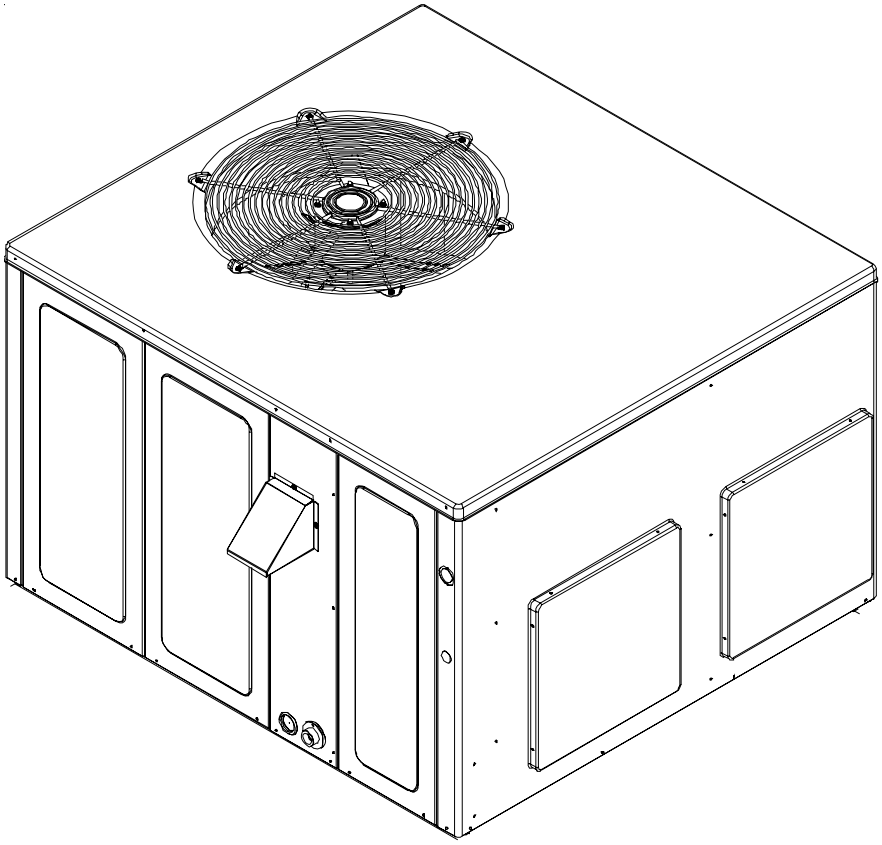
Service Instructions

Model numbers listed on page 6

[A/G]PG PACKAGE GAS



This Forced Air Central Unit Design Complies With Requirements Embodied in The American National Standard / National Standard of Canada Shown Below.

ANSI Z21.47•CSA-2.3

RS6300005
October 2005

INDEX

IMPORTANT NOTICES FOR CONSUMERS AND SERVICERS

RECOGNIZE SAFETY SYMBOLS, WORDS AND LABELS

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

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

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

WARNING

DO NOT STORE COMBUSTIBLE MATERIALS OR USE GASOLINE OR OTHER FLAMMABLE LIQUIDS OR VAPORS IN THE VICINITY OF THIS APPLIANCE AS PROPERTY DAMAGE OR PERSONAL INJURY COULD OCCUR. HAVE YOUR CONTRACTOR POINT OUT AND IDENTIFY THE VARIOUS CUT-OFF DEVICES, SWITCHES, ETC., THAT SERVES YOUR COMFORT EQUIPMENT.

WARNING

HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

WARNING

THIS UNIT SHOULD NOT BE CONNECTED TO, OR USED IN CONJUNCTION WITH, ANY DEVICES THAT ARE NOT DESIGN CERTIFIED FOR USE WITH THIS UNIT OR HAVE NOT BEEN TESTED AND APPROVED BY GOODMAN. SERIOUS PROPERTY DAMAGE OR PERSONAL INJURY, REDUCED UNIT PERFORMANCE AND/OR HAZARDOUS CONDITIONS MAY RESULT FROM THE USE OF DEVICES THAT HAVE NOT BEEN APPROVED OR CERTIFIED BY GOODMAN.

IMPORTANT INFORMATION

Pride and workmanship go into every product to provide our customers with quality products. It is possible, however, that during its lifetime a product may require service. Products should be serviced only by a qualified service technician who is familiar with the safety procedures required in the repair and who is equipped with the proper tools, parts, testing instruments and the appropriate service manual. **REVIEW ALL SERVICE INFORMATION IN THE APPROPRIATE SERVICE MANUAL BEFORE BEGINNING REPAIRS.**

IMPORTANT NOTICES

WARNING

IF REPAIRS ARE ATTEMPTED BY UNQUALIFIED PERSONS, DANGEROUS CONDITIONS (SUCH AS EXPOSURE TO ELECTRICAL SHOCK) MAY RESULT. THIS MAY CAUSE SERIOUS INJURY OR DEATH.

CAUTION

GOODMAN WILL NOT ASSUME RESPONSIBILITY FOR ANY INJURY OR PROPERTY DAMAGE ARISING FROM IMPROPER SERVICE OR SERVICE PROCEDURES. IF YOU PERFORM SERVICE ON YOUR OWN PRODUCT, YOU ASSUME RESPONSIBILITY FOR ANY PERSONAL INJURY OR PROPERTY DAMAGE WHICH MAY RESULT.

To locate an authorized servicer, please consult your telephone book or the dealer from whom you purchased this product. For further assistance, please contact:

CONSUMER INFORMATION LINE
GOODMAN COMPANY, L.P. TOLL FREE
1-877-254-4729 (U.S. only)
email us at: customerservice@goodmanmfg.com
fax us at: (731) 856-1821
(Not a technical assistance line for dealers.)

Outside the U.S., call 1-713-861-2500.
(Not a technical assistance line for dealers.)
Your telephone company will bill you for the call.

IMPORTANT INFORMATION

⚠ WARNING

SYSTEM CONTAMINANTS, IMPROPER SERVICE PROCEDURE AND/OR PHYSICAL ABUSE AFFECTING HERMETIC COMPRESSOR ELECTRICAL TERMINALS MAY CAUSE DANGEROUS SYSTEM VENTING.

The successful development of hermetically sealed refrigeration compressors has completely sealed the compressor's moving parts and electric motor inside a common housing, minimizing refrigerant leaks and the hazards sometimes associated with moving belts, pulleys, or couplings.

Fundamental to the design of hermetic compressors is a method whereby electrical current is transmitted to the compressor motor through terminal conductors which pass through the compressor housing wall. These terminals are sealed in a dielectric material which insulates them from the housing and maintains the pressure tight integrity of the hermetic compressor. The terminals and their dielectric embedment are strongly constructed, but are vulnerable to careless compressor installation or maintenance procedures and equally vulnerable to internal electrical short circuits caused by excessive system contaminants.

In either of these instances, an electrical short between the terminal and the compressor housing may result in the loss of integrity between the terminal and its dielectric embedment. This loss may cause the terminals to be expelled, thereby venting the vaporous and liquid contents of the compressor housing and system.

A venting compressor terminal normally presents no danger to anyone providing the terminal protective cover is properly in place.

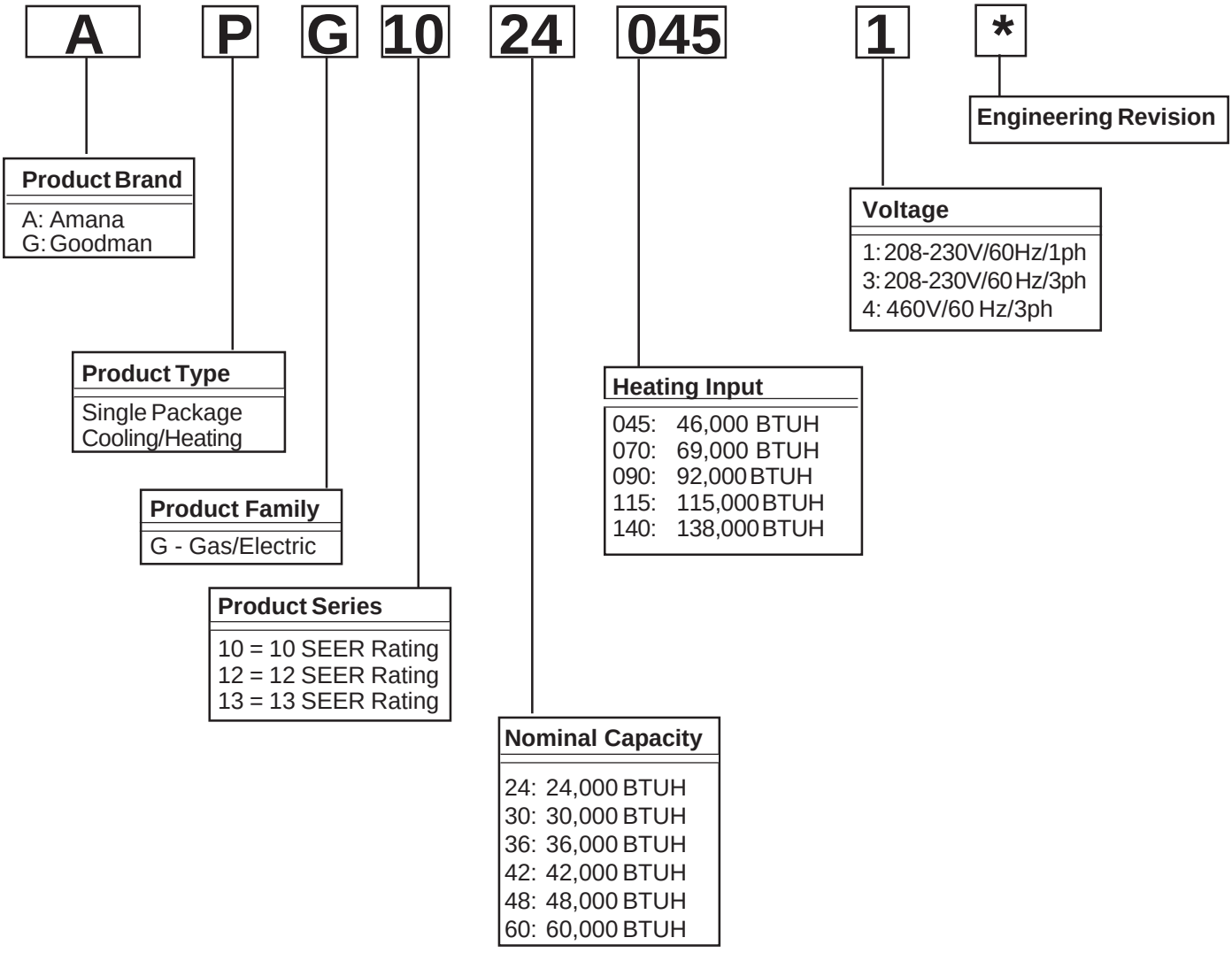
If, however, the terminal protective cover is not properly in place, a venting terminal may discharge a combination of

(a) hot lubricating oil and refrigerant

(b) flammable mixture (if system is contaminated with air) in a stream of spray which may be dangerous to anyone in the vicinity. Death or serious bodily injury could occur.

Under no circumstances is a hermetic compressor to be electrically energized and/or operated without having the terminal protective cover properly in place. See Service Section S-17 for proper servicing.

PRODUCT IDENTIFICATION



PRODUCT IDENTIFICATION

MODEL NO.	DESCRIPTION
APG10*****1*	**A**mana® **P**ackage **G**as - 10 Seer 208-230/1/60 Single-Phase Gas/Electric unit.
GPG10*****1*	**G**oodman **P**ackage **G**as - 10 Seer 208-230/1/60 Single-Phase Gas/Electric unit.
APG10*****3*	**A**mana® **P**ackage **G**as - 10 Seer 208-230/3/60 3-Phase Gas/Electric unit.
GPG10*****3*	**G**oodman **P**ackage **G**as - 10 Seer 208-230/3/60 3-Phase Gas/Electric unit.
GPG10*****4*	**G**oodman **P**ackage **G**as - 10 Seer 460/3/60 3-Phase Gas/Electric unit.
APG12*****1*	**A**mana® **P**ackage **G**as - 12 Seer 208-230/1/60 Single-Phase Gas/Electric unit.
GPG12*****1*	**G**oodman **P**ackage **G**as - 12 Seer 208-230/1/60 Single-Phase Gas/Electric unit.
APG13*****1*	**A**mana® **P**ackage **G**as - 13 Seer 208-230/1/60 Single-Phase Gas/Electric unit.
APG13*****3*	**A**mana® **P**ackage **G**as - 13 Seer 208-230/3/60 3-Phase Gas/Electric unit.
GPG13*****1*	**G**oodman **P**ackage **G**as - 13 Seer 208-230/1/60 Single-Phase Gas/Electric unit.
GPG13*****3*	**G**oodman **P**ackage **G**as - 13 Seer 208-230/3/60 3-Phase Gas/Electric unit.

ACCESSORIES

Part Number	Description	Fits Models
LPT-00A	Propane Conversion Kit	All
HA-02	High Altitude Kit	All
PGC101/102/103	Roof Curb	All
PGED101/102 PGED103	Downflow Economizer - *PG*24 - 42 Downflow Economizer - *PG*48 - 60	All
PGEH101/102 PGEH103	Horizontal Economizer - *PG*24 - 42 Horizontal Economizer - *PG*48 - 60	All
PGMDD101/102 PGMDD103	Downflow Manual 25% Fresh Air Damper Downflow Manual 25% Fresh Air Damper	A/GPG*24 - 42 A/GPG*48 - 60
PGMDH101 PGMDH102 PGMDH103	Horizontal Manual 25% Fresh Air Damper Horizontal Manual 25% Fresh Air Damper Horizontal Manual 25% Fresh Air Damper	A/GPG*24 - 30 A/GPG*36 - 42 A/GPG*48 - 60
PGMDMD101/102 PGMDMD103	Downflow Motorized 25% Fresh Air Damper Downflow Motorized 25% Fresh Air Damper	A/GPG*24 - 42 A/GPG*48 - 60
PGMDMH101 PGMDMH102 PGMDMH103	Horizontal Motorized 25% Fresh Air Damper Horizontal Motorized 25% Fresh Air Damper Horizontal Motorized 25% Fresh Air Damper	A/GPG*24 - 30 A/GPG*36 - 42 A/GPG*48 - 60
SQRPG101/102 SQRPG103	Square to Round Adapter (16" Round) Square to Round Adapter (18" Round)	A/GPG*24 - 42 A/GPG*48 - 60
PGFR101/102	Internal Filter Rack	All
CDK1/2 CDK3	Concentric Converter Concentric Converter	A/GPG*24 - 42 A/GPG*48 - 60

AMANA® THERMOSTATS

1213401	White	Manual Changeover	5 + 2 Programming	1 Cool - 1 Heat
1213402	White	Manual Changeover	Nonprogrammable	1 Cool - 1 Heat
1213408	White	Manual/Auto Changeover	7 Day Programming	1 Cool - 1 Heat

GOODMAN THERMOSTATS

CHSATG	White	Nonprogrammable	1 Cool - 1 Heat
CH70TG	White	Nonprogrammable, Digital	1 Cool - 1 Heat

LIGHTING INSTRUCTIONS

FOR YOUR SAFETY READ BEFORE OPERATING

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 does not have a pilot. It is equipped with an ignition device which automatically lights the burners. Do not try to light the burners by hand.

B. BEFORE OPERATING smell 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 telephone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas suppliers instructions.
- If you cannot reach your gas supplier, call the fire department.

C. Use only your hand to move the gas control switch or knob. Never use tools. If the gas control switch or knob will not operate, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.

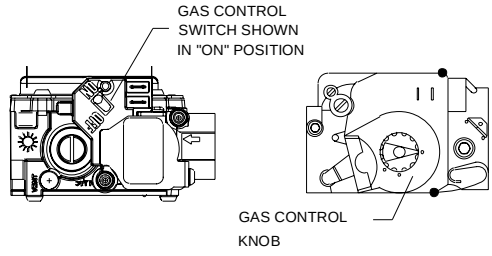
D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

WARNING: Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to the user's information manual provided with this furnace. For assistance or additional information consult a qualified installer, service agency or the gas supplier.

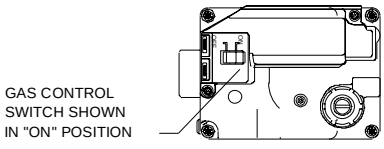
This furnace must be installed in accordance with the manufacturers instructions and local codes. In the absence of local codes, follow the National Fuel Gas Code, ANSI Z223.1.

OPERATING INSTRUCTIONS

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 automatic ignition system which automatically lights the burners. Do not try to light the burners by hand.
5. Remove control access panel.
6. Move the gas control switch or knob to "OFF".



7. Wait five (5) minutes to clear out any gas. If you then 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. Move the gas control switch or knob to "ON".
9. Replace control access panel.
10. Turn on all electric power to the appliance.
11. Set the thermostat to the 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.



This Package Gas Unit is for outdoor installation only.

WARNING: If not installed, operated and maintained in accordance with the manufacturer's instructions, this product could expose you to substances in fuel combustion which can cause death or serious illness and which are known to the State of California to cause cancer, birth defects or other reproductive harm. This product contains fiberglass insulation. Fiberglass insulation contains a chemical known by the State of California to cause cancer.

TO TURN OFF GAS TO APPLIANCE

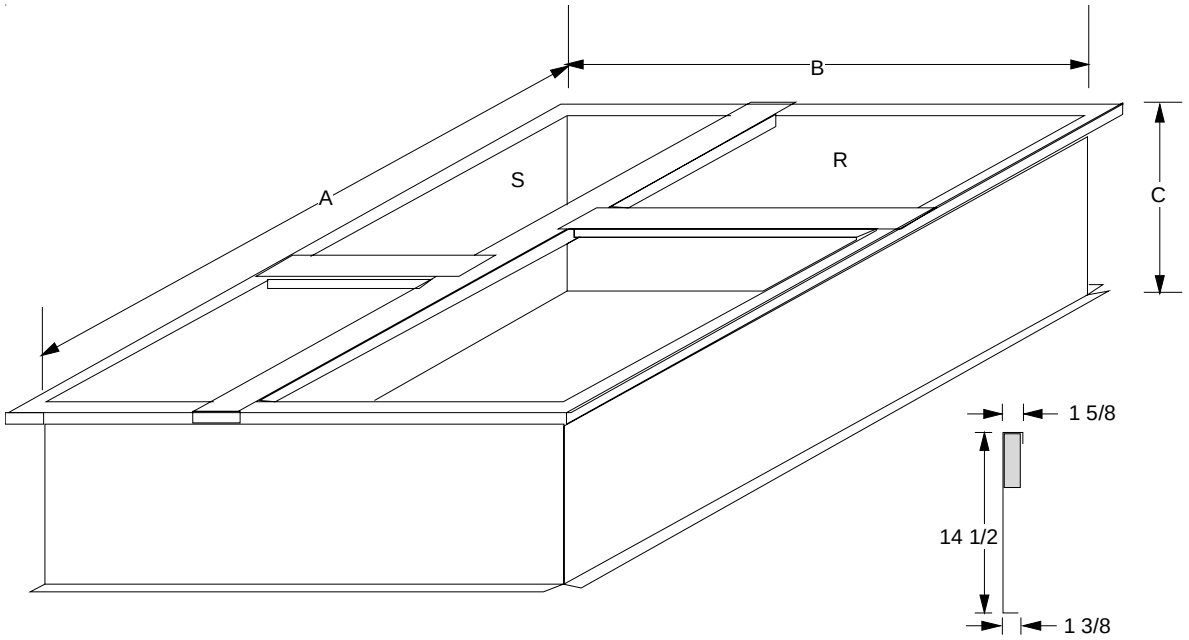
1. Set the thermostat to its lowest setting.
2. Turn off all electric power to the appliance if service is to be performed.
3. Remove control access panel.
4. Move the gas control switch or knob to "OFF". Do not force.
5. Replace control access panel.

FOR YOUR SAFETY Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

B14933-247

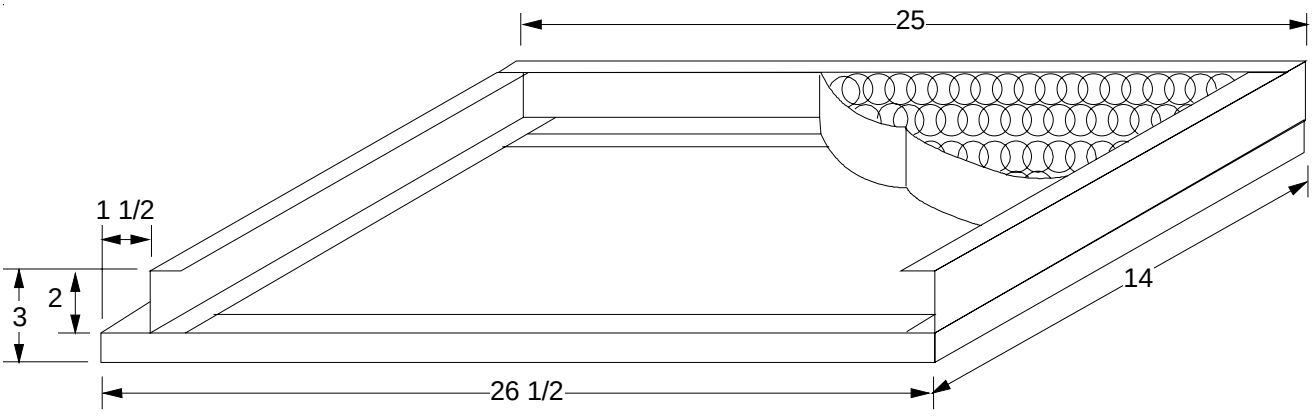
ACCESSORIES

ROOF CURBS



MODEL	A	B	C	RETURN	SUPPLY
PGC101/102/103	46 1/4	39 3/8	14 1/2	12 1/2 x 23	15 x 22 1/2

DOWNFLOW FILTER RACK (PGFR101/102/103)



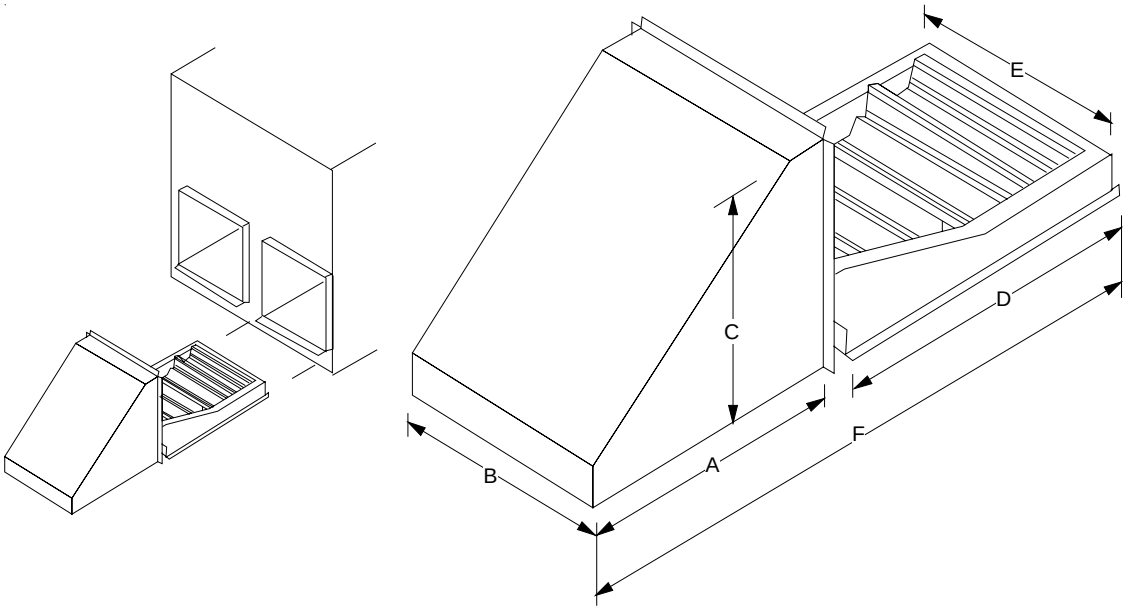
Filter Size: 14" x 25" x 2"

Measurement in inches.

