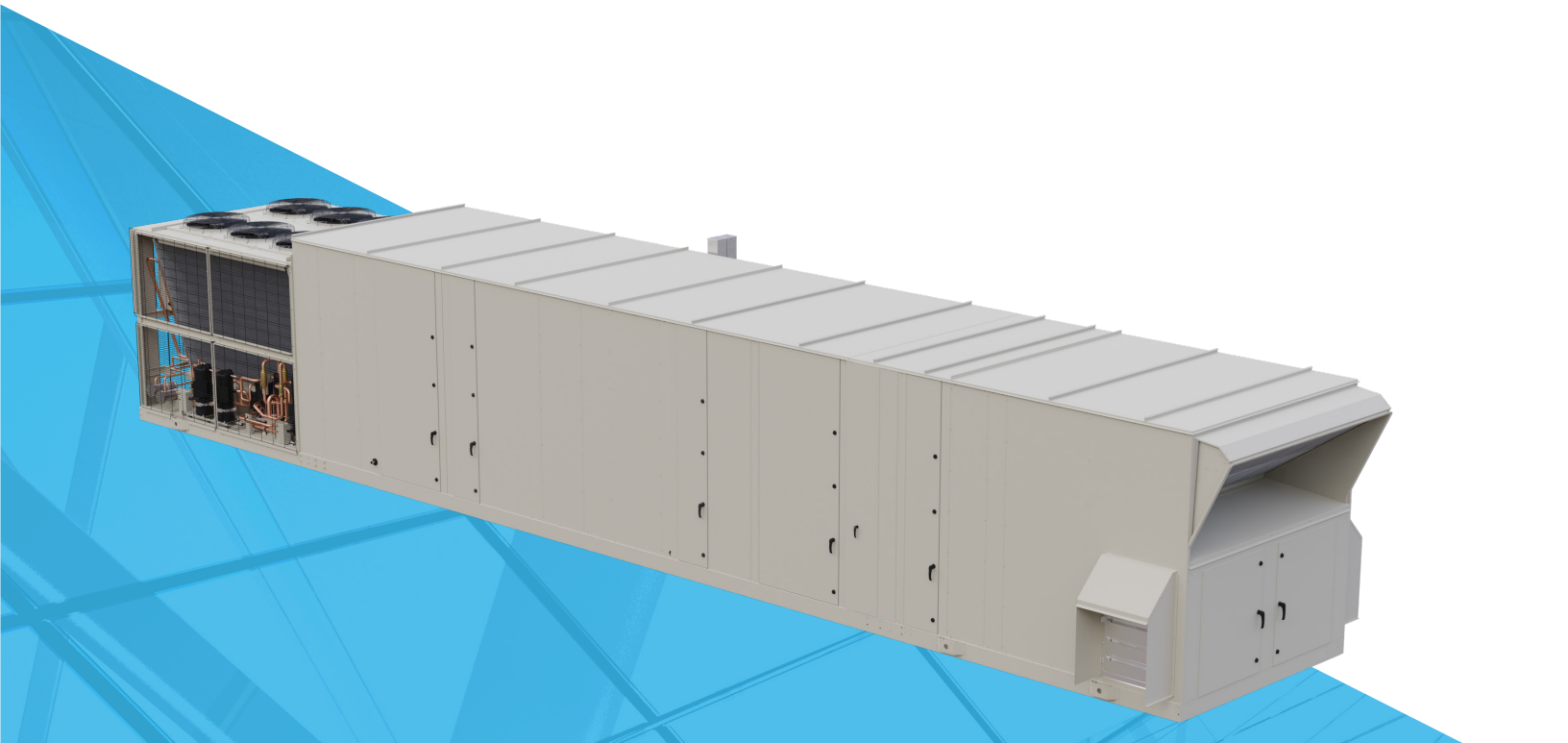
INSTALLATION & MAINTENANCE MANUAL

IM 684-8

JUNE 2025

REBEL APPLIED® PACKAGED ROOFTOP FORCED DRAFT FURNACE

DRUM AND TUBE STYLE



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Safety Information

Hazard Identification

⚠ DANGER

Danger indicates a hazardous situation, which will result in death or serious injury if not avoided.

⚠ WARNING

Warning indicates a potentially hazardous situations, which can result in property damage, personal injury, or death if not avoided.

⚠ CAUTION

Caution indicates a potentially hazardous situations, which can result in minor injury or equipment damage if not avoided.

NOTICE

Notice indicates practices not related to physical injury.

NOTE: Indicates important details or clarifying statements for information presented in Figures or Tables.

This manual provides installation, operation, and maintenance information for Daikin Applied Drum and Tube style gas furnace systems with a MicroTech® controller.

NOTICE

Installation and maintenance are to be performed only by licensed, if required by local codes and regulations, or qualified personnel who are familiar with local codes and regulations and are experienced with this type of equipment.

⚠ DANGER

LOCKOUT/TAGOUT all power sources prior to service, pressurizing, de-pressuring, or powering down the unit. Failure to follow this warning exactly can result in serious injury or death. Disconnect electrical power before servicing the equipment. More than one disconnect may be required to denergize the unit. Be sure to read and understand the installation, operation, and service instructions within this manual.

⚠ WARNING

Electric shock hazard. Improper handling of this equipment can cause personal injury or equipment damage. This equipment must be properly electrically grounded in accordance with local codes or, in the absence of local codes, with the National Electrical Code, ANSI/NFPA 70, and/or the Canadian Electrical Code, CSA C22.1, if an external electrical source is utilized. Connections to and service of the MicroTech control panel must be performed only by personnel that are knowledgeable in the operation of the equipment being controlled.

⚠ WARNING

FIRE OR EXPLOSION HAZARD!

Failure to follow safety warnings exactly could result in serious injury, death, or property damage.

Be sure to read and understand the installation, operation, and service in this manual.

Improper installation, adjustment, alteration, service, or maintenance can cause serious injury, death, or property damage.

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

— WHAT TO DO IF YOU SMELL GAS:

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

— Installation and service must be performed by a qualified installer, service agency, or the gas supplier.

⚠ AVERTISSEMENT

RISQUE D´INCENDIE OU D´EXPLOSION!

Le non respect des mises en garde pourrait entraîner des blessures graves, la mort, ou des pertes matérielles.

Prende soin de lire et de comprendre les instructions d´installation, de fonctionnement, et d´entretien contenues dans ce guide.

Une installation, un réglage, une modification, une réparation, ou un entretien inapproprié peut entraîner des blessures graves, la mort, ou des pertes matérielles.

— Ne pas entreposer ni utiliser d´essence ou autre vapeurs ou liquides inflammables à proximeté de cet appareil ou de tout autre appareil.

— QUE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAZ:

- Ne tentez pas d´allumer un appareil.
- Ne touchez pas à un interrupteur; n´utilisez pas de téléphone dans l´édifice où vous vous trovez.
- Sortez de l´édifice immédiatement.
- Appelez immédiatement le fournisseur de gaz à partir d´un téléphone a l´extérieur de l´édifice. Suivez les instructions du fournisseur de gaz.
- Si vous ne pouvez joindre le fournisseur de gaz, appelez les pompiers.

— L´installation et les réparations doivent être confiées, à un installateur qualifié, ou au fournisseur de gaz.

⚠ CAUTION

Static sensitive components. A static discharge while handling electronic circuit boards can cause damage to the components. Discharge any static electrical charge by touching the bare metal inside the control panel before performing any service work. Never unplug any cables, circuit board terminal blocks, or power plugs while power is applied to the panel.

Introduction

When writing to Daikin Applied for service or replacement parts, refer to the model number of the unit as stamped on the serial plate, attached to the unit. If there is an in-warranty failure, state the date of installation of the unit and the date of failure along with an explanation of the malfunctions and the description of the replacement parts required.

General

⚠ WARNING

Units equipped with gas heating must not be operated in an atmosphere contaminated with chemicals which will corrode the unit such as halogenated hydrocarbons, chlorine, cleaning solvents, refrigerants, swimming pool exhaust, etc. Exposure to these compounds may cause severe damage to the gas furnace and result in improper or dangerous operation. Operation of the gas furnace in such a contaminated atmosphere constitutes product abuse and will void all warranty coverage by the manufacturer. Questions regarding specific contaminants should be referred to your local gas utility.

This forced draft gas burner is specifically designed for use with the furnace on Daikin Applied rooftop heating and air conditioning units which are for outdoor installation only. Each model size has unique burner head components to tailor the shape of the flame to each particular stainless steel combustion chamber, to match the capacity requirement, and to offer a desirable turndown potential when arranged for modulation. This is a forced draft burner with a high pressure combustion air fan and will operate against pressure. This eliminates the need for draft inducers, chimneys, draft hoods, barometric dampers, and Breidert caps.

Warranty Exclusion

Warranty is void if the furnace is operated in the presence of chlorinated vapors, if the airflow through the furnace is not in accordance with rating plate, or if the wiring or controls have been modified or tampered with.

Ventilation & Flue Pipe Requirements

The Daikin Applied rooftop unit is equipped with an outdoor air louver to supply adequate combustion air. The unit also has a flue outlet assembly and requires no additional chimney, flue pipe, Breidert cap, draft inducer, etc. Outdoor air louver screens must be cleaned at least once per year.

Unit Location and Clearances

The following items cover location and clearances specific to the gas heat section of the unit. For additional information on unit location and clearances, see the unit installation manual supplied with your Rebel Applied rooftop system.

1. This unit must be installed and connected to a non-combustible duct and is not designed to have any portion of the heat exchanger exposed outside the cabinet in which this furnace module is housed.
2. A recommended service clearances label is attached to the unit. Following the clearance recommendations will ensure optimal access to service the gas heat system. In general, a minimum of 4 ft. is required in front of the door of the gas heat section to allow for door swing, piping, flue installation, and combustion makeup air.
3. Openings for combustion air are provided in a louvered panel on the front door of the gas heat vestibule. Cabinet location and orientation must provide for an adequate, unimpeded supply of fresh air.
4. Clearance from combustibles to be no less than as listed below:
    a. Furnace access side: 18 in. (457 mm)
    b. All other sides: 6 in. (152 mm)
    c. Flue to any combustible surface: 18 in. (457 mm)
5. Flue discharge should be at least 120 in. away from any opening or other equipment through which combustion products could enter an occupied building or space.

Factory Checkout

This complete furnace system was fired and tested at the factory. It was adjusted to the required capacity and efficiency. The modulating air damper, modulating gas valve, and pressure regulator were adjusted for proper operation. The unit was fired through several complete sequences of start-up through shutdown to check operation. A check was made of the air switch, gas pressure switches, and combustion characteristics including CO_2 and CO (at several firing rates on modulating burners).

Installation

General

The installation of this equipment must be in accordance with the regulations of authorities having jurisdiction and all applicable codes. It is the responsibility of the installer to determine and follow the applicable codes. Sheet metal parts, self-tapping screws, clips, and such items inherently have sharp edges, and it is necessary that the installer exercise caution. This equipment must be installed by an experienced professional installation company that employs fully trained and experienced technicians.

Table 1: Flue Height by Unit Model

Furnace Size (Input MBH)	Flue Height Over Cabinet (in)
800	9.0
1200	5.6
1600	5.6
2000	5.3
2400	5.3

A rating plate is attached to the unit and contains information, including:

- Designated gas type
- Maximum and minimum input rating
- Manifold pressure
- Maximum and minimum inlet gas pressure
- Maximum and minimum airflow requirements
- Output capacity
- Electrical ratings

The rating plate also contains the model and serial number of this product.

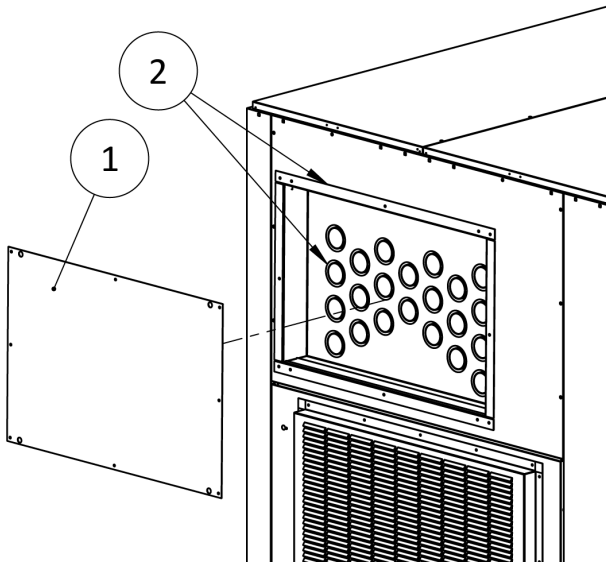
NOTE: Do not remove the rating plate.

Flue Box

The flue box is not installed at the factory to ensure an allowable shipping width. All holes are pre-punched. The fasteners are furnished and shipped inside one of the compartments elsewhere on the unit, depending on the specific configuration (typically the plenum or out-of-airstream section). Remove the shipping cover (1) installed over the furnace tube outlets before installing the flue box. Refer to Figure 1.

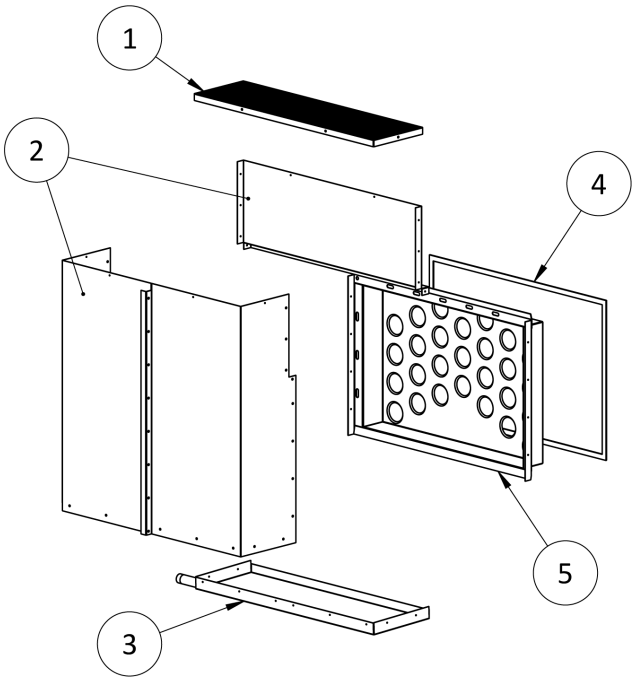
Ensure the sealant around the secondary tubes of the heat exchanger and tube sheet (2) is undamaged and creating a good seal. See Figure 1. The tubes are sealed at the factory, but it is possible that during shipping and/or lifting of the unit that the seals may have become compromised. If touch up or resealing is required, use of the high temperature, silicone-free sealant, Mil-Pac Black is recommended.

Figure 1: Flue Box Shipping Cover



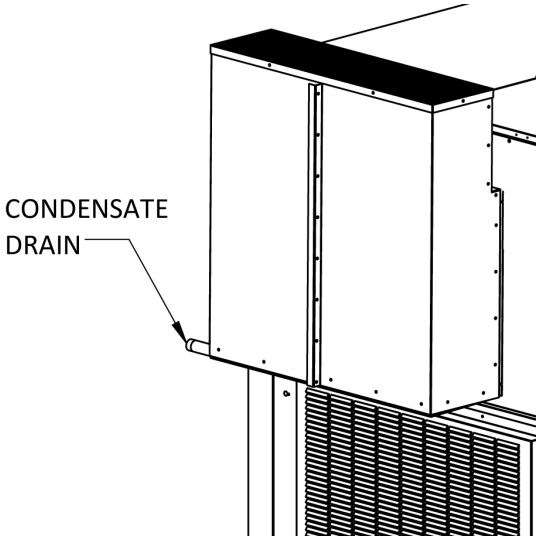
Assemble the flue box by first ensuring that the flue wrapper sheet pieces are fastened together (2). See Figure 2. The bird grate (1) can then be installed and fastened on top of the wrapper. Attach and secure the wrapper to the flue tube sheet (5). This may require reusing some of the fasteners that hold the flue tube sheet to the cabinet. Finally, install the drain pan (3) and ensure there are no large gaps. Depending on unit configuration, a strip gasket or caulking (4) is present to ensure a seal from the flue tube sheet to the cabinet.

Figure 2: Flue Box Assembly



See Figure 3 for a depiction of final installation. The condensate connection should be piped and routed appropriately and is the primary source of condensation for the furnace system. See "Valve and Regulator Venting" on page 7 and "Furnace Condensation" on page 24 for details.

Figure 3: Final Installation and Condensate Drain



Electrical

The furnace system receives its electrical power from the main unit control panel. The sequencing of the burner is controlled through the flame safeguard located in the burner control panel. The flame safeguard communicates and receives its firing rate signal from the main control panel via a ModBus gateway. No additional power or communication wiring needs to be routed to the section.

⚠ WARNING

The burner control panel and flame safeguard is a 120 VAC system and should be maintained and serviced by trained technicians only.

⚠ WARNING

The combustion blower is a 3-phase motor which is connected to the overall unit's 3-phase power via a contactor in the main control panel. Always disconnect power before servicing.

Gas Piping

Customer gas connection for this furnace system is standardized at 1-1/2 in. NPT, regardless of furnace input rating. See Figure 4 on page 7 to view the location of the gas connection.

Gas Pressure Requirements

The pressure furnished to the appliance must be between 7 in. WC and 14 in. WC. When the available supply pressure is above 14 in. WC, a pressure regulator must precede the appliance connection. See Figure 19 on page 17. Care should be taken to size an appropriate pressure regulator to ensure that the supply pressure will not drop below the minimum required pressure of 7 in. WC, even during times of high gas demand in the facility.

Gas Line Sizing

The connection size at the appliance is 1-1/2 in. NPT. Gas piping must be sized to provide the minimum required pressure at the burner when the burner is operating at maximum input. Consult your local utility for any questions on gas pressure available, allowing for piping pressure drops, and local piping requirements.

Install all piping in accordance with the National Fuel Gas Code (ANSI Z223.1), (NFPA 54-1999) and any applicable local codes.

The proper size piping must be run from the meter or identified tap from an existing supply line to the gas burner without reductions. Undersized piping will result in inadequate pressure at the burner. The pressure will be at its lowest when it is needed the most - at times of maximum demand. This can cause intermittent problems that are difficult to troubleshoot, as the problem may disappear before it can be serviced by a technician. Avoid the use of bushings wherever possible.

