REZNOR®

Revision: LDAP-IOM (01-22) 207733-A

Supersedes: I-LDAP (01-19) PN207733R11

DOWNFLOW UNIT HEATER INSTALLATION/OPERATION/MAINTENANCE

MODEL LDAP

⚠ DANGER ⚠

FIRE OR EXPLOSION HAZARD

- **Failure to follow safety warnings exactly could result in serious injury, death, or property damage.**
- **Improper installation, adjustment, alteration, service, or maintenance can cause serious injury, death, or property damage.**
- **Installation and service must be performed by a qualified installer, service agency, or the gas supplier.**
- **Be sure to read and understand the installation, operation, and service instructions in this manual.**
- **Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.**

WHAT TO DO IF YOU SMELL GAS

- **Do not try to light any appliance.**
- **Do not touch any electrical switch; do not use any phone in your building.**
- **Leave the building immediately.**
- **Immediately call your gas supplier from a phone remote from the building. Follow the gas supplier's instructions.**
- **If you cannot reach your gas supplier, call the fire department.**

DO NOT DESTROY. PLEASE READ CAREFULLY. KEEP IN A SAFE PLACE FOR FUTURE REFERENCE.

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GENERAL INFORMATION

- This unit heater has been tested for capacity and efficiency so as to provide many years of safe and dependable comfort providing it is properly installed and maintained. With regular maintenance, this unit will operate satisfactorily year after year. Abuse, improper use, and/or improper maintenance can shorten the life of the appliance and create unsafe hazards.
- To achieve optimum performance and minimize equipment failure, it is recommended that periodic maintenance be performed on this unit. The ability to properly perform maintenance on this equipment requires certain tools and mechanical skills.
- The instructions in this manual apply only to model LDAP heaters.

References

Table 1. Related Technical Manuals Available from Factory Distributor

Type	Form	PN*
Replacement parts	LDAP-RPL	271892
Gas conversion kit installation	LDAP-GC	208881
Heat exchanger gasket kit installation	LDAP-HX	209212
High-elevation pressure switch replacement instructions	LDAP-DJ20	208081
Vertical louver kit installation	LDAP-CD32	208898
Downturn nozzle kit installation	LDAP-CD57,58,59	208899

*Also available at **www.reznorhvac.com**.

Important Safety Information

Please read all information in this manual thoroughly and become familiar with the capabilities and use of your appliance before attempting to operate or maintain this unit. Pay attention to all dangers, warnings, cautions, and notes highlighted in this manual. Safety markings should not be ignored and are used frequently throughout to designate a degree or level of seriousness.

DANGER: A danger statement describes a potentially hazardous situation that if not avoided, will result in severe personal injury or death and/or property damage.

WARNING: A warning statement describes a potentially hazardous situation that if not avoided, can result in severe personal injury and/or property damage.

CAUTION: A caution statement describes a potentially hazardous situation that if not avoided, can result in minor or moderate personal injury and/or property damage.

NOTE: A note provides important information that should not be ignored.

⚠ WARNING ⚠

- **Gas-fired appliances are not designed for use in hazardous atmospheres containing flammable vapors or combustible dust, in atmospheres containing chlorinated or halogenated hydrocarbons, or in applications with airborne silicone substances.**
- **Should overheating occur, or the gas supply control system fail to shut off the flow of gas, shut off the manual gas valve to the unit before shutting off the electrical supply.**
- **Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and replace any gas control that has been under water.**
- **Installation should be done by a qualified agency in accordance with these instructions. The qualified service agency installing this heater is responsible for the installation.**
- **This appliance is not intended for use by persons with reduced physical, sensory, or mental capabilities or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety.**
- **Children should be supervised to ensure that they do not play with the appliance.**

Certification

- All model LDAP high-bay packaged heaters are design-certified by ITS for use in industrial and commercial installations.
- All unit sizes are available for use with either natural or propane gas. The type of gas, the input rate, and the electrical supply requirement are shown on the heater rating plate. Check the rating plate to determine if the heater is appropriate for the intended installation.
- Unit is certified as a Category III heater.

Warranty

Refer to the limited warranty form in the literature bag provided with the unit. The warranty is void if:

- Wiring is not in accordance with the diagram furnished with the heater.
- The heater is installed without proper clearance to combustible materials.
- The heater is connected to a duct system or if the air delivery system is modified by other than manufacturer-designed accessories.

Installation Codes

- These heaters must be installed in accordance with local building codes. In the absence of local codes, in the United States, the heater must be installed in accordance with the National Fuel Gas Code, ANSI Z223.1. Local authorities having jurisdiction should be consulted before installation is made to verify local codes and installation procedure requirements.
- Installations in aircraft hangars should be in accordance with ANSI/NFPA No. 409 (latest edition), *Standard for Aircraft Hangars,* in public garages in accordance with ANSI/NFPA No. 88A (latest edition), *Standard for Parking Structures,* or in repair garages in accordance with ANSI/NFPA No. 88B (latest edition), *Standard for Repair Garages*.
- If the heater is being installed in the Commonwealth of Massachusetts, installation must be performed by a licensed plumber or licensed gas fitter.

Cabinet Configurations

These indirect-fired, indoor, downflow packaged heaters are available in three different configurations, as shown in **Figure 1**.

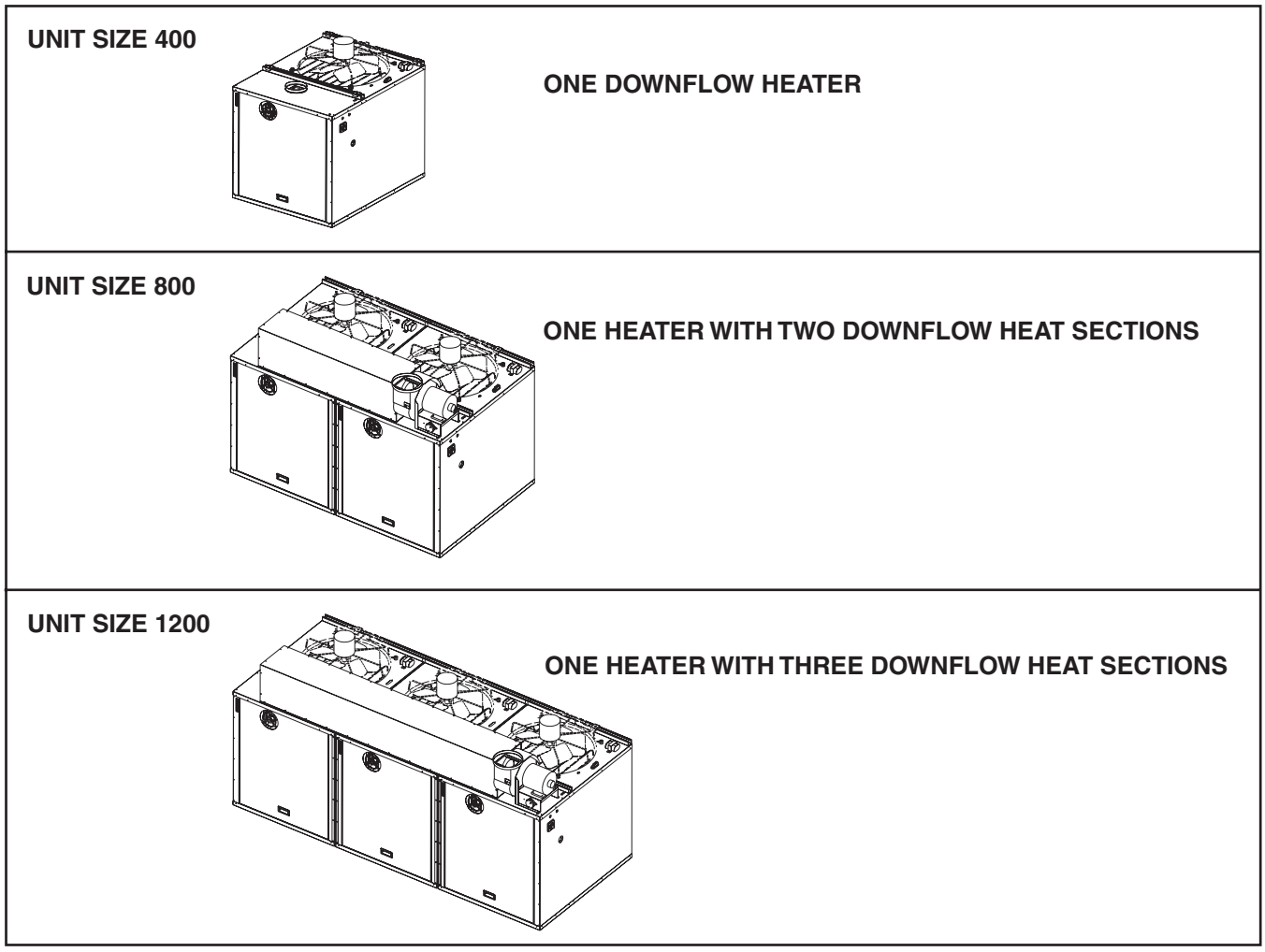


Figure 1. Cabinet Configurations

Unit Location

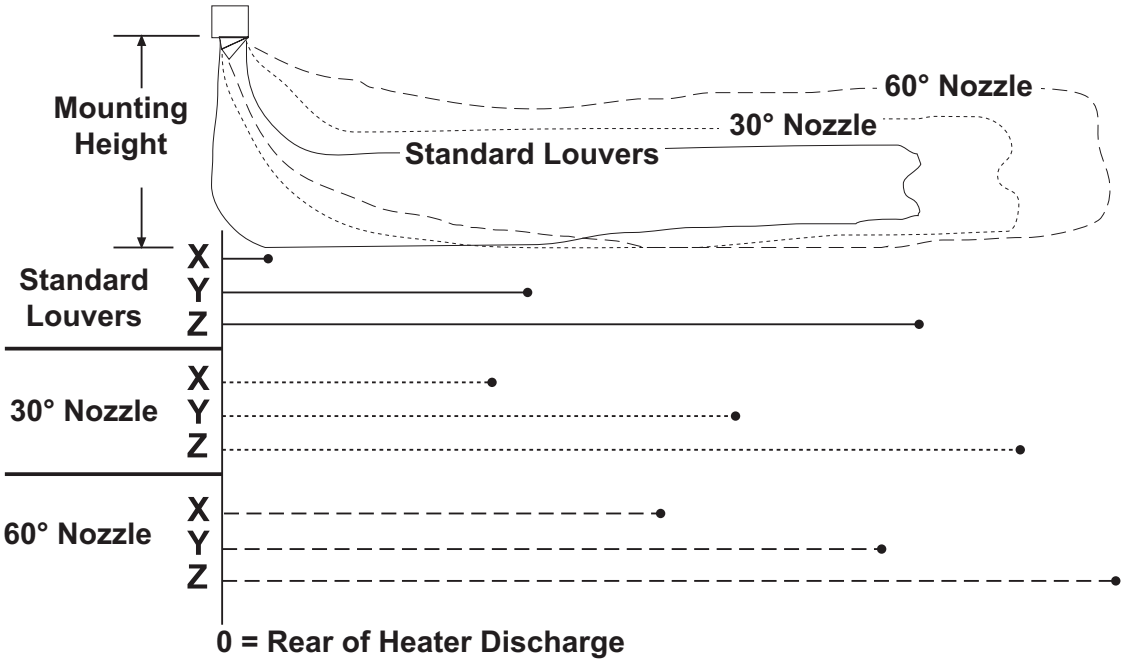
⚠ CAUTION ⚠

- **Unit heaters should not be used in an application where the heated space temperature is below 40°F (4°C). Operating under low ambient conditions may cause condensation to form in the heat exchanger.**
- **Do not locate the heater where it may be exposed to water spray, rain, or dripping water.**

- Refer to the following sections of this manual to determine where to suspend the heater: **Heater Throw**, **Mounting Height Requirements**, **Hazards of Chlorine**, **Dimensions**, **Clearances**, **Weights**, **Combustion Air Requirements**, **Acoustical Considerations**, and **Venting Connections**.

Heater Throw

Figure 2 shows throw patterns for all unit sizes in heat mode at high speed. **Table 2** lists throw distances for standard louvers facing one direction and fully open. Throw pattern changes with louver angle, two-way louver direction, and/or optional four-way louvers.



X = DISTANCE FROM 0 TO BEGINNING OF FLOOR COVERAGE
Y = DISTANCE FROM 0 TO END OF FLOOR COVERAGE
Z = DISTANCE FROM 0 TO POINT WHERE AIR VELOCITY DROPS TO <50 FEET (15.2 METERS) PER MINUTE
Y – X = LENGTH OF FLOOR COVERAGE

Figure 2. Heater Throw Patterns (Refer to Table 2)

Table 2. Heater Throw Distances									
Mounting Height	Standard Louvers			30-Degree Nozzle			60-Degree Nozzle		
	Dimension*								
	X	Y	Z	X	Y	Z	X	Y	Z
	Feet (Meters)								
20 (6.1)	5 (1.5)	55 (16.8)	134 (40.8)	40 (12.2)	90 (27.4)	146 (44.5)	70 (21.3)	125 (38.1)	158 (48.2)
30 (9.1)	8 (2.4)	53 (16.2)	121 (36.9)	44 (13.4)	86 (26.2)	133 (40.5)	76 (23.2)	119 (36.3)	145 (44.2)
40 (12.2)	12 (3.7)	49 (14.9)	109 (33.2)	47 (14.3)	81 (24.7)	120 (36.6)	—		
50 (15.2)	17 (5.2)	45 (13.7)	96 (29.3)	—					
*See Figure 2.									

Mounting Height Requirements

⚠ WARNING ⚠

If touched, the vent pipe and internal heater surfaces that are accessible from outside the heater will cause burns. Suspend the heater a minimum of 15 feet (4.6 meters) above the floor.

- For best results, the heater should be mounted with certain rules in mind. In general, a unit should be located 15 to 40 feet (4.6 to 12.2 meters) above the floor. Where two or more units are installed in the same room, a general scheme of air circulation should be maintained for best results.
- Suspended heaters are most effective when located as close to the working zone as possible, and this fact should be kept in mind when determining the mounting heights to be used. However, care should be exercised to avoid directing the discharged air directly on the room occupants.
- Partitions, columns, counters, or other obstructions should be taken into consideration when locating the unit heater so that a minimum quantity of airflow will be deflected by such obstacles.

Hazards of Chlorine

The presence of chlorine vapors in the combustion air of gas-fired heating equipment presents a potential corrosion hazard. Chlorine is usually found in the form of freon or degreaser vapors. When chlorine is exposed to flame, it will precipitate from the compound and go into solution with any condensation that is present in the heat exchanger or associated parts. The result is hydrochloric acid, which readily attacks all metals including 300 grade stainless steel. Care should be taken to separate these vapors from the combustion process. This may be done by wise location of the heater with regard to exhausters or prevailing wind directions. Chlorine is heavier than air. Keep these facts in mind when determining installation location of the heater in relation to building exhaust systems.

Dimensions

Unit dimensions are shown in **Figure 3** and **Figure 4**. Dimensions of optional nozzle(s) on the discharge opening (option CD57, CD58, or CD59) are shown in **Figure 5**.

