TRSW/G Series Air Conditioning System

Model Sizes 150 thru 420

Installation and Maintenance Manual
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Installation and servicing of this equipment can be hazardous due to system pressure and electrical components. Only trained and qualified personnel should install, repair, or service the equipment.

Before performing service or maintenance operations on the system, turn off main power to the unit. Electrical shock could cause personal injury or death.

When working on equipment, always observe precautions described in the literature, tags, and labels attached to the unit. Follow all safety codes. Wear safety glasses and work gloves. Use a quenching cloth for brazing, and place a fire extinguisher close to the work area.

To avoid the release of refrigerant into the atmosphere, the refrigerant circuit of this unit must be serviced only by technicians who meet local, state, and federal proficiency requirements.

This unit contains HFC-(R410A), an azeotropic mixture of R-32 (Difluoromethane) and R-125 (Pentafluoroethane). DO NOT VENT HFC-(R410A) to the atmosphere. The U. S. Clean Air Act requires the recovery of any residual refrigerant. Do not use R-22 service equipment or components on R410A systems.

All refrigerant discharged from this unit must be recovered WITHOUT EXCEPTION. Technicians must follow industry accepted guidelines and all local, state, and federal statutes for the recovery and disposal of refrigerants. If a compressor is removed from this unit, refrigerant circuit oil will remain in the compressor. To avoid leakage of compressor oil, refrigerant lines of the compressor must be sealed after it is removed.

To avoid equipment damage, DO NOT use these units as a source of heating or cooling during the construction process. Doing so may affect the unit’s warranty. The mechanical components and filters will quickly become clogged with construction dirt and debris, which may cause system damage.

SAFETY LABELING AND SIGNAL WORDS

The signal words DANGER, WARNING and CAUTION are used to identify levels of hazard seriousness.

DANGER - Immediate hazards which WILL result in severe personal injury or death.

WARNING - Hazards or unsafe practices COULD result in severe personal injury or death.

CAUTION - Hazards or unsafe practices COULD result in minor personal injury or product/property damage.

Signal Words in this Manual will appear as follows;

This is a Danger Warning!

This is a Cautionary Note.
Safety labels on the product will appear as follows:

**DANGER**

| Electric Shock Hazard. Turn OFF All Power Before Servicing. |

**WARNING**

| Fire Hazard. Use copper wire only. Failure to observe could result in property damage, bodily injury or death. |

**CAUTION**

| Cutboard Abrasion Hazard. Wear gloves and handle with care. Failure to observe could result in bodily injury. |

### GENERAL DESCRIPTION

The model TRS Series A packaged cooling and heating unit is designed to cool a conditioned space with mechanical refrigeration, energy conservation wheel or a combination of these systems. During the heating mode supply air may be heated by reverse cycle refrigerant heating, electric strip or by steam or hot water. The cabinet design provides space for a number of options, including 100% outside air applications and the use of desiccant wheels. Most of these options will be covered in this manual; for customized units, consult the distributor.

Model TRS units are designed for rooftop curb, slab mounted or installed on post and rail applications. Horizontal supply with 100% outside air does not require a curb and may be slab mounted. Horizontal or vertical supply with vertical return is available with a 14” high solid bottom roof curb (sold separately as an option). Horizontal supply and return air duct connections are made with the use of 24” high solid bottom roof curb (sold separately as an option).

Note that some options are offered in limited sizes and/or voltages.

### Unpacking and Inspection

When received, the unit should be checked for damage that might have occurred in transit. If damage is found, it should be noted on the carrier’s freight bill. Request for inspection by carrier’s agent should be made in writing at once.

- Never lift or move units by filter racks, external piping or attached options/accessories.
- Never stack units when transporting them.

### Design Certification

All units are certified by Electrical Testing Laboratories (E.T.L) under the ANSI/UL 1995. The gas furnace designs are certified by E.T.L. under the appropriate ANSI standards for use with natural or propane (L.P.) gas as specified when ordering unit.

### Codes & Ordinances

These units must be installed in accordance with the standard of the National Fire Protection or the National Fuel Gas Code. The National Fuel Gas Code is available from the American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209. NFPA Publications are available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269. Local authorities having jurisdiction should be consulted before the installations are made to verify local codes and installation procedures.

All field wiring to the unit must be done in accordance with these instructions, The National Electric Code (ANSI/NFPA 70-1981) in the United States and all local codes and ordinances.

Clearances from the heater and vent to construction or material in storage must conform with the National Fuel Gas Code, pertaining to gas- burning devices.

- Gas material must not attain a temperature over 160°F by continued operation of the heater.

- Installation should be done by a qualified agency in accordance with the instructions in this manual and compliance with all codes clearances and requirements of authorities having jurisdiction.
**INSTALLATION**

- Do not locate the unit above supply piping.
- Do not locate the unit under an overhang that will short circuit hot air to the coil intakes.

- A 36" clearance must be allowed for access to the compressor and electrical panel. A 24" clearance must be maintained for the air inlet to the condenser coil(s).

**Unit Location, Clearances**

When installed at ground level, the unit should be mounted on a level concrete slab which should extend at least 2" beyond the unit on all sides. The top of the slab should be 2" above the ground level. The depth of the slab below the ground level and its structural design is governed by the type of soil and climatic conditions. The slab must not be in contact with any part of the building wall or foundation. The space between the slab and building wall prevents the possibility of transmitting vibration to the building. The dimensions of the slab or roof mount should be checked and verified before the equipment arrives. Unit supports, roof opening, roof curb flashing, drain requirements, and electric locations are important to a good installation.

When installing the equipment on top of a building, the following should be considered. Structural members supporting the unit must be sufficiently strong for the weight of the unit and mounting rails. Transmission of sound into the building is sometimes a problem when the structure is not strong enough.

Locate the unit as near as possible to the center of the area to be environmentally controlled. Sufficient clearance must be available for service, edge of roof, other units, or hazards. The condenser air inlet and discharge air must be unobstructed by overhang, walls, or other equipment. Avoid locations next to exhaust fans or flues.

Select a location where external water drainage cannot collect around the unit. Locate the unit so roof runoff water does not pour directly on the unit. Provide gutter or other shielding at roof level.

Where snowfall is anticipated, mount the unit above the maximum snow depth for the area.

**Curb Installation**

Proper installation for the TRS series requires that the roof mounting of the curb be firmly and permanently attached to the roof structure. Check for adequate fastening method prior to setting rooftop unit on curb.

Inspect curb to insure that none of the utility services (electric, gas, drain lines) routed through the curb protrude above the curb. Being a fully welded solid bottom curb, duct connections can be made before unit is set on curb. Duct openings are to be sized and cut by the installing contractor in the solid curb.

**Rigging**

- Be sure that the crane and lift material (bars, cable, chain), (or other lifting device) capacity is adequate for the unit weight. The total unit weight calculated must include all appropriate options for your unit. Certain options can add significant weight to a unit. See specification literature for unit weights.

Spreader bars keep the lift cables from damaging the cabinet once the unit has been lifted, these bars will be required in all instances. Keep the tension equal, improper lift tension can damage wiring, refrigeration lines and the water tight integrity of the cabinet as well as sheet metal damage to the unit cabinet.

Lower unit carefully onto roof mounting curb or mounting rails or ground level slab. While rigging unit, center of gravity will cause condenser end to be lower than supply/return air end. Bring condenser end of unit into alignment with curb. With condenser end of unit resting on curb member and using curb as fulcrum, lower front end of unit until entire unit is seated on curb.