Remove all burrs and obstructions from pipe. Do not bend pipe; use elbows, or apply other pipe fittings to properly locate pipe. A drip leg must be installed in the vertical line before each burner such that it will not freeze. Install unions so gas train components can be removed for service. After installation, pressurize the piping as required and test all joints for tightness with a bubble detecting solution. Any bubbling is considered a leak and must be eliminated. Do not use open flame to locate leaks.

Table 2: Capacity of Pipe Natural Gas (CFH)

WITH PRESSURE DROP OF 0.3 in. WC & SPECIFIC GRAVITY OF 0.60									
PIPE LENGTH (FT.)	PIPE SIZE-INCHES (IPS)								
	½	¾	1	1¼	1½	2	2½	3	4
10	132	278	520	1050	1600	2050	4800	8500	17500
20	92	190	350	730	1100	2100	3300	5900	12000
30	73	152	285	590	890	1650	2700	4700	9700
40	63	130	245	500	760	1450	2300	4100	8300
50	56	115	215	440	670	1270	2000	3600	7400
60	50	105	195	400	610	1150	1850	3250	6800
70	46	96	180	370	560	1050	1700	3000	6200
80	53	90	170	350	530	990	1600	2800	5800
90	40	84	160	320	490	930	1500	2600	5400
100	38	79	150	305	460	870	1400	2500	5100
125	34	72	130	275	410	780	1250	2200	4500
150	31	64	120	250	380	710	1130	2000	4100
175	28	59	110	225	350	650	1050	1850	3800
200	26	55	100	210	320	610	980	1700	3500
NOTE: Use multipliers for other specific gravities and pressure drops.									

Table 3: Specific Gravity Other than 0.60

SPECIFIC GRAVITY	MULTIPLIER
0.50	1.100
0.60	1.000
0.70	0.936
0.80	0.867
0.90	0.816
1.00	0.775

Table 4: Pressure Drop Other than 0.3 in.

PRESSURE DROP	MULTIPLIER	PRESSURE	MULTIPLIER
0.1	0.577	1.0	1.83
0.2	0.815	2.0	2.58
0.3	1.000	3.0	3.16
0.4	1.16	4.0	3.65
0.6	1.42	6.0	4.47
0.8	1.64	8.0	5.15

Example Scenario:

The appliance is located 80 feet from the gas pressure tap that has been identified to feed the appliance. Pressure available at the tap is 14 in. WC and it is already known that pressure at the tap will not drop below 12 in. WC during times of high demand. The unit size is a 2400 MBH input. Assume standard specific gravity of 0.6.

2,400,000 BTU/Hr ÷ 1000 BTU/SCF = 2,300 CFH

12 in. WC – 7 in. WC = 5 in. WC allowable pressure drop

Using Table 4: Multiplier = 3.65

Using Table 2: 80 ft pipe = 990 CFH

990 CFH * 3.65 = 3,613 CFH capacity.

Result: 2-inch pipe will provide sufficient capacity.

On-The-Roof Piping

Route gas to connection on the outside of the cabinet. Carefully plan pipe route and fitting locations to avoid interference with swinging of doors, etc.

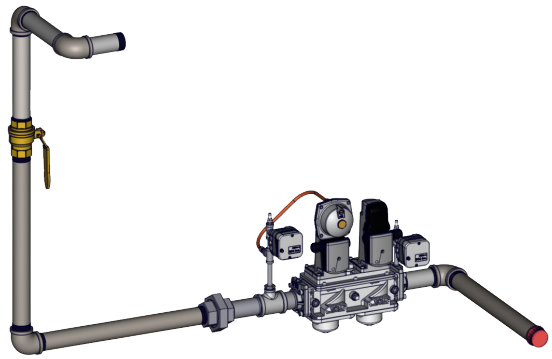
Field Gas Piping Requirements

The gas train components have all been factory installed and require only a connection to the supply gas line. The manual shutoff valve is located within the burner vestibule. If local codes require a manual shutoff valve that is accessible from outside the unit, an additional valve must be added. In locating such a valve, it is to be readily accessible and oriented such that no obstructions interfere with operation of the handle.

The furnace and manual furnace shutoff valve must be disconnected from the gas supply piping system during any pressure testing of the gas supply system at test pressures more than 0.5 psi (14.0 in. WC).

The furnace must be isolated from the gas supply piping system by closing the manual furnace shutoff valve during any pressure testing of the gas supply system at test pressures equal to or less than 0.5 psi (14.0 in. WC).

Figure 4: Typical Piping Configuration



Valve and Regulator Venting

Valve diaphragm vents, pressure regulator vents, and pressure switch vents are located inside the gas heat section vestibule. If local regulations require these vents to be run to the outside of the cabinet, it is to be done as part of the field gas piping hookup.

A vent limiter is provided on the atmospherically vented side of the Pressure Regulating Valve's diaphragm, see "Gas Train and Built-in Pressure Regulating Valve" on page 10, in many cases this provision removes the need for routing the vent line outside of the cabinet.

Normally Open Vent Valve

Vent valves such as those required by Industrial Risk Insurers (IRI) for over units with over 1000 MBh input or Factory Mutual (FM) requirements must always be routed to the outdoors. This is field piping.

Condensate Drains

All units are equipped with condensate drain connections, including:

- A combustion/flue condensate drain connection directly connected to the flue box.
- A combustion condensate drain located at the rear of the unit.
- A vestibule rain and condensate ingress connection. This connection does not handle flue combustion products.

The locations and connection sizes of these connections are detailed in Figure 5 and Figure 6. Drainage of combustion condensate directly onto the roof may be acceptable in certain areas, but refer to local codes. If applicable codes or regulations require, these can be routed to a drain. A trap is not recommended and heat tape or some other method of freeze protection is required.

Figure 5: Front Elevation - Gas Heat Section

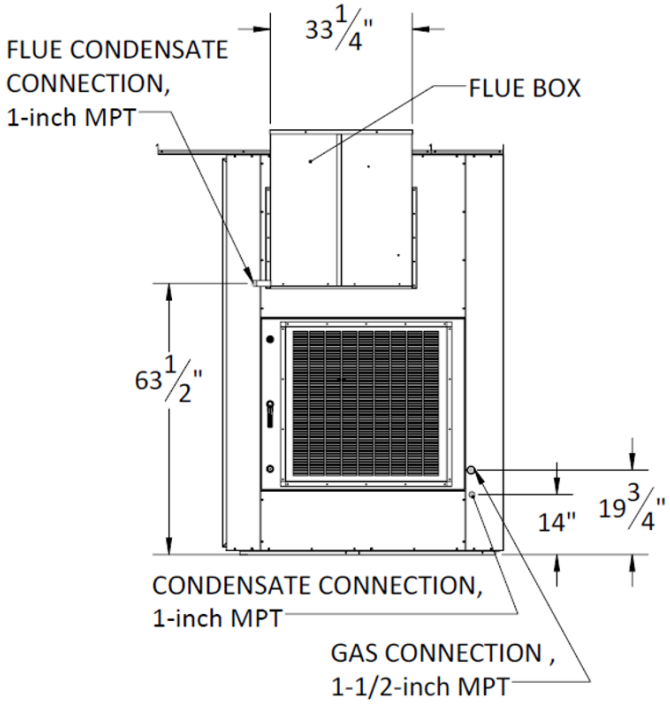
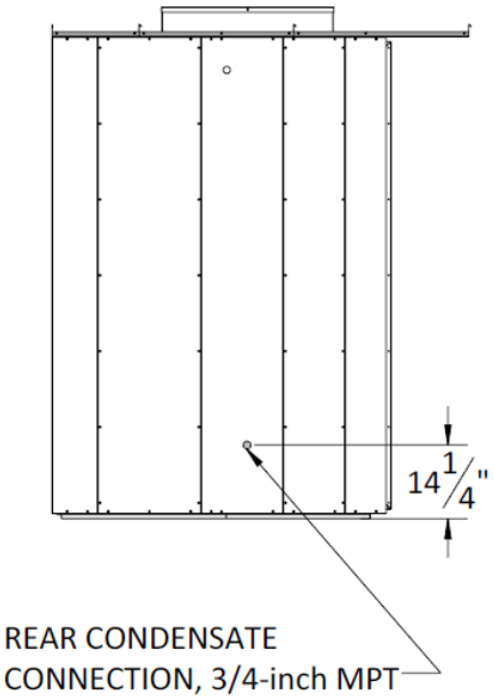


Figure 6: Rear Elevation - Gas Heat Section



⚠ CAUTION

For installations where the ambient temperatures fall below freezing, if the condensate is not piped to the drain properly, or does not include some heat protection, the condensate will freeze. Frozen drain lines may cause a build up of condensate inside the heat exchanger resulting in leakage and damage to the rooftop unit and probably to the facility.

Start-Up & Operation

About the Furnace

Daikin Applied's drum and tube furnace is composed of several major sections. See Figure 7 and Figure 8, where the components are numbered accordingly:

1. Flue
2. Burner
3. Burner control panel (BCP)
4. Gas Train
5. Heat Exchanger
6. Block Offs/Baffles

The burner control panel contains the flame safeguard (FSG), which is responsible for monitoring and safe operation of the furnace system.

There may be top, bottom, and or side baffles present depending on the temperature rise of the unit, the cabinet size, and the discharge location.

Figure 7: Gas Heat Section

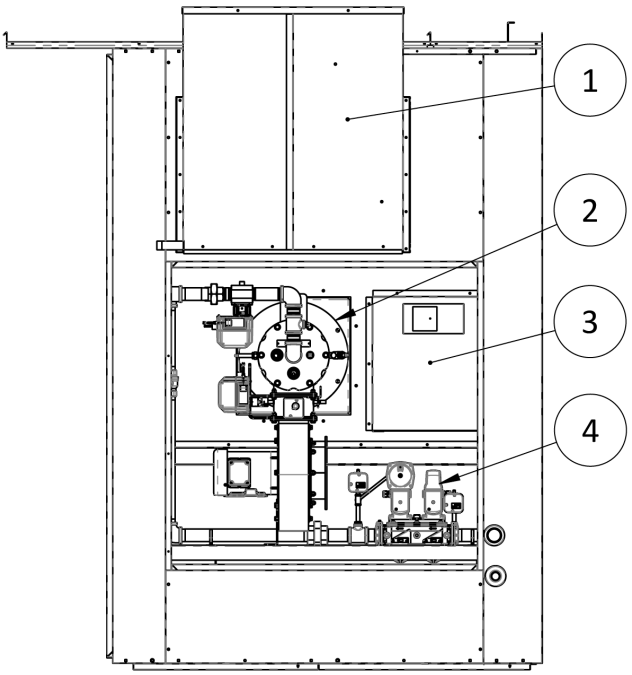
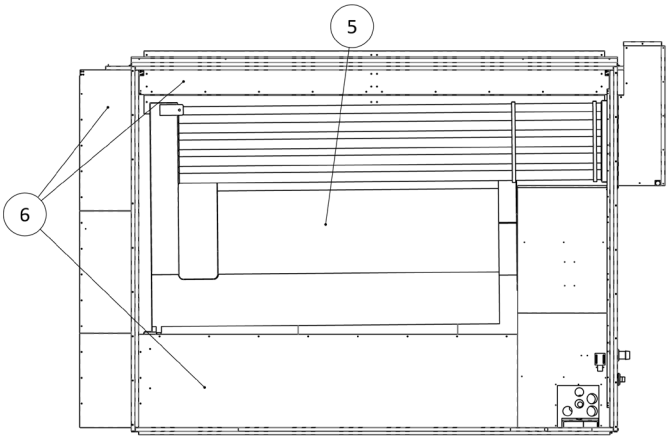


Figure 8: Heat Exchanger and Baffles



Burner

The Daikin Applied burner is a forced draft, nozzle mixing type power burner utilizing parallel positioning control of the gas and air mixture. Parallel positioning means there is an electronically controlled air damper and gas fuel valve that can be independently, electronically operated without mechanical linkages. This setup gives excellent turndown performance with clean operation throughout the range of heat input.

All attempts are made to ensure clean, efficient operation from the factory. If for any reason there is unsatisfactory performance, adjustments can be made to the combustion curve to optimize the performance based on field requirements.

A combustion blower draws air in through the air inlet screen and provides pressurized air to the burner head. The air and fuel mixture combusts at the burner head and is controlled via the air damper actuator and gas valve actuator. The ignitor generates the direct spark for ignition. The flame rod confirms flame presence. The combustion airflow pressure switch confirms combustion blower operation. The flame leaves the burner through the sleeve where the hot combustion products enter the drum of the heat exchanger.

See the diagrams on page 10 to identify the burner's main components

See Figure 9 and Figure 10 to identify burner components. Each component is numbered accordingly:

1. Valve Actuator
2. Ignitor
3. Viewport
4. Air Damper Actuator
5. Combustion Blower
6. Flame Rod
7. Burner Head
8. Combustion Airflow Pressure Switch
9. Air Inlet Screen
10. Sleeve

Figure 9: Burner Assembly (1)

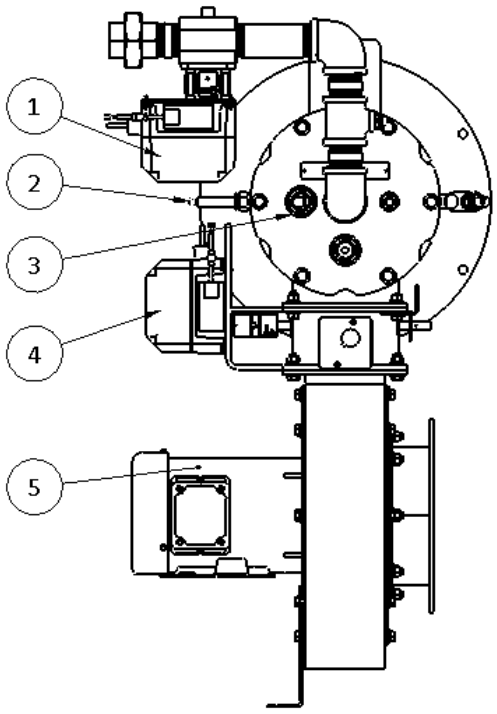
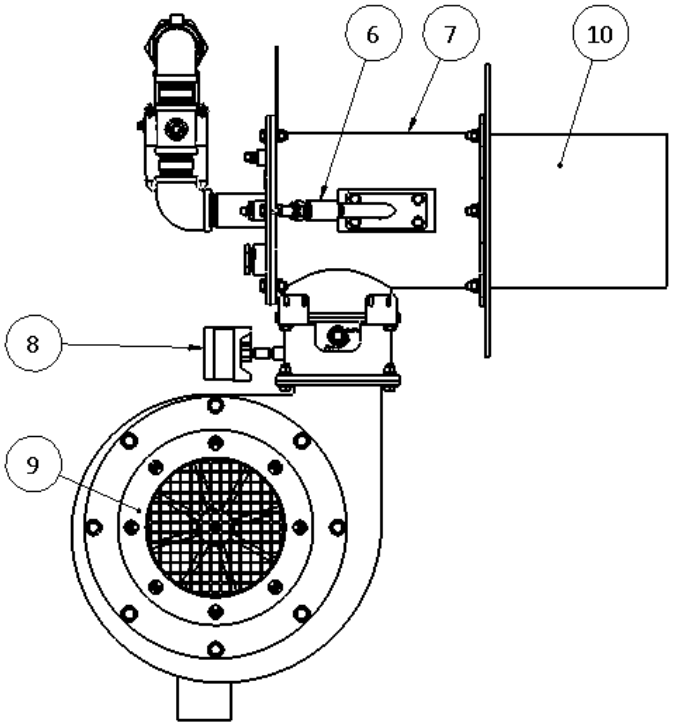


Figure 10: Burner Assembly (2)



Gas Train and Built-in Pressure Regulating Valve

The following describes a typical gas train which comes fully pre-assembled and leak-checked from the factory. However, the gas train of your appliance may vary depending on the unique application, customization of the unit order, and ultimate installation location.

See, for example, "Valve and Regulator Venting" on page 7 or "Normally Open Vent Valve" on page 8.

Gas enters the customer connection and enters the double-blocking safety shut-off valve (SSOV). A manual gas shut-off valve exists inline before the burner connection. There is a pressure regulating valve (PRV) that has been preset at the factory to ensure satisfactory full heat input rate with gas pressure at the customer connection varying anywhere between 7 to 14 in. WC. Under normal operating conditions, the PRV should not need to be adjusted.

⚠ CAUTION

The PRV should only be adjusted by knowledgeable and trained service personnel as it directly affects the manifold pressure of the burner and, indirectly, the heat input rate. For manifold pressure information see Table 9 on page 36.

The low gas pressure switch (LGS) and high gas pressure switch (HGS) have been set at the factory at approximately 8 in. WC and 3 in. WC respectively. Actual setpoint may vary based on the specific burner installed. Both switches have indicator lights for visual indication of alarm conditions.

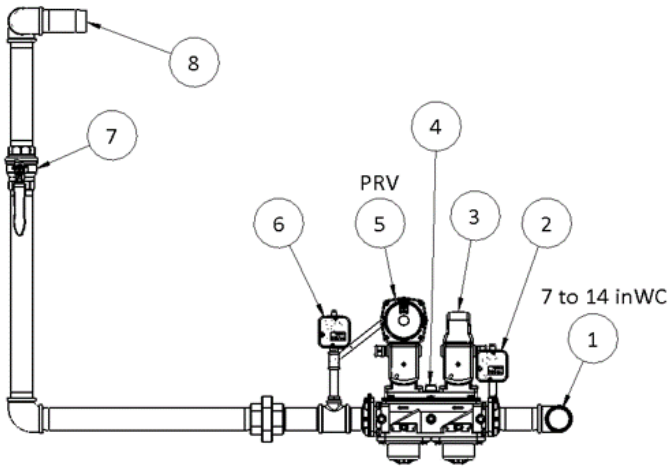
The on/off safety shut-off valve (SSOV) actuator provides proof

of closure feedback to the flame safeguard (FSG). For further details on the wiring and operation of the valve, refer to the schematics located on interior face of the burner control panel as well as Siemens Combustion Controls VGD20 valve series manual.