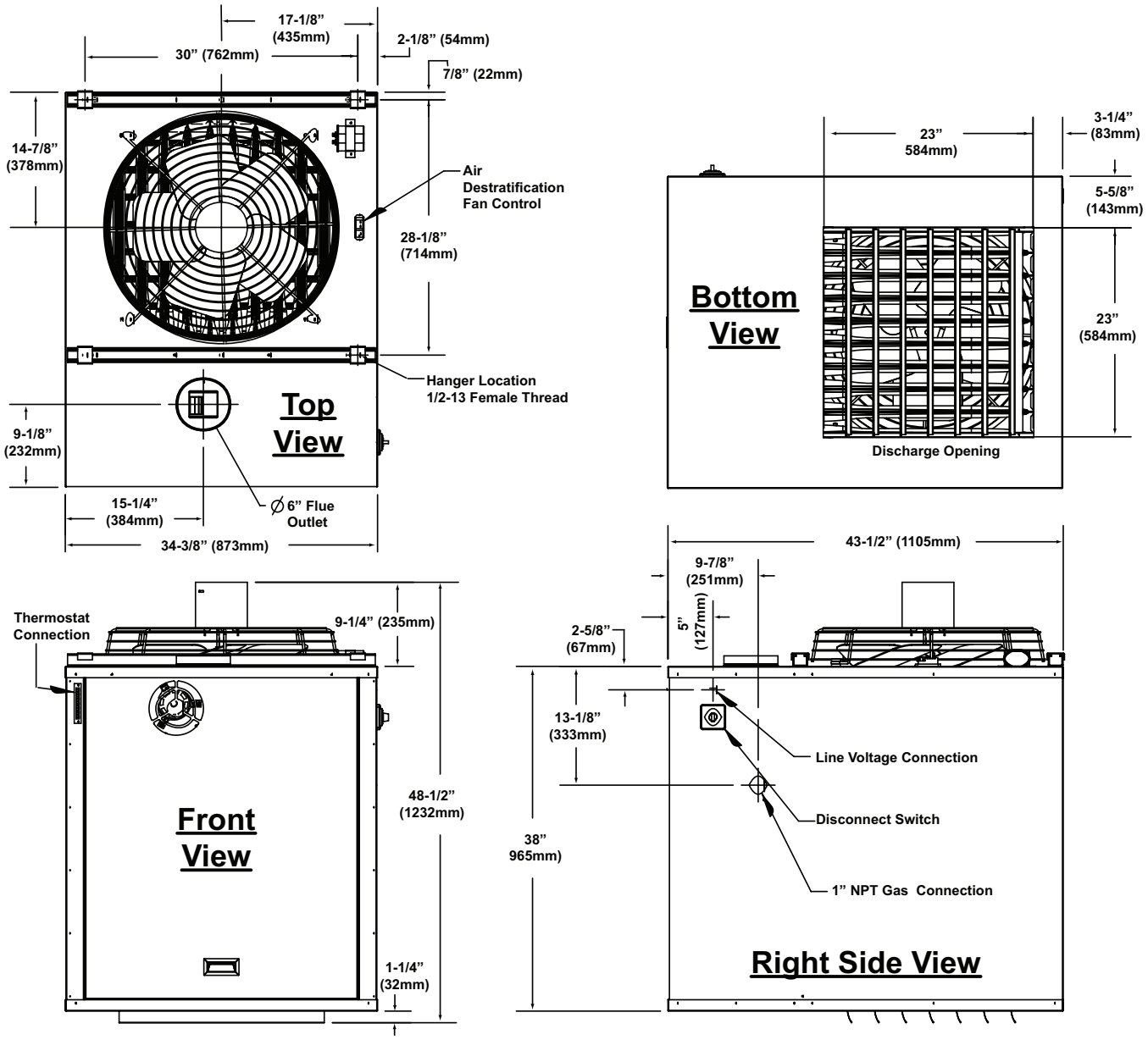


Figure 3. Dimensions—Unit Size 400

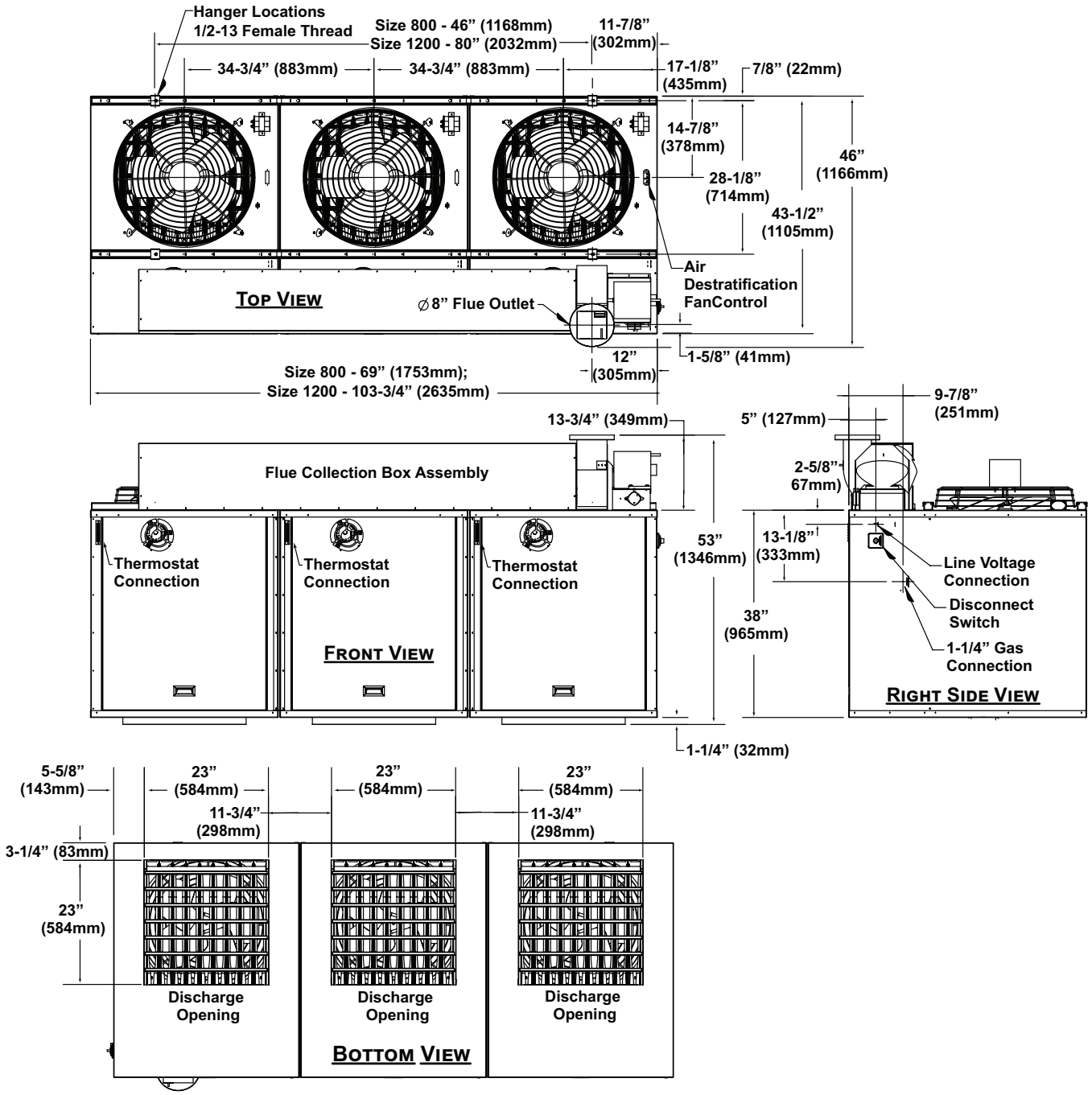


Figure 4. Dimensions—Unit Sizes 800 and 1200

Dimensions—Continued

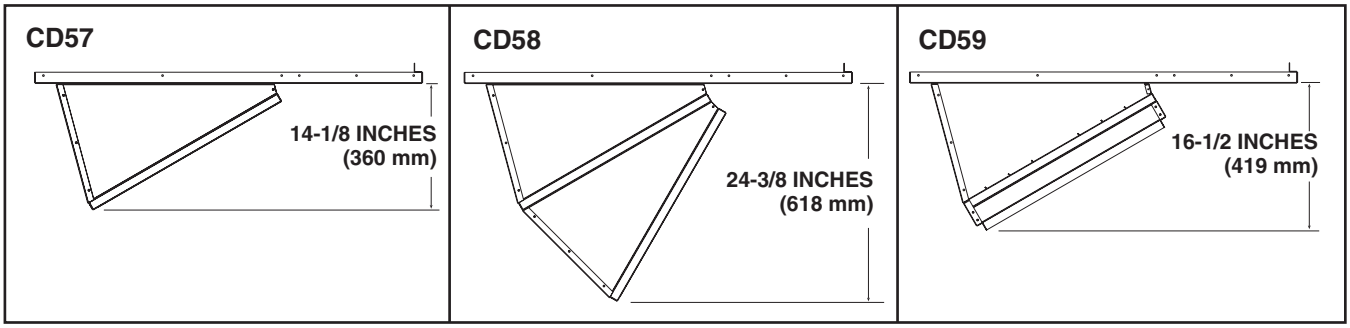


Figure 5. Dimensions—Downturn Nozzle Assemblies

Clearances

Units must be installed so that the clearances listed in **Table 3** are provided for with regards to combustion air space, inspection, and service and for proper spacing from combustible construction. Clearance to combustibles is defined as the minimum distance from the heater to a surface or object for which it is necessary to ensure that a surface temperature of 90°F (50°C) above the surrounding ambient temperature is not exceeded. Refer to the dimensions shown in **Figure 3**, **Figure 4**, and **Figure 5** when determining clearances to combustibles.

Table 3. Clearances to Combustibles

Heater Surface	Minimum Clearance (Inches (mm))
Top	12 (305)
Flue connector	6 (152)
Front (access panel)	18 (457)
Rear	2 (51)
Disconnect side	18 (457)
Side	2 (51)
Bottom	60 (1524)

Weights

⚠ WARNING ⚠

Check the supporting structure to be used to verify that it has sufficient load carrying capacity to support the weight of the unit. Suspend the heater only from the threaded nut retainers or with a manufacturer-provided kit. Do NOT suspend from the heater cabinet.

NOTE: For unit shipping weight, contact an authorized Factory Distributor.

Before installing the heater, ensure that the supporting structure to be used has sufficient load-carrying capacity to support the weight (refer to **Table 4**) of the unit.

Table 4. Unit Weights

Unit Size	Pounds (kg)
400	375 (170)
800	805 (365)
1200	1195 (542)

Combustion Air Requirements

⚠ WARNING ⚠

- **Do not install a unit in a confined space without providing wall openings leading to and from the space.**
- **A model LDAP power-vented heater is designed to take combustion air from the space in which the heater is installed and is not designed for connection to outside combustion air intake ducts. Connecting outside air ducts voids the warranty and could cause hazardous operation.**

- This heater must be supplied with the air that enters into the combustion process and is then vented to the outdoors. Sufficient air must enter the equipment location to replace that exhausted through the heater vent system. In the past, the infiltration of outside air assumed in heat loss calculations (one air change per hour) was assumed to be sufficient. However, current construction methods using more insulation, vapor barriers, tighter fitting and gasketed doors and windows, weather-stripping, and/or mechanical exhaust fans may now require the introduction of outside air through wall openings or ducts.
- Under all conditions, enough air must be provided to ensure there will not be a negative pressure condition within the equipment room or space.
- Requirements for combustion air and ventilation air depend upon whether the unit is located in a confined or unconfined space. A ***confined*** space is defined as a space whose volume is <50 cubic feet per 1,000 BTUh of the installed appliance input rating. An ***unconfined*** space is defined as a space whose volume is ≥50 cubic feet per 1,000 BTUh of the installed appliance input rating.
- Provide openings (depending on the combustion air source) near the floor and ceiling for ventilation and air for combustion, as shown in **Figure 6** and as listed in **Table 5**.

NOTE: For further details on supplying combustion air to a confined space, refer to the National Fuel Gas Code ANSI Z223.1a (latest edition).

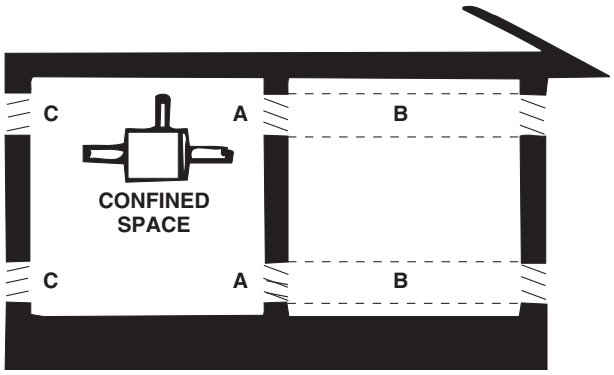


Figure 6. Confined Space Combustion Air Openings (Refer to Table 5)

Table 5. Determining Confined Space Combustion Air Requirements

Letter*	Air Source	Required Opening Size	Calculate Combustion Air Requirements
A	Air inside building	1 square inch free area per 1000 BTUh	Add total BTUh of all appliances in confined space and divide by figures at left for square inch free area size of each (top and bottom) opening
		Never <100 square inches free area for each opening	
B	Outside air through duct	1 square inch free area per 2000 BTUh	
C	Direct outside air	1 square inch free area per 4000 BTUh	

*See **Figure 6**.

Acoustical Considerations

Refer to the sound level data listed in **Table 6** when determining unit location based on acoustical considerations.

Table 6. Technical Data

Parameter	Unit of Measurement	Unit Size		
		400	800	1200
Input heating capacity	BTUh	400,000	800,000	1,200,000
	kW	117.1	234.2	351.4
Thermal efficiency	%	83		
Output heating capacity	BTUh	332,000	664,000	996,000
	kW	97.2	194.4	291.6
Gas connection	inch	1	1-1/4	1-1/4
Vent connection diameter		6	8	8
Control amps (24V)	amp	1.0	2.0	3.0
Full load amps (208V)		5.6	13.6	19.4
Full load amps (230V)		5.5	12.8	18.5
Normal power consumption @ 208V	watt	1150	2448	3730
Normal power consumption @ 230V		1230	2597	3959
Discharge air temperature rise	°F	55		
Air volume, heat @ high speed	cfm	5589	11,178	16,768
	m^3/minute	158	317	475
Discharge air opening area	$feet^2$	3.67	7.35	11.02
	$meters^2$	0.34	0.68	1.02
Outlet velocity, heat @ high speed	fpm	1521		
	m/minute	464		
Air volume, destratification @ medium speed	cfm	4650	9300	13,950
	m^3/minute	132	263	395
Outlet velocity, destratification @ medium speed	fpm	1266		
	m/minute	386		
Air volume, destratification @ low speed	cfm	3250	6500	9750
	m^3/minute	92	184	276
Outlet velocity, destratification @ low speed	fpm	885		
	m/minute	270		
Fan motor* power	HP	1		
Fan motor* speed	rpm	1050		
Fan diameter	inch	24	24	24
Sound level @ 20 feet (6.1 meters)	dBa	69	72	74
	Pascal (Pa)	0.058	0.080	0.100
	microbar (µbar)	0.580	0.800	1.000
Sound level @ 25 feet (7.6 meters)	dBa	65	68	70
	Pascal (Pa)	0.037	0.051	0.064
	microbar (µbar)	0.371	0.512	0.640
Sound level @ 30 feet (9.1 meters)	dBa	62	65	67
	Pascal (Pa)	0.026	0.036	0.044
	microbar (µbar)	0.258	0.356	0.444
Sound level @ 35 feet (10.7 meters)	dBa	60	62	64
	Pascal (Pa)	0.019	0.026	0.033
	microbar (µbar)	0.189	0.261	0.327
Sound level @ 40 feet (12.2 meters)	dBa	57	60	62
	Pascal (Pa)	0.015	0.020	0.025
	microbar (µbar)	0.145	0.200	0.250

*Quantity is one (1) for unit size 400, two (2) for unit size 800, and three (3) for unit size 1200.

INSTALLATION

Unpacking and Inspection

- The unit was test-operated and inspected at the factory prior to crating and was in operating condition.
- It is important to note when uncrating the unit that the crate bottom should be removed after the heater is lifted. Shipping brackets are attached with cabinet screws. When removing shipping brackets, re-insert ALL screws into the cabinet.
- If, upon removing it from its crate, the unit has been found to have incurred any damage in shipment, document the damage with the transporting agency and contact an authorized Factory Distributor. If you are an authorized Distributor, follow the FOB freight policy procedures.

Pre-Installation Checklist

- ❑ Check the rating plate for the gas specifications and electrical characteristics of the heater to ensure that they are compatible with the gas and electric supplies at the installation site.
- ❑ Read this manual and become familiar with the installation requirements of your particular heater.
- ❑ If you do not have knowledge of local requirements, check with the local gas company or any other local agencies who might have requirements concerning this installation.
- ❑ Before beginning, make preparations for necessary supplies, tools, and manpower.
- ❑ Locate the hardware kit supplied with the heater. The plastic bag contains spring nuts, hex nuts, U-shaped fittings, lockwashers, louvers, and compression springs.
- ❑ Ensure that all shipped-separate options that were ordered are at the installation site. Shipped-separate items could include a vent cap, louvers, nozzles, hanger kit, a manual shutoff valve, a thermostat, multiple heater controls, high-temperature tape, and/or a high-elevation conversion kit.

Heater Mounting

⚠ WARNING ⚠

- **Before installing the heater, check the supporting structure to be used to verify that it has sufficient load-carrying capacity to support the weight (refer to Weights section) of the unit.**
- **The heater must be level for proper operation. DO NOT place or add additional weight to a suspended heater.**

⚠ CAUTION ⚠

- **When the heater is lifted for suspension, support the bottom of the heater with the crate bottom. If the bottom is not supported, damage could occur.**
- **Before suspending or wall-mounting the heater, ensure that all screws used for holding shipping brackets have been re-installed in the cabinet.**

Heater Mounting—Continued

Suspension-Mounting

- **Suspending the heater using threaded rods (see Figure 7, DETAIL A):**
  a. Install spring nuts in strut that is attached to top of unit.
  b. Lock 1/2-13 threaded rods (recommended maximum length is 6 feet (1.8 meters) to heater using U-shaped fittings, lockwashers, and hex nuts.
- **Suspending the heater from 1-inch pipe using swivel connectors (option CK10, see Figure 7, DETAIL B):**
  a. Install spring nuts in strut that is attached to top of unit.
  b. Lock swivel connectors to heater using U-shaped fittings, lockwashers, and hex nuts.

