly in accordance with the wiring diagram furnished with the unit. Any wiring different from the wiring diagram could result in a hazard to persons and property.

WARNING

12. Any original factory wiring that requires replacement must be replaced with wiring material having a temperature rating of at least 105°C.
13. Ensure that the supply voltage to the appliance, as indicated on the serial plate, is not 5% greater than rated voltage.
14. When servicing or repairing this equipment, use only factory-approved service replacement parts. A complete replacement parts list may be obtained by contacting Modine Manufacturing Company. Refer to the rating plate on the unit for complete unit model number, serial number, and company address. Any substitution of parts or controls not approved by the factory will be at owner's risk.

CAUTION

1. As with all infrared equipment, clearances to combustible materials are critical. Be sure all units have reflectors installed along the entire length of the tube, and that they are not mounted at an angle greater than 45° from the horizontal plane. In locations used for storage of combustible materials, signs shall be clearly posted in the vicinity of the heater where readily apparent to material handlers to specify the maximum permissible stacking height to maintain required clearances from the heater to the combustibles.
2. Installation must conform with local building codes or in the absence of local codes, with Part 7, Venting of Equipment, or the National Fuel Gas Code, ANSI Z223.1 (NFPA 54) – latest edition. In Canada installation must be in accordance with CAN/CGA-B149.1 for natural gas units, and CAN/CGA-B149.2 for propane units.
3. Purging of air from gas lines should be performed as described in ANSI Z223.1 – latest edition "National Fuel Gas Code" or in Canada in CAN/CGA-B149 codes.
4. When leak testing the gas supply piping system, the appliance and its combination gas control must be isolated during any pressure testing in excess of 14" W.C. (1/2 psi).
5. The unit should be isolated from the gas supply piping system by closing its field installed manual shut-off valve. This manual shut-off valve should be located within 6' of the heater.
6. Turn off all gas before installing appliance.
7. Ensure that the supply voltage to the appliance, as indicated on the serial plate, is not 5% less than the rated voltage.
8. Do not attempt to reuse any mechanical or electrical controllers which have been wet. Replace defective controller.

SI (METRIC) CONVERSION FACTORS/UNIT LOCATION

IMPORTANT

- Approval requirements for infrared heaters specify that the suspended type heaters shall be installed in accordance with certain sections of the National Fire Codes published by the National Fire Protection Association and various ANSI standards. SOME of the requirements are listed below.

Aircraft Hangars: Approval requirements are contained in the current edition of ANSI/NFPA 409 (or in accordance with the enforcing authority for Canada).

Public Garages: Approval requirements are contained in the current edition of NFPA 88B (CAN/CGA B149 for Canada).

Parking Structures: Approval requirements are contained in the current edition of NFPA 88A.

General: All installations must be in accordance with the current edition of ANSI Z-223.1 (NFPA 54) National Fuel Gas Code and the current edition of the National Electric Code, ANSI/NFPA 70. For Canada, installations must conform with local building codes, or in the absence of local codes, in accordance with the current edition of CAN/CGA B149 and the Canadian Electric Code, C22.1.

- Start-up and adjustment procedures should be performed by a qualified service agency.
- To check most of the Possible Remedies in the troubleshooting guide listed in Table 21.1, refer to the applicable sections of the manual.

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Table 3.1
SI (Metric) Conversion Factors

To Convert	Multiply By	To Obtain	To Convert	Multiply By	To Obtain
"W.C.	0.249	kPa	feet	0.305	m
°F	(°F-32) x 5/9	°C	Gal/Hr.	0.00379	m ³ /hr
Btu	1.06	kJ	Gal/Hr.	3.79	l/hr
Btu/ft ³	37.3	kJ/m ³	gallons	3.79	l
Btu/hr	0.000293	kW	Horsepower	746	W
CFH (ft ³ /hr)	0.000472	m ³ /min	inches	25.4	mm
CFH (ft ³ /hr)	0.0000787	m ³ /s	pound	0.454	kg
CFM (ft ³ /min)	0.0283	m ³ /min	psig	6.89	kPa
CFM (ft ³ /min)	0.000472	m ³ /s	psig	27.7	"W.C.

UNIT LOCATION

DANGER

Appliances must not be installed where they may be exposed to a potentially explosive or flammable atmosphere.

WARNING

Do not locate ANY gas-fired units in areas where chlorinated, halogenated, or acidic vapors are present in the atmosphere. These substances can cause premature heat exchanger failure due to corrosion which can cause property damage, serious injury or death.

CAUTION

As with all infrared equipment, clearances to combustible materials are critical. Be sure all units have reflectors installed along the entire length of the tube, and that they are not mounted at an angle greater than 45° from the horizontal plane. In locations used for storage of combustible materials, signs, shall be clearly posted in the vicinity of the heater where readily apparent to material handlers to specify the maximum permissible stacking height to maintain required clearances from the heater to the combustibles.

IMPORTANT

Approval requirements for infrared heaters specify that the suspended type heaters shall be installed in accordance with certain sections of the National Fire Codes published by the National Fire Protection Association and various ANSI standards. SOME of the requirements are listed below.

Aircraft Hangars: Approval requirements are contained in the current edition of ANSI/NFPA 409 (or in accordance with the enforcing authority for Canada).

Public Garages: Approval requirements are contained in the current edition of NFPA 88B (CAN/CGA B149 for Canada).

Parking Structures: Approval requirements are contained in the current edition of NFPA 88A.

General: All installations must be in accordance with the current edition of ANSI Z-223.1 (NFPA 54) National Fuel Gas Code and the current edition of the National Electric Code, ANSI/NFPA 70. For Canada, installations must conform with local building codes, or in the absence of local codes, in accordance with the current edition of CAN/CGA B149 and the Canadian Electric Code, C22.1.

Location Recommendations

- When locating the heater, consider the general space and heating requirements and availability of gas and electrical supply.
- Be sure the structural support and chain at the unit location is adequate to support the weight of the unit.

UNIT LOCATION /AIR REQUIREMENTS

- Be sure that the minimum clearances to combustibles are maintained. The minimum clearances to combustibles are shown in Table 4.1, and Figures 4.1 and 4.2, as well as affixed to the burner Model Identification plate.
- Maintain a recommended minimum of 18" clearance from the access side of the burner box and also on the combustion air inlet end of the burner box.
- Mounting height (measured from the bottom of unit) at which heaters are installed is important to maintain proper occupant comfort levels. Please refer to mounting height information in Table 19.1.
- Do not locate units in areas where chlorinated, halogenated, or acid vapors are present in the atmosphere.
- Unit gas control can be field configured for right or left access, depending on unit location. See general instructions for "Rotation of Gas Control" on page 5.

Combustion Air Requirements

Units installed in tightly sealed buildings or confined spaces must be provided with two permanent openings, one near the top of the confined space and one near the bottom. Each opening should have a free area of not less than one square inch per 1,000 BTU per hour of the total input rating off all units in the enclosure, freely communicating with interior areas having, in turn adequate infiltration from the outside.

For further details on supplying combustion air to a confined (tightly sealed) space or unconfined space, see the National Fuel Gas Code ANSI Z223.1 of CAN/CGA B149.1 or .2 Installation Code, latest edition.

An accessory combustion air intake collar can be used to bring outside combustion air to the unit using 4" pipe. Refer to the venting section "Utilizing Outside Combustion Air" on page 14 for details on pipe length and location.

Clearance to Combustibles

Insure that:

- Clearances to combustibles (as shown on the Model Identification plate and in Table 4.1) are maintained. These Clearances also apply to vehicles parked below the heater.
- Adequate clearances to sprinkler heads are maintained. As a guideline, certified minimum distance to combustible material is based on the combustible material surface not exceeding 90°F above ambient (160°F typical).
- The stated clearance to combustibles represents a surface temperature of 90°F (32°F) above room temperature. Building materials with a low heat tolerance (such as plastics, 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.

Storage of Combustible Materials

In locations used for storage of combustible materials, signs shall be clearly posted in the vicinity of the heater where readily apparent to material handlers to specify the maximum permissible stacking height to maintain required clearances from the heater to the combustibles. See Figure 4.3.

Table 4.1
Combustible Material Clearances (inches) ① ②

Input MBH	"A" ①	"B" ②	"C" ③
50/60	9	54	20
75	9	58	20
100/125	9	76	24
150/175/200	12	106	38

① Clearance to each end and above the U-Tube is 12 inches.

② In unvented applications, clearance from radiant tube end is 36" in all directions.

③ Refer to Figures 4.1 and 4.2.

Figure 4.1
Combustible Material Clearances - Straight Tube

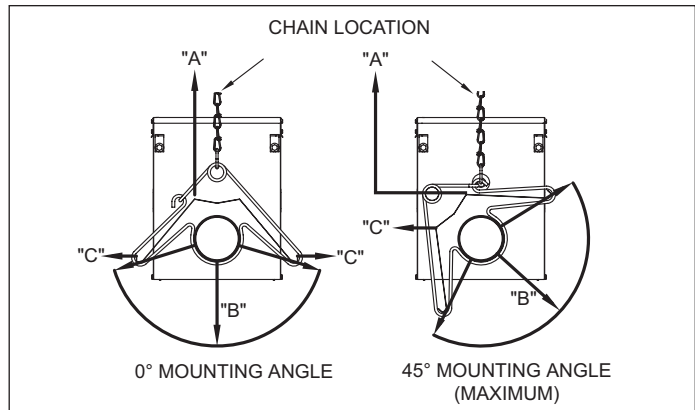


Figure 4.2
Combustible Material Clearances - U-Tube

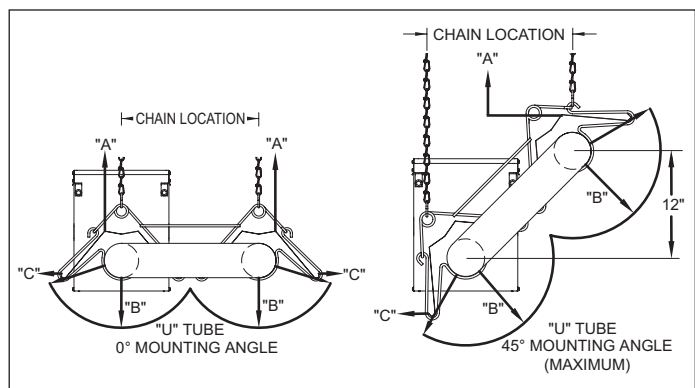
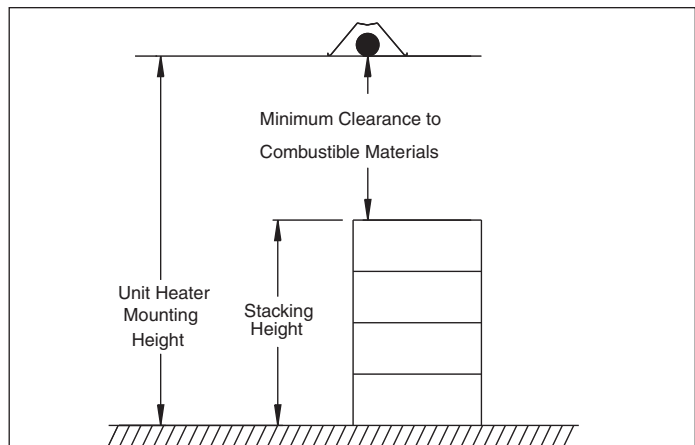


Figure 4.3
Stacking Height



INSTALLATION

Unit Mounting – Pre-Installation Notes

⚠ WARNING

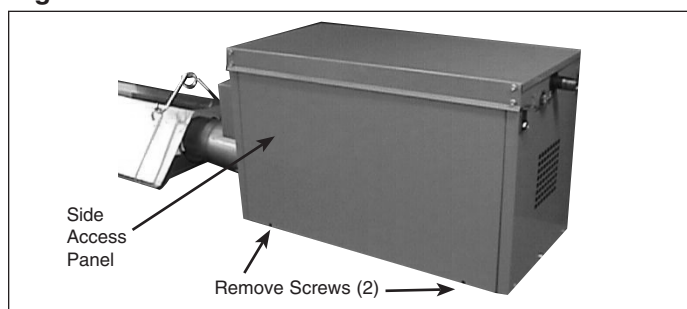
1. To prevent risk of fire or improper unit operation, radiant tube baffle must be properly selected from Table 10.1 according to fuel type, burner input, and tube system length and it must also be properly assembled and installed.
2. To prevent tube sections from separating during unit operation, tube clamps must be centered over the joints of adjoining tube sections and tightened to 50 ft. - lb. and the clamp fastened to the tubes using (2) self-tapping screws. Failure to do so may result in separation of tube sections which could fall and result in death or serious injury.

1. Be sure the method of unit suspension is adequate to support the weight of the burner and tube system (see Tables 18.1 and 18.2 for system weights).
2. Combustible material and service clearances as specified in Table 4.1 and Figures 4.1 through 4.3 must be strictly maintained.
3. Maintain a recommended minimum of 18" clearance from the access side of the burner box and also on the combustion air inlet end of the burner box.
4. Before installing, review the components to be installed against Figure 6.1 and Table 6.1 for straight tube systems or Figure 7.1 and Table 7.1 for U-Tube systems. Ensure that all parts are identified and available before proceeding with installation of the unit.
5. It is recommended that the uninstalled system components be arranged on the floor, where possible, to match the intended layout. This can help ensure the layout matches the intended design.
6. The standard gas control access is on the left side when looking at the back end of the burner (combustion air inlet end). If the intended installation requires access from the opposite side, please follow the instructions in the section titled "Rotation of Gas Control" prior to burner installation.
7. For proper operation, the burner and tube system must be installed in a level horizontal position. Use a spirit level during installation to ensure that the unit is suspended level.
8. Under no circumstances should the gas supply line or the electrical supply line to the heater provide any assistance in the suspension of the heater. Do not locate any gas or electric service line directly above or below the heater.