**Figure # 1 Typical Crane Lift Lug Location**
Rigging Removal
Remove spreader bars, lifting cables and other rigging equipment. Use caution not to dent, scratch or otherwise damage cabinet or intake and exhaust hoods.

Electrical
Do not tamper with Factory Warning!

Wiring Connections
Power wiring should be connected to the main power terminal block located within the unit main control section. Power wiring connections on units with factory disconnects should be made at the line side of the disconnect switch. Low voltage wiring connections are made to the remote mounted controller or time clock. Contact your local representative or the factory if assistance is required. The internal power and control wiring of these units is factory installed and each unit is thoroughly tested prior to shipment.

Main Power Wiring
The units are factory wired for the voltage shown on the nameplate. Main power wiring should be sized for the minimum wire Ampacity shown on the nameplate. An external weather-tight disconnect switch properly sized for the unit total load is required for each unit. Disconnect must be installed in accordance with Local and/or National Electric Codes. Power wiring may enter the rooftop unit through the unit base and roof curbs on all models. Install conduit connectors at the entrance locations. External connectors must be weatherproof.

Grounding
All units must be properly grounded. The ground lug is provided for this purpose.

DO NOT use the ground lug for connecting a neutral conductor.

The unit must be electrically grounded in accordance with local codes, or in the absence of local codes, with NEC ANSI/NFPA 70 1981. Once it is established that supply voltage is within the utilization range, check and calculate if an unbalanced condition exists between phases. Calculate percent voltage unbalance as follows:

\[
\text{Percent Voltage} = \frac{100 \times X}{\text{Maximum Voltage Deviation From Average Voltage}}
\]

\[
\text{EXAMPLE} \quad \text{With voltage of 220, 215 and 210}
\]

\[
\text{Average voltage} = \frac{220 + 215 + 210}{3} = 215
\]

\[
\text{Maximum voltage deviation from Average voltage} = 220 - 215 = 5
\]

\[
\text{Percent Voltage} = \frac{100 \times 5}{215} = \frac{500}{215} = 2.3\%
\]

Percent voltage unbalance must not exceed (2%) two percent

Contact power company if phase unbalance exceeds 2%.

Control System Wiring
For commercial equipment, the following table lists the minimum size of 24 volt class 2 wire to be used.

<table>
<thead>
<tr>
<th>WIRE SIZE</th>
<th>Ft. Run from Unit to Thermostat or Longest Run</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 AWG</td>
<td>Maximum Run 50 feet</td>
</tr>
<tr>
<td>16 AWG</td>
<td>Maximum Run 75 feet</td>
</tr>
<tr>
<td>14 AWG</td>
<td>Maximum Run 100/125 feet</td>
</tr>
<tr>
<td>12 AWG</td>
<td>Maximum Run 150/200 feet</td>
</tr>
</tbody>
</table>

Consult the wiring diagram furnished with the unit. These units are custom designed for each application. The unit wiring diagram is located inside the control panel of each unit.
**Duct System**

Properly sized and installed ductwork is critical to reliable performance of the unit and system. The TRS series has two options; down flow (vertical), horizontal supply and 100% outside air or horizontal supply and return air duct connections with the use of a tall horizontal duct curb.

All duct connections with the use of a curb are to be field sized and cut. All ductwork must be installed according to local codes, practices and requirements. Industry manuals should be used as a guide to sizing and designing the duct system. Ducts passing through unconditioned spaces must be well insulated with vapor barrier to prevent condensation.

**Condensate Piping/Drainage**

A condensate trap must be provided by customer. Drainage of condensate directly onto the roof is acceptable if permitted by local codes. It is recommended that a small drip pad of either stone, or tar, wood or metal be provided to prevent any possible damage to the roof. If condensate is to be piped into the building drainage system, the drain line must penetrate the roof external to the unit. Refer to local codes for additional requirements.

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**Table 2: Dimensions of Schedule 40 Pipe (Inches)**

<table>
<thead>
<tr>
<th>Size</th>
<th>Nominal Outside</th>
<th>Diameter Inside</th>
<th>Wall Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>1.050</td>
<td>0.824</td>
<td>0.113</td>
</tr>
<tr>
<td>1</td>
<td>1.315</td>
<td>1.049</td>
<td>0.133</td>
</tr>
<tr>
<td>1 1/4</td>
<td>1.660</td>
<td>1.380</td>
<td>0.140</td>
</tr>
<tr>
<td>1 1/2</td>
<td>1.900</td>
<td>1.610</td>
<td>0.145</td>
</tr>
<tr>
<td>2</td>
<td>2.375</td>
<td>2.067</td>
<td>0.154</td>
</tr>
<tr>
<td>2 1/2</td>
<td>2.875</td>
<td>2.467</td>
<td>0.203</td>
</tr>
<tr>
<td>3</td>
<td>3.500</td>
<td>3.068</td>
<td>0.216</td>
</tr>
</tbody>
</table>
For TRS units with gas furnace options locate the gas furnace instruction manual located inside each unit control vestibule.

Service Clearances
Adequate clearance around the unit must be kept for safety, accessibility, service, and maintenance. 48 inches clearance is required on the side (furnace and electrical) end of the unit. This clearance must be maintained for compressor removal and up to 64 inches in the case of a furnace or ECW wheel unit.

All combustible materials must be kept out of the area. A 48 inch clearance is also required on the front (outside air) end of the unit for blower removal and for adequate outside air accessibility. The clearance of 64 inches on the filter access side of the unit is required for ECW wheel removal if installed. A clearance of 36 inches is required on the condenser side for an adequate supply of condenser air.

Gas-fired appliances are not designed for use in hazardous atmospheres containing flammable vapors or combustible dust, in atmospheres containing chlorinated or halogenated hydrocarbons, or in applications with airborne silicone substances.

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

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

To prevent carbon monoxide poisoning; no windows, doors, exhaust or intake air opening may be located in front of the gas furnace flue outlet.
Water Connections

Water connections are inside the unit, in the compressor compartment. There are two pipe sleeves in the bottom pan of the unit, and the water lines must be brought up to the roof through the curb. Dimensions locating the sleeve centerlines are shown on the dimensional drawings.

Where the two condensers are used, they are manifolded at the factory, so only two connections are required in the field.

Follow all local plumbing codes in connecting water lines, and insulate against freezing.

Most of these units will be installed on closed loop systems. If well water is used, an adequate supply of good water must be available. If it is high in mineral content, it may need to be treated to keep the heat exchanger from "liming up". If high in sulfur content, an optional Cupronickel condenser may need to be specified.

Consult local water treatment companies for advice on the condition of the water you intend to use.

To Measure Water Flow

Pressure taps are provided on each water connection, in order to measure water pressure at the inlet and outlet. This will allow the pressure drop across the unit to be determined, and the unit specification sheet will indicate water flow in GPM.

Rated flow in accordance with applicable ARI standards is that rate which gives a 10 degree F. water temperatures rise on the cooling cycle, at rated CFM, 80°F dry bulb and 67°F wet bulb air across the evaporator coil (see unit specification sheet).

For most closed loop applications, the recommended flow rate will vary according to inlet water temperature.

<table>
<thead>
<tr>
<th>Model</th>
<th>Water Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRSW/G150</td>
<td>1 3/8&quot;</td>
</tr>
<tr>
<td>TRSW/G180</td>
<td>1 3/8&quot;</td>
</tr>
<tr>
<td>TRSW/G210</td>
<td>1 3/8&quot;</td>
</tr>
<tr>
<td>TRSW/G200</td>
<td>2 1/8&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>To Measure Water Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRSW/G240</td>
<td>2 1/8&quot;</td>
</tr>
<tr>
<td>TRSW/G300</td>
<td>2 1/8&quot;</td>
</tr>
<tr>
<td>TRSW/G360</td>
<td>2 1/8&quot;</td>
</tr>
<tr>
<td>TRSW/G420</td>
<td>2 1/8&quot;</td>
</tr>
</tbody>
</table>
Start-Up Instructions

The following steps are offered as a general guide to start up.

