

F. CONTROL / THERMOSTAT WIRING

F.2.5.1. Factory Smoke Detector Kit

If a field or factory installed factory smoke detector kit is used, the kit contains a wiring harness that connects to the 12-Molex plug in the economizer section in place of the 3-wire jumper plug. Retain the jumper plug for future service or maintenance. Use a zip tie to secure the jumper plug to the main wiring harness. Remote fire control panels or other options for the smoke detector will connect directly to the smoke detector controls. Refer to the instructions with those accessories for more information.

F.2.5.2. Remote Smoke Detector/Fire Control Connection

In the air-filter section or on the side economizer, locate the 12-pin Molex jumper plug with the long Red, short Yellow and Orange wire loops; see **Figure F.2.5.2. – B** for reference. Cut the Red wire loop and connect these to a minimum of 18AWG wire that will be connected to a Normally Closed Dry Contact Relay, or in common Fire Control Panels and Smoke Detectors, the Auxiliary Connections for C and NC. See the instructions for the remote devices. Do not connect multiple control boards to the same dry contact relay.

Figure F.2.5.2. – A: Wiring Harness location in Air-Filter Section

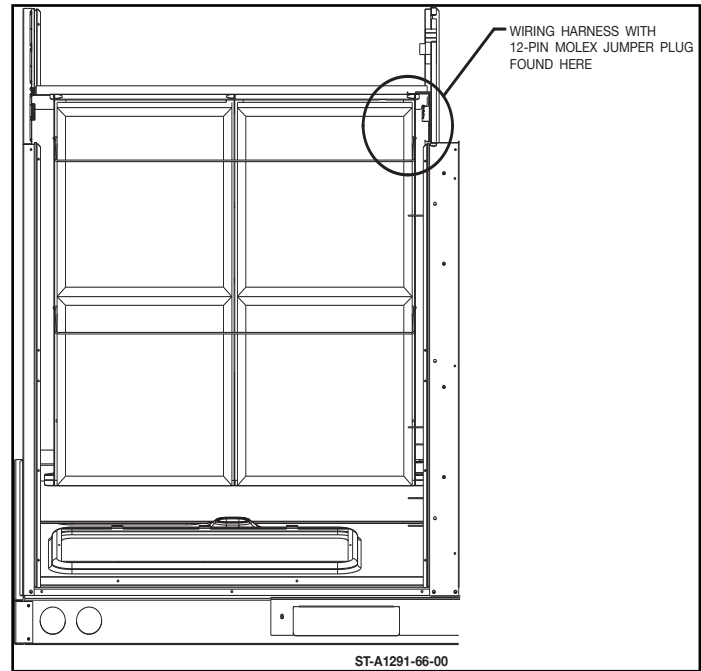
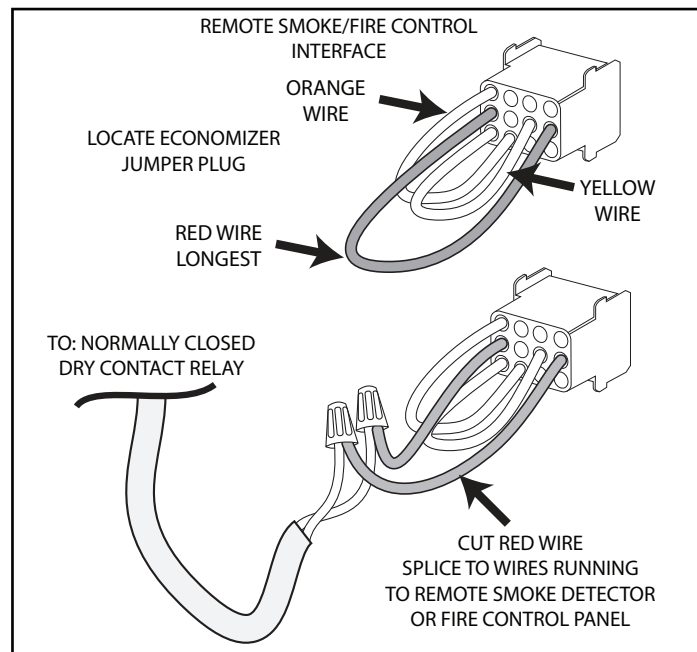


Figure F.2.5.2. – B: Smoke Detector Connection (DDC)



F. CONTROL / THERMOSTAT WIRING

F.3. Routing Control wiring

Figure F.3. – A: Electrical and Piping Routing

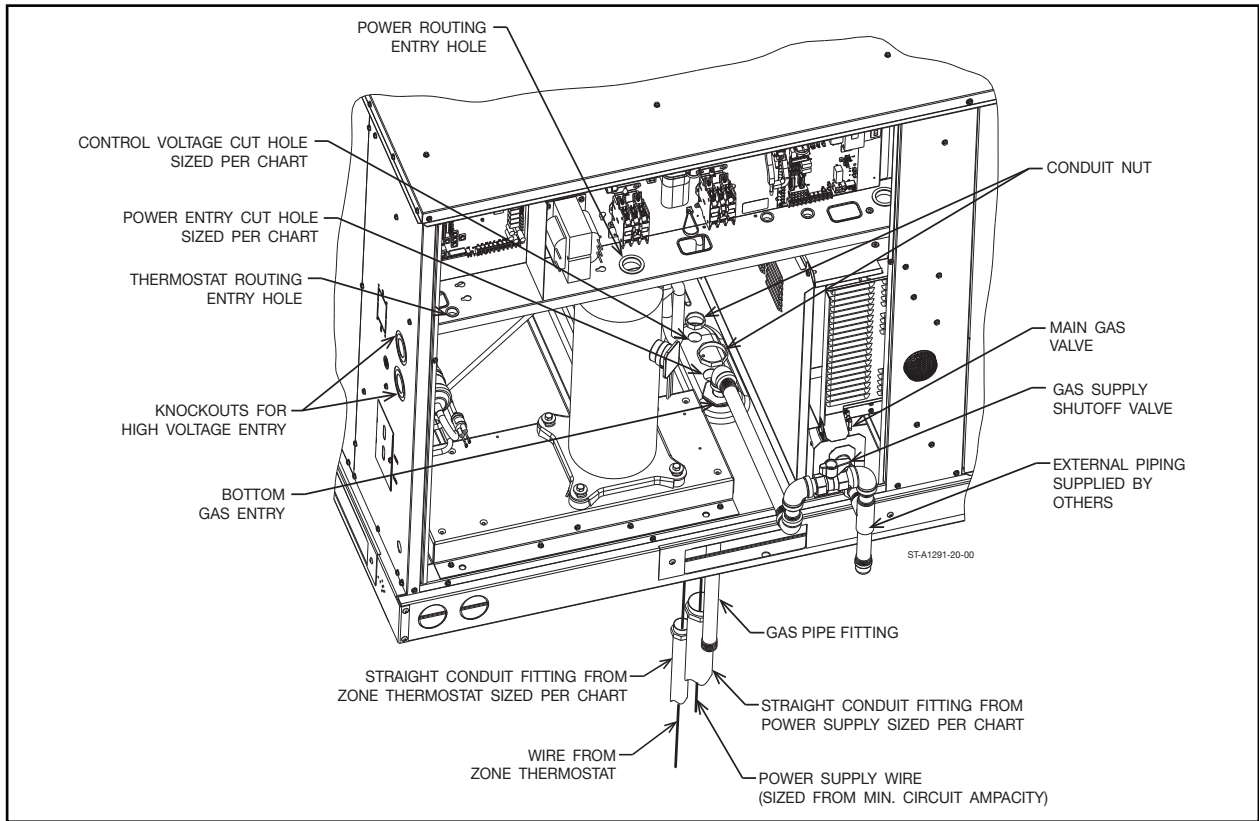


Figure F.3. – B: Hole Sizing for Conduit

	WIRE SIZE, AWG											
	14	12	10	8	6	4	3	2	1	0	00	000
CONDUIT SIZE	1/2"	1/2"	1/2"	3/4"	1"	1"	1-1/4"	1-1/4"	1-1/2"	1-1/2"	2"	2"
HOLE SIZE	7/8"	7/8"	7/8"	1-31/32"	1-23/64"	1-23/64"	1-23/32"	1-23/32"	1-31/32"	1-31/32"	2-15/32"	2-15/32"

NOTES: 1. DETERMINE REQUIRED WIRE SIZE FROM MINIMUM CIRCUIT AMPACITY SHOWN IN INSTALLATION & OPERATING INSTRUCTION.
 2. BOTTOM POWER ENTRY WILL NOT ACCOMMODATE WIRE LARGER THAN #2 AWG (SHADED AREA).

F.4. Measuring Control Voltage Loads

Use a voltmeter to measure the low voltage and low voltage amp draws during operation. Accessories such as remote smoke detectors and excessive wire length can increase the amp draw on the low voltage wiring. Verify that the total amp draw on the 24VAC side is less than 0.3A in full operation.

G. GAS

G.1. Gas Piping Requirements

Install gas piping in accordance with local codes and regulations of the local utility company. In the absence of local codes, the installation must conform to the specifications of the latest edition of the National Fuel Gas Code.

IMPORTANT: Connect this unit only to gas supplied by a commercial utility.

G.1.1. Pipe Material Requirements

Ridged black iron pipe and fittings are recommended for the gas lines, or other materials as local codes allow or considered best practice. The use of flexible connectors is not recommended. Install a Union joint near the unit, after the cut off valve, for service.

G.1.2. Tools Required

Pipe wrenches, Pliers, gas rated thread sealant, and leak detection fluid or soap and water is required.

G.1.3. Code Requirements

Local codes should be followed for the installation and marking of the gas piping. In the absence of local codes follow the latest edition of the National Fuel Gas Code, International Field Gas Code, or the Canadian B149.1HB-00, must be followed.