Removal of Burner Side Access Panels

Each of the two side access panels are held in place by two (2) screws, as shown in Figure 5.1. Once the screws are removed, the panels slide down, where they can either hang on the hooks shown in Figure 20.1 or be removed completely during service or maintenance. The unit is designed to operate without these panels in place so that adjustments of the controls can be made. The panels must be returned to the unit once installation is complete.

Figure 5.1 - Side Access Panels



Rotation of Gas Control

⚠ WARNING

1. All field gas piping must be pressure/leak tested prior to operation. Never use an open flame. Use a soap solution or equivalent for testing.
2. Gas pressure to appliance controls must never exceed 14" W.C. (1/2 psi).

This section is only required if opposite side gas control access is required. The standard access is on the left side when looking at the back of the burner box (combustion air inlet end).

In order to install the heater so that the gas valve's controls can be accessed from the opposite side of the burner box, the valve may be rotated 180° by following the procedure below.

1. Remove burner side access panels as described in the previous section.
2. Unplug all wire harnesses from the valve.
3. Using two wrenches, loosen the factory-supplied union in the burner box and remove the gas valve. Do not apply the wrenches directly to either the gas valve or the gas manifold.
4. Remove the plug from the factory-supplied "tee" fitting and screw it into the opposite leg of the tee. Be sure to properly seal the threads of this connection.
5. Seat the gas valve onto the factory-supplied union, so that the valve faces the opposite side of the burner box. Tighten the union using two wrenches, without applying them directly to either the gas valve or the gas manifold.
6. Plug-in all wire harnesses removed from the valve in step 2.
7. The gas piping/fitting connections must be pressure/leak tested as outlined in the section titled "Gas Connections" on page 14.
8. Replace the burner side access panels.

INSTALLATION

Figure 6.1
Straight Tube System Components

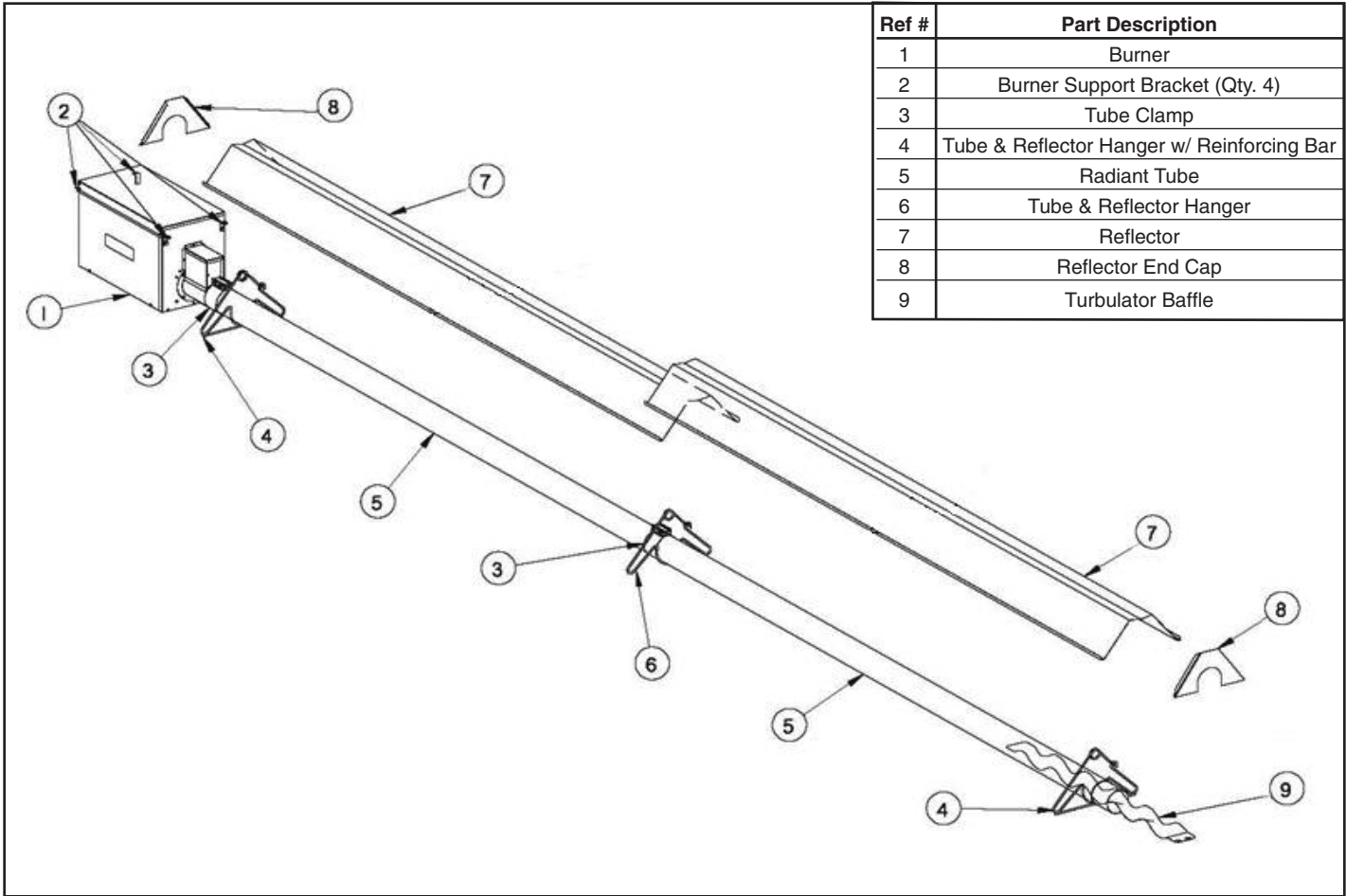


Table 6.1
Straight Tube System Component List

Tube Length (ft.)	Available Burner Input MBH	10' Tubes	10' Reflectors	Single-Tube Hangers with Reinforcing Bar	Single-Tube Hangers (regular)	Tube Clamps	Reflector End Cap	Turbulator Baffle Sections	Stocking Kit Option Requires the Following Tube Kits ②:
20	50, 60	2	2	2	1	3	2	3	A
30	50, 60, 75, 100	3	3	2	2	4	2	3	E
40	60, 75, 100, 125	4	4	2	3	5 ①	2	3	A + D
50	100, 125	5	5	2	4	6 ①	2	3	E + D
	150, 175, 200	5 ①	5	2	4	6 ①	2	3	B + C
60	125	6	6	2	5	7 ①	2	3	A + D + D
	150, 175, 200	6 ①	6	2	5	7 ①	2	3	B + D
70	175, 200	7 ①	7	2	6	8 ①	2	3	B + E

① Tube systems for input ratings of 150MBH and higher utilize a Titanium Aluminized Steel first tube section with stainless steel tube clamps.

② Tube systems can be ordered as either Modular (complete system) or Stocking Kits (combination of kits to form complete system).

INSTALLATION

Figure 7.1
U-Tube System Components

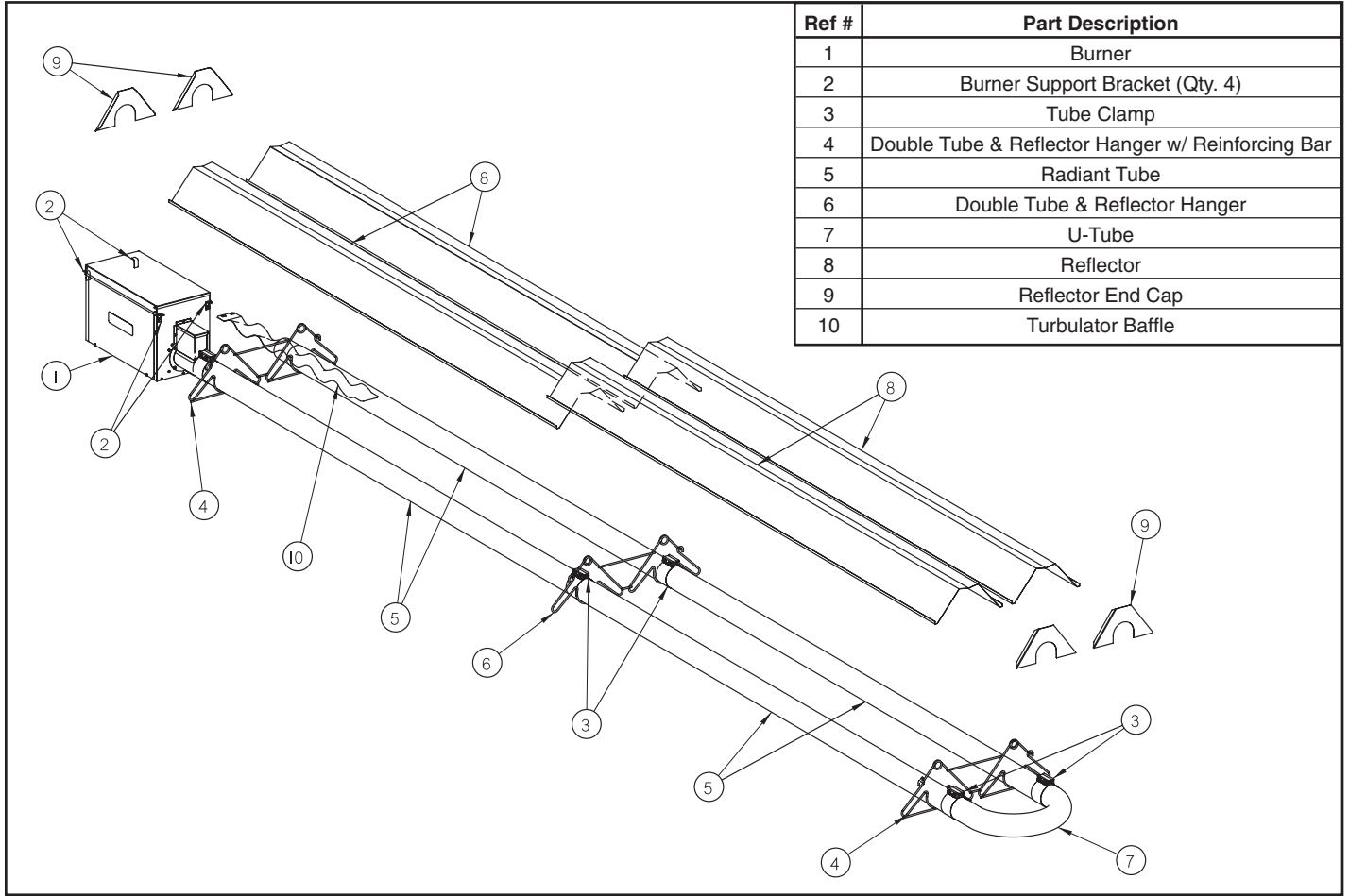


Table 7.1
U-Tube System Component List

Tube Length (ft.)	Available Burner Input MBH	5' Tubes	10' Tubes	10' Reflectors	Double-Tube Hangers with Reinforcing Bar	Double-Tube Hangers (regular)	Tube Clamps	Reflector End Cap	U-Tube	Turbulator Baffle Sections	Stocking Kit Option Requires the Following Tube Kits ^② :
20	50, 60	-	2	2	2	-	4	4	1	3	A + U-Tube
30	50, 60, 75, 100	2	2	4	2	1	6	4	1	3	N/A
40	60, 75, 100, 125	-	4	4	2	1	6	4	1	3	A + D + U-Tube
50	100, 125, 150, 175, 200	2	4 ①	6	2	2	8 ①	4	1	3	N/A
60	125	-	6	6	2	2	8	4	1	3	A + D + D + U-Tube
60	150, 175, 200	-	6 ①	6	2	2	8 ①	4	1	3	B + D + U-Tube
70	175, 200	2	6 ①	8	2	3	10 ①	4	1	3	N/A

① Tube systems for input ratings of 150MBH and higher utilize a Titanium Aluminized Steel first tube section with stainless steel tube clamps.

② Tube systems can be ordered as either Modular (complete system) or Stocking Kits (combination of kits to form complete system).

INSTALLATION

Unit Mounting – Tube System

⚠ WARNING

To prevent tube sections from separating during unit operation, tube clamps must be centered over the joints of adjoining tube sections and tightened to 50 ft. - lb. and the clamp fastened to the tubes using (2) self-tapping screws. Failure to do so may result in separation of tube sections which could fall and result in death or serious injury.

For steps 1-8 of this section, please refer to Figures 8.1 and 9.1

1. Locate and install tube and reflector system hanging chains (200 lb. minimum working load) as shown, following spacing indicated in Table 8.1 or 9.1.
2. Fasten tube and reflector hangers to the hanging chains installed in the previous step using ¼" diameter S-Hooks (70 lb. minimum working load). The hangers must be positioned so that the tube system to be installed will be in the horizontal plane and level. Refer to Figures 8.1 and 9.1 for chain location on tube systems mounted at a 45° angle. Also note that the first and last hangers are to be the type with reinforcing bar. Do not close ends until the tube system installed in subsequent steps is confirmed to be level.
3. Identify the first burner tube and first and second tube clamps as follows:
 - For units under 150,000 Btu/hr, all tubes and clamps are the same.

- For units 150,000 Btu/hr and over, the first tube is shinier than the other tubes and is stenciled with the words "First Tube". The first two tube clamps have a shiny, mirror-like appearance.
4. Loosely slide the second tube clamp approximately 6" past the swaged end (see Figure 8.2 for identification of tube ends).
 5. Starting from the end of the tube system where the burner will be installed (done in later steps), slide the first burner tube through the first and second tube hangers. The non-swaged end is to go through the first tube hanger and the swaged end is to go through the second tube hanger. Position the tube so the welded seam is directed toward the floor.
 6. Loosely slide the next tube clamp over the swaged end of the next tube and slide the non-swaged end over the swaged end of the preceding tube, ensuring that the welded seam on the tube is directed toward the floor. The other end is to be inserted through the following tube hanger.
 7. Center the tube clamp on the preceding tube over the joint of the two tubes as shown in Figures 8.1 or 9.1 and tighten the tube clamp bolts to 50 ft.-lb. Secure the tube clamp to both tubes using (2) self-tapping sheet metal screws.
 8. Repeat steps 6 and 7 until all tube sections are installed.
 9. Verify that the tube system is level. If the tube is not level, adjust the position of the hanger on the hanging chain. Once level, crimp the ends of the S-hooks on the hangers closed.