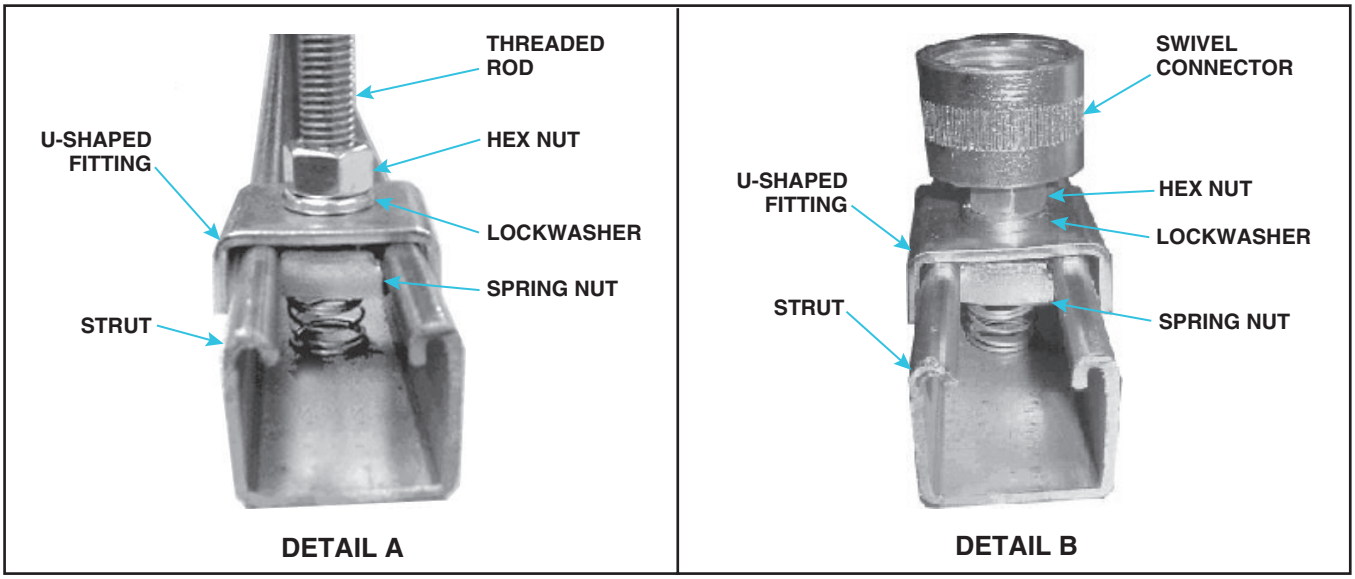


Figure 7. Suspension-Mounting

Wall-Mounting

The heater may be attached to a wall. Place supports as shown in **Figure 8** and comply with all of the following guidelines:

- Mounting is the responsibility of the installer. Verify that the supporting structure has sufficient load-carrying capacity to support the weight (refer to **Weights** section).
- Prior to installation, ensure that the method of support is in agreement with all local building codes. Check for service platform requirements.
- Maintain a 2-inch (51 mm) minimum clearance from the discharge air openings to structural supports. Additional clearance will be required if an optional nozzle is to be field-installed.
- Determining the need for installing vibration or noise isolation is the responsibility of the installer.
- To prevent potential movement, field-supplied angles must be placed around the perimeter of the heater to anchor it to the structural supports.
- Structural supports must be placed as shown in **Figure 8** to prevent damage to the heater.
- All structural supports must be noncombustible materials.

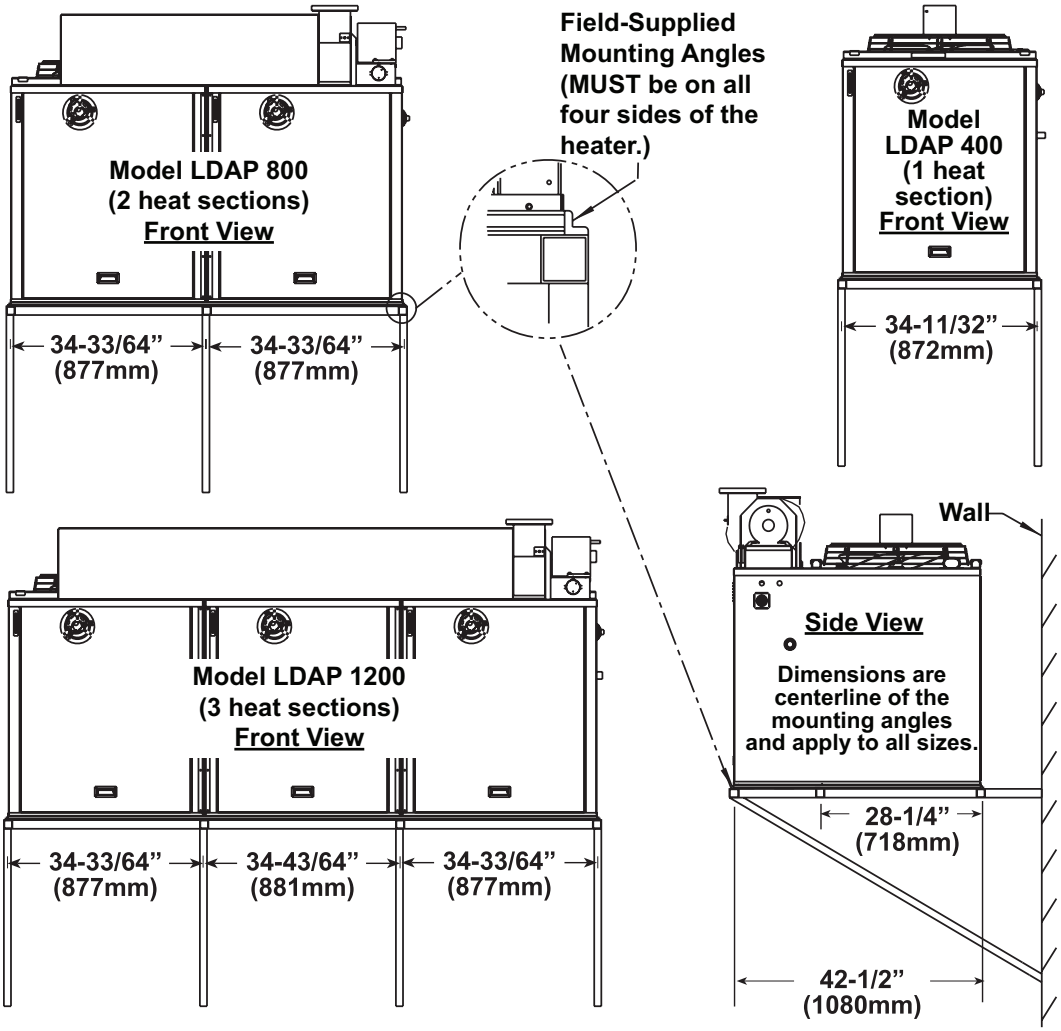


Figure 8. Wall-Mounting

Piping Connections

Gas Supply Pressure

The unit is equipped for a maximum gas supply pressure of 1/2 psi, 3.5 kPa, or 14 IN WC.

NOTES:

Supply pressure higher than 1/2 psi requires the installation of an additional service regulator external to the unit.

PRESSURE TESTING SUPPLY PIPING

- **Test pressures *above* 1/2 psi—disconnect the heater and manual valve from the gas supply line to be tested. Cap or plug the supply line.**
- **Test pressures *below* 1/2 psi—before testing, close the manual valve on the heater.**

GAS CONVERSION

- **Gas conversion kits are available for changing from propane to natural gas or natural gas to propane. A factory-authorized conversion kit MUST be used.**

Piping Connections—Continued

Gas Supply Piping

⚠ DANGER ⚠

- **All components of a gas supply system must be leak tested prior to placing equipment in service. NEVER TEST FOR LEAKS WITH AN OPEN FLAME. Failure to comply could result in personal injury, property damage, or death.**
- **The combination gas valve is the prime safety shutoff. All gas supply lines must be free of dirt or scale before connecting the heater to ensure positive closure.**
- **Pipe joint compounds (pipe dope) shall be resistant to the action of liquefied petroleum gas or any other chemical constituents of the gas being supplied.**

- All piping must be in accordance with requirements outlined in the National Fuel Gas Code ANSI/Z223.1 (latest edition).
- Gas supply piping installation shall conform with good practice and with local codes.
- Support gas piping with pipe hangers, metal strapping, or other suitable material. Do not rely on the heater to support the gas pipe.
- The heater is orificed for operation with natural gas having a heating value of 1,000 (±50) BTU per cubic foot or with propane gas having a heating value of 2,500 (±100) BTU per cubic foot. Sizing of gas supply lines depends on piping capacity and is based on cubic feet per hour based on a 0.3 IN WC pressure drop, a 0.6 specific gravity for natural gas at 1,050 BTU per cubic feet, and a 1.6 specific gravity for propane at 2,550 BTU per cubic feet. If the gas at the installation does not meet this specification, consult the factory for proper orificing.
- Variables for sizing gas supply lines are listed in **Table 7**. When sizing supply lines, consider possibilities of future expansion and increased requirements. Refer to National Fuel Gas Code for additional information on line sizing.

Table 7. Gas Supply Line Sizes

Length of Pipe (Feet)	Diameter of Pipe (Inches)									
	1		1-1/4		1-1/2		2		2-1/2	
	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane	Natural Gas	Propane
	Cubic Feet per Hour									
20	350	214	730	445	1100	671	2100	1281	3300	2013
30	285	174	590	360	890	543	1650	1007	2700	1647
40	245	149	500	305	760	464	1450	885	2300	1403
50	215	131	440	268	670	409	1270	775	2000	1220
60	195	119	400	244	610	372	1105	674	1850	1129
70	180	110	370	226	560	342	1050	641	1700	1037
80	170	104	350	214	530	323	990	604	1600	976
90	160	98	320	195	490	299	930	567	1500	915
100	150	92	305	186	460	281	870	531	1400	854
125	130	79	275	168	410	250	780	476	1250	763
150	120	73	250	153	380	232	710	433	1130	689
175	110	67	225	137	350	214	650	397	1050	641
200	100	61	210	128	320	195	610	372	980	598

Supply Piping Connections

⚠ CAUTION ⚠

IMPORTANT: Two pipe wrenches are required when installing gas piping. The gas pipe that is supplied with the heater MUST be held with a pipe wrench to prevent damage to the heater.

- Install a ground joint union and manual shutoff valve upstream of the unit control system, as shown in **Figure 9**.
- The 1/8-inch plugged tapping in the manual shutoff valve in **Figure 9** provides connection for a supply line pressure test gauge.
- The National Fuel Gas Code requires the installation of a trap with a minimum 3-inch drip leg (see **Figure 9**). Local codes may require a drip leg longer than 3 inches (typically 6 inches). To permit burner removal, this drip leg must extend beyond the edge of the heater.
- Leak-test all connections by brushing on a leak-detecting solution. Bleed trapped air from gas lines as needed.
- The gas connection is made at the pipe nipple that extends outside the cabinet, as shown in **Figure 9**. Gas connection sizes are listed in **Table 8**.

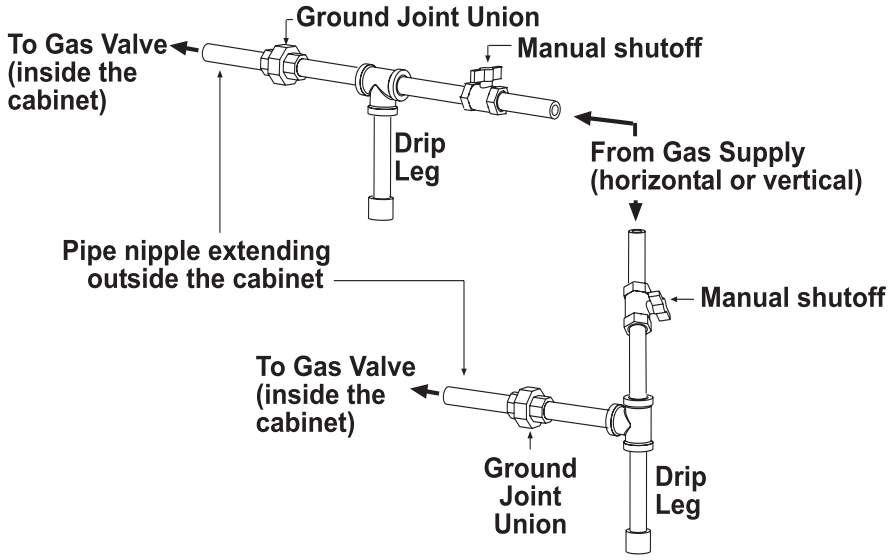


Figure 9. Gas Connections

Table 8. Gas Connection Sizes

Unit Size	Natural Gas	Propane
	Connection (Inches)*	
400	1	1
800, 1200	1-1/4	1-1/4

*Connection size for a standard unit (not gas supply line size).

Venting Connections

⚠ DANGER ⚠

- **Each heater requires its own individual vent pipe run and vent cap. Manifolding of vent runs can cause recirculation of combustion products into the building. Failure to comply could result in severe personal injury or death and/or property damage.**
- **If this heater is replacing an existing heater, be sure that the vent is sized properly for the heater being installed and that the existing vent is in good condition.**
- **A properly sized vent system is required for safe operation of the heater. An improperly sized vent system can cause unsafe conditions and/or create condensation.**
- **Do not intermix different vent system parts from different manufacturers in the same venting system.**
- **Do not vent into an existing gravity vent or chimney.**

Venting Connections—Continued

Venting Requirements

- These power-vented heaters are designed to operate safely and efficiently with either a horizontal or vertical vent. Comply with the specific requirements and instructions.
- Installation should be done by a qualified agency in accordance with these instructions. The qualified service agency installing this system is responsible for the installation.
- Venting must be in accordance with local codes and with the National Fuel Gas Code Z223.1. Local requirements supersede national requirements.
- Model LDAP heaters are certified as Category III heaters. Refer to **Table 9** for a list of Category III vent manufacturers.

Table 9. Category III Vent Manufacturers

Manufacturer	Model(s)	Diameter (Inches)
CaptiveAire Systems	2V-Type BH	—
Cheminee Lining E Inc.	IPP, HEP, HEPL, HEPLA, HEPL1, and HEPL2	6–48
Cleaver-Brooks Inc.	CBH, CBHL, CBHL2, CBHLA, and CBHL1	
DuraVent Inc.	FasNSeal fixed blade damper assembly	4–18 (ID)
	FasNseal special gas vent assembly	—
	FasNSeal W2 special gas vent system	
	FasNSmooth chimney liner system for use in masonry chimneys only	
	FasNSeal CVS special gas vent system and direct vented pellet system	
	S-Vent and PVP	4 and 5
ENERVEX Inc.	EPS and EPS-1	4–48
ECCO Manufacturing Division of ECCO Heating Products Ltd.	SGDW series	3–6
ICC Industrial Chimney Co.	VIC	4–24
Industrial Combustion LLC	ICH, ICHL, ICHLA, ICHL1, and ICHL2	4–48
Jeremias Inc.	DWKL, SWKL, DWFL, and SWFL	4–36
	DWGV double-wall, air-insulated, 1 inch between inner and outer pipe diameter	—
	DWGV1 double-wall, fiber-insulated, 1 inch between inner and outer pipe diameter	
	DWGV2 double-wall, fiber-insulated, 2 inches between inner and outer pipe diameter	
	SWGV single-wall	4–12
Lifetime Chimney Supply LLC	Xi1, Xi2, and Xi4	5
METAL-FAB Inc.	CGSW, FCSSW, CG, FCS, FCG-1, and FCS-1	6–24 (ID)
	FCGSW, FCG, FCG-1, FCS-3 CORR/GUARD, and FCS-2 CORR/GUARD	6–36 (ID)
	CGSW, CG, FCG, 3CGSWHVK, and 4CGSWHVK	4 and 5
Noritz America Corporation	N-Vent	4 and 5
Rheem Sales Co. Inc.	RTG	3
Security Chimneys International Ltd.	Secure Seal Flex chimney lining system	3–12
Selkirk Corporation	Saf-T-CI and Saf-T C1	4, 5, and 6
	Saf-T-Vent	3–6 and 8
	EZ Seal	3–6
	SGV	3, 4, and 5
	CI Plus	6 and 8
	SC, DGV, EZ Seal Quick Kit, Sel-Vent, and Sel-Vent II	4
	IPS316, PS316, and G316	5 and 6
SFL Flue & Chimney	DEVON EPS and EPS-1	4–6
The Schebler Co.	SSD, ESW, eVent, and eVent PLUS	2 and 4–6
	eVent SD	4–6
Sunair Products	SADW-2V and SADW-V	4
Tokyo Gas Renovation Co. Ltd.	KP and KC	4 and 5
	N-Vent	3, 4, and 5
VAN-PACKER CO INC	MW, CS, and CSplus	4–6 (ID)
Z-FLEX US INC	SVE and SVEII	3 and 4
	SVEIII	2, 3, and 4
	SVEIV single-wall and SVEIV double-wall	4, 5, and 6
	NovaVent single-wall and NovaVent double-wall	
	Z-VentBlu single-wall and Z-VentBlu double-wall	3, 4, and 5

Vent Pipe Type

The type of vent pipe is determined by whether the vent is horizontal or vertical:

- **Horizontal:** approved for Category III appliance or appropriately sealed 26-gauge or heavier galvanized steel or equivalent single-wall pipe
- **Vertical:** approved for Category III appliance, appropriately sealed 26-gauge or heavier galvanized steel or equivalent single-wall pipe, or if at least 75% of equivalent length of vent run is vertical, double-wall (Type B) vent pipe

Vent Pipe Size

- Use only one diameter of vent pipe on an installation.
- The minimum vent length is 3 feet (1 meter).
- A minimum of 1 foot (0.3 meter) of vertical vent is required on the venter outlet before installing an elbow.
- Vent pipe diameters and maximum vent lengths in **Table 10** apply to both horizontal and vertical vents.

Table 10. Vent Pipe Diameters and Lengths

Unit Size	Venter Outlet Diameter	Vent Pipe Diameter	Maximum Vent Length*	Equivalent Straight Length**		Venter Outlet Connection***
				90-Degree Elbow	45-Degree Elbow	
	Inches (mm)		Feet (Meters)			Inches (mm)
400	6 (152)	6 (152)	45 (13.7)	15 (4.6)	7.5 (2.3)	—
		7 (178)	60 (18.3)	8 (2.4)	4 (1.2)	6–7 (152–178)
800	8 (203)	8 (203)	50 (15.2)	15 (4.6)	7.5 (2.3)	—
		10 (254)	45 (13.7)	5 (1.5)	2.5 (0.8)	8–10 (203–254)
1200	8 (203)	8 (203)	50 (15.2)	15 (4.6)	7.5 (2.3)	—
		10 (254)	45 (13.7)	5 (1.5)	2.5 (0.8)	8–10 (203–254)

*Includes one 90° elbow at venter outlet.

**Add all straight sections and equivalent lengths for elbows—the total combined length must not exceed the maximum vent length.