G.1.4. Gas Pressures and Regulations

IMPORTANT: ENSURE that the furnace gas valve is not to be subjected to high gas line supply pressures.

DISCONNECT the furnace and its individual manual gas stop from the gas supply piping during any pressure testing that exceeds 1/2 PSIG (3.48 kPa). Natural gas supply pressure must be 5" to 10.5" w.c. LP gas supply pressure must be 11" to 13" w.c. This pressure must be maintained with all other gas-fired appliances in operation. The minimum gas supply pressure to the gas valve for proper furnace input adjustments is 5" w.c. for natural gas, however 6" to 7" is recommended. The minimum gas supply pressure is 11" w.c. for LP gas.

See sections **J.5.1.1. "Measuring and Adjusting Supply Gas Pressures"** and **J.5.1.2. "Measuring and Adjusting Manifold Gas Pressures"** for more details.

⚠ WARNING

ELEVATIONS ABOVE 2000 FT. REQUIRE THAT THE FURNACE INPUT RATING BE ADJUSTED AND THAT THE SIZE OF THE BURNER ORIFICES BE RECALCULATED BASED ON ELEVATION AND GAS HEATING VALUE. THE BURNER ORIFICES MAY (OR MAY NOT) NEED TO BE CHANGED. SEE THE SECTION TITLED "HIGH ALTITUDE INSTALLATIONS" OF THIS BOOK FOR INSTRUCTIONS.

G.1.5. Flue Diverter

Flue diverter and inlet air diverter are pictured at the bottom of this page. See **Figure G.1.5.**

G.1.5.1. Flue Diverter Installation

Using integrated hooks, insert into the appropriate slots on post to the right of the furnace access door. The opening should be facing up towards the top of the unit. Once slots and hooks are mated, secure with one (1) screw (included) in topmost flange, and installation is complete.

The door hood is secured onto the furnace access door with six (6) screws (included). There are four (4) key holes cut into the air hood for easy mounting. Insert screws into the door and the left and right edges leaving enough space to put on the hood. Then place the door hood onto the door and finish by securing the screws tightly. Secure the final two (2) screws at the tops of the hood to complete the installation.

⚠ WARNING

NEVER PURGE A GAS LINE INTO THE COMBUSTION CHAMBER. NEVER USE MATCHES, FLAME OR ANY IGNITION SOURCE FOR CHECKING LEAKAGE. FAILURE TO ADHERE TO THIS WARNING CAN CAUSE A FIRE OR EXPLOSION RESULTING IN PROPERTY DAMAGE, PERSONAL INJURY OR DEATH. TO CHECK FOR GAS LEAKAGE, USE AN APPROVED CHLORIDE-FREE SOAP AND WATER SOLUTION, OR OTHER APPROVED METHOD.

GAS VALVE

This furnace has a 24-volt gas valve. It has ports for measuring supply and manifold gas pressure. The valve body contains a pressure regulator to maintain proper manifold gas pressure. A control switch is on the valve body. It can be set to only the “ON” or “OFF” positions. The gas valve is a slow-opening valve. See Figure **G.1.4. – A.**

When energized, it takes 2 to 3 seconds to fully open.

Figure G.1.4. – A White-Rodgers Two-Stage Gas Valve

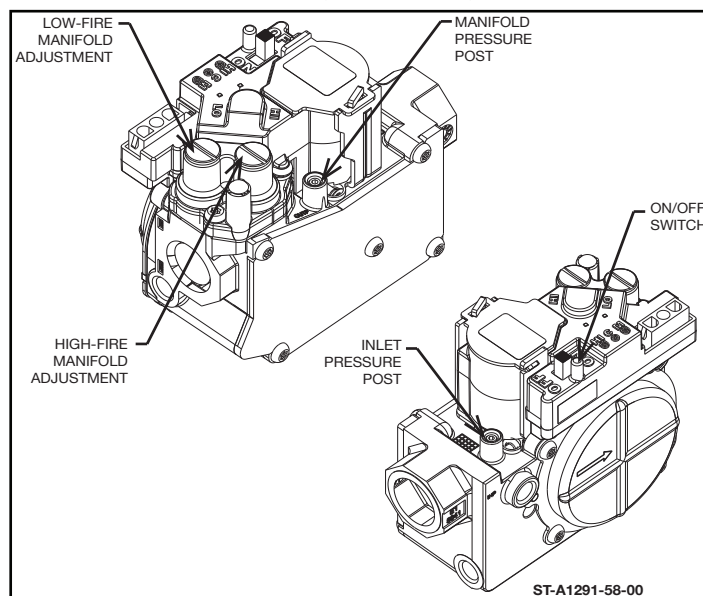


Figure G.1.4. – B: Burner Assembly Front View

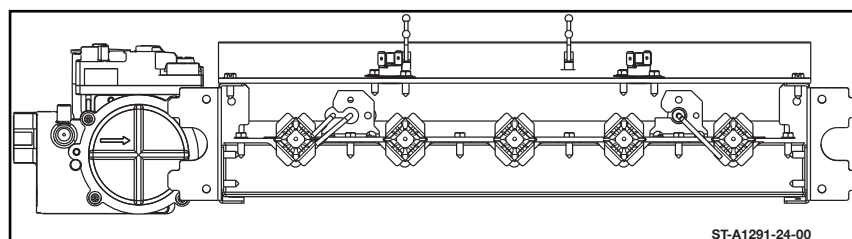
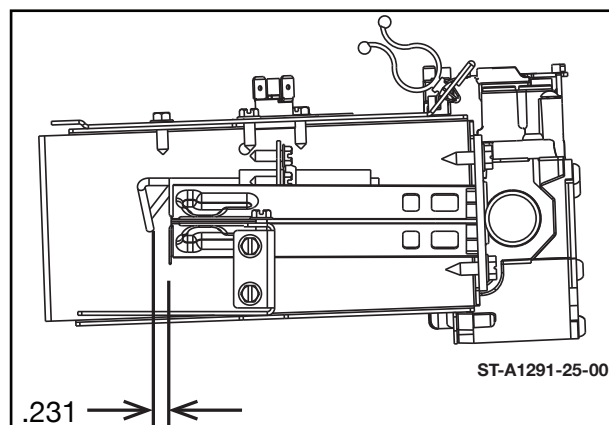


Figure G.1.4. – C: Burner Assembly Side View

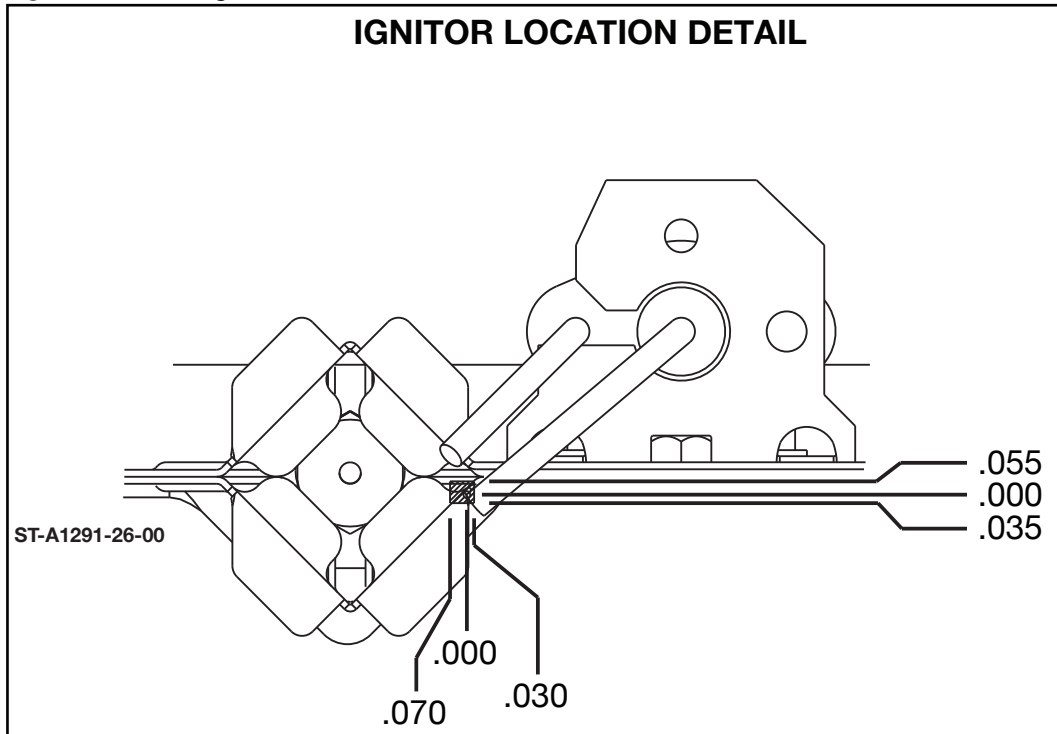


G. GAS

For 75,000 BTU input furnaces, the outside manifold orifice taps are plugged. The ignitor and flame sense are located on the outside of the center burner.