Figure 8.1 - Straight Tube System Suspension

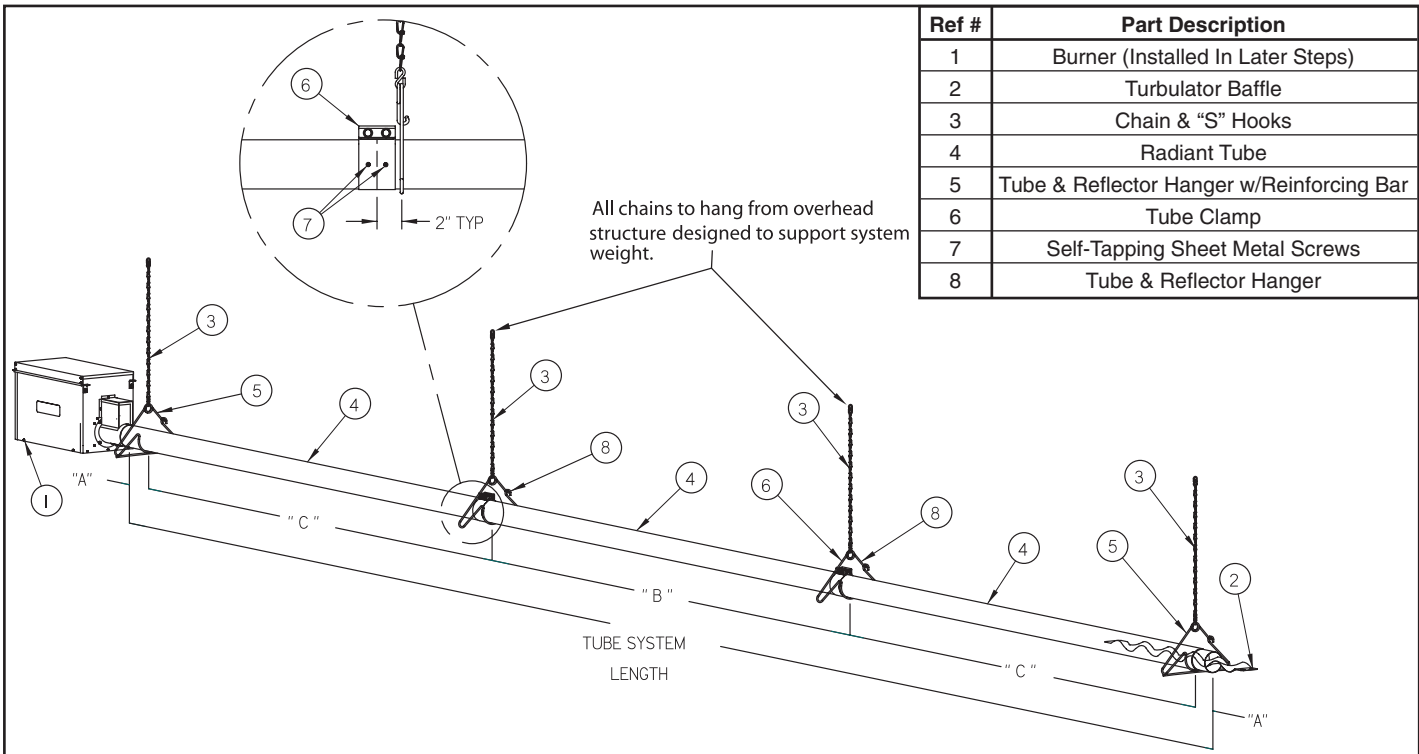
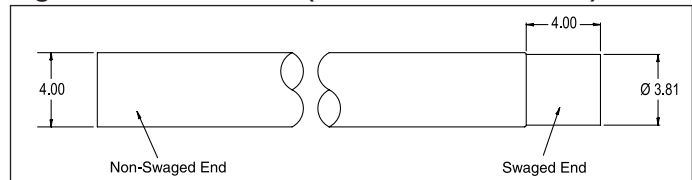


Table 8.1 - Straight Tube Chain Spacing

Tube System Length (ft)	Number of Chains	Minimum Chain Length	Chain to Chain Spacing Dimensions		
			"A" ①	"B" ②	"C" ③
20	3	18"	6"	N/A	9' 4"
30	4	18"			
40	5	18"			
50	6	18"			
60	7	24"			
70	8	24"			

- ① "A" Dimension is spacing from the tube system ends to the first and last hangers.
 ② "B" Dimension is spacing between hangers for tubes between "C" dimensions.
 ③ "C" Dimension is spacing between the first two hangers and the last 2 hangers.

Figure 8.2 - Tube Ends (Dimensions in inches)



INSTALLATION

Figure 9.1
U-Tube System Suspension

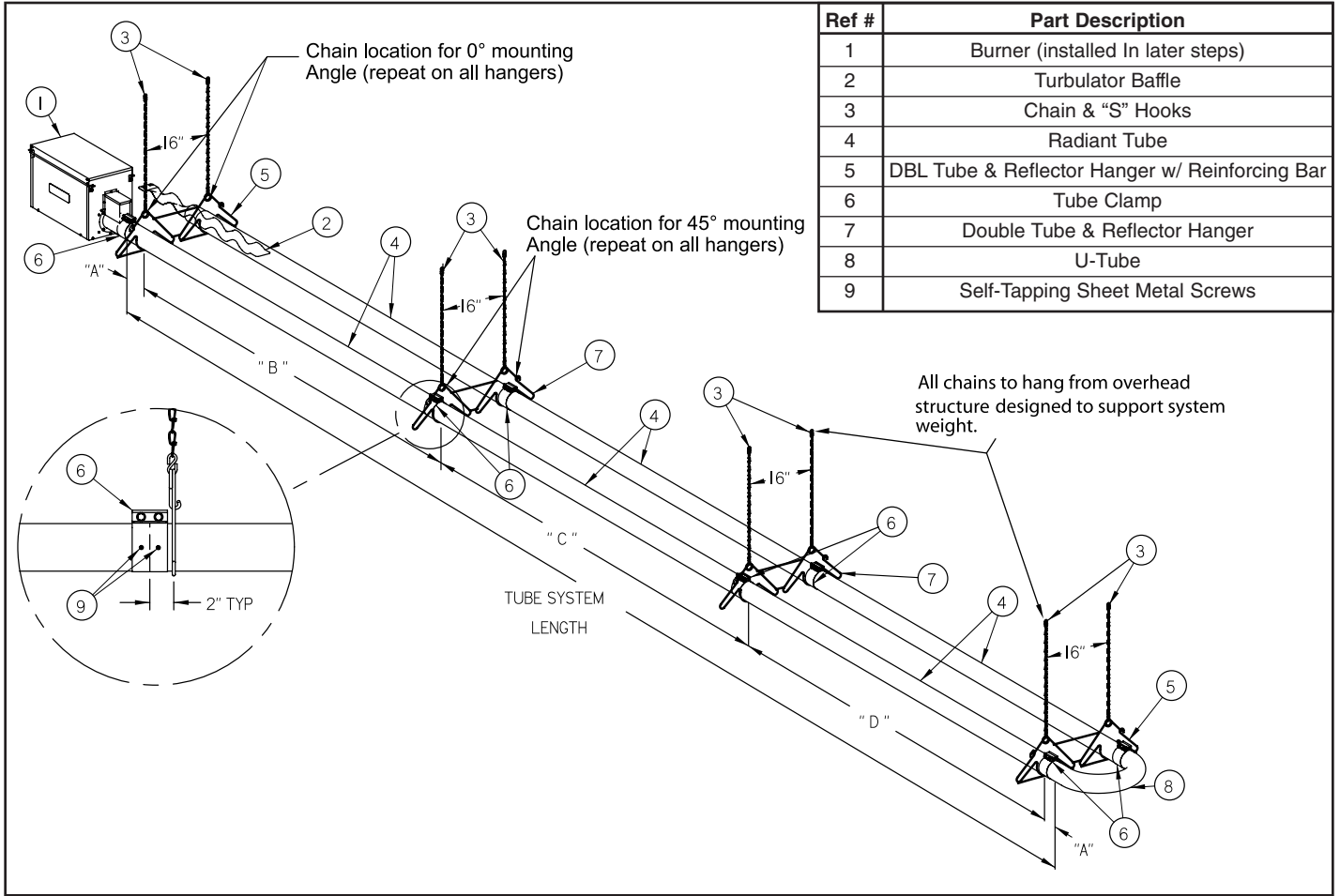


Table 9.1
U-Tube Chain Spacing

Tube System Length (ft)	Number of Chains	Minimum Chain Length	Chain to Chain Spacing			
			"A" Dimension ①	"B" Dimension ②	"C" Dimension ③	"D" Dimension ④
20	4	18"	6"	N/A	N/A	N/A
30	6			9' 4"		4' 4"
40	6				9' 4"	
50	8				4' 4"	
60	8				9' 4"	
70	10			4' 4"		

- ① "A" Dimension is spacing from the tube system ends to the first hanger and from the U-tube ends to the last hanger.
- ② "B" Dimension is spacing between first and second hangers away from burner.
- ③ "C" Dimension is spacing between hangers for tubes between "B" and "D" dimensions.
- ④ "D" Dimension is spacing between first and second hangers away from U-tube.

INSTALLATION

Unit Mounting – Turbulator Baffle

⚠ WARNING

To prevent risk of fire or improper unit operation, radiant tube baffle must be properly selected from Table 10.1 according to fuel type, burner input, and tube system length and it must also be properly assembled and installed.

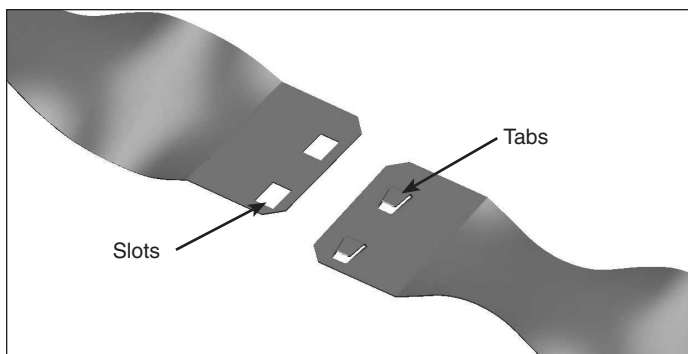
1. The last section of radiant tube is to include a turbulator baffle assembly. Determine the quantity of baffle sections to be installed based on the burner rating and tube system length, per Table 10.1. Discard any baffle sections that will not be required for the assembly.

**Table 10.1
Turbulator Baffle Assembly Section Qty. Determination**

Input MBH	Tube System Length (ft.)						
	20	30	40	50	60	70	
50	Nat	2	2	-	-	-	-
	Prop	2	2	-	-	-	-
60	Nat	2	1	0	-	-	-
	Prop	3	2	0	-	-	-
75	Nat	-	3	2	-	-	-
	Prop	-	2	1	-	-	-
100	Nat	-	3	2	1	-	-
	Prop	-	3	2	-	-	-
125	Nat	-	-	3	2	1	-
	Prop	-	-	3	2	1	-
150	Nat	-	-	-	3	1	-
	Prop	-	-	-	3	1	-
175	Nat	-	-	-	3	1	0
	Prop	-	-	-	3	0	-
200	Nat	-	-	-	3	1	0
	Prop	-	-	-	3	0	-

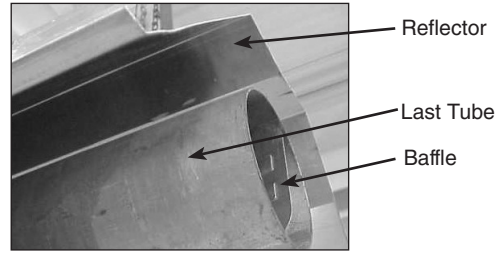
2. Assemble the turbulator baffle assembly by mating the sections determined in the previous step as shown in Figure 10.1.

**Figure 10.1
Assembly of Turbulator Baffle Assembly**



3. Insert the completed turbulator baffle assembly into the last radiant tube, flush with the end as shown in Figure 10.2.

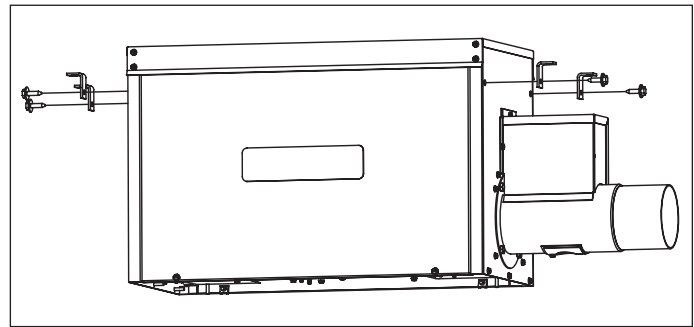
**Figure 10.2
Insertion of Turbulator Baffle Assembly**



Unit Mounting – Burner

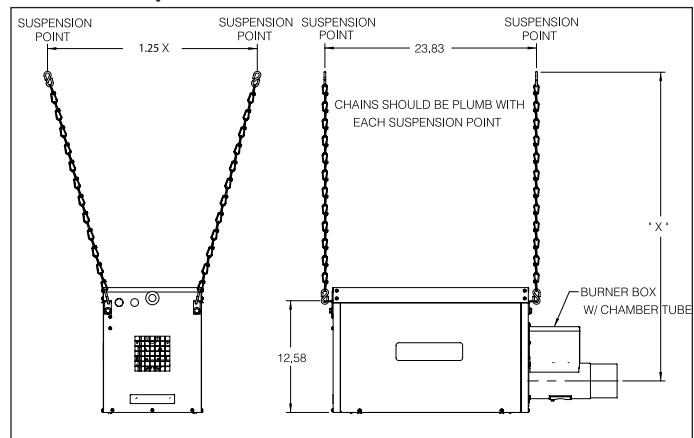
1. Install four burner support brackets as shown in Figure 10.3 with the bolts supplied.