***Field-supplied taper-type increaser connection required at the venter outlet.

Vent System Sealing

Vent system joints depend on the type of pipe being used:

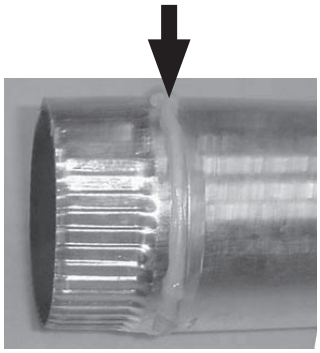
- **Category III pipe:** follow manufacturer's instructions for joining pipe sections—connect venter outlet or the vent cap using secure, sealed joints that follow a procedure best suited to the style of Category III pipe being used.
- **Single-wall galvanized pipe (26-gauge or heavier):** secure slip-fit connections using sheet metal screws or rivets—seal all joints and seams inside the building using tape such as option FA1 (PN 98266) or high-temperature silicone sealant.
- **Double-wall Type B vent pipe:** join pipe sections in accordance with the pipe manufacturer's requirement—refer to the illustrated instructions in **Figure 10** to connect double-wall pipe to the heater collar, single-wall pipe, and vent cap. Work quickly to assemble components before sealant dries.

NOTE: A double-wall pipe run is allowed only if at least 75% of the vent length is vertical.

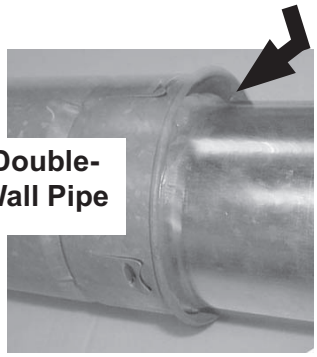
Venting Connections—Continued

Vent System Sealing—Continued

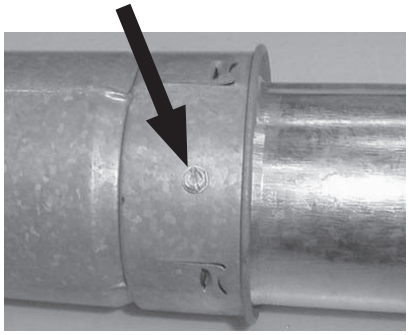
STEP 1: Place continual 1/4-inch bead of silicone sealant around circumference of single-wall pipe.



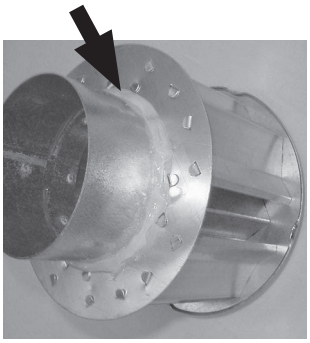
STEP 2: Before sealant can dry, insert single-wall pipe into inner pipe of double-wall pipe until bead of sealant contacts inner pipe to create sealed joint.



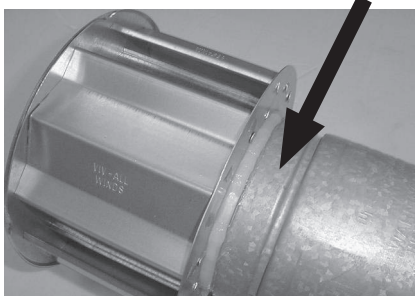
STEP 3: Drill three small holes spaced equally around double-wall pipe below sealant ring. Secure joint using 3/4-inch-long sheet metal screws. Do not overtighten screws.



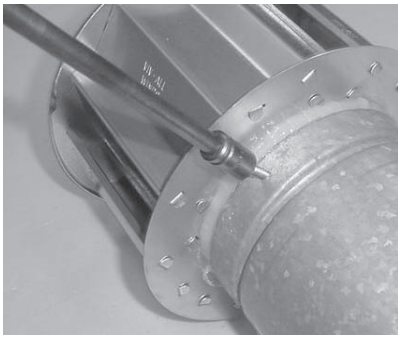
STEP 4: Place continual 3/8-inch bead of silicone sealant around he circumference of vent cap collar to prevent any water inside vent cap from running down double-wall pipe.



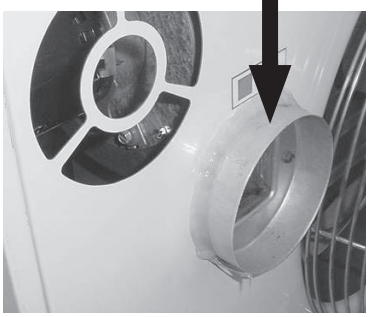
STEP 5: Before sealant can dry, insert collar on vent cap as far as possible inside inner wall of double-wall pipe. Apply silicone sealant to fully close any gaps between vent cap and double-wall pipe to prevent water from entering double-wall pipe.



STEP 6: Drill small hole through vent cap and double-wall pipe. Secure joint using 3/4-inch-long sheet metal screw. Do not overtighten screw.



STEP 7: Place continual 1/4-inch bead of silicone sealant around circumference of venter outlet collar.



STEP 8: Before sealant can dry, slide double-wall pipe over collar so that collar is inside inner pipe. Push double-wall pipe tight to heater cabinet. Drill three small holes through the pipe and into collar spaced equally around pipe below sealant ring. Secure joint using 3/4-inch-long sheet metal screws. Do not overtighten screws.

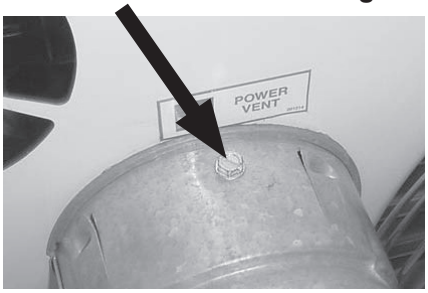


Figure 10. Instructions for Attaching Double-Wall Type B Vent Pipe to Single-Wall Pipe

Condensation Mitigation

- Any length of single-wall vent pipe exposed to cold air or run through an unheated area or an area with an ambient temperature of 45°F or less, must be insulated along its entire length with a minimum of 1/2-inch foil-faced fiberglass, 1-1/2# density insulation.
- Where extreme conditions are anticipated, install a means of condensate disposal.

Vent System Support Requirements

- Support horizontal runs every 6 feet (1.8 meters).
- Support vertical runs—of Type B double-wall or Category III vent pipe—in accordance with the pipe manufacturer's requirements.
- Support single-wall pipe in accordance with accepted industry practice.

⚠ CAUTION ⚠

- **Do not rely on the heater to support either horizontal or vertical vent pipe.**
- **Use non-combustible supports on vent pipe.**

Vent Terminal (Type of Pipe and Vent Cap) Requirements

⚠ DANGER ⚠

- **To prevent combustion products from entering the occupied space, all vent terminations must be positioned or located away from fresh air intakes, doors, and windows. Failure to comply could result in severe personal injury or death and/or property damage.**
- **Consider local snow depth conditions. The vent must be at least 6 inches (152 mm) above the anticipated snow depth.**

⚠ WARNING ⚠

- **A different style vent cap could cause nuisance problems or unsafe conditions. The vent cap must be the same size as the vent pipe.**
- **Do not locate a vent termination where it may cause hazardous frost or ice accumulations on adjacent property surfaces.**

⚠ CAUTION ⚠

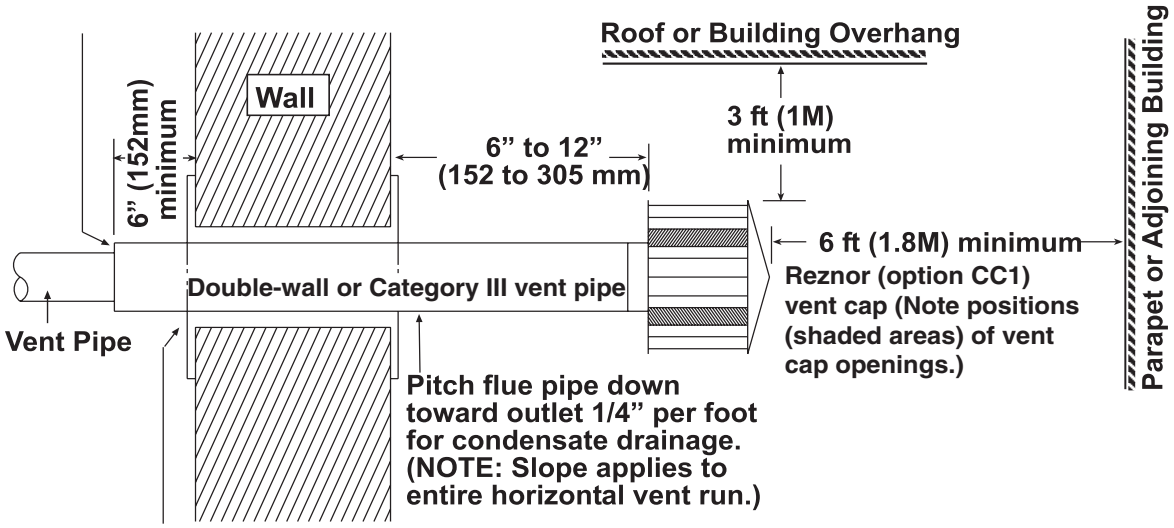
Maintain the required clearance from the wall to the vent terminal cap for stability under wind conditions and to protect the building.

NOTE: Products of combustion can cause discoloration of some building finishes and deterioration of masonry materials. Applying a clear silicone sealant that is normally used to protect concrete driveways can protect masonry materials. If discoloration is an esthetic problem, relocate the vent or install a vertical vent.

- The vent terminal pipe must be either Category III or double-wall (Type B).
- Terminate the vent pipe with an option CC1 vent cap that is the same diameter as the vent pipe.
- Install the horizontal vent terminal in accordance with **Figure 11**. Refer to **Table 11** for horizontal vent terminal clearance requirements.
- Install the vertical vent terminal in accordance with **Figure 12**.

Venting Connections—Continued

Vent Terminal (Type of Pipe and Vent Cap) Requirements—Continued



Approved clearance thimble is required when flue pipe extends through combustible materials. Follow the requirements of the thimble and/or the vent pipe manufacturer.

Figure 11. Horizontal Vent Terminal

Table 11. Minimum Clearance Requirements for Horizontal Vent Terminal

Component/Structure	Minimum Clearance, All Directions Unless Specified (Feet (Meters))
Forced air inlet within 10 feet (3.1 meters)*	3 (0.9) above
Combustion air inlet of another appliance	6 (1.8)
Mechanical air supply inlet to any building	Canada: 6 (1.8)
Any building opening (door, window, or gravity air inlet)	4 (1.2) horizontal and below
	1 (0.3) above
Gas meter,** electric meter, and relief equipment	US: 4 (1.2) horizontal
	Canada: 6 (1.8) horizontal
Gas regulator**	US: 3 (0.9) horizontal
	Canada: 6 (1.8) horizontal
Adjoining building or parapet	6 (1.8)
Adjacent public walkway	7 (2.1) above
Grade (ground level)	3 (0.9) above
*Does not apply to the inlet of a direct vent appliance.	
**Do not terminate the vent directly above a gas meter or service regulator.	

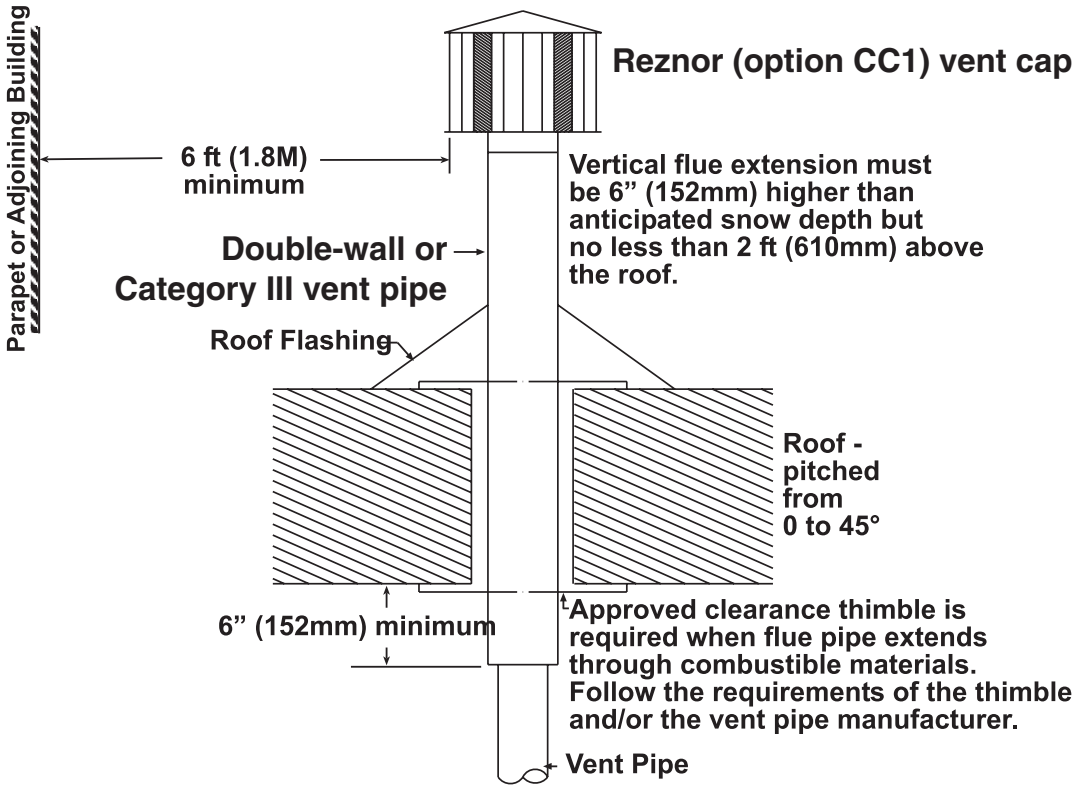


Figure 12. Vertical Vent Terminal

Electrical Connections

⚠ CAUTION ⚠

- **Route wires so that they do not contact the flue wrapper or venter housing.**
- **If any of the original wire supplied with the appliance must be replaced, it must be replaced with wiring material having a temperature rating of at least 105°C except for limit control, high limit control, and sensor lead wires, which must be rated at 150°C.**

NOTE: Ensure that all wiring is in accordance with the wiring diagram provided with the unit.

- All electrical wiring and connections, including electrical grounding MUST be made in accordance with the National Electric Code ANSI/NFPA No. 70 (latest edition). In addition, the installer should be aware of any local ordinances or gas company requirements that might apply.
- Check the rating plate on the heater for the supply voltage and current requirements. A dedicated line voltage supply with a disconnect switch should be run directly from the main electrical panel to the heater.
- All external wiring must be within approved conduit and have a minimum temperature rise rating of 60°C. Conduit must be run so as not to interfere with the heater access panel.
- Use #18 gauge wire for all wiring on the heater.
- Line and fan motor branch wire sizes should be of a size to prevent voltage drops beyond 5% of supply line voltage.
- The control transformer has a dual voltage primary. For 230V heaters, the black lead goes to the 240 terminal. Cap the 208 terminal. For 208V heaters, the black lead goes to the 208 terminal. Cap the 240 terminal.
- When providing or replacing fuses in the fusible disconnect switch, use dual elements time delay fuses and size according to 1.25 times the maximum total input amps.
- The line side of the lockable disconnect switch must be connected to the incoming power supply such that the voltage between terminal L1 and ground is the greater value.

Electrical Connections—Continued

Disconnect Switch Wiring

The heater is equipped with a built-in, non-fusible, lockable disconnect switch (see **Figure 13**). If a fusible disconnect is required, it must be field-supplied. The built-in disconnect switch requires copper wiring with ampacity based on 60°C maximum temperature rating at the line side terminals. The supply wiring enters above and connects directly to the disconnect switch.

Figure 13. Built-In Disconnect Switch

Circuit Board Wiring

The circuit board (see **Figure 14**) is located in the control compartment of each heat section. The circuit board is polarity sensitive. It is advisable to check the electrical supply ensure that the black wire is the ***hot*** wire and that the white wire is the ***neutral*** wire. The ***hot*** wire must be connected to terminal L1 on the circuit board.