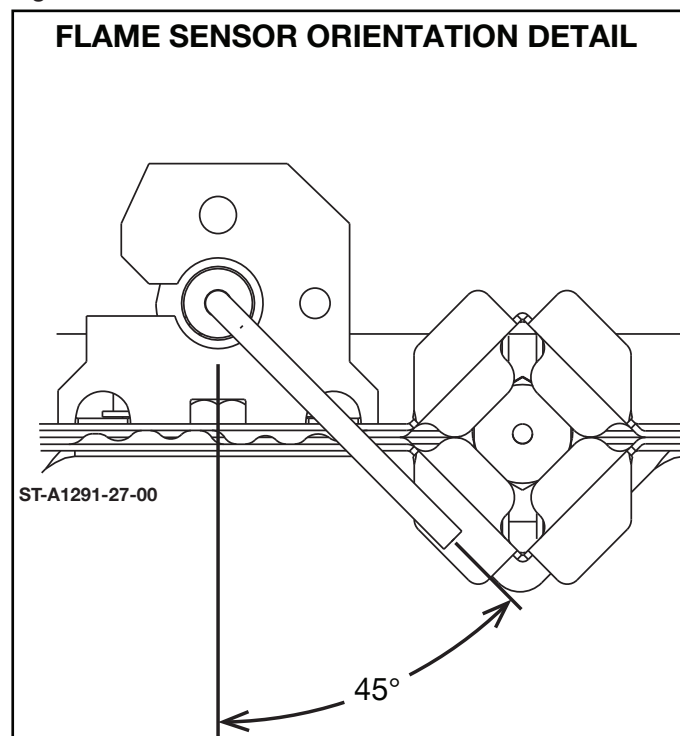
Ignitor location is critical for insuring a consistent carryover of the burner flame during ignition. The top of the electrode at dimension (0,0) must remain inside the hatched area

Figure G.1.4. – D: Ignitor Location



Correct location of the flame sensor will help to eliminate weak or no flame sense issues.

Figure G.1.4. – E: Flame Sense Location



G.1.6. Sealing Threaded Connections – Best Practice

Use a gas rated and approved liquid, paste, or tape thread sealant on all threaded connections. Apply sealant to the male threads and tighten the fitting using wrenches to hold both the fitting and the pipe. **DO NOT OVERTIGHTEN THE PIPE GOING INTO THE GAS VALVE, DAMAGE MAY OCCUR.** Test all threaded connections with leak test fluid or soap and water.

G.1.7. Gas Pipe Sizing and Capacity

Size the gas line to the furnace adequate enough to prevent undue pressure drop and never less than 3/4" pipe.

See **Table G.1.1. – A** for Gas Pipe Capacity. The capacities of gas pipe of different diameters and lengths in Cubic Ft/hr with pressure drop of 0.3 in. and specific gravity of 0.60 (natural gas) are shown in **Table G.1.1. – A**. After determining the pipe length, select the pipe size which will provide the minimum cubic foot/hour required for the gas input rating of the furnace.

By formula:

$$\frac{\text{ft}^3}{\text{hr}} \text{ required} = \frac{\text{Gas Input of Furnace } \frac{\text{BTU}}{\text{hr}}}{\text{Heating Value of Gas } \frac{\text{BTU}}{\text{hr}}}$$

The gas input of the furnace is marked on the furnace rating plate. The heating value of the gas (BTU/FT³) may be determined by consulting the local natural gas utility or the L.P. gas supplier.

Table G.1.1 – A

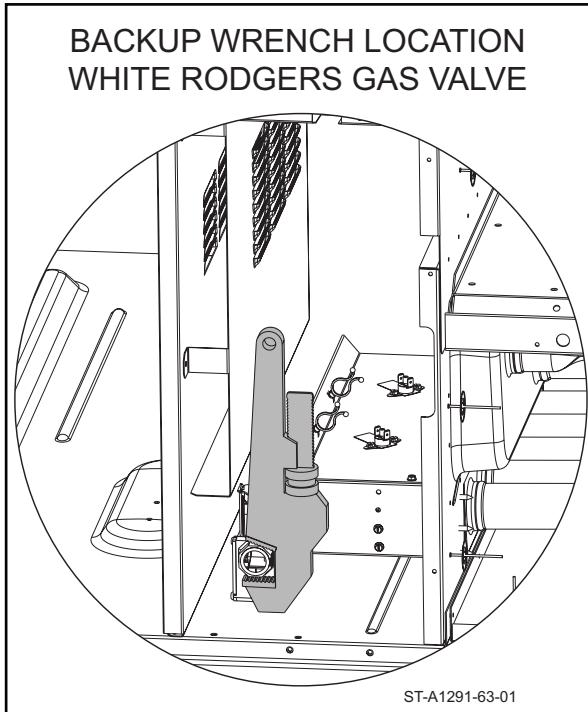
NATURAL GAS PIPE CAPACITY TABLE (CU FT/HR) Maximum capacity of pipe in thousands of BTU/hr of natural gas Inlet pressure: less than 2 psi Pressure Drop: 0.3 in. W.C. Specific Gravity: 0.60										
Nominal Iron Pipe* Size, Inches	Length of Pipe, Feet									
	10	20	30	40	50	60	70	80	90	100
1/2	131	90	72	62	55	50	46	42	40	38
3/4	273	188	151	129	114	104	95	89	83	79
1.0	514	353	284	243	215	195	179	167	157	148
1-1/4	1,060	726	583	499	442	400	368	343	322	304
1-1/2	1,580	1,090	873	747	662	600	552	514	484	455
After the length of pipe has been determined, select the pipe size which will provide the minimum cubic feet per hour required for the gas input rating of the furnace. By formula: $\text{Cubic feet per hour required} = \frac{\text{Gas Input of Furnace (BTU/HR)}}{\text{Heating Value of Gas (BTU/FT}^3\text{)}}$ The gas input of the furnace is marked on the furnace rating plate. Call your local natural gas utility for the heating value of the gas (BTU/FT ³). *Schedule 40 metallic pipe. Reference the National Fuel Gas Code NFPA 54, ANSI Z223.1- Pipe Sizing for more information.										

G. GAS

G.2. Procedure: Connecting Gas Lines to Gas Valve

1. Place backup wrench on valve, shown below in **Figure G.2. – A.**

Figure G.2. – A: Backup Wrench Location



2. Connect the gas line to the gas valve supplied with unit. Routing can be through the gas pipe opening shown in **Figure G.2.1.** or through the base as shown in **Figure F.3. – A: Electrical and Piping Routing.**

In making gas connections, avoid strains as they may cause noise and damage the controls. A backup wrench is required to be used on the valve to avoid damage.

3. Size the gas line to the furnace adequate enough to prevent undue pressure drop and never less than 3/4" pipe. See **Section G.1.6** on Gas Pipe Sizing and Capacity.
4. Install a drip leg or sediment trap in the gas supply line as close to the unit as possible. See **Section G.2.1** on Drip Leg Requirements.
5. Install a gas-rated union to connect the gas supply to the control assembly at the gas valve.
6. Gas valves have been factory installed. Install a manual gas valve where local codes specify a shut-off valve outside the unit casing. (See **Figure G.2.1.**)

7. Make sure piping is tight. **A pipe compound resistant to the action of liquefied petroleum gases must be used at all threaded pipe connections.**

8. IMPORTANT: Any additions, changes or conversions required for the furnace to satisfactorily meet the application should be made by a qualified installer, service agency or the gas supplier, using factory specified or approved parts. In the Commonwealth of Massachusetts, installation must be performed by a licensed plumber or gas fitter for appropriate fuel.

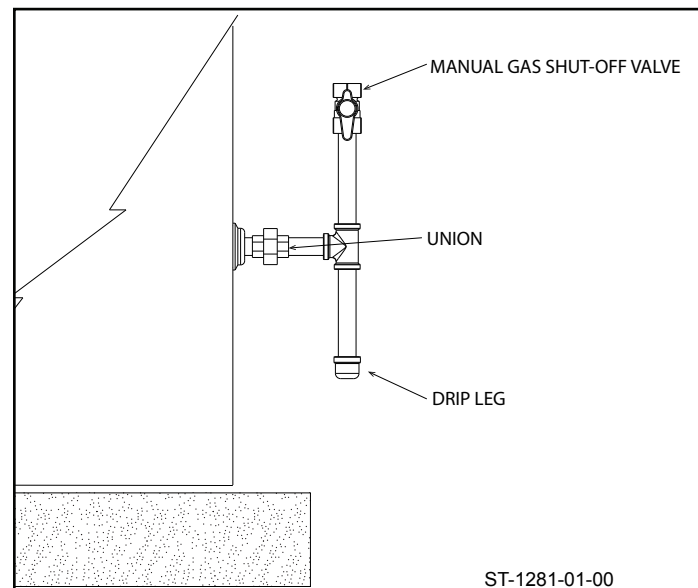
IMPORTANT: Disconnect the furnace and its individual shutoff valve from the gas supply piping during any pressure testing of that system at test pressures in excess of 1/2 pound per square inch gauge or isolate the system from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing of this gas supply system at pressures equal to or less than 1/2 PSIG.

IMPORTANT: Check the rating plate to make certain the appliance is equipped to burn the type of gas supplied. Care should be taken after installation of this equipment that the gas control valve not be subjected to high gas supply line pressure.

G.2.1. Drip Leg Requirement

When connecting the supply gas to the gas valve, install a drip leg/sediment trap in compliance with the latest edition of the National Fuel Gas Code.

Figure G.2.1. – A: Drip Leg



G.2.2. Purging Gas Lines

It may be necessary to purge any air from the gas lines prior to operation. This can be done through the gas pressure tap on the gas valve or at a union in the gas line. Follow best practices to purge the gas line. Ensure all fittings are sealed and tight after purging.

G.2.3. Leak Testing

To check for gas leaks, use a soap and water solution or other approved method. **DO NOT USE AN OPEN FLAME.**

⚠ WARNING: DO NOT use an open flame to check for leaks. The use of an open flame can result in fire, explosion, property damage, personal injury or death.

⚠ WARNING: This unit is equipped at the factory for use on natural gas only. Conversion to LP gas requires a special kit supplied by the distributor or manufacturer. Mailing addresses are listed on the furnace rating plate, parts list, and warranty. Failure to use the proper conversion kit can cause fire, carbon monoxide poisoning, explosion, personal injury, property damage or death.