NOTE: **PGFR cannot be used with downflow economizers.**

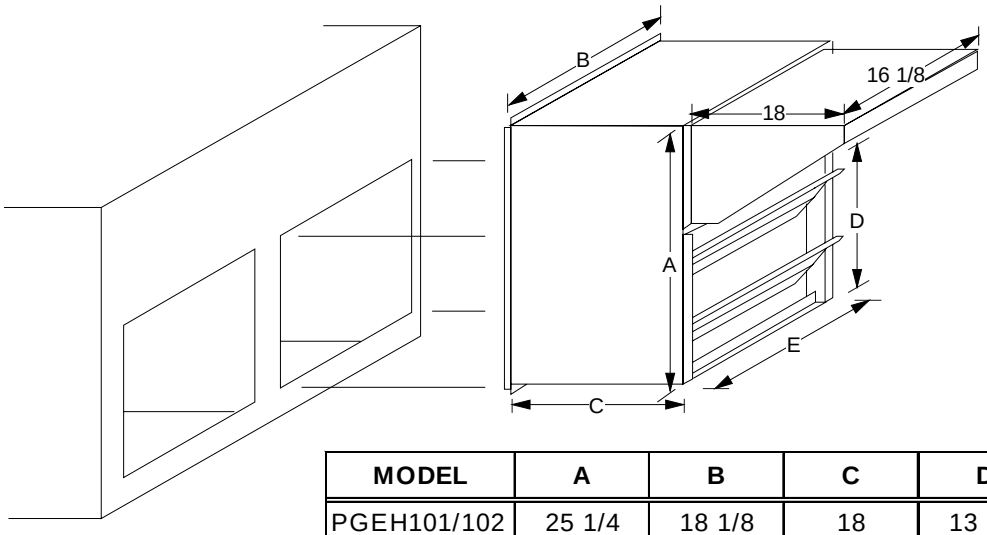
ACCESSORIES

ECONOMIZER
(DOWNFLOW APPLICATIONS)



MODEL	A	B	C	D	E	F
PGED101/102	20	16 1/4	16	23 1/2	12 1/2	45 3/4
PGED103	20	16 1/4	18	23 1/2	12 1/2	45 3/4

ECONOMIZER
(HORIZONTAL APPLICATIONS)

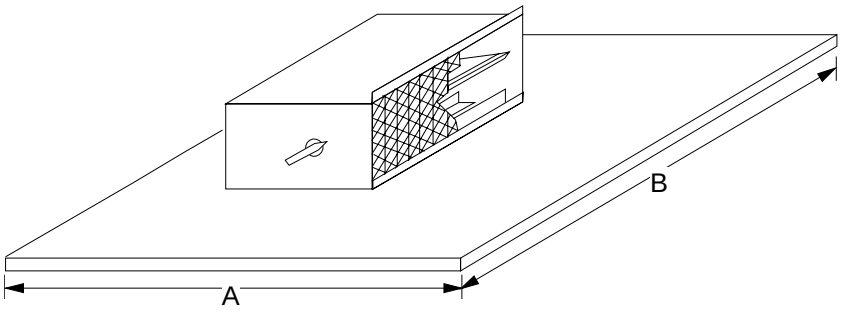


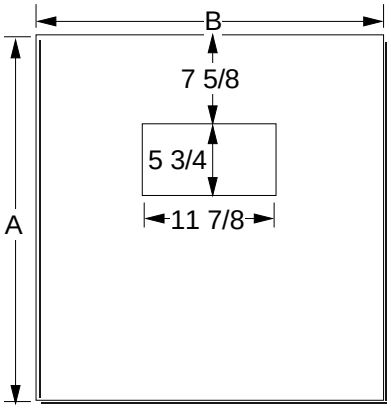
MODEL	A	B	C	D	E	FILTER
PGEH101/102	25 1/4	18 1/8	18	13 3/4	16 1/8	16 x 25 x 1
PGEH103	35 1/4	18 1/8	18	18 1/4	16 1/8	16 x 25 x 1

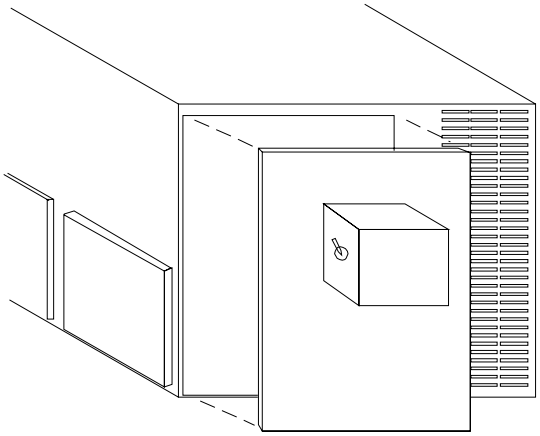
Measurement in inches.

ACCESSORIES

MOTORIZED/MANUAL FRESH AIR DAMPERS - (DOWNFLOW APPLICATIONS)

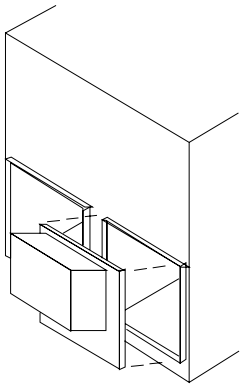


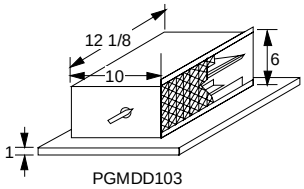




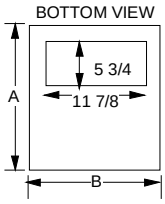
MODEL	A	B
PGMDH101	26 1/2	29 3/4
PGMDH102	31 1/2	29 3/4
PGMDH103	39	29 3/4

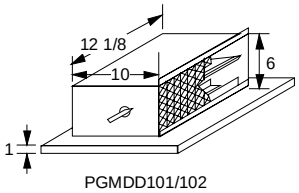
MOTORIZED/MANUAL FRESH AIR DAMPERS (HORIZONTAL APPLICATIONS)



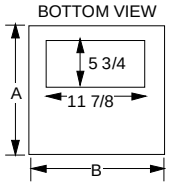


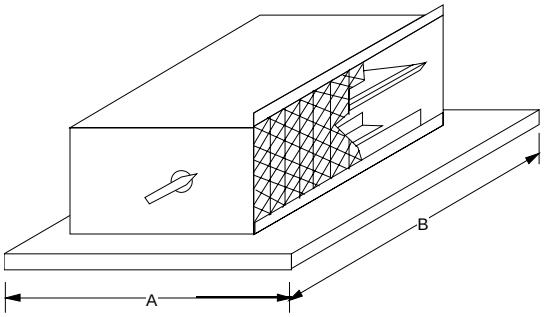
PGMDD103





PGMDD101/102

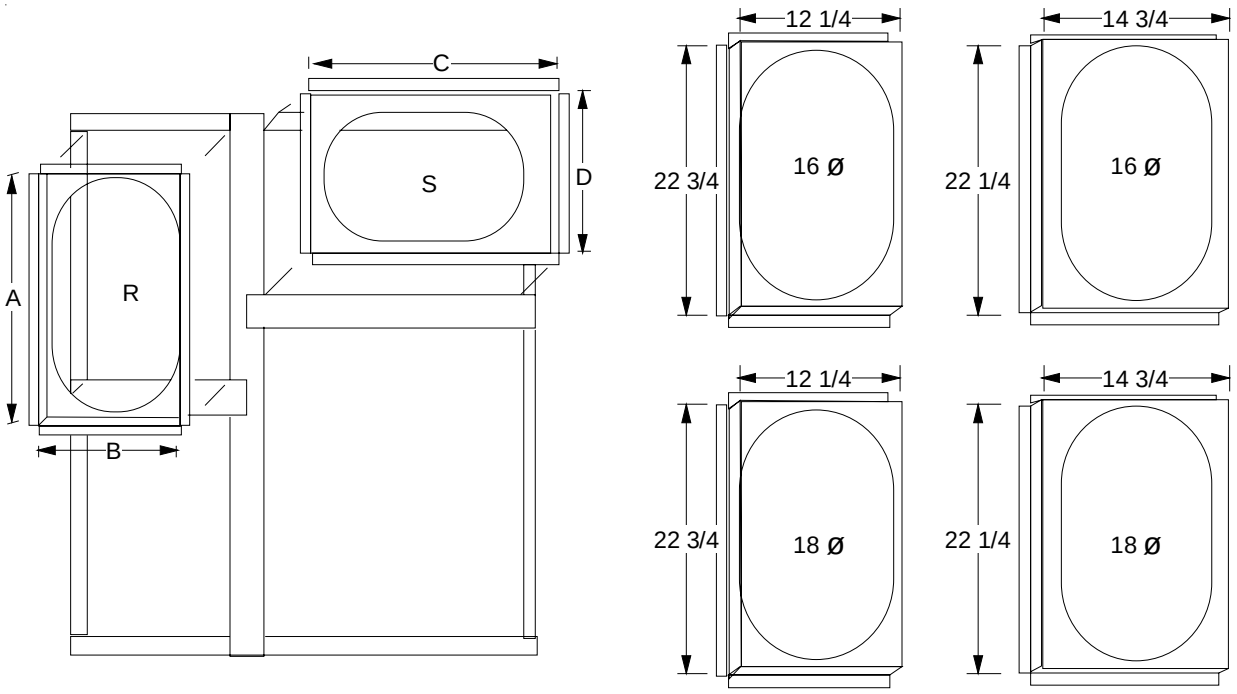




MODEL	A	B
PGMDD101/102	16	16
PGMDD103	18	16

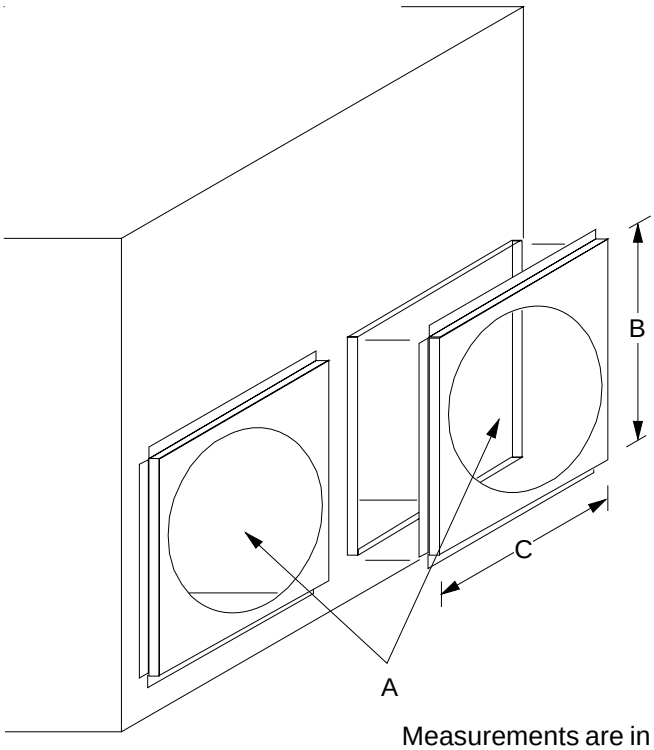
ACCESSORIES

SQUARE TO ROUND CONVERTER (DOWNFLOW APPLICATIONS)



MODEL	A	B	C	D	RETURN	SUPPLY
SQRPG101/102	22 3/4	12 1/4	22 1/4	14 3/4	16	16
SQRPG103	22 3/4	12 1/4	22 1/4	14 3/4	18	18

SQUARE TO ROUND CONVERTER (HORIZONTAL APPLICATIONS)

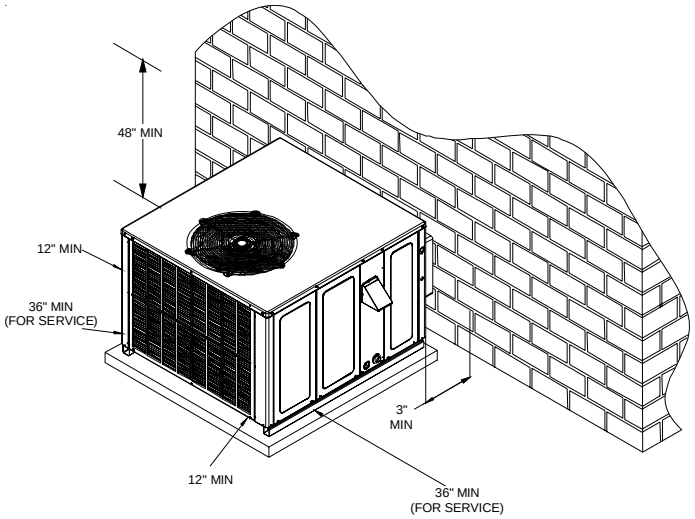


MODEL	A	B	C
SQRPG101/102	16	16 1/2	16 1/2
SQRPG103	18	18 1/2	18 1/2

Measurements are in inches.

PRODUCT DESIGN

In installations where the unit is installed above ground level and not serviceable from the ground (Example: Roof Top installations) the installer must provide a service platform for the service person with rails or guards in accordance with local codes or ordinances or in their absence with the latest edition of the National Fuel Gas Code ANSI Z223.1.



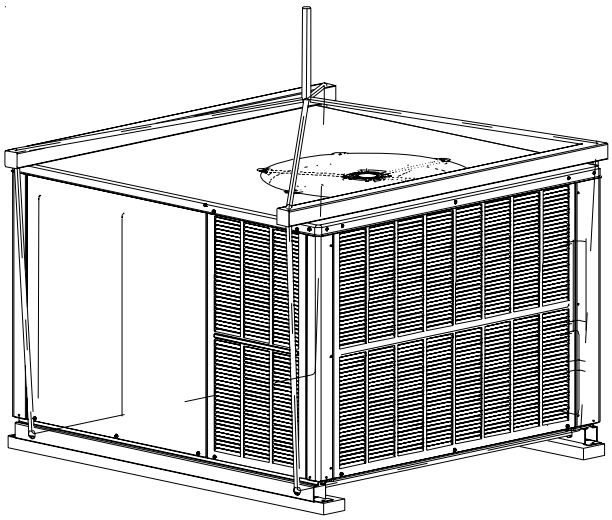
NOTE: Roof overhang should be no more than 36".

Minimum clearances are required to avoid air recirculation and keep the unit operating at peak efficiency. A minimum 12 inch clearance is required to the condenser coil.

NOTE: The flue outlet hood is packaged separately inside the unit and must be installed prior to operation.

⚠ WARNING

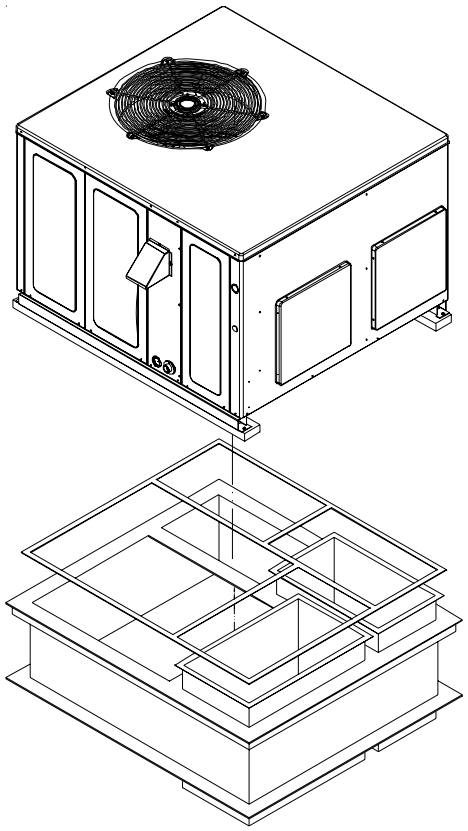
TO PREVENT POSSIBLE DAMAGE, THE UNIT SHOULD REMAIN IN AN UPRIGHT POSITION DURING ALL RIGGING AND MOVING OPERATIONS. TO FACILITATE LIFTING AND MOVING IF A CRANE IS USED, PLACE THE UNIT IN AN ADEQUATE CABLE SLIDE.



IMPORTANT NOTE: IF USING BOTTOM DISCHARGE WITH ROOF CURB, DUCTWORK SHOULD BE ATTACHED TO THE CURB PRIOR TO INSTALLING THE UNIT.

Refer to Roof curb Installation Instructions for proper curb installation. Curbing must be installed in compliance with the National Roofing Contractors Association Manual.

Lower unit carefully onto roof mounting curb. While rigging unit, center of gravity will cause condenser end to be lower than supply air end.



NOTE: A roof curb can be used to utilize bottom discharge.

APG/GPG Package Units are designed for outdoor installations only in either residential or light commercial applications.

The connecting ductwork (Supply and Return) can be connected for either horizontal or down discharge airflow. In the down discharge applications a matching Roof Curb is recommended .

A return air filter must be installed behind the return air grille(s) or provision must be made for a filter in an accessible location within the return air duct. The minimum filter area should not be less than those sizes listed in the Specification Section. Under no circumstances should the unit be operated without return air filters.

A 3/4" - 14 NPT drain connector is provided for removal of condensate water from the indoor coil. In order to provide proper condensate flow, do not reduce the drain line size.

Refrigerant flow control is achieved by use of restrictor orifices or thermostatic expansion valves (TXV).

The single phase units use permanent split capacitors (PSC) design compressors. Starting components are therefore not required. A low MFD run capacitor assists the compressor to start and remains in the circuit during operation.

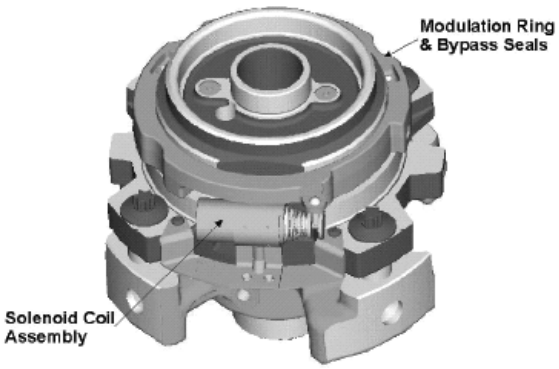
PRODUCT DESIGN

The outdoor fan and indoor blower motors are single phase capacitor type motors.

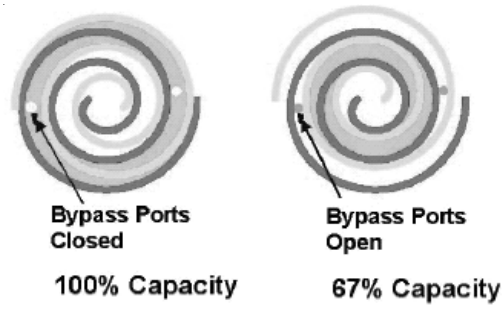
Air for condensing (cooling) is drawn through the outdoor coil by a propeller fan, and is discharged vertically out the top of the unit. The outdoor coil is designed for .0 static. No additional restriction (ductwork) shall be applied.

Conditioned air is drawn through the filter(s), field installed, across the evaporator coil and back into the conditioned space by the indoor blower.

Some APG/GPG series package units use a two-stage scroll compressor. The two-step modulator has an internal unloading mechanism that opens a bypass port in the first compression pocket, effectively reducing the displacement of the scroll. The opening and closing of the bypass port is controlled by an internal electrically operated solenoid.



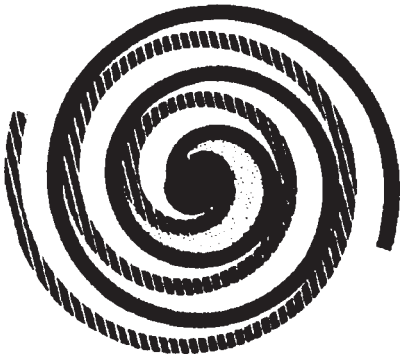
The ZPS/ZRS two-step modulated scroll uses a single step of unloading to go from full capacity to approximately 67% capacity. A single speed, high efficiency motor continues to run while the scroll modulates between the two capacity steps.



Other A/GPG series package units use the Compliant Scroll compressor, instead of traditional reciprocating compressor.

A scroll is an involute spiral which, when matched with a mating scroll form as shown, generates a series of crescent shaped gas pockets between the two members.

During compression, one scroll remains stationary (fixed scroll) while the other form (orbiting scroll) is allowed to orbit (but not rotate) around the first form.



As this motion occurs, the pockets between the two forms are slowly pushed to the center of the two scrolls while simultaneously being reduced in volume. When the pocket reaches the center of the scroll form, the gas, which is now at a high pressure, is discharged out of a port located at the center.

During compression, several pockets are being compressed simultaneously, resulting in a very smooth process. Both the suction process (outer portion of the scroll members) and the discharge process (inner portion) are continuous.

Some design characteristics of the Compliant Scroll compressor are:

- Compliant Scroll compressors are more tolerant of liquid refrigerant.

  NOTE: Even though the compressor section of a Scroll compressor is more tolerant of liquid refrigerant, continued floodback or flooded start conditions may wash oil from the bearing surfaces causing premature bearing failure.
- Compliant Scroll compressors use white oil which is compatible with 3GS. 3GS oil may be used if additional oil is required.
- Compliant scroll compressors perform "quiet" shutdowns that allow the compressor to restart immediately without the need for a time delay. This compressor will restart even if the system has not equalized.

  NOTE: Operating pressures and amp draws may differ from standard reciprocating compressors. This information can be found in the unit's Technical Information Manual.

ELECTRICAL WIRING

⚠ WARNING

TO AVOID PERSONAL INJURY OR DEATH DUE TO ELECTRIC SHOCK, WIRING TO THE UNIT MUST BE PROPERLY POLARIZED AND GROUNDED.

⚠ WARNING

TO AVOID PERSONAL INJURY OR DEATH DUE TO ELECTRIC SHOCK, DISCONNECT ELECTRICAL POWER BEFORE CHANGING ANY ELECTRICAL WIRING.