**Figure 10.3
Burner Support Bracket Installation**



2. The burner must be suspended with four chains (200 lb. minimum working load) to allow for system expansion and contraction during unit operation, as shown in Figure 10.4. Note that for U-tube systems mounted at a 45° angle, the exiting side of the tube system is 12" higher than the burner (see Figure 4.2). Locate and mount burner to ensure that Clearance to Combustibles are maintained (refer to "Clearance to Combustibles" on page 4).

**Figure 10.4
Burner Suspension**



INSTALLATION

Unit Mounting – Radiant Reflector

⚠ CAUTION

As with all infrared equipment, clearances to combustible materials are critical. Be sure all units have reflectors installed along the entire length of the tube, and that they are not mounted at an angle greater than 45° from the horizontal plane. In locations used for storage of combustible materials, signs, shall be clearly posted in the vicinity of the heater where readily apparent to material handlers to specify the maximum permissible stacking height to maintain required clearances from the heater to the combustibles.

For steps 1-7, refer to Figure 11.1.

1. The entire radiant tube length must have radiant reflector installed. The only exception is that on U-tube systems, a reflector is not installed over the U-tube.
2. Remove any protective plastic covering the reflectors.
3. Starting from the burner, slide a reflector through the tube and reflector hangers and position the reflector so that it is centered over the tube. The end closest to the burner should be 6" from the first tube and reflector hanger.
4. Slide the next reflector through the tube and reflector hangers and center over the next tube. The reflector should overlap the previous reflector by 4". Repeat until all reflectors are installed (alternating top and bottom overlaps).

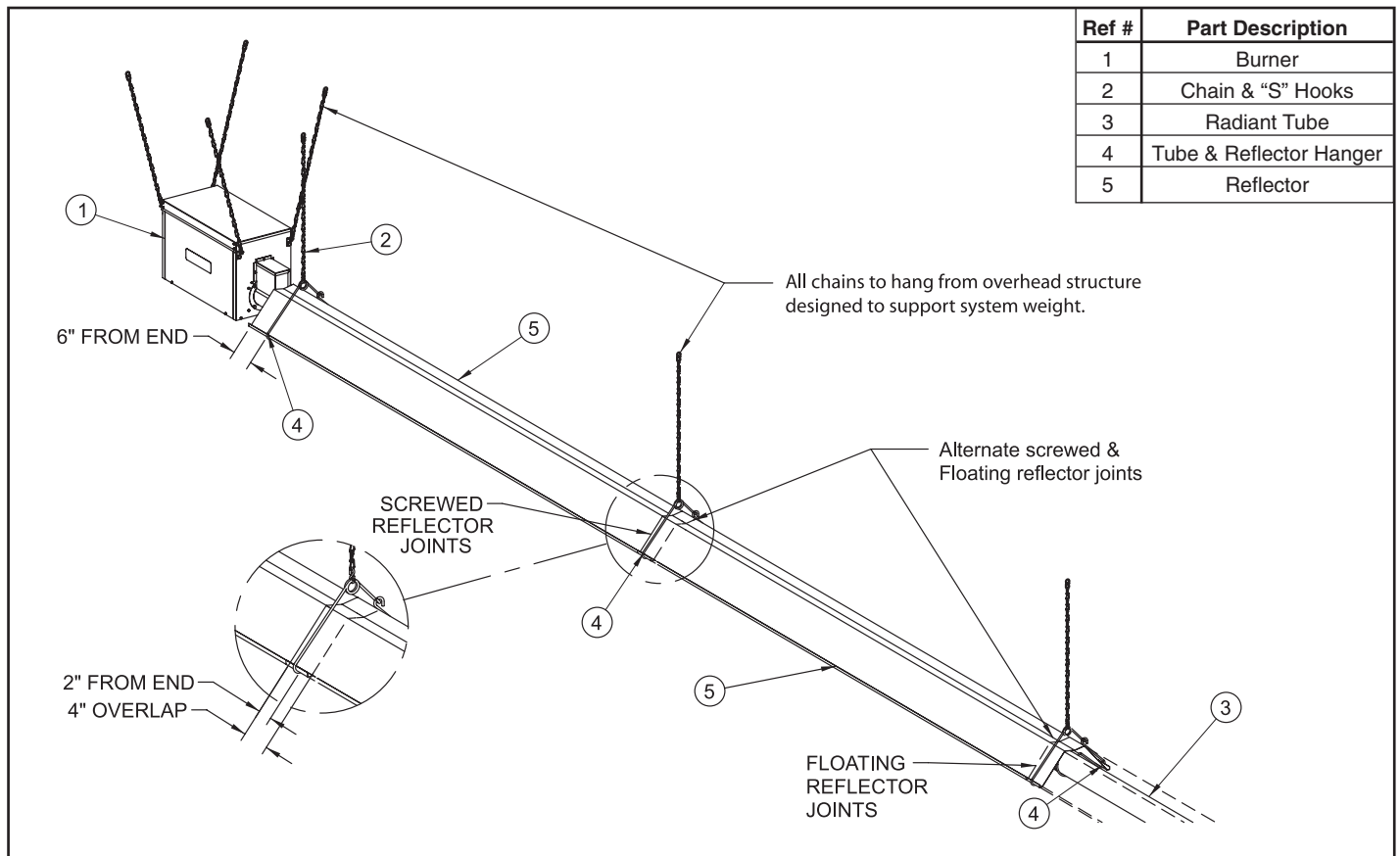
5. Starting from the burner end and working toward the vent end of the tube system, overlapping reflector joints are to be either secured or remain unsecured as follows:
 - Every odd numbered reflector to even numbered reflector joint (reflectors 1 to 2, 3 to 4, etc.) is to be secured with self-tapping sheet metal screws.
 - Every even numbered reflector to odd numbered reflector joint (reflectors 2 to 3, 4 to 5, etc.) is to remain unsecured to allow for expansion and contraction during operation.
6. Reflector end caps are to be fastened to both ends of the reflector system using sheet metal screws.

Additional Recommendations for Outdoor Installation

When utilized in an outdoor installation or in aircraft hangars, the following is required:

1. A screened combustion air intake cap.
2. All electrical connections must be water tight and suitable for outdoor use.

Figure 11.1
Installation of the Radiant Reflectors



INSTALLATION

Venting

⚠ WARNING

1. Do not join two sections of Type B double wall vent pipe within the vent system. A compromised pipe joint/liner pipe may not be detected, resulting in serious injury or death.
2. A built-in combustion air blower is provided – additional external draft hoods (diverters) or power exhausters are not required or permitted.

⚠ CAUTION

Installation must conform with local building codes or in the absence of local codes, with Part 7, Venting of Equipment, or the National Fuel Gas Code, ANSI Z223.1 (NFPA 54) – latest edition. In Canada installation must be in accordance with CAN/CGA-B149.1 for natural gas units, and CAN/CGA-B149.2 for propane units.

General Venting Instructions

The vent pipe may be installed in either a vertical or horizontal method. Certified vent pipe lengths are as follows:

Table 12.1
Maximum Vent Length

Input MBH	Maximum Vent Length (ft.)		
	(2) 90° elbows	(1) 90° elbow	(0) 90° elbows
50, 60, 75, 100	20'	25'	30'
125	30'	35'	40'
150, 175, 200	40'	45'	50'

1. Do not use any vent pipe other than 4" in diameter. Refer to the National Fuel Gas Code for the minimum material thickness and composition of the vent material.
2. It is recommended that vent pipes be fitted with a tee with a drip leg and a clean out cap to prevent any moisture in the vent pipe from entering the unit. The drip leg should be inspected and cleaned out periodically during the heating season.
3. The National Fuel Gas Code requires a minimum clearance of 6 inches from combustible materials for single wall vent pipe. The minimum distance from combustible materials is based on the combustible material surface not exceeding 160°F. Clearance from the vent pipe (or the top of the unit) may be required to be greater than 6 inches if heat damage other than fire (such as material distortion or discoloration) could result.
4. Avoid venting through unheated space when possible. When single wall pipe does pass through an unheated space, insulate runs greater than 5' to minimize condensation. Inspect for leakage prior to insulating and use insulation that is noncombustible with a rating of not less than 600°F. Install a tee fitting at the low point of the vent system and provide a drip leg with a clean out cap as shown in Figure 12.1. The drip leg should be cleaned annually.

Figure 12.1
Vertical Venting

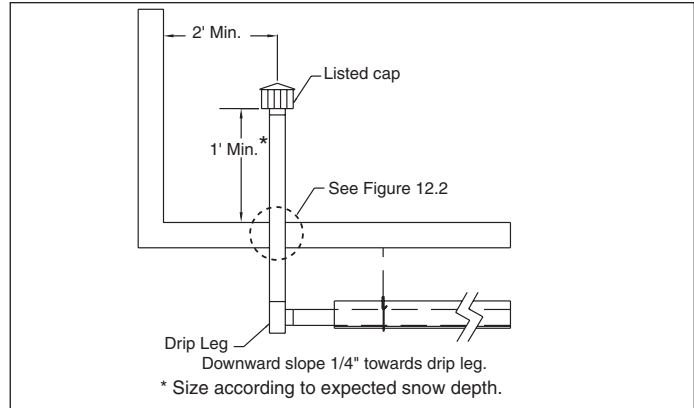
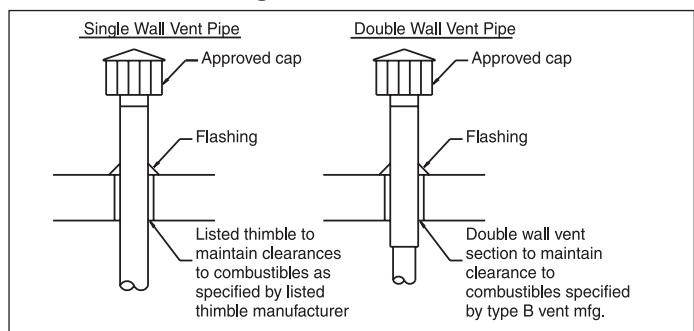


Figure 12.2
Construction through Combustible Roof



5. Where the vent passes through a combustible wall or floor or ceiling, a listed metal thimble 4" greater than the vent diameter is necessary. If there are six feet or more of vertical vent pipe in the open space between the unit heater and where the vent pipe passes through the floor or roof, the thimble need only be 2" greater than the diameter of the vent pipe. If a thimble is not used, all combustible material must be cut away to provide a 6 inch clearance. Any material used to close an opening must be noncombustible. Vent pipes must be adequately supported and sealed with a 600°F RTV silicone sealant.
6. Units must be vented with single wall vent pipe, although Type B vent can be used to terminate the vent system. The Type B double wall vent must be one continuous section. Under no circumstances should two sections of double wall vent pipe be joined together within one vent system due to the inability to verify complete seal at inner pipes. See Figure 12.2.
7. All vents must be terminated with one of the following approved vent caps: Gary 1092 or equivalent.
8. Do NOT vent this appliance into a masonry chimney.
9. Do NOT use dampers or other devices in the vent pipes.
10. Do NOT use PVC pipe.
11. Precautions must be taken to prevent degradation of building materials by flue products.
12. The top of the vertical stack should extend at least 2' above any portion of a building within a horizontal distance of 2'.
13. For pitched roof vertical venting, refer to Figure 13.1 and Table 13.1 for the vertical distance that the cap must extend above the pitched roof.
14. Single wall vent pipe must not pass through any attic, inside wall, concealed space, or floor.

INSTALLATION

Figure 13.1
Vertical Venting through Sloped Roof

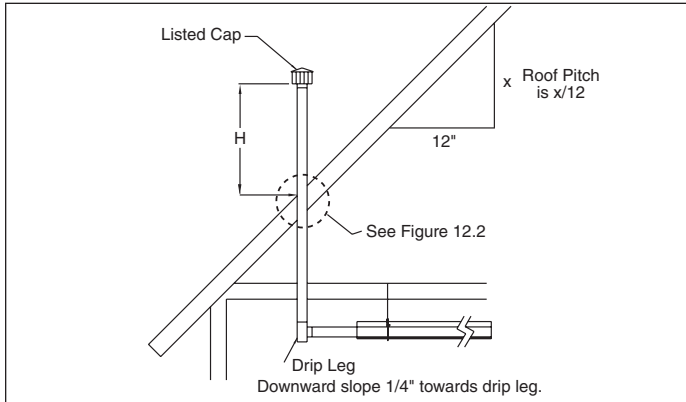


Table 13.1
Minimum Height from Roof to Lowest Discharge Opening

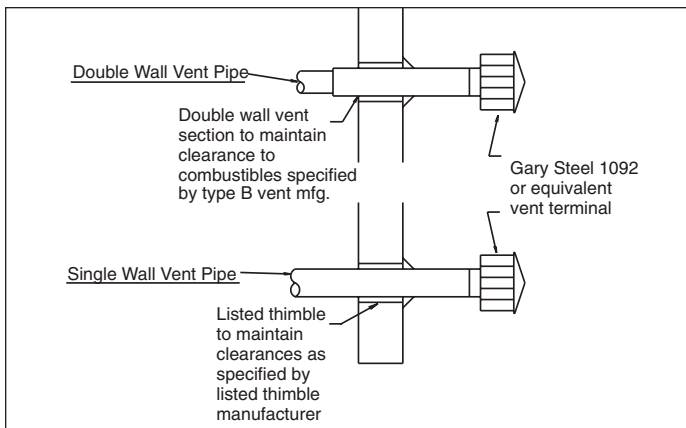
Rise X (in)	Roof Pitch	Min Height H (ft)*
0-6	Flat to 6/12	1.00
6-7	6/12 to 7/12	1.25
7-8	7/12 to 8/12	1.50
8-9	8/12 to 9/12	2.00
9-10	9/12 to 10/12	2.50
10-11	10/12 to 11/12	3.25
11-12	11/12 to 12/12	4.00
12-14	12/12 to 14/12	5.00
14-16	14/12 to 16/12	6.00
16-18	16/12 to 18/12	7.00
18-20	18/12 to 20/12	7.50
20-21	20/12 to 21/12	8.00

* Size according to expected snow depth.