1. With a voltmeter, check to see that the voltage to be applied to the unit is correct. If it is low by more than 10%, consult the power company before starting the unit. If it is high, watch carefully to see that it does not remain more than 10% high during full load running conditions.

2. Before turning power on to the unit, see that the thermostat switch is in the OFF position. Then turn power on. Allow it to remain on at least 1 hour prior to starting the unit.

3. Feel the compressor crankcase. It should be warm, since the heaters have been on at least 12 hours. This will assure that no refrigerant liquid is present in the crankcase. If the crankcase is allowed to contain liquid refrigerant, compressor damage or failure can occur on start-up.

4. Install suction and discharge gauge set on compressor, to read suction and discharge pressure.

5. Turn the thermostat Fan Switch to the ON position. The supply air blower should operate. Observe that airflow is present. Measure that airflow in order to determine if it is as specified for the particular application. Normal methods of measurement should be used, as with any commercial installation. Since blower motor is three-phase, check to be sure it is not running backwards. If it is, interchange any two of the three power leads to the unit, after first stopping the unit and opening the disconnect to remove power from the unit.

6. Be sure that water flow to the unit is correct. Section VIII gives correct pressure drop readings across the condenser; Schrader fittings are provided to read that pressure drop. Water flow should be as specified for the job.

7. After being satisfied that airflow and water flow are correct, turn the temperature setting on the thermostat as high as it will go. Then turn the system switch to COOL. The unit compressor should not come on yet. Then, slowly turn the temperature setting down until the thermostat contacts make, calling for cooling.

8. The compressor should now come on. Check to see that it is operating correctly. If compressor is equipped with an oil level sight glass, check for proper oil level.

9. With a voltmeter, check to see that the unit is receiving rated voltage while running. If it remains more than 10% low or high during full load running conditions, consult the power company.

10. With an ammeter, check to see that the unit is drawing approximately rated current in amps.

11. Check pressure readings on the suction and discharge gauges. While these will vary with start-up conditions, suction pressure will usually be from 118 to 120 psig, and the discharge pressure will usually be from 425 to 450 psig. Not until the room temperature conditions have been brought to normal can you check pressures closer.

12. Check superheat at the suction line just before the compressor...it should be about 15 degrees during normal operation.

13. After checking the cooling operation, turn the thermostat to the OFF position, and listen for the unit reversing valve to shift. Then, turn the temperature setting as low as it will go. Switch to the HEAT position. Then, gradually raise the temperature setting until the compressor comes on. See that the unit is providing heat. The unit cannot be properly checked for pressures, etc., on the heating cycle until the heating season has started and room return conditions are in the normal range of 70 degrees dry bulb. However, since the unit was factory operated in both cooling and heating, if you have correct operation in cooling, the heating operation should be satisfactory. Do not run the unit too long in heating, with high summer-time return air temperatures. Return at the beginning of the heating season to check the operation.

All units are equipped with compressor crankcase heaters, which must be energized at least 12 hours prior to start-up.
14. With room return air of 70 degrees dry bulb, on the heating cycle, compressor operating pressures should be: suction pressure from 112 to 115 psig, and discharge pressure from 450 to 475 psig.

15. Check to see that filters are properly positioned, and that they are clean.

16. Finally, check to see that all panels are on and correctly positioned, and that the unit seems to be operating normally, and that the owner's representative is instructed in unit operation and precautions.

MAINTENANCE PROCEDURES

Proper, regularly scheduled maintenance is important to insure the most efficient operation and longest life for your equipment. The following points are to serve as a general guide. Always consult with your maintenance contractor with regard to the specific requirements of your own installation.

Filters
Check the air filters at least once each month. Wash or replace as necessary.

Bearings
Only sealed bearings are used in the evaporator blower motors. Therefore, bearing oiling is not required.

Paint Finish
Unit is primed and painted giving a durable finish. If paint is lifting or peeling occurs, scrape and sand the affected area and touch up with paint obtained from the factory for this purpose.

Water System
The pump should be checked whenever filters are cleaned, to assure that it is operating normally. Clogged coils lead to high pressures and inefficient operation. Abnormal pressures may indicate liming or scaling. If so cleaning is necessary. Condenser coils should be checked yearly for liming or clogging.

Refrigerant Pressure
Check at any time unit does not seem to be performing at top efficiency. These should be checked only by a competent service contractor.

Contactor Points
Check contactor points twice a year, to be sure they are not badly burned or pitted as a result of low voltage, lightning strikes, or other electrical difficulties.

Condensate Drains
Always check to see that condensate is draining properly from the unit, whenever you check the filters.

Condensate Drain Pan
Each 6 months, clean and flush evaporator condensate drain pan.

Evaporator Fans
Be alert for any noise that would indicate blower wheels loose, motors or bearing failing.

Belts and Pulleys
Check whenever filters are changed, to make sure belts are tight and pulleys are not loose.

COOLING SYSTEM OPTIONS

Hot Gas Bypass
Hot gas bypass is a means of capacity control during lower ambient temperature conditions. The Hot Gas Bypass valve is an adjustable valve and should be set to open when the refrigerant suction pressure drops to 107-112 psig. It varies unit capacity by introducing discharge refrigerant into the evaporator circuit where it creates a false evaporator load. The hot gas is cooled prior to its return to the compressor as it passes through the evaporator.

The Hot Gas Bypass Solenoid Valve is energized through the thermostat and routes discharge gas to the hot gas bypass valve. It is de-energized during the pump down cycle.

Head Pressure Control- Air Cooled Systems Only
Low ambient control. Cycling the condenser fan or fans in response to compressor discharge pressure will permit stable operation in ambient down to 32F. The operating pressure switch is adjustable to match customer needs; it is factory set to re-energize the fans when discharge pressure drops to 295 psig and energize them when pressure increases to 410 psig.

Variable Speed Control
The VARISPEED Fan Control System controls the compressor discharge pressure. The speed control module responds to discharge pressure; it speeds the condenser fan up as pressure rises and slows the fan down as pressure falls due to load conditions or as outdoor ambient temperature falls.
Head pressure control is accomplished with one or two variable speed condenser fan drives and controller, factory set to begin fan rotation at 311 psig and be at full fan speed at 410 psig.

Single or tandem compressor, four fan units have one variable speed motor and control and three 3 phase constant speed motors. Two adjustable pressure controls are used on the 3 fans, the first operating one fan between 443 psig and 358 psig, the second operating two fans between 460 psig and 375 psig.

Single compressor, single fan units will have one variable speed motor and control. At low ambient, the variable speed fan operates, increasing in speed until maximum RPM is achieved at or around 45°F ambient. An adjustable pressure switch operates the constant speed three-phase fan set to energize the motor at 443 psig and de-energize at 358 psig. In the ambient temperature span of approximately 50°F to 53°F, the variable speed fan will ramp between maximum and minimum speed while the constant speed fan cycles. The start-stop cycle varies from 45 seconds to 2½ minutes during this period. At 53°F, both fans are operating; the variable speed at minimum RPM and the constant speed at full RPM. As the ambient continues to rise, the variable speed motor increases to full speed and remains there.

If the application calls for a closer setting between maximum and minimum pressure settings on the constant speed fan, for example 443 psig on, 388 psig off, the effect will be to lengthen the temperature span during which the cycling takes place, for example 50°F to 57°F.