PRODUCT DESIGN

The units are designed for operation on 60 hertz current and at voltages as shown on the rating plate. All internal wiring is complete. Ensure the power supply to the compressor contactor is brought to the unit as shown on the supplied unit wiring diagram. The 24V wiring must be connected between the unit control panel and the room thermostat.

LINE VOLTAGE WIRING

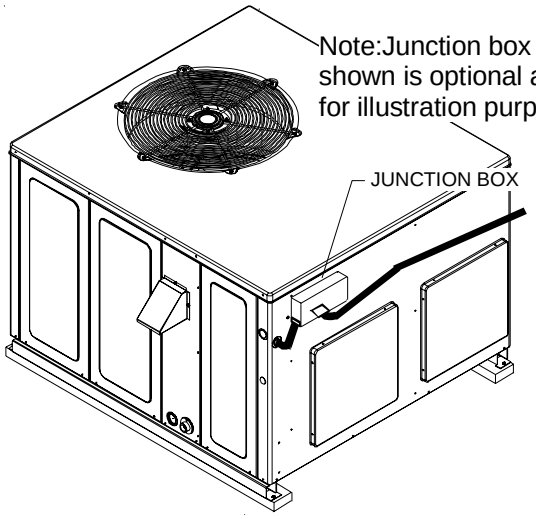
Power supply to the unit must be N.E.C. Class 1, and must comply with all applicable codes. The unit must be electrically grounded in accordance with the local codes or, in their absence, with the latest edition of the National Electrical Code, ANSI/NFPA No. 70, or in Canada, Canadian Electrical Code, C22.1, Part 1. A fused disconnected must be provided and sized in accordance with the unit minimum circuit ampacity.

The best protection for the wiring is the smallest fuse or breaker which will hold the equipment on line during normal operation without nuisance trips. Such a device will provide maximum circuit protection.

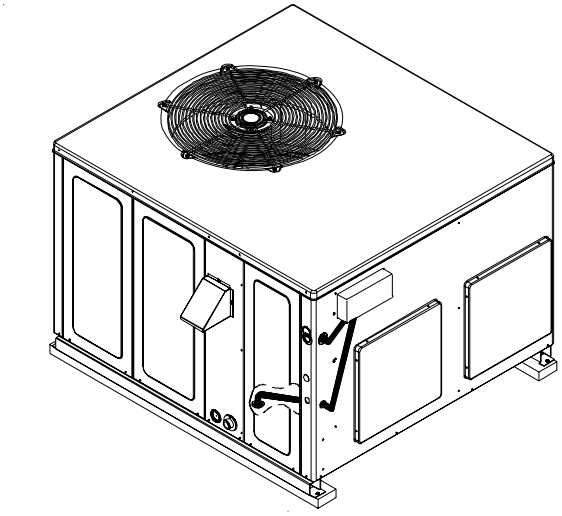
⚠ WARNING

DO NOT EXCEED THE MAXIMUM OVERCURRENT DEVICE SIZE SHOWN ON THE UNIT DATA PLATE.

All line voltage connections must be made through weather proof fittings. All exterior power supply and ground wiring must be in approved weather proof conduit. Low voltage wiring from the unit control panel to the thermostat requires coded cable. See the following figures for ground level and rooftop wiring.



Electrical Power Directly To Junction Box



Electrical Power Routed Through Bottom of Unit

The unit transformer is connected for 230V operation. If the unit is to operate on 208V, reconnect the transformer primary lead and the induced draft blower leads as shown on the unit wiring diagram. **NOTE:** Some models use an induced draft blower that has only a 230V lead. No wiring change is required if the unit is equipped with a single tap induced draft blower.

⚠ WARNING

TO AVOID THE RISK OF PROPERTY DAMAGE, PERSONAL INJURY OR FIRE, USE ONLY COPPER CONDUCTORS.

If it is necessary for the installer to supply additional line voltage wiring to the inside of the package unit, the wiring must comply with all local codes. This wiring must have a minimum temperature rating of 105°C. and must be routed away from the burner compartment. All line voltage splices must be made inside the unit control box.

GAS SUPPLY AND PIPING

⚠ CAUTION

THIS PACKAGE GAS UNIT IS FACTORY SET TO OPERATE ON NATURAL GAS AT THE ALTITUDES SHOWN ON THE RATING PLATE. IF OPERATION ON PROPANE IS REQUIRED, OBTAIN AND INSTALL THE PROPER CONVERSION KIT(S) BEFORE OPERATING THIS UNIT. FAILURE TO DO SO MAY RESULT IN UNSATISFACTORY OPERATION AND/OR EQUIPMENT DAMAGE.

The rating plate is stamped with the model number, type of gas, and gas input rating. Make sure the unit is equipped to operate on the type of gas available.

PRODUCT DESIGN

Inlet Gas Pressure	
Natural	Min. 5.0" W.C., Max. 10.0" W.C.
Propane	Min. 11.0" W.C., Max. 13.0" W.C.

Inlet Gas Pressure Must Not Exceed the Maximum Value Shown in the table above.

The minimum supply pressure must not be varied downward because this could lead to unreliable ignition. In addition, gas input to the burners must not exceed the rated input shown on the rating plate. Overfiring of the unit could result in premature heat exchanger failure.

GAS PIPING

⚠ CAUTION

TO AVOID POSSIBLE UNSATISFACTORY OPERATION OR EQUIPMENT DAMAGE DUE TO UNDERFIRING OF EQUIPMENT, DO NOT UNDERSIZE THE NATURAL GAS/PROPANE PIPING FROM THE METER/TANK TO THE FURNACE. WHEN SIZING A TRUNK LINE PER THE TABLES, INCLUDE ALL APPLIANCES ON THAT LINE THAT COULD BE OPERATED SIMULTANEOUSLY.

The gas pipe supplying the unit must be properly sized based on the cubic feet per hour of gas flow required, specific gravity of the gas and length of the run. The gas line installation must comply with local codes, or in the absence of local codes, with the latest edition of the National Fuel Gas Code ANSI Z223.1.

NATURAL GAS CAPACITY OF PIPE IN CUBIC FEET OF GAS PER HOUR (CFH)

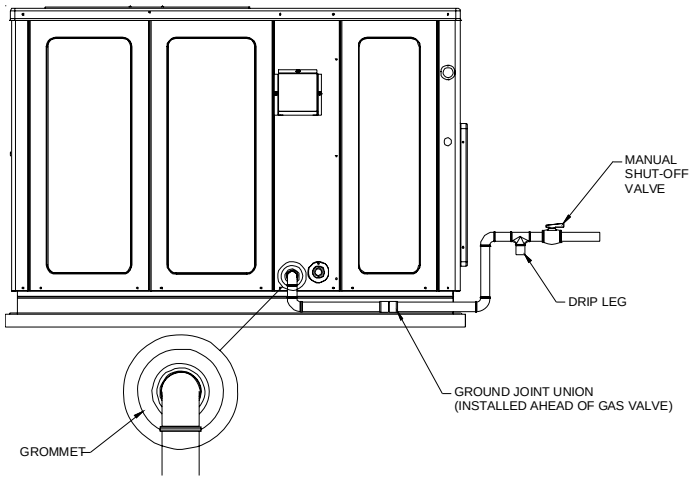
LENGTH OF PIPE IN FEET	NOMINAL BLACK PIPE SIZE				
	1/2"	3/4"	1"	1 1/4"	1 1/2"
10	132	278	520	1050	1600
20	92	190	350	730	1100
30	73	152	285	590	980
40	63	130	245	500	760
50	56	115	215	440	670
60	50	105	195	400	610
70	46	96	180	370	560
80	43	90	170	350	530
90	40	84	160	320	490
100	38	79	150	305	460

$$CFH = \frac{\text{BTUH FURNACE INPUT}}{\text{CALORIFIC VALUE OF GAS}}$$

CONNECTING THE GAS PIPING - NATURAL GAS

1. Use black iron or steel pipe and fittings for the building piping.
2. Use pipe joint compound on male threads only. Pipe joint compound must be resistant to the action of the fuel used.
3. Use ground joint unions.
4. Install a drip leg to trap dirt and moisture before it can enter the gas valve. The drip leg must be a minimum of three inches long.
5. Use two pipe wrenches when making connection to the gas valve to keep it from turning.
6. Install a manual shut off valve. This shut off valve should be conveniently located within six (6) feet of the unit, and between the meter and unit.
7. Tighten all joints securely.
8. Connect the unit to the building piping by one of the following methods.
   a. Rigid metallic pipe and fittings.
   b. Semi-rigid metallic tubing and metallic fittings. Aluminum alloy tubing shall not be used in exterior locations.
   c. Listed gas appliance connectors used in accordance with the terms of their listing that are completely in the same room as the equipment.

NOTE: In "b" and "c" above, the connector or tubing must be installed so as to be protected against physical and thermal damage. Aluminum-alloy tubing and connectors must be coated to protect against external corrosion where they are in contact with masonry, plaster, or insulation or are subject to repeated wettings by such liquids as water (except rain water), detergents, or sewage.



NOTE: The unit gas supply entrance is factory sealed with plugs. Keep plugs in place until gas supply is ready to be installed. Once ready, replace the plugs with the supplied grommets and install gas supply line.

PRODUCT DESIGN

CHECKING THE GAS PIPING

⚠ CAUTION

TO AVOID THE POSSIBILITY OF PROPERTY DAMAGE, PERSONAL INJURY OR FIRE, THE FOLLOWING INSTRUCTIONS MUST BE PERFORMED REGARDING GAS CONNECTIONS AND PRESSURE TESTING.

The unit and its gas connections must be leak tested before placing in operation. Because of the danger of explosion or fire, never use a match or open flame to test for leaks. Never exceed specified pressure for testing. Higher pressure may damage the gas valve and cause overfiring which may result in heat exchanger failure.

This unit must be isolated from the gas supply system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 psig (3.48 kPa).

TANKS AND PIPING - PROPANE UNITS

⚠ WARNING

PERSONAL INJURY HAZARD
IRON OXIDE (RUST) CAN REDUCE THE LEVEL OF ODORANT IN PROPANE GAS. A GAS DETECTING DEVICE IS THE ONLY RELIABLE METHOD TO DETECT A PROPANE GAS LEAK. CONTACT YOUR LOCAL PROPANE SUPPLIER ABOUT INSTALLING A GAS DETECTING WARNING DEVICE TO ALERT YOU IN THE EVENT THAT A GAS LEAK SHOULD DEVELOP. FAILURE TO DETECT A PROPANE GAS LEAK COULD RESULT IN AN EXPLOSION OR FIRE WHICH COULD CAUSE SERIOUS PERSONAL INJURY OR DEATH.

All propane gas equipment must conform to the safety standards of the National Board of Fire Underwriters (See NBFU Manual 58) or Natural Standards of Canada B149.2, Installation Code for Propane Gas Burning Appliances and Equipment.

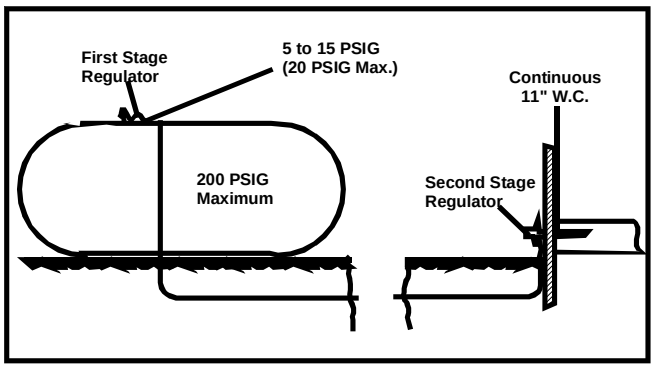
For satisfactory operation, propane gas pressure must be 10 inch W.C. at the unit manifold with all gas appliances in operation. Maintaining proper gas pressure depends on three main factors.

1. Vaporization rate, which depends on (a) temperature of the liquid, and (b) "wetted surface" area of the container or containers.
2. Proper pressure regulation. (Two-stage regulation is recommended from the standpoint of both cost and efficiency.)
3. Pressure drop in lines between regulators, and between second stage regulator and the appliance. Pipe size required will depend on length of pipe run and total load of all appliances.

Complete information regarding tank sizing for vaporization, recommended regulator settings, and pipe sizing is available from most regulator manufacturers and propane gas suppliers.

Propane is an excellent solvent, and special pipe dope must be used when assembling piping for this gas as it will quickly dissolve white lead or most standard commercial compounds. Shellac base compounds resistant to the actions of liquefied petroleum gases such as Gasolac®, Stalactic®, Clyde's or John Crane are satisfactory.

TYPICAL PROPANE PIPING



⚠ WARNING

IF YOUR PROPANE GAS APPLIANCE IS INSTALLED IN AN EXCAVATED AREA OR A CONFINED SPACE, WE STRONGLY RECOMMENDED THAT YOU CONTACT YOUR PROPANE SUPPLIER ABOUT INSTALLING A GAS DETECTING WARNING DEVICE THAT WOULD ALERT YOU TO A GAS LEAK.

- **PROPANE GAS IS HEAVIER THAN AIR AND ANY LEAKING GAS CAN SETTLE IN ANY LOW AREAS OR CONFINED SPACES.**
- **PROPANE GAS ODORANT MAY FADE, MAKING THE GAS UNDETECTABLE EXCEPT WITH A WARNING DEVICE.**

AN UNDETECTED GAS LEAK WILL CREATE A DANGER OF EXPLOSION OR FIRE. IF YOU SUSPECT THE PRESENCE OF GAS, FOLLOW THE INSTRUCTIONS ON PAGE 7. FAILURE TO DO SO COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

PROPANE TANK SIZING (MINIMUM)

MAXIMUM GAS NEEDED TO VAPORIZE*	TANK SIZE REQUIRED IF LOWEST OUTDOOR TEMPERATURE (AVG. FOR 24 HOURS) REACHES						
	32°F	20°F	10°F	0°F	-10°F	-20°F	-30°F
125K BTU/HR (50 CFH)	115 GAL	115 GAL	115 GAL	250 GAL	250 GAL	400 GAL	600 GAL
250K BTU/HR (100 CFH)	250 GAL	250 GAL	250 GAL	400 GAL	500 GAL	1000 GAL	1500 GAL
375K BTU/HR (150 CFH)	300 GAL	400 GAL	500 GAL	500 GAL	1000 GAL	1500 GAL	2500 GAL
500K BTU/HR (200 CFH)	400 GAL	500 GAL	750 GAL	1000 GAL	1500 GAL	2000 GAL	3500 GAL
750K BTU/HR (300 CFH)	750 GAL	1000 GAL	1500 GAL	2000 GAL	2500 GAL	4000 GAL	5000 GAL

* AVERAGE RATE/HOUR WITHDRAWL IN 8 HOUR PERIOD

PRODUCT DESIGN
PROPANE GAS PIPING CHARTS

Sizing Between First and Second Stage Regulator
Maximum Propane Capacities listed are based on 1 PSIG Pressure Drop at 10 PSIG Setting. Capacities in 1,000 BTU/HR

PIPE OR TUBING LENGTH, FEET	TUBING SIZE, O.D., TYPE L					NOMINAL PIPE SIZE, SCHEDULE 40	
	3/8"	1/2"	5/8"	3/4"	7/8"	1/2"	3/4"
30	309	700	1,303	2,205	3,394	1,843	3,854
40	265	599	1,115	1,887	2,904	1,577	3,298
50	235	531	988	1,672	2,574	1,398	2,923
60	213	481	896	1,515	2,332	1,267	2,649
70	196	446	824	1,394	2,146	1,165	2,437
80	182	412	767	1,297	1,996	1,084	2,267
90	171	386	719	1,217	1,873	1,017	2,127
100	161	365	679	1,149	1,769	961	2,009
150	130	293	546	923	1,421	772	1,613
200	111	251	467	790	1,216	660	1,381
250	90	222	414	700	1,078	585	1,224
300	89	201	378	634	976	530	1,109
350	82	185	345	584	898	488	1,020
400	76	172	321	543	836	454	949

To convert to Capacities at 15 PSIG Settings -- Multiply by 1.130
To convert to Capacities at 5 PSIG Settings -- Multiply by 0.879

Sizing Between Single or Second Stage Regulator and Appliance*
Maximum Propane Capacities Listed are Based on 1/2" W.C. Pressure Drop at 11" W.C. Setting. Capacities in 1,000 BTU/HR

PIPE OR TUBING LENGTH, FEET	TUBING SIZE, O.D., TYPE L					NOMINAL PIPE SIZE, SCHEDULE 40				
	3/8"	1/2"	5/8"	3/4"	7/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"
10	49	110	206	348	539	291	608	1,146	2,353	3,525
20	34	76	141	239	368	200	418	788	1,617	2,423
30	27	61	114	192	296	161	336	632	1,299	1,946
40	23	52	97	164	253	137	284	541	1,111	1,665
50	20	46	86	146	224	122	255	480	985	1,476
60	19	42	78	132	203	110	231	436	892	1,337
80	16	36	67	113	174	94	198	372	764	1,144
100	14	32	59	100	154	84	175	330	677	1,014
125	12	28	52	89	137	74	155	292	600	899
150	11	26	48	80	124	67	141	265	544	815
200	10	22	41	69	106	58	120	227	465	697
250	9	19	36	61	94	51	107	201	412	618
300	8	18	33	55	85	46	97	182	374	560
350	7	16	30	51	78	43	89	167	344	515
400	7	15	28	47	73	40	83	156	320	479

*DATA IN ACCORDANCE WITH NFPA PAMPHLET NO. 54

SYSTEM OPERATION

COOLING

The refrigerant used in the system is R-22. It is clear, colorless, non-toxic, non-irritating, and non-explosive liquid. The chemical formula is $CHCIF_2$. The boiling point, at atmospheric pressure is -41.4°F.

A few of the important principles that make the refrigeration cycle possible are: heat always flows from a warmer to a cooler body, under lower pressure a refrigerant will absorb heat and vaporize at a low temperature, the vapors may be drawn off and condensed at a higher pressure and temperature to be used again.

The indoor evaporator coil functions to cool and dehumidify the air conditioned spaces through the evaporative process taking place within the coil tubes.

NOTE: Actual temperatures and pressures are to be obtained from the expanded ratings in the Technical Information Manual.

High temperature, high pressure vapor leaves the compressor through the discharge line and enters the condenser coil. Air drawn through the condenser coil by the condenser fan causes the refrigerant to condense into a liquid by removing heat from the refrigerant. As the refrigerant is cooled below its condensing temperature it becomes subcooled.

The subcooled high pressure liquid refrigerant now leaves the condenser coil via the liquid line until it reaches the indoor expansion device.

As the refrigerant passes through the expansion device and into the evaporator coil a pressure drop is experienced causing the refrigerant to become a low pressure liquid. Low pressure saturated refrigerant enters the evaporator coil where heat is absorbed from the warm air drawn across the coil by the evaporator blower. As the refrigerant passes through the last tubes of the evaporator coil it becomes superheated, that is, it absorbs more heat than is necessary for the refrigerant to vaporize. Maintaining proper superheat assures that liquid refrigerant is not returning to the compressor which can lead to early compressor failure.

Low pressure superheated vapor leaves the evaporator coil and returns through the suction line to the compressor where the cycle begins again.

COOLING CYCLE

All Models

When the contacts of the room thermostat close, the terminals R to Y and G on the control board are energized.

The control board recognizes this as a demand for cooling and energizes the compressor contactor and indoor blower motor. The blower delay is an integral part of the control board.

When the thermostat is satisfied, it opens its contacts, breaking the low voltage circuit, causing the compressor contactor to open and indoor fan to stop after a 60 second delay.

If the room thermostat fan selector switch should be set to the "on" position then the indoor blower would run continuous rather than cycling with the compressor.

HEATING CYCLE

When the contacts of the room thermostat close, the terminals R to W on the control board are energized.

The heating cycle is accomplished by using a unique tubular design heat exchanger which provides efficient gas heating on either natural gas or propane gas fuels. The heat exchangers compact tubular construction provides excellent heat transfer for maximum operating efficiency.

Inshot type gas burners with integral cross lighters are used eliminating the need for adjustable air shutters. The same burner is designed for use on either natural or propane gas fuels.

The induced draft blower draws fuel and combustion air into the burners and heat exchanger for proper combustion. A pressure switch is used in conjunction with the I. D. blower to detect a blocked flue condition.

Blower operation is controlled by the ignition control module. The module allows for field adjustment of the blower delay at the end of the heating cycle. The range of adjustment is for 120, 135, or 150 seconds. The factory delay setting is 30 seconds delay on 150 seconds delay off.

Direct Spark Ignition (DSI) Systems

APG/GPG units are equipped with a direct spark ignition system. Ignition is provided by 22,000 volt electronic spark. A flame sensor then monitors for the presence of flame and closes the gas valve if flame is lost.

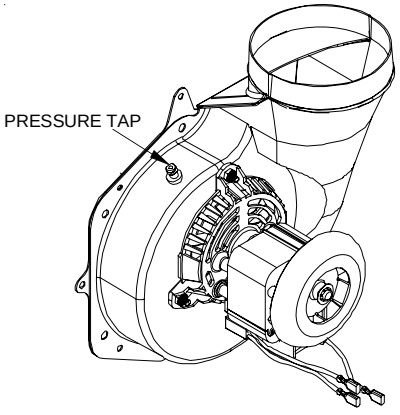
The system may be controlled by most good heating and cooling thermostats with an adjustable heat anticipator.

NOTE: Some night setback thermostats that do not have a common terminal, use a power robbing circuit in the off cycle to maintain the batteries. This type of thermostat may interfere with the operation of the ignition control module and <u>should not</u> be used.