See Figure 11 to identify gas train components. Each component is numbered accordingly:

1. Customer Connection
2. Low Gas Pressure Switch (LGS)
3. Safety Shut Off Valve (SSOV) Actuator
4. Safety Shut Off Valve (SSOV)
5. Pressure Regulating Valve (PRV)
6. High Gas Pressure Switch (HGS)
7. Manual Gas Shut Off Valve
8. Burner Connection

Figure 11: Typical Gas Train Components



Burner Control Panel (BCP)

The burner control panel (BCP) houses the flame safeguard (FSG) controller and all wiring provisions to complete the connections between the safety devices and operational devices of the furnace and the FSG.

⚠ WARNING

The burner control panel and flame safeguard utilize a 120 VAC electrical system and should be maintained and serviced only by trained technicians.

Flame Safeguard (FSG) and Display

Daikin Applied's furnace utilizes a Siemens Combustion Controls LMV3 flame safeguard (FSG) controller with the AZL display module. While the LMV3 FSG is capable of running dual fuel (Gas and/or Fuel Oil trains), Parameter 201 has been preset to a value of 1, which limits the available options to those that affect a gaseous fuel train setup with direct ignition. Daikin Applied's drum and tube furnace system has been certified for use with only natural gas (NG) at this time.

The AZL display is the interface for the FSG and serves several important functions:

- Indicates current status. A reading of "Off" indicates the unit is in standby mode awaiting a heat call. During operation, a display of "oP: 20.0" indicates operation at 20% firing rate.
- Displays any fault codes (Error or Lockout codes), including a history of 25 fault codes.
- Allows the changing of certain parameters, depending on the level of access (User, Service, or OEM). Each level of access has a unique password to gain entry to the subset of parameters.

Figure 12: AZL Button Navigation

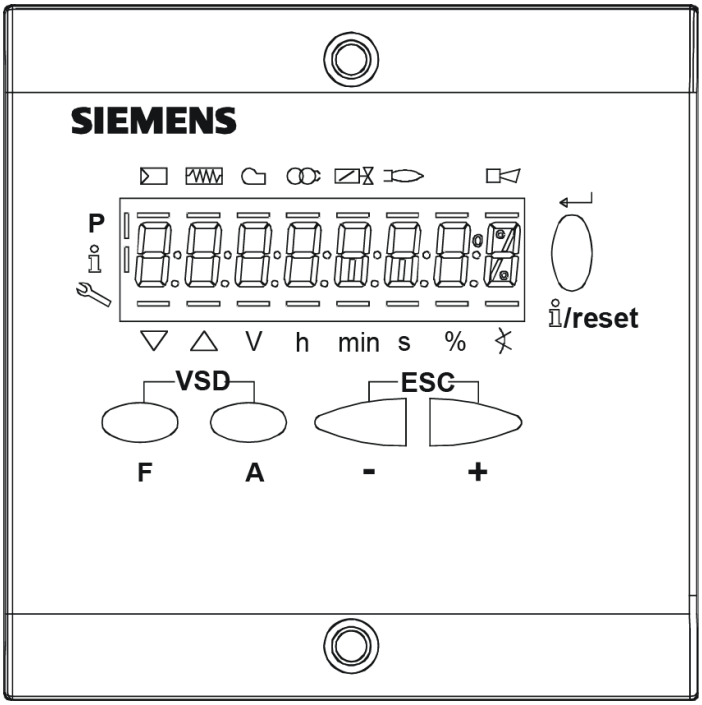


Figure 13: AZL Display and Symbols

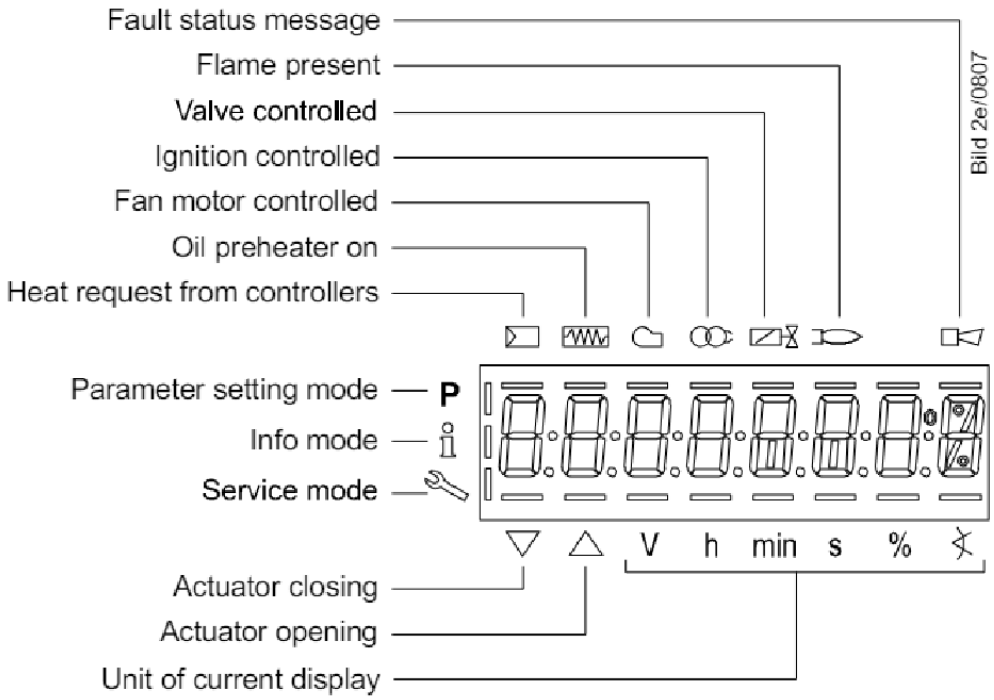


Figure 14: AZL Button Functions

Button	Function
F	**F button** - For driving the fuel actuator to another position (keep F depressed and adjust the value by pressing - or +)
A	**A button** - For driving the air actuator to another position (keep A depressed and adjust the value pressing - or +)
VSD F A	**A-button and F-button: Parameterization function** - For changing to parameter setting mode **P** (press simultaneously F and A plus - or +) - For readjusting the speed of the VSD operation (press F and A with - or + simultaneously)
i/reset	**Info and Enter button** - For navigating in info and service mode * Incrementing the selection (flashing symbol) (press button for <1 s) * Going one menu level down (press button for 1…3 s) * Going one menu level up (press button for 3…8 s) * Changing to operating mode (press button for >8 s) - **Enter** in parameter setting mode - **Reset** in the event of fault - One menu level down
-	**- button** - For decreasing the value - For navigating during curve adjustments in info and service mode
+	**+ button** - For increasing the value - For navigating during curve adjustments in info and service mode
ESC - +	**- and + buttons: Escape function** (press - and + simultaneously) - No adoption of value - One menu level up

For further information and advanced functions of the display, refer to the AZL.23 user manual from Siemens Combustion Controls.

Temperature Limit Controls

There are two high temperature limits used to protect the furnace system and overall unit from potentially high temperature conditions; the primary and secondary high temp limits. Under normal operating conditions, the limits should never trip and should never be relied upon for routine ON/OFF control of the furnace. If the limits are consistently tripping, it indicates an issue somewhere and the problem should be investigated and corrected.

NOTICE

Both limits are connected in series to the safety loop circuit of the flame safeguard (FSG). See the burner control panel schematics. The FSG will be unable to tell which limit trips in the event of a high temperature event. If the FSG is giving a fault code due to the safety circuit, the limits should be inspected.

Primary High Temp Limit

This limit is located on the discharge opening of the unit and its primary function is to limit the discharge air temperature to below 250°F (121°C). It must also allow for the supply of air at a temperature equal to the warmest return air expected (typically 70°F (21°C)) plus the temperature rise of the unit without causing nuisance trips. It is an automatic resetting style 3/4 in. snap disc with a setpoint that varies depending on the furnace input size, cabinet size, and temperature rise.

Secondary High Temp Limit

This limit is located near the top of the VFD vestibule area in the supply air fan section of the unit. Its primary function is to protect the fan motors, VFD, and associated devices in the event of a complete supply fan array failure in conjunction with a runaway furnace. It is a manual reset style 3/4 in. snap disc with a setpoint of 125°F (52°C). If this limit trips, it must be manually reset before operation of the furnace can resume.

Additional Information

Pre-Purge is High Air

The burner air control valve will be at the minimum position when in off/standby. Upon a call for heat, or any other time that a pre-purge cycle occurs, the air control valve will fully open but the gas valve will remain closed. This allows for maximum airflow through the heat exchanger when purging.

Low Fire Start

The burner is controlled for a proven low fire start. The actuators will position the modulating gas valve and the modulating air valve to the low fire position each time the burner is to light off. The gas and air actuators drive to reference positions prior to each heat cycle to ensure accurate position feedback to the flame safeguard (FSG). If the actuators are unable to drive to their reference positions, the valves will not open and the FSG will lock out, requiring manual reset.

"Pilot" is Main Flame Modulated Down to Pilot Rate

The "pilot" is not a separate flame or burner. The "pilot" is the main flame operating at its minimum rate. That minimum rate is low such that it qualifies as a pilot burner.

Start-Up Responsibility

The start-up organization is responsible for determining that the furnace, as installed and as applied, will operate within the limits specified on the furnace rating plate:

1. The furnace must not exceed the specified Maximum Input (MBh) on the rating plate.
2. The furnace must not operate at an airflow below the specified Minimum Airflow on the rating plate. On variable air volume systems, it must be determined that the furnace will not be operated with an airflow below the specified Minimum Airflow.
3. It must be established that the gas supply is within the proper pressure range. See "Gas Pressure Requirements" on page 6.

Start-Up Procedure

⚠ WARNING

Overheating or failure of the gas supply to shut off can cause equipment damage, severe personal injury, or death. Turn off the manual gas valve to the appliance before shutting off the electrical supply.

Burner start-up and service must be done by trained, experienced technicians. It is highly recommended that the initial start-up and future service be performed by Daikin Applied trained technicians who are familiar with working on live equipment. A representative of the owner or the operator of the equipment should be present during start-up to receive instructions in the operation, care, and adjustment of the unit.

Before Start-Up

1. Set control system to enable heating. To allow start-up and check-out of the burner, the control system must be set to call for heating and must he used to control the amount of heating. Refer to the main unit and/or controls manuals to understand how to increase, maintain, or reduce the firing rate of the burner as required for these tests.
2. Notify inspectors or representatives who may be required to be present during start-up of gas fuel equipment. These could include the gas utility company, city gas inspectors, heating inspectors, etc.
3. Review the equipment and service literature and become familiar with the location and purpose of the burner controls. Determine where the gas and power can be turned off at the unit and upstream of the unit.
4. Determine that power is connected to the unit and available.
5. Determine that the gas piping, meter, and service regulator

have been installed, tested, and meet the equipment requirements.

6. Determine that proper instruments will be available for the start-up. A proper start-up requires the following: voltmeter, manometer or gauges with ranges for both manifold pressure and inlet gas pressure, CO_2 indicator, CO indicator, temperature measuring device for the flue gas, and a stopwatch for timing the gas meter.
7. Leak check. Using a bubble detector solution, check the gas lines for leaks. Correct all leaks before attempting to start the burner.

Start-Up Preliminary

1. Close manual gas shut-off valve.
2. Check the burner fan wheel for binding, rubbing, or loose setscrews, or other debris.
3. Check for power to the burner control panel. If the AZL display has its backlight on and is displaying “Off”, then power is being supplied to the burner control panel.
4. Check for counter-clockwise rotation of the combustion blower as viewed through blower housing inlet.

NOTE: Power to the combustion blower can be manually turned on in several ways, the following are example methods:

Manually activate the contactor to the combustion blower in the main control panel.

Manually initiate a startup via the AZL display. Hold "F" and "A" together on the display until it prompts "CodE", then press "i/reset" to enter the User Level access of the burner. Navigate to parameter "121" and enter a manual firing rate of 20% to turn the burner combustion fan on. Reduce firing rate below 20% to turn the burner off again. When finished, repeatedly press "Esc" (both “+” and “-“ together) until you return to the main screen and reading displays "Off".

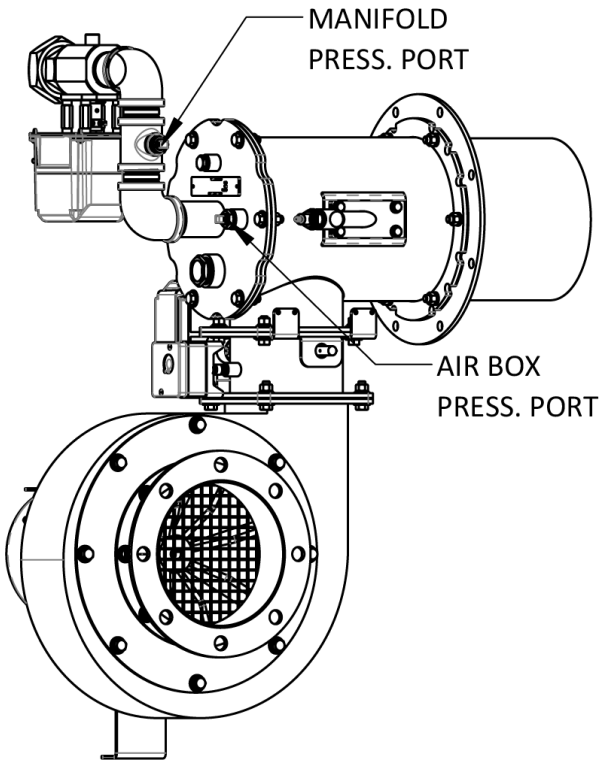
If the combustion blower is spinning the wrong direction, the motor requires reversal via rewiring in its junction box or ensuring that the 3-phase power is connected correctly to the overall unit.

⚠ CAUTION

Ensure the manual gas shut-off valve is closed so that the unit will not establish flame while checking combustion blower direction. The unit supply fans must be running anytime the furnace is actively firing.

5. Purge the gas lines. Turn off electrical power. Open the pressure tap or pipe plug from the inlet of the Safety Shut-Off Valve (SSOV) and bleed the gas line of all air. Close the pressure tap or replace the pipe plug.
6. Connect a manometer to measure gas manifold pressure. There is a 1/8 in. pipe plug in the gas line just before it enters the burner housing.
7. Connect a manometer to measure the air box pressure. There is an 1/8 in. pipe plug on the front of the burner head assembly.

Figure 15: Manifold and Air Box Ports



Start-Up "Dry Run"

1. Close the main manual gas shut off valve.
2. Initiate a heat call. It may take a few minutes for the MicroTech unit controller to complete its checks, ramp up the supply fans, etc. before calling for heat from the furnace.
3. The AZL display will change from “Off” to “Ph 22”, and the indicators for “Heat Request” and “Fan Motor” will show solid bars.

Figure 16: AZL Display "OFF"

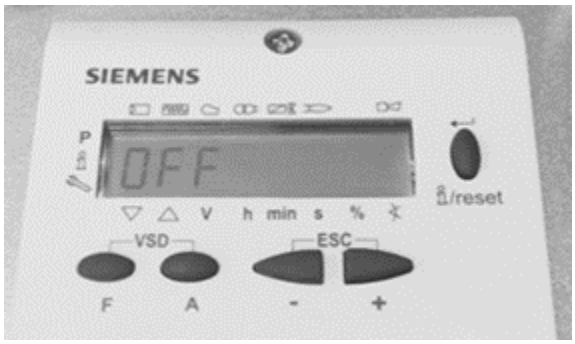
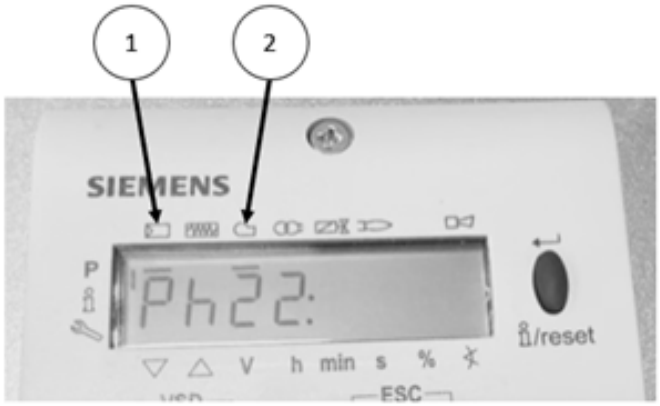


Figure 17: AZL Display "Ph22"



NOTE: 1 = Heat Request
2 = Fan Motor

4. The blower motor will start and the air actuator will drive to its pre-purge position.
5. After pre-purge is completed, the air and gas actuator will drive to their light off positions and the unit will spark and attempt to light off.

NOTE: For detailed sequencing of each phase, see "Phase Table" on page 37. Additional information on the details of each phase can be found in the LMV3 manual.

6. Light off should fail because the main manual gas valve is closed. The high gas pressure switch should illuminate, showing indication of an alarm condition. The AZL display should show a lockout code due to the alarm.
7. As necessary, hold the “i/reset” button on the display to clear the lockout alarm and open and reclose the main manual gas valve to clear the high gas pressure alarm. Clear any error codes from the MicroTech controller.
8. Repeat the above procedure as required to achieve the following outcomes:
   - Verify spark through the burner observation port.
   - Verify the burner response to the heat call was successful.
   - Verify movement and operation of the air actuator and the gas actuator.
   - Verify supply fans successfully started up.

NOTE: Supply fans may not start up if the unit is a Dedicated Outdoor Air System (DOAS) and the outdoor temperature is too low to meet the sequence of operation criteria for a warm-up. See "Typical Sequence of Operation with MicroTech Control System - DOAS" on page 19.