NOTE: The valve can be converted to use liquefied petroleum (LP) gas by replacing the high and low fire pressure regulator springs with the conversion kit springs. The LP kit springs allow the regulator to maintain the proper manifold pressure at high and low fire for LP gas.

NOTE: Order the correct LP conversion kit from the furnace manufacturer.

See Conversion Kit Index shipped with unit and table below for proper LP kit number.

A qualified technician must perform furnace conversion to LP gas.

G.2.4. Orifice Installation

LP Gas is a manufactured gas that has consistent heating value across most regions. The Sea Level input should still be reduced by 4% per thousand ft. above 2,000 feet and the orifice size must be selected based on the reduced input selection chart in High Alt. Instruction Section.

To change orifice spuds for conversion to LP:

1. Shut off the gas supply and remove gas connection to the gas valve.
2. Remove the gas manifold.
3. Replace the natural gas orifices with LP orifices.
4. Reassemble in reverse order.
5. Refer to section **J.5.1.1. Measuring and Adjusting Supply Gas Pressures** for confirming inlet pressure and adjusting manifold pressure.

G.3. LP Conversion

When connecting the supply gas to the gas valve, install a drip leg/sediment trap in compliance with the latest edition of the National Fuel Gas Code.

⚠ WARNING: This unit is equipped at the factory for use on natural gas only. Conversion to LP gas requires a special kit supplied by the distributor or manufacturer. Mailing addresses are listed on the furnace rating plate, parts list and warranty. Failure to use the proper conversion kit can cause fire, carbon monoxide poisoning, explosion, personal injury, property damage or death.

NOTE: The valve can be converted to use liquefied petroleum (LP) gas by replacing the high and low fire pressure regulator springs with the conversion kit springs. The LP kit springs allow the regulator to maintain the proper manifold pressure at high and low fire for LP gas.

NOTE: Order the correct LP conversion kit from the furnace manufacturer.

See Conversion Kit Index shipped with unit and table below for proper LP kit number.

A qualified technician must perform furnace conversion to LP gas.

G.3.1. Using Conversion Kit Table

1. Find the control system code: 3G
2. Find the model number and BTU input listed in the left hand column.
3. From your model number and BTU input, go across to associated Gas Code, and finally LP Conversion Kit part number.

CONVERSION KITS – NATURAL GAS TO PROPANE

Model Number	Number of Burners	BTU/HR Per Burner	Valve Brand	Gas Code	Kit Number U.S./ Canadian
(-)GEC 75K	3	25,000	W-R	3G, 3H	RXGJ-FP40
(-)GEC 100K	5	20,000	W-R	3G, 3H	RXGJ-FP41
(-)GEC 120K	5	24,000	W-R	3G, 3H	RXGJ-FP40

G. GAS

Table G.3 – A

LP GAS PIPE CAPACITY TABLE (CU FT/HR) Maximum capacity of pipe in thousands of BTU/hr of undiluted liquified petroleum gases (at 11.0" W.C. inlet pressure) (Based on a Pressure Drop of 0.5" W. C.)												
Nominal Iron Pipe* Size, Inches	Length of Pipe, Feet											
	10	20	30	40	50	60	70	80	90	100	125	150
1/2	275	189	152	129	114	103	96	89	83	78	69	63
3/4	567	393	315	267	237	217	196	182	173	162	146	132
1.0	1,071	732	590	504	448	409	378	346	322	307	275	252
1-1/4	2,205	1,496	1,212	1,039	913	834	771	724	677	630	567	511
1-1/2	3,307	2,299	1,858	1,559	1,417	1,275	1,181	1,086	1,023	976	866	787
2.0	6,221	4,331	3,465	2,992	2,646	2,394	2,205	2,047	1,921	1,811	1,606	1,496
Example (LP): Input BTU requirement of unit, 120,000 Equivalent length of pipe, 60 ft. = 3/4" Inside Diameter required *Schedule 40 metallic pipe. Reference the National Fuel Gas Code NFPA 54, ANSI Z223.1- Pipe Sizing for more information.												

⚠ WARNING: LP tanks from local LP supplier must not be used to store anything (such as fertilizer) except LP gas. This includes all delivery vessels (LP trucks). If material other than LP gas is used in the same vessels/tank as the LP gas, the LP gas can become contaminated and damage the furnace. This will void the manufacturer's warranty. Contact the supplier to make sure fertilizer is not used in the same tanks used to store and deliver LP gas.

G.4. Operation and Testing

G.4.1. Warnings

⚠️WARNING: DO NOT attempt to manually light this furnace with a match or any open flame. Attempting to do so can cause an explosion or fire resulting in property damage, personal injury or death.

⚠️WARNING: The spark ignitor and ignition lead from the ignition control are high voltage. Keep hands or tools away to prevent electrical shock. Shut off electrical power before servicing any of the controls. Failure to adhere to this warning can result in personal injury or death.

⚠️WARNING: Should overheating occur or the gas supply fail to shut off, turn off the manual gas control valve to the furnace. Failure to do so can result in an explosion or fire causing severe personal injury or death!

G.4.2. First time operation

G.4.2.1. 230V & 575V – Normal Furnace Sequence Of Operation

1. Thermostat initiates call for heat.
2. Core Command runs self-diagnostic. Core Command confirms the Main Limit Control (MLC) is closed; the low fire Negative Pressure Control (NPC) is open and checks Manual Reset Limit Controls (MRLC) for continuity.
3. Core Command energizes Induced Draft Motor (IDM) low-speed tap.
4. Core Command confirms low fire NPC is closed.
5. If the low fire NPC is closed, the Core Command starts a 30-second prepurge.
6. Following 30 second prepurge, the Core Command energizes the Spark Electrode (SE) up to 7 seconds or until the Remote Flame Sensor proves burner flame. Core Command de-energizes the SE and begins the 20-second blower ON delay.
7. The furnace will respond to thermostat command following 20-second blower ON delay.

Second Stage Heat (high fire) After First Stage Heat (low fire) is Established

1. Call for second stage heat initiated by thermostat.
2. Core Command energizes IDM high-speed tap and confirms high fire NPC is closed.
3. Core Command energizes second stage of the gas valve.

Call for Heat Satisfied

1. When the thermostat call for heat is satisfied, the thermostat de-energizes the gas valve.
2. The IDM is de-energized after a 20-second post-purge period.
3. The Indoor Blower Motor (IBM) continues to run for an additional three minutes.

Sequences– system doesn't light or doesn't sense flame (Fault Code 11 – Failed ignition):

• Low Fire NPC Remains Open After the IDM is Energized:

1. The IDM will run for 60 seconds in an attempt to close the low fire NPC. IDM is de-energized then energized and the ignition attempt is repeated.
2. After two attempts to close the low fire NPC, the Core Command will energize the IDM high-speed tap and two ignition sequences attempted at high fire.
3. If ignition fails at high fire, the system will enter a 1-hour lockout period.

• Failed Ignition or Core Command Doesn't Sense Flame:

1. Following the 30-second prepurge period, the Spark Igniter and gas valve are energized up to 8 seconds.
2. If flame is not sensed during the 8-second period after the gas valve is energized, the gas valve and Spark Igniter are de-energized.
3. IDM is de-energized and the Core Command verifies that the low fire NPC is open. Once the low fire NPC is confirmed open, the Core Command will begin a second ignition attempt.
4. After two failed ignition attempts at low fire, the Core Command will energize the IDM high-speed tap and an ignition sequence attempted at high fire.
5. If ignition fails after an attempts at high fire, the system will enter a 1-hour lockout period.

G. GAS

G.4.2.2. 460V – Normal Furnace Sequence Of Operation

1. Thermostat initiates call for heat.
2. Integrated Furnace Control (IFC) runs self-diagnostic. Core Command confirms the Main Limit Control (MLC) is closed; the Negative Pressure Control (NPC) is open and checks Manual Reset Limit Controls (MRLC) for continuity.
3. IFC energizes Induced Draft Motor (IDM).
4. IFC confirms NPC is closed.
5. If NPC is closed, the IFC starts a 30-second prepurge.
6. Following 30 second prepurge, the IFC energizes the Spark Electrode (SE) up to 7 seconds or until the Remote Flame Sensor proves burner flame. IFC de-energizes the SE and begins the 20-second blower ON delay.
7. The furnace will respond to thermostat command following 20-second blower ON delay. Sequences– system doesn't light or doesn't sense flame:

- NPC Remains Open After the IDM is Energized:

1. The IDM will run for 60 seconds in an attempt to close the NPC. IDM is de-energized then energized and the ignition attempt is repeated.
2. After four attempts to close the NPC, the system will enter a 1-hour lockout period.

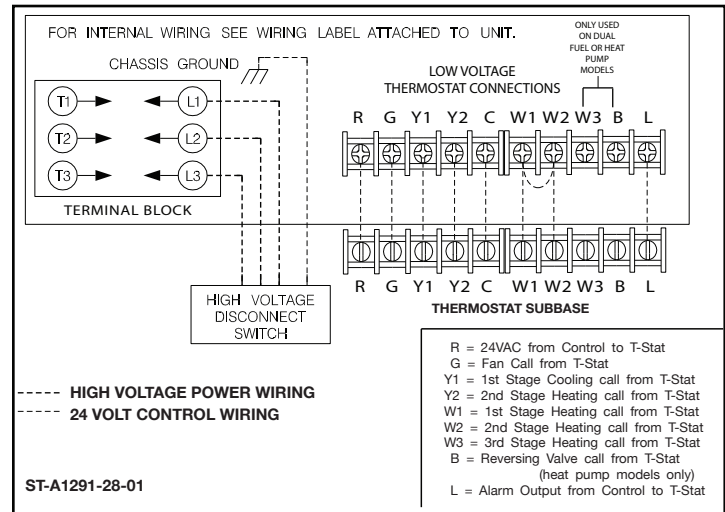
- Failed Ignition or Core Command Doesn't Sense Flame:

1. Following the 30-second prepurge period, the SE and gas valve are energized up to 8 seconds.
2. If flame is not sensed during the 8-second period after the gas valve is energized, the gas valve and SE are de-energized.
3. IDM is de-energized and the IFC verifies that the NPC is open. Once the NPC is confirmed open, the IFC will begin a second ignition attempt.
4. The system will attempt three tries at ignition. Following a third failed attempt the system will enter a 1-hour lockout period.