HEATING SEQUENCE

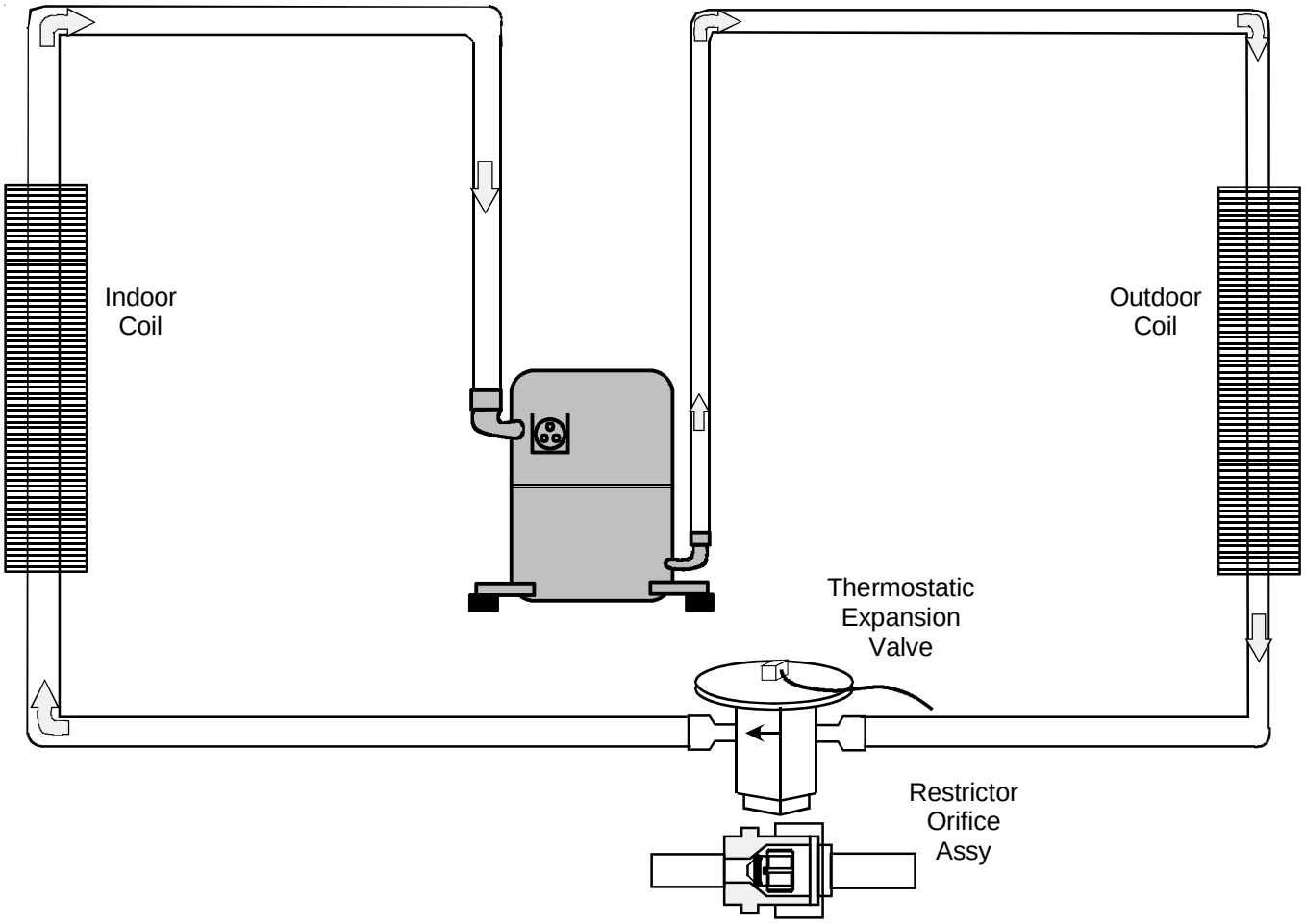
In order to illustrate the heating sequence, the following has been simplified to give a better understanding of the pressure switch operation.

The figure below is a view of the induced draft blower showing the location of the pressure tap. The induced draft blower is mounted on the collector box, where the combustion gases from the heat exchanger are drawn through the collector box.



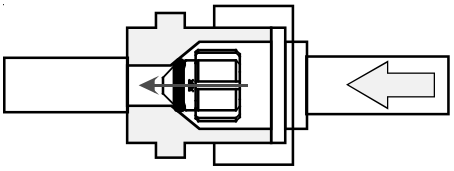
SYSTEM OPERATION

Typical Package Cooling or Package Gas



Either a thermostatic expansion valve or restrictor orifice assembly may be used depending on model, refer to the parts catalog for the model being serviced.

Restrictor Orifice Assembly in Cooling Operation

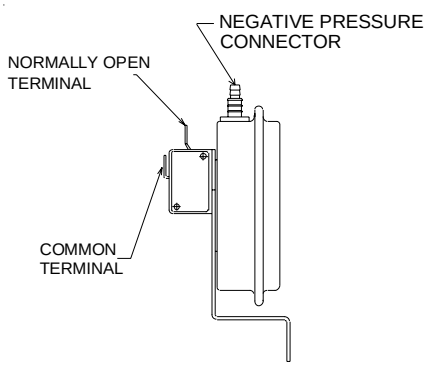


In the cooling mode the orifice is pushed into its seat forcing refrigerant to flow through the metered hole in the center of the orifice.

SYSTEM OPERATION

The pressure tap has a predetermined orifice size for reading static pressures. The induced draft blower motor assembly is mounted to the collector box. When the motor is in operation, a negative pressure will be created on the pressure tap, collector box and heat exchanger flue passages.

A pressure control using a single pole, single throw electrical switch is used as a safety device in case of a blocked flue.



With the unit in the off position the induced draft blower motor will not be running. Atmospheric pressure will therefore be on both sides of the diaphragm and the electrical switch will be open between (C) common and (NO) normally open terminals.

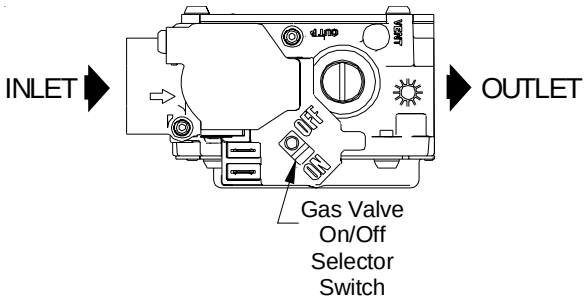
When the induced draft blower motor is in operation, it creates a negative pressure on one side of the diaphragm and atmospheric pressure on the other side causing the diaphragm to move toward the negative pressure.

This in turn will close the switch and make the (C) common to the (NO) normally open terminals.

In the event of partially restricted or blocked flue the induced draft blower will create less negative pressure and will open the contacts (C) to (NO).

OPERATING INSTRUCTIONS

1. Close the manual gas valve external to the unit.
2. Turn off the electrical power supply to the unit.
3. Set the room thermostat to its lowest possible setting.
4. Remove the heat exchanger door on the side of the unit by removing screws.
5. This unit is equipped with an ignition device which automatically lights the burners. **DO NOT** light burners by any other method.
6. Turn the gas control valve to the OFF position. Do not force. Some Gas valves may have a different off/on style switch.



7. Wait five minutes to clear out any gas.
8. Smell for gas, including near the ground. This is important because some types of gas are heavier than air. If you have waited five minutes and you do smell gas, immediately follow the lighting instructions of this manual (page 7). If having waited for five minutes and no gas is smell is noted, turn the gas control valve to the ON position.
9. Replace the heat exchanger door on the side of the unit.
10. Open the manual gas valve external to the unit.
11. Turn on the electrical power supply to the unit.
12. Set the thermostat to desired setting.

NOTE: There is approximately a 20-second delay between thermostat energizing and burner firing.

FAN OPERATION

Continuous Fan Mode

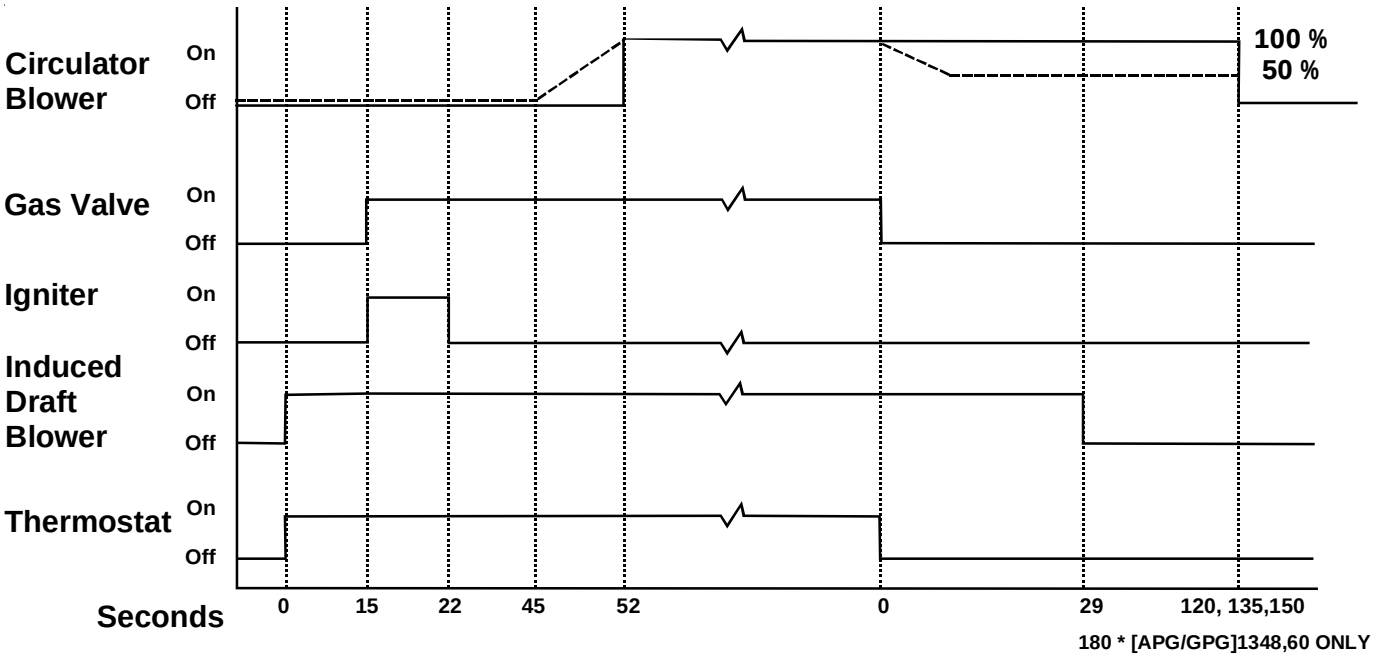
If the thermostat calls for continuous fan without a call for heat or cool, the indoor blower will be energized at the heat speed. The fan remains energized as long as there is not a call for heat or cool. Once the call for continuous fan is de-energized, the indoor blower will go through a 60 second off delay.

If a call for cool occurs during continuous fan operation, the blower will switch to the cooling speed.

If a call for heat occurs during continuous fan operation, the indoor blower will de-energize when the heat on blower delay begins. The heat cycle will control the indoor blower operation until the heat blower off delay is over. The continuous fan mode will function normally even while the control is in heat lockout.

SYSTEM OPERATION

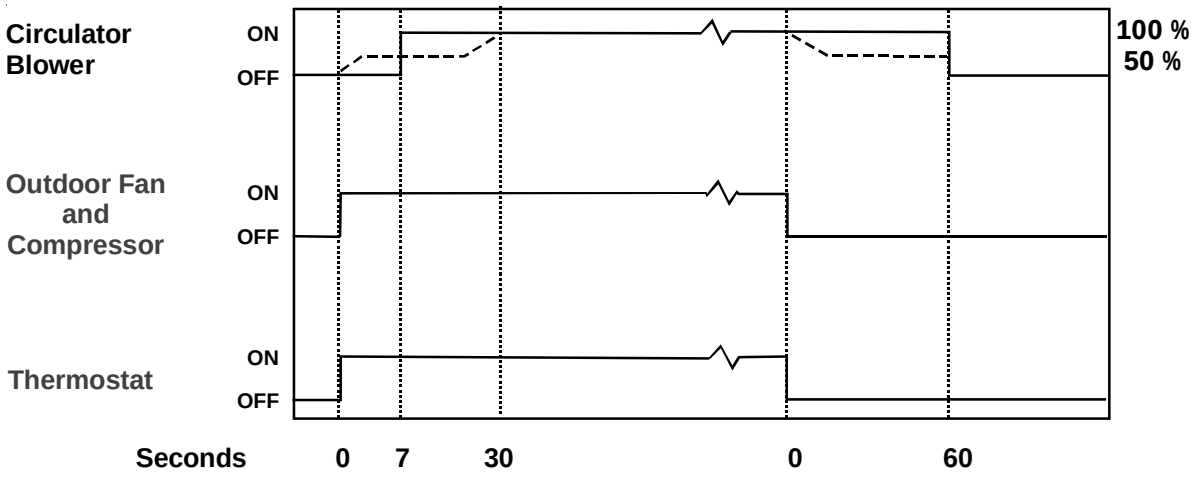
Heating Timing Chart



Legend: —— **[APG/GPG]10,12,24-60, [A/G]PG1324-42**

------- **[APG/GPG]1348,60**

COOLING TIMING CHART



Legend: —— **[APG/GPG]10,12,24-60, *PG1324-42**

------- **[APG/GPG]1348,60**

SCHEDULED MAINTENANCE

Package gas units requires regularly scheduled maintenance to preserve high performance standards, prolong the service life of the equipment, and lessen the chances of costly failure.

In many instances the owner may be able to perform some of the maintenance; however, the advantage of a service contract, which places all maintenance in the hands of a trained serviceman, should be pointed out to the owner.

⚠ WARNING

HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

ONCE A MONTH

1. Inspect the return filters of the evaporator unit and clean or change if necessary. **NOTE:** Depending on operation conditions, it may be necessary to clean or replace the filters more often. If permanent type filters are used, they should be washed with warm water and dried.
2. When operating on the cooling cycle, inspect the condensate line piping from the evaporator coil. Make sure the piping is clear for proper condensate flow.

ONCE A YEAR

Qualified Service Personnel Only

1. Clean the indoor and outdoor coils.
2. Clean the cabinet inside and out .
3. Motors are permanently lubricated and do not require oiling. TO AVOID PREMATURE MOTOR FAILURE, DO NOT OIL.
4. Manually rotate the outdoor fan and indoor blower to be sure they run freely.
5. Inspect the control panel wiring, compressor connections, and all other component wiring to be sure all connections are tight. Inspect wire insulation to be certain that it is good.
6. Check the contacts of the compressor contactor. If they are burned or pitted, replace the contactor.
7. Using a halide or electronic leak detector, check all piping and etc. for refrigerant leaks.
8. Check the combustion chamber (Heat Exchanger) for soot, scale, etc. Inspect all burners for lint and proper positioning.
9. Start the system, using the proper instrumentation check gas inlet and manifold pressures, burner flame and microamp signal. Adjust if necessary.
10. Start the system and run a Heating Performance Test. If the results of the test are not satisfactory, see the "Service Problem Analysis" Guide for the possible cause.

TEST EQUIPMENT

Proper test equipment for accurate diagnosis is as essential as regular hand tools.

The following is a must for every service technician and service shop:

1. Thermocouple type temperature meter - measure dry bulb temperature.
2. Sling psychrometer- measure relative humidity and wet bulb temperature.
3. Amprobe - measure current.
4. Volt-Ohm Meter - testing continuity, capacitors, motor windings and voltage.
5. Accurate Leak Detector - testing for refrigerant leaks.
6. High Vacuum Pump - evacuation.
7. Electric Vacuum Gauge, Manifold Gauges and high vacuum hoses - to measure and obtain proper vacuum.
8. Accurate Charging Cylinder or Electronic Scale - measure proper refrigerant charge.
9. Inclined Manometer - measure static pressure and pressure drop across coils.

Other recording type instruments can be essential in solving abnormal problems, however, in many instances they may be rented from local sources.

Proper equipment promotes faster, more efficient service, and accurate repairs with less call backs.

HEATING PERFORMANCE TEST

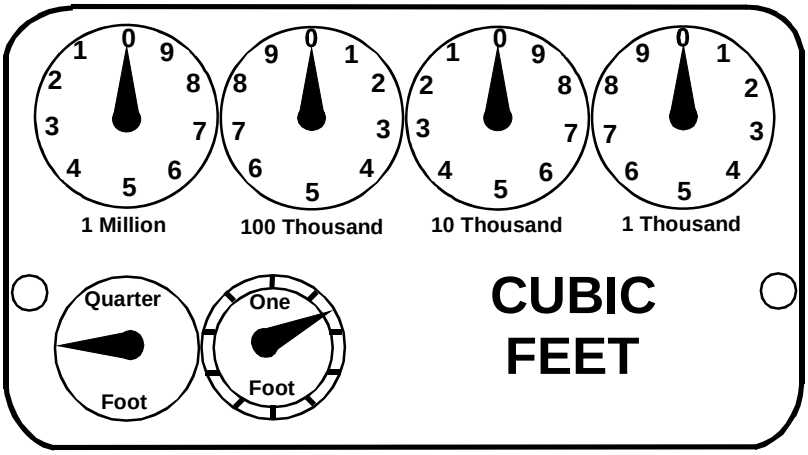
Before attempting to diagnose an operating fault, run a Heating Performance Test and apply the results to the Service Problem Analysis Guide.

To conduct a heating performance test, the BTU input to the package gas unit must be calculated.

After the heating cycle has been in operation for at least fifteen minutes and with all other gas appliances turned off, the gas meter should be clocked.

To find the BTU input, multiply the number of cubic feet of gas consumed per hour by the heating value of the gas being used. (The calorific value of the gas being used is found by contacting your local utility.)

SCHEDULED MAINTENANCE



GAS RATE -- CUBIC FEET PER HOUR

Seconds for One Revolution	Size of Test Dial 1/4 cu/ft	1/2 cu/ft	1 cu/ft	2 cu/ft	5 cu/ft	Seconds for One Revolution	Size of Test Dial 1/4 cu/ft	1/2 cu/ft	1 cu/ft	2 cu/ft	5 cu/ft
10	90	180	360	720	1800	36	25	50	100	200	500
11	82	164	327	655	1636	37	--	--	97	195	486
12	75	150	300	600	1500	38	23	47	95	189	474
13	69	138	277	555	1385	39	--	--	92	185	462
14	64	129	257	514	1286	40	22	45	90	180	450
15	60	120	240	480	1200	41	--	--	--	176	439
16	56	113	225	450	1125	42	21	43	86	172	429
17	53	106	212	424	1059	43	--	--	--	167	419
18	50	100	200	400	1000	44	--	41	82	164	409
19	47	95	189	379	947	45	20	40	80	160	400
20	45	90	180	360	900	46	--	--	78	157	391
21	43	86	171	343	857	47	19	38	76	153	383
22	41	82	164	327	818	48	--	--	75	150	375
23	39	78	157	313	783	49	--	--	--	147	367
24	37	75	150	300	750	50	18	36	72	144	360
25	36	72	144	288	720	51	--	--	--	141	355
26	34	69	138	277	692	52	--	--	69	138	346
27	33	67	133	265	667	53	17	34	--	136	340
28	32	64	129	257	643	54	--	--	67	133	333
29	31	62	124	248	621	55	--	--	--	131	327
30	30	60	120	240	600	56	16	32	64	129	321
31	--	--	116	232	581	57	--	--	--	126	316
32	28	56	113	225	563	58	--	31	62	124	310
33	--	--	109	218	545	59	--	--	--	122	305
34	26	53	106	212	529	60	15	30	60	120	300
35	--	--	103	206	514						

Example:

It takes forty (40) seconds on the gas meter for the hand on the cubic foot dial to make one complete revolution, with all appliances off, except the unit. Using the gas rate chart, observe the forty (40) seconds, locate and read across to the one (1) cubic foot dial column. There you will find the number 90, which shows that ninety (90) cubic feet of gas will be consumed in one (1) hour.

Let's assume the local gas utility has stated that the calorific value of the gas is 1025 BTU per cubic foot.

Multiplying the ninety (90) cubic feet by 1025 BTU/ft^3 gives us an input of 92,250 BTU/hr.

Checking the BTU input on the rating plate of the unit being tested.

EXAMPLE: APG10300901A

INPUT: 92,000 BTU/HR

OUTPUT CAP: 72,900 BTU/HR

Should the figure you calculated not fall within five (5) percent of the nameplate rating of the unit, adjust the gas valve pressure regulator or resize orifices. **In no case should the input exceed that shown on the rating plate.**

⚠ CAUTION

ALWAYS CONNECT A MANOMETER TO THE 1/8" PIPE TAP AT THE GAS VALVE BEFORE ADJUSTING THE PRESSURE REGULATOR. IN NO CASE SHOULD THE FINAL MANIFOLD PRESSURE VARY MORE THAN PLUS OR MINUS .3 INCHES WATER COLUMN FROM 3.5 INCHES WATER COLUMN FOR NATURAL GAS OR 10 INCHES WATER COLUMN FOR PROPANE GAS.

To adjust the pressure regulator on the gas valve, turn down (clockwise) to increase pressure and input, and out (counterclockwise) to decrease pressure and input.

Since propane gas is not normally installed with a gas meter, clocking will be virtually impossible. The gas orifices used with propane are calculated for 2500 BTU gas per cubic foot and with proper inlet pressures and correct piping size, full capacity will be obtained.

With propane gas, no unit gas valve regulator is used; however, the second stage supply line pressure regulator should be adjusted to give 11" water column with all other gas consuming appliances running.

The dissipation of the heat transferred to the heat exchanger is now controlled by the amount of air circulated over its surface.

The flow rate (CFM) of air circulated is governed by the external static pressure in inches of water column of duct work, cooling coil, registers and etc., applied externally to the unit versus the motor speed tap.

A properly operating unit must have the BTU input and flow rate (CFM) of air, within the limits shown to prevent short cycling of the equipment. As the external static pressure goes up, the temperature rise will also increase. Consult the proper tables for temperature rise limitation.