Start-Up Establish Flame

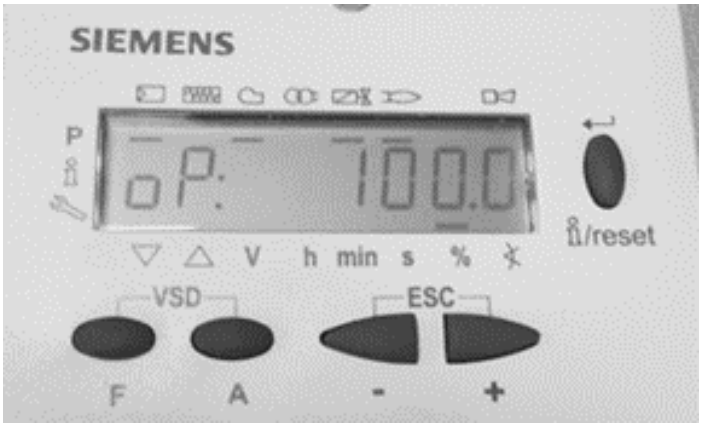
This procedure assumes that the checks and activities outlined in "Before Start-Up", "Start-Up Preliminary", and "Start-Up "Dry Run"" sections have been completed.

1. Open the manual gas shut-off valve.
2. Initiate a heat call.
3. The furnace will cycle through its start-up phases and light at a low fire setting. For a detailed phase sequence, see Figure 30 on page 37.

NOTE: If this is the first time commissioning the unit after installation, light off may not occur right away due to air needing to purge through any newly installed gas line and gas train of the furnace. The burner will attempt to light 4 times before locking out. If lockout occurs, purge the line further or continue the purge with the burner by clearing the lockout code on the AZL display and retrying light off.

4. After successful light off, allow the furnace to slowly warm up and gradually increase the heat call to achieve a 100% firing rate. When the furnace is firing at 100%, the AZL will display “oP: 100.0” as shown in Figure 18.

Figure 18: 100% Firing Rate (P9)



5. Monitor the furnace, and ensure the following:
   a. Appliance gas pressure at the customer connection is between 7 and 14 in. WC. Adjust any field-installed pressure regulators as necessary.
   b. Gas manifold pressure should be close to the values listed on the rating plate (see Table 9 on page 36) at the 100% high fire (P9) condition. Compensate for altitude if above 2000 ft (610 m). See "Altitude Considerations" on page 21.

NOTE: Elevations above 2000 ft (610 m) will affect the airbox pressure, which also can affect the gas manifold pressure.

NOTE: Any appreciable deviations from the pressures listed on the rating plate may indicate a problem and should be reviewed.

c. Flue gas temperatures must be maintained below 450°F (232°C). If temperature is at or above this value, it may indicate airflow over the furnace is insufficient.

6. Verify the heat input rate is close to the rated heat input as listed on the rating plate. See "Verify Input Rate" on page 21. Compensate for altitude if above 2000 ft (610 m), see "Altitude Considerations" on page 21.

⚠ CAUTION

If adjustments are required to achieve the rated heat input, adjustments to the pressure regulating valve (PRV) on the safety shut-off valve (SSOV) may be necessary. Adjustments should only be made if necessary and as determined by a qualified service technician. See "Pressure Regulating Valve (PRV) Adjustment" on page 21.

7. Complete combustion checks. These tests should be run when the furnace is at normal operating temperature (after the furnace has been running 10 to 15 minutes) and should be run at several firing rates including maximum and minimum.

   a. Check input. See "Verify Input Rate" on page 21.

   b. Check CO, CO_2, and stack temperature. See "Check CO2, CO & Stack Temperature" on page 21.

NOTE: If any adjustments are needed to achieve clean combustion, refer to "Combustion Testing" on page 21.

Start-Up Cycle and Modulate Fire Rates

After main flame has been established and the preceding checks have been thoroughly carried out, cycle the unit through several start-ups with controls first calling for low fire and then subsequent increases until finally calling for high fire. Watch for any indications that the unit not operating as expected.

Tips for Field Start-Up, Tuning, and Commissioning

Using a fuel flow meter (temporary or permanent) for field start-up/tuning is recommended. The fuel input (heat input) is factory set and increases on a preset curve with the firing rate.

The burner manifold pressure may be used as a last resort to estimate firing rate. Note that manifold pressure does not increase with gas flow in a linear manner.

There is a square root relationship between the differential pressure across the burner head and the gas flow. In addition, airbox pressure must be accounted for by comparing both manometers (at the airbox and at the gas manifold).

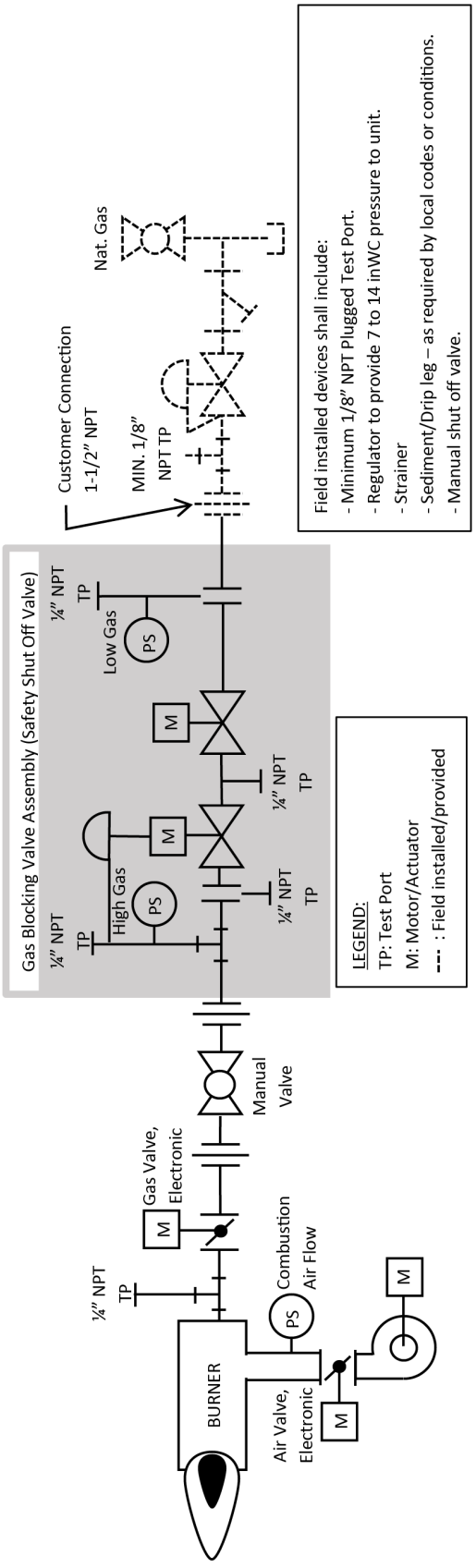
⚠ WARNING

Carbon monoxide (CO) is produced when combustion is incomplete, typically due to the flame being too rich or too lean. CO is potentially explosive when mixed with air in the right proportions. For CO to be explosive in air, it must reach a concentration of at least 12.5% (125,000 ppm) with an ignition source present.

If a burner is commissioned properly, combustion curves should increase actuator positions smoothly with increasing load (firing rate).

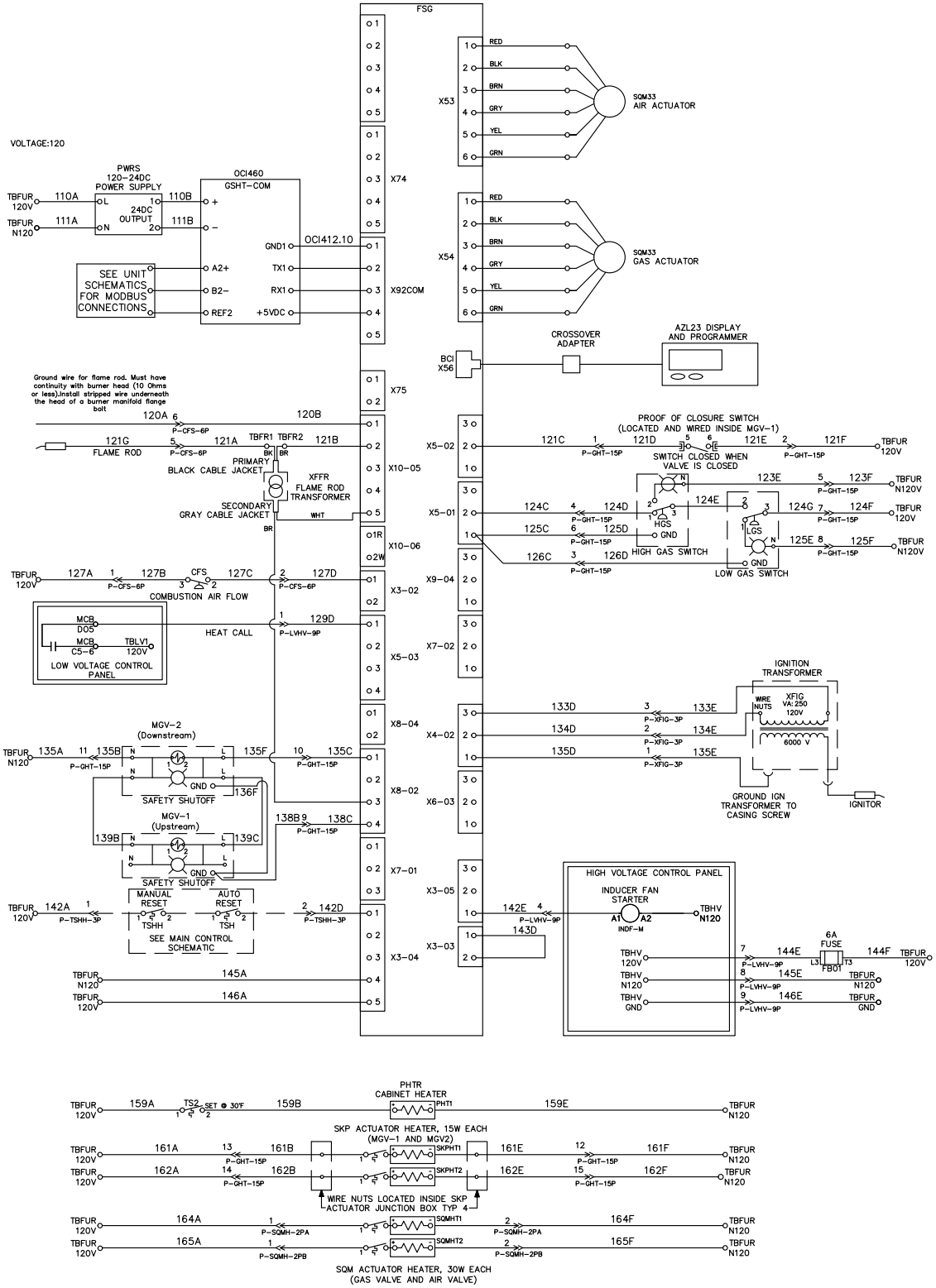
NOTE: Holding the “i/reset” button and pressing any other button on the AZL at the same time will cause the LMV3 to immediately close the fuel valves and lockout.

Figure 19: Typical Piping Schematic



Typical Electrical Schematic for MicroTech Control System with Siemens LMV3 Burner Management System

Figure 20: Typical Electrical Schematic for Burner Control Panel



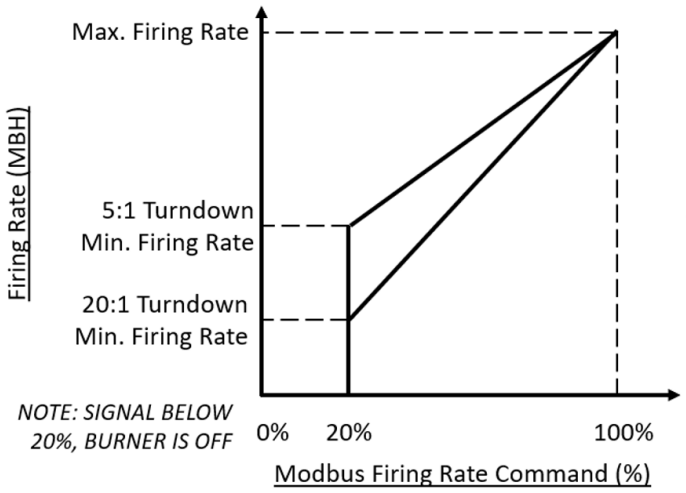
Normal Operation, Stand-By, and Start-Up

Typical Sequence of Operation with MicroTech Control System

1. A call for heat is initiated by the MicroTech unit controller. The controller closes a relay contact, which provides 120V to terminal X5-03.1 on the LMV3 (indicating a heat call) and puts the burner into standby. In addition, a modulation signal is sent over Modbus to the Modbus gateway in the burner control panel. A command of 20% or more will start the burner.

NOTE: The LMV3 must receive a Modbus signal between 20% and 100% to start the firing sequence, regardless of the turndown of the specific unit. A signal below 20% will not start the burner, and will remain in standby. See Figure 21.

Figure 21: Firing Rate Signal



2. The combustion blower motor will start. Then, the air valve will drive to its pre-purge, fully open position, and complete the pre-purge ("Ph 30").
3. The gas and air valves will drive to the ignition positions ("Ph 36").
4. A spark then initiates, followed immediately by the opening of the safety shut-off valve (SSOV), and a countdown will display on the AZL display. The countdown is the amount of time the spark will be maintained with the SSOV open. This time is referred to as the Safety Time.
5. If, at the end of the Safety Time, flame is established, the unit will enter a warmup period, controlled by the MicroTech unit controller, before fully entering Heating Mode and modulating as required to maintain the desired setpoint. The AZL display will show at what firing rate percentage the burner is currently operating.
6. If, at the end of the Safety Time, flame is not established, the LMV3 will repeat the pre-purge and ignition cycles a total of four times. After four failed attempts, the LMV3 will lockout and require a manual reset.
7. The run cycle will continue until any of the following conditions are met:
   a. The call for heat is terminated.
   b. Any of the safety devices (high limit, air pressure, gas pressure, etc.) are triggered.
8. Once the run cycle has completed, the SSOV will close, the gas and air valves will drive to their post-purge position, and the system will go through a post-purge cycle.
9. The control will then enter the “Off” state, indicated by the AZL displaying “Off”. Safety devices continue to be monitored.

Typical Sequence of Operation with MicroTech Control System - DOAS

A Dedicated Outdoor Air System (DOAS) provides 100% outdoor air to a conditioned space. For a DOAS application, the furnace system goes through a special firing sequence before the supply fans turn on. This allows the furnace and the air in the cabinet to warm up so that when the supply fans turn on, warm air is provided immediately to the conditioned space. The special startup sequence is orchestrated by the MicroTech unit controller. For details on the sequence, see the unit installation manual. The basic sequence will be as follows:

- The supply fans are off.
- The furnace fires at low fire for a period (typically 40 sec.). This is the low warmup.
- At the end of low warmup, the furnace ramps to a firing rate that is calculated based on the outdoor temperature for an additional period (typically 240 sec.). This is the high warmup.
- After the full warmup sequence, the supply fans turn on and the unit will transition to its typical heating mode.

Typical Sequence of Operation with Refrigeration Only Control System

A DPSA unit with a gas heat furnace system can be ordered with a Refrigeration Only Controls option. This type of control scheme separates the control of the furnace heat input from the MicroTech unit controller.

The sequence of operation for furnace startup and shutdown is the same as the items outlined in "Typical Sequence of Operation with MicroTech Control System" on page 19. However, the control of the heat rate is accomplished via a field provided external control signal.

The MicroTech unit controller will still safeguard against unsafe operating conditions. For example, it will not allow the furnace to fire unless the supply fans are on. It will also limit the temperature rise of the air to remain withing the limits specified on the rating plate.

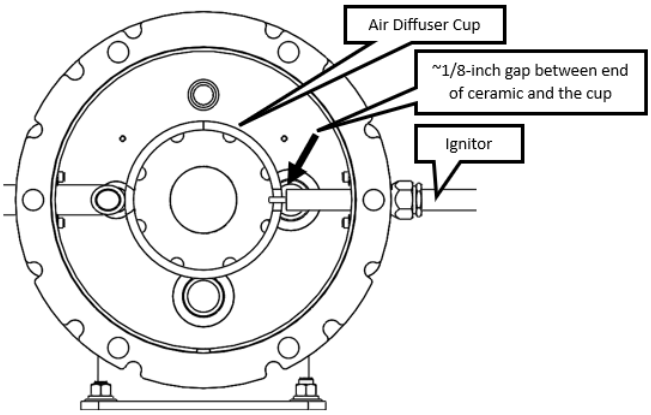
For more detailed information, see the main unit installation manual and the MicroTech operations manual.

Service

Ignition Electrode

Model R Burners are a direct spark burner configuration and always ignite the burner at the low fire setting only.

Figure 22: Standard Air Flow Igniter Settings



The ignitor should consistently spark to the air diffuser cup (see Figure 22). To position the ignitor, loosen the compression fitting, slide the ignitor in-and-out and up-and-down – feeling for the thru-hole in the air diffuser cup with the ceramic.

Once the ceramic is touching the outside edge of the diffuser cup thru-hole, back out the ignitor ~1/8-inch and tighten the compression fitting. Gapping in this way will create a strong spark and allow for observation of the spark through the observation view port on the front of the burner head.

Do not overtighten the fitting or the ceramic may be damaged or break.

In cases of higher than standard startup airflow such as constant air it is important to position the igniter close to the gas nozzle to insure proper and consistent combustion. If the igniter is positioned too far away in a high air flow startup scenario, the spark plasma is too far to ignite the gas.

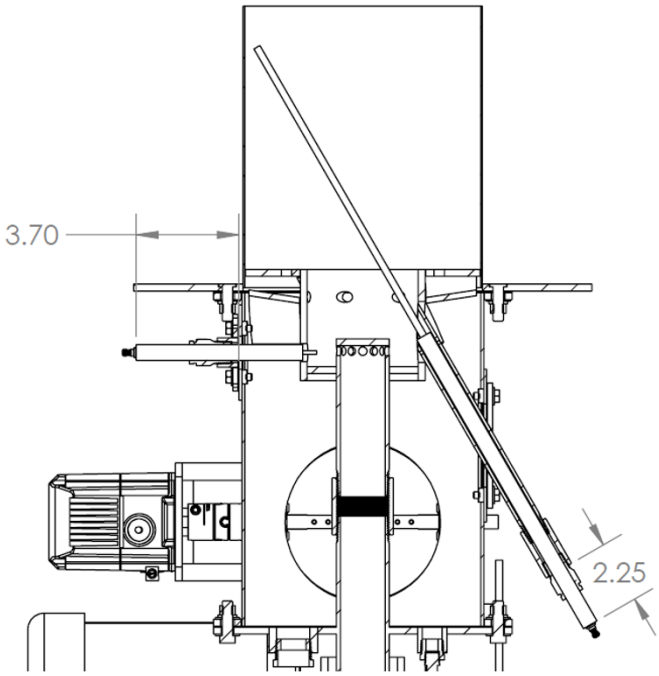
Ignition Transformer

Use minimally 5000V ignition transformer for spark generation.