Additional Requirements for Horizontal Venting

- All horizontal vents must be terminated with one of the following approved vent caps: Gary 1092 or equivalent. In the United States, the vent cap must be 24" from wall, while in Canada, a distance of 48" from the wall is required.
- When horizontal vents pass through a combustible wall (up to 8 inches thick), use a thimble with 2" clearances to the vent and insulate between thimble and vent. The vent passage may also be constructed and insulated as shown in Figure 13.2. Where horizontal vents pass through a non-combustible wall, no clearances to the wall are required.

Figure 13.2
Vent Construction through Combustible Wall



- The vent system shall terminate at least 3' above any forced air inlet (except direct vent units) located within 10', and at least 4' below, 4' horizontally from, or 1' above any door, window or gravity air inlet into any building. The bottom of the vent terminal shall be located above the snow line or at least 1' above grade; whichever is greater. When located adjacent to public walkways the vent system shall terminate not less than 7' above grade.
- Vent must extend beyond any combustible overhang of the building.
- The vent system shall not terminate over public walkways, building entrances, or where condensate or vapor could cause a nuisance or hazard or could be detrimental to the operation of regulators, relief openings, or other equipment.
- Precautions must be taken to prevent degradation of building materials by flue products.
- When vented horizontally, maintain a 1/4" per foot rise away from the heater. Place a drain tee and clean out near the vent connector (see Figure 13.3). Where local authorities have jurisdiction, a 1/4" downward slope is acceptable. Use a drain tee with a clean out near the exit of the vent (see Figure 13.4) or allow the condensate to drip out the end.

Figure 13.3
Horizontal Venting w/Upward Pitch

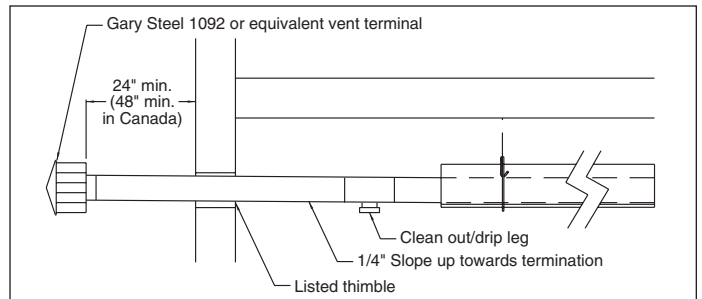
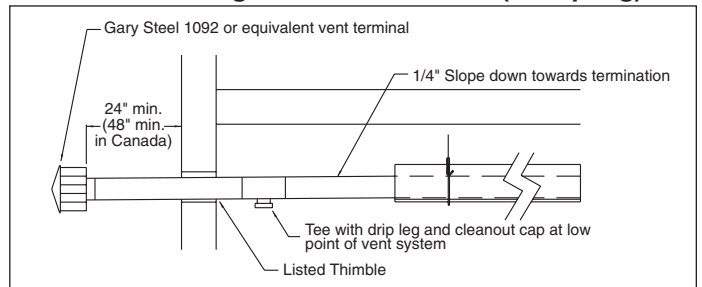


Figure 13.4
Horizontal Venting w/Downward Pitch (w/drip leg)



Additional Requirements for Common Venting

- Only two identical units of the same Btu/hr rating and tube length may be common vented into a 6" diameter or greater vent pipe. The individual vents can connect to the common vent as shown in Figure 14.1 or 14.2.
- The common vent system can be either horizontal or vertical. For through-wall penetrations, refer to horizontal or vertical vent instructions.
- Both units must be controlled by one thermostat. Refer to the latest version of literature number 9-410, "Multiple Wiring of Low Intensity Infrared Unit Heaters".
- Limit the length of horizontal run to 3/4 the length of vertical run when common venting vertically. Maintain certified vent lengths to vent termination.
- The vent length of each unit must be identical.
- If the system does not utilize a 4" x 4" x 6" wye as shown in Figure 14.2, the individual vents must enter the common vent at different levels, as shown in Figure 14.1.

INSTALLATION

Figure 14.1
Common Venting Entering at Different Levels

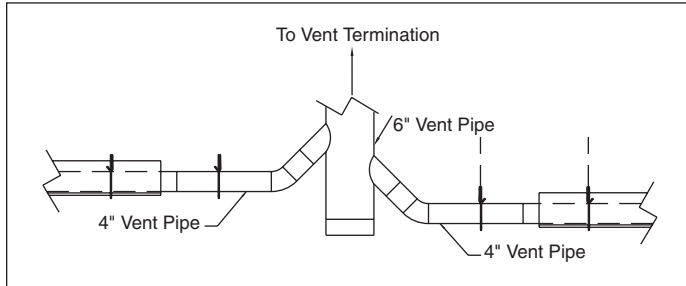
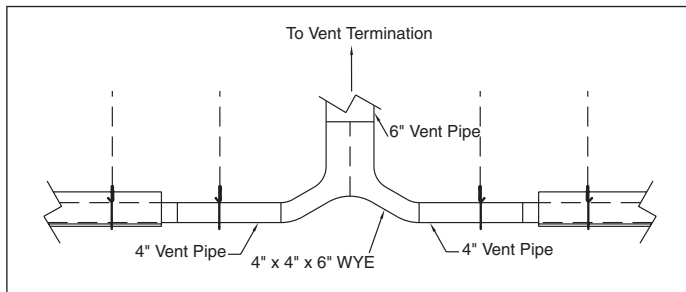


Figure 14.2
Common Venting Utilizing a 4" x 4" x 6" Wye



Utilizing Outside Combustion Air (Optional)

1. An accessory combustion air intake collar is required for connecting the combustion air piping to the burner box. For outdoor installation, the air intake collar connects directly to the accessory air intake cap.
2. All units may utilize a maximum of 20' of 4" O. D. fresh air intake pipe with two (2) 90° elbows, 25' with one (1) elbow, or 30' with no elbows.
3. Modine recommends using 4" insulated (sealed) pipe or Schedule 40 PVC pipe to provide fresh air and limit condensation from forming on outer surface. A Modine-specified accessory screened combustion air intake cap is required.
4. Insure that air intake cap is protected from snow blockage.
5. Keep intake opening at least 5 feet from any exhaust vent opening.
6. Where practical, the outside combustion air intake is recommended to be in the same pressure zone as the vent termination.

Gas Connections

⚠ WARNING

1. All field gas piping must be pressure/leak tested prior to operation. Never use an open flame. Use a soap solution or equivalent for testing.
2. Gas pressure to the appliance controls must never exceed 14" W.C. (1/2 psi).
3. To reduce the opportunity for condensation, the minimum sea level input to the appliance, as indicated on the serial plate, must not be less than 5% below the rated input.
4. A certified flexible connector must be used (local codes permitting) as the method of connecting the heaters to the gas supply to avoid placing stress on the gas supply line due to the expansion of the low intensity infrared tubes during operation.

⚠ CAUTION

1. Purging of air from gas supply line should be performed as described in ANSI Z223.1 - latest edition "National Fuel Gas Code", or in Canada in CAN/CGA-B149 codes.
2. When leak testing the gas supply piping system, the appliance and its combination gas control must be isolated during any pressure testing in excess of 14" W.C. (1/2 psi).
3. The unit should be isolated from the gas supply piping system by closing its field installed manual shut-off valve. This manual shut-off valve should be located within 6' of the heater.
4. Turn off all gas before installing appliance.

1. Installation of piping must conform with local building codes, or in the absence of local codes, of the National Gas Fuel Code, ANSI Z223.1 (NFPA 54) – Latest Edition. In Canada, installation must be in accordance with CAN/CGA-B149.1 for natural gas units and CAN/CGA-B149.2 for propane units.
2. Piping to units should conform with local and national requirements for type and volume of gas handled, and pressure drop allowed in the line. Refer to Table 17.1 to determine the cubic feet per hour (cfh) for the type of gas and size of unit to be installed. Using this cfh value and length of pipe necessary, determine the pipe diameter from Table 17.1. Where several units are served by the same main, the total capacity, cfh, and length of main must be considered. Avoid pipe sizes smaller than 1/2". Table 17.1 allows for a 0.3" W.C. pressure drop in the supply pressure from the building main to the unit. The inlet pressure to the unit must be 5-7" W.C. for natural gas and 12-14" W.C. for propane gas. The gas supply pressure must never exceed 14" W.C. If the pressure exceeds 14" W.C., a gas pressure regulator must be added upstream of the combination gas valve. When sizing the inlet gas pipe diameter, make sure that the unit supply pressure can be met after the 0.3" W.C. has been subtracted. If the 0.3" W.C. pressure drop is too high, refer to the Gas Engineer's Handbook for other gas pipe capacities.
3. Install a ground joint union with brass seat and a manual shutoff valve adjacent to the unit for emergency shut-off and easy servicing of controls, including a 1/8" NPT plugged tapping immediately upstream of the gas supply connection to the heater, accessible for test gauge connection. See Figure 15.1.
4. Provide a sediment trap before each unit and in the line where low spots cannot be avoided. (See Figure 15.1).
5. A certified, metallic stainless steel connector (local codes permitting) of at least 3/4" minimum ID by 36" long, must be used as the method of connecting the heater to the gas supply line. The connector must be certified to ANSI Z21.24/CSA 6.10. A flexible connector avoids placing stress on the gas supply line due to the thermal expansion of the unit while operating.
Canadian installation codes do not permit the use of flexible metallic connectors. In Canada, Installation Code CAN/CSA-B149.1-05 requires the use of a Type I hose connector certified to CSA CAN/CGA-8.1. Use a hose that is of the same diameter and length as noted above. The certified flexible connectors must be installed as illustrated in Figure 15.2, in one plane, without any sharp bends, kinks, or twists. The gas take-off from the drop line must be parallel to the burner gas inlet connection.
6. Under no circumstances should the gas supply line to the heater provide any assistance in the suspension of the heater. Do not locate any gas service line directly above or below the heater.

INSTALLATION

- When pressure/leak testing pressures above 14" W.C. (1/2 psi), close the field installed shut-off valve, disconnect the unit, and its combination gas control from the gas supply line, and plug the supply line before testing. When testing pressures 14" W.C. (1/2 psi) or below, close the manual shut-off valve on the unit before testing.
- If the gas valve was rotated to change control access side, leak test fittings

Figure 15.1 - Recommended Sediment Trap/ Manual Shut-Off Valve Installation

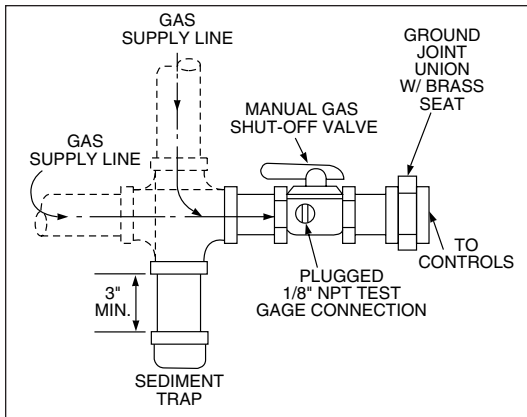
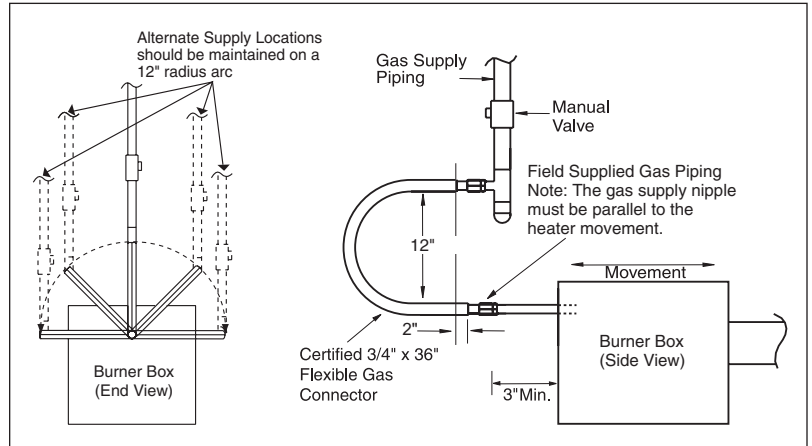


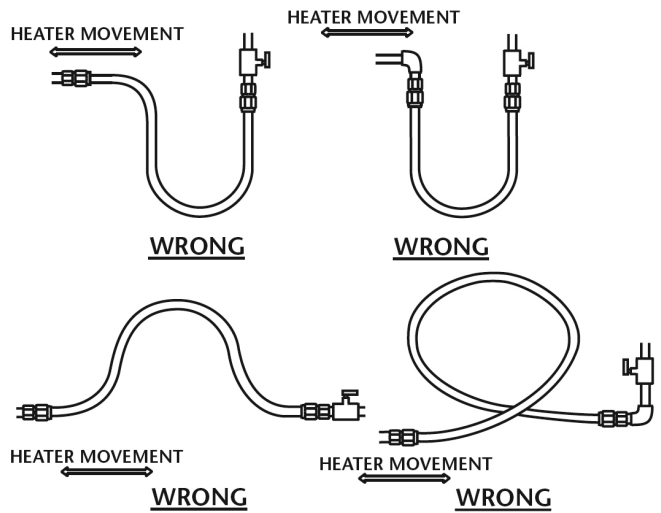
Table 15.1 - 3/4" x 36" Flexible Gas Connector Pressure Drop ("W.C.)