COOLING - SERVICE ANALYSIS GUIDE

Complaint	No Cooling							Unsatisfactory Cooling						System Operating Pressures				Test Method Remedy	See Service Procedure Ref.
POSSIBLE CAUSE DOTS IN ANALYSIS GUIDE INDICATE "POSSIBLE CAUSE" SYMPTOM	System will not start	Compressor will not start - fan runs	Comp. and Cond. Fan will not start	Evaporator fan will not start	Condenser fan will not start	Compressor runs - goes off on overload	Compressor cycles on overload	System runs continuously - little cooling	Too cool and then too warm	Not cool enough on warm days	Certain areas too cool, others too warm	Compressor won't shift to high stage cooling	Compressor is noisy	Low suction pressure	Low head pressure	High suction pressure	High head pressure		
Power Failure	●																	Test Voltage	S-1
Blown Fuse	●		●	●														Inspect Fuse Size & Type	S-1
Loose Connection	●		●	●	●	●												Inspect Connection - Tighten	S-2, S-3
Shorted or Broken Wires	●	●	●	●	●	●												Test Circuits With Ohmmeter	S-2,S-3
Open Overload		●		●	●	●												Test Continuity of Overload	S-16A, S-17A
Faulty Thermostat	●								●									Test continuity of Thermostat & Wiring	S-3
Faulty Transformer	●		●															Check control circuit with voltmeter	S-4
Shorted or Open Capacitor		●		●	●	●												Test Capacitor	S-15
Shorted or Grounded Compressor		●				●												Test Motor Windings	S-17B
Unloader Solenoid								●		●		●						Test unloader operation	S-17C
Compressor Stuck	●	●				●												Use Test Cord	S-17D
Faulty Compressor Contactor	●		●		●	●												Test continuity of Coil & Contacts	S-7, S-8
Faulty Fan Relay				●														Test continuity of Coil And Contacts	S-7
Open Control Circuit			●	●	●													Test Control Circuit with Voltmeter	S-4
Low Voltage		●				●	●											Test Voltage	S-1
Faulty Evap. Fan Motor				●										●				Repair or Replace	S-16A
Shorted or Grounded Fan Motor					●												●	Test Motor Windings	S-16A
Improper Cooling Anticipator							●		●									Check resistance of Anticipator	S-3B
Shortage of Refrigerant							●	●						●	●			Test For Leaks, Add Refrigerant	S-101, 103
Restricted Liquid Line							●	●						●	●			Remove Restriction, Replace Restricted Part	S-112
Dirty Air Filter								●		●	●			●				Inspect Filter-Clean or Replace	
Dirty Indoor Coil								●		●	●			●				Inspect Coil - Clean	
Not enough air across Indoor Coil								●		●	●			●				Check Blower Speed, Duct Static Press, Filter	S-200
Too much air across Indoor Coil																●		Reduce Blower Speed	S-200
Overcharge of Refrigerant						●	●						●			●	●	Recover Part of Charge	S-113
Dirty Outdoor Coil						●	●			●							●	Inspect Coil - Clean	
Noncondensibles							●			●							●	Recover Charge, Evacuate, Recharge	S-114
Recirculation of Condensing Air							●			●							●	Remove Obstruction to Air Flow	
Infiltration of Outdoor Air								●		●	●							Check Windows, Doors, Vent Fans, Etc.	
Improperly Located Thermostat						●			●									Relocate Thermostat	
Air Flow Unbalanced									●		●							Readjust Air Volume Dampers	
System Undersized								●		●								Refigure Cooling Load	
Broken Internal Parts													●					Replace Compressor	S-115
Inefficient Compressor								●							●	●		Test Compressor Efficiency	S-104
Unbalanced Power, 3PH		●				●	●											Test Voltage	S-1
Wrong Type Expansion Valve						●	●	●		●				●	●			Replace Valve	S-110
Expansion Device Restricted						●	●	●		●				●	●			Remove restriction or replace expansion device	S-110
Expansion Valve Bulb Loose													●					Tighten Bulb Bracket	S-105
Inoperative Expansion Valve						●		●						●				Check Valve Operation	S-110
Loose Hold-down Bolts													●					Tighten Bolts	
Flowrator Not Seating Properly								●							●	●		Check Flowrator & Seat or Replace Flowrator	S-111

GAS HEATING - SERVICE ANALYSIS GUIDE

Complaint	No Heat			Unsatisfactory Heat						Test Method Remedy	See Service Procedure Reference
POSSIBLE CAUSE **DOTS IN ANALYSIS GUIDE INDICATE "POSSIBLE CAUSE"** **SYMPTOM**	System Will Not Start	Burner Won't Ignite	Burner Ignites-Locks Out	Burner Shuts Off prior to T'Stat being Satasfied	Short Cycles	Long Cycles	Soot and /or Fumes	To Much Heat	Not Enough Heat		
Power Failure	●									Test Voltage	S-1
Blown Fuse	●									Test Voltage	S-1
Loose Connection	●	●								Check Wiring	S-2, S-3
Shorted or Broken Wires	●	●								Check Wiring	S-2, S-3
No Low Voltage	●									Check Transformer	S-4
Faulty Thermostat	●				●	●		●		Check Thermostat	S-3
Faulty Transformer	●									Check Transformer	S-4
Poor or High Resistance Ground			●							Measure Ground Resistance	S-313
Improper Heat Anticipator Setting					●	●		●	●	Adjust Heat Anticipator Setting	S-3
Improper Thermostat Location					●	●		●	●	Relocate Thermostat	
Faulty Limit or Roll Out Switch		●		●						Test Control	S-300-302
Faulty Flame Sensor			●							Test Flame Sensor	S-314
Faulty Ignition Control	●	●	●							Test Control	S-313
Gas Valve or Gas Supply Shut Off		●								Turn Valves to On Position	S-304
Faulty Induced Draft Blower	●	●					●			Test Blower	S-303
Dirty Flame Sensor, Low uA			●							Clean Flame Sensor	S-314
Flame Sensor not in Flame, Low uA			●							Test/Adjust Position of Flame Sensor	S-314
Faulty Gas Valve		●					●		●	Replace Gas Valve	S-304
Open Auxillary Limit		●	●	●						Check Airflow	S-200, 201 S-300, 301
Improper Air Flow or Distribution				●				●	●	Check Duct Static	S-200
Locking out on Main Limit			●	●					●	Check Limit, Gas Press., & Temp. Rise	S-300, 307, 201
Delayed Ignition							●			Test for Delayed Ignition	S-308
Flashback							●			Test for Flashback	S-309
Orifice Size							●	●	●	Check Orifices	S-306
Gas Pressure		●					●	●	●	Check Gas Pressure	S-307
Cracked Heat Exchanger							●			Check Burner Flames	S-302
Stuck Gas Valve		●					●	●		Replace Gas Valve	S-304
Unit Undersized						●			●	Replace with Proper Size Unit	
Faulty Pressure Switch		●	●	●						Test Pressure Switch	S-310
Blocked or Restricted Flue		●					●			Check Flue/Drawdown Pressure	S-310
Open Roll Out Switch		●	●							Test Control	S-302
Bouncing On Pressure Switch		●	●	●						Test Negative Pressure, Flue Blockage	S-310
Unit Oversized					●			●		Replace with Proper Size Unit	

SERVICING

S-1 CHECKING VOLTAGE

⚠ WARNING
HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

1. Remove doors, control panel cover, etc. from unit being tested.

With power ON:

⚠ WARNING
LINE VOLTAGE NOW PRESENT.

2. Using a voltmeter, measure the voltage across terminals L1 and L2 of the contactor for single phase units, and L3, for 3 phase units.
3. No reading - indicates open wiring, open fuse(s) no power or etc. from unit to fused disconnect service. Repair as needed.
4. With ample voltage at line voltage connectors, energize the unit.
5. Measure the voltage with the unit starting and operating, and determine the unit Locked Rotor Voltage.

   Locked Rotor Voltage is the actual voltage available at the compressor during starting, locked rotor, or a stalled condition. Measured voltage should be above minimum listed in chart below.

   To measure Locked Rotor Voltage attach a voltmeter to the run "R" and common "C" terminals of the compressor, or to the T_1 and T_2 terminals of the contactor. Start the unit and allow the compressor to run for several seconds, then shut down the unit. Immediately attempt to restart the unit while measuring the Locked Rotor Voltage.
6. Voltmeter should read within the voltage tabulation as shown. If the voltage falls below the minimum voltage, check the line wire size. Long runs of undersized wire can cause low voltage. If wire size is adequate, notify the local power company in regards to either low or high voltage.

Unit Supply Voltage		
Voltage	Min.	Max.
460	437	506
208/230	198	253

Three phase units require a balanced 3 phase power supply to operate. If the percentage of voltage imbalance exceeds 3% the unit must not be operated until the voltage condition is corrected.

$$\text{\% Voltage Imbalance} = \frac{\text{Max. Voltage Deviation From Average Voltage}}{\text{Average Voltage}} \times 100$$

To find the percentage of imbalance, measure the incoming power supply.

L1 - L2 = 240V
L1 - L3 = 232V
L2 - L3 = 238V
Total 710V

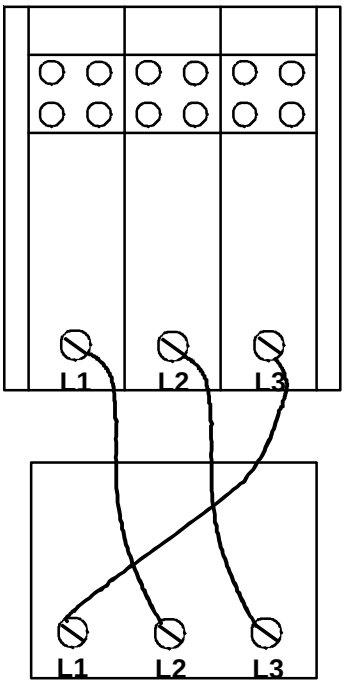
Avg. V = 710 / 3 = **236.7**

To find Max. deviation:
240 - 236.7 = +3.3
232 - 236.7 = **-4.7**
238 - 236.7 = +1.3

Max deviation was 4.7V

% Voltage Imbalance = 4.7 / 236.7 = **1.99%**

If the percentage of imbalance had exceeded 3%, it must be determined if the imbalance is in the incoming power supply or the equipment. To do this rotate the legs of the incoming power and retest voltage as shown below.



L1 - L2 = 240V
L1 - L3 = 227V
L2 - L3 = 238V

Rotate all 3 incoming legs as shown.

L1 - L2 = 227V
L1 - L3 = 238V
L2 - L3 = 240V

SERVICING

By the voltage readings we see that the imbalance rotated or traveled with the switching of the incoming legs. Therefore the imbalance lies within the incoming power supply.

If the imbalance had not changed then the problem would lie within the equipment. Check for current leakage, shorted motors, etc.

S-2 CHECKING WIRING

WARNING
HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

1. Check wiring visually for signs of overheating, damaged insulation and loose connections.
2. Use an ohmmeter to check continuity of any suspected open wires.
3. If any wires must be replaced, replace with comparable gauge and insulation thickness.

S-3 CHECKING THERMOSTAT, WIRING, AND ANTICIPATOR

S-3A Thermostat and Wiring

WARNING
LINE VOLTAGE NOW PRESENT.

With power ON and thermostat calling for cooling.

1. Use a voltmeter to check for 24 volts at thermostat wires C and Y.
2. No voltage indicates trouble in the thermostat, wiring or external transformer source.
3. Check the continuity of the thermostat and wiring. Repair or replace as necessary.

Indoor Blower Motor

With power ON:

WARNING
LINE VOLTAGE NOW PRESENT.

1. Set fan selector switch at thermostat to "ON" position.
2. With voltmeter, check for 24 volts at wires C and G.
3. No voltage, indicates the trouble is in the thermostat or wiring.
4. Check the continuity of the thermostat and wiring. Repair or replace as necessary.

S-3B Cooling Anticipator

The cooling anticipator is a small heater (resistor) in the thermostat. During the "off" cycle it heats the bimetal element helping the thermostat call for the next cooling cycle. This prevents the room temperature from rising too high before the system is restarted. A properly sized anticipator should maintain room temperature within 1 1/2 to 2 degree range.

The anticipator is supplied in the thermostat and is not to be replaced. If the anticipator should fail for any reason, the thermostat must be changed.

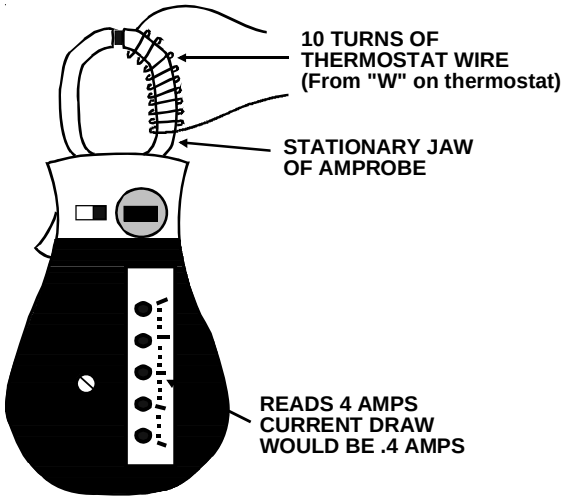
S-3C Heating Anticipator

The heating anticipator is a wire-wound adjustable heater, which is energized during the "ON" cycle to help prevent overheating of the conditioned space.

The anticipator is a part of the thermostat and if it should fail for any reason, the thermostat must be replaced. See the following for recommended heater anticipator setting.

To determine the proper setting, use an ammeter to measure the current on the "W" wire going to the thermostat.

Use an amprobe as shown below. Wrap 10 turns of thermostat wire around the stationary jaw of the amprobe and divide the reading by 10.



Checking Heat Anticipator Amp Draw

S-4 CHECKING TRANSFORMER AND CONTROL CIRCUIT

A step-down transformer (208/240 volt primary to 24 volt secondary) is provided with each package unit. This allows ample capacity for use with resistance heaters.

WARNING
HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

SERVICING

1. Remove control panel cover or etc. to gain access to transformer.

With power ON:

WARNING

LINE VOLTAGE NOW PRESENT.

2. Using a voltmeter, check voltage across secondary voltage side of transformer (R to C).
3. No voltage indicates faulty transformer, bad wiring, or bad splices.
4. Check transformer primary voltage at incoming line voltage connections and/or splices.
5 If line voltage is present at the primary voltage side of the transformer and 24 volts is not present on the secondary side, then the transformer is inoperative. Replace.

S-7 CHECKING CONTACTOR AND/OR RELAYS

The compressor contactor and other relay holding coils are wired into the low or line voltage circuits. When the control circuit is energized the coil pulls in the normally open contacts or opens the normally closed contacts. When the coil is de-energized, springs return the contacts to their normal position.

1. Remove the leads from the holding coil.
2. Using an ohmmeter, test across the coil terminals.

If the coil does not test continuous, replace the relay or contactor.

S-8 CHECKING CONTACTOR CONTACTS

SINGLE PHASE

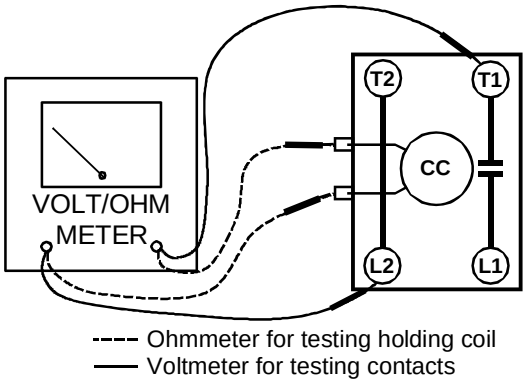
WARNING

HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

1. Disconnect the wire leads from the terminal (T) side of the contactor.
2. With power ON, energize the contactor.

WARNING

LINE VOLTAGE NOW PRESENT.



TESTING COMPRESSOR CONTACTOR (Single Phase)

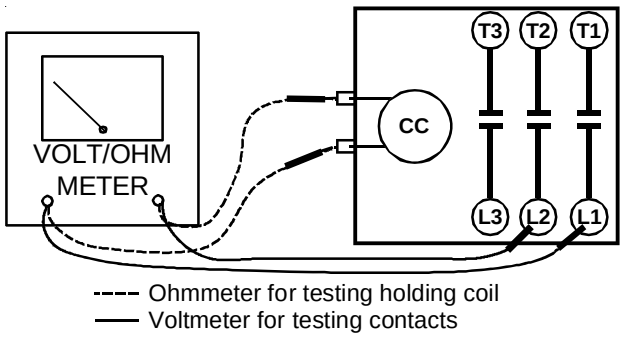
3. Using a voltmeter, test across terminals.
   A. L1 - L2 - No voltage. Check breaker or fuses on main power supply.
   B. L2 - T1 - No voltage indicates CC1 contacts open.

If a no voltage reading is obtained - replace the contactor.

THREE PHASE

Using a voltmeter, test across terminals.

A. L1-L2, L1-L3, and L2-L3 - If voltage is present, proceed to B. If voltage is not present, check breaker or fuses on main power supply..
B. T1-T2, T1-T3, and T2-T3 - If voltage readings are not the same as in "A", replace contactor.



TESTING COMPRESSOR CONTACTOR (ThreePhase)

S-9 CHECKING FAN RELAY CONTACTS

The fan relays are incorporated into the control board. See section S-313 for checking control board.

SERVICING

S-15 CHECKING CAPACITOR

CAPACITOR, RUN

A run capacitor is wired across the auxiliary and main windings of a single phase permanent split capacitor motor. The capacitors primary function is to reduce the line current while greatly improving the torque characteristics of a motor. This is accomplished by using the 90° phase relationship between the capacitor current and voltage in conjunction with the motor windings so that the motor will give two phase operation when connected to a single phase circuit. The capacitor also reduces the line current to the motor by improving the power factor.

CAPACITOR, START

SCROLL COMPRESSOR MODELS

Hard start components are not required on Scroll compressor equipped units due to a non-replaceable check valve located in the discharge line of the compressor. However hard start kits are available and may improve low voltage starting characteristics.

This check valve closes off high side pressure to the compressor after shut down allowing equalization through the scroll flanks. Equalization requires only about one or two seconds during which time the compressor may turn backwards.

Your unit comes with a 180-second anti-short cycle to prevent the compressor from starting and running backwards.

MODELS EQUIPPED WITH A HARD START DEVICE

A start capacitor is wired in parallel with the run capacitor to increase the starting torque. The start capacitor is of the electrolytic type, rather than metallized polypropylene as used in the run capacitor.

A switching device must be wired in series with the capacitor to remove it from the electrical circuit after the compressor starts to run. Not removing the start capacitor will overheat the capacitor and burn out the compressor windings.

These capacitors have a 15,000 ohm, 2 watt resistor wired across its terminals. The object of the resistor is to discharge the capacitor under certain operating conditions, rather than having it discharge across the closing of the contacts within the switching device such as the Start Relay, and to reduce the chance of shock to the servicer. See the Servicing Section for specific information concerning capacitors.

RELAY, START

A potential or voltage type relay is used to take the start capacitor out of the circuit once the motor comes up to speed. This type of relay is position sensitive. The normally closed contacts are wired in series with the start capacitor and the relay holding coil is wired parallel with the start winding. As the motor starts and comes up to speed, the increase in voltage across the start winding will energize the start relay holding coil and open the contacts to the start capacitor.

Two quick ways to test a capacitor are a resistance and a capacitance check.

S-15A Resistance Check

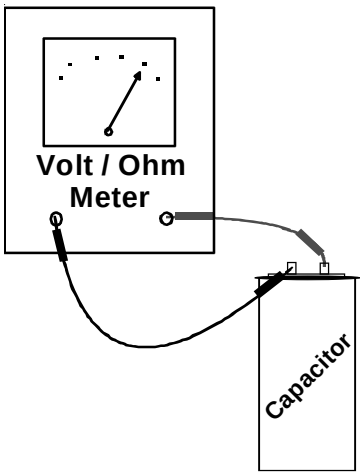
WARNING

HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

1. Discharge capacitor and remove wire leads.

WARNING

DISCHARGE CAPACITOR THROUGH A 20 TO 30 OHM RESISTOR BEFORE HANDLING.



TESTING CAPACITOR RESISTANCE

2. Set an ohmmeter on its highest ohm scale and connect the leads to the capacitor -

   A. Good Condition - indicator swings to zero and slowly returns to infinity. (Start capacitor with bleed resistor will not return to infinity. It will still read the resistance of the resistor).

   B. Shorted - indicator swings to zero and stops there - replace.

   C. Open - no reading - replace. (Start capacitor would read resistor resistance).

S-15B Capacitance Check

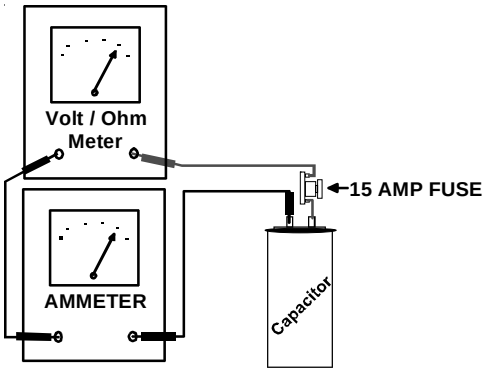
Using a hookup as shown below, take the current and voltage readings and use them in the formula:

WARNING

DISCHARGE CAPACITOR THROUGH A 20 TO 30 OHM RESISTOR BEFORE HANDLING.

$$\text{Capacitance (MFD)} = \frac{2650 \times \text{Current}}{\text{Voltage}}$$

SERVICING



TESTING CAPACITANCE

S-16A CHECKING FAN AND BLOWER MOTOR WINDINGS (PSC MOTORS)

The auto reset fan motor overload is designed to protect the motor against high temperature and high current conditions by breaking the common circuit within the motor, similar to the compressor internal overload. However, heat generated within the motor is faster to dissipate than the compressor, allow at least 45 minutes for the overload to reset, then retest.

WARNING

HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

1. Remove the motor leads from its respective connection points and capacitor (if applicable).
2. Check the continuity between each of the motor leads.
3. Touch one probe of the ohmmeter to the motor frame (ground) and the other probe in turn to each lead.

If the windings do not test continuous or a reading is obtained from lead to ground, replace the motor.

S-16B CHECKING FAN AND BLOWER MOTOR (ECM MOTORS)

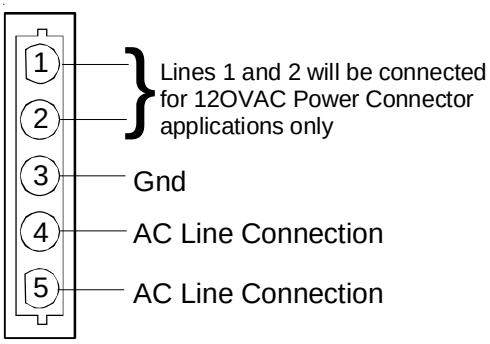
An ECM (*Electronically Commutated Motor)* has near zero rotor loss, synchronous machine operation, variable speed, low noise and programmable air flow. The ECM motor stator contains a permanent magnet which results in the shaft feeling "rough" when turned by hand. This is a characteristic of the motor, not an indication of defective bearings. An ECM motor requires power (line voltage) and a signal (24 volts) to operate. Use an ECM motor tester (GE Techmate or equivalent) with a VOM meter to perform basic troubleshooting on ECM motors.

WARNING

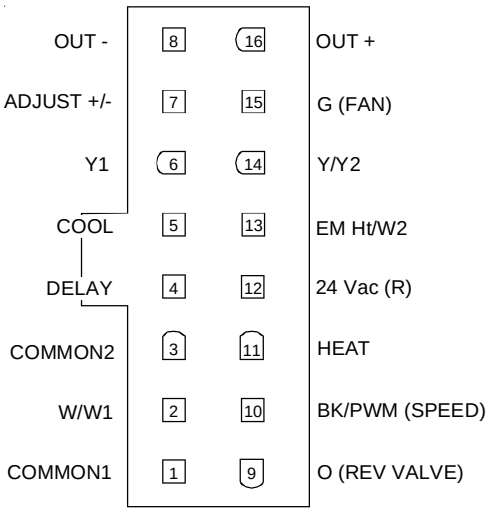
LINE VOLTAGE NOW PRESENT.

1. Disconnect the 5-pin connector from the motor.
2. Using a volt meter, check for line voltage at terminals #4 and #5 at the power connector. If no voltage is present, proceed to step 3. If voltage is present, skip to step 5.
3. Check the unit for incoming power. See section S-1.
4. Check the control board, See section S-313.
5. If line voltage is present, reinsert the 5-pin connector and remove the 16-pin connector.
6. Check for signal (24 volts) at the transformer.
7. Using an ohmmeter, check for continuity from the #1 & #3 (common pins) to the transformer neutral or "C" thermostat terminal. If you do not have continuity, the motor may function erratically. Trace the common circuits, locate and repair the open neutral.
8. Set the thermostat to "Fan-On". Using a voltmeter, check for 24 volts between pin # 15 (G) and pins #1 or #3 (common).
9. Disconnect power to compressor. Set thermostat to call for cooling. Using a voltmeter, check for 24 volts at pin # 6 and/or #14, and pins #1 and/or #3 (common).
10. Set the thermostat to a call for heating. Using a voltmeter, check for 24 volts at pin #2 and/or #13, and pins #1 and/or #3 (common).