Flame Rod

The flame rod is a serviceable wear item and may need to be replaced several times over the lifetime of the furnace. Compromised (cracked) ceramic or an inability to light off and detect flame indicates a need for replacement. The flame rod's ability to properly detect flame is sensitive to its position inside of the allow sleeve of the burner head. See Figure 23 for recommended positioning.

Figure 23: Flame Rod Orientation



Altitude Considerations

For altitudes above 2000 feet, the gas burner must be derated 4% for every 1000 feet of altitude.

Example: An 800 MBh output furnace at an altitude of 3000 feet is derated (0.04 x (3000-2000)/1000 = 4% derate). At 800 MBh input, the actual input rate at 3,000 ft is (800 x 96% = 768 MBh).

The method of derating the burner is to reduce the manifold pressure for the main burner. First, refer to "Capacities & Dimensions" on page 36. Multiply the 100% Gas Manifold Orifice Pressure by the following altitude factors:

2000 feet = 1.0	5000 feet = 0.774
3000 feet = 0.922	6000 feet = 0.706
4000 feet = 0.846	7000 feet = 0.64

Pressure Regulating Valve (PRV) Adjustment

To adjust the pressure, remove the brass cap and turn the internal adjustment screw with a flat blade screwdriver. Counter-clockwise will decrease pressure. Clockwise will increase pressure. See Figure 24 and Figure 25.

⚠ WARNING

The integral pressure regulating valve of the safety shut-off valve (SSOV) should only be adjusted by qualified service personnel with an understanding of the application and the equipment. Incorrect adjustment of firing rate can cause equipment damage, property damage, and create CO, which is a poisonous gas.

Figure 24: Pressure Regulating Valve, Brass Cap

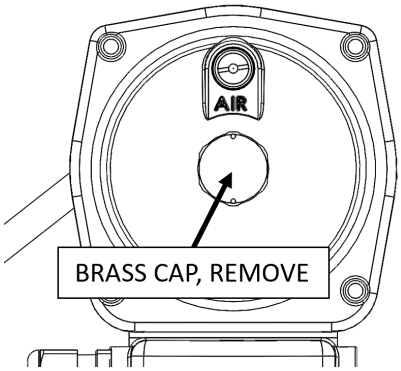
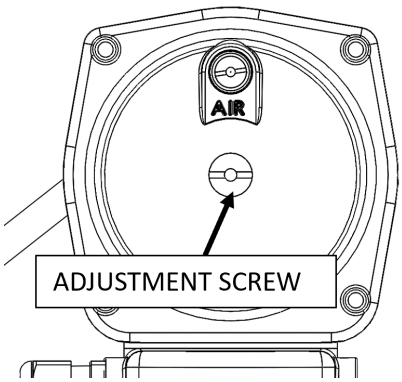


Figure 25: Pressure Regulating Valve Adjustment



Combustion Testing

Proper start-up and maintenance requires periodic combustion tests and the systematic recording of those test results for future reference. Before making combustion air adjustments, check for proper input rate.

Verify Input Rate

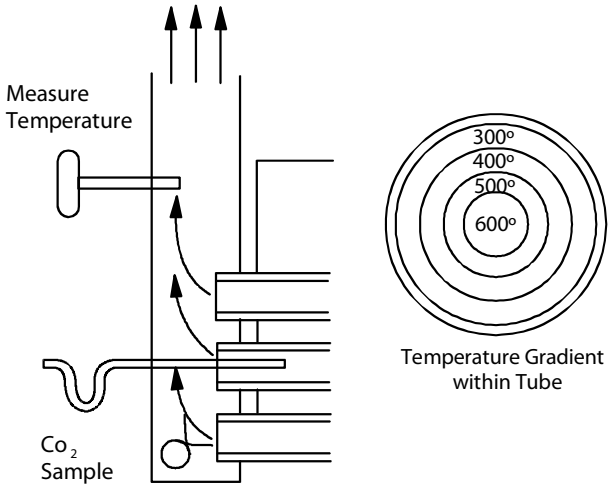
To determine the input rate, it is necessary to know the BTU per cubic foot of gas being used. If this is not known, contact the gas supplier. Check input rate by timing the gas meter dial with all other appliances and their pilot lights off. If 1000 BTU/cu. ft. gas is being used, the input can be verified using the measured manifold pressure and checking the burner model number. See Table 9 on page 36.

Typical: Natural gas = 1075 BTU/cu. ft.

Check CO_2, CO & Stack Temperature

Flue gas samples are to be taken from inside one of the secondary tubes. If the sample is taken from the flue box rather than the tube, the sample may be diluted with outside air and lower readings will result. If flue gas temperature is to be measured, this must be done in the flue box, not in the tube. The temperature gradient within the tubes will cause high readings near the center of the tube and low readings near the edge. Measure temperatures within the flue box where a good mix will be present. The flue box includes two 5/16 in. holes for test purposes. One hole lines up with the end of a secondary tube for taking flue gas samples. The other hole is for thermometer insertion.

Figure 26: Checking Temperature



Typical Readings:

CO_2 9½ to 10½ percent at maximum rate
1 to 7 percent at minimum rate
CO .001 percent (10 PPM) or less

Combustion Curves

⚠ WARNING

Changing the combustion curves should only be carried out by qualified service personnel with an understanding of the application and the equipment. Incorrect adjustment of firing rate can cause equipment damage, property damage, and create CO, which is a poisonous gas.

In a typical installation, adjustment to the combustion curves should not be needed. However, due to aging of the equipment, movement during shipping, or specific field requirements, adjustment may be necessary.

Adjustment to the combustion curves can be accomplished using the AZL display or a Siemens Combustion Controls OCI410.30 programmer. Changing of the curves requires Service Level access. Contact Daikin Applied for the Service Level password or to purchase a Service Level OCI programmer.

1. The furnace must be operating to adjust the curves.
2. Hold the “F” and “A” together on the display until it prompts “CodE”, then enter the Service Level passcode.
3. Navigate to Parameter 400 and enter the submenu.
4. At a given firing point (P-point), adjust the fuel by holding “F” and press the “+” or “-“ buttons; adjust the air by holding “A” press the “+” or “-“ buttons.
5. After adjustment, ensure that clean, efficient combustion is occurring throughout the entire range of the combustion curve.

Restore/Backup to Factory Defaults

If an issue arises with the flame safeguard (FSG), it can be restored to its original condition from the Daikin Applied factory. The AZL display has a backup file pushed to it during its Factory Checkout. The AZL display can, therefore, be used as a restore device.

Restoring from the AZL display curves requires Service Level access. Contact Daikin Applied for the Service Level password or to purchase a Service Level OCI programmer.

1. Navigate to Parameter 050 and enter the submenu.
2. Select “Restore”.
3. Set parameter to 1 and press “Enter” to begin the restore. When the value changes back to 0, the restore was completed successfully. If the value changes to any other number besides 0, see error code 137 for the cause of the failure.

The AZL can also be used to backup the parameter set of the LMV3. The procedure is the same as the above, except “Backup” is selected instead of “Restore”.

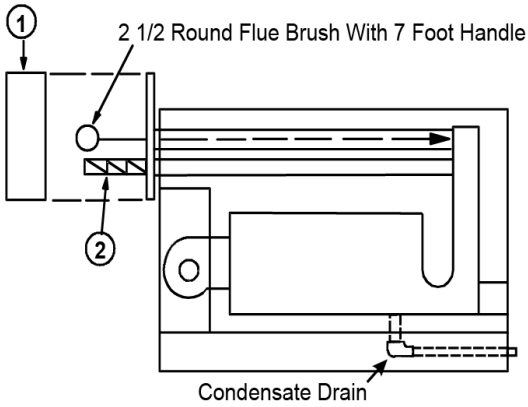
For additional details on the procedure, see the LMV3 series manual.

Cleaning Heat Exchangers

NOTE: Refer to Figure 27.

1. Remove the flue box front wrap (1).
2. Remove and clean the turbulator (2) from each tube and clean the flue box.
3. Inspect for obstructions and signs of turbulator degradation. Replace as required.
4. Clean each tube with a 2-1/2 in. round flue brush.
5. Reinstall a turbulator in each tube approximately flush with the tube ends.
6. Reinstall the flue box front wrap (1).

Figure 27: Models 800 through 3000 Heat Exchanger



Leakage Symptoms

1. **Odor** - Odors in the building are usually brought in through the outdoor air intakes and do not indicate leakage from the furnace. Check for down draft conditions and check for location of the flue exhausts of other equipment that may be pulled into the outdoor air intake. A major and obvious furnace rupture can be a source of odor. In general, small leaks in a furnace will not be a source of odor because the pressure created by the supply fan is greater than the pressure inside the furnace. Therefore, when the supply fan is operating, leakage will be into the furnace, not out of the furnace and into the air stream. If the control system is such that the furnace comes ON and warms up the heat exchanger before the supply air fan comes ON, and there is odor when the supply fan first comes ON, this could be caused by leakage. During the time the furnace is ON and the supply fan is OFF, the leakage would be out off the furnace. Then, when the supply fan came ON, it would blow those products of combustion into the supply duct.
2. **Low CO_2 Readings** - Low CO_2 readings that cannot be corrected can be caused by air leaking into the heat exchanger and diluting the flue gas. If this is suspected, take two consecutive CO_2 readings, one with the supply fan running and one with the supply fan OFF. If the CO_2 increases with the supply fan OFF, it could indicate leakage. Note that CO_2 samples must be taken from inside a tube, not just from inside the flue box, see Figure 26 on page 21.

⚠ CAUTION

CO_2 reading taken when the supply fans are off must only be attempted by qualified service personnel. The furnace temperature will rise extremely fast, and damage to the equipment or property may result.

Checking For Leaks

1. **Visually inspect the heat exchanger** using light, bubble detection, or other methods.
2. **Perform consecutive CO_2 tests** with supply fan OFF and ON. See "Leakage Symptoms" on page 23.
3. **Smoke Bomb Test** - cover the openings of the flue, remove the bottom flue panel, and insert a smoke bomb into one of the secondary tubes. Reinstall the bottom flue panel and, using a bright light, visually inspect the heat exchanger inside the cabinet, looking for any smoke leaking through the heat exchanger. Remove the remains of the smoke bomb and uncover the flue box openings before attempting to operate the furnace.

Causes of Failures

1. **Improper Application** - The furnace rating plate specifies a “Minimum Airflow CFM.” The furnace must not be operated when airflow is below this minimum cfm. If the furnace is being used on a variable air volume system, the control system must be such that the furnace will not operate when the supply fan cfm has fallen below this minimum specified cfm. The furnace rating plate also specifies a “Maximum MBh Input” which must not be exceeded. See "Verify Input Rate" on page 21.
2. **Control Failure** - The limit control does not function properly and shuts off the burner when the heat exchanger temperature becomes excessive. In most situations, a properly controlled unit will never require the limit control to shut off the unit. The limit control should be a backup control; a problem attributed to a limit failure generally indicates a control problem in addition to the limit failure.
3. **Excessive Condensation** - Applications which will produce condensation require an all stainless steel heat exchanger to be resistant to the effects of this condensation and to give longer heat exchanger life. The likelihood of condensation increases with:
    a. Colder supply air temperature across the secondary tubes, as on units taking in a lot of outdoor air in colder weather.
    b. Lower heat flow through the secondary tubes, as on modulating burners when operating at reduced input.
    c. High airflow across the secondary tubes such as any application with a low temperature rise furnace.
4. **Chemical Deterioration** - Refrigerant leaks, some aerosol can propellants, fumes from dry cleaning establishments, beauty shops, swimming pools, and others, often have detrimental effects on heat exchangers when they get into the combustion air supply and thereby into the combustion. Even fumes from nearby roof exhaust fans can cause problems.
5. **Inadequate or Distorted Airflow** - Internal baffles that have been repositioned or that have loosened up and moved can distort the airflow and cause failures. Construction rubbish, shipping cartons, and insulation that has come loose can end up inside a unit and block airflow to part of the furnace, resulting in a failure. Or these items can alter the air or heat flow to the fan limit or some other control and contribute to a failure.

Replacing a Heat Exchanger

1. Remove the complete flue box, the tube sheet through which the flue tubes pass, and the cabinet panel.
2. Remove the complete gas train.
3. Remove the complete burner. The burner is mounted on and supported by studs and nuts on the heat exchanger studs.
4. When it is necessary to remove any air baffles surrounding the heat exchanger, carefully note the locations and clearances of these baffles before removing them so they can be replaced in the exact same position.
5. Remove any other support provisions on the front and rear of the heat exchanger and any other cabinet panels to allow for removal of the heat exchanger.
6. Withdraw the heat exchanger through the front or read of the cabinet, depending on what field conditions allow.

Furnace Condensation

A furnace will produce condensation when the flue gas temperature falls below its dew point temperature. A more efficient furnace will transfer more of its heat into the conditioned air, and leave less heat in the flue gas. This results in a lower flue gas temperature and more condensate.

A modulating burner will produce more condensate than an ON-OFF burner. As the firing rate of the burner is reduced, the flue gas temperature will be reduced, and more condensate may be produced.

A furnace that is heating a high percentage of outside air will also produce more condensate. The colder the air contacting the heat exchanger, the lower the resulting flue gas temperature, and consequently the more condensate.

A furnace that produces condensate is normal. However, suitable steps must be taken to manage the flow of the condensate produced.

Most condensate will be produced in the secondary tubes where flue gas will be swept it into the flue box and exit via the condensate drain. Condensate will also come from the combustion chamber.

Condensate may also drip from the outer corners of the flue box. Condensate should not be running down the unit, except at times when wind may blow the dripping condensate mentioned above.

Maintenance

Planned maintenance is the best way to avoid unnecessary expense and inconvenience. Have this system inspected at regular intervals by a trained and experienced service technician. The following service intervals are typical for average situations but will have to be adjusted to suit your particular circumstances.

Fuel pressure settings, control settings, and linkage adjustments should be made only by persons thoroughly experienced with the burner and control system and must not be tampered with by persons without such experience.

Always replace covers on burner controls and boxes as the electrical components can be sensitive to dust, dirt, and temperature. Perform maintenance of flame safeguard, controls, gas valves, and other such components in accordance with instructions contained in the manufacturer's bulletins.

Monthly

Check air filters and main supply fan drives, replacing if required.

Twice Yearly

1. **Burner Air**. Check burner fan wheel for dirt buildup and lint. Check combustion air intake louver and flue box for dirt buildup and accumulation of windborne debris.
2. **Check flame signal** via the AZL display, parameter 954. If the flame rod is getting weaker over time or results in nuisance tripping, replace it.

Yearly

1. **Gas Train**. Check all valves, piping and connections for leakage. Inspect and clean flame rod, ignition electrode.
2. **Combustion**. Check quality of combustion. Test CO_2 and CO and look for irregularities in fire. If combustion characteristics have changed since the last test, determine the cause. Changes in the BTU content of gas being supplied, reduced combustion air due to a dirty blower wheel, or flue passages in need of cleaning can cause changes in CO_2 reading. When a readjustment seems necessary, do not make the adjustment without first trying to determine if the required change is not an indication that something else is in need of correction.
3. **Clean the flame rod** by marking its position with a marker on the ceramic, removing it and wiping it down with a wet rag, replace it and retighten the compression fitting.
4. **Clean the vent screens** on the inlet of the combustion blower and the bird guard on the flue opening.
5. **Cleaning**. Inspect flue tubes and combustion chamber, cleaning as required. Keep burner vestibule clean. Dirt and debris can result in burner air blockages.
6. **Flame Safeguard**. Perform a flame failure check. See control manufacturer's bulletin for further information.
7. **Motor.** Motor life can be increased by proper oiling. Oil bearings as specified by the motor manufacturer.
8. **Extended (Summer) Shutdown.** If the burner is to be out of service for an extended period of time, close the main gas shut off valve until needed.
9. **Condensate Drain.** Inspect all condensate drains for blockage. Paying special attention to the Rear Condensate Drain where debris has a higher tendency to build up.
10. **Safety Shut-Off Valve (SSOV) Air Tightness.** The SSOV shall be leak checked for an air-tight seal. One method for checking the seal is as follows:
    a. Prepare a water bottle/bucket with clean water. Have bubble detector solution ready. Close the manual ball valve downstream of the SSOV. At this point, if there is a gas regulator upstream of the SSOV, increase its regulation pressure to 14 in. WC (up to a maximum of 27 in. WC (1 psig) is also acceptable). Record the number of turns of the regulator, so it can be returned to its pre-test position. If possible, attempt to start the furnace. It will lock out due to ignition failure or high gas pressure alarm. Spray the entire gas train assembly with the bubble detector solution. Ensure no leaks are observed on any joints or fittings. If leaks are observed, correct before proceeding.
    b. Attach a barb and soft tubing to the test port in the center of the double blocking valve (which checks for air tightness of the upstream blocking valve). Insert the other end of the tubing into the water bottle/bucket. Observe the tube in the water for any bubbles that appear over the course of 5 minutes. Test passes if no bubbles are observed. Remove barb fitting and seal the test port. Repeat the above bubble check procedure using one of the test ports downstream of the SSOV assembly. Observe the tube in the water for any bubbles that appear over the course of 5 minutes. Test passes if no bubbles are observed.
    c. As a final measure, a pressure decay test can be completed as follows. Attach a pressure gauge to the SSOV downstream test port with a resolution of ~1 in. WC and range of ~32 in. WC. Attempt to start the furnace, ensuring the manual ball valve is closed. It will lock out due to ignition failure or high gas pressure alarm. Monitor pressure over the course of 30 minutes. If no decay, test passes. During this time, the assembly can be sprayed with additional bubble detector to chase any leaks.
    d. Return the pressure regulator to its previous setting. Return all test ports to their previous conditions.
    e. The procedure can be carried out with compressed air instead of NG if field conditions allow it.