Input MBH	Gas Type	
	Natural	Propane
50	0.03	0.02
60	0.04	0.02
75	0.05	0.03
100	0.08	0.04
150	0.14	0.07
175	0.18	0.09
200	0.23	0.11

Figure 15.2 - Recommended Installation of Flexible Gas Connector



INCORRECT POSITIONS



Warning: Connector must be installed in a C configuration. Use only a 36" long connector of 3/4" nominal ID with this heater. This is offered as a factory supplied, field installed accessory.

Table 15.2 - Gas Pipe Capacities

Gas Pipe Capacities (Up to 14" W.C. Gas Pressure through Schedule 40 Pipe) Cubic Feet per Hour with Pressure Drop of 0.3" W.C. Natural Gas - Specific Gravity - 0.60 Propane Gas - Specific Gravity - 1.50												
Length Of Pipe (feet)	Pipe Diameter											
	1/2"		3/4"		1"		1-1/4"		1-1/2"		2"	
	Natural	Propane	Natural	Propane	Natural	Propane	Natural	Propane	Natural	Propane	Natural	Propane
10	132	83	278	175	520	328	1050	662	1600	1008	3050	1922
20	92	58	190	120	350	221	730	460	1100	693	2100	1323
30	73	46	152	96	285	180	590	372	890	561	1650	1040
40	63	40	130	82	245	154	500	315	760	479	1450	914
50	56	35	115	72	215	135	440	277	670	422	1270	800
60	50	32	105	66	195	123	400	252	610	384	1150	725
70	46	29	96	60	180	113	370	233	560	353	1050	662
80	43	27	90	57	170	107	350	221	530	334	990	624
90	40	25	84	53	160	101	320	202	490	309	930	586
100	38	24	79	50	150	95	305	192	460	290	870	548
125	34	21	72	45	130	82	275	173	410	258	780	491
150	31	20	64	40	120	76	250	158	380	239	710	447

INSTALLATION/START-UP PROCEDURE

Electrical Connections

WARNING

1. Disconnect power supply before making wiring connections to prevent electrical shock and equipment damage.
2. All appliances must be wired strictly in accordance with wiring diagram furnished with the appliance. Any wiring different from the wiring diagram could result in a hazard to persons and property.
3. Any original factory wiring that requires replacement must be replaced with wiring material having a temperature rating of at least 105°C.
4. Ensure that the supply voltage to the appliance, as indicated on the serial plate, is not 5% greater than rated voltage.

CAUTION

Ensure that the supply voltage to the appliance, as indicated on the serial plate, is not 5% less than the rated voltage.

1. Installation of wiring must conform with local building codes, or in the absence of local codes, of the National Electric Code ANSI/NFPA 70 - Latest Edition. Unit must be electrically grounded in conformance to this code. In Canada, wiring must comply with CSA C22.1 Part 1, Electrical Code.
2. Make sure all multi-voltage components (motors, transformers, etc.) are wired in accordance with the power supply voltage.
3. The unit must be wired strictly in accordance with the wiring diagram furnished with the unit.
4. The power supply to the unit should be protected with a fused disconnect switch or circuit breaker.
5. The power supply must be within 5 percent of the voltage rating and each phase must be balanced within 2 percent of each other. If not, advise the utility company.
6. External electrical service connections that must be installed include:
 - a. Supply power connection (120 volts).
 - b. Connection of thermostats, summer/winter switches, or any other accessory control devices that may be supplied (24 volts).
7. Control wire used to connect the heater to the thermostat must have adequate ampacity and insulation temperature rating for the total connected load, see Table 19.2.
8. Under no circumstances should the electrical supply or control wiring to the heater provide any assistance in the suspension of the heater. Do not locate any wiring directly above or below the heater.
9. All outdoor electrical connections must be weatherized to prevent moisture from entering the electrical compartment.
10. Ensure proper polarity of unit and power source.
11. Refer to the unit dimensional drawings on Figure 18.1 for the electrical knockout locations.

CAUTION

Purging of air from gas lines should be performed as described in ANSI Z223.1 - Latest Edition "National Fuel Gas Code", or in Canada, CAN/CGA-B149 codes.

IMPORTANT

Start-up and adjustment procedures should be performed by a qualified service agency.

1. Turn off power to the unit at the disconnect switch. Check that fuses or circuit breakers are in place and sized correctly. Turn all hand gas valves to the "OFF" position.
2. Remove service access side burner access panel as outlined on page 5 in section titled "Removal of Burner Side Access Panels".
3. Check that the supply voltage matches the unit supply voltage listed on the serial plate. Verify that all wiring is secure and properly protected. Trace circuits to insure the unit has been wired according to the wiring diagram.
4. If utilizing indoor air for combustion, ensure adequate ventilation for intake of fresh air. Check to see that there are no obstructions to the intake of the unit.
5. Perform a visual inspection of the unit to make sure no damage has occurred during installation. Check reflectors to ensure they are installed between 0° and 45° from the horizontal plane.
6. Recheck the gas supply pressure. The inlet pressure to the unit must be 5-7" W.C. for natural gas and 12-14" W.C. for propane gas. The gas supply pressure must never exceed 14" W.C. If the pressure exceeds 14" W.C., a gas pressure regulator must be added upstream of the combinations gas valve.
7. Open the field installed manual shutoff valve and turn power on to the unit.
8. Check to make sure that the main gas valve opens upon a call for heat from the thermostat. Check the manifold gas pressure (see main burner adjustment).
9. Check to insure that gas controls sequence properly (See Control Operating Sequence).

During checkout procedure, use the following steps to verify that the venting system is adequately sized:

1. Inspect the venting system for proper size and horizontal pitch, as required in the National Fuel Gas Code ANSI Z223.1 or CAN/CGA B149.1 or .2 Installation Code – latest edition and these instructions. Determine that there is no blockage or restriction, leakage, corrosion and other deficiencies, which could cause an unsafe condition.
2. Insofar as practical, close all building doors and windows and all doors between the space in which the unit(s) connected to the venting system are located and other spaces of the building. Turn on any exhaust fans so they shall operate at maximum speed. Do not operate a summer exhaust fan.
3. Place the unit being inspected in operation. Adjust thermostat so that the unit will operate continuously.
4. After it has been determined that each unit connected to the venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, and any other gas-burning unit to their previous condition of use.
5. If improper venting is observed during any of the above tests, the venting system must be corrected.
6. If the venting system must be resized, it must conform with the National Fuel Gas Code ANSI Z223.1 or CAN/CGA B149.1 or .2 Installation Code – latest edition. If the venting system must be resized, it should be resized to approach the minimum size as determined using the appropriate table in Appendix G of the National Fuel Gas Code ANSI Z223.1.

START-UP PROCEDURE

Main Burner Adjustment

The gas pressure regulator (integral to the combination gas control) is adjusted at the factory for average gas conditions. It is important that gas be supplied to the heater in accordance with the input rating on the serial plate. Actual input should be checked and necessary adjustments made after the heater is installed. Over-firing, a result of too high an input, reduces the life of the unit and increases maintenance. Under no circumstances should the input exceed that shown on the serial plate.

Measuring the manifold pressure is done at the manifold pressure tap on the main gas valve on the heater (see Figure 17.1).

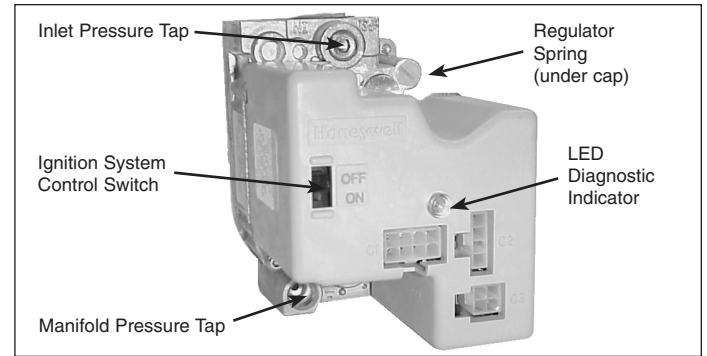
To adjust the manifold pressure:

1. The correct manifold pressure is 3.5" W.C. for natural gas and 10" W.C. for propane gas. Adjust the main gas pressure regulator spring to achieve the proper manifold pressure (see Figure 17.1).
2. Move the field installed manual shut-off valve to the "OFF" position.
3. Remove the 1/8" pipe plug in manifold pressure tap in combination gas control and attach a water manometer of "U" tube type that is at least 12" high.
4. Move the field installed manual shut-off valve to the "ON" position.
5. Create a call for heat from the thermostat.
6. After adjustment, move the field installed manual shut-off valve to the "OFF" position, remove manometer and replace the 1/8" pipe plug.
7. After the plug is in place, move the field installed manual shut-off valve to the "ON" position and recheck pipe plugs for gas leaks with a soap solution.
8. Replace the side access panels.

Table 17.1
Manifold Pressure and Gas Consumption

Input MBH	Type of Gas	Natural	Propane	No. of Orifices
	Btu/ft ³	1040	2500	
	Specific Gravity	0.60	1.53	
Manifold Pressure " W.C.		3.5	10.0	
50	cfh	48.1	20.0	1
	Gal/hr.	-	0.55	
	Orifice Drill Size	#29	#46	
60	cfh	57.7	24.0	1
	Gal/hr.	-	0.66	
	Orifice Drill Size	#27	#43	
75	cfh	72.1	30.0	1
	Gal/hr.	-	0.83	
	Orifice Drill Size	#22	#38	
100	cfh	96.2	40.0	1
	Gal/hr.	-	1.10	
	Orifice Drill Size	#11	#32	
125	cfh	120.2	50.0	1
	Gal/hr.	-	1.38	
	Orifice Drill Size	#3	#30	
150	cfh	144.2	60.0	1
	Gal/hr.	-	1.65	
	Orifice Drill Size	#B	#28	
175	cfh	168.3	70.0	1
	Gal/hr.	-	1.93	
	Orifice Drill Size	#F	#23	
200	cfh	192.3	80.0	1
	Gal/hr.	-	2.2	
	Orifice Drill Size	#L	#18	

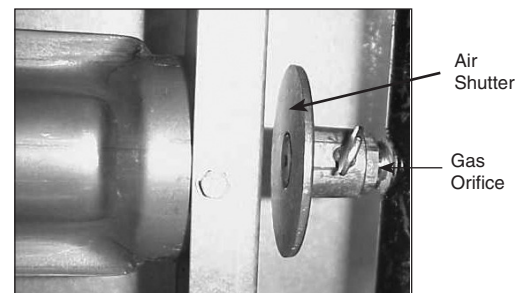
Figure 17.1 - Combination Gas Valve/Ignition Controller



Primary Air Shutter (Propane Gas Only)

All propane gas models are equipped with an adjustable primary air shutter, mounted flush with the end of the gas orifice, as shown in Figure 17.2. These are set at the factory; do not adjust.

Figure 17.2 - Propane Gas Primary Air Shutter



Control Operating Sequence

These models utilize a combination gas valve/ignition controller and a single stage thermostat.

1. The thermostat calls for heat.
2. The combustion air blower is energized and begins a fifteen (15) second pre-purge cycle. The pre-purge clears any residual gas left over from the previous operation.
3. The pressure switch closes during the pre-purge, energizing the indicator light on the underside of the burner box.
4. After the pre-purge, the hot surface igniter is energized and begins a seventeen (17) second warm-up period.
5. After this warm-up period, the gas valve is energized and the hot surface igniter attempts to light the gas at the burner. Ignition trial time is 7 seconds.
6. Upon proper ignition, the flame is visible through the combustion chamber sight glass (see Figure 20.2). The unit continues to operate until the thermostat is satisfied, at which time the thermostat contacts open and the gas valve is de-energized until the thermostat makes another call for heat.
7. If a flame is not sensed for any reason, the main gas valve will close and there will be a short purge period before ignition is tried again. The igniter warm-up period for retries is 27 seconds.
8. If flame is not sensed after three re-tries (four total tries), there will be at least a one hour wait before ignition is tried again. Power can be interrupted during this one-hour lockout to reset the sequence of operation.

DIMENSIONAL DATA

Figure 18.1
Casing Dimensions (in.)