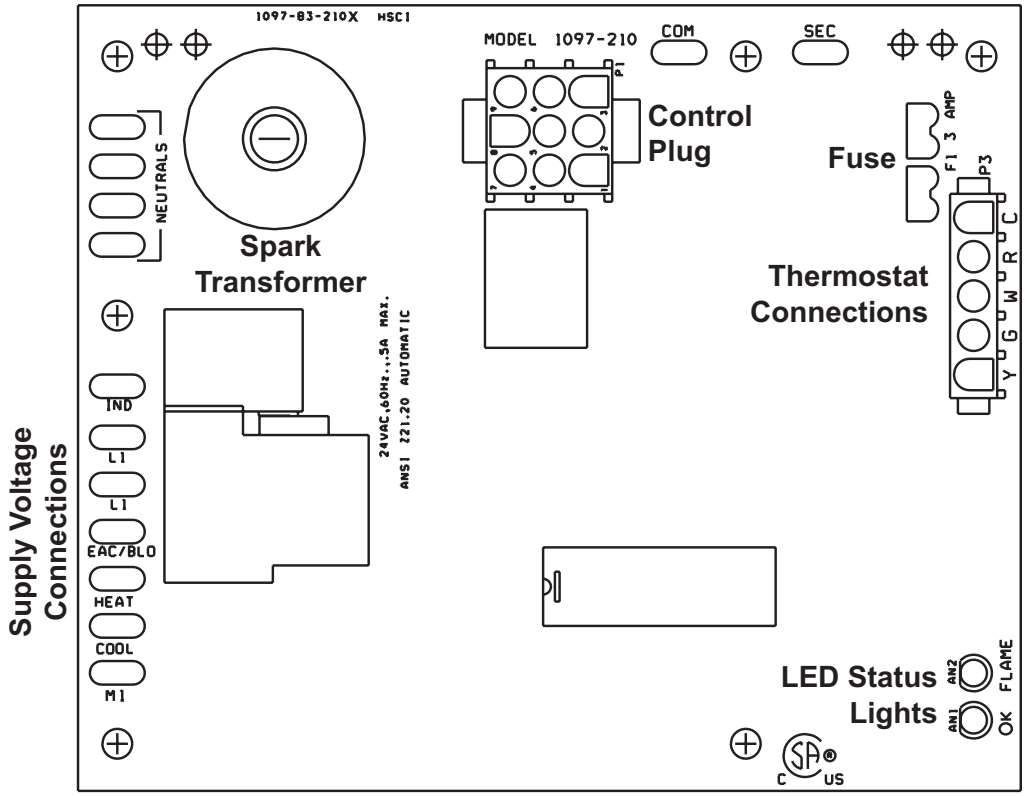


Figure 14. Circuit Board (DSI Control Module)

Fan Motor Wiring

Fan motor wires are color-coded as follows:

- White = neutral
- Black = high (heat speed)
- Blue = medium (destratification speed, factory-wired)
- Red = low (optional destratification speed, field-wired)

Thermostat Wiring

- Each heat section in the heater has a terminal strip for 24V thermostat connections. The terminal strip is located on the outside of the cabinet at the front of each heat section. Wires from the terminal strip(s) are factory wired to the circuit board(s).
- Use either an optional thermostat available with the heater or a field-supplied 24V thermostat. Install according to the thermostat manufacturer's instructions, paying particular attention to the requirements regarding the location of the thermostat.
- Make thermostat connections at the terminal strip on the front of the heater. The strip has seven terminals, R, G, C, Y1, Y2, W1, and W2. Refer to the wiring diagram on the heater.
- Refer to **Table 12** for field-supplied control wiring sizes.

Table 12. Field-Supplied Control Wiring Sizes

Distance from Unit to Control (Feet (Meters))	Minimum Recommended Wire Gauge (AWG)	Total Wire Length (Feet (Meters))
75 (23)	#18	150 (46)
125 (38)	#16	250 (76)
175 (53)	#14	350 (107)

Optional Discharge Air Connections

NOTES:

- **After the unit is suspended/mounted, install the air directional louvers or optional nozzle.**
- **Each option package includes illustrated installation instructions.**

All Model LDAP heaters have discharge louvers but are available with additional louvers and/or nozzle discharge air options. Optional louver and discharge nozzles are shipped separately for field installation. Heat sections on unit sizes 800 and 1200 have independent airflow and do not require the same discharge options.

Four-Way Discharge Louvers (Option CD32)

⚠ CAUTION ⚠

To avoid getting burned, adjust louvers while heater is not operating. If adjusting louvers while heater is operating, wear gloves.

Option CD32 consists of additional louvers that are installed perpendicular to the standard individually-adjustable louvers. By installing the optional perpendicular louvers, the two sets of louvers can be adjusted to direct airflow in any of the four directions, enabling the installer to select and increase or decrease the coverage area.

Discharge Nozzles (Options CD57, CD58, and CD59)

A discharge nozzle may be installed at each discharge air opening in any direction. The following options are available:

- **Option CD57:** 30-degree discharge nozzle
- **Option CD58:** 60-degree discharge nozzle
- **Option CD59:** 30-degree discharge nozzle with four-way louvers

NOTE: Do not install four-way louvers with a 60-degree nozzle.

NOTE: Refer to the TROUBLESHOOTING section for probable causes and reset instructions for the following controls.

Locations for the following controls are shown in **Figure 15**.

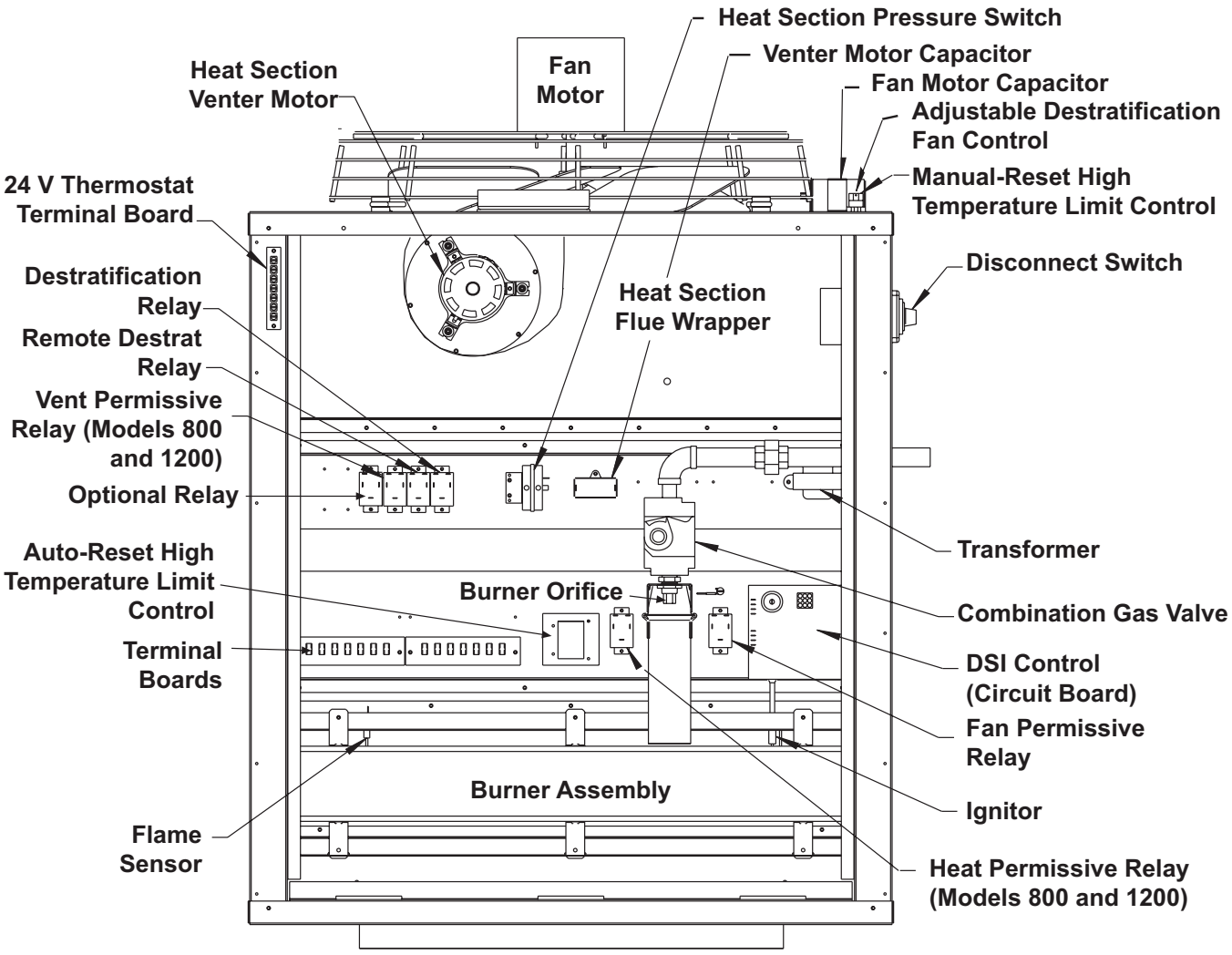


Figure 15. Component Locations (Typical)

Pressure Switches

⚠ DANGER ⚠

Safe operation of this unit requires proper venting flow. NEVER bypass the pressure switch or attempt to operate the unit without the venter running and the proper flow in the vent system. Hazardous conditions could result.

- The heat section (combustion air proving) pressure switch (see **Figure 15** for location) is a pressure-sensitive switch that monitors air pressure to ensure that proper combustion airflow is available. The switch is a single-pole/normally-open device that closes when a differential pressure is sensed between the venter housing and the flue collection box. Each section in the heater has a pressure switch. In addition, heaters with more than one heat section (unit sizes 800 and 1200) have a flue collection box section pressure switch that senses the negative pressure in the main venter housing.

- At startup when the heater is cold, the sensing pressure is at the most negative level, and as the heater and flue system warm up, the sensing pressure becomes less negative. After the system has reached equilibrium (about 20 minutes), the sensing pressure levels off.
- If a restriction or excessive flue length or turns cause the sensing pressure to be outside the switch's setpoint, the pressure switch will function to shut off the burner. If the flue collection box section pressure switch opens, it will interrupt the electric supply to all gas valves. If a heat section pressure switch opens, it will interrupt the electric supply to the gas valve in that heat section. The burner(s) will remain off until the system has cooled and/or the flue system resistance is reduced.
- **Table 13** lists the approximate water column differential pressure settings of the heat section pressure switch(es) and the negative pressure readings of the flue collection box section pressure switch.

Table 13. Pressure Switch Settings

Heat Section Pressure Switches						
Unit Size	Elevation (Feet (Meters))	Differential Pressure (IN WC)				Label Color
		Startup Cold	Equilibrium Hot	Setpoint OFF	Setpoint ON	
400	≤6000 (≤1830)	1.80 to 1.50	1.05 to 0.85	0.65	0.83	Yellow
	>6000 (>1830)	1.75 to 1.45	1.00 to 0.80	0.60	0.78	Light blue
800	≤6000 (≤1830)	1.90 to 1.60	1.10 to 0.90	0.65	0.83	Yellow
	>6000 (>1830)	1.85 to 1.55	1.05 to 0.85	0.60	0.78	Light blue
1200	≤6000 (≤1830)	2.40 to 1.90	1.55 to 1.00	0.65	0.83	Yellow
	>6000 (>1830)	2.35 to 1.85	1.50 to 0.95	0.60	0.78	Light blue
Flue Collection Box Section Pressure Switch						
Unit Size	Elevation (Feet (Meters))	Negative Pressure (IN WC)				Label Color
		Startup Cold	Equilibrium Hot	Setpoint OFF	Setpoint ON	
400	≤6000 (≤1830)	—				
	>6000 (>1830)					
800	≤6000 (≤1830)	–1.30 to –1.00	–0.85 to –0.65	–0.15	–0.33	Gray
	>6000 (>1830)	–1.25 to –0.95	–0.80 to –0.60			
1200	≤6000 (≤1830)	–1.40 to –0.90	–0.97 to –0.59			
	>6000 (>1830)	–1.35 to –0.85	–0.92 to –0.54			

High Temperature Limit Controls

⚠ WARNING ⚠

The high temperature limit control will continue to shut down the heater until the cause is corrected. Never bypass this control as hazardous conditions could result.

All units are equipped with temperature-activated, high temperature limit controls that are factory-set and non-adjustable. If the setpoint is reached, the controls interrupt the electric supply to the gas valve. This safety device provides protection in the case of motor failure or lack of airflow due to a restriction at the inlet or outlet.

Automatic-Reset High Temperature Limit Control

The automatic-reset high temperature limit control (see **Figure 15** for location) provides protection in the case of motor failure or lack of airflow due to a restriction at the inlet or outlet.

Manual-Reset High Temperature Limit Control

⚠ WARNING ⚠

If the manual-reset high temperature limit control activates, identify and correct the cause before resetting the switch.

The high limit control is located at the top of each heat section (see **Figure 15** for location). If the setpoint is reached, the control interrupts the electric supply to the gas valve in that heat section. If the control activates, identify and correct the cause before resetting the switch (refer to **TROUBLESHOOTING** section).

Combination Gas Valve

⚠ WARNING ⚠

The combination gas valve is the prime safety shutoff. All gas supply lines must be free of dirt or scale before connecting the unit to ensure positive closure.

Each heat section in the heater has a combination gas valve (see **Figure 15** for location): unit size 400 has one, unit size 800 has two, and unit size 1200 has three. The gas valve is powered by the 24V control circuit through the thermostat and safety controls. The diaphragm-type valve is pre-set at the factory and provides regulated gas flow.

Fan Motor

Each heat section in the heater has a fan motor (see **Figure 15** for location): unit size 400 has one, unit size 800 has two, and unit size 1200 has three. The fan motor is equipped with automatic-reset thermal overload protection. If the motor does not run, the cause may be due to improper current. Ensure that the correct voltage is available at the motor.

Thermostat

⚠ CAUTION ⚠

IMPORTANT: all units MUST be operated by a 24V thermostat. Never use a line voltage disconnect switch as a means of operating the heater. Operating by means other than a 24-volt thermostat may result in the high limit control tripping and may cause damage to the heater from excessive heat.

For all availaible thermostat and thermostat accessory options, contact contact an authorized Factory Distributor.

Multiple Heater Control (Options CL31 and CL32)

- If the heater was ordered with a relay kit (option CL31 or CL32) for multiple heater control option, one thermostat can be used to control multiple heaters. For unit size 400, up to six heaters can be connected. For unit size 800, three, and for unit size 1200, two. The relay kit is installed on the control heater and on up to five additional heaters.
- The kit includes a 40VA transformer that replaces the standard transformer in the control heater and a relay assembly that connects to the non-control heater. Option CL31 provides for control of two heaters. If control of additional heaters is desired, option CL32—the relay assembly only—must be installed on each non-control heater.
- The option kits are shipped separately and include complete instructions for installation and wiring.

Circuit Board (DSI Control Module)

Each heat section's ignition system is controlled by a circuit board (Direct-Spark Integrated (DSI) control module, see **Figure 14**) that monitors the safety devices and controls the operation of the fan and venter motors and the gas valve between heat cycles. Troubleshooting the heater using the circuit board's LEDs is described in the **Unit Troubleshooting Using DSI Control Module** section.

Air Destratification Fan Control

- An adjustable fan control is located on top of the first heat section. It is adjacent to the circulating air fan and motor and controls the fan motors in all heat sections. The purpose of the fan control is to energize the fan motor(s) when the ambient air temperature around the heater reaches the setting on the control. The fan motor(s) will be de-energized when the fan control is satisfied. The fan(s) recirculates the heated air near the ceiling down to the floor level (destratification) and improves heat recovery. A call for heat by the thermostat overrides the air destratification fan control.
- Set the adjustable fan control for the desired temperature setting for energizing the circulating air fan(s). The fan control setting should be set 5 to 10°F higher than the wall-mounted thermostat setting. The heater is factory-wired to energize the fan(s) at medium speed when energized by the adjustable fan control. For lower mounting heights it may be desirable to operate the fan(s) at low speed. Switching the blue (medium speed) and red (low speed) fan motor wires on each heat section will change the fan motor(s) speed. Refer to the wiring diagram for the wire locations.

- To manually override the fan control, the heater may be tuned off at the circuit breaker in the main electrical panel or a field-installed electrical box with a SPST switch can be located near the wall thermostat with the switch wired in series with the fan control.

NOTE: The air destratification fan control feature can be a benefit in summertime to improve working conditions by alleviating stagnant air conditions and creating a cooling effect for occupants.

OPERATION

⚠ DANGER ⚠

- **For your safety, read before operating. If you do not follow these instructions exactly, a fire or explosion may result, causing property damage, personal injury, or loss of life.**
- **This appliance does not have a pilot. It is equipped with an ignition device that automatically lights the burner(s). Do not try to light the burner(s) by hand.**
- **Before operating, smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.**
- **WHAT TO DO IF YOU SMELL GAS:**
  - **Do not try to light any appliance.**
  - **Do not touch any electrical switch; do not use any phone in your building.**
  - **Leave the building immediately.**
  - **Immediately call your gas supplier from a phone remote from the building. Follow the gas supplier's instructions.**
  - **If you cannot reach your gas supplier, call your fire department.**
- **Use only your hand to turn the gas control ON/OFF knob on the gas valve. Never use tools. If the valve ON/OFF knob will not turn by hand, do not try to repair it. Call a qualified service technician. Force or attempted repair may result in a fire or explosion.**
- **Should overheating occur, or the gas supply control system fail to shut off the flow of gas, turn off the manual gas valve to the appliance before shutting off the electrical supply.**
- **Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.**
- **All components of a gas supply system must be leak tested prior to placing equipment in service. NEVER TEST FOR LEAKS WITH AN OPEN FLAME. Failure to comply could result in personal injury, property damage, or death.**

Pre-Startup Checklist

Check the following ***before*** startup:

- ❑ Check to ensure that all screws used to secure shipping brackets have been re-installed in heater cabinet
- ❑ Check suspension—unit must be secure and level
- ❑ Check to ensure that clearances from combustibles are in accordance with **Table 3**
- ❑ Check vent system to ensure that it is installed in accordance with **Venting Connections** section
- ❑ Check piping for leaks and proper gas line pressure and bleed trapped air from gas lines (refer to **Supply Piping Connections** section)
- ❑ Check electrical wiring—ensure that all wire gauges are as recommended—verify that fusing or circuit breakers are adequate for load use
- ❑ Check polarity—verify that line voltage exists between black L1 wire and earth ground
- ❑ If installation elevation is >6,000 feet (>1,830 meters), replace pressure switch in accordance with **Pressure Switch Replacement** section

Startup

Startup the heater as follows:

1. Set thermostat at lowest setting.
2. Turn OFF all electric power to appliance.

NOTE: This appliance is equipped with an ignition device that automatically lights the burner. Do not try to light the burner by hand.