Adjustable High and Low Pressure Switches

Standard cooling units are equipped with non-adjustable pressure switches. The low pressure switch is set to open at 135± psig and is an automatic reset switch closing at 99± psig. The high pressure switch is set to open at 640± psig and is a manual reset switch set to close at 595± psig.

Units can be equipped with adjustable high and low pressure switches for those installations that require finer settings than the non-adjustable switches provide. Low pressure switches have both set point and differential adjustments and are automatic reset. High pressure switches must not be set above 640 psig and are manual reset. Set point and differential are adjustable.

MECHANICAL ADJUSTMENTS

Set Fan RPM

All evaporator motor sheaves are set when tested and shipped from the factory. Actual rpm must be set and verified with a tachometer. Refer to the following Blower Performance Chart for basic unit fan rpm.

With disconnect switch open, place a jumper wire across Terminals R and G at TS1 Terminal Block. Close disconnect switch; evaporator fan motor will operate so rpm can be checked.

Fan Rotation Check

Check that fan rotates clockwise when viewed from the drive side of unit and in accordance with rotation arrow shown on blower housing. If it does not, reverse two incoming power cables at TB Terminal Block.

Do not attempt to change load side wiring.

Internal wiring assures all motors will rotate in correct direction once evaporator fan motor rotation check has been made.

Drive Belt Tension/Alignment

For ease of service the TRS model unit is equipped with a slide out fan assembly. Two screws must be removed and the wire harness wire tie must be cut to allow the fan to slide forward.
Fan belt alignment and tension should be checked. Tension should be 3/4” depression per foot of belt span between pulleys.

The following safety rules MUST always be followed when working near belt drive.

1. Always turn the power to the unit OFF before you begin working on it.
2. Always Wear protective clothing. NEVER wear loose or bulky clothing such as neckties, exposed shirrtails, loose sleeves or lab coats around the belt drive. Wear gloves while inspecting sheaves to avoid nicks, burrs or sharply worn pulley edges.

The blower speed is changed by adjusting the variable speed pulley mounted on the blower motor.

1. Turn electric power OFF.
2. Remove the side blower access panel. Loosen the four motor mount bolts.
3. Turn the motor adjustment bolt counterclockwise until the belt is slack enough to come off easily.
4. Remove the belt. DO NOT pry off the belt.
5. Loosen set screw(s) on the outer half of the adjustable pulley.
6. The unit has one of two different types of adjustable pulleys.
7. Remove the key if unit has a keyway type pulley.
8. To set the blower for a desired CFM (L/s), first turn the outer half of the adjustable pulley clockwise until it meets the inner half of the pulley.
9. Turn the outer half of the adjustable pulley counter clockwise the correct number of turns to obtain the desired CFM (L/s).

To increase the blower speed, turn the outer half of the adjustable pulley clockwise. To decrease the blower speed, turn the outer half of the adjustable pulley counter clockwise.

10. Replace key if unit has keyway type pulley.
11. Tighten set screw(s)
12. Put on belt.
13. Turn motor adjustment bolt clockwise until the belt has enough tension at the proper deflection. Use one of the commercially available belt tension gauges to set the correct tension at the proper deflection.
14. Use a straight edge (angle iron, straight piece of board or anything with a straight surface or edge) to check the alignment of the blower pulley with the blower pulley.
15. It may be necessary to back the tension off the belt temporarily and tighten one of the motor mount bolts before it is possible to adjust the angle of the blower motor.
16. Tighten all four blower motor mount bolts.
17. See Figure #5.
ELECTRICAL SYSTEM OPTIONS
A multi-function PLC unit controller is installed, in which complete unit operation is established through inputs of temperature, pressure, humidity sensors and other analog and digital inputs. The controller will provide a complete operating and monitoring system. There are also the following features;

Air Flow Switch
Designed to prevent system operation unless there is proof of blower operation. A differential pressure switch measures the air pressures at the suction and discharge of the blower.

Clogged Filter Indicator
Dirty or clogged filters are indicated when the preset pressure differential across the filters is reached. The indicator is factory installed and is manually reset. It includes contacts for remote indication.

Convenience Outlet
1. Field Wired - A 115V GFCI receptacle mounted in a 2"x4" enclosure and is furnished with a 15 amp circuit breaker. Separate 115-volt power source and ground is required.

2. Factory Wired - A 115V GFCI receptacle mounted in a 2"x4" enclosure may be furnished with a 15 amp circuit breaker, disconnect and 1500 Watt transformer. The transformer will be field connected to the line side of the unit disconnect switch.

Exhaust Fan Interlock
A relay installed in the unit control panel is energized when the blower is energized to interlock the unit with building exhaust fan(s).

Power Through the Curb
A chase is installed in the curb, directly under the electrical control section to bring power wiring inside the curb, preventing a separate roof penetration. The sleeve must be sealed after wiring is completed with suitable mastic to prevent water from entering the space.

Firestat
This control, mounted in the return air section, de-energizes the unit when return air reaches 135°F. The Firestat is a manual reset control.

Sure-Trip
This control automatically stops the unit whenever a phase is lost, when phases are out of sequence, or when supply voltage drops too low. Restart is automatic with a 5-minute delay after proper power supply conditions are restored.
SEQUENCE OF OPERATION (HEAT)

Heating, Hydronic or Steam
Both hydronic and steam heat require a one or two row coil generally located downstream of the evaporator coil. Controls for hydronic heat will involve a 3 way motorized mixing or blending valve, driven by a signal from a leaving air temperature thermostat. Controls for low-pressure steam heat contain a motorized throttling valve driven by a signal from a leaving air temperature thermostat.

Heating, Electric Resistance
1. Three-phase power to the unit distribution block energizes 24-volt circuit in transformer T.
2. Indoor blower motor contactor is energized through normally closed contact of heat relay, stage 1, and HR1 - completing circuit from C to D.
3. A call for first stage heat closes circuit W1 and C, energizing HR1.
4. Heating contactor No. 1, HC1 is energized through closed air pressure differential switch APS, if used; closed high limit switches AR1 and AR2 and closed HR1 contact.
5. A call for second stage heat closes circuit W2 and C, energizing heat relay stage 2, HR2.
6. Closed HR2 contact energizes Heating Contactor No.2, HC2.
7. Fusing and high limit switches protect the unit from malfunction.

Heating, Gas
See the Gas Furnace instructions for gas furnace wiring and performance data. Additional information can be found on the furnace access door such as the rating and serial label, wiring and lighting instruction label.

The furnace section is made from the control terminal across the N.C. contacts of the combustion pressure switch, energizing pilot ignition time delay relay heater. After delay of approximately 30-50 seconds the time delay relay’s switch closes energizing the furnace Venter motor. As the Venter operates, it causes the combustion pressure switch to open. The ignition control energizes a high voltage electric spark, and the pilot valve solenoid in the combination gas valve.

The flame sensor proves the presence of the pilot flame generating a DC current of 0.2 micro-amp (or greater) to the ignition control. The ignition control’s internal switch action then de-energizes the spark transformer and makes a circuit to the high fire solenoid of the combination gas valve. When there is a call for gas furnace operation the discharge air temperature causes a change in the resistance of a discharge air sensor thermistor. The Maxitrol solid state control center measures the sensor’s change in resistance and sends a varying DC current to the Modulator-Regulator valve to adjust the gas input as required.