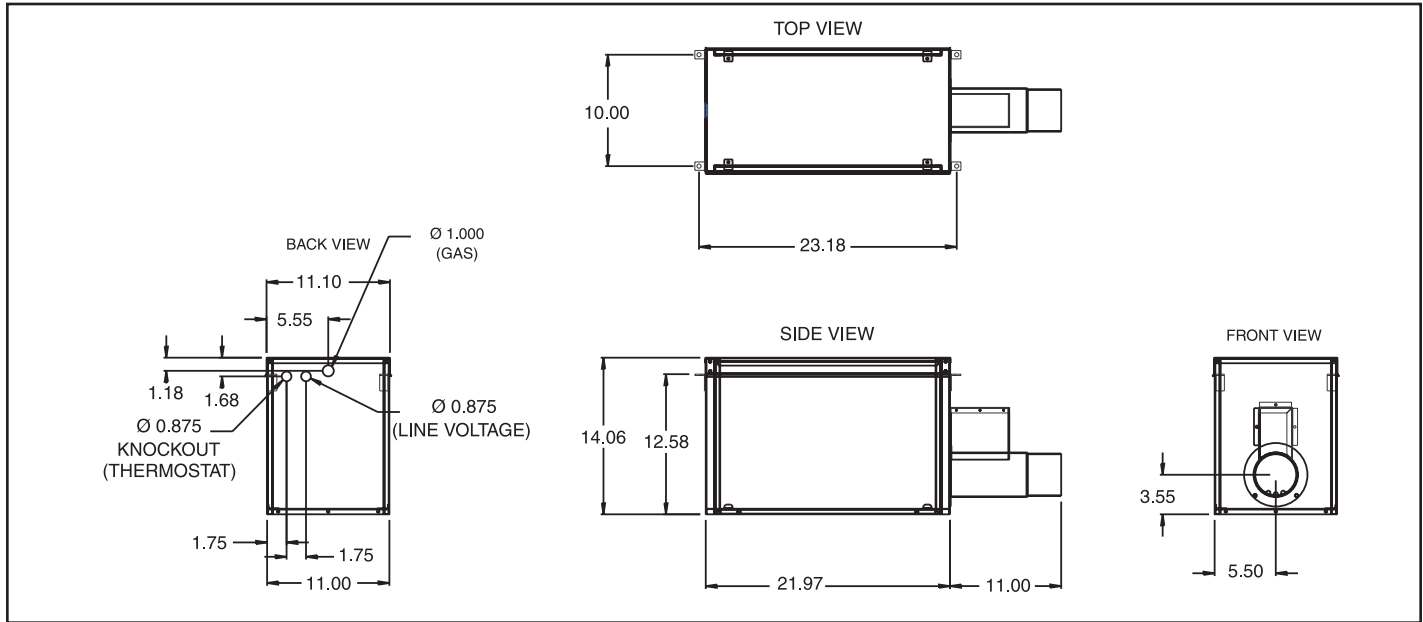


Figure 18.2
Burner and Tube System Dimensions (inches)

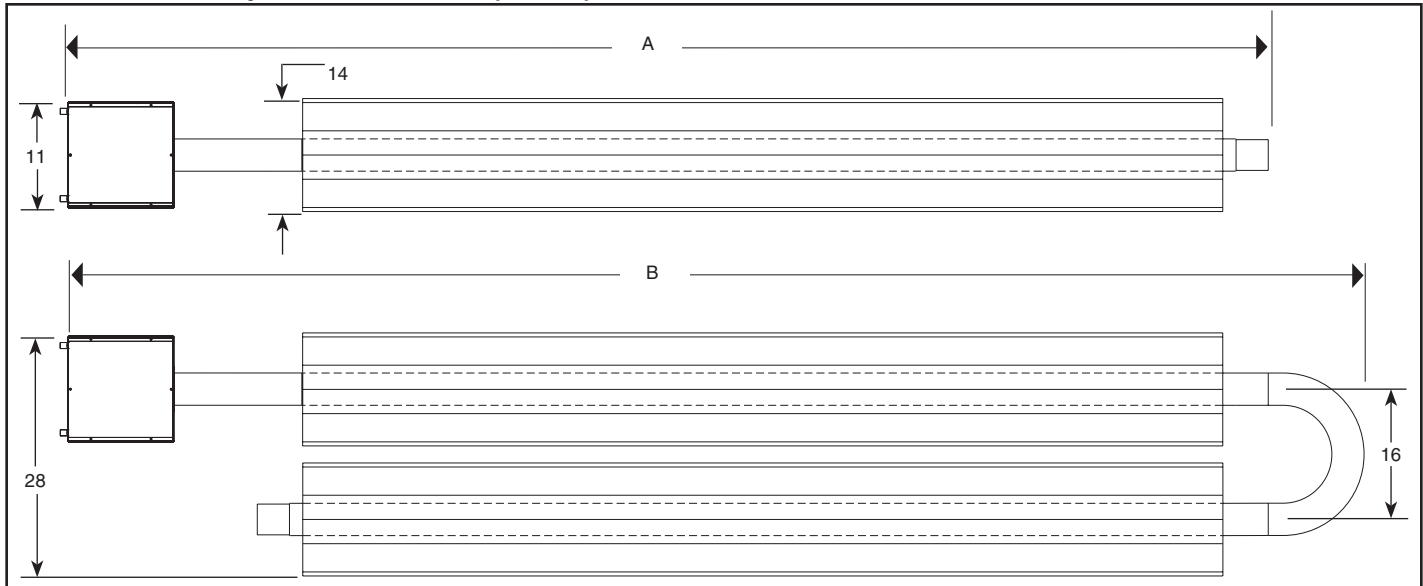


Table 18.1
Tube Systems Data

Tube Length (ft.)	Straight Tube		U-Tube System	
	System Length "A" (ft.)	System Weight (lb.)	System Length "B"	System Weight (lb.) (ft.)
20	23	78	13	89
30	33	112	18	132
40	43	146	23	157
50	53	180	28	200
60	63	214	33	225
70	73	252	38	277

Table 18.2
Burner Shipping Weights

Model	Shipping Wt. (lb.)
All Burners	43

PERFORMANCE

**Table 19.1
Performance**

Input MBH	50	60	75	100	125	150	175	200
Certified Tube Lengths (ft.)	20, 30	20, 30, 40	30, 40	30, 40, 50 ②	40, 50, 60	50, 60	50, 60, 70 ③	50, 60, 70 ③
Recommended Mounting Height (ft.) ①	10 – 12	10 – 12	12 – 14	12 – 14	15 – 22	15 – 22	18 – 28	20 - 30
Recommended Tube System Application ①	Spot or Area Heating	U-Tube						
	Total Building Heating	Straight Tube						

① Recommended Mounting Height and Tube System Applications are meant as a general guide and are adjusted to meet the requirements of the actual application. The applications are as follows:

- Spot or Area Heating is an application where occupant comfort is the goal and occupant(s) are either relatively stationary (Spot - Example: small work cell or dispersed over a slightly wider range than with Spot Heating (Area - Example: assembly line). Mounting height is typically at the low end of the range shown above.
- Total Building Heating is an application where average space temperature is to be maintained, however due to the significant temperature gradient differences on long straight tube systems, areas may exist where direct occupant comfort is not achieved.

② TLP 100 not available for Propane Gas operation at 50 ft. tube system length.

③ TLP 175 and 200 not available for Propane Gas operation at 70 ft. tube system length.

Table 19.2 - Utilities

Electrical Rating	Gas Connection (inch)	Minimum Gas Inlet Pressure (" W.C.)	Maximum Gas Inlet Pressure (" W.C.)	Manifold Gas Pressure (" W.C.)	Tube/Vent Diameter (inch)
120V/60Hz/1Ph 1.0 amps running 5.5 amps starting*	1/2 NPT	7.0 (natural gas) 11.0 (propane gas)	14.0	3.5 (natural gas) 10.0 (propane gas)	4 (O.D.)

* Includes 4.5 amps for hot surface igniter on start-up only.

MAINTENANCE/SERVICE & TROUBLESHOOTING

MAINTENANCE

Qualified gas service personnel should service all heating equipment before each heating season to assure proper operation. The following items may require more frequent service based on the environment in which the unit is installed, and how long the unit is operated.

Burner Assembly

Disconnect all electrical power to the heater and close the gas supply valve installed adjacent to the heater. With an air hose regulated to 15 psig maximum, blow off any dust and dirt that has accumulated on the heater.

Burner Orifice

Remove burner orifice, clean, and reinstall on the heater manifold. Drill sizes can be found in Table 17.1.

Combustion Air Blower

The combustion air blower motor is permanently lubricated, and does not require additional lubrication. An air restrictor plate (see Figure 20.1), sized for the appropriate fuel type and burner input, is installed by the factory and must not be field-adjusted.

Radiant Tube and Vent System

Check for restrictions and/or condensate and correct as required. Sections with corrosion are to be replaced.

Electrical Wiring

The electrical wiring should be checked annually for loose connections or deteriorated insulation.

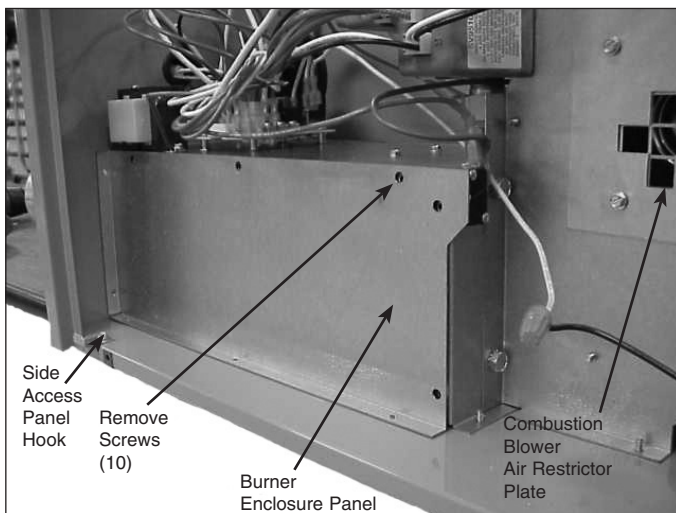
Gas Piping & Controls

The gas valves and piping should be checked annually for general cleanliness and tightness. Verify the manual shut-off valve is gas-tight on annual basis. The gas controls should be checked to insure that the unit is operating properly.

Removal of Burner Enclosure Panels

Each of the two burner enclosure side panels is held in place by ten (10) screws, as shown in Figure 20.1. Once the screws are removed, the burner enclosure side panels can be removed for access to the burner assembly.

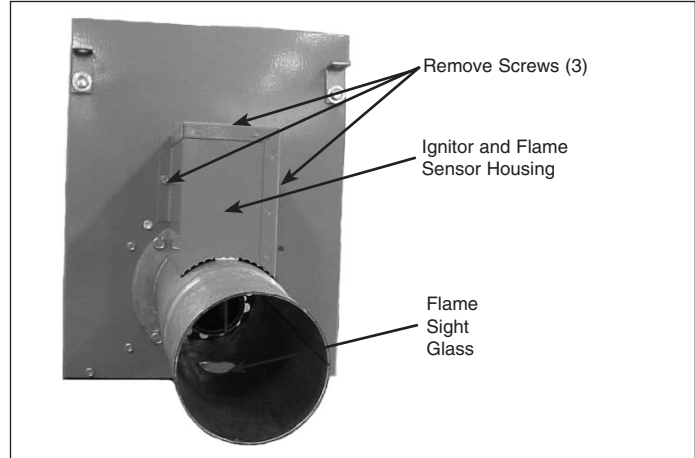
Figure 20.1 - Burner Enclosure



Removal of Ignitor and Flame Sensor Housing

The ignitor and flame sensor housing is held in place by three (3) screws, as shown in Figure 20.2. Once the screws are removed, the ignitor and flame sensor can be accessed. The housing must be returned to the unit once service/maintenance is complete.

Figure 20.2 - Ignitor and Flame Sensor Housing



SERVICE & TROUBLESHOOTING

IMPORTANT

To check most of the Possible Remedies in the troubleshooting guide listed in Table 21.1, refer to the applicable sections of the manual.



WARNING

When servicing or repairing this equipment, use only factory-approved service replacement parts. A complete replacement parts list may be obtained by contacting Modine Manufacturing Company. Refer to the rating plate on the unit for complete unit model number, serial number, and company address. Any substitution of parts or controls not approved by the factory will be at owner's risk.



CAUTION

Do not attempt to reuse any mechanical or electrical controllers which have been wet. Replace defective controller.

TROUBLESHOOTING

Table 21.1
Troubleshooting

Trouble	Possible Cause	Possible Remedy
No Gas	<ol style="list-style-type: none"> 1. Main gas is off. 2. Power supply is off. 3. Air in gas line. 4. External regulator malfunctioning. 5. External regulator reversed. 	<ol style="list-style-type: none"> 1. Open manual gas valve. 2. Turn on main power. 3. Purge gas line. 4. Replace external regulator. 5. Remove and properly install regulator.
Thermostat contacts closed, no unit operation	<ol style="list-style-type: none"> 1. Defective thermostat. 2. Power supply is off. 3. Loose or disconnected wire. 4. Defective combustion air blower. 5. Blown fuse/tripped circuit breaker. 	<ol style="list-style-type: none"> 1. Replace thermostat. 2. Turn on main power. 3. Replace as required. 4. Lubricate, repair or replace as required. 5. Replace fuse/re-set circuit breaker.
Combustion air blower operates, hot surface igniter is not energized	<ol style="list-style-type: none"> 1. Loose or disconnected wire. 2. Restricted exhaust vent. 3. Restricted or defective pressure switch. 4. Defective hot surface igniter. 5. Burner enclosure cover open. 	<ol style="list-style-type: none"> 1. Replace as required. 2. Remove restrictive object(s). 3. Clean pressure switch line or replace pressure switch. 4. Replace hot surface igniter. 5. Replace cover to closed position.
Hot surface igniter fails to ignite burner	<ol style="list-style-type: none"> 1. Hot surface igniter improperly positioned. 2. Hot surface igniter cracked. 3. Hot surface igniter wiring is loose or damaged. 4. Low manifold gas pressure. 5. Gas valve fails to open. 6. Ignition detection control defective. 	<ol style="list-style-type: none"> 1. Relocate to correct position. 2. Replace hot surface igniter. 3. Replace as required. 4. Provide proper gas pressure. 5. Replace gas valve. 6. Replace ignition control module.
Locks out without cycling	<ol style="list-style-type: none"> 1. Reversed polarity of the AC wiring at the unit. 	<ol style="list-style-type: none"> 1. Check for proper AC wiring and grounding of unit and power source.
Burner fires but cycles after lit for over 1 minute	<ol style="list-style-type: none"> 1. Defective gas valve/ignition controller. 2. No electrical power to gas valve. 3. Unit not properly grounded. 4. Defective flame sensor. 5. Improper thermostat wiring. 6. Manual valve closed on combination gas valve. 7. Thermostat located within line-of-sight of heat exchanger. 	<ol style="list-style-type: none"> 1. Replace gas valve/ignition controller. 2. Check wiring to gas valve. 3. Properly ground unit. 4. Replace flame sensor. 5. Verify wiring compared to diagram. 6. Turn knob to ON position on combination gas valve. 7. Relocate thermostat.
Heater will not turn off	<ol style="list-style-type: none"> 1. Defective thermostat. 2. Gas valve stuck open. 3. Unit undersized. 	<ol style="list-style-type: none"> 1. Repair or replace thermostat. 2. Replace gas valve. 3. Check design conditions. If the unit is undersized, additional heater(s) may be required.
Carbon formation inside burner tube	<ol style="list-style-type: none"> 1. Misaligned or incorrect orifice. 2. Low or high gas pressure. 3. Wrong gas supplied to the heater. 	<ol style="list-style-type: none"> 1. Insure proper alignment or replace orifice. 2. Provide proper gas pressure. 3. Check label for gas required.
Low heater output	<ol style="list-style-type: none"> 1. Low inlet or manifold gas pressure. 2. Orifice partially blocked with foreign matter. 3. Products of combustion not adequately vented. 4. Manifold misaligned from excessive torque applied at time of gas pipe installation. 5. Gas supply piping too small. 6. Unit undersized. 	<ol style="list-style-type: none"> 1. Adjust to proper gas pressure. 2. Remove orifice, clean, and reinstall. 3. Provide adequate ventilation for products of combustion. 4. Replace the manifold. 5. Replace piping or increase gas supply pressure within specifications. 6. Check design conditions. If unit is undersized, an additional unit(s) or other heat source must be added.
Gas odor	<ol style="list-style-type: none"> 1. Loose pipe connection 	<ol style="list-style-type: none"> 1. Check all connections with a soap solution and tighten as necessary.