If you do not read voltage and continuity as described, the problem is in the control or interface board, but not the motor. If you register voltage as described, the ECM power head is defective and must be replaced.



5 PIN POWER CONNECTOR



16-PIN ECM HARNESS CONNECTOR

Troubleshooting Chart for ECM Variable Speed Air Circulator Blower Motors

Symptom	Fault Description(s)	Possible Causes	Corrective Action	Cautions and Notes
- Motor rocks slightly when starting.	- This is normal start-up for variable speed motor.	----	----	----
- Motor won't start.	- No movement.	- Manual disconnect switch off or door switch open. - Blown fuse or circuit breaker. - 24 Vac wires miswired. - Unseated pins in wiring harness connectors. - Bad motor/control module. - Moisture present in motor or control module.	- Check 230 Vac power at motor. - Check low voltage (24 Vac R to C) at motor. - Check low voltage connections (G, Y, W, R, C) at motor. - Check for unseated pins in connectors on motor harness. - Test with a temporary jumper between R - G. - Check m	- Turn power OFF prior to repair. Wait 5 minutes after disconnecting power before opening motor. - Handle electronic motor/control with care.
	- Motor rocks, but won't start.	- Loose motor mount. - Blower wheel not tight on motor shaft. - Bad motor/control module.	- Check for loose motor mount. - Make sure blower wheel is tight on shaft. - Perform motor/control replacement check, ECM motors only.	- Turn power OFF prior to repair. Wait 5 minutes after disconnecting power before opening motor. - Handle electronic motor/control with care.
- Motor oscillates up & down while being tested off of blower.	- It is normal for motor to oscillate with no load on shaft.	----	----	----
- Motor starts, but runs erratically.	- Varies up and down or intermittent.	- Variation in 230 Vac to motor. - Unseated pins in wiring harness connectors. - Erratic CFM command from "BK" terminal. - Improper thermostat connection or setting. - Moisture present in motor/control module.	- Check line voltage for variation or "sag". - Check low voltage connections (G, Y, W, R, C) at motor, unseated pins in motor harness connectors. - Check-out system controls - Thermostat. - Perform Moisture Check.*	- Turn power OFF prior to repair.
	- "Hunts" or "puffs" at high CFM (speed).	- Incorrect or dirty filter(s). - Incorrect supply or return ductwork. - Incorrect blower speed setting.	- Does removing panel or filter reduce "puffing"? - Check/replace filter. - Check/correct duct restrictions. - Adjust to correct blower speed setting.	- Turn power OFF prior to repair.
	- Stays at low CFM despite system call for cool or heat CFM.	- 24 Vac wires miswired or loose. - "R" missing/not connected at motor. - Fan in delay mode.	- Check low voltage (Thermostat) wires and connections. - Verify fan is not in delay mode - wait until delay complete. - Perform motor/control replacement check, ECM motors only.	- Turn power OFF prior to repair. Wait 5 minutes after disconnecting power before opening motor. - Handle electronic motor/control with care.
	- Stays at high CFM.	- "R" missing/not connected at motor. - Fan in delay mode.	- Is fan in delay mode? - wait until delay time complete. - Perform motor/control replacement check, ECM motors only.	- Turn power OFF prior to repair. Wait 5 minutes after disconnecting power before opening motor. - Handle electronic motor/control with care.
	- Blower won't shut off.	- Current leakage from controls into G, Y, or W.	- Check for Triac switched t'stat or solid state relay.	- Turn power OFF prior to repair.
- Excessive noise.	- Air noise.	- High static creating high blower speed. - Incorrect supply or return ductwork. - Incorrect or dirty filter(s). - Incorrect blower speed setting.	- Check/replace filter. - Check/correct duct restrictions. - Adjust to correct blower speed setting.	- Turn power OFF prior to repair.
	- Noisy blower or cabinet.	- Loose blower housing, panels, etc. - High static creating high blower speed. - Air leaks in ductwork, cabinets, or panels.	- Check for loose blower housing, panels, etc. - Check for air whistling thru seams in ducts, cabinets or panels. - Check for cabinet/duct deformation.	- Turn power OFF prior to repair.
	- "Hunts" or "puffs" at high CFM (speed).	- High static creating high blower speed. - Incorrect or dirty filter(s). - Incorrect supply or return ductwork. - Incorrect blower speed setting.	- Does removing panel or filter reduce "puffing"? - Check/replace filter. - Check/correct duct restrictions. - Adjust to correct blower speed setting.	- Turn power OFF prior to repair.
- Evidence of Moisture.	- Motor failure or malfunction has occurred and moisture is present.	- Moisture in motor/control module.	- Replace motor and perform Moisture Check.*	- Turn power OFF prior to repair. Wait 5 minutes after disconnecting power before opening motor. - Handle electronic motor/control with care.

***Moisture Check**

- Connectors are oriented "down" (or as recommended by equipment manufacturer).
- Is condensate drain plugged?
- Check for undercharged condition.
- Arrange harnesses with "drip loop" under motor.
- Check for low airflow (too much latent capacity).
- Check and plug leaks in return ducts, cabinet.

Note: You must use the correct replacement control/motor module since they are factory programmed for specific operating modes. Even though they look alike, different modules may have completely different functionality. The ECM variable speed motors are c

Important Note: Using the wrong motor/control module voids all product warranties and may produce unexpected results.

SERVICING

ECM VARIABLE SPEED CIRCULATOR BLOWER MOTORS	
DO	**DON'T**
- Check-out motor, controls, wiring, and connections before replacing motor.	- Automatically assume the motor is bad.
- Orient connectors down to prevent water infiltration. - Install "drip loops".	- Locate connectors above 7 and 4 o'clock positions.
- Use authorized motor and control model #'s for replacement.	- Replace one motor or control model # with another (unless an authorized replacement).
- Keep static pressure to a minimum: - Recommend high efficiency, low static filters. - Recommend keeping filters clean. - Design ductwork for min. static, max comfort. - Look for and recommend ductwork improvement, where necessary, in replacement.	- Use high pressure drop filters - some have 1/2" H2O drop! - Use restricted returns.
- Size the equipment wisely.	- Oversize system then compensate with low airflow.
- Check orientation before inserting motor connectors.	- Plug in power connector backwards. - Force plugs.

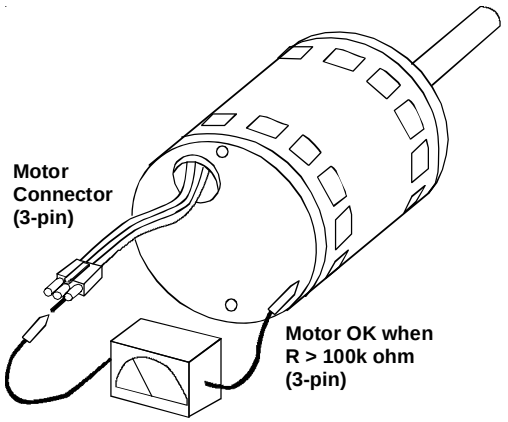
SERVICING

S-16C CHECKING ECM MOTOR WINDINGS

⚠ WARNING

HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

1. Disconnect the 5-pin and the 16-pin connectors from the ECM power head.
2. Remove the 2 screws securing the ECM power head and separate it from the motor.
3. Disconnect the 3-pin motor connector from the power head and lay it aside.
4. Using an ohmmeter, check the motor windings for continuity to ground (pins to motor shell). If the ohmmeter indicates continuity to ground, the motor is defective and must be replaced.
5. Using an ohmmeter, check the windings for continuity (pin to pin). If no continuity is indicated, the thermal limit (over load) device may be open. Allow motor to cool and retest.



WINDING TEST

S-17 CHECKING COMPRESSOR WINDINGS

⚠ WARNING

HERMETIC COMPRESSOR ELECTRICAL TERMINAL VENTING CAN BE DANGEROUS. WHEN INSULATING MATERIAL WHICH SUPPORTS A HERMETIC COMPRESSOR OR ELECTRICAL TERMINAL SUDDENLY DISINTEGRATES DUE TO PHYSICAL ABUSE OR AS A RESULT OF AN ELECTRICAL SHORT BETWEEN THE TERMINAL AND THE COMPRESSOR HOUSING, THE TERMINAL MAY BE EXPELLED, VENTING THE VAPOR AND LIQUID CONTENTS OF THE COMPRESSOR HOUSING AND SYSTEM.

If the compressor terminal PROTECTIVE COVER and gasket (if required) is not properly in place and secured, there is a remote possibility if a terminal vents, that the vaporous and liquid discharge can be ignited, spouting flames several feet, causing potentially severe or fatal injury to anyone in its path.

This discharge can be ignited external to the compressor if the terminal cover is not properly in place and if the discharge impinges on a sufficient heat source.

Ignition of the discharge can also occur at the venting terminal or inside the compressor, if there is sufficient contaminant air present in the system and an electrical arc occurs as the terminal vents.

Ignition cannot occur at the venting terminal without the presence of contaminant air, and cannot occur externally from the venting terminal without the presence of an external ignition source.

Therefore, proper evacuation of a hermetic system is essential at the time of manufacture and during servicing.

To reduce the possibility of external ignition, all open flame, electrical power, and other heat sources should be extinguished or turned off prior to servicing a system.

If the following test indicates shorted, grounded or open windings, see procedure S-19 for the next steps to be taken.

S-17A Resistance Test

Each compressor is equipped with an internal overload.

The line break internal overload senses both motor current and winding temperature. High motor temperature or current heats the disc causing it to open, breaking the common circuit within the compressor on single phase units. The three phase internal overload will open all three legs.

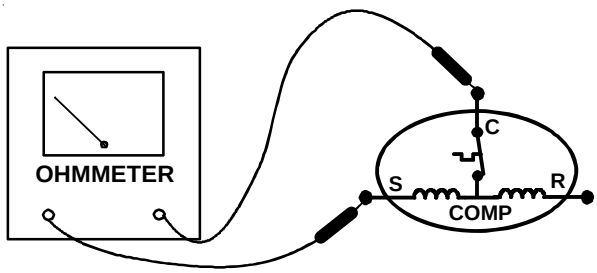
Heat generated within the compressor shell, usually due to recycling of the motor, high current or insufficient gas to cool the motor, is slow to dissipate, allow at least three to four hours for it to cool and reset, then retest.

1. Remove the leads from the compressor terminals.

⚠ WARNING

SEE WARNING S-17 BEFORE REMOVING COMPRESSOR TERMINAL COVER.

2. Using an ohmmeter, test continuity between terminals S-R, C-R, and C-S, on single phase units or terminals T1, T2 and T3, on 3 phase units.



TESTING COMPRESSOR WINDINGS

If either winding does not test continuous, replace the compressor.

NOTE: If an open compressor is indicated allow ample time for the internal overload to reset before replacing compressor.

S-17B Ground Test

If fuse, circuit breaker, ground fault protective device, etc., has tripped, this is a strong indication that an electrical problem exists and must be found and corrected. The circuit protective device rating must be checked and its maximum rating should coincide with that marked on the equipment nameplate.

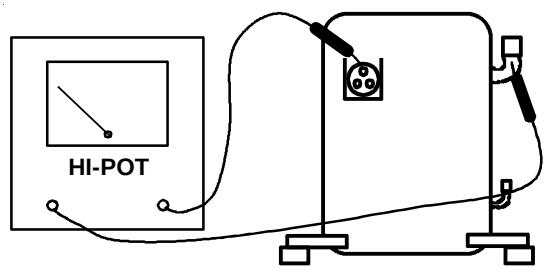
With the terminal protective cover in place, it is acceptable to replace the fuse or reset the circuit breaker ONE TIME ONLY to see if it was just a nuisance opening. If it opens again, DO NOT continue to reset.

Disconnect all power to unit, making sure that all power legs are open.

1. DO NOT remove protective terminal cover. Disconnect the three leads going to the compressor terminals at the nearest point to the compressor.

⚠ WARNING

DAMAGE CAN OCCUR TO THE GLASS EMBEDDED TERMINALS IF THE LEADS ARE NOT PROPERLY REMOVED. THIS CAN RESULT IN TERMINAL AND HOT OIL DISCHARGING.



COMPRESSOR GROUND TEST

2. Identify the leads and using a Megger, Hi-Potential Ground Tester, or other suitable instrument which puts out a voltage between 300 and 1500 volts, check for a ground separately between each of the three leads and ground (such as an unpainted tube on the compressor). Do not use a low voltage output instrument such as a volt-ohmmeter.
3. If a ground is indicated, then carefully remove the compressor terminal protective cover and inspect for loose leads or insulation breaks in the lead wires.
4. If no visual problems indicated, carefully remove the leads at the compressor terminals.

   Carefully retest for ground, directly between compressor terminals and ground.
5. If ground is indicated, replace the compressor.

S-17C Unloader Test Procedure

A nominal 24-volt direct current coil activates the internal unloader solenoid. The input control circuit voltage must be 18 to 28 volt ac. The coil power requirement is 20 VA. The external electrical connection is made with a molded plug assembly. This plug contains a full wave rectifier to supply direct current to the unloader coil.

UNLOADER SOLENOID (Molded Plug)

Unloader Test Procedure

If it is suspected that the unloader is not working, the following methods may be used to verify operation.

1. Operate the system and measure compressor current. Cycle the unloader ON and OFF at 10 second intervals. The compressor amperage should go up or down at least 25 percent.
2. If step one does not give the expected results shut unit off. Apply 18 to 28 volt ac to the unloader molded plug leads and listen for a click as the solenoid pulls in. Remove power and listen for another click as the unloader returns to its original position.
3. If clicks can't be heard, shut off power and remove the control circuit molded plug from the compressor and measure the unloader coil resistance. The resistance should be 32 to 60 ohms, depending on compressor temperature.
4. Next check the molded plug.
   A. Voltage check: Apply control voltage to the plug wires (18 to 28 volt ac). The measured **dc** voltage at the female connectors in the plug should be around 15 to 27 vdc.
   B. Resistance check: Measure the resistance from the end of one molded plug lead to either of the two female connectors in the plug. One of the connectors should read close to zero ohms while the other should read infinity. Repeat with other wire. The same female connector as before should read zero while the other connector again reads infinity. Reverse polarity on the ohmmeter leads and repeat. The female connector that read infinity previously should now read close to zero ohms.
   C. Replace plug if either of these test methods doesn't show the desired results.

S-17D Operation Test

If the voltage, capacitor, overload and motor winding test fail to show the cause for failure:

⚠ WARNING
HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

1. Remove unit wiring from disconnect switch and wire a test cord to the disconnect switch.

NOTE: The wire size of the test cord must equal the line wire size and the fuse must be of the proper size and type.

2. With the protective terminal cover in place, use the three leads to the compressor terminals that were disconnected at the nearest point to the compressor and connect the common, start and run clips to the respective leads.
3. Connect good capacitors of the right capacitance and voltage rating into the circuit.
4. With power ON, close the switch.

⚠ WARNING
LINE VOLTAGE NOW PRESENT.

A. If the compressor starts and continues to run, the cause for failure is somewhere else in the system.

B. If the compressor fails to start - replace.

S-18 TESTING CRANKCASE HEATER

The crankcase heater must be energized a minimum of four (4) hours before the package unit is operated.

Crankcase heaters are used to prevent migration or accumulation of refrigerant in the compressor crankcase during the off cycles and prevents liquid slugging or oil pumping on start up. Scroll Compressors are not equipped with a crankcase heaters.

A crankcase heater will not prevent compressor damage due to a floodback or over charge condition.

⚠ WARNING
HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

1. Disconnect the heater lead wires.
2. Using an ohmmeter, check heater continuity - should test continuous, if not, replace.

S-100 REFRIGERATION REPAIR PRACTICE

⚠ DANGER
ALWAYS REMOVE THE REFRIGERANT CHARGE IN A PROPER MANNER BEFORE APPLYING HEAT TO THE SYSTEM.

When repairing the refrigeration system:

1. Never open a system that is under vacuum. Air and moisture will be drawn in.
2. Plug or cap all openings.
3. Remove all burrs and clean the brazing surfaces of the tubing with sand cloth or paper. Brazing materials do not flow well on oxidized or oily surfaces.
4. Clean the inside of all new tubing to remove oils and pipe chips.
5. When brazing, sweep the tubing with dry nitrogen to prevent the formation of oxides on the inside surfaces.
6. Complete any repair by replacing the liquid line drier in the system, evacuate and charge.

At any time the system has been open for repair, the factory installed liquid line filter drier **must** be replaced.

BRAZING MATERIALS

Copper to Copper Joints - Sil-Fos used without flux (alloy of 15% silver, 80% copper, and 5% phosphorous). Recommended heat 1400°F.

Copper to Steel Joints - Silver Solder used without a flux (alloy of 30% silver, 38% copper, 32% zinc). Recommended heat - 1200°F.

S-101 LEAK TESTING

Refrigerant leaks are best detected with a halide or electronic leak detector.

However, on outdoor installed systems, provisions must be made to shield the copper element of an halide torch from the sun and wind conditions in order to be able to see the element properly.

NOTE: The flame of the halide detector will glow green in the presence of R-22 refrigerant.

For a system that contains a refrigerant charge and is suspected of having a leak, stop the operation and hold the exploring tube of the detector as close to the tube as possible, check all piping and fittings. If a leak is detected, do not attempt to apply more brazing to the joint. Remove and capture the charge, unbraze the joint, clean and rebraze.

For a system that has been newly repaired and does not contain a charge, connect a cylinder of refrigerant, through a gauge manifold, to the liquid and suction line dill valves and/or liquid line dill valve and compressor process tube.

SERVICING

NOTE: Refrigerant hoses must be equipped with dill valve depressors or a special adaptor used. Open the valve on the cylinder and manifold and allow the pressure to build up within the system. Check for and handle leaks, as described above. After the test has been completed, remove and capture the leak test refrigerant.

S-102 EVACUATION

This is the most important part of the entire service procedure. The life and efficiency of the equipment is dependent upon the thoroughness exercised by the serviceman when evacuating air (non-condensable) and moisture from the system.

Air in a system causes high condensing temperature and pressure, resulting in increased power input and reduced performance.

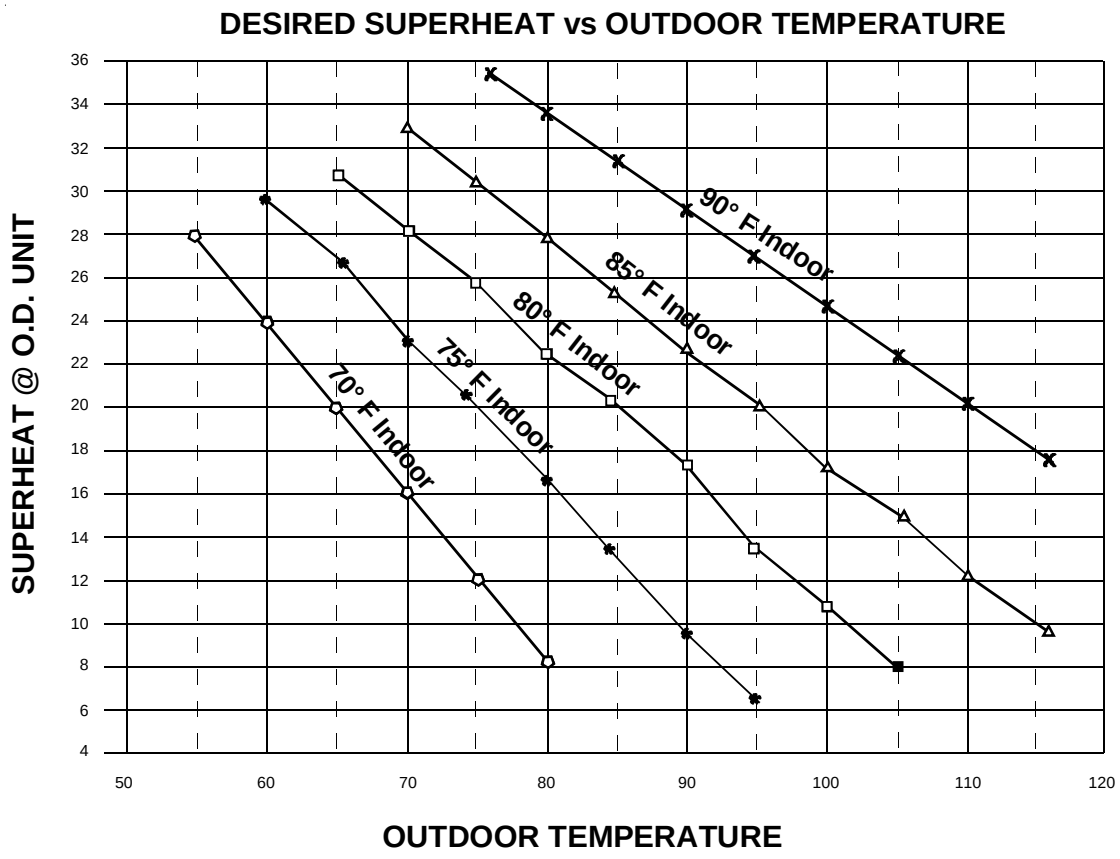
Moisture chemically reacts with the refrigerant and oil to form corrosive hydrofluoric and hydrochloric acids. These attack motor windings and parts, causing breakdown.

The equipment required to thoroughly evacuate the system is a high vacuum pump, capable of producing a vacuum equivalent to 25 microns absolute and a thermocouple vacuum gauge to give a true reading of the vacuum in the system

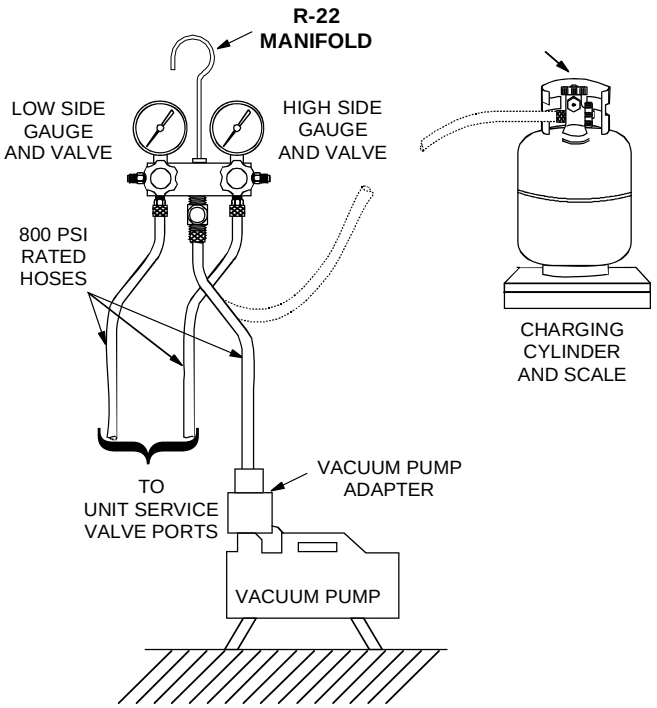
NOTE: Never use the system compressor as a vacuum pump or run when under a high vacuum. Motor damage could occur.