GAS FURNACE

Installation Codes
The duct furnace covered in this manual are design-certified by Intertek Testing Services (ETL) and are approved for use in the United States and Canada for use with natural or propane gas. See the ‘Ratings and Serial Information’ label located on the inside of the vestibule access door for the type of gas, correct firing rate and electrical characteristics your furnace is equipped for.

In the United States, these furnaces must be installed in accordance with the standard of the National fire Protection Association (NFPA) or the National Fuel Gas Code ANSI Z223.1a (latest edition). The National Fuel Gas Code is available from the American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209. NFPA Publications are available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

In Canada, installations must be in accordance with the CAN/CGA B149.1 and B149.2 Installation Code for Gas Burning Appliances and Equipment. Canadian codes are available from the Standards Department, Canadian Gas Association, 55 Scarsdale Rd., Don Mills, Ontario M3B-2R3.

Local authorities having jurisdiction should be consulted before installations are made to verify local codes and installation procedures.

To ensure safety, follow the instructions provided on the “LIGHTING INSTRUCTIONS” label located on the inside of the vestibule access door and on Pg#14 of this instruction manual.

Read ALL instructions to prevent personal injury or death. This manual is for use by a qualified heating installer/service technician ONLY.
Chlorines and Harsh Environments
The presence of chlorine vapors in the combustion air of gas-fired heating equipment presents a potential corrosion hazard. Chlorine will, when exposed to flame, precipitate from the compound, usually Freon or degreaser vapors, and go into solution with any condensation that is present in the heat exchanger or associated parts. The result is hydrochloric acid which readily attacks all metals including 409 and 439 stainless steels. Care should be taken to separate these vapors from the combustion process. This may be done by wise location of the furnace with regard to exhausters or prevailing wind direction. Remember, chlorine is heavier than air. This fact should be kept in mind when determining installation locations of heating equipment and building exhaust systems.

Gas Piping (Individual or Multiple Furnace Applications)
All piping must be in accordance with the National Fuel Gas Code ANSI Z223.1a (latest edition), published by the American Gas Association or CAN/CGA-B149.1 and B149.2 (latest edition), published by the Canadian Gas Association. Always refer to local codes where required. Open the vestibule access door. Select the proper gas pipe clearance hole pre-installed in the furnace cabinet in three places depending on the best location for the field gas line. This may require moving the pipe grommet from its factory installed position to the desired location as well as moving the cap to the old location of the pipe grommet to ensure rain water will not get inside the furnace vestibule. All model DF duct furnace use ¾” NPT gas connections to the gas valve. See Table ## for proper pipe diameter for the length and Btu input.

Support piping with hangers, NOT by the furnace. Purge ALL air from the gas supply piping.

Before placing the duct furnace into operation, check the furnace and its gas connections for leaks.
Use Pipe sealing compound compatible with propane gases. Apply sparingly only to male threads of pipe joints so that pipe sealing compound does not block gas flow.

Failure to apply pipe sealing compound as detailed can result in severe personal injury, death or substantial property damage.

To obtain cubic feet per hour, divide furnace input by 1,000.

Natural Gas Required Pressures:
- Maximum: 13 IN. WC
- Minimum: 5 IN. WC
- Manifold gas pressure: 3.5 IN. WC

PROPANE GAS
Contact the gas supplier to size pipes, tanks and 100% lockup gas pressure regulator. Adjust propane regulator provided by the gas supplier for 13 IN WC maximum pressure.

Propane Gas Required Pressures:
- Maximum: 13 IN. WC
- Minimum: 11 IN. WC
- Manifold gas pressure: 3.5 IN. WC

Close manual main shut off valve during any pressure testing at less than 13 IN. WC. The gas valve is equipped with two 1/8” NPT taps for gas pressure measurements.

Disconnect furnace and gas valve from the gas supply piping during any pressure testing greater than 13 IN. WC.

DO NOT check for gas leaks with an open flame. Use a bubble test. Failure to use a bubble test or check for leaks can cause severe personal injury, death or substantial property damage.

Failure to apply pipe sealing compound as detailed can result in severe personal injury, death or substantial property damage.

Table 4:

<table>
<thead>
<tr>
<th>Pipe length (feet)</th>
<th>Natural Gas (1000 BTU/Cubic Feet) Capacity of pipe for pipe size of: (Capacity in cubic feet gas per hour)</th>
<th>Propane Gas (2550 BTU/Cubic Feet) Capacity of pipe for pipe size of: (Capacity in cubic feet gas per hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pipe capacity for 0.60 specific gravity</td>
<td>Pipe capacity for 1.60 specific gravity</td>
</tr>
<tr>
<td></td>
<td>3/4&quot;</td>
<td>1&quot;</td>
</tr>
<tr>
<td>10</td>
<td>278</td>
<td>520</td>
</tr>
<tr>
<td>20</td>
<td>190</td>
<td>350</td>
</tr>
<tr>
<td>30</td>
<td>152</td>
<td>285</td>
</tr>
<tr>
<td>40</td>
<td>130</td>
<td>245</td>
</tr>
<tr>
<td>50</td>
<td>115</td>
<td>215</td>
</tr>
<tr>
<td>60</td>
<td>105</td>
<td>195</td>
</tr>
<tr>
<td>70</td>
<td>96</td>
<td>180</td>
</tr>
<tr>
<td>90</td>
<td>84</td>
<td>160</td>
</tr>
<tr>
<td>100</td>
<td>79</td>
<td>150</td>
</tr>
<tr>
<td>125</td>
<td>72</td>
<td>130</td>
</tr>
<tr>
<td>150</td>
<td>64</td>
<td>120</td>
</tr>
<tr>
<td>175</td>
<td>59</td>
<td>110</td>
</tr>
<tr>
<td>200</td>
<td>55</td>
<td>100</td>
</tr>
<tr>
<td>Problem</td>
<td>Possible Cause</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
</tbody>
</table>
| Compressor will not run – no hum. | Disconnect switch open.  
Blown fuse(s).  
Thermostat not calling  
Open control contacts – defective control  
High or low pressure control open or defective.  
Oil pressure control open or defective (larger units with semi-hermetic compressors).  
Overload protector tripped or defective.  
Defective wiring. |
| Compressor will not start – hums but cycles on overload | Low voltage  
Wiring incorrect or loose connections.  
Blown fuse  
Compressor motor defective  
Bearings or pistons tight – low oil charge  
Defective compressor motor controller |
| Compressor starts and runs but cycles on overload protector | Low voltage  
Defective overload protector  
Defective high pressure control or lock-out circuit.  
Compressor motor partially grounded  
Bearings or pistons tight – low oil pressure  
Improper refrigerant charge |
| Head pressure too high | Refrigerant overcharge  
Air or other non-condensable gases in system  
Dirty or clogged condenser (cool cycle)  
Defective fan motor (heat cycle)  
Restriction in strainer or drier  
Restriction in discharge or liquid line  
Clogged air filter in unit (heat cycle)  
Insufficient water flow (cool cycle)  
Loose blowers, pulleys or belts (heat cycle)  
Restricted air flow (heat cycle)  
Defective expansion valve  
Indoor blower(s) running backwards (heat cycle). |
<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Head pressure too low</strong></td>
<td>Insufficient refrigerant charge</td>
</tr>
<tr>
<td></td>
<td>Refrigerant leak in system</td>
</tr>
<tr>
<td></td>
<td>Defective compressor</td>
</tr>
<tr>
<td></td>
<td>Insufficient water flow (heat cycle).</td>
</tr>
<tr>
<td></td>
<td>Dirty or clogged water coil (heat cycle).</td>
</tr>
<tr>
<td></td>
<td>Leaking check valves.</td>
</tr>
<tr>
<td></td>
<td>Clogged air filter in unit (cool cycle).</td>
</tr>
<tr>
<td></td>
<td>Defective or improperly adjusted expansion valve</td>
</tr>
<tr>
<td></td>
<td>Defective reversing valve</td>
</tr>
<tr>
<td><strong>Suction pressure too high.</strong></td>
<td>Refrigerant overcharge</td>
</tr>
<tr>
<td></td>
<td>Defective compressor discharge valves.</td>
</tr>
<tr>
<td></td>
<td>Leaking check valve</td>
</tr>
<tr>
<td></td>
<td>Defective expansion valve</td>
</tr>
<tr>
<td></td>
<td>Expansion valve bulb not secured to suction line.</td>
</tr>
<tr>
<td></td>
<td>System overload – too much air or excessive temperatures (cool cycle) – too</td>
</tr>
<tr>
<td></td>
<td>much water or excessive temperatures (heat cycle).</td>
</tr>
<tr>
<td></td>
<td>Defective reversing valve</td>
</tr>
<tr>
<td><strong>Suction Pressure too Low</strong></td>
<td>Refrigerant undercharge</td>
</tr>
<tr>
<td></td>
<td>Restriction in suction or liquid line.</td>
</tr>
<tr>
<td></td>
<td>Defective or improperly adjusted expansion valve</td>
</tr>
<tr>
<td></td>
<td>Check valve not fully opening</td>
</tr>
<tr>
<td></td>
<td>System underload – too little air or low entering temperature (cool cycle) –</td>
</tr>
<tr>
<td></td>
<td>too little water or low entering temperature (heat cycle).</td>
</tr>
<tr>
<td></td>
<td>Clogged air filter in unit (cool cycle).</td>
</tr>
<tr>
<td></td>
<td>Loose blower(s), pulley(s) or belts (cool cycle).</td>
</tr>
<tr>
<td></td>
<td>Blower(s) running backwards (cool cycle).</td>
</tr>
<tr>
<td><strong>Compressor short cycles.</strong></td>
<td>Room thermostat malfunction or improper location.</td>
</tr>
<tr>
<td></td>
<td>Improper heat anticipator setting.</td>
</tr>
<tr>
<td></td>
<td>Refrigerant undercharge or overcharge and defective high or low pressure</td>
</tr>
<tr>
<td></td>
<td>control or lock-out circuit.</td>
</tr>
<tr>
<td></td>
<td>Cycling on overload protector due to tight bearings, stuck piston, high head</td>
</tr>
<tr>
<td></td>
<td>pressure, or leaking discharge valves.</td>
</tr>
<tr>
<td></td>
<td>Defective expansion valve</td>
</tr>
<tr>
<td></td>
<td>Insufficient water flow (both cycles).</td>
</tr>
<tr>
<td></td>
<td>Defective reversing valve</td>
</tr>
<tr>
<td></td>
<td>Poor air distribution causing short circuiting</td>
</tr>
<tr>
<td>Problem</td>
<td>Possible Cause</td>
</tr>
<tr>
<td>---------</td>
<td>---------------</td>
</tr>
</tbody>
</table>
| Running cycle too long or unit operates continuously | Refrigerant undercharge – possible leak  
Dirty or restricted air coil (cool cycle)  
Scaled or otherwise clogged water coil (heat cycle).  
Control contacts stuck  
Air or other non-condensable gasses in system  
Restriction in suction or liquid line  
Unit too small for application  
Defective compressor.  
Insufficient water flow (heat cycle) or insufficient airflow (cool cycle)  
Room thermostat malfunction or improper location. Incorrect heat anticipator setting |
| Supply air temperature too low | Shortage of refrigerant or leak in system (cool cycle).  
Restriction in strainer or drier (cool cycle).  
Coil plugged with ice or dirt  
Defective compressor  
Restricted airflow (heat cycle)  
Restricted water flow (cool cycle)  
Maladjusted or defective expansion valve causing high suction superheat and low suction pressure (cool cycle).  
Defective reversing valve (cool cycle) |
| Supply air temperature too low (2) | Compressor not running (heat cycle).  
Refrigerant undercharge (heat cycle).  
Insufficient water flow or temperature (heat cycle)  
Malfunctioning or defective expansion valve (heat cycle).  
Defective (or stuck) reversing valve (heat cycle)  
Insufficient airflow (cool cycle).  
Dirty air filters (cool cycle).  
Return air temperature too low. |
| Noisy unit. | Defective compressor  
Blower(s) out of balance  
Fan motor bearings worn.  
Tubing rattle  
Loose parts (belts, pulleys, etc.)  
Air velocity too high. |
| Liquid line too hot | Refrigerant undercharge or leak in system.  
Excessive head pressure. |
### Unit Troubleshooting

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid line frosted.</td>
<td>Restriction upstream of point of frosting</td>
</tr>
<tr>
<td></td>
<td>Malfunctioning or defective expansion valve</td>
</tr>
<tr>
<td></td>
<td>Refrigerant undercharge</td>
</tr>
<tr>
<td></td>
<td>Restriction in suction or liquid line.</td>
</tr>
<tr>
<td></td>
<td>Insufficient evaporator air flow or temperature (cool cycle).</td>
</tr>
<tr>
<td></td>
<td>Insufficient water flow or temperature (heat cycle).</td>
</tr>
<tr>
<td>Suction line frosted</td>
<td></td>
</tr>
<tr>
<td>Blower motor not running.</td>
<td>Improper wiring.</td>
</tr>
<tr>
<td></td>
<td>Defective motor or controller.</td>
</tr>
<tr>
<td></td>
<td>Defective thermostat or control circuit</td>
</tr>
<tr>
<td></td>
<td>Motor off on overload protective device</td>
</tr>
</tbody>
</table>
GAS HEAT OPERATION

Lighting Instructions

FOR YOUR SAFETY READ BEFORE LIGHTING

WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

A. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the pilot by hand.

B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

WHAT TO DO IF YOU SMELL GAS

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

C. Use only your hand to turn the gas control knob. Never use tools. If the knob will not turn by hand, don’t try to repair it, call a qualified service technician. Force or attempt repair may result in a fire or explosion.

D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

LIGHTING INSTRUCTION

1. STOP! Read the safety information above on this label
2. Set the thermostat to lowest setting.
3. Turn off all electric power to the appliance.
4. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
5. Open the control access door.
6. Turn the gas control knob clockwise \(\bigcirc\) to “OFF”.
7. Wait five (5) minutes to clear out any gas. Then smell for gas, including near the floor. If you smell gas, STOP! Follow “B” in the safety information above on this label. If you don’t smell gas go to the next step.
8. Turn gas control knob counterclockwise \(\bigcirc\) to “ON”
9. Close the control access door.
10. Turn on all electric power to the appliance.
11. Set thermostat to desired setting.
12. If the appliance will not operate, follow the instructions “To Turn Off Gas To Appliance” and call your service technician or gas supplier.

TO TURN OFF GAS TO APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn off all electric power to the appliance if service is to be performed.
3. Open the control access door.
4. Push in gas control knob slightly and turn clockwise \(\bigcirc\) to “OFF”. Do not force.
5. Close the control access door.

To ensure safety, follow the instructions provided on the “Lighting Instructions” label located inside the vestibule access door and on this page.

1. Read Lighting Instructions
2. Raise space thermostat to call for heat.
3. Inducer motor energizes. After pressure switch proves proper airflow, control module initiates a 30-second purge.