G.4.2.3. Single-Stage Thermostat and Auto-Staging: 208/230V, 460V & 575V

Application where a single-stage thermostat is used with this two-stage furnace. Furnace will run at low-fire input for a 15 minute period. If thermostat demand is not satisfied, Integrated Furnace Control will automatically stage to high-fire until thermostat demand is met. To accommodate auto-staging, simply secure a jumper wire between W1 and W2 on the non-DDC furnace control board. See **Figure G.4.2.3. – A** for details.

Figure G.4.2.3. – A: Thermostat Connections



G.4.2.4. Gas Pressure Testing And Adjustment

Refer to **Section J.5.1.1.** for detailed instructions on testing and adjusting gas pressure.

G.4.2.5. Flame inspection

Inspect burner flame after the indoor blower motor is energized. Burner flame should be directed down the center of primary heat exchanger tube. Any flame turbulence could be an indication of an air leak between the burner and heat exchanger compartment or a partially blocked burner orifice.

Natural Gas Flame: almost completely blue with some yellow in the center of the flame.

LP Gas Flame: predominantly a blue flame with some yellow tipping.

G.4.2.6. Orifice Selection and High Altitude Adjustments

Notice: derating of the heating input for high altitude in the field is unlawful in Canada (refer to CAN/CGA 2.17). Units installed in altitudes greater than 2,000 feet (610 meters) must be shipped from the factory or from a factory authorized conversion station with the heating input derated by 10% so as to operate properly in altitudes from 2,000 – 4,500 feet (610 – 1,373 meters).

NATURAL GAS AT HIGH ALTITUDES

Furnaces installed above 2,000 feet require the furnace to be de-rated 4% per thousand feet above sea level.

IMPORTANT: Factory installed orifices are calculated and sized based on a sea level Natural Gas heating value of 1050 BTU per cubic ft.

NOTE: Orifices are available through your local distributor. Reference the following tables for approximate orifice sizing.

The following are examples of orifice sizing using the “Flow of Gas Through Fixed Orifices” section in the National Fuel Gas Code.

For a simplified estimation of orifice size based on gas heating value and elevation, the following tables may be used. However, calculations are the best method.

Example: 900 BTU/ft³ Regional Natural Gas Heating Value

$I/H = Q$

$25000 / 900 = 27.78 \text{ ft}^3$

I = Sea Level input (per burner): 25000

H = Sea Level Heating Value: 900

Q = 27.78 ft³ Natural Gas per hour.

From Table E1.1a of National Fuel Gas Code, 2015 (3.5” w.c.).

Orifice required at Sea Level: #40

from the National Fuel Gas Code. Orifice required at 5000 ft. elevation (4% de-rate per thousand ft): #42

Orifice required at 8000 ft. elevation (4% de-rate per thousand ft.): #44

Example: 1050 BTU/ft³ Regional Natural Gas Heating Value

$I / H = Q$

$25000 / 1050 = 23.81 \text{ ft}^3$

I = Sea Level input (per burner): 25000

H = Sea Level Heating Value: 1050

Q = 23.81 ft³ Natural Gas per hour.

From the National Fuel Gas Code, (3.5” w.c.).

Orifice required at Sea Level: #43 From the National Fuel Gas Code,

Orifice required at 5000 ft. elevation (4% de-rate per thousand ft.): #45

Orifice required at 8000 ft elevation (4% de-rate per thousand ft): #47

ORIFICE ORDERING INFORMATION

Orifice sizes are selected by adding the 2-digit drill size required in the orifice part number. Drill sizes available are 39 through 64; metric sizes available 1.10mm (-90) and 1.15mm (-91):

Orifice Part Number 62-22175-(drill size)

Example 1:

60 drill size orifice required

Part # 62-22175-60

Example 2:

1.15mm drill size orifice required

Part # 62-22175-91

NATURAL GAS ORIFICE SELECTION BASED ON HEATING VALUE & ELEVATION*

Reference tables on the following page for more information.

HIGH ALTITUDE

Notes:

1. Furnaces are factory equipped with orifices sized for 1050 sea level heating value gas.
2. Installer must be aware of the local heating value (sea level standard) to use the chart below.
3. This chart is based on the National Fuel Gas Code (NFGC) and based on natural gas with a specific gravity of 0.60
4. The recommended orifices below allow the furnace to operate within 10% of design rate. However, NFGC calculations are the best method.
5. Furnace operation is optimized when operating at design rate. Installer is responsible to verify rate.

G. GAS

NATURAL GAS ORIFICE SELECTION BASED ON HEATING VALUE & ELEVATION*

25,000 BTU/Burner

		ELEVATION								
Grey Cells Indicate Factory Orifice Size		Sea Level to 2,000'	2001' to 3,000'	3,001' to 4,000'	4,001' to 5,000'	5,001' to 6,000'	6,001 to 7,000'	7,001' to 8,000'	8,001' to 9,000'	9,001' to 10,000'
Gas Heat- ing Value (BTU's/ ft3) @ Sea Level**	1,100	2.30 mm	43	43	44	44	45	46	47	47
	1,050	42	42	43	43	44	44	45	46	47
	1,000	41	42	42	43	43	44	44	45	47
	950	40	40	41	42	43	43	44	44	45
	900	38	39	40	41	42	2.30 mm	43	44	45
	850	37	38	39	40	41	42	42	43	44
	800	36	36	37	38	40	41	42	2.30 mm	43
	750	34	35	36	37	38	39	40	42	2.30 mm
	700	33	33	35	36	37	38	39	40	42

24,000 BTU/Burner

		ELEVATION								
Grey Cells Indicate Factory Orifice Size		Sea Level to 2,000'	2001' to 3,000'	3,001' to 4,000'	4,001' to 5,000'	5,001' to 6,000'	6,001 to 7,000'	7,001' to 8,000'	8,001' to 9,000'	9,001' to 10,000'
Gas Heat- ing Value (BTU's/ ft3) @ Sea Level**	1,100	43	44	44	45	45	46	47	48	49
	1,050	43	43	43	44	45	45	47	48	48
	1,000	43	43	43	44	44	45	46	47	48
	950	42	42	42	43	43	44	45	46	47
	900	41	41	42	42	43	43	44	45	45
	850	39	40	41	41	42	43	43	44	45
	800	38	39	39	40	41	42	43	43	44
	750	36	37	37	38	38	41	42	42	43
	700	35	35	36	37	38	39	41	42	42

20,000 BTU/Burner

		ELEVATION								
Grey Cells Indicate Factory Orifice Size		Sea Level to 2,000'	2001' to 3,000'	3,001' to 4,000'	4,001' to 5,000'	5,001' to 6,000'	6,001 to 7,000'	7,001' to 8,000'	8,001' to 9,000'	9,001' to 10,000'
Gas Heat- ing Value (BTU's/ ft3) @ Sea Level**	1,100	47	47	47	48	49	48	50	50	51
	1,050	45	46	47	47	48	49	49	50	51
	1,000	45	45	46	47	47	48	49	49	50
	950	44	44	45	46	46	47	48	49	50
	900	43	43	44	45	45	46	47	48	49
	850	2.30 mm	43	43	44	2.10 mm	45	46	47	48
	800	42	42	2.30 mm	43	44	44	45	46	47
	750	40	41	42	2.30 mm	43	43	44	45	46
	700	38	39	41	41	42	43	43	44	45

Note: Grey cells indicate the factory recommendation for specific elevations.

* Tables are derived from the National Fuel Gas Code. To determine the correct orifice for your installation consult the National Fuel Gas Code.

** Be sure to use sea level heating value. Heating value may be obtained from a local utility, heating value must be converted to sea level equivalent sea level equivalent in order to use this table.

LP GAS AT HIGH ALTITUDES

NOTICE: The conversion shall be carried out by a manufacturer's authorized representative, in accordance with the requirements of the manufacturer, provincial, or territorial authorities having jurisdiction and in accordance with the requirements of the CSA b149.1 Or CSA b149.2 Installation codes.

NOTE: Keep any parts removed during LP conversion procedure stored with the product literature for future use.

LP Gas is a manufactured gas that has consistent heating value across most regions.

The NFGC guidelines calculate LP orifice size based on 11.0" W.C. manifold pressure. When converted to LP gas, the unit operates at 10.0" W.C. manifold pressure.

The sea level input should be reduced by 4% per thousand feet at altitudes greater than 2,000 feet. The orifice size must be selected based on the BTU/hr per burner input noted in the following tables.

LP Gas BTU/hr per Burner based on Orifice Size & Elevation

Orifice Pressure: 10" W.C.

BTU/hr per burner	ELEVATION								
	Sea Level to 2,000'	2001' to 3,000'	3,001' to 4,000'	4,001' to 5,000'	5,001' to 6,000'	6,001 to 7,000'	7,001' to 8,000'	8,001' to 9,000'	9,001' to 10,000'
20,000 BTU/hr	55	55	56	56	56	56	57	57	57
24,000 BTU/hr	54	54	54	54	55	55	56	56	56
25,000 BTU/hr	54	54	54	54	55	55	56	56	56

LP Gas BTU/hr per Burner based on Orifice Size & Elevation

Orifice Pressure: 10" W.C.