⚠ WARNING

SCROLL COMPRESSORS
DO NOT FRONT SEAT THE SERVICE VALVE(S) WITH THE COMPRESSOR OPERATING IN AN ATTEMPT TO SAVE REFRIGERANT. WITH THE SUCTION LINE OF THE COMPRESSOR CLOSED OR SEVERLY RESTRICTED, THE SCROLL COMPRESSOR WILL DRAW A DEEP VACUUM VERY QUICKLY. THIS VACUUM CAN CAUSE INTERNAL ARCING OF THE FUSITE RESULTING IN A DAMAGED OR FAILED COMPRESSOR.



SERVICING



1. Connect the vacuum pump, vacuum tight manifold set with high vacuum hoses, thermocouple vacuum gauge and charging cylinder as shown.
2. If the service dill valves are to be used for evacuation, it is recommended that a core remover be used to lift the core for greater efficiency.
3. Start the vacuum pump and open the shut off valve to the high vacuum gauge manifold only. After the compound gauge (low side) has dropped to approximately 29 inches of vacuum, open the valve to the vacuum thermocouple gauge. See that the vacuum pump will blank-off to a maximum of 25 microns. A high vacuum pump can only produce a good vacuum if its oil is non-contaminated.
4. If the vacuum pump is working properly, close the valve to the vacuum thermocouple gauge and open the high and low side valves to the high vacuum manifold set. With the valve on the charging cylinder closed, open the manifold valve to the cylinder.
5. Evacuate the system to at least 29 inches gauge before opening valve to thermocouple vacuum gauge.
6. Continue to evacuate to a minimum of 250 microns. Close valve to vacuum pump and watch rate of rise. If vacuum does not rise above 1500 microns in three to five minutes, system can be considered properly evacuated.
7. If thermocouple vacuum gauge continues to rise and levels off at about 5000 microns, moisture and non-condensables are still present. If gauge continues to rise a leak is present. Repair and re-evacuate.
8. Close valve to thermocouple vacuum gauge and vacuum pump. Shut off pump and prepare to charge.

S-103 CHARGING

Charge the system with the exact amount of refrigerant.

Refer to the specification section or check the unit nameplates for the correct refrigerant charge.

An inaccurately charged system will cause future problems.

1. Using a charging scale, allow liquid refrigerant only to enter the high side.
2. After the system will take all it will take, close the valve on the high side of the charging manifold.
3. Start the system and charge the balance of the refrigerant through the low side. DO NOT charge in a liquid form.
4. With the system still running, close the valve on the charging manifold. At this time, you may still have some liquid refrigerant in the charging manifold and will definitely have liquid in the liquid hose. Reseat the liquid line core. Slowly open the high side manifold valve and transfer the liquid refrigerant from the liquid line hose and charging manifold into the suction service valve port. **CAREFUL:** Watch so that liquid refrigerant does not enter the compressor.
5. With the system still running, reseat the suction valve core, remove hose and reinstall both valve core caps.
6. Check system for leaks.

Units having capillary tubes or flow control restrictors can be checked against the Desired Superheat vs. Outdoor Temperature Chart in this section. Coils with thermostatic expansion valves (TXVs) must be checked by subcooling. See "Checking Subcooling and Superheat" sections in this manual.

If a restriction is located, replace the restricted part, replace drier, evacuate and recharge.

S-104 CHECKING COMPRESSOR EFFICIENCY

The reason for compressor inefficiency is broken or damaged suction and/or discharge valves, or scroll flanks on Scroll compressors, reducing the ability of the compressor to pump refrigerant vapor.

The condition of the valves or scroll flanks is checked in the following manner.

1. Attach gauges to the high and low side of the system.
2. Start the system and run a "Cooling Performance Test.

If the test shows-

⇒ Below normal high side pressure.

⇒ Above normal low side pressure.

⇒ Low temperature difference across coil.

⇒ Low amp draw at compressor.

-and the charge is correct. The compressor is faulty - replace the compressor.

SERVICING

S-105 THERMOSTATIC EXPANSION VALVE

The expansion valve is designed to control the rate of liquid refrigerant flow into an evaporator coil in exact proportion to the rate of evaporation of the refrigerant in the coil. The amount of refrigerant entering the coil is regulated since the valve responds to temperature of the refrigerant gas leaving the coil (feeler bulb contact) and the pressure of the refrigerant in the coil.

This regulation of the flow prevents the return of liquid refrigerant to the compressor.

The three forces which govern the operation of the valve are: (1) the pressure created in the power assembly by the feeler bulb, (2) evaporator pressure, and (3) the equivalent pressure of the superheat spring in the valve.

0% bleed type expansion valves are used on the indoor coils. The 0% valve will not allow the system pressures (High and Low side) to equalize during the shut down period. The valve will shut off completely at approximately 100 PSIG Pressure.

Good thermal contact between the feeler bulb and the suction line is essential to satisfactory valve control and performance.

The bulb must be securely fastened to a clean straight section of the suction line. Application of the bulb to a horizontal run of line is preferred. If a vertical installation cannot be avoided the bulb should be mounted so that the capillary tubing comes out at the top.

THE VALVES PROVIDED ARE DESIGNED TO MEET THE SPECIFICATION REQUIREMENTS FOR OPTIMUM PRODUCT OPERATION. **DO NOT USE SUBSTITUTES.**

S-106 OVERFEEDING

Overfeeding by the expansion valve results in high suction pressure, cold suction line, and possible liquid slugging of the compressor.

If these symptoms are observed:

1. Check for an overcharged unit by referring to the cooling performance charts in the servicing section.
2. Check the operation of the power element in the valve as explained in S-110 Checking Expansion Valve Operation.
3. Check for restricted or plugged equalizer tube.

S-107 UNDERFEEDING

Underfeeding by the expansion valve results in low system capacity and low suction pressures.

If these symptoms are observed:

1. Check for a restricted liquid line or drier. A restriction will be indicated by a temperature drop across the drier.
2. Check the operation of the power element of the valve as described in S-110 Checking Expansion Valve Operation.

S-108 SUPERHEAT

The expansion valves are factory adjusted to maintain 12 to 18 degrees superheat of the suction gas. Before checking the superheat or replacing the valve, perform all the procedures outlined under Air Flow, Refrigerant Charge, Expansion Valve - Overfeeding, Underfeeding. These are the most common causes for evaporator malfunction.

CHECKING SUPERHEAT

Refrigerant gas is considered superheated whenever its temperature is higher than the saturation temperature corresponding to its pressure. The degree of superheat equals the degrees of temperature increase above the saturation temperature at existing pressure. See Temperature - Pressure Chart.

1. Attach an accurate thermometer or preferably a thermocouple type temperature tester to the suction line at a point at least 6" from the compressor.
2. Install a low side pressure gauge on the suction line service valve at the outdoor unit.
3. Record the gauge pressure and the temperature of the line.
4. Convert the suction pressure gauge reading to temperature by finding the gauge reading in Temperature - Pressure Chart and reading to the left, find the temperature in the °F. Column.
5. The difference between the thermometer reading and pressure to temperature conversion is the amount of superheat.

EXAMPLE:

a. Suction Pressure = 84

b. Corresponding Temp. °F. = 50

c. Thermometer on Suction Line = 63°F.

To obtain the degrees temperature of superheat subtract 50.0 from 63.0°F.

The difference is 13° Superheat. The 13° Superheat would fall in the ± range of allowable superheat.

SUPERHEAT ADJUSTMENT

The expansion valves used are factory set and are not field adjustable. If the superheat setting becomes disturbed, replace the valve.

S-109 CHECKING SUBCOOLING

Refrigerant liquid is considered subcooled whenever its temperature is lower than the saturation temperature corresponding to its pressure. The degree of subcooling equals the degrees of temperature decrease below the saturation temperature at the existing pressure.

1. Attach an accurate thermometer or preferably a thermocouple type temperature tester to the liquid line as it leaves the condensing unit.

2. Install a high side pressure gauge on the high side service valve.
3. Record the gauge pressure and the temperature of the line.
4. Convert the discharge pressure gauge reading to temperature by finding the gauge reading in Temperature - Pressure Chart and reading to the left, find the temperature in the °F. Column.
5. The difference between the thermometer reading and pressure to temperature conversion is the amount of subcooling.

EXAMPLE:

a. Discharge Pressure = 260

b. Corresponding Temp. °F. = 120°

c. Thermometer on Liquid line = 109°F.

To obtain the amount of subcooling subtract 109°F from 120°F.

The difference is 11° subcooling. The normal subcooling range is 14° - 18°.

S-110 CHECKING EXPANSION VALVE OPERATION

1. Remove the remote bulb of the expansion valve from the suction line.
2. Start the system and cool the bulb in a container of ice water, closing the valve. As you cool the bulb the suction pressure should fall and the suction temperature will rise.
3. Next warm the bulb in your hand. As you warm the bulb the suction pressure should rise and the suction temperature will fall.
4. If a temperature or pressure change is noticed, the expansion valve is operating. If no change is noticed, the valve is restricted, the power element is faulty, or the equalizer tube is plugged.
5. Remove the charge, replace the valve and drier, evacuate and recharge.

S-111 FIXED ORIFICE RESTRICTION DEVICES

The fixed orifice restriction device (flowrator) used in conjunction with the indoor coil is a predetermined bore (I.D.).

It is designed to control the rate of liquid refrigerant flow into an evaporator coil.

The amount of refrigerant that flows through the fixed orifice restriction device is regulated by the pressure difference between the high and low sides of the system.

Temp. °F.	Gauge Pressure (PSIG) Freon-22	Temp. °F.	Gauge Pressure (PSIG) Freon-22
-40	0.61	60	102.5
-38	1.42	62	106.3
-36	2.27	64	110.2
-34	3.15	65	114.2
-32	4.07	68	118.3
-30	5.02	70	122.5
-28	6.01	72	126.8
-26	7.03	74	131.2
-24	8.09	76	135.7
-22	9.18	78	140.5
-20	10.31	80	145.0
-18	11.48	82	149.5
-16	12.61	84	154.7
-14	13.94	86	159.8
-12	15.24	88	164.9
-10	16.59	90	170.1
-8	17.99	92	175.4
-6	19.44	94	180.9
-4	20.94	96	186.5
-2	22.49	96	192.1
0	24.09	100	197.9
2	25.73	102	203.8
4	27.44	104	209.9
6	29.21	106	216.0
8	31.04	108	222.3
10	32.93	110	228.7
12	34.88	112	235.2
14	36.89	114	241.9
16	38.96	116	248.7
18	41.09	118	255.6
20	43.28	120	262.6
22	45.53	122	269.7
24	47.85	124	276.9
26	50.24	126	284.1
28	52.70	128	291.4
30	55.23	130	298.8
32	57.83	132	306.3
34	60.51	134	314.0
36	63.27	136	321.9
38	66.11	136	329.9
40	69.02	140	338.0
42	71.99	142	346.3
44	75.04	144	355.0
46	78.18	146	364.3
48	81.40	158	374.1
50	84.70	150	384.3
52	88.10	152	392.3
54	91.5	154	401.3
56	95.1	156	411.3
58	98.8	158	421.8
		160	433.3

TEMPERATURE - PRESSURE (R-22)

SERVICING

In the cooling cycle when the outdoor air temperature rises, the high side condensing pressure rises. At the same time, the cooling load on the indoor coil increases, causing the low side pressure to rise, but at a slower rate.

Since the high side pressure rises faster when the temperature increases, more refrigerant flows to the evaporator, increasing the cooling capacity of the system.

When the outdoor temperature falls, the reverse takes place. The condensing pressure falls, and the cooling loads on the indoor coil decreases, causing less refrigerant flow.

A strainer is placed on the entering side of the tube to prevent any foreign material from becoming lodged inside the fixed orifice restriction device.

If a restriction should become evident, proceed as follows:

1. Recover refrigerant charge.
2. Remove the orifice or tube strainer assembly and replace.
3. Replace liquid line drier, evacuate and recharge.

CHECKING EQUALIZATION TIME

During the "OFF" cycle, the high side pressure bleeds to the low side through the fixed orifice restriction device. Check equalization time as follows:

1. Attach a gauge manifold to the suction and liquid line dill valves.
2. Start the system and allow the pressures to stabilize.
3. Stop the system and check the time it takes for the high and low pressure gauge readings to equalize.

If it takes more than seven (7) minutes to equalize, the restriction device is inoperative. Replace, install a liquid line drier, evacuate and recharge.

S-112 CHECKING RESTRICTED LIQUID LINE

When the system is operating, the liquid line is warm to the touch. If the liquid line is restricted, a definite temperature drop will be noticed at the point of restriction. In severe cases, frost will form at the restriction and extend down the line in the direction of the flow.

Discharge and suction pressures will be low, giving the appearance of an undercharged unit. However, the unit will have normal to high subcooling.

If a restriction is located, replace the restricted part, replace drier, evacuate and recharge.

S-113 REFRIGERANT OVERCHARGE

An overcharge of refrigerant is normally indicated by excessively high head pressure and/or liquid return to the compressor.

Evaporator coils with a **fixed orifice** metering device could allow refrigerant to return to the compressor under extreme overcharge conditions.

If high head pressure is not indicated, an overcharge or a system containing non-condensables could be the problem.

If overcharging is indicated:

1. Start the system.
2. Remove small quantities of gas from the suction line dill valve until the head pressure is reduced to normal.
3. Observe the system while running a cooling performance test, if a shortage of refrigerant is indicated, then the system contains non-condensables. See S-114 Non-Condensables.

S-114 NON-CONDENSABLES

Check for non-condensables.

1. Shut down the system and allow the pressures to equalize for a minimum of 15 minutes.
2. Take a pressure reading.
3. Compare this pressure to the temperature of the coldest coil since this is where most of the refrigerant will be. If the pressure indicates a higher temperature than that of the coil temperature, non-condensables are present.

To remove the non-condensables.

1. Remove the refrigerant charge.
2. Replace and/or install liquid line drier
3. Evacuate and recharge.

S-115 COMPRESSOR BURNOUT

When a compressor burns out, high temperature develops causing the refrigerant, oil and motor insulation to decompose forming acids and sludge.

If a compressor is suspected of being burned-out, attach a refrigerant hose to the liquid line dill valve and properly remove and dispose of the refrigerant.

Now determine if a burn out has actually occurred. Confirm by analyzing an oil sample using a Sporlan Acid Test Kit, AK-3 or its equivalent.

Remove the compressor and obtain an oil sample from the suction stub. If the oil is not acidic, either a burnout has not occurred or the burnout is so mild that a complete cleanup is not necessary.

If acid level is unacceptable the system must be cleaned by using the cleanup drier method.

⚠ CAUTION

DO NOT ALLOW THE SLUDGE OR OIL TO CONTACT THE SKIN, SEVERE BURNS MAY RESULT.

SERVICING

Suction Line Drier Clean-up Method

Discard at least twelve (12) inches of the suction line immediately out of the compressor stub due to burned residue and contaminates.

1. Remove compressor discharge line strainer, liquid line strainer and/or drier and capillary tubes from indoor and outdoor coils.
2. *Units with an expansion valve coil,* remove the liquid line drier and expansion valve.
3. Purge all remaining components with dry nitrogen or carbon dioxide until clean.
4. Install new components including liquid liner drier.
5. Install suction line drier.
6. Braze all joints, leak test, evacuate, and recharge system.
7. Start up the unit and record the pressure drop across the cleanup drier.
8. Continue to run the system for a minimum of twelve (12) hours and recheck the pressure drop across the drier. Pressure drop should not exceed 6 - 8 PSIG.
9. Continue to run the system for several days repeatedly checking pressure drop across the suction line drier. If the pressure drop never exceeds the 6 - 8 PSIG, the drier must be adequate and is trapping the contaminants and it is permissible to leave it in the system.
10. If the pressure drop becomes greater, then it must be replaced and steps 5 through 9 repeated until it does not exceed 6 - 8 PSIG.

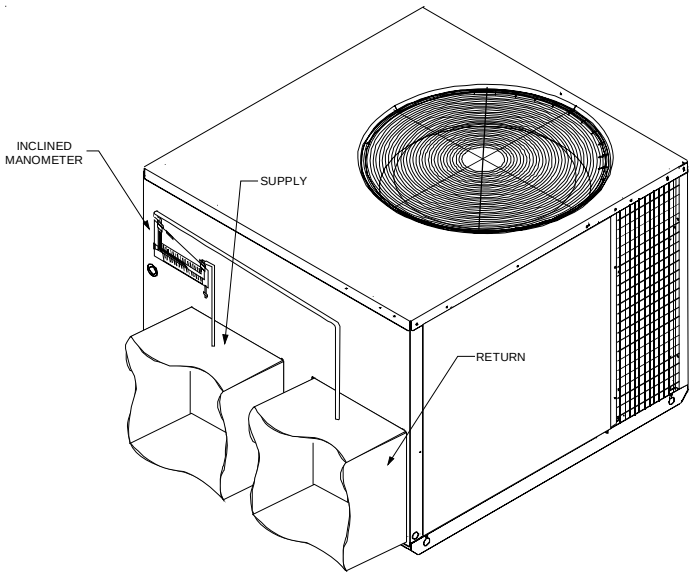
NOTE: The cause for burnout **MUST** be determined **and** corrected BEFORE the new compressor is started.

S-200 CHECKING EXTERNAL STATIC PRESSURE

The minimum and maximum allowable duct static pressure is found in the Technical Information Manual.

Too great of an external static pressure will result in insufficient air that can cause icing of the coil, whereas too much air can cause poor humidity control, and condensate to be pulled off the evaporator coil causing condensate leakage. Too much air can cause motor overloading and in many cases this constitutes a poorly designed system. To determine proper air movement, proceed as follows:

1. Using a draft gauge (inclined manometer) measure the static pressure of the return duct at the inlet of the unit, (Negative Pressure).



Total External Static

2. Measure the static pressure of the supply duct, (Positive Pressure).
3. Add the two readings together.

NOTE: Both readings may be taken simultaneously and read directly on the manometer if so desired.

4. Consult proper table for quantity of air.

If the external static pressure exceeds the minimum or maximum allowable statics, check for closed dampers, dirty filters, undersized or poorly laid out ductwork.

S-201 CHECKING TEMPERATURE RISE

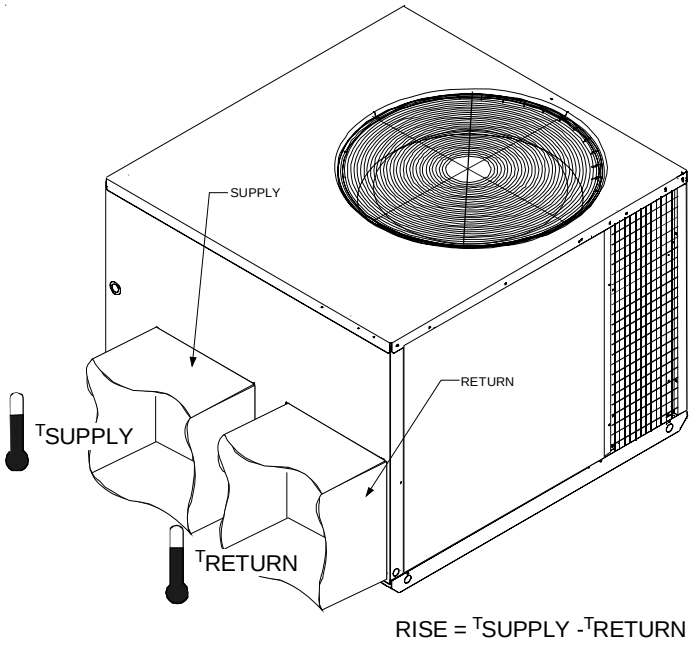
Temperature rise is related to the BTUH output of the unit and the amount of air (CFM) circulated over the heat exchanger.

All units are designed for a given range of temperature increase. This is the temperature of the air leaving the unit minus the temperature of the air entering the unit.

The more air (CFM) being delivered through a given unit the less the rise will be; the less air (CFM) being delivered, the greater the rise. The temperature rise should be adjusted in accordance to a given unit specifications and its external static pressure.

1. Check BTUH input to unit. Do not exceed input rating stamped on rating plate.
2. Take entering and leaving air temperatures.
3. Select the proper speed tap or dip switch setting for direct drive units.
4. Take motor current draw to determine that the motor is not overloaded during adjustments.

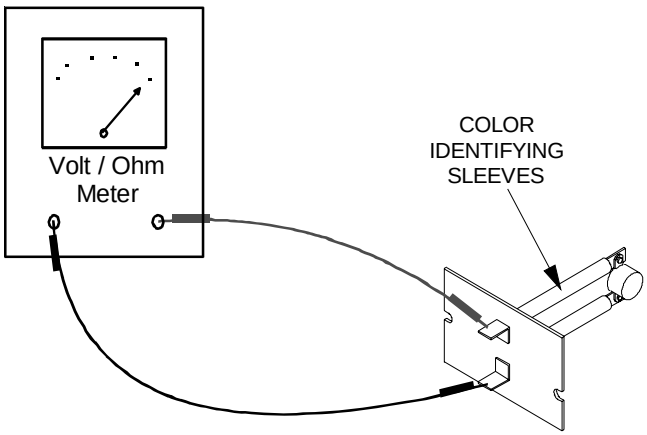
SERVICING



Checking Temperature Rise

S-300 TESTING PRIMARY LIMIT CONTROL

APG/GPG units use a snap-disk type primary limit device. Sometimes referred to as "stat on a stick". The limit setting is fixed and must not be readjusted in the field.



TESTING PRIMARY LIMIT CONTROL

In all instances the limit control is wired in series with the ignition control.

If the temperature within the appliance should exceed this setting, the control will open, de-energizing the ignition control which in turn will open the electrical circuit to the gas valve.

The control will automatically reset when the temperature within the unit is sufficiently lowered.

⚠ WARNING

HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

1. Remove electrical power to unit. Some units may have more than one source of power.
2. Remove the wires from the limit control terminals.
3. Using an ohmmeter, test for continuity across the two terminals.
4. If limit tests open, allow unit to cool and retest.
5. If still open, replace the control.

Limit Switch Operation (applies to Primary) Direct Spark Ignition (DSI) systems.

If a limit switch opens, the indoor blower is energized on heat speed and the induced draft blower is energized. The LED on the control flashes "4" to indicate an open limit switch. The blower and inducer remain on while the limit switch is open. The gas valve is de-energized. Power to the thermostat "R" is removed while the limit switch is open.

When the limit switch re-closes, the induced draft motor runs through its post purge and the indoor blower goes through the heat off delay.

If a call for heat exists when the limit switch re-closes, the control goes through a pre-purge period and then makes an ignition attempt. The indoor blower remains on (for the delay off time) during the re-ignition attempt.

1. If no voltage is measured on either side of control it indicates ignition control or wiring to control problem.
2. If voltage is measured on one side of the control and not the other, it indicates the control is open.
3. If voltage is measured on both sides of the control the wiring to the gas valve is at fault.