Troubleshooting

The LMV3 has an extensive list of fault codes to help clarify the nature of the fault. For a complete list of error and lockout codes, reference the LMV3 manual from Siemens Combustion Controls.

When a lockout occurs, the AZL will alternate between displaying “Loc:c” and “Loc:d”. The number listed after “Loc:c” is the error code, and the number listed after “Loc:d” is the diagnostic code. For example, an error code 3, diagnostic code 0 will alternate between displaying “Loc:c: 3” and “Loc:d: 0”.

If a fault occurs that does not cause a lockout, the AZL will alternate between displaying “InF:c” and “InF:d”. The number listed after “InF:c” is the error code, and the number listed after “InF:d” is the diagnostic code. These faults are intended to provide the user information even though a lockout did not occur.

The fault history is stored in the 700 set of parameters. The LMV3 stores the last 25 fault codes:

- Parameter 701 displays information about the current status of the LMV3.
- Parameter 702 displays information about the most recent fault.
- Parameter 703 displays information about the second most recent fault.
- Parameter 725 displays information about the 24th most recent fault.

Each fault code listed has indexes that provide additional information about the fault:

- Index 01 = Error code
- Index 02 = Diagnostic code
- Index 03 = Error class (not used in North America)
- Index 04 = Phase
- Index 05 = Start number
- Index 06 = Load
- Index 07 = Fuel (LMV36 only)

Often, index 05 and index 06 will display a value of “._._”. This means that the AZL display ran out of room to display the start number or load. When this happens, hold down the info button to display the value.

An example of how the AZL displays a fault code in the fault history is shown below.

Figure 28: LMV3 Fault History Example

Figure 29: Complete Error Code List

Error Code	Diag. Code	Meaning for the LMV3 System	Corrective Action
No Comm	-	No communication between the LMV3 and the AZL23	Check for a loose connection between the LMV3 and AZL23. If the connection is good, replace the cable connecting the LMV3 to the AZL23. If that does not fix the issue, replace the AZL23.
2	Any #	No flame at the end of safety time (TSA)	A flame failure occurred during lightoff. 1. Check the wiring of the ignition transformer, pilot valve, and main valve(s). 2. Check manual shutoff valves for the pilot gas and main gas. 3. Check the position of the air damper and close it further if necessary. The pilot flame might be getting blown out. 4. Check the flame detector signal in the presence of a known flame source. Replace the flame detector if it does not produce the anticipated signal.
	1	No flame at the end of safety time 1 (TSA1)	
	2	No flame at the end of safety time 2 (TSA2)	
	4	No flame at the end of safety time 1 (TSA1) (software version ≤ V02.00)	
3	Any #	Air pressure failure	A fault occurred related to the air pressure switch input X3-02.1. See diagnostic codes for more information.
	0	Air pressure off	The air pressure switch input was de-energized when it should have been energized. Make sure the blower starts in phase 22 and the switch setpoint is set appropriately.
	1	Air pressure on	The air pressure switch input was energized when it should have been deenergized. Make sure the blower turns off in phase 78 and the switch setpoint is set appropriately. If necessary, increase the setting of parameter 213.
	2	Evaluation of air pressure	Check the setting of parameter 235/335. This can only be set to 2 on pneumatic fuel train options.
	4	Air pressure on - prevention of startup	The air pressure switch input is energized, preventing the LMV3 from starting up. If other inputs besides the air pressure switch input are in the wrong state, causing a start prevention, the diagnostic code calls out what other inputs are in the wrong state.
	20	Air pressure, combustion pressure - start prevention	
	68	Air pressure, POC - start prevention	
	84	Air pressure, combustion pressure, POC - start prevention	

NOTE: Diagnostic codes are additive. If a diagnostic code appears that is not on this list, it is a combination of multiple diagnostic codes.
For complete list of error codes, see manufacturer's documentation.

Appendix

Table 5: Typical Parts List

Description	Marshall Nelson Part Number	Daikin Applied Part Number
BURNERS		
800 MBH FURNACE-208/230/480	378479	404239401
800 MBH FURNACE - 575	378480	404239402
1200 MBH FURNACE-208/230/480	378481	404241003
1200 MBH FURNACE - 575	378482	404241004
1600 MBH FURNACE-208/230/480	378481	404241003
1600 MBH FURNACE - 575	378482	404241004
2000 MBH FURNACE-208/230/480	378485	404239201
2000 MBH FURNACE - 575	378486	404239202
2400 MBH FURNACE-208/230/480	378490	404239203
2400 MBH FURNACE - 575	378491	404239204
Diffuser 800	397995	-
Diffuser 1200/1600	365415	-
Diffuser 2000	397997	-
Diffuser 2400	397996	-
Gasket Set - R06 size burner (burner mouting gasket, burner sleeve gasket, kraft paper gasket(s)	380606	-
Gasket Set - R08 size burner (burner mouting gasket, burner sleeve gasket, kraft paper gasket(s)	380605	-
BURNER HEAT EXCHANGER		
800 MBH	-	910408487
1200 MBH	-	910421846
1600 MBH	-	910421846
2000 MBH	-	910376096
2400 MBH	-	910376096
WEAR PARTS (EX. IGNITOR)		
SSOV 1-inch Full Asm	378498	910474009
SSOV 1-1/2-inch Full Asm	378600	910463792
1" SSOV Dual Valve Body	346785	-
1-1/2" SSOV Dual Valve Body	260070	-
SSOV Actuator (w/ pressure regulating)	31009	-
SSOV Actuator (no pressure regulating)	29180	-
Gas Shut-off Ball Valve - 1-1/2-inch	347995	910464394
Gas Pressure Switch - High w/ Indicator (Siemens or Dungs)	359183, 369600, or 189095	-
Gas Pressure Switch - Low w/ Indicator (Siemens or Dungs)	359183, 369600, or 189095	-
SKP Actuator NEMA 4 Gasket	167698	-
SKP Actuator Heater	279800	-
Vent Limiter for SKP w/Reg	347061	-
SSOV Flanges - 1-1/2 NPT	347059	-
Test Ports	16416	-
SQM Actuator	209355	-
SQM Heater	359182	-
7 to 10.5 in. WC NG Regulator - sized for our furnace input rates (40 MBH to 2500 MBH)	347467	-
1.5" NPT Y Strainer (protects regulator)	346048	-
BURNER CONTROLS		
Burner Management System-LMV3	196562	910462607
AZL Display (Burnner Management System Remote Display)	23733	910462638
AZL Display Comm Cable	23735	910472559
Spare Fuse Set - LMV3	347810	-
OCI 460 Modbus Gateway	347823	910462641
OCI 460 Modbus Gateway, Plug Set	353136	910462646
Combustion Fan Differential Pressure Switch (Siemens or Dungs) Dungs Version AA-A2-6-3 (set at 3 in WC)	370290 or 36991	-
IGNITOR		
Flame Rod - 16-inch (Model R06)	397994	-
Ignitor (Model R06)	349683	-
Flame Rod - 20-inch (Model R08)	358905	-
Ignitor (Model R08)	354688	-
Ignitition Transformer (8), Allanson	5175	910462657
Flame Rod Signal Booster (transformer)	364354	910472398
Ignition Wire Set	374831	910479099
INSTRUMENTS / SENSORS		
Hi-Limit, Automatic Reset, 250°F	ThermoDisc: 60T11 610080	910475796
Hi-Limit, Automatic Reset, 230°F	ThermoDisc: 60T11 65000120	910495389
Hi-Limit, Automatic Reset, 210°F	ThermoDisc: 60T11 65000119	910495387
Hi-Limit, Automatic Reset, 175°F	ThermoDisc: 60T12 65000117	910495124
Hi-Limit, Secondary, Manual Reset Style, 125°F	ThermoDisc 60T12 65000118	910475449

Table 6: Control Parameter Sets and Burner

Furnace Asm	Parameter Set PN	Cabinet	Burner Size	Burner Temperature Rise	Temperature Rise Label	Burner Turn-down	Burner ID
910408487	910474101	D	800	50	HTR	5:1	4080015
	910474102	D	800	50	HTR	20:1	4080012
	910474103	D	800	25	LTR	5:1	4080035
	910474104	D	800	25	LTR	20:1	4080032
910421846	910474105	D	1200	75	HTR	5:1	4120015
	910474106	D	1200	75	HTR	20:1	4120012
	910474107	D	1200	50	MTR	5:1	4120025
	910474108	D	1200	50	MTR	20:1	4120022
	910474109	D	1200	25	LTR	5:1	4120035
	910474110	D	1200	25	LTR	20:1	4120032
910421846	910474111	D	1600	100	HTR	5:1	4160015
	910474112	D	1600	100	HTR	20:1	4160012
	910474113	D	1600	60	MTR	5:1	4160025
	910474114	D	1600	60	MTR	20:1	4160022
	910474115	D	1600	35	LTR	5:1	4160035
	910474116	D	1600	35	LTR	20:1	4160032
910376096	910474117	D	2000	100	HTR	5:1	4200015
	910474118	D	2000	100	HTR	20:1	4200012
	910474119	D	2000	60	LTR	5:1	4200035
	910474120	D	2000	60	LTR	20:1	4200032
910376096	910474121	D	2400	100	HTR	5:1	4240015
	910474122	D	2400	100	HTR	20:1	4240012
	910474123	D	2400	60	MTR	5:1	4240025
	910474124	D	2400	60	MTR	20:1	4240022
910421846	910474125	E	1200	50	MTR	5:1	5120025
	910474126	E	1200	50	MTR	20:1	5120022
	910474127	E	1200	25	LTR	5:1	5120035
	910474128	E	1200	25	LTR	20:1	5120032
910421846	910474129	E	1600	75	HTR	5:1	5160015
	910474130	E	1600	75	HTR	20:1	5160012
	910474131	E	1600	50	MTR	5:1	5160025
	910474132	E	1600	50	MTR	20:1	5160022
	910474133	E	1600	25	LTR	5:1	5160035
	910474134	E	1600	25	LTR	20:1	5160032
910376096	910474135	E	2000	100	HTR	5:1	5200015
	910474136	E	2000	100	HTR	20:1	5200012
	910474137	E	2000	60	MTR	5:1	5200025
	910474138	E	2000	60	MTR	20:1	5200022
	910474139	E	2000	30	LTR	5:1	5200035
	910474140	E	2000	30	LTR	20:1	5200032
910376096	910474141	E	2400	100	HTR	5:1	5240015
	910474142	E	2400	100	HTR	20:1	5240012
	910474143	E	2400	60	MTR	5:1	5240025
	910474144	E	2400	60	MTR	20:1	5240022
	910474145	E	2400	30	LTR	5:1	5240035
	910474146	E	2400	30	LTR	20:1	5240032

Table 7: Parameters Common to All Burners

Parameter #	Parameter Name	Default Programmed Value	DAA Programmed Value	Range	Description of Parameter
041	Service Level PW	9876	9876	Any 4 characters	The service level password can be changed here. It must be exactly 4 characters in length. Enter the same password twice to change it (n = new, r = repeat).
123	Min Load Change	123:00 - 0% 123:01 - 1% 123:02 - 0%	123:00 - 0% 123:01 - 1% 123:02 - 0%	0-100%	This serves as a dead band for load changes. If the requested change in fire rate is less than the setting of this parameter, the actuators (and VSD) will not move. Settings of 5% or above may be counterproductive, not permitting the boiler to closely match the load which may in turn cause hunting. Index 00 = fire rate via Modbus (terminal X92) Index 01 = fire rate via analog input (terminal X64) Index 02 = fire rate via 3-position input (terminal X5-03)(LMV37 only)

Parameter #	Parameter Name	Default Programmed Value	DAA Programmed Value	Range	Description of Parameter
124	TUV Test	-6 - 1	-7	-7	Activates the loss of flame test (TUV test). Setting this parameter to 1 starts the test. A value of 0 is returned when the test is completed successfully. A negative value is returned if the test was unsuccessful. See error code 150 for the cause of an unsuccessful test.
125	Mains Frequency	1	1	0-1	Sets the mains frequency: 0 = 50 Hz (Europe) 1 = 60 Hz (US)
133, 134	Load for TUV	Not set	20%	20-100%	This sets the load for the loss of flame test (TUV test).
141	Modbus Activation	0	1	0-2	Sets the Modbus operating mode: 0 = off (inactive) 1 = on (active) 2 = not used
142	Modbus Watchdog	120	60	0-7200 sec	If no communication occurs for this period of time, the LMV3 considers the Modbus to be unavailable and will look for a fire rate command from another source (see parameter 942 for more details). A setting of 0 makes the timeout inactive and the LMV3 will wait for the Modbus communication to be available again.
145	Modbus Address	1	1	1-247	Sets the LMV3 address for Modbus (job specific).
146	Baud Rate	1	1	0-1	Sets the baud rate of the Modbus port X92: 0 = 9600 bit/s 1 = 19200 bit/s
147	Parity	0	0	0-2	Sets the parity of the Modbus port X92: 0 = none 1 = odd 2 = even
148, 149	Default Load	Not Set	0%	0-100%	This sets the fire rate when Modbus communication is interrupted. A setting from 20-100% will set the output of the burner. A setting of 0-19.9% will shut down the burner.
186, 187	Flame Failure Response Time (FFRT)	0	186:00 - 0 186:01 - 30	0-30	Sets the flame failure response time (FFRT). The LMV3 has a base flame failure response time of approximately 1 second. This setting adds tenths of a second to the base time. For example, the maximum setting of 30 adds 3 seconds to the 1 second base time for a total flame failure response time of 4 seconds. Index 00 = Flame failure response time when using a QRB... flame scanner Index 01 = Flame failure response time when using a QRA... flame scanner or a flame rod
190	Lockout Position	0	0	0-1	This setting determines the position that the actuators and VSD will drive to when a lockout occurs: 0 = home position 1 = postpurge position
194	Repetition Safe 1	1	2	1-4	Sets the number of times the LMV3 will attempt to light-off when a flame failure occurs during pilot trial for ignition or main trial for ignition. After this number of tries, a lockout will occur. Cycle power to the LMV3 after changing this parameter.
196	Repetition APS	1	1	1-2	Sets the number of times the LMV3 will attempt to proceed past phase 24 when the air pressure switch input X3-02.1 is not energized. After this number of tries, a lockout will occur.
197	Flame Sensitivity	0	0	0-1	Sets the flame signal sensitivity during phases 60 to 70 for ION (flame rod) and UV flame detectors. 0 = standard sensitivity 1 = high sensitivity
198	Flame Sensitivity Switch Point	4	4	2-9	Sets the switching point on the fuel / air ratio curve for high flame sensitivity. 2 = no switching point (always high sensitivity) 3-9 = sets the point (P3-P9) to switch back to standard sensitivity
199	Repetition Actuator Position	3	3	1-3	Sets the number of times the LMV3 will recycle if there is a issue moving the actuators to the commandedpositions. After this number of repetitions, a lockout will occur. 1 = no repetitions 2 = 1 repetition 3 = 2 repetitions
201, 301	Fuel Train**	Not set	1	1-29	Sets the fuel train. There are 29 options available. See section 4 for details about each option. Setting this parameter to undefined (----) will delete any existing fuel curves.
210	Alarm Start Prevent	1	1	0-1	Determines if the alarm output X3-05.2 will be energized in the event of a start prevention (an alarm in standby). The LMV3 will wait 5 seconds after receiving a call for heat before displaying the start prevention on the AZL. 0 = deactivated 1 = activated
211	Fan Ramp Up Time	2	2	2-60 sec	Sets the length of phase 22, which is the time allowed to let the fan accelerate up to speed before the actuators start driving to prepurge position.
212	Max Time Low Fire	45	45	0.2-600 sec	The allowable time to let the LMV3 drive to low fire before shutting the fuel valves after a call for heat has been removed from input X5-03.1. In summary, this sets the maximum time for phase 62. This setting does not affect fuel valve closing time in the event of a safety shutdown.