BTU/hr per burner	ELEVATION	
	Sea Level to 2,000'	2001' to 4,500'
20,000 BTU/hr	55	56
24,000 BTU/hr	54	54
25,000 BTU/hr	54	54

J. STARTUP AND OPERATION

J.1. Final Inspection

J.1.1. Check for Refrigerant Leaks

Before beginning any work on the system or conducting any hot work, ensure that the area is in the open or that it is adequately ventilated. Ventilation must continue while the unit is being worked on. Ventilation is required to safely disperse any released refrigerant into the atmosphere.

Inspect the unit for any damage to the coils and tubing that could cause a leak.

Under no circumstances shall potential sources of ignition be used to search for or detect refrigerant leaks. A halide torch or any other detector using a naked flame must not be used.

Electronic leak detectors may be used to detect refrigerant leaks, but the sensitivity may not be accurate and may need recalibration to accurately detect R-454B. Before use, ensure that the detector is not a potential ignition source and is suitable for R-454B.

Leak detection equipment shall be set at a percentage of the LFL of the refrigerant and must be calibrated to R-454B.

Leak detection fluids are also suitable but do not use detergents containing chlorine. Examples of leak detection fluids are the bubble method and fluorescent method agents.

If a leak is suspected, all naked flames must be extinguished.

If a refrigerant leak is found that requires brazing, all of the refrigerants must be removed from the system.

J.1.1.1. Refrigerant Leak Detection System

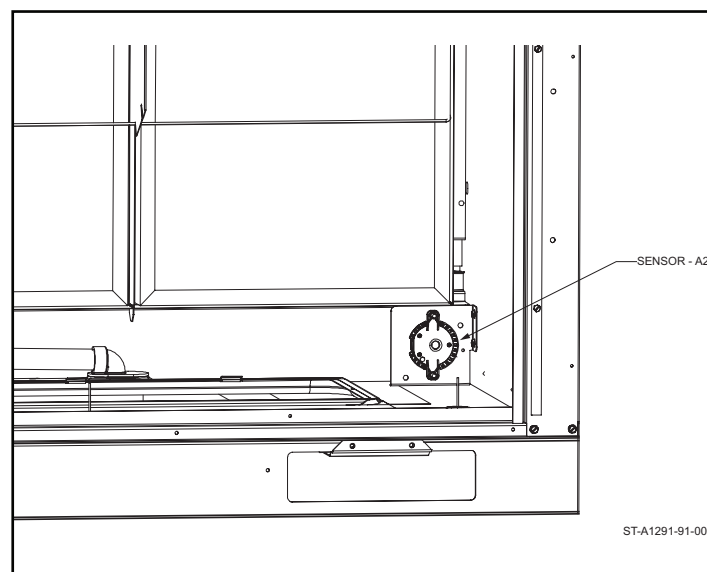
The refrigerant leak detection system will continuously monitor the air for a refrigerant leak. If the leak detection system detects a leak, the system will begin mitigation procedures: the blower will turn on and the compressors will shut down. Note: Gas or electric heat functions may continue during mitigation.

At the end of 15 years or if the refrigerant leak detection system becomes inoperable, the leak detection system must be replaced with components specified by the unit's manufacturer. Refer to the manufacturer's website for replacement components. Refer to the alarm code diagnostics section for refrigerant leak detection system error codes.

Figure J.1.1.1. - A: A2L Sensor Location shows the location of the sensor on the bracket in the filter compartment.

Please note that the sensor is mounted on the backside of the bracket, facing the filters.

Figure J.1.1.1. - A: A2L Sensor Location



J.1.1.2. Operation When a Leak is Detected

When the unit receives a signal from the A2L sensor, circulation airflow is activated, and the control board will display an error (for DDC units) or a fault code (for Non-DDC units). The following mitigation actions will also be activated:

1. Energize the fan(s) of the appliance to deliver indoor airflow at or above the minimum airflow. See **Appendix F – A2L Refrigerant Installation Safety Data**.
 - a. The fans shall be energized following the input signal to turn on the fans(s).
2. The system de-energizes compressor operation.
3. Activate additional mechanical ventilation, if applicable.

The above-mentioned actions shall continue for at least 5 minutes after the leak detection system begins mitigation. If the leak is no longer detected, the leak detection system will reset. If the leak is still present, mitigation actions will continue for another 5 minutes. This cycle will repeat until no leak is detected.

For DCC units, user-selectable Fan Off Delay will remain in effect after the A2L sensor triggers the mitigation procedure.

J.1.1.3. Removal and Evacuation of Refrigerant

The refrigerant charge shall be recovered into R-454B recovery cylinders. The unit system must be purged with oxygen-free nitrogen to render the appliance safe for flammable refrigerants, such as R-454B, again. This process might need to be repeated several times. **DO NOT USE** compressed air or oxygen for purging R-454B refrigerant systems.

Refrigerant purging shall be achieved by breaking the vacuum in the system with oxygen-free nitrogen and continuing to fill until the working pressure is achieved, then venting to the atmosphere, and finally pulling down to a vacuum. This process shall be repeated until no refrigerant is within the system. When the final oxygen-free nitrogen charge is used, the system shall be vented down to the atmospheric pressure to enable work to take place.

The outlet for the vacuum pump must not be close to any potential ignition sources.

Ventilation is required during removal and evacuation.

When breaking into the refrigeration circuit for any reason, this procedure must be followed:

1. Ensure there is no power to the unit.
2. With an accurate scale, ½ oz., set the refrigerant recovery cylinder in the upright position.
3. Connect the recovery cylinder to the unit using the service valves.
4. Evacuate refrigerant from the unit until the vacuum pump reads a minimum of 500 microns.
5. Purge the refrigeration circuit with inert gas until there is no refrigerant within the system.
6. Evacuate the circuit again.
7. Once all inert gas is removed, pull a vacuum on the unit to check for any leaks in the system.
8. If leaks are present, spray a soapy substance over the refrigeration circuit. Bubbles will help locate the leak.
 - a. Patch the leak and pull a vacuum again.
 - b. If leaks are still detected, repeat steps seven and eight.
9. If no leaks are present, charge the system as directed in the next section.
10. Remove the vacuum pump from suction, discharge, and liquid shut-off.

J.1.2. Check Level of Unit

Refer to **Section C.6.2.** for setting/checking the level of the unit.

J. STARTUP AND OPERATION

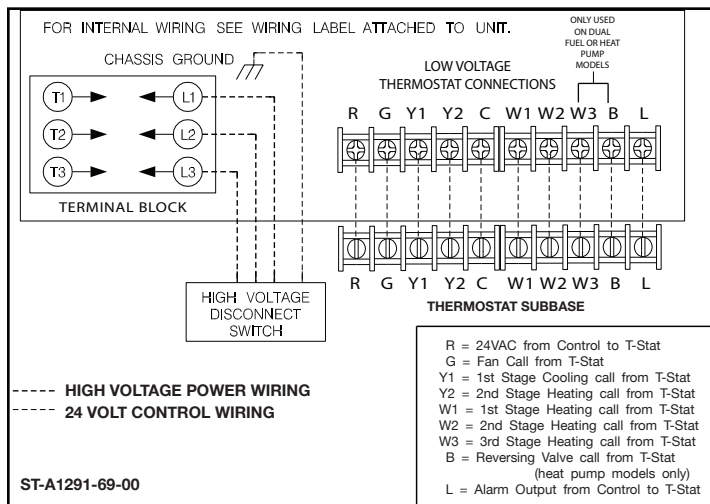
J.1.3. Check Electrical Connections For Proper Torque

Use an Inch Pound rated torque wrench to ensure proper torque. **DO NOT CONFUSE THIS WITH A FOOT POUND RATED WRENCH,** Damage will occur.

Recommended torques for securing wiring:

- To the contactor: 40 in-lb.
- From the T-stat to the control board: 8.0 in-lb.

Figure J.1.3. – A: Where to Wire for Thermostat



J.1.4. Check Control Cables For Proper Connection

Verify all cables are seated and connected in the unit as some might come loose during shipping and transport.

J.1.5. Check Filter Installation

Verify that filters are seated and oriented correctly in the unit as some might come displaced during shipping and transport. Refer to **Section D.3.** for more information on filters and filter installation.

J.1.6. Check Condensate Drain installation

Verify the Condensate Drain Trap is a minimum of 3 inches deep, plus the Blower Fan Static Pressure. Verify the Outlet of the drain trap is a minimum of 3 inches below the outlet of the drain pan. Ensure the outlet of the trap is routed to a suitable drain location as required by local code. Refer to **Section C.5** and **Figure C.5.1 – A** for more information.

J. STARTUP AND OPERATION

J.1.7. Check Blower Compartment for Accessories

Open all compartments to ensure there are no tools or other misc parts remaining in the unit from setup. This is most important on the blower section to avoid damage to the blower assembly.

J.1.8. Check Wiring

After completing refrigerant removal, evacuation, and charging, check that the internal and field wiring will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges, or any other adverse environmental effects, taking into account the effects of aging or continual vibration from sources such as compressors or fans.

J.1.9. Check for Gas Leaks

Double-check for any gas leaks on the installed piping. Refer to **Section G.2.3.** for more information.

J.2. Turning on Power for the First time

J.2.1. Checking for Proper 3-Phase Voltage

Verify that proper power has been supplied to the unit. This is critical for correct operation of the compressor.