3. Open access door and locate gas control (ON/OFF) knob or switch on gas valve (see **Figure 16**).

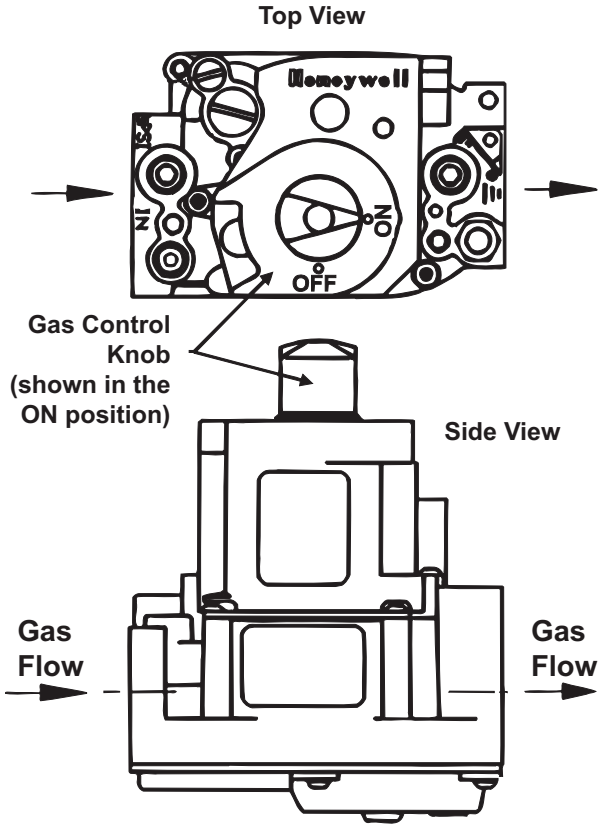


Figure 16. Gas Valve ON/OFF Control

4. Turn gas control switch to OFF or turn knob clockwise to OFF.
5. Wait 5 minutes to clear out any gas and then smell for gas (including near floor).
   a. If you smell gas, STOP! and follow steps in DANGER message listed above or on heater operating label.
   b. If you do not smell gas, proceed to step 6.
6. Turn gas control knob(s) counterclockwise to ON.
7. Close access door.
8. Turn ON electric power to heater.
9. Set thermostat to desired setting.
   a. If heater does not operate, follow instructions in step 13 or on heater operating label and call your service technician.
   b. If heater operates, thermostat calls for heat, which energizes venter motor.
10. Pressure switches close, which fires unit.
11. Burner flame is sensed and in 30 seconds after gas valve is energized, fan motor(s) is energized.

12. If flame is extinguished during main burner operation, integrated control system closes main valve and must be reset by interrupting power to control circuit (refer to lighting instructions provided with heater).
13. TO TURN OFF GAS TO APPLIANCE:
    a. Set thermostat to lowest setting.
    b. If service is to be performed, turn OFF all electric power to appliance.
    c. Open the access door.
    d. Turn gas control knob(s) clockwise to OFF (do not force).
    e. Close access door.

Operating Sequences

Table 14 describes the heater's normal operating sequence. **Table 15** describes the heater's abnormal heat cycle functions. **Table 16** describes the heater's fault modes. Refer to **Table 20** for circuit board LED indications.

Table 14. Operating Sequence (Normal Heat Cycle)

Step	Condition	Action
1. Call for heat	Terminal W is energized	Thermostat calls for heat by energizing terminal W
		Control determines whether limit switch is open or closed and if heat section and flue collection box section (unit sizes 800 and 1200) pressure switches are open
	Auto-reset or manual-reset high temperature limit switch is open	Control proceeds as specified in **Table 15**: abnormal function ***Limit Switch Operation***
	Heat section or flue collection box section pressure switch is closed	Green LED on circuit board flashes four times
		Control waits indefinitely for pressure switches to open
	Pressure switches are open	Control proceeds to step 2
2. Prepurge	Heat section and main venter motors are energized	Control waits for heat section and flue collection box section (unit sizes 800 and 1200) pressure switches to close
	Either pressure switch not closed within 30 seconds of venter motors energizing	Green LED on circuit board flashes two times
		Control maintains venter motor(s) energized indefinitely as long as call for heat remains and either pressure switch is open
	Pressure switch(s) proven closed	Control begins prepurge
	Flame is present at any time during prepurge	Prepurge is restarted
	Flame is present long enough to cause lockout	If flame is sensed longer than 20 seconds while gas valve is de-energized, control energizes heat section venter motor, main venter motor, and fan motor on heat speed
		When flame is no longer sensed, venter motors run through post-purge and fan motor runs through selected delay OFF time
		Control proceeds to soft lockout but still responds to open limit and flame
		Yellow LED on circuit board flashes rapidly when lockout is due to undesired flame
	Venter motors runs for 20-second prepurge time	Control proceeds to step 3
3. Ignition trial period	Spark and main gas valve are energized	The venter remains energized
	Flame is sensed during first 16 seconds	Control de-energizes spark and proceeds to heat fan ON delay
	Flame is not sensed during first 16 seconds	Control de-energizes spark and maintains gas valve energized for additional 1-second flame-proving period
	Flame is not present after flame-proving period	Control de-energizes gas valve and proceeds with ignition retries as specified in **Table 15**: abnormal function ***Ignition Retry***
	Flame is present after flame-proving period	Control proceeds to step 4
4. Fan ON delay	30 seconds after gas valve has opened	Control energizes fan motor
	Gas valve and venter motors remain energized	Control proceeds to step 5
5. Steady heat	High temperature limit switches are closed	Control continuously monitors inputs
	Pressure switches are closed	
	Flame is established	
	Thermostat call for heat remains	
	Thermostat call for heat is removed	Control de-energizes gas valve and proceeds to steps 6 and 7
6. Post-purge	Thermostat is satisfied	Venter motor remains on for 45-second post-purge period
7. Fan OFF delay		Fan motor is de-energized after selected fan OFF delay

Operating Sequences—Continued

Table 15. Operating Sequence (Abnormal Heat Cycle)

Abnormal Function	Condition	Action
Interrupted thermostat call for heat	Thermostat demand for heat is removed before flame is recognized	Control runs heat section and main venter motors for post-purge period
		All outputs are deenergized
	Thermostat demand for heat is removed after successful ignition	Control de-energizes gas valve
		Control runs venter motors through post-purge period
		Control runs fan motor on heat speed for selected delay OFF time
Ignition retry	Flame is not established on first trial for ignition period	Control de-energizes gas valve
		Venter motors remain energized for 10-second inter-purge period
		Spark and gas valve are re-energized
		Control initiates another trial for ignition
	Flame is not established on second trial for ignition	Control de-energizes gas valve and runs fan motor on heat speed
		Venter motors remain energized
		Fan motor deenergizes after 120 seconds and spark and gas valve are re-energized
		Control initiates another trial for ignition (this fan delay is self-healing feature for open auxiliary limit switch)
	Flame is not established on third trial for ignition	Control de-energizes gas valve
		Venter motors remain energized for 10-second inter-purge period
		Spark and gas valve are re-energized
		Control initiates another trial for ignition
	Flame is not established on fourth trial for ignition (initial try plus three re-tries)	Control de-energizes gas valve and proceeds to lockout
		Green LED on circuit board flashes once to indicate ignition failure lockout
Limit switch operation*	Auto-reset and manual-reset high temperature limit switches are open and call for heat is present	Control de-energizes gas valve
		Control energizes venter motors and fan motor on heat speed
	Limit switches re-close or call for heat is not present	Control runs venter motors through post-purge period
		Control runs fan motor on heat speed through selected delay OFF period before returning to normal operation
Pressure switch operation	Heat section or flue collection box section pressure switch opens before trial for ignition period	Venter motors run through 2-second pressure switch recognition delay
		Control de-energizes gas valve
		Control runs venter motors through post-purge period
		Control restarts heat cycle at pressure switch proving state if call for heat still exists
	Either pressure switch opens for less than 2 seconds during trial for ignition period (shall not interrupt heat cycle)	Control de-energizes gas valve while pressure switches are open
	Either pressure switch opens after successful ignition	Control de-energizes gas valve
	Flame is lost before end of 2-second pressure switch recognition delay	Control responds to loss of flame
	Pressure switch(s) remains open for 2 seconds and flame remains	Control deenergizes gas valve
		Control runs venter motors through post-purge period
		Control runs fan motor on heat speed through selected delay OFF period
		When fan OFF delay ends, fan motor is de-energized and heat cycle begins if call for heat still exists
Continuous fan operation	Thermostat calls for continuous fan (G) without call for heat	Fan motor is energized after 0.25-second delay (this brief ON delay allows terminal G to energize slightly before terminal Y and allows external changeover relay to switch from terminal G to terminal W without causing momentary glitches in fan output
		Fan remains energized as long as call for fan remains without call for heat
	Thermostat calls for heat (W) during continuous fan operation	Fan is de-energized
		Call for fan is ignored during lockout

*The limit switch is ignored unless a call for heat is present (terminal W energized).

Table 16. Fault Modes		
Fault Mode	**Condition**	**Action**
Undesired flame	Flame is sensed longer than 20 seconds while gas valve is deenergized	Control runs heat section and main venter motors and fan motor on heat speed
		When flame is no longer sensed, venter motors run through post-purge and fan motor runs through selected delay OFF time
		Control proceeds to soft lockout but still responds to open limit and flame
		Yellow LED on circuit board flashes rapidly when lockout is due to undesired flame
Gas valve relay fault	Control senses that gas valve is energized for more than 1 second when control is not attempting to energize gas valve or control senses that gas valve is not energized when it is supposed to be energized	Control proceeds to lockout (green LED on circuit board is extinguished)
		Control assumes either that contacts of relay driving gas valve have welded shut or that sensing circuit has failed
		Heat section venter motor is forced OFF to open heat section pressure switch to stop gas flow unless flame is present
	Control senses that gas valve is closed when it should be open (has not de-energized after venter motors have been shut off for 15 seconds	Venter motors are re-energized to vent unburned gas
Soft lockout	Control does not initiate call for heat or call for continuous fan operation while in lockout	Control still responds to open limit and undesired flame
		Lockout is automatically reset after 1 hour
		Lockout may be manually reset by removing power from control for more than 1 second or by removing thermostat call for heat for more than 1 but less than 20 seconds
Hard lockout	Control detects fault on control board	Green LED on circuit board is extinguished
		Control remains in lockout as long as fault remains
		Hard lockout automatically resets when hardware fault clears
Power interruption	Momentary interruption or voltage level is below minimum operating voltage (line voltage or low voltage)	System self-recovers without lockout when voltage returns to operating range
	Interruption <80 milliseconds	Control does not change operating state
	Interruption >80 milliseconds	Control may interrupt current operating cycle to restart
	Interruption during heat cycle	Manual-reset high temperature limit switch may trip

Vent System Testing

For each heater connected to the venting system and placed in operation while any other appliance(s) connected to the venting system(s) is not in operation, test the vent system as follows:

1. Seal unused openings(s) in vent system.
2. Inspect vent system for proper size and horizontal pitch as required in National Flue Gas Code (ANSI Z223.1/ NFPA 54) and in **Venting Connections** section.
3. Verify that there is no blockage or restriction, leakage, corrosion, and/or other deficiencies that could cause any unsafe condition.
4. In so far as is practical, close all doors, windows, and other open spaces within building and all doors between space in which appliance(s) is connected and space where vent system is located.
5. Close any fireplace dampers.
6. Turn on clothes dryers and any exhaust fans (such as range hoods and bathroom exhausts) so that they operate at maximum speed. Do not operate a summer exhaust fan.
7. Following lighting instructions provided with heater, place heater being inspected in operation. Adjust thermostat so that heater will operate continuously.
8. After it has been determined that each heater connected to vent system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers, and any other gas-burning appliance to their previous condition of use.
9. If improper venting is observed during above tests, vent system must be corrected.

Post-Startup Checklist

Check the following ***after*** startup:

- ❑ Ensure that vent system has been tested in accordance with **Vent System Testing** section
- ❑ With unit in operation, measure manifold (outlet) gas pressure in accordance with **Measure and Adjust Manifold (Outlet) Gas Pressure** section
- ❑ Turn unit OFF and ON, pausing 2 minutes between each cycle; observe for smooth ignition
- ❑ Place literature bag that contains Limited Warranty, this manual, and any control or optional information in accessible location near heater

⚠ DANGER ⚠

- **The gas burner in this gas-fired equipment is designed and equipped to provide safe controlled *complete combustion*. However, *if the installation* does not permit the burner to receive the proper supply of combustion air, complete combustion may not occur. The result is *incomplete combustion*, which produces carbon monoxide, a poisonous gas that can cause death. *Safe operation of indirect-fired gas burning equipment requires a properly operating vent system that vents all flue products to the outside atmosphere*. FAILURE TO PROVIDE PROPER VENTING WILL RESULT IN A HEALTH HAZARD THAT COULD CAUSE SERIOUS PERSONAL INJURY OR DEATH.**
- **Always comply with the combustion air requirements listed in the installation codes and in this manual. Combustion air at the burner should be regulated only by manufacturer-provided equipment. NEVER RESTRICT OR OTHERWISE ALTER THE SUPPLY OF COMBUSTION AIR TO ANY HEATER. Heaters installed in a confined space must be supplied with air for combustion as required by code and the requirements listed in this manual. MAINTAIN THE VENT SYSTEM IN STRUCTURALLY SOUND AND PROPER OPERATING CONDITION.**

ADJUSTMENTS

After startup, the gas valve outlet pressure must be measured and adjusted if necessary in accordance with the **Measure and Adjust Manifold (Outlet) Gas Pressure** section. If the heater is being installed at an elevation of >6,000 feet (>1,830 meters), the pressure switch must be replaced in accordance with the **Pressure Switch Replacement** section before the gas pressure is adjusted.

Pressure Switch Replacement

For installations at elevations >6,000 feet (>1,830 meters), the heat section pressure switch(es) (see **Figure 17**) must always be replaced before the heater is operated. If ordered with the unit as option DJ20, the switch is shipped separately for field-installation. Replace the pressure switch as follows:

1. Locate pressure switch in heat section (see **Figure 15**) and mark and disconnect two switch wires.
2. Mark and disconnect sensing tube(s) from pressure switch.
3. Remove two screws that secure mounting bracket and remove bracket and pressure switch. Save bracket and screws for reuse.
4. Install replacement pressure switch (refer to replacement parts manual listed in **Table 1** for PN) using mounting bracket and two screws. Reconnect sensing tube(s) and wires.

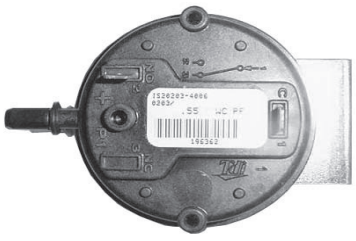


Figure 17. Pressure Switch

NOTE: For unit sizes 800 and 1200, be sure to replace the pressure switch in each heat section but do not replace the flue connection box pressure switch—it is the same for all elevations.

Measure and Adjust Manifold (Outlet) Gas Pressure

If the heater is being installed at an elevation ≤2,000 feet (≤610 meters), adjust the manifold (outlet) gas pressure in accordance with the **Measure and Adjust Manifold Gas Pressure—Elevation ≤2,000 Feet (≤610 Meters)** section. If the heater is being installed at an elevation >2,000 feet (>610 meters), adjust the manifold (outlet) gas pressure in accordance with the **Measure and Adjust Manifold Gas Pressure—Elevation >2,000 Feet (>610 Meters)** section.

⚠ WARNING ⚠

Valve outlet gas pressure must never exceed 3.5 IN WC for natural gas or 10 IN WC for propane. The maximum inlet supply pressure for natural gas or propane is 14 IN WC. Maximum gas pressure can never be exceeded either during operation or when unit is static (with lock-up regulator).

⚠ CAUTION ⚠

Before attempting to measure or adjust valve outlet gas pressure, the inlet supply pressure must be within the specified range, both when the heater is in operation and when it is on standby. Incorrect inlet pressure could cause excessive valve outlet gas pressure immediately or at some future time. If natural gas supply pressure is too high, install a regulator in the supply line before it reaches the heater. If natural gas supply pressure is too low, contact your gas supplier.

NOTES:

- **Measuring outlet pressure cannot be done until the heater is in operation.**
- **During normal operation at sea level, adjustment to factory-setting should not be necessary.**
- **Unit size 400 has one gas valve, unit size 800 has two gas valves, and unit size 1200 has three gas valves. Adjust both/all gas valves on unit sizes 800 and 1200.**
- **For natural gas: when the heater leaves the factory, the combination gas valve is set so that the valve outlet gas pressure for a single-stage valve or high fire of a two-stage valve is regulated to 3.5 IN WC. Low fire on a two-stage valve (unit size 400 only) is set to 1.8 IN WC. Inlet supply pressure to the valve for natural gas must be a minimum of 5 IN WC or as noted on the rating plate and a maximum of 14 IN WC.**
- **For propane: when the heater leaves the factory, the combination gas valve is set so that the valve outlet gas pressure for a single-stage valve or high fire of a two-stage valve is regulated to 10 IN WC. Low fire on a two-stage valve (unit size 400 only) is set to 5.0 IN WC. Inlet supply pressure to the valve for propane must be a minimum of 11 IN WC and a maximum of 14 IN WC.**
- **Gas conversion kits are available for changing from propane to natural gas or natural gas to propane. A factory-authorized conversion kit MUST be used.**

Measure and Adjust Manifold Gas Pressure—Elevation ≤2,000 Feet (≤610 Meters)

For installations at normal elevations, measure and adjust the manifold (outlet) gas pressure as follows:

1. Turn knob or switch on top of valve to OFF to prevent flow to gas valve.

NOTE: A manometer (fluid-filled gauge) is recommended rather than a spring-type gauge due to the difficulty of maintaining the calibration of a spring-type gauge. Use a water column manometer that is readable to the nearest tenth of an inch.