Parameter #	Parameter Name	Default Programmed Value	DAA Programmed Value	Range	Description of Parameter
213	Min Time Home Run	2	2	2-60 sec	Sets the minimum time that the LMV3 will stay in phase 10 before proceeding to phase 12. The time does not start until the actuators have finished moving (referencing and driving to home position).
214	Max Time Start Release	35	35	0.2-600 sec	On gas trains, this sets the maximum amount of time before input X5-01.2 must be energized after receiving a call for heat. Typically a low gas pressure switch and / or other start releases are wired to input X5-01.2 on gas trains. On oil trains, this sets the maximum amount of time before input X5-02.2 must be energized after receiving a call for heat. Typically a high oil pressure switch and / or other start releases are wired to input X5-02.2 on oil trains.
215	Repetition SL	1	16	1-16	Sets how many times the LMV3 will attempt to restart without manual reset when the safety loop is opened. This parameter should always be set to 1 (no repetitions). A setting of 16 indicates unlimited repetitions.
217	Max Time Home Run	30	30	5-600 sec	Sets the maximum time to satisfy all conditions required in phase 10 (home run). Two of the conditions that must be met are the air pressure switch input X3-02.1 is de-energized and the actuators have reached their home position. On oil trains, this also sets the maximum time to satisfy the low oil pressure switch in phase 38. The low oil switch is wired to input X9-04.2. This parameter only has effect on the low oil pressure switch if parameter 276 (fuel 0) or 376 (fuel 1) are set to 1. If parameter 276 or 376 are set to 2, the low oil pressure switch must be made by the beginning of safety time 1 (phase 40).
221	Flame Detector Select	1	1	0-1	This parameter sets the type of flame scanner that is connected to the LMV3. 0 = QRB… flame scanner (Europe) 1 = QRA… flame scanner or flame rod (North America)
222	Prepurge	1	1	0-1	Activates or deactivates prepurge. It is recommended that the prepurge be activated for most burners in North America. 0 = deactivated 1 = activated
223	Repetition LGPS	1	1	1-16	Sets how many times the LMV3 will attempt to proceed past phase 22 if the low gas pressure switch and / or other start releases wired to input X5-01.2 are not made. After this number of tries, a lockout will occur. A setting of 16 indicates unlimited repetitions.
225	Prepurge Time	30	30	5-3600 sec	Sets the prepurge time (phase 30). Prepurge time will begin once the actuators / VSD have reached their prepurge positions and the air pressure switch input X3-02.1 is energized.
226	Pre-Ignition Time	2	2	0.4-3600 sec	The period of time that the ignition transformer (output X4-02.3) is energized before the pilot valve (output X7-02.3) for piloted fuel trains. The function is similar for direct ignition fuel trains, except that the timing is before the main valves (outputs X8-02.1 and X7-01.3) instead of the pilot valves. In summary, sets the length of phase 38. On oil trains, this setting has no effect if parameter 281 (fuel 0) or 381 (fuel 1) is set to 1.
227	Safety Time 1	5	6	1-10 sec	When a fuel train with a pilot is used, this setting defines the overlap of the spark (output X4-02.3) and the pilot valve (output X7-02.3). After this time expires, the spark is de-energized but the pilot valve remains open if a flame is still present. If a flame is not sensed, a lockout will occur. If directly spark igniting the main fuel, this defines the overlap of the spark and the main fuel valves (outputs X8-02.1 and X7-01.3). This time is also known as TSA1. In summary, sets the length of phases 40-42.
229	Pressure Reaction Time	1.8	1.8	0.4-9.6 sec	Sets the time that the LMV3 will ignore the high and low gas pressure switch inputs after the main valves open. This is done so that pressure spikes do not cause erroneous alarms on properly adjusted automatic reset pressure switches. This parameter does not work with manual reset pressure switches.
230	Interval 1	2	2	0.4-60 sec	When a fuel train is selected that has a pilot, this setting defines the pilot stabilizing period. This time begins after TSA1 expires. During this period, only the pilot valve is open. The spark is de-energized. If directly spark igniting the main fuel, this defines the main stabilizing period. In summary, sets the length of phase 44.
233	Afterburn Time	8	8	0.2-60 sec	This setting defines the permissible time for a flame to be detected after the main fuel valves are closed without causing an alarm.
234	Postpurge Time 1	15	30	0.2-6480 sec	This setting defines the mandatory postpurge time. If a call for heat exists during this time, the LMV3 will still continue to postpurge until this time expires. See parameter 248/284/348/384 for information on the optional postpurge time. Sets the length of phase 74.
235	Air PS	1	1	1-2	Sets the behavior of the air pressure switch (input X3-02.1): 1 = must be energized from prepurge through postpurge (phases 24-78) 2 = same as option 1 except the input can be de-energized during phases 60-66 without an alarm (only permitted on pneumatic fuel train options - see parameters 201/301)
236	Low Gas PS	1	1	1-3	Sets the location of the low gas pressure switch (input X5-01.2): 1 = before upstream shutoff valve V1 2 = between shutoff valves V1 and V2 (low gas pressure switch is also used as valve proving pressure switch) 3 = downstream of shutoff valves V1 and V2 (for B149.3 compliance)
237	High Gas PS	2	2	1-4	This setting defines the function of input X5-02.2 on gas trains: 1 = high gas pressure switch 2 = POC 3 = valve proving pressure switch 4 = speed dependent air pressure switch

Parameter #	Parameter Name	Default Programmed Value	DAA Programmed Value	Range	Description of Parameter
239	Forced Intermittent	1	0	0-1	When activated, this forces the LMV3 to shut the burner down every 23 hours, 45 minutes of uninterrupted operation. The burner will automatically restart afterwards. The purpose of the shutdown is to check and cycle safety devices. Activating this feature is highly recommended if a non-self check flame scanner is used. 0 = deactivated 1 = activated
240	Repetition Flame	1	1	1-2	This sets the numbers of times a flame failure must occur before causing a lockout. Most North American codes require 1. Cycle power to the LMV3 after changing this parameter.
241	Valve Proving	0	0	0-3	This setting determines if gas valve proving (leak testing) will be performed. Gas valve proving can be performed on startup, shutdown, or both. If 0 is selected, valve proving will not be performed. 0 = no valve proving 1 = valve proving on startup 2 = valve proving on shutdown 3 = valve proving on startup and shutdown
242	VP Evacuation Time	3 sec	If no valve proving, negligible	0.2-10 sec	If valve proving is performed, this specifies the length of time that the downstream valve (V2) is energized (output X7-01.3). This will evacuate any gas that might exist between the gas valves. Sets the length of phase 80. Note: The time it takes for the gas valve to be at least half open must be less than the maximum value for this parameter.
243	VP Upstream Test	10 sec	If no valve proving, negligible	0.2-60 sec	If valve proving is performed, this specifies the length of time that both the upstream and downstream valves are closed. If the pressure between the valves rises during this period (enough to open the NC valve proving pressure switch), then the upstream valve is leaking and the LMV3 will lockout. A longer time period will produce a more sensitive test. Sets the length of phase 81.
244	VP Fill Time	3 sec	If no valve proving, negligible	0.2-10 sec	If valve proving is performed, this specifies the length of time that the upstream valve (V1) is energized (output X8-02.1). This will fill the volume between the main gas valves to line pressure. Sets the length of phase 82. Note: The time it takes for the gas valve to be at least half open must be less than the maximum value for this parameter.
245	VP Downstream Test	10 sec	If no valve proving, negligible	0.2-60 sec	If valve proving is performed, this specifies the length of time that both the upstream and downstream valves are closed. If the pressure between the valves falls during this period (enough to close the NC valve proving pressure switch), then the downstream valve is leaking and the LMV3 will lockout. A longer time period will produce a more sensitive test. Sets the length of phase 83.
248	Postpurge Time 3	1 sec	1 sec	1-6480 sec	This setting defines the optional postpurge time. If a call for heat exists during this time, the LMV3 stops postpurging immediately and goes directly to standby. Once the air pressure switch is proven open and the actuators reach their home positions, the burner will startup provided a call for heat still exists. See parameter 234/274/334/374 for information on the mandatory postpurge time. Sets the maximum length of phase 78.
501	Special Position Fuel	00 = 0° 01 = 0° 02 = 15	00 = 0° 01 = 0° 02 = 15	0-90°	This sets the special positions for the fuel actuator: Index 00 = home position Index 01 = prepurge position Index 02 = postpurge position
502	Special Position Air	00 = 0° 01 = 90° 02 = 45°	00 = 0° 01 = 90° 02 = 45°	0-90°	This sets the special positions for the air actuator: Index 00 = home position Index 01 = prepurge position Index 02 = postpurge position
544	Modulation Ramp	32 sec	32 sec	32-80 sec	This setting controls the speed at which the actuators will ramp during phases 60-62 (fuel valves open). The time chosen is how long it would actually take for the actuators to drive from 0-90°. During all other phases, the actuator ramp speed is fixed depending on the model of the SQM33 actuator being used (SQM33.5 = 5 sec, SQM33.7 = 17 sec). If using a VSD, this time should be set at least 20% longer than the longest VSD ramp time (parameters 522 and 523).
545	Load Low Fire	Not set	20%	20-100%	Sets the low fire load. During normal operation, the burner will not modulate below this point.
546	Load High Fire	Not set	100%	20-100%	Sets the high fire load. During normal operation, the burner will not modulate above this point.
601	Reference Point**	601:00 = 1 601:01 = 0	601:00 = 1 601:01 = 0	0-1	Determines the reference point of the SQM33 actuators. The actuators will reference after a normal shutdown, lockout, or loss of power to the LMV3. In order to reference, the actuators must drive outside of their 0-90° operating range. This parameter sets whether the actuators will reference closed (<0°) or open (>90°). Index 00 = fuel actuator. Index 01 = air actuator 0 = closed (<0°) 1 = open (>90°) Note: The reference point of the air actuator can only be set under parameter 601 and is not displayed under parameter 608.
602	Rotation Direction**	602:00 = 0 602:01 = 0	602:00 = 0 602:01 = 0	0-1	Determines the direction of rotation of the SQM33 actuators. The descriptions of the rotation are valid when the actuator shaft is pointed at your eye. Index 00 = fuel actuator. Index 01 = air actuator 0 = counterclockwise 1 = clockwise Note: The direction of rotation of the air actuator can only be set under parameter 602 and is not displayed under parameter 609.

Parameter #	Parameter Name	Default Programmed Value	DAA Programmed Value	Range	Description of Parameter
606	Position Tolerance	606:00 = 1.7° 606:01 = 1.7°	606:00 = 1.7° 606:01 = 1.7°	0.5-4.0°	Determines the allowed tolerance on the position of the actuators. If the actuator's position differs by greater than this amount from the expected position, a lockout occurs. The default setting of 1.7° is recommended. Index 00 = fuel actuator. Index 01 = air actuator Note: The allowed tolerance of the air actuator can only be set under parameter 606 and is not displayed under parameter 610.
613	Actuator Type	613:00 = 0 613:01 = 0	613:00 = 0 613:01 = 0	0-2	Determines the type of actuators being used. Index 00 = fuel actuator. Index 01 = air actuator 0 = SQM33.5... actuators (27 in-lb, 5 sec / 90°) 1 = Not used 2 = SQM33.7... actuators (90 in-lb, 17 sec / 90°) Note: The type of air actuator being used can only be set under parameter 613 and is not displayed under parameter 614.
Parameter Values Unique to Burner ID					
113	Burner ID LMV3	Not Set	See "Burner" tab	0-99999999	The burner ID is set here. The burner ID must be all digits (no letters), from 1-8 digits in length. Typically the burner / boiler serial number is used. This serves as an identifier for the parameter set. The burner ID must be set in order to perform a parameter backup.
124	TUV Test	-6 - 1	-7	-7	Activates the loss of flame test (TUV test). Setting this parameter to 1 starts the test. A value of 0 is returned when the test is completed successfully. A negative value is returned if the test was unsuccessful. See error code 150 for the cause of an unsuccessful test.
133, 134	Load for TUV	Not set	20%	20-100%	This sets the load for the loss of flame test (TUV test).
141	Modbus Activation	0	1	0-2	Sets the Modbus operating mode: 0 = off (inactive) 1 = on (active) 2 = not used
142	Modbus Watchdog	120	60	0-7200 sec	If no communication occurs for this period of time, the LMV3 considers the Modbus to be unavailable and will look for a fire rate command from another source (see parameter 942 for more details). A setting of 0 makes the timeout inactive and the LMV3 will wait for the Modbus communication to be available again.
148, 149	Default Load	Not Set	0%	0-100%	This sets the fire rate when Modbus communication is interrupted. A setting from 20-100% will set the output of the burner. A setting of 0-19.9% will shut down the burner.
186, 187	"Flame Failure Response Time (FFRT)"	0	30	0-30	Sets the flame failure response time (FFRT). The LMV3 has a base flame failure response time of approximately 1 second. This setting adds tenths of a second to the base time. For example, the maximum setting of 30 adds 3 seconds to the 1 second base time for a total flame failure response time of 4 seconds. Index 00 = Flame failure response time when using a QRB... flame scanner Index 01 = Flame failure response time when using a QRA... flame scanner or a flame rod
194	Repetition Safe 1	1	2	1-4	Sets the number of times the LMV3 will attempt to light-off when a flame failure occurs during pilot trial for ignition or main trial for ignition. After this number of tries, a lockout will occur. Cycle power to the LMV3 after changing this parameter.
201, 301	Fuel Train**	Not set	1	1-29	Sets the fuel train. There are 29 options available. See section 4 for details about each option. Setting this parameter to undefined (----) will delete any existing fuel curves.
215	Repetition SL	1	16	1-16	Sets how many times the LMV3 will attempt to restart without manual reset when the safety loop is opened. This parameter should always be set to 1 (no repetitions). A setting of 16 indicates unlimited repetitions.
227	Safety Time 1	5	4	1-10 sec	When a fuel train with a pilot is used, this setting defines the overlap of the spark (output X4-02.3) and the pilot valve (output X7-02.3). After this time expires, the spark is de-energized but the pilot valve remains open if a flame is still present. If a flame is not sensed, a lockout will occur. If directly spark igniting the main fuel, this defines the overlap of the spark and the main fuel valves (outputs X8-02.1 and X7-01.3). This time is also known as TSA1. In summary, sets the length of phases 40-42.
234	Postpurge Time 1	15	30	0.2-6480 sec	This setting defines the mandatory postpurge time. If a call for heat exists during this time, the LMV3 will still continue to postpurge until this time expires. See parameter 248/284/348/384 for information on the optional postpurge time. Sets the length of phase 74.
239	Forced Intermittent	1	0	0-1	When activated, this forces the LMV3 to shut the burner down every 23 hours, 45 minutes of uninterrupted operation. The burner will automatically restart afterwards. The purpose of the shutdown is to check and cycle safety devices. Activating this feature is highly recommended if a non-self check flame scanner is used. 0 = deactivated 1 = activated
242	VP Evacuation Time	3 sec	If no valve proving, negligible	0.2-10 sec	If valve proving is performed, this specifies the length of time that the downstream valve (V2) is energized (output X7-01.3). This will evacuate any gas that might exist between the gas valves. Sets the length of phase 80. Note: The time it takes for the gas valve to be at least half open must be less than the maximum value for this parameter.

Parameter #	Parameter Name	Default Programmed Value	DAA Programmed Value	Range	Description of Parameter
243	VP Upstream Test	10 sec	If no valve proving, negligible	0.2-60 sec	If valve proving is performed, this specifies the length of time that both the upstream and downstream valves are closed. If the pressure between the valves rises during this period (enough to open the NC valve proving pressure switch), then the upstream valve is leaking and the LMV3 will lockout. A longer time period will produce a more sensitive test. Sets the length of phase 81.
244	VP Fill Time	3 sec	If no valve proving, negligible	0.2-10 sec	If valve proving is performed, this specifies the length of time that the upstream valve (V1) is energized (output X8-02.1). This will fill the volume between the main gas valves to line pressure. Sets the length of phase 82. Note: The time it takes for the gas valve to be at least half open must be less than the maximum value for this parameter.
245	VP Downstream Test	10 sec	If no valve proving, negligible	0.2-60 sec	If valve proving is performed, this specifies the length of time that both the upstream and downstream valves are closed. If the pressure between the valves falls during this period (enough to close the NC valve proving pressure switch), then the downstream valve is leaking and the LMV3 will lockout. A longer time period will produce a more sensitive test. Sets the length of phase 83.
248	Postpurge Time 3	1 sec	1 sec?	1-6480 sec	This setting defines the optional postpurge time. If a call for heat exists during this time, the LMV3 stops postpurging immediately and goes directly to standby. Once the air pressure switch is proven open and the actuators reach their home positions, the burner will startup provided a call for heat still exists. See parameter 234/274/334/374 for information on the mandatory postpurge time. Sets the maximum length of phase 78.
400	Ratio Control**	Not set	See Combustion Curves tab	Points 0-9	This is where actuator position curves and VSD speed curves are set from low to high fire. These position curves determine the fuel-air ratio for the burner across the firing range. Nine points must be set from low to high fire (P1-P9) in addition to the ignition point (P0). See Section 4 for more information on commissioning.
545	Load Low Fire	Not set	20%	20-100%	Sets the low fire load. During normal operation, the burner will not modulate below this point.
546	Load High Fire	Not set	100%	20-100%	Sets the high fire load. During normal operation, the burner will not modulate above this point.