J.2.2. Check For Proper Phase

In applications with 3-phase power, the compressor rotation can be affected and potentially run backwards depending on the phase wiring. It is recommended to use a phase rotation meter to verify the proper wiring of the supply power. Do not rely on the rotation of the blower because models equipped with a VFD or ECM drive motor will always run in the correct direction.

J.2.2.1. Standard Blower Rotation

As a reminder, all units with an ECM-drive blower motor will have the correct rotation even if the phase to the unit is wired incorrectly. See **Section E.3.4. Checking Phase and Motor Rotation** for more information.

J.2.3. Checking Low (Control) Voltage

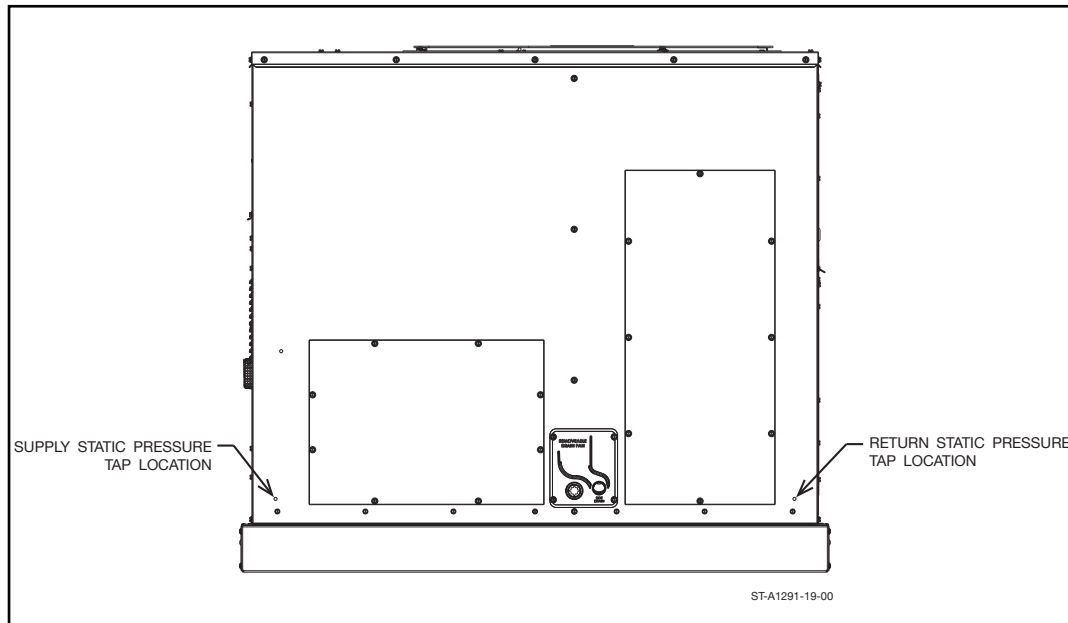
Use a voltmeter to measure the low voltage and low voltage amp draws during operation. Accessories such as remote smoke detectors and excessive wire length can increase the amp draw on the low voltage wiring. Verify that the total amp draw on the 24VAC side is less than 0.3A in full operation. Refer to **Figure F. – A** for proper low voltage wire lengths.

J. STARTUP AND OPERATION

J.3. Checking and Adjusting Air Flow

For Economizer and Diffuser Pressure Drop Data, please refer to the end of **Appendix C: Airflow Performance Data**. For the minimum rated airflows for this unit's base models, see **Appendix F: A2L Refrigerant Installation Safety Data**

Figure J.3. – A: Static Pressure and Air Temp Measurement Location



J.3.1. Static Pressures and Measurements

- To measure the static pressure of the system, locate the static pressure testing dimples near the supply/return duct openings, and drill a hole to the size necessary for the test probe. The location of these dimples are shown in **Figure J.3. – A**.
- NOTE: After taking airflow measurements, seal these openings per best practice to prevent airflow leakage and water entry into the unit.
- NOTE: Drilling test tap locations in other panels or doors could put the test probe in a turbulent zone providing false readings.

J.3.1.1. Using Tools

Use a manometer to measure the static pressure of the blower. Insert the meter probe into the tap location. Make sure any economizer or outside air dampers are closed and run the fan at the maximum, full speed setting. Record the reading for the return air and supply air separately.

J.3.2. Air Flow Measurements and Adjustments

- Measure the supply/return static to get the unit static pressure by drilling out the dimple locations shown in **Figure J.3. – A**.
- Take the measured static pressure and match to the static listed on the airflow table to find your CFM. Use the charts and guide provided in the Installation and Operation instructions provided

with the unit to calculate the airflow, against the measured static pressures and number of turns on the adjustable blower sheave. Verify the measured air flow against the charts.

- For non-DDC units, the unit ships standard with the orange wire (wire 607) having a quick-connect towards the control board—end of the harness. If more airflow is needed, unplug the orange wire and reattach to the T-connection on the yellow wire (yellow 608). Refer to **Figure J.3.2. – A**.

J.3.2.1. 3 to 5 ton Models – High or Low Static Drive

This adjustment only affects the fan speed during cooling operation and does not change the airflow for fan only or heating.

For non-DDC units, the unit ships standard with the orange wire (wire 607) with a quick-connect toward the control board—end of the harness.

If more airflow is needed, unplug the orange wire, and reattach it to the T-connection on the yellow wire (wire 608). Refer to **Figure J.3.2. – A**.

For DDC units, the unit ships with the orange wire for the indoor fan connected to the CC2 terminal on the board.

If more airflow is needed, remove the wire from CC2 and connect it to the CC1 terminal. Reconnect the yellow CC1 wire to the piggyback connection of the orange wire now on CC1. Refer to **Figure J.3.2. – B**.

J. STARTUP AND OPERATION

Figure J.3.2. – A: How to Increase Airflow for All Single-Stage Units

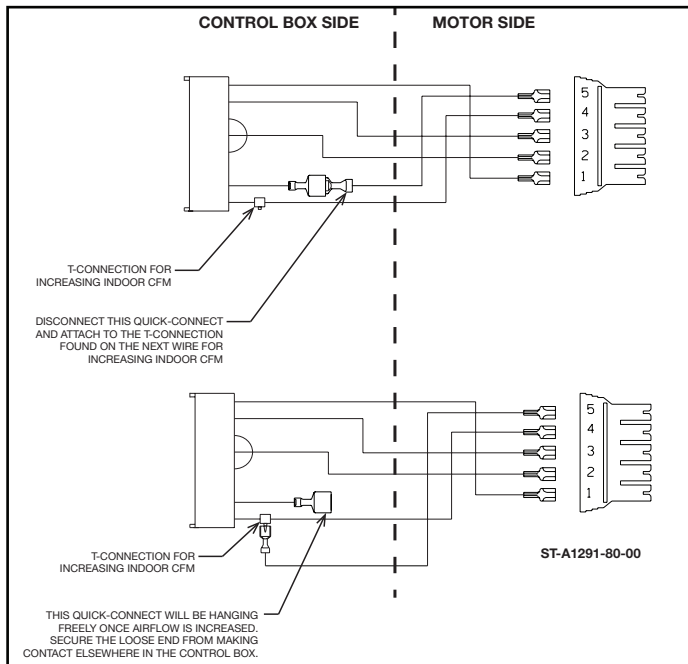
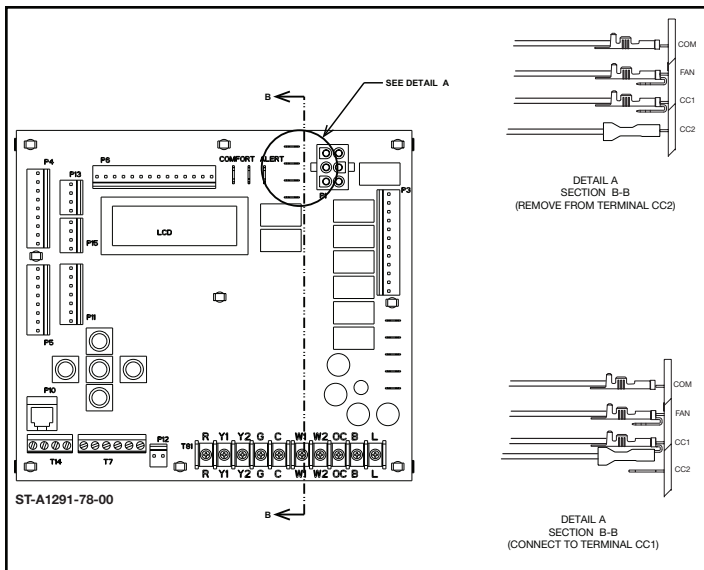


Figure J.3.2. – B: How to Increase Airflow for 3 to 5 ton DDC Units



J.3.2.2. 6 ton Models – High or Low Static Drive

This adjustment only affects the fan speed during second stage cooling operation, and does not change the airflow for fan only, any heating stage, or the first stage cooling call.

For non-DDC units, the unit ships standard with the purple wire with a quick-connect toward the control board-end of the harness, disconnected.

If more airflow is needed, attach the purple wire to the T-connection on the orange wire (wire 607). Refer to **Figure J.3.2.–C.**

For DDC units, the units ships standard with the purple wire with a quick connect toward the control board-end of the harness, disconnected.