2. Connect manometer to 1/8-inch output pressure tap on valve (see **Figure 18**).
3. Open manual valve and operate heater.
4. Observe manometer gauge to measure outlet pressure of gas valve. To measure low-stage pressure on unit size 400 equipped with two-stage valve, disconnect wire from the HI terminal on valve. Be sure to reconnect wire.

Measure and Adjust Manifold (Outlet) Gas Pressure—Continued

Measure and Adjust Manifold Gas Pressure—Elevation ≤2,000 Feet (≤610 Meters)—Continued

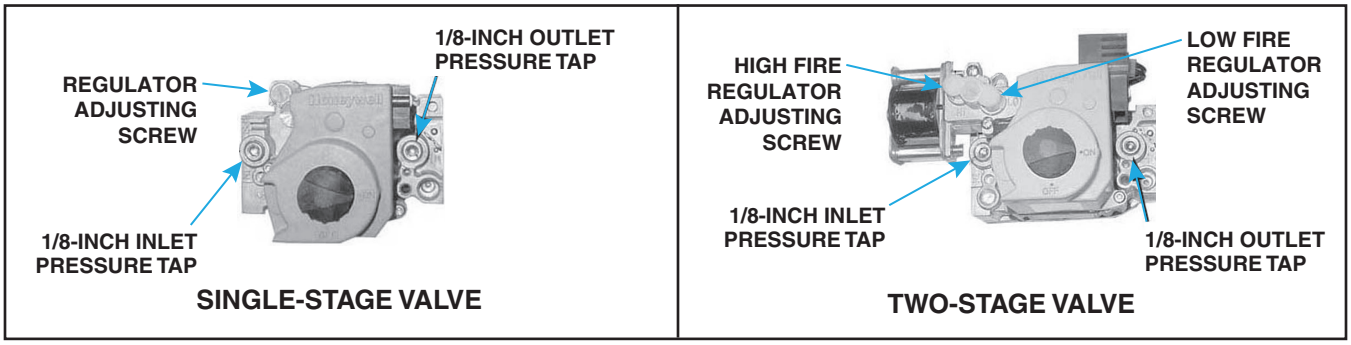


Figure 18. Gas Valves

⚠ CAUTION ⚠

DO NOT bottom out the gas valve regulator screw. This can result in excessive overfire and heat exchanger failure due to unregulated manifold pressure.

5. If manometer reading does not indicate that valve outlet pressure is in accordance with **Table 17**, remove cap from regulator screw(s) (see **Figure 18**) and adjust pressure by turning regulator screw IN (clockwise) to increase pressure or OUT (counterclockwise) to decrease pressure.
6. When manometer reading indicates that outlet pressure is in accordance with **Table 17**, disconnect manometer and install cap(s) on regulator screw(s).

Table 17. Required Manifold (Outlet) Gas Pressure

Elevation		Single-Stage and Two-Stage High-Fire		Two-Stage Low-Fire	
Feet	Meters	Natural Gas	Propane	Natural Gas	Propane
		Manifold Pressure (IN WC)			
US					
0–2000	0–610	3.5	10.0	1.8	5.6
2001–3000	611–915	3.1	8.8	1.6	5.0
3001–4000	916–1220	3.0	8.5	1.5	4.8
4001- 5000	1221–1525	2.8	8.1	1.5	4.6
5001–6000	1526–1830	2.7	7.7	1.4	4.4
6001–7000	1831–2135	2.6	7.4	1.3	4.2
7001–8000	2136–2440	2.5	7.1	1.3	4.0
8001–9000	2441–2745	2.4	6.7	1.2	3.8
9001–10,000	2746–3045	2.4	6.7	1.3	3.6

Measure and Adjust Manifold Gas Pressure—Elevation >2,000 Feet (>610 Meters)

For installations at high elevations, measure and adjust the manifold (outlet) gas pressure as follows:

1. If installation is at elevation >6,000 feet (1,830 meters), replace pressure switch in accordance with **Pressure Switch Replacement** section.

⚠ WARNING ⚠

Manifold gas pressure must never exceed 3.5 IN WC for natural gas or 10 IN WC for propane.

2. Determine correct outlet pressure (refer to **Table 17**) for elevation of installation. If unsure of elevation, contact local gas supplier.
3. Turn knob or switch on top of valve to OFF to prevent flow to gas valve.

NOTE: A manometer (fluid-filled gauge) is recommended rather than a spring-type gauge due to the difficulty of maintaining the calibration of a spring-type gauge. Use a water column manometer that is readable to the nearest tenth of an inch.

4. Connect manometer to 1/8-inch output pressure tap on valve (see **Figure 18**).

⚠ CAUTION ⚠

DO NOT bottom out the gas valve regulator screw. This can result in excessive overfire and heat exchanger failure due to unregulated manifold pressure.

5. For single-stage or two-stage high fire valve:
   a. Turn knob or switch on top of valve to ON.
   b. Remove cap from regulator screw (see **Figure 18**) and adjust pressure in accordance with **Table 17** by turning regulator screw IN (clockwise) to increase pressure or OUT (counterclockwise) to decrease pressure.
6. For two-stage low fire valve:
   a. Disconnect wire from HI terminal on gas valve.
   b. Remove cap from low-fire regulator screw (see **Figure 18**) and adjust pressure in accordance with **Table 17** by turning regulator screw IN (clockwise) to increase pressure or OUT (counterclockwise) to decrease pressure.
   c. Reconnect wire to Hi terminal on gas valve.
7. Turn up thermostat.
8. Cycle burner once or twice to properly seat adjustment spring in valve and recheck outlet pressure. When pressure corresponds to **Table 17**, disconnect manometer and install cap on regulator screw.
9. Check for leakage at 1/8-inch outlet pressure tap fitting. Correct as necessary.
10. Connect manometer to inlet pressure tap (see **Figure 18**). While heater is operating, measure inlet pressure, which should be between 5 and 13.5 IN WC for natural gas or between 10 and 13.5 IN WC for propane.
11. If inlet pressure is not between 5 and 13.5 IN WC for natural gas or between 10 and 13.5 IN WC for propane, inlet pressure must be corrected by adjusting manifold (outlet) pressure in accordance with steps 3 through 6.

NOTE: The inputs and capacity of the heater varies depending on elevation.

12. Refer to **Table 18** for input and capacity values for elevation of installation.
    a. Use permanent marker to fill in appropriate input and capacity values on high-elevation adjustment label from literature bag provided with unit.
    b. Select location for label on outside of heater access panel that will be conspicuous to anyone operating or servicing unit.
    c. Ensure that surface is clean and dry and affix label.
13. Observe heater operation for at least one complete cycle to check for safe and proper operation.

ADJUSTMENTS—CONTINUED

Measure and Adjust Manifold (Outlet) Gas Pressure—Continued

Measure and Adjust Manifold Gas Pressure—Elevation >2,000 Feet (>610 Meters)—Continued

Table 18. Inputs and Capacities by Elevation in US

Elevation (Feet (Meters))	Unit Size								
	400			800			1200		
	Normal Input	Thermal Output Capacity	Minimum Input	Normal Input	Thermal Output Capacity	Minimum Input	Normal Input	Thermal Output Capacity	Minimum Input
	BTUh								
0–2000 (0–610)	400,000	332,000	300,000	800,000	664,000	400,000	1,200,000	996,000	400,000
2001–3000 (611–915)	376,000	312,080	282,000	752,000	624,160	376,000	1,128,000	936,240	376,000
3001–4000 (916–1220)	368,000	305,440	276,000	736,000	610,880	368,000	1,104,000	916,320	368,000
4001–5000 (1221–1525)	360,000	298,800	270,000	720,000	597,600	360,000	1,080,000	896,400	360,000
5001–6000 (1526–1830)	352,000	292,160	264,000	704,000	584,320	352,000	1,056,000	876,480	352,000
6001–7000 (1831–2135)	344,000	285,520	258,000	688,000	571,040	344,000	1,032,000	856,560	344,000
7001–8000 (2136–2440)	336,000	278,880	252,000	672,000	557,760	336,000	1,008,000	836,640	336,000
8001–9000 (2441–2745)	328,000	272,240	246,000	656,000	544,480	328,000	984,000	816,720	328,000
9001–10,000 (2746–3045)	320,000	265,600	240,000	640,000	531,200	320,000	960,000	796,800	320,000

MAINTENANCE

The unit is designed to operate with a minimum of maintenance. However, to ensure long life and satisfactory performance, routine service is recommended. When servicing, follow standard safety procedures and those specific instructions and warnings in this manual.

⚠ DANGER ⚠

- **If you turn OFF the electrical power supply, turn OFF the gas.**
- **To prevent injury or death due to electrocution or contact with moving parts, lock disconnect switch open.**

⚠ WARNING ⚠

- **Eye protection is recommended when cleaning unit.**
- **When any service is completed, ensure that the unit is reassembled correctly so that no unsafe conditions are created.**
- **When re-lighting, always follow the lighting instructions on the heater.**

⚠ CAUTION ⚠

- **If any of the original wire supplied with the appliance must be replaced, it must be replaced with wiring material having a temperature rating of at least 105°C, except for limit control, flame rollout, and sensor lead wires which must be rated at 150°C.**
- **If replacement parts are required, use only factory-authorized parts.**

NOTE: To ensure long life and satisfactory performance, a heater that is operated under normal conditions should be inspected and cleaned at the start of each heating season. If the heater is operating in an area where an unusual amount of dust or soot or other impurities are present in the air, more frequent maintenance is recommended.

Service Checklist

The following section is designed to aid a qualified service person in maintaining and servicing this equipment. At a minimum, perform the following annually (see **Figure 15** for component locations):

- ❑ Inspect burner/control compartment annually to determine if cleaning is necessary
- ❑ Clean all dirt, lint, and grease from combustion air openings and venter assembly
- ❑ Clean all dirt, lint, and grease from fan blade, fan guard, and motor
- ❑ Check heat exchanger both internally and externally
- ❑ Check burner for scale, dust, or lint accumulation and clean if needed
- ❑ Check gas valve to ensure that gas flow is being shut off completely
- ❑ Check vent system for soundness and clean openings
- ❑ Replace any parts that do not appear sound
- ❑ Check for any damaged wiring and replace as necessary

Maintenance Procedures

Burner Maintenance

NOTE: Each heat section is equipped with a TCORE^{2}® burner.

Visually inspect each burner assembly (see **Figure 15**) compartment. If there is an accumulation of dirt, dust, and/or lint, clean the compartment and remove and clean the burner as follows:

1. **Remove gas and electric supply:**
   a. Shut OFF gas supply ahead of union at manual shutoff valve outside cabinet.
   b. Turn OFF electric supply.
   c. Disconnect gas supply at union outside of cabinet.

⚠ WARNING ⚠

Use of eye protectection is recommended.

2. **Remove burner assembly:**
   a. Remove access panel.
   b. Detach gas train:
      (1) Mark and disconnect wires at combination gas valve.
      (2) Disconnect union on one or both sides of gas line inside of heater.
      (3) Carefully remove burner orifice and orifice adapter locking nut.
      (4) Slide orifice adapter out through bracket on burner and move gas train out of way.
   c. Locate three upper burner body supports. At each support, remove one screw that secures support to burner shield.
   d. While holding venturi tube, slide entire burner assembly slightly upward to disengage burner from supports on bottom.
   e. Rotate open end of venturi tube outward toward access door opening and carefully pull burner assembly out of cabinet.

Maintenance Procedures—Continued

Burner Maintenance—Continued

3. Inspect and clean burner:

NOTE: If, upon inspection, any of the burner components are damaged or deteriorated, replace the burner assembly.

a. With burner assembly removed, shine flashlight on burner ribbons. Look for carbon buildup, scale, dust, lint, and/or anything that might restrict flow through spaces between burner ribbons.

b. While holding burner assembly so that any foreign material will fall away from burner, use stiff bristle brush to loosen and remove any foreign material(s).

c. If burner is excessively dirty, remove one burner end cap:

(1) Remove four screws that secure end cap to burner housing.

(2) Lightly tap end cap to remove it.

d. Clean all foreign material from burner and venturi.

e. When burner is thoroughly clean, replace end cap, ensuring that it is tight against burner housing.

4. Inspect lower part of heat exchanger:

a. With burner assembly removed, shine bright light into each heat exchanger section at burner flame entrance of each tube.

b. With light shining into heat exchanger, observe outside for visible light. Repeat for each heat exchanger section.

c. If any light is observed, replace heat exchanger.

5. Re-install burner assembly:

a. Attach burner assembly:

(1) While holding venturi tube, slide entire burner assembly into position.

(2) Align supports on bottom with slots in burner shield and slide supports into slots.

(3) On top, install screw that secures each burner body support to burner shield.

b. Attach gas train:

(1) Slide gas train into position so that orifice adapter is slid through bracket on burner.

(2) Secure gas train to bracket using locking nut.

(3) Install gas orifice and reconnect wires to gas valve.

(4) Reconnect union(s) inside of control compartment.

c. Install access panel.

d. Reconnect gas supply at union outside of cabinet.

e. Leak test connection using leak detecting solution. If leak is detected, tighten connection. If leak cannot be stopped by tightening connection, replace part(s).

6. Turn ON electric and gas.

7. Check for proper operation.

Burner Orifice Maintenance

The burner orifice usually needs to be replaced only when installing a gas conversion kit. When ordering a replacement orifice only, provide BTUh content and specific gravity of gas as well as the model and serial number of the unit. When removing or replacing the burner orifice, use two wrenches and take care not to damage the venturi tube and/or the bracket.

Heat Exchanger Maintenance

NOTES:

- **Each heat section is equipped with a TCORE^2® heat exchanger.**
- **Inspection of the lower portion of the heat exchanger is done with the burner removed. Refer to the Burner Maintenance section for information on inspecting the lower portion of the heat exchanger.**

1. Remove burner in accordance with **Burner Maintenance** section.
2. Remove any external dirt or dust accumulation.
3. Visually inspect heat exchanger for cracks and holes.
4. If crack or hole is found, replace heat exchanger.
5. Install burner in accordance with **Burner Maintenance** section.

Ignition System Maintenance

NOTE: Each heat section is equipped with a DSI control module.

- The DSI control module (circuit board, see **Figure 14**) monitors the operation of the heater including ignition. The only replaceable component is the 3-amp Type ATC or ATO fuse (color code: violet, PN 201685). If the fuse is blown, the problem is most likely an external overload. Correct the problem and replace the fuse.
- Do not attempt to disassemble the control module. However, check the lead wires each heating season for insulation deterioration and good connections.
- For the flame sensor (see **Figure 15** for location), disconnect the wire and remove the screw and the flame sensor. Clean flame sensor with an emery cloth before reinstalling.
- Proper operation of the direct spark ignition system requires a minimum flame signal of 1.0 microamps as measured by a microampmeter.

⚠ WARNING ⚠

- **Due to high voltage on the spark wire and electrode, do not touch when energized.**
- **IMPORTANT: When re-assembling, the brown ground wire must remain attached to the ignitor.**

- For the ignitor (see **Figure 15** for location), disconnect the wire and remove the screw and ignitor. Clean the ignitor assembly with an emery cloth before reinstalling. The spark gap (see **Figure 19**) must be maintained to 1/8 inch.

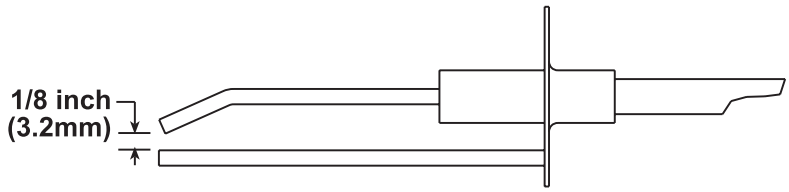


Figure 19. Ignitor Spark Gap

Maintenance of Fan Motor, Fan Blades, and Fan Guard

NOTE: Each heat section is equipped with a fan assembly.

Inspect and clean the motor, fan guard, and blades. Remove any dirt and grease. Take care when cleaning the fan blades so as prevent causing misalignment or imbalance. Check to ensure that the hub of the fan blades is secure to the shaft. If necessary, replace the assembly as follows:

1. If heater has been installed, turn OFF gas and disconnect electric power.
2. Remove access panel and disconnect fan motor wires, capacitor wires at capacitor, and ground screw.
3. Remove assembled parts (fan guard, motor, and fan blade).
4. Disassemble and replace part(s) as needed.

Maintenance Procedures—Continued

Maintenance of Fan Motor, Fan Blades, and Fan Guard—Continued

5. Reassemble using replacement part(s) as needed and original parts.
6. Ensure that fan blade is in proper position on shaft (see **Figure 20**).

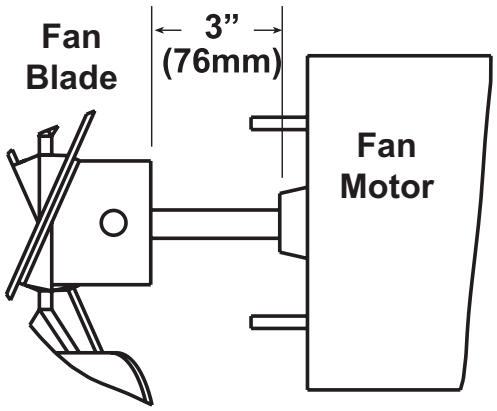


Figure 20. Fan Blade Positioning and Spacing

7. Position assembly on heater and attach fan guard.
8. Rotate fan blade to check for adequate clearance. If adjustment is required, loosen mounting screws, reposition fan guard, and tighten screws. Repeat until assembly is positioned properly.
9. Reconnect fan motor wires in accordance with wiring diagram.
10. Install access panel.
11. Restore electric power to heater and turn ON gas.
12. Follow instructions on lighting instruction plate to light heater.
13. Check for proper heater operation.