Table 8: Gas & Damper Curves

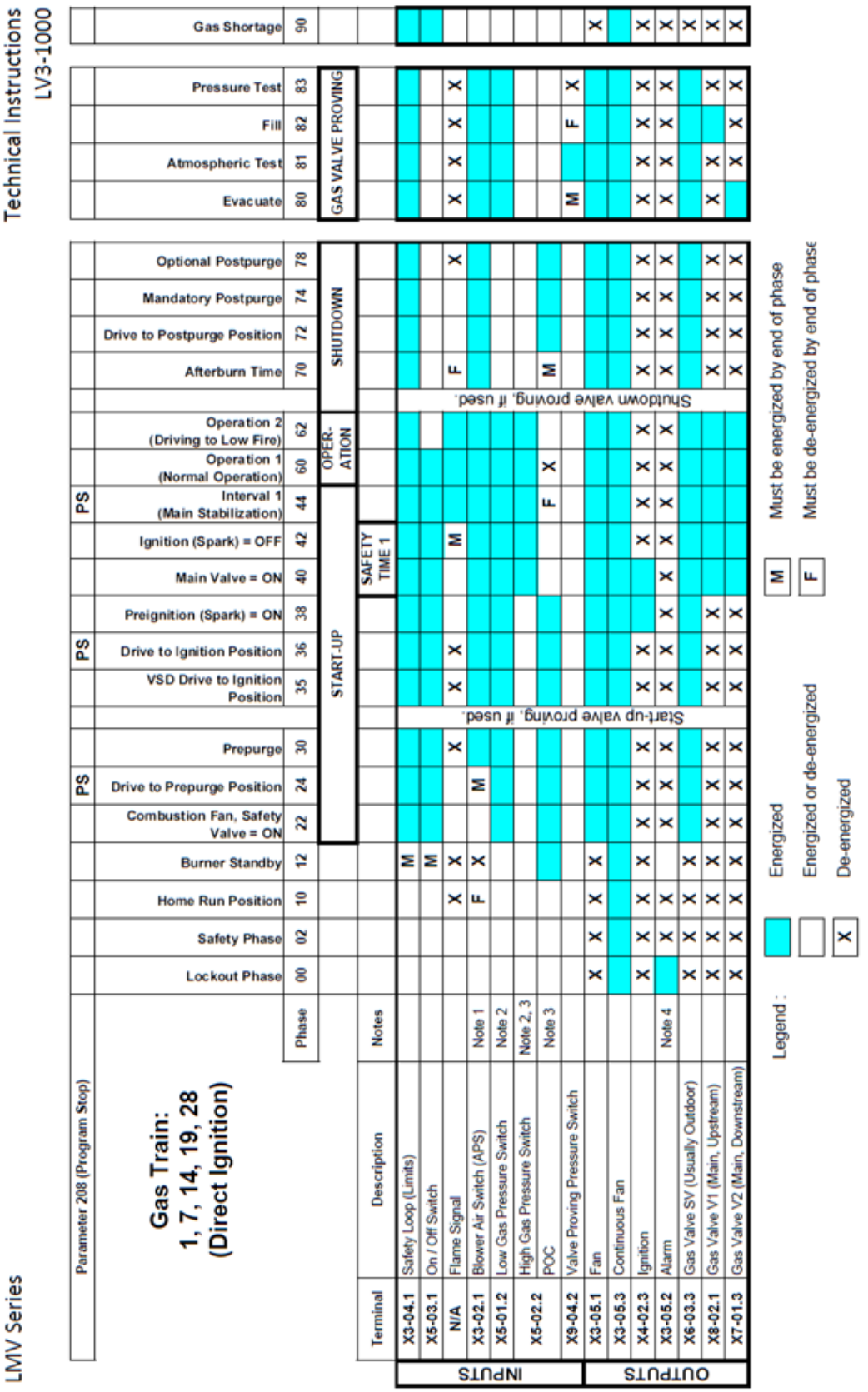
				Combustion Curve Points (82.0% target)									
Furnace Size	**Turndown**	**Temp. Rise**	**Actuator Position (degrees)**	**P0 (Ignition)**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**
800 D	20:1	HTR	Gas	5.0	3.1	12.1	17.3	22.4	26.9	30.9	33.8	39.4	48.5
			Air	10.0	4.0	20.0	32.0	40.8	42.6	44.1	43.4	44.8	46.8
		LTR	Gas	5.0	2.6	11.8	17.0	22.4	27.0	30.7	34.7	39.5	48.7
			Air	10.0	4.0	19.0	29.6	42.2	43.8	44.5	43.6	44.8	45.7
	5:1	HTR	Gas	5.0	13.4	17.7	22.0	25.8	29.2	32.1	35.2	40.2	48.5
			Air	10.0	23.0	32.7	40.1	42.2	43.5	43.8	43.8	45.0	46.8
		LTR	Gas	5.0	13.1	17.5	22.0	25.9	29.2	32.4	35.9	40.3	48.7
			Air	10.0	21.7	30.7	41.2	43.4	44.2	44.1	43.9	44.9	45.7
1200 D	20:1	HTR	Gas	5.0	8.7	18.2	24.6	30.0	34.6	38.8	43.1	49.6	52.0
			Air	10.0	4.5	17.0	26.7	36.0	44.5	46.7	48.1	47.4	50.6
		MTR	Gas	5.0	9.5	18.2	24.6	30.0	34.8	38.8	43.1	47.3	52.0
			Air	10.0	3.5	15.0	20.2	36.0	45.0	52.0	52.7	53.5	55.0
		LTR	Gas	5.0	9.1	17.8	24.1	29.3	33.8	37.6	41.6	45.4	50.0
			Air	10.0	3.5	15.5	23.1	31.5	40.5	45.6	46.7	48.1	49.0
	5:1	HTR	Gas	5.0	19.8	25.1	29.6	33.5	37.1	40.6	44.7	49.8	52.0
			Air	10.0	19.4	27.5	35.2	42.4	45.8	47.3	47.9	47.7	50.6
		MTR	Gas	5.0	19.8	25.1	29.6	33.6	37.1	40.6	44.2	47.7	52.0
			Air	10.0	16.3	21.5	34.7	42.8	49.1	52.3	52.9	53.6	55.0
		LTR	Gas	5.0	19.4	24.5	28.9	32.7	36.0	39.3	42.6	45.8	50.0
			Air	10.0	17.4	23.8	30.8	38.3	43.5	46.1	47.1	48.2	49.0
1600 D	20:1	HTR	Gas	5.0	9.3	20.2	28.0	34.6	40.7	47.2	54.3	64.4	81.8
			Air	10.0	5.0	16.0	28.0	33.5	44.5	56.0	61.1	63.3	68.0
		MTR	Gas	5.0	9.3	20.0	27.8	34.0	40.0	46.4	53.5	64.2	81.8
			Air	10.0	5.0	22.0	29.0	35.5	44.5	60.3	59.8	63.0	68.6
		LTR	Gas	5.0	9.3	20.0	27.6	34.0	40.0	46.3	52.9	62.3	80.7
			Air	10.0	5.0	20.0	28.0	32.5	43.0	52.5	61.6	64.2	68.7
	5:1	HTR	Gas	5.0	22.2	28.6	34.1	39.2	44.5	50.2	56.8	66.0	81.8
			Air	10.0	19.0	28.5	33.0	41.8	51.2	58.1	61.7	63.7	68.0
		MTR	Gas	5.0	22.0	28.3	33.5	38.5	43.7	49.4	56.2	65.8	81.8
			Air	10.0	23.8	29.5	35.0	42.3	53.7	60.1	60.6	63.5	68.6
		LTR	Gas	5.0	21.9	28.1	33.5	38.5	43.7	49.1	55.3	64.0	80.7
			Air	10.0	22.0	28.4	32.1	40.4	48.5	56.3	62.3	64.6	68.7
2000 D	20:1	HTR	Gas	5.0	7.6	15.5	21.6	27.1	32.3	36.8	42.7	50.4	71.0
			Air	10.0	8.7	17.5	34.0	47.5	61.0	60.4	64.2	70.5	84.0
		LTR	Gas	5.0	7.6	15.5	21.6	26.8	32.0	36.8	42.6	49.8	66.6
			Air	10.0	8.3	16.5	32.0	43.0	69.0	71.0	82.0	90.0	90.0
	5:1	HTR	Gas	5.0	17.2	22.2	26.7	31.3	35.3	39.7	44.8	52.5	71.0
			Air	10.0	20.0	28.0	45.0	58.5	59.4	62.0	66.0	74.0	84.0
		LTR	Gas	5.0	17.3	22.1	26.5	31.0	35.1	39.6	44.8	52.1	66.6
			Air	10.0	19.5	29.0	41.0	52.0	69.5	78.3	90.0	90.0	90.0
2400 D	20:1	HTR	Gas	5.0	8.5	17.3	23.6	29.5	35.2	40.3	45.7	52.8	67.5
			Air	10.0	9.0	17.5	25.7	37.5	45.2	46.0	47.0	48.5	51.4
		LTR	Gas	5.0	8.4	17.2	23.7	29.2	34.8	41.5	47.9	56.2	76.7
			Air	10.0	8.0	17.0	26.0	34.5	43.2	54.0	56.0	56.9	57.9
	5:1	HTR	Gas	5.0	19.0	24.2	28.9	33.6	38.2	42.5	47.6	54.1	67.5
			Air	10.0	20.7	27.7	34.9	41.2	45.4	46.0	47.0	48.2	51.4
		LTR	Gas	5.0	19.9	25.2	30.1	34.2	39.0	43.9	49.6	57.5	76.7
			Air	10.0	22.5	28.0	36.0	42.5	50.0	54.0	54.9	56.4	57.9

				Combustion Curve Points (82.0% target)									
Furnace Size	**Turndown**	**Temp. Rise**	**Actuator Position (degrees)**	**P0 (Ignition)**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**
1200 E	20:1	MTR	Gas	5.0	6.6	16.2	22.4	27.6	32.1	36.4	40.6	44.6	50.0
			Air	10.0	4.9	23.5	31.0	40.5	45.0	53.5	63.6	63.6	64.9
		LTR	Gas	5.0	7.7	16.6	23.0	28.2	32.8	36.6	40.5	44.8	49.8
			Air	10.0	9.6	21.2	27.5	41.8	49.6	55.2	57.8	59.4	61.6
	5:1 (calculated)	MTR	Gas	5.0	17.8	22.8	27.2	31.0	34.6	38.2	41.6	45.1	50.0
			Air	10.0	25.4	31.8	39.7	43.9	50.0	57.7	63.6	63.7	64.9
		LTR	Gas	5.0	18.2	23.4	27.8	31.7	35.0	38.2	41.6	45.3	49.8
			Air	10.0	22.8	28.7	40.6	47.7	52.9	56.3	58.2	59.6	61.6
1600 E	20:1	HTR	Gas	5.0	9.3	19.6	27.1	33.3	38.6	44.1	49.9	58.4	76.6
			Air	10.0	5.6	37.0	40.0	45.0	55.0	67.0	69.1	71.1	72.2
		MTR	Gas	5.0	9.2	19.2	26.9	33	38.6	44.3	50.3	59.7	79.7
			Air	10.0	5.0	18.4	28.8	36.8	45.6	58.7	70.7	72.8	75.5
		LTR	Gas	5.0	9.1	19.2	26.9	33.2	38.7	44.2	50.3	59.7	79.2
			Air	10.0	2.1	16.1	29.8	38	46.3	55.8	58	59.5	61.5
	5:1	HTR	Gas	5.0	21.5	27.6	32.8	37.3	41.8	46.5	52.0	60.1	76.6
			Air	10.0	37.8	40.4	44.6	52.5	62.0	67.9	69.6	71.2	72.2
		MTR	Gas	5.0	21.5	27.5	32.5	37.2	42.0	46.9	52.9	61.5	79.7
			Air	10.0	20.5	30.5	37.5	43.5	52.5	61.5	64.6	67.6	70.2
		LTR	Gas	5.0	21.5	27.4	32.5	37.2	42	46.9	52.4	60.8	78.2
			Air	10.0	21.6	27.4	36.4	44.1	53.6	57.7	59.5	61.4	62.6
2000 E	20:1	HTR	Gas	5.0	6.8	14.2	20.2	25.0	29.8	34.2	38.7	45.3	53.8
			Air	10.0	6.8	15.4	29.0	37.5	54.5	66.6	62.0	64.0	69.0
		MTR	Gas	5.0	6.6	14.2	19.9	24.8	29.6	34.1	38.6	44.0	52.3
			Air	10.0	6.5	19.0	29.0	37.5	53.0	61.0	61.0	61.0	62.7
		LTR	Gas	5.0	6.8	14.0	19.5	24.5	28.5	34.0	38.0	43.5	54.1
			Air	10.0	7.0	15.0	24.0	30.0	40.0	71.0	74.0	73.0	77.5
	5:1 (calculated)	HTR	Gas	5.0	15.7	20.6	24.6	28.6	32.4	36.1	40.4	46.1	53.8
			Air	10.0	18.8	29.7	36.8	50.3	61.6	64.7	62.5	64.5	69.0
		MTR	Gas	5.0	15.6	20.3	24.4	28.4	32.2	36.0	40.0	44.8	52.3
			Air	10.0	21.5	29.7	36.8	49.1	57.7	61.0	61.0	61.2	62.7
		LTR	Gas	5.0	15.4	19.9	24.1	27.5	31.7	35.7	39.4	44.5	54.1
			Air	10.0	17.3	24.5	29.5	37.5	58.1	72.3	73.8	73.4	77.5
2400 E	20:1	HTR	Gas	5.0	8.1	16.4	22.7	27.8	32.8	37.4	42.1	47.2	55.6
			Air	10.0	10.0	16.9	24.7	32.0	44.6	45.3	46.5	47.9	49.2
		MTR	Gas	5.0	7.3	16.4	22.6	27.6	32.8	37.4	43.9	49.7	60.4
			Air	10.0	8.0	17.4	24.7	32.0	43.0	45.8	52.7	53.5	54.0
		LTR	Gas	5.0	8.0	16.3	22.4	27.3	32.5	37.4	43.2	47.9	55.9
			Air	10.0	11.0	17.6	24.7	32.0	40.7	46.0	54.0	50.0	51.4
	5:1 (calculated)	HTR	Gas	5.0	18.0	23.1	27.4	31.6	35.5	39.4	43.4	48.0	55.6
			Air	10.0	18.9	25.3	31.4	41.5	45.0	45.8	46.9	48.0	49.2
		MTR	Gas	5.0	18.0	23.0	27.2	31.5	35.5	40.1	45.4	50.7	60.4
			Air	10.0	19.2	25.3	31.4	40.3	44.6	48.7	52.9	53.5	54.0
		LTR	Gas	5.0	17.8	22.8	26.9	31.2	35.4	39.8	44.4	48.6	55.9
			Air	10.0	19.4	25.3	31.4	38.5	43.8	49.3	53.0	50.1	51.4

Table 9: Capacities & Dimensions

MODEL	Daikin Applied MAX. RATED OUTPUT (MBTU)	VENDOR BURNER MODEL NUMBER	MANIFOLD PRESS. FOR RATED OUTPUT (in. WC)	VOLTAGE, FREQ./PHASE	FUEL	MIN. TURN-DOWN AND MODULATION	COMBUSTION BLOWER	IGNITOR	FLAME ROD P/N	FLAME ROD LENGTH (4)	MODULATING GAS VALVE	MODULATING GAS VALVE ACTUATOR	AIR DAMPER	AIR DAMPER ACTUATOR
					NGAS									
800	800	810-R006-0081AS	3.85	208-230/460 60/3	X	20:1 or better with linkageless, electronic control for use with LMV3 BMS and constant speed combustion blower	Jan Air, R-Series Ø10-5/8" X 2"	Crown Engineering #: CA331 Access #: 627-001-0013 Requires step up signal booster: A5Q20002669	Crown Engineering #: 27731 Access #: 627-0014-0020	20 IN.	VKG10.025.U	SQM33.550A9	Full Port Butterfly Valve	SQM33.550A9
		810-R006-0081AS-5		575, 60/3	X									
1200	1200	810-R006-0080AS	2.50	208-230/460 60/3	X		Jan Air, R-Series Ø10-5/8" X 2-1/2"							
		810-R006-0080AS-5		575, 60/3	X									
1600	1600	810-R006-0080AS	4.30	208-230/460 60/3	X									
		810-R006-0080AS-5		575, 60/3	X									
2000	2000	800-R008-0111AS	3.85	208-230/460 60/3	X		Jan Air, R-Series Ø10-5/8" X 3-1/2"				VKG10.040.U			
		800-R008-0111AS-5		575, 60/3	X									
2400	2400	800-R008-0112AS		208-230/460 60/3	X		Chicago Blower, D 38 Ø12-1/4" X 2-7/8"							
		800-R008-0112AS-5		575, 60/3	X									

Figure 30: Phase Table



Limited Product Warranty

DAIKIN APPLIED AMERICAS INC.
LIMITED PRODUCT WARRANTY
(**United States and Canada**)

WARRANTY

Daikin Applied Americas Inc. dba Daikin Applied ("Company") warrants to contractor, purchaser and any owner of the product (collectively "Owner") that, subject to the exclusions set forth below Company, at its option, will repair or replace defective parts in the event any product manufactured by Company, including products sold under the brand name Daikin and used in the United States or Canada, proves defective in material or workmanship within twelve (12) months from initial startup or eighteen (18) months from the date shipped by Company, whichever occurs first. Authorized replacement parts are warranted for the remainder of the original warranty. All shipments of such parts will be made FOB factory, freight prepaid and allowed. Company reserves the right to select carrier and method of shipment. In addition, Company provides labor to repair or replace warranty parts during Company normal working hours on products with rotary screw compressors or centrifugal compressors. Warranty labor is not provided for any other products.

Company must receive the Registration and Startup Forms for products containing motor compressors and/or furnaces within ten (10) days of original product startup, or the ship date and the startup date will be deemed the same for determining the commencement of the warranty period and this warranty shall expire twelve (12) months from that date. For additional consideration, Company will provide an extended warranty(ies) on certain products or components thereof. The terms of the extended warranty(ies) are shown on a separate extended warranty statement.

No person (including any agent, sales representative, dealer or distributor) has the authority to expand the Company's obligation beyond the terms of this express warranty or to state that the performance of the product is other than that published by Company.

EXCLUSIONS

1. If free warranty labor is available as set forth above, such free labor does not include diagnostic visits, inspections, travel time and related expenses, or unusual access time or costs required by product location.
2. Refrigerants, fluids, oils and expendable items such as filters are not covered by this warranty.
3. This warranty shall not apply to products or parts : (a) that have been opened, disassembled, repaired, or altered, in each case by anyone other than Company or its authorized service representative; (b) that have been subjected to misuse, abuse, negligence, accidents, damage, or abnormal use or service; (c) that have not been properly maintained; (d) that have been operated or installed, or have had startup performed, in each case in a manner contrary to Company's printed instructions; (e) that have been exposed, directly or indirectly, to a corrosive atmosphere or material such as, but not limited to, chlorine, fluorine, fertilizers, waste water, urine, rust, salt, sulfur, ozone, or other chemicals, contaminants, minerals, or corrosive agents; (f) that were manufactured or furnished by others and/or are not an integral part of a product manufactured by Company; or (g) for which Company has not been paid in full.
4. This warranty shall not apply to products with rotary screw compressors or centrifugal compressors if such products have not been started, or if such startup has not been performed, by a Daikin Applied or Company authorized service representative.

SOLE REMEDY AND LIMITATION OF LIABILITY

THIS WARRANTY CONSTITUTES THE SOLE WARRANTY MADE BY COMPANY. COMPANY'S LIABILITY TO OWNER AND OWNER'S SOLE REMEDY UNDER THIS WARRANTY SHALL NOT EXCEED THE LESSER OF: (i) THE COST OF REPAIRING OR REPLACING DEFECTIVE PRODUCTS; AND (ii) THE ORIGINAL PURCHASE PRICE ACTUALLY PAID FOR THE PRODUCTS. COMPANY MAKES NO REPRESENTATION OR WARRANTY, EXPRESS OR IMPLIED, REGARDING PREVENTION OF MOLD/MOULD, FUNGUS, BACTERIA, MICROBIAL GROWTH, OR ANY OTHER CONTAMINATES. THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT, WHICH ARE HEREBY DISCLAIMED. IN NO EVENT AND UNDER NO CIRCUMSTANCE SHALL COMPANY BE LIABLE TO OWNER OR ANY THIRD PARTY FOR INCIDENTAL, INDIRECT, SPECIAL, CONTINGENT, CONSEQUENTIAL, DELAY OR LIQUIDATED DAMAGES FOR ANY REASON, ARISING FROM ANY CAUSE WHATSOEVER, WHETHER THE THEORY FOR RECOVERY IS BASED IN LAW OR IN EQUITY, OR IS UNDER A THEORY OF BREACH CONTRACT OR WARRANTY, NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE. THE TERM "CONSEQUENTIAL DAMAGE" INCLUDES, WITHOUT LIMITATION, THOSE DAMAGES ARISING FROM BUSINESS INTERRUPTION OR ECONOMIC LOSS, SUCH AS LOSS OF ANTICIPATED PROFITS, REVENUE, PRODUCTION, USE, REPUTATION, DATA OR CROPS.

ASSISTANCE

To obtain assistance or information regarding this warranty, please contact your local sales representative or a Daikin Applied office.

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