If more airflow is needed, connect the purple wire to the piggyback connection of the orange wire on CC2. Refer to **Figure J.3.2.–D.**

Figure J.3.2. – C: How to Increase Airflow for All Two-Stage Units

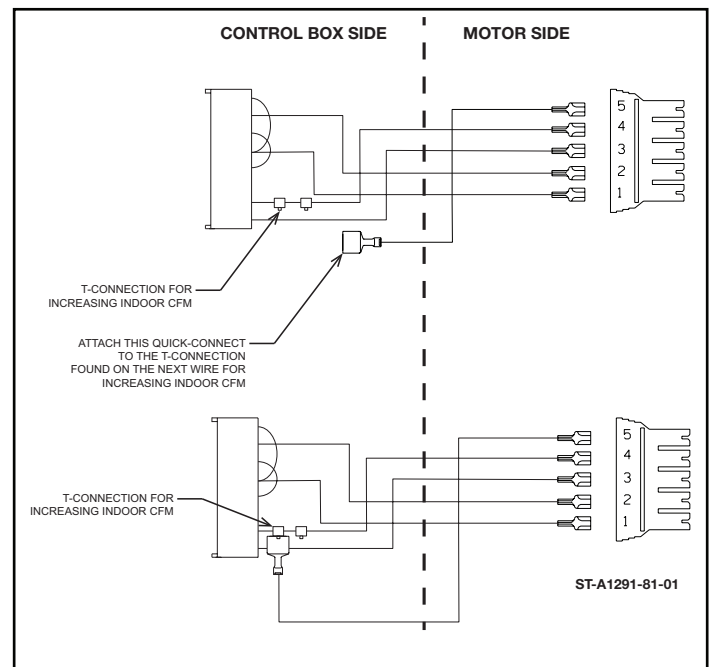
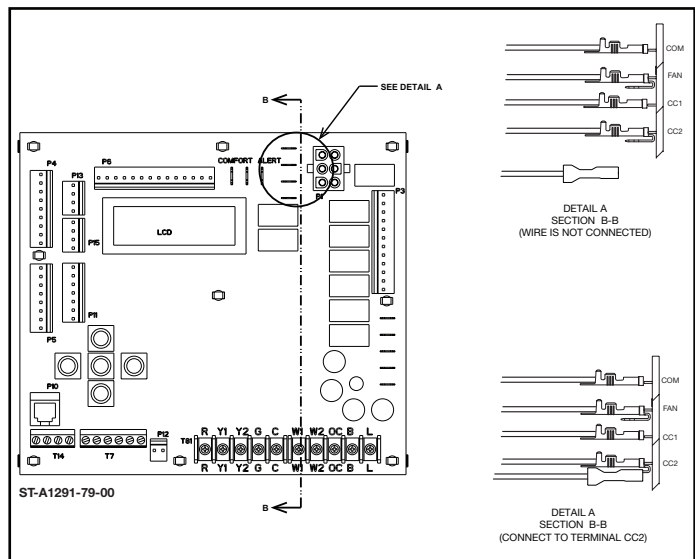


Figure J.3.2. – D: How to Increase Airflow for 6 ton DDC Units



J. STARTUP AND OPERATION

J.3.2.3. Adjusting Fresh Air Flow with Economizer

See section **J.3. Checking and Adjusting Air Flow** for measuring airflow, and refer to the I&O included with the Economizers for more information on adjusting airflow.

J.3.2.4. Adjusting Fresh Air Flow with Damper

All dampers are field install accessories. See the above sections for measuring airflow, and refer to the I&O included with the fresh air dampers for more information on adjusting airflow. Refer to local building codes for any fresh air requirements.

These accessory I&Os can also be found on the manufacturer's website.

J.4. Checking Cooling Operation

Note: In this section, first and second stage cooling applies ONLY to the two stage (YB072 and all YC) units. For all other units, only first stage cooling applies.

COOLING SEQUENCE OF OPERATION

A. Call for cooling

1. The zone thermostat contacts close, and a call for cooling is initiated.
2. Inputs 'Y1' and 'G' to the control are energized.
3. The control senses input to 'Y1' and 'G'. After a 1sec delay, the control energizes both the indoor blower and first stage compressor.
4. The control enters normal operating loop where all inputs are continuously checked.
5. Zone thermostat is satisfied.
6. The blower will continue to run for a preset period of time after the zone thermostat is satisfied.
7. The control goes into standby mode displaying "O".

B. Call for second stage cooling. After first stage cooling established; starting from A4.

1. If a call for second stage cooling is initiated after a call for first stage cooling is established, the control energizes 'Y2' and energizes the second stage compressor.
2. Then the control enters the normal operating loop where all inputs are continuously checked.

C. Second stage satisfied and first stage still called for; starting from B2.

1. 'Y2' is de-energized and the second compressor stage is de-energized.

D. First stage and second stage called simultaneously.

1. The zone thermostat contacts close, and a call for first and second stage cooling is initiated.
2. Inputs 'Y1', 'Y2' and 'G' to the control are energized.
3. The control senses 'Y1', 'Y2' and 'G'. After a 1sec delay, the control energizes the indoor blower, and the first and second compressor stages.

E. First stage and second stage removed simultaneously.

1. Upon a loss of 'Y1' and 'Y2', the compressor is de-energized. The control de-energizes the indoor blower relay, and cuts off the blower after an indoor blower delay.
2. The control goes into standby mode displaying "O".

CONTINUOUS FAN MODE

A 'G' input only indicates a zone thermostat call for continuous indoor blower operation.

TIME DELAY BYPASS for non-DDC units

The Time Delay Bypass resets the ICC (Integrated Compressor Control) from any lockout mode or bypasses compressor anti-short cycle delay timer. To bypass the time delay, press the SW1 button with an insulated probe for 1sec and then release.

FAULT RECALL OPERATION for non-DDC units

To enter FAULT RECALL mode, press the SW1 button with an insulated probe for 2sec and release. Upon entering and exiting the FAULT RECALL mode, the top bottom segments of the 7-segment display will be activated. The ICC will automatically scroll through the stored faults on the 7-segment display. Each fault is displayed one time with the top segment of the 7-segment display activated between faults. Each fault is displayed with the most recent fault displayed first. An "O" will be displayed when no faults are stored. The ICC will automatically exit the FAULT RECALL mode after displaying stored faults.

An example of one LPC fault and one HPC fault scrolled on the display is shown as: "21"23"

CLEAR FAULT HISTORY for non-DDC units

To clear FAULT HISTORY, press the SW1 button with an insulated probe for 5sec and release. The top and bottom segments of the 7-segment display will be activated and flash to indicate the history has been cleared.

Example: =====

TEST MODE for DDC Units

For units with DDC, there is a "Run Test" mode that will aid in diagnostics during installation. Please refer to the CLEAR CONTROL MANUAL for more information.

J. STARTUP AND OPERATION

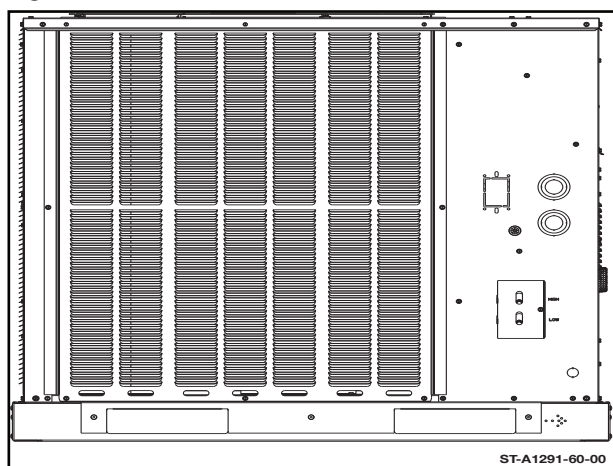
J.4.1. Checking Refrigerant Pressures

This unitary packaged system comes fully charged and tested with R-454B refrigerant from the factory. Adjustment of the refrigerant charge is not required. If the unit is suspected of not having the proper refrigerant charge, any adjustment must not exceed 2% of the total refrigerant weight listed on the rating plate of the unit and should not supersede correctly weighed-in refrigerant.

Note: Factory charge chart and/or design target subcooling are for gross charge verification.

See section **C.2.1. Tools Required for Installing and Servicing R-454B Models.**

Figure J.4.1. -A: Service Port Location



J.4.1.1. Refrigerant Pressure Charts

See **Appendix G** towards the end of this manual for Refrigerant Pressure Charts.

J.4.2. Checking Sub Cooling for Adjusting Charge Weight

When breaking into the refrigeration circuit for any reason the procedure included in section **J.1.1.3. Removal and Evacuation of Refrigerant** must be followed.

Prior to recharging the system, complete a leak check and purge the system with inert gas as detailed in **J.1.1.3. Removal and Evacuation of Refrigerant.**

See **Appendix G** towards the end of this manual for Refrigerant Charging Charts.

Charge verification instructions:

1. Allow the unit to operate for 15 minutes before checking or adjusting the charge.
2. Ensure that the contamination of different refrigerants does not occur when using charging equipment. Hoses or lines shall be as short as possible to minimize the amount of refrigerant contained in them.
3. Ensure that the unit is properly grounded.

4. Return air temperature must be within comfort conditions (72°F – 82°F).

5. Remove caps from the high-side and low-side pressure service fittings.

6. Cylinders shall be kept in an upright position for the entirety of the testing and charging procedure.

7. Record the following measurements:

- a. High-side pressure at the service fitting
- b. Liquid line temperature

8. Using R-454B refrigerant saturation T-P tables, find the corresponding refrigerant saturation temperature relative to the measured high-side pressure.

9. To determine subcooling, subtract the liquid line temperature measured in Step 7 from the saturation temperature found in Step 8.

10. Compare the subcooling result from Step 9 to the subcooling table located on the unit or in the I&O manual.

11. If the subcooling value from Step 9 is more than 1°F above the value listed in the subcooling table, remove charge to match the value listed in the table, $\pm 0.5^\circ\text{F}$.

- a. Take extreme care not to overfill the system.

12. If the subcooling value from Step 9 is more than 1°F below the value listed in the subcooling table, add charge to match the value listed in the table, $\pm 0.5^\circ\text{F}$.

- a. Take extreme care not to overfill the system.