SERVICE & TROUBLESHOOTING/REPLACEMENT PARTS ORDERING

LED Diagnostic Capability

The LED on the ignition controller (see Figure 17.1) indicates the condition of the control system. The diagnostic codes and their respective definitions are shown in Table 22.1.

Table 22.1

LED Diagnostic Codes

FLASHES	REASON
Off	No power to system
Bright-Dim	Normal operation
2	Pressure switch closed longer than 30 seconds
3	Pressure switch open longer than 30 seconds
4	Burner enclosure switch open
5	Flame signal sensed out of sequence
6	System Lockout

Replacement Parts Ordering

When servicing, repairing or replacing parts on these units, locate the model identification plate of the unit and always give the complete Model Number and Serial Number. The model identification plate is located inside the burner casing, and is shown in Figure 22.1. The part numbers for common replacement parts are also listed on a separate plate, shown in Figure 22.2. For a complete description of the Model Number and Serial Number, see Figures 23.1 and 23.2.

Figure 22.1

Model Identification Plate

Modine Manufacturing Company 1500 DeKoven Ave., Racine, WI 53403 Phone: 800-828-4328			INFRARED RADIANT TUBE HEATER FOR INDUSTRIAL/COMMERCIAL USE RADIATEUR A TUBE RAYONNANT A INFRA-ROUGES POUR USAGE INDUSTRIEL/COMMERCIAL Made in U.S.A.								
MODEL NUMBER NUMERO DE MODELE	TLP150H34	MIN. INPUT BTU/HR DEBIT CALORIFIQUE MIN. BTU/HEURE	150000	VOLTS	115	AMPS	5.5	PHASE	1	HERTZ	60
SERIAL NUMBER NUMERO DE SERIE	301011600-5006	MIN. INLET PRESS. FOR PURPOSE OF INPUT ADJUSTMENT PRESSION D'ALIMENTATION EN GAZ MIN. ADMISE	5	IN. W.C. P.O.C.D'E		DESIGN COMPLIES WITH: ANSI Z83.20-2001 CSA 2.34-2001					
TYPE OF GAS TYPE DE GAZ	Natural	MANIFOLD PRESSURE PRESSION A LA TUBULURE D'ALIMENTATION	3.5	IN. W.C. P.O.C.D'E		APPROVALS ACCEPTED BY CITY OF NEW YORK					
(IN USA) FOR INSTALLATIONS ABOVE 2000 FEET, DERATE 4 PERCENT FOR EACH 1000 FEET OF ELEVATION ABOVE SEA LEVEL.			MINIMUM CLEARANCE TO COMBUSTIBLE MATERIAL DEGAGEMENT MINIMUM POUR MATIERES COMBUSTIBLES			CLEARANCE TO EACH END IS 12 IN. (36" for unvented units)					
INPUT BTU/HR DEBIT CALORIFIQUE BTU/HEURE	150000	(IN CANADA) 2000 TO 4500 FT. 610 ET 1370 M.	135000	TOP HAUT	12	IN. PO.	38	IN. PO.			
ORIFICE SIZE DIM DE L'INJECTEUR	B	BOTTOM BAS	106	IN. PO.	106	IN. PO.					
THIS UNIT APPROVED FOR USE: Indoor/Outdoor Vented/Unvented						<p>INSTALLATIONS IN AIRCRAFT HANGARS, PARKING STRUCTURES, AND REPAIR GARAGES SHALL BE IN ACCORDANCE WITH THE STANDARD ON AIRCRAFT HANGARS, ANSINFFA 409, THE STANDARD FOR PARKING STRUCTURES, ANSINFFA 88A, THE STANDARD FOR REPAIR GARAGES, ANSINFFA 88B AND IN CANADA WITH THE CAN1-8149 CODES.</p>					
						For U-Tube systems, refer to the I & S Manual 5H75590B					

Figure 22.2

Replacement Parts/Lighting Instructions Plate

COMMON REPLACEMENT PARTS	Combination Gas Control	Control Transformer	10' Tube
For parts ordering, contact the parts wholesaler or the manufacturer's representative serving your area.	5H75025B	5H75029B	5H75472B
When inquiring about parts, always provide model number, serial number, description and part number. When ordering parts, provide part number listed.	Ignition Control N/A	Hot Surface Igniter 5H75032B	10' Reflector 5H75475B
For service, contact your local qualified installation and service contractor or appropriate utility company.	Pressure Switch 5H78034B7	Combination Air Blower/Exhauster 5H75038B	Tube Clamp 5H75466B
	Pressure Switch (Outlet) N/A	TLP150H34	Wiring Diagram 5H78025B
LIGHTING INSTRUCTIONS 1. TURN OFF POWER, TURN THERMOSTAT DOWN, CLOSE ALL GAS VALVES AND WAIT 5 MINUTES. 2. OPEN ALL GAS VALVES, TURN ON POWER. 3. SET THERMOSTAT TO DESIRED SETTING (MAIN BURNER WILL LIGHT AUTOMATICALLY WHEN THERMOSTAT CALLS FOR HEAT). SHUT DOWN INSTRUCTIONS - TURN OFF POWER & CLOSE ALL GAS VALVES.		INSTRUCTIONS D'ALLUMAGE 1. COUPER LE COURANT, BAISSER LE THERMOSTAT, FERMER TOUTES LES ROBINETS A GAZ ET ATTENDRE 5 MINUTES. 2. DUVRIER TOUTES LES ROBINETS A GAZ, DONNER LE COURANT. 3. REGLER LE THERMOSTAT SUR LA POSITION DESIREE (LE BRULEUR PRINCIPAL S'ALLUMERONT AUTOMATIQUEMENT LORSQUE LE THERMOSTAT DEMANDERA DE LA CHALEUR). INSTRUCTIONS DE FER METURE - COUPER LE COURANT ET FERMER TOUTES LES ROBINETS A GAZ.	

MODEL NUMBER / SERIAL NUMBER / WIRING DIAGRAM

Figure 23.1
Model Number Designations

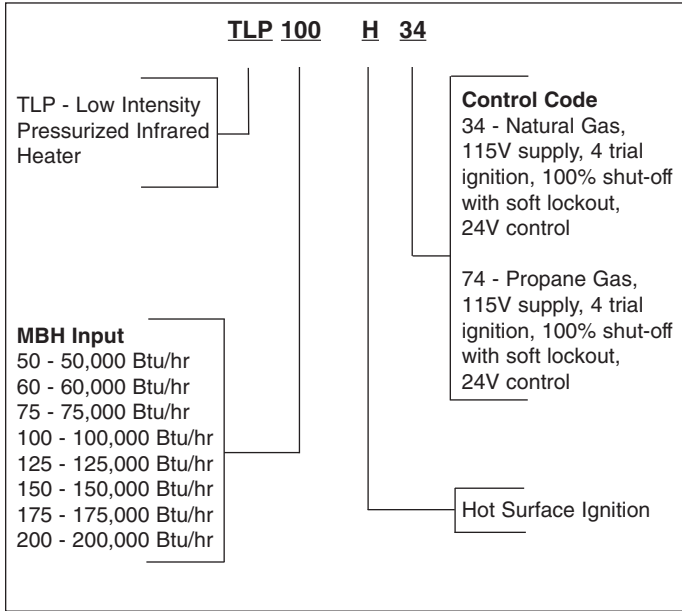


Figure 23.2
Serial Number Designations

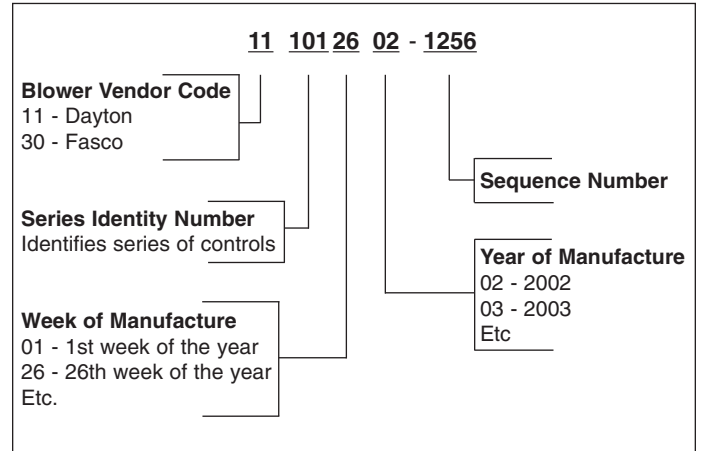
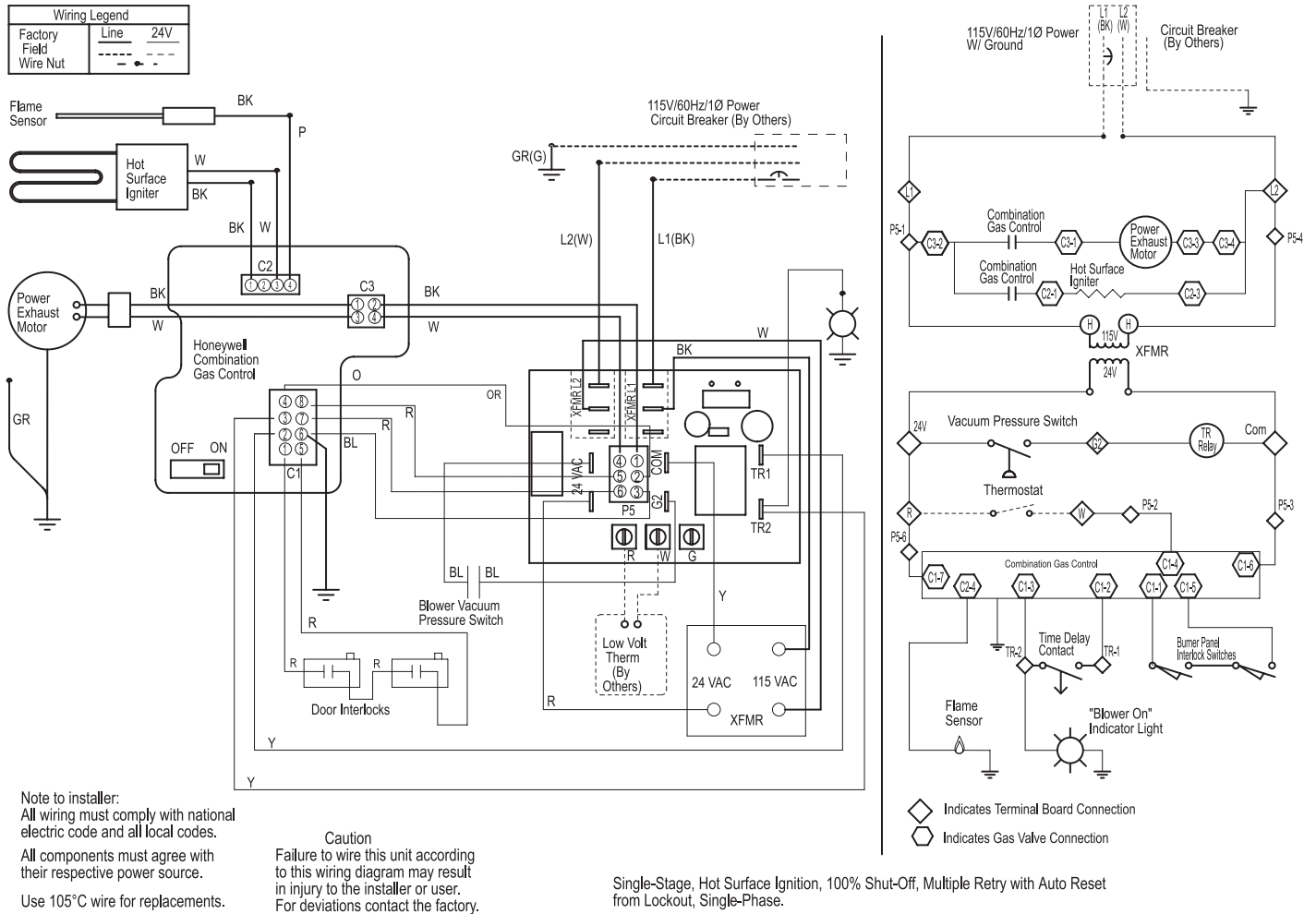


Figure 23.3
Wiring Diagram



COMMERCIAL 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 judgment 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 AND 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 judgment of 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'S REMEDY FOR BREACH OF 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 SHALL 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

The above referenced 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.

Component Applicable Models	"APPLICABLE WARRANTY PERIOD"
Heat Exchangers Gas-Fired Units except PSH/BSH	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, PSH/BSH, Steam/Hot Water Units, Oil-Fired Units, Electric Units, Cassettes, Vertical Unit Ventilators Compressors Vertical Unit Ventilators 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.



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