4. Control module sparks the direct spark igniter and opens main gas valve.
   • If main burners do not light within 4 seconds, the main gas valve is closed and the spark igniter turned off. The ignition control initiates a 30 second post-purge, then starts a new cycle.
   • If main burner does light and control module senses flame current, spark igniter is turned off and burners stay on until space temperature satisfies the thermostat.

5. During main burn operation:
   • The ignition control monitors main flame current. If signal is lost, the spark igniter is energized and sequence returns to step 4.
   • If power is interrupted, control systems shuts off main gas valve and restarts at step 2 when power is restored.

6. In the event the supply air limit control shuts down the furnace during operation, the control module closes the main gas valve, but keep the inducer energized for 30-seconds post-purge.

7. Lower space thermostat setting to stop call for heat. Thermostat is satisfied-Main gas valve is closed inducer is turned off.

8. Furnace is now in the off cycle.

9. Repeat steps 1 through 7 several times to verify correct furnace operation.

10. Return the space thermostat to normal setting.

11. If so equipped, set thermostat heat anticipator setting to 0.4 amps, adjusted for gas valve and control current.

<table>
<thead>
<tr>
<th>LED Status</th>
<th>Code Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEADY ON</td>
<td>Good Control-Normal Operation</td>
</tr>
<tr>
<td>1 FLASH</td>
<td>Open Position Pressure Switch</td>
</tr>
<tr>
<td>2 FLASHES</td>
<td>Stuck Closed Position Pressure Switch</td>
</tr>
<tr>
<td>3 FLASHES</td>
<td>Failed Ignition</td>
</tr>
<tr>
<td>4 FLASHES</td>
<td>Too Many Flame Losses</td>
</tr>
<tr>
<td>5 FLASHES</td>
<td>Internal Ignition Control Fault</td>
</tr>
<tr>
<td>6 FLASHES</td>
<td>Too Many Pressure Switch Losses</td>
</tr>
</tbody>
</table>
# Unit Check Out Sheet

## Customer Data
Customer Name _____________________________________________ Date ___________________________
Address _______________________________________________________________________________________
Phone ___________________________________________________ Unit Number ___________________________

## Unit Nameplate Data
Unit Make ________________________________________________ Model Number ____________________________
Serial Number __________________________________________
Refrigerant Charge (oz) _____________________________________ Compressor: RLA ____________________ LRA ____________
Model Number ____________________________________ Serial Number ____________________________________
Blower Motor: FLA (or NPA) _____________________ HP ____________________________
Maximum Fuse Size (Amps) __________________________
Maximum Circuit Ampacity __________________________

## Operating Conditions

<table>
<thead>
<tr>
<th></th>
<th>Cooling Mode</th>
<th>Heating Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entering / Leaving Air Temp</td>
<td>_________ / _________</td>
<td>_________ / _________</td>
</tr>
<tr>
<td>Entering Air Measured at:</td>
<td>__________________</td>
<td>__________________</td>
</tr>
<tr>
<td>Leaving Air Measured at:</td>
<td>__________________</td>
<td>__________________</td>
</tr>
<tr>
<td>Entering / Leaving Fluid Temp</td>
<td>_________ / _________</td>
<td>_________ / _________</td>
</tr>
<tr>
<td>Fluid Flow (gpm)</td>
<td>__________________</td>
<td>__________________</td>
</tr>
<tr>
<td>Compressor Volts / Amps</td>
<td>_________ / _________</td>
<td>_________ / _________</td>
</tr>
<tr>
<td>Blower Motor Volts / Amps</td>
<td>_________ / _________</td>
<td>_________ / _________</td>
</tr>
<tr>
<td>Source Fluid Type</td>
<td>__________________</td>
<td>__________________</td>
</tr>
<tr>
<td>Fluid Flow (gpm)*</td>
<td>__________________</td>
<td>__________________</td>
</tr>
<tr>
<td>Fluid Side Pressure Drop*</td>
<td>__________________</td>
<td>__________________</td>
</tr>
<tr>
<td>Suction / Discharge Pressure (psig)*</td>
<td>_________ / _________</td>
<td>_________ / _________</td>
</tr>
<tr>
<td>Suction / Discharge Temp*</td>
<td>_________ / _________</td>
<td>_________ / _________</td>
</tr>
<tr>
<td>Suction Superheat*</td>
<td>__________________</td>
<td>__________________</td>
</tr>
<tr>
<td>Entering TXV / Cap Tube Temp*</td>
<td>__________________</td>
<td>__________________</td>
</tr>
<tr>
<td>Liquid Subcooling*</td>
<td>__________________</td>
<td>__________________</td>
</tr>
<tr>
<td>* Required for Troubleshooting ONLY</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Auxiliary Heat
Unit Make ________________________________________________ Model Number: ____________________________ Serial Number ____________________________
Max Fuse Size (Amps) __________________________
Volts / Amps __________________________
Entering Air Temperature __________________________
Leaving Air Temperature __________________________

MAIL TO: Bosch.Fhp.TechSupport@us.bosch.com or scan the QR code and attach picture of this form with the information requested.
HF- Sequence of Operation – Two Stage Operation with Speed Controller

Fenwal 35-61 Series Direct Ignition Control w/ TR1 Timer Relay Control

When system is powered up 24 VAC will be applied to the ignition control (IC) terminals 24VAC / R and to the Timer Relay Control (TR1). The ignition control will reset, perform a self check routine, initiate full time flame sensing, flash the diagnostic LED for up to four seconds and enter the thermostat scan standby state. The amber light on the TR1 will be lit indicating it is in the ready position.

Call for Heat
1. Thermostat (controller) (1<sup>st</sup> stage or 1<sup>st</sup> and 2<sup>nd</sup> stage) closes on call for heat.
2. 24 VAC to is supplied to IC terminal 5H, provided limit switch is in closed position.
3. The control will check that pressure switch contacts are open (IC terminal P5W is not powered).
4. Combustion blower is then energized at high speed.
5. When the Air Switch (APS1) closes, a 10 second pre-purge period begins.
6. At end of pre-purge period, the spark commences and the 1<sup>st</sup> and 2<sup>nd</sup> stage gas valves are energized for the trial for ignition period.
7. Burners ignite and cross light, operating at maximum input rate (Manifold pressure 3.5" w.c.)
8. TR1 is powered (terminal 7) simultaneously (OR LED III) and begins timing a 90 second warm-up period while maintaining the combustion blower at high speed (FR LED III). The TR1 will maintain this mode of operation, regardless of status of thermostat. 2<sup>nd</sup> stage.
9. When flame is detected by flame sensor, the spark is shut-off immediately and gas valves and combustion blower remain energized.
10. When the initial timer in TR1 times out, it defaults the gas valve to low fire and the combustion blower to low speed and returns time, the normal sequence will begin with pressure controller. The OR LED turns off and the MR LED is lit.
11. If the controller is calling for 2<sup>nd</sup> stage heat TR1 terminal 6 is powered. After a shorttime delay (approximately 15 seconds), the system switches the combustion blower to high speed (FR LED III) and the 2<sup>nd</sup> stage gas valve @ 3.5" w.c. manifold pressure (CR LED III), provided the High Air Pressure Switch (APS2) is proved.
12. During heating operation, the thermostat, pressure switch and main burner flame are constantly monitored by the IC to assure proper system operation.
13. Operation continues on high fire until the 2<sup>nd</sup> stage thermostat is satisfied, opening the 3<sup>rd</sup> stage contact and de-energizes terminal 6 on the TR1, turning off the 2<sup>nd</sup> stage gas valve and returning the combustion blower to low speed.
14. When the thermostat (controller) is satisfied and the demand for heat ends, the 1<sup>st</sup> stage valve is de-energized immediately, the control senses loss of flame and a 30 second post-purge occurs (at high speed) before de-energizing the combustion blower.