Combination Gas Valve Maintenance

⚠ WARNING ⚠

The combination gas valve is the prime safety shutoff. All gas supply lines must be free of dirt or scale before connecting to the unit to ensure positive closure.

NOTE: Each heat section is equipped with a combination gas valve.

Inspect the combination gas valve, carefully remove any external dirt accumulation, and check wiring connections. Check the valve annually to ensure that the valve is shutting off gas flow completely as follows:

1. Turn manual shutoff valve OFF to prevent flow to gas valve.

NOTE: A manometer (fluid-filled gauge) is recommended rather than a spring-type gauge due to the difficulty of maintaining the calibration of a spring-type gauge. Use a water column manometer that is readable to the nearest tenth of an inch.

2. Connect manometer to 1/8-inch output pressure tap on valve (see **Figure 18**).
3. Turn manual valve ON and heater OFF.
4. Use finger to fully block main burner orifice for several seconds.
5. Observe manometer with orifice blocked. If ***any*** pressure is indicated, gas valve is leaking.
6. Replace leaking gas valve before heater is restored to operation.

Maintenance Procedures—Continued

Venter Motor and Wheel Assembly Maintenance

NOTES:

- **Venter motor bearings are permanently lubricated.**
- **Keep all hardware removed to be used in reassembling and installing the replacement parts.**
- **Each heat section is equipped with a venter motor and wheel assembly.**
- **One venter motor and wheel assembly is located in the flue collection box section on unit sizes 800 and 1200.**

Remove dirt and grease from the motor casing, venter housing, and venter wheel. Replace the venter motor and wheel assembly as follows:

1. Turn OFF gas and disconnect electric power.
2. For heat section venter, remove burner/control compartment access panel.
3. Disconnect three venter motor wires at DSI control, capacitor wires at capacitor, and ground screw (located on control panel).
4. While holding venter motor, remove six screws that secure venter motor mounting plate to venter housing. Remove motor and wheel assembly from heater.
5. Reassemble with replacement venter motor and wheel assembly (see **Figure 21**, DETAIL A for heat section venter or **Figure 21**, DETAIL B for flue collection box section venter.
6. For flue collection box section venter motor and wheel assembly:
   a. Do not use key provided with motor.
   b. Locate setscrew on wheel approximately 180° from keyway in motor.
   c. Torque setscrew to 125 (±5) inch-pounds.
7. Reconnect venter wires in accordance with wiring diagram.
8. Install access panel.
9. Restore electric power to heater and turn ON gas.
10. Follow instructions on lighting instruction plate to light heater.
11. Check for proper heater operation.

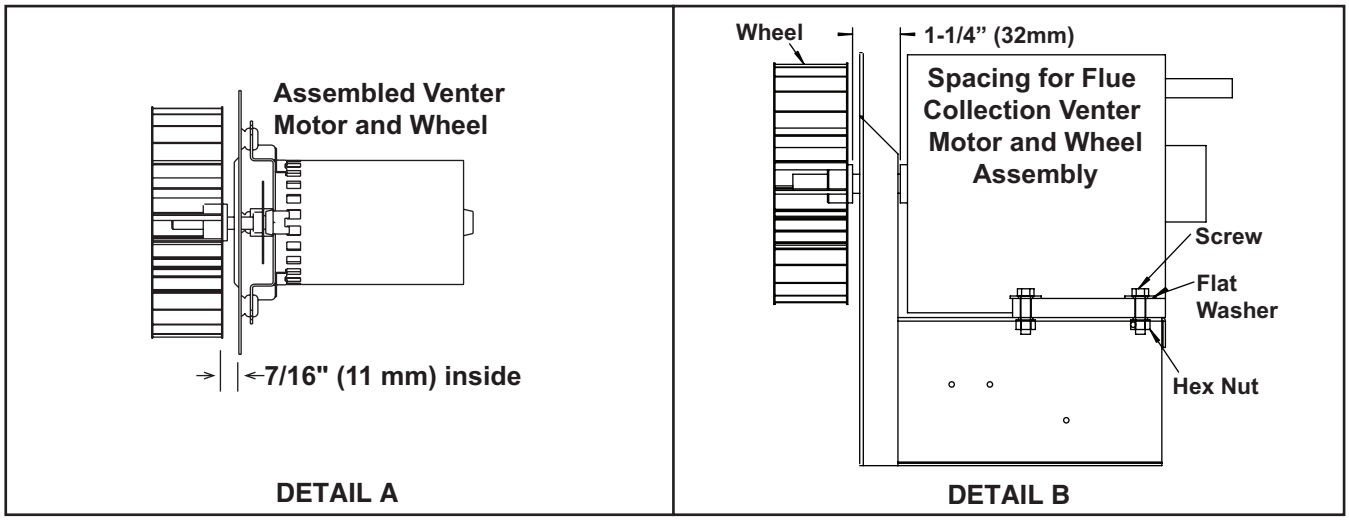


Figure 21. Venter Motor and Wheel Assemblies

Maintenance Procedures—Continued

Pressure Switch Maintenance

If it is determined that the pressure switch (see **Figure 17**) needs replacing, use only the factory-authorized replacement part that is designed for the model and size of heater being serviced. Replace the switch in accordance with the **Pressure Switch Replacement** section. For pressure switch locations, see **Figure 15**.

NOTE: A unit operating above 6,000 feet (1,830 meters) in elevation requires a high-elevation pressure switch (refer to Pressure Switch Replacement section).

High Temperature Limit Control Maintenance

⚠ CAUTION ⚠

Do not reset the manual-reset high temperature limit control without correcting the problem.

If it is determined that either high temperature limit control (see **Figure 22**) needs replacing, use only a factory-authorized replacement part that is designed for the size of heater. For limit control locations, see **Figure 15**.

AUTO-RESET HIGH TEMPERATURE LIMIT CONTROL

MANUAL-RESET HIGH TEMPERATURE LIMIT CONTROL

TRANSFORMER

FAN CONTROL

Figure 22. Replaceable Components

Transformer Maintenance

Use a voltmeter to verify 24V output from the transformer (see **Figure 22**). If the transformer is not functioning, it must be replaced. Use a replacement transformer identical to the factory-installed model. For the transformer location, see **Figure 15**.

Fan Control Maintenance

Check the wiring connections and the adjustment knob. If it is determined that the adjustable destratification fan control (see **Figure 22**) needs replacing, use only a factory-authorized replacement part that is designed for the heater. For the fan control location, see **Figure 15**.

Vent System Maintenance

Check the complete vent system at least once a year. Inspection should include all joints, seams, and the vent terminal cap. Clean all openings and replace any defective parts.

TROUBLESHOOTING

General Troubleshooting

Refer to **Table 19** for general troubleshooting symptoms, probable causes, and remedies.

Table 19. General Troubleshooting		
Symptom	**Probable Cause**	**Remedy**
Venter motor will not start	1. No power to unit	Turn ON power and check supply fuses or circuit breaker
	2. No 24V power to integrated circuit board	Turn up thermostat
		Check control transformer output
	3. Integrated circuit board fuse blown	Correct cause and replace fuse (3A, type ATC or ATO, 32VDC)
	4. No power to venter motor	Tighten connections at circuit board and/or motor terminals
	5. Integrated circuit board defective	Replace integrated circuit board
	6. Defective venter motor	Replace venter motor (refer to **Venter Motor and Wheel Assembly Maintenance** section)
Burner will not light	1. Manual valve not open	Open manual valve
	2. Air in the gas line	Bleed gas line (initial startup only)
	3. Gas pressure too high or too low	Supply pressure should be 5–14 IN WC for natural gas or 11–14 IN WC for propane
	4. No spark	Perform following:
	a. Loose wire connections	Ensure that all wire connections are solid
	b. Transformer failure	Ensure that 24V power is available
	c. Incorrect spark gap	Maintain spark gap at 1/8 inch
	d. Spark cable shorted to ground	Replace worn or grounded spark cable
	e. Spark electrode shorted to ground	Replace ceramic spark electrode if it is cracked or grounded
	f. Burner not grounded	Ensure that integrated circuit board is grounded to ignitor
	g. Circuit board not grounded	Ensure that integrated circuit board is grounded to furnace chassis
	h. Unit not properly grounded	Ensure that unit is properly field grounded to earth ground and properly phased (L1 to hot lead L2 to neutral)
	i. Integrated circuit board fuse blown	Correct cause and replace fuse (3A, type ATC or ATO, 32VDC)
	j. Faulty integrated circuit board	If 24V power is available to integrated circuit board and all other causes have been eliminated, replace board
	5. Lockout device interrupting control circuit by above causes	Reset lockout by interrupting control at thermostat or main power
	6. Heat section pressure switch(es) not closing	Perform following:
		Ensure that unit is properly vented
		Remove obstruction(s) from vent
		Replace faulty tubing to pressure switch
	7. Faulty heat section pressure switch	Replace pressure switch
	8. Main valve not operating	Perform following:
	a) Defective valve	If 24V power is measured at valve connections and valve remains closed, replace valve
	b) Loose wire connections	Check and tighten all wiring connections
	9. Integrated circuit board does not power main valve	Perform following:
	a) Loose wire connections	Ensure that all wire connections are solid
	b) Flame sensor grounded	Ensure that flame sensor lead is not grounded or that sensor insulation or ceramic is not cracked—replace as required
	c) Incorrect gas pressure	Supply pressure should be 5–14 IN WC for natural gas or 11–14 IN WC for propane
	d) Cracked ceramic at sensor	Replace sensor
Burner cycles ON and OFF	1. Gas pressure too high or too low	Supply pressure should be 5–14 IN WC for natural gas or 11–14 IN WC for propane
	2. Burner not grounded	Ensure that integrated circuit board is grounded to ignitor
	3. Circuit board not grounded	Ensure that integrated circuit board is grounded to furnace chassis
	4. Faulty integrated circuit board	If 24V power is available to integrated circuit board and all other causes have been eliminated, replace board
	5. Heat section pressure switch(es) not closing	Perform following:
		Ensure that unit is properly vented
		Remove obstruction(s) from vent
		Replace faulty tubing to pressure switch
	6. Faulty heat section pressure switch	Replace pressure switch
	7. Flame sensor grounded	Ensure that flame sensor lead is not grounded or that sensor insulation or ceramic is not cracked—replace as required
	8. Cracked ceramic at sensor	Replace sensor
	9. Incorrect polarity	Reverse line volt leads to integrated circuit board

General Troubleshooting—Continued

Table 19. General Troubleshooting—Continued

Symptom	Probable Cause	Remedy
No heat (heater operating)	1. Incorrect valve outlet pressure or orifice	Check valve outlet pressure (refer to unit rating plate for manifold pressure)
	2. Cycling on limit control	Check air throughput
	3. Improper thermostat location or adjustment	Refer to thermostat manufacturer's instructions
Fan or venter motor will not run	1. Circuit open	Check wiring and connections
	2. Defective integrated circuit board	Replace board
	3. Defective motor	Replace motor
Fan or venter motor turns ON and OFF while burner is operating	1. Motor overload device cycling ON and OFF	Check motor load against motor rating plate—replace motor if needed
Fan or venter motor cuts out on overload	1. Low or high voltage supply	Correct electric supply
	2. Defective motor	Replace motor
	3. Poor airflow	Clean motor, fan, fan guard, filter, and coils
	4. Defective bearing or lubrication	Lubricate bearings (motor permitting) or replace motor

Unit Troubleshooting Using DSI Control Module

The DSI control module (refer to **Circuit Board (DSI Control Module)** section) may be used to troubleshoot the unit. The control module monitors monitors the operation of the heater and includes two indicator LEDs (green indicates control status, yellow indicates flame status) that indicate normal operation and various abnormal conditions (refer to **Table 20**). If the heater fails to operate properly, check the LEDs to determine the cause and/or to eliminate certain causes. See **Figure 23** for a flowchart for troubleshooting the unit using the DSI control module.

NOTES:

- **If troubleshooting indicates that repair of the DSI control module is required, note that its only replaceable part is the fuse (see Figure 14), which is a type ATC or ATO 3A fuse, color code violet (PN 201685).**
- **IMPORTANT: When using a multimeter to troubleshoot the 24V circuit, place the multimeter's test leads into the 5- or 9-pin connectors located on the ignition control. Do not remove connectors or terminals from the electrical components. Doing so can result in misinterpreted readings caused by the control module's fault mode monitoring circuits.**

Table 20. Circuit Board (DSI Control Module) Display Codes

LED	Status	Indication
Green	Steady ON	Normal operation—no call for heat
	Fast flash	Normal operation—call for heat
	One flash	System lockout—failed to detect or sustain flame
	Two flashes	Heat section or flue collection box section pressure switch does not close within 30 seconds of venter being energized
	Three flashes	Auto-reset or manual-reset high temperature limit switch is open
	Four flashes	Heat section or flue collection box section pressure switch is closed before venter is energized
	Steady OFF	Blown fuse, no power, or defective board
Yellow	Steady ON	Flame is sensed
	Slow flash	Weak flame—current below 1.0 microamps ±50%
	Fast flash	Undesired flame—valve open and no call for heat

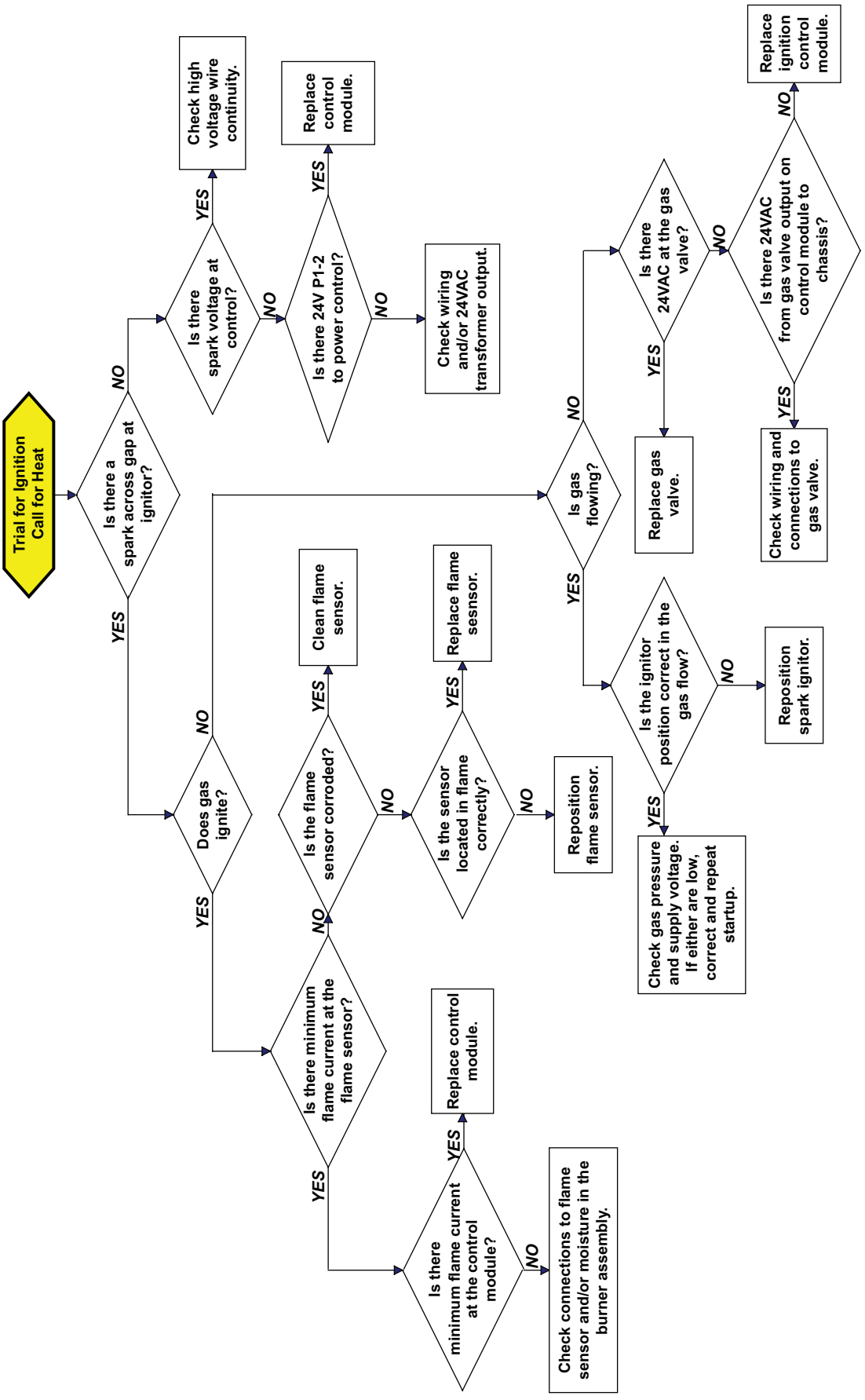


Figure 23. DSI Control Module Troubleshooting Flowchart

INSTALLATION RECORD (TO BE COMPLETED BY INSTALLER)

Installer:

Name _____

Company _____

Address _____

_____

Phone _____

Distributor (company from which the unit was purchased):

Company _____

Contact _____

Address _____

_____

Phone _____

Model _____ **Serial No.** _____ **Date of Installation** _____

Specific installation notes (i.e., location, amps, gas pressure, temperature, voltage, adjustments, warranty, etc.):

_____

_____

_____

BUILDING OWNER OR MAINTENANCE PERSONNEL:

For service or repair:

Contact the Installer listed above.

If you need additional assistance, contact the Distributor listed above.

For more information, contact your Factory Representative.

LDAP-IOM (01-22) 207733-A