Ignition and Operational failures during a call for heat result in "lockout" of the ignition control.

1. If flame is lost during an operational cycle, the control will respond within 0.8 seconds. The spark will be energized for a trial for ignition period to attempt to reignite burners and prove flame sensor. If flame is re-established, normal operation resumes.
2. If the burners fail to light or carryover during a trial for ignition, the control will attempt two additional ignition trials. If no flame is prevented at the flame sensor within 10 seconds, the spark and gas valve will be de-energized. A 15 second inter-purge period begins and the combustion blower continues to run. After the inter-purge period another ignition trial will take place.
3. If burner fails to light or prove the flame sensor following the two additional trials the control will go into lockout. The valve relay in the IC will be de-energized shutting of the gas valve immediately and the combustion blower following a 30 second post-purge period.

Recovery from Lockout
1. If the thermostat (controller) is still calling for heat one hour after a lockout occurs, the control will automatically reset and initiate a call for heat sequence.
2. The ignition control may also be manually reset by turning the thermostat (controller) down and back up to previous temperature setting or removing power (24V) to IC terminal 24VAC.

Fault Conditions and LED Key

<table>
<thead>
<tr>
<th>LED Steady On</th>
<th>Internal Control Fault</th>
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<td>Flame with No Call for Heat</td>
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LED flashes on for 1/2 second, and off for 1/2 second during fault condition. Pause between fault codes is 3 seconds.

1. If during the initial call for heat the air switch contacts are closed for 30 seconds without an output to the combustion blower, an airflow fault occurs (one LED flash) and control will remain in this mode.
2. If the air flow switch remains open (or a rollout switch is open) for more than 30 seconds after the combustion blower output (NO) is energized, an airflow fault occurs (one LED flash), and control will stay in this mode with combustion blower on, waiting for airflow switch (or rollout) to close.
3. If the airflow signal is lost during operation, the control immediately de-energizes the gas valve and maintains blower operation. If the call for heat remains and proper airflow is not detected, and airflow fault occurs (one LED flash). If proper airflow is detected at any time, the next button will begin with a pre-purge.
4. If the main valve fails to close properly at the end of a heating cycle and a flame is maintained, the combustion blower will continue in operation. If the valve does close completely later removing the flame signal, the blower will run for the post purge period and shut-off.
25-100% MODULATION CONTROL
MD- Sequence of Operation – Electronic Modulation with Inducer Speed Control

Fenwal 35-61 Series Direct Ignition Control, TR1 Timer Relay Control and SC30 Modulation Control

When system is powered up 24 VAC will be applied to the ignition control (IC) terminals 24VAC / R and to the Timer Relay Control (TR1). The ignition control will reset, perform a self check routine, initiate full time flame sensing, flash the diagnostic LED for up to four seconds and enter the thermostat scan standby state. The amber light on the TR1 will be lit indicating its in the ready position.

Call for Heat
1. Thermostat (heat on) opens call for heat.
2. 24 VAC is supplied to IC terminal TP, provided limit switch is in closed position.
3. The control will check that pressure switch contacts are open (IC terminal PSW is not powered).
4. Combustion blower is then energized at high speed.
5. When the Air Switch (APS1) closes, a 15 second pre-purge period begins.
6. At end of pre-purge period, the spark commence and the 1<sup>st</sup> stage gas valve is energized for the trial for ignition period.
7. TR1 is powered (terminal 7) simultaneously (SR LED lit) and begins timing a 90 second warm-up period while maintaining the combustion blower at high speed (FR LED lit) and powers the SC30. The SC30 will output 12 to 13 VDC to the modulating control valve during the timing duration (90 seconds) of TR1, regardless of the analog input signal to SC30 terminals 7 & 8.
8. Burners ignite and cross light, operating at the adjusted mid-fire input rate (Manifold pressure set at 1.2” to 1.5” w.c.).
9. When flame is detected by flame sensor, the spark is shut-off immediately and gas valve(s) and combustion blower remain energized.
10. When the initial timer in TR1 times out, it deactivates the gas valve to low fire and the combustion blower to low speed and returns control of the operating mode to the building temperature controller. The SR LED turns off and the MR LED is lit.
11. If the controller is providing an analog signal between 0.5 and 5.3 VDC to the SC30 control, the system will continue to run at low speed combustion blower and with only the 1<sup>st</sup> stage valve open. The modulating valve will be powered proportional to the input signal from the controller, and will open or close changing the gas manifold pressure. Manifold pressure will vary from 0.3 to 1.2" w.c. operating in this mode.
12. If the signal increases above 5.3 VDC, the SC30 relay closes powering terminal 6 on the TR1, and starts a second time delay of 15 seconds. At the end of this time delay the fan switches to high speed (FR LED lit) and the 2<sup>nd</sup> stage gas valve opens (SR LED lit) through the TR1 (terminal 9) providing the High Air Switch contacts are closed. The manifold pressure will vary from 1.4 to 3.5" w.c. in this mode.
13. During heating operation, the thermostat, pressure switch and main burner flame are constantly monitored by the IC to assure proper system operation.
14. Operation continues in the High fire mode until the controller input signal to the SC30 control drops to 4.7 VDC. At this point the SC30 relay circuit opens (SC30 terminal 5 has no output) de-energizing the 2<sup>nd</sup> stage valve and the TR1 switches the combustion blower to low-speed operation. Low-fire modulation will continue as in Step 11.
15. When the thermostat (temperature controller) is satisfied and the demand for heat is met, the heat enable contacts opens and the 1<sup>st</sup> stage valve is de-energized immediately, the control senses loss of flame and a 30 second post-purge occurs (at high speed) before de-energizing the combustion blower.

Ignition and Operational failures during a call for heat result in “lockout” of the ignition control. 
1. If flame is lost during an operational cycle, the control will respond within 0.8 seconds. The spark will be energized for a trial for ignition period to attempt to reignite burners and prove flame sensor. If flame is re-established, normal operation resumes.
2. If the burners fail to light or carryover during a trial for ignition, the control will attempt two additional ignition trials. If no flame is present at the flame sensor within 10 seconds, the spark and gas valve will be de-energized. A 15 second inter-purge period begins and the combustion blower continues to run. After the inter-purge period another ignition trial will take place.
3. If burner fails to light or prove the flame sensor following the two additional trials the control will go into lockout. The valve relay in the IC will be de-energized shutting of the gas valve immediately and the combustion blower following a 30 second post-purge period.

Recovery from Lockout
1. If the thermostat (controller) is still calling for heat one hour after a lockout occurs, the control will automatically reset and initiate a call for heat sequence.
2. The ignition control may also be manually reset by turning the thermostat (controller) down and back up to previous temperature setting or removing power (24V) to IC terminal 24VAC.

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LED flashes on for ¾ second, and off for ¼ second during fault condition. Pause between fault codes is 3 seconds.

SOP-MD-3561-SC-1
9/24/10
Installation Code and Annual Inspections:

All installation and service of equipment must be performed by a contractor qualified in the installation and service of equipment sold and supplied and conform to all requirements set forth in the manuals and all applicable governmental authorities pertaining to installation, service and operation of the equipment. To help facilitate optimum performance and safety, it is recommended that a qualified contractor annually inspect your equipment and perform service where necessary, using only replacement parts sold and supplied by the manufacturer.

Further Information: Applications, engineering and detailed guidance on systems design, installation and equipment performance is available through manufacturer's representative. Please contact us for any further information you may require, including the Installation, Operation and Service Manual.

These products are not for residential use.

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