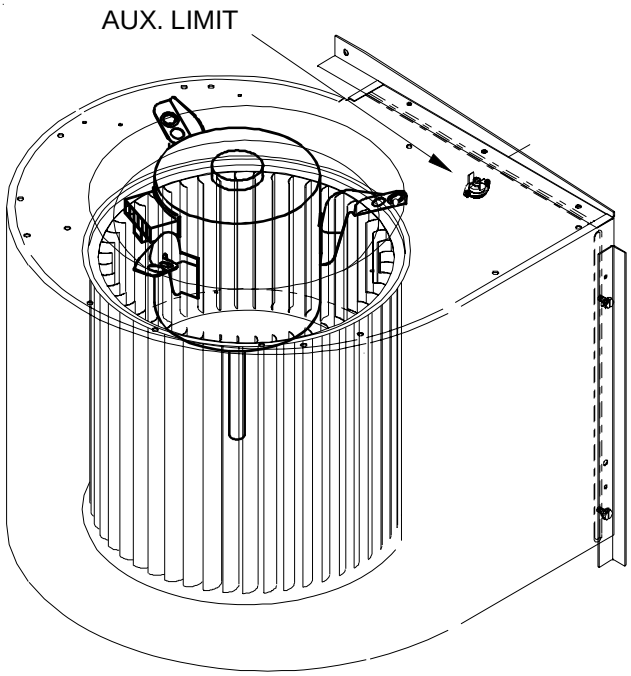
S-301 TESTING AUXILIARY LIMIT

The auxiliary limit control is an automatic reset, nonadjustable control mounted in the blower compartment area.

It is connected in series with the rollout switch wiring to the gas valve. If its temperature should be exceeded, it will open, interrupting the voltage to the gas valve causing it to open.

An additional limit (primary limit) control is required for safety control of high temperature within the unit or duct work.

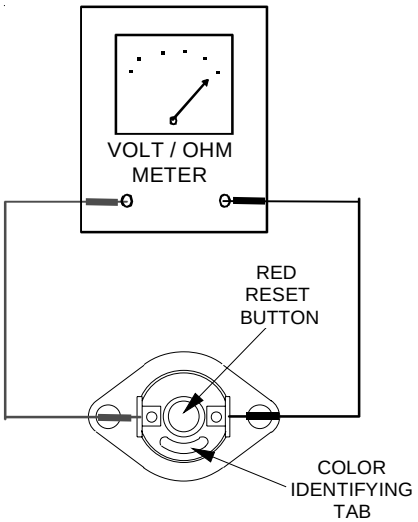
SERVICING



⚠ WARNING

HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

1. Remove the wires from the auxiliary limit control terminals.
2. Using an ohmmeter, test for continuity across the two terminals. No reading indicates the control is open. If limit tests open, allow to cool and retest.
3. If still open, replace the control.

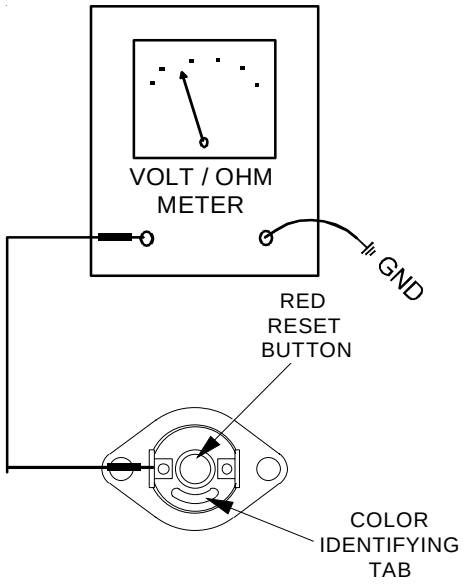


TESTING AUXILIARY LIMIT CONTROL

S-302 CHECKING FLAME ROLLOUT SWITCH

APG/GPG units are equipped with a temperature-activated manual reset control. This control is mounted to the manifold assembly and is wired in series with the auxiliary limit and gas valve. The control is designed to open should a flame roll out occur. An over firing condition or flame impingement on the heat shield can also cause the control to open.

If the rollout control has opened, the circuit between the ignition control and gas valve will be interrupted and the ignition control module will go into lockout. The servicer should reset the ignition control by opening and closing the thermostat circuit. The servicer should look for the ignitor arcing which indicates there is power to the ignition control. The servicer should measure the voltage between each side of the rollout control and ground while the ignition control is try to power the gas valve.



CHECKING FLAME ROLLOUT SWITCH

Auxiliary Limit and Rollout Limit Operation DSI Systems

If the auxiliary limit and/or rollout limit switch opens, the circuit to the gas valve will be broken and the gas valve will be de-energized. The control will recognize this as a loss of flame and will make an ignition attempt. If the limit switch is still open, the gas will not be energized for the ignition attempt and ignition will fail. The ignition control will make two additional ignition attempts and lock out due to failed ignition. The diagnostic LED will flash an error code of "1" to indicate the control has locked out due to failed ignition.

Servicing procedure with unit not firing.

1. Confirm that the outer door was in place and all screws tightened. (No leaks under the door.)
2. Check to see if any damage was done to the unit especially the wiring.
3. Confirm that heat exchanger is not obstructed by feeling for discharge air from the flue hood when the combustion blower is running but the unit is not firing.

SERVICING

If the preceding steps do not suggest the reason the control has tripped the unit should be operated as shown below.

1. Remove the heating compartment door.
2. Turn off the power or open the thermostat circuit.
3. Reset the rollout control.
4. Turn power on and put the unit into a call for heating.

⚠ CAUTION

FLAME ROLLOUT COULD OCCUR. KEEP FACE AND HANDS A SAFE DISTANCE FROM BURNER AREA.

5. Look under the heat shield as the unit is running. Flames should be drawn into firing tubes.
   a. If only one burner flame is not drawn into the tube, that tube is restricted.
   b. If, without the air circulation blower running, all flames are not drawn into the tubes either the collector box, combustion blower, or flue outlet is obstructed. If the combustion blower or flue outlet is obstructed, the pressure switch should have opened preventing the unit from firing, also inspect the unit pressure switch and wiring.
   c. If the burner flame is not drawn into the tube when the air circulation blower is running, then a cracked heat exchanger tube may be present.

S-303 TESTING INDUCER MOTOR

⚠ WARNING

HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

1. Disconnect the motor wire leads from its connection point at integrated ignition control module.
2. Using and ohmmeter, test for continuity between each of the motor leads.
3. Touch one probe of the ohmmeter to the motor frame (ground) and the other probe in turn to each lead.

If the windings do not test continuous or a reading is obtained to ground, replace the motor.

4. After completing check and/or replacement of induced draft blower motor, turn on electrical power and verify proper unit operation.

S-304 TESTING GAS VALVE

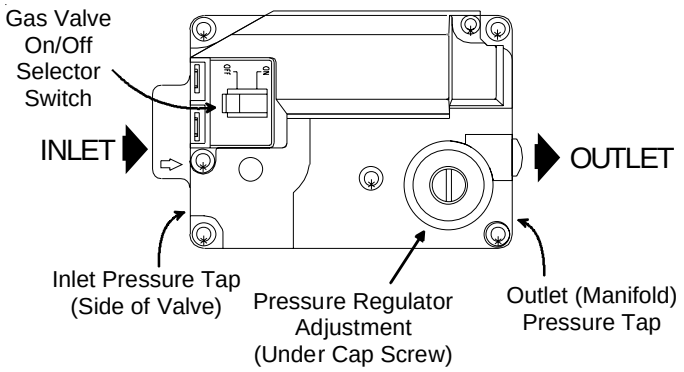
Direct Spark Ignition (DSI) Systems

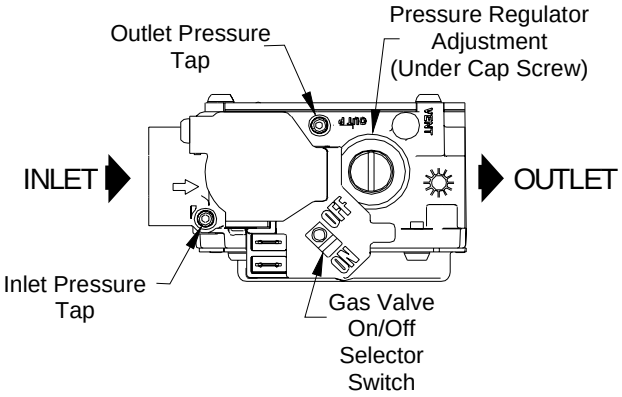
A combination redundant operator type gas valve which provides all manual and automatic control functions required for gas fired heating equipment is used.

The valve provides control of main burner gas flow, pressure regulation, and 100 percent safety shut-off.

1. Ensure gas valve and main gas supply are on.
2. Using a voltmeter, check for 24 volts to gas valve.
3. If 24 volts are present and no gas flows through the valve, replace valve.

If no voltage is present, check the safety controls (S-300, S-301 and S-302).





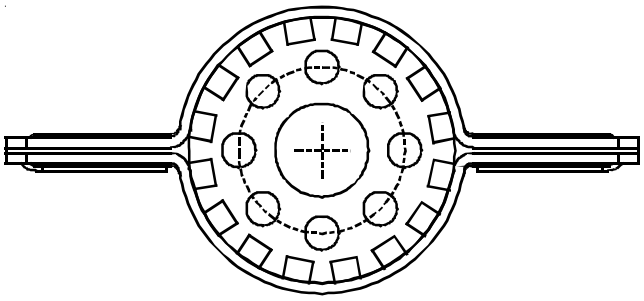
WHITE ROGERS MODELS 36F & 36G GAS VALVES

S-305 CHECKING MAIN BURNERS

The main burners are used to provide complete combustion of natural gas or liquid propane in a limited space, and transfer this heat of the combustion process to the heat exchanger.

Proper ignition, combustion, and extinction are primarily due to burner design, orifice sizing, gas pressure, primary and secondary air, vent and proper seating of burners.

SERVICING



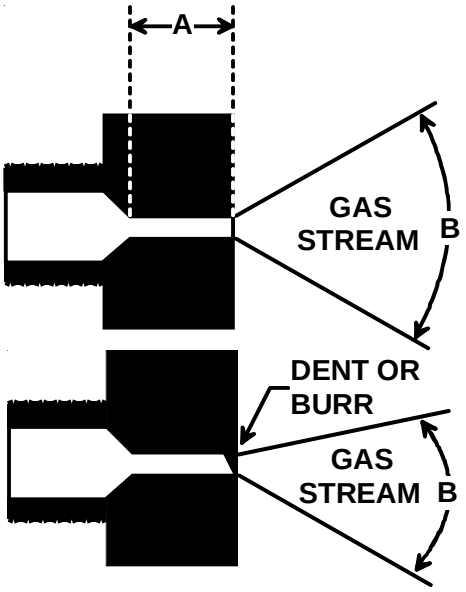
BECKETT BURNER

WARNING
HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

In checking main burners, look for signs of rust, oversized and undersized carry-over ports restricted with foreign material, etc.

S-306 CHECKING ORIFICES

A predetermined fixed gas orifice is used in all of these package gas units. That is an orifice which has a fixed bore and position.



The length of Dimension "A" determines the angle of Gas Stream Defraction, "B".

A dent or burr will cause severe deflection of gas stream.

No resizing should be attempted until all factors are taken into consideration such as inlet manifold gas pressure, alignment, and positioning, specific gravity and BTU content of the gas being consumed.

The only time resizing is required is when a reduction in firing rate is required for an increase in altitude.

Orifices should be treated with care in order to prevent damage. They should be removed and installed with a box-end wrench in order to prevent distortion. Under no circumstances should an orifice be altered. Altering the orifice will change the angle or deflection of the vacuum effect or entraining of primary air, making it difficult to adjust the flame properly. This same problem can occur if an orifice spud of a different length is substituted.

WARNING
DISCONNECT GAS AND ELECTRICAL POWER SUPPLY.

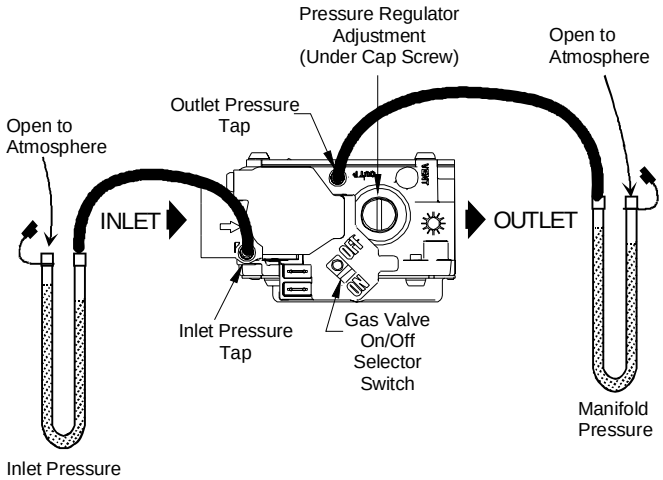
1. Check orifice visually for distortion and/or burrs.
2. Check orifice size with orifice sizing drills.
3. If resizing is required, a new orifice of the same physical size and angle with proper drill size opening should be installed.

S-307 CHECKING GAS PRESSURE

Gas inlet and manifold pressures should be checked and adjusted in accordance to the type of fuel being consumed.

WARNING
DISCONNECT GAS AND ELECTRICAL POWER SUPPLY.

1. Connect a water manometer or adequate gauge to the inlet pressure fitting of the gas valve.
2. Remove the pressure tap fitting at the manifold if provided or check at the gas valve outlet fitting and connect another manometer or gauge.



MEASURING INLET AND MANIFOLD GAS PRESSURE

SERVICING

With Power ON:

WARNING

LINE VOLTAGE NOW PRESENT.

3. Put the unit into heating cycle and turn on all other gas consuming appliances.

For **NATURAL GAS:**

a. Inlet pressure should be a nominal 7" w.c.

b. Manifold pressure should be 3.5 ± .3"w.c.

(Canadian - Sea Level 4.2" ± .3" w.c.)

For **PROPANE GAS:**

a. Inlet pressure should be a nominal 11" w.c.

b. Manifold pressure should be a nominal 10" w.c.

If operating pressures differ from above, make necessary pressure regulator adjustments, check piping size, etc., and/or consult with local utility.

S-308 CHECKING FOR DELAYED IGNITION

Delayed ignition is a delay in lighting a combustible mixture of gas and air which has accumulated in the combustion chamber.

When the mixture does ignite, it may explode and/or rollout causing burning in the burner venturi.

If delayed ignition should occur, the following should be checked:

1. Improper gas pressure - adjust to proper pressure. (See S-307)
2. Improper burner positioning - burners should be in locating slots, level front to rear and left to right.
3. Carry over (lighter tube or cross lighter) obstructed - clean.
4. Main burner orifice(s) deformed, or out of alignment to burner - replace.

S-309 CHECKING FOR FLASHBACK

Flashback will also cause burning in the burner venturi, but is caused by the burning speed being greater than the gas-air flow velocity coming from a burner port.

Flashback may occur at the moment of ignition, after a burner heats up or when the burner turns off. The latter is known as extinction pop.

Since the end results of flashback and delayed ignition can be the same (burning in the burner venturi) a definite attempt should be made to determine which has occurred.

If flashback should occur, check for the following:

1. Improper gas pressure - adjust to proper pressure. See **S-307**.
2. Check burner for proper alignment and/or replace burner.
3. Improper orifice size - check orifice for obstruction.

S-310 CHECKING PRESSURE CONTROL

A pressure control device is used to measure negative pressure at the induced draft blower motor inlet to detect a partial or blocked flue.

Pressure Switch Operation (DSI Direct Spark System)

The pressure switch is ignored unless there is a call for heat. When the control receives a call for heat, the control checks to see that the pressure switch is open. If the control sees that the pressure switch is closed before the induced draft blower is energized, the LED will flash a code of "3" (to indicate the pressure switch is stuck closed) and the inducer will remain off until the pressure switch opens.

If the pressure switch opens before the ignition period, the induced draft blower will remain on and the control will stay in pre-purge until the pressure switch is closed for an entire 15 second pre-purge period. The LED will flash a code of "2" to indicate open pressure switch.

If the pressure switch opens after the gas valve has been energized, the control will de-energize the gas valve and run the indoor blower through the heat off delay. The inducer stays on until the pressure switch re-closes. Then the control makes another ignition attempt.

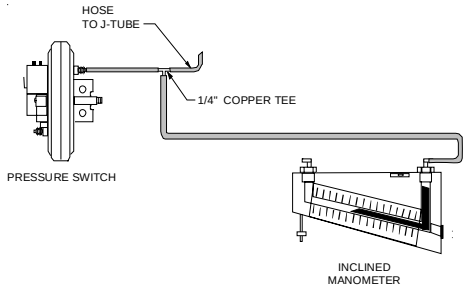
WARNING

HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

1. Remove wires from the electrical terminals.
2. Using a VOM check from Common to NO (Normally Open) - should read open.

If switch reads as noted proceed to Step 3, otherwise replace control.

3. Remove the pressure control hose from the control and interconnect with an inclined manometer as shown:



Reconnect wires to the Common and normally open (NO) terminals.

SERVICING

WITH POWER ON:

⚠ WARNING

LINE VOLTAGE NOW PRESENT.

4. Energize unit for heating cycle. The induced draft blower motor will begin to run. The inclined manometer should read approximately -1.25" ± 0.1" W.C. with no combustion.
5. Remove and check the two electrical wires and using the VOM check from Common to NO (Normally Open), it should read closed (with I.D. motor running). If not as above, replace the pressure switch.
6. Reconnect all wires to the control and place in heating cycle.
7. As the unit fires, the inclined manometer negative pressure will drop to -1.0" ± 0.1" W.C.
8. If not as listed, replace control.

Note: The pressure switch **must** be mounted with the diaphragm in a vertical position.

S-311 HIGH ALTITUDE APPLICATION

High Altitude Derate

When this package unit is installed at high altitude, the appropriate High Altitude orifice kit must be installed. This is required due to the natural reduction in the density of both the gas fuel and combustion air as altitude increases. The kit will provide the proper design certified input rate within the specified altitude range. High altitude kits are not approved for use in Canada. For installations above 2,000 feet, use kit HA-02. The HA-02 kit is used for both Natural and LP gas (it contains Natural and LP orifices).

Use LPT-00A propane conversion kit for propane conversions at altitudes below 2000 feet. Natural gas installations below 2000 feet do not require a kit.

Natural gas and LP gas installations at altitudes

> 2000 ft

INPUT/BURNER	HIGH ALTITUDE KIT	20,000 BTUH NAT/20,OOO BTUH/L.P. ELEVATION ABOVE SEA-LEVEL (FEET)							
		2000	3000	4000	4500	5000	6000	7000	8000
U.S. BURNER ORIFICE	HA02	45/55	47/55	47/56	-	47/56	48/57	48/58	49/58
CANADA BURNER ORIFICE		45/55	-	-	48/57	-	-	-	-

INPUT/BURNER	HIGH ALTITUDE KIT	22,500 BTUH NAT/20,OOO BTUH/L.P. ELEVATION ABOVE SEA-LEVEL (FEET)							
		2000	3000	4000	4500	5000	6000	7000	8000
U.S. BURNER ORIFICE	HA02	44/55	44/55	45/56	-	45/56	46/57	47/58	47/58
CANADA BURNER ORIFICE		44/55	-	-	47/57	-	-	-	-

INPUT/BURNER	HIGH ALTITUDE KIT	25,000 BTUH NAT/20,OOO BTUH/L.P. ELEVATION ABOVE SEA-LEVEL (FEET)							
		2000	3000	4000	4500	5000	6000	7000	8000
U.S. BURNER ORIFICE	HA02	43/55	53/55	44/56	-	44/56	44/56	45/57	45/57
CANADA BURNER ORIFICE		43/55	-	-	46/57	-	-	-	-

S-313 TESTING IGNITION CONTROL MODULE

NOTE: Failure to earth ground the unit, reversing the neutral and hot wire connection to the line (polarity), or a high resistance connection in the ground or neutral lines may cause the control to lockout due to failure to detect flame.

⚠ WARNING

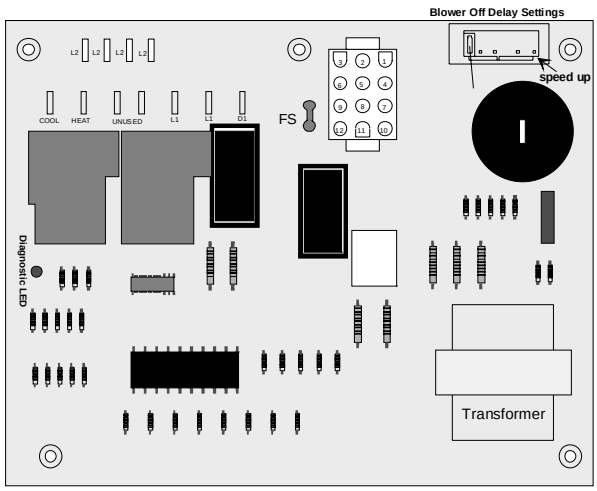
TO AVOID PERSONAL INJURY OR DEATH DUE TO ELECTRIC SHOCK, WIRING TO THE UNIT MUST BE PROPERLY POLARIZED AND GROUNDED. DISCONNECT POWER BEFORE INSTALLING OR SERVICING.

The ground wire must run from the unit all the way back to the electrical panel. Proper grounding can be confirmed by disconnecting the electrical power and measuring resistance between the neutral (white) connection and the burner closest to the flame sensor. Resistance should be less than 10 ohms.

DSI Direct Spark Ignition Systems

NORMAL SEQUENCE OF OPERATION (DSI Direct Spark Ignition System)

1. Thermostat calls for heat by energizing "W". The control checks the pressure switch for open condition. If the pressure switch is closed the control will flash code "3" and wait for the pressure switch to open.
2. The induced draft motor is energized and the control flashes code "2" and waits for the pressure switch to close. Once the pressure switch is closed, the LED stops flashing and the control begins timing the 15 second pre-purge.



DSI Control Board

3. The control energizes the spark igniter and gas valve for 7 seconds. If flame is established, the control goes into a 30 second heat on delay.
4. The indoor blower is energized at the heat speed after a 30 second on delay.
5. The control monitors the safety circuit inputs, flame, and thermostat during operation.

6. When the thermostat is satisfied, the gas valve is de-energized and the induced draft blower remains on for a 29 second post purge. The indoor blower remains on for the selected heat blower off delay (90, 120, or 150 seconds). Indoor blower off timing begins when thermostat call for heat ends.

Testing Direct Spark Ignition (DSI) systems

Thermostat calling for heat (15 second prepurge time and 7 second trial for ignition).

1. Check for 230 VAC from L1 terminal of control module to L2. No voltage - check wire connections, continuity, etc.
2. Check for 24 VAC at "R" to "C" thermostat terminals.
   a. No voltage - check 3 amp automotive type fuse on control board. A blown fuse would indicate a short in the 24 VAC circuit (thermostat or limit circuit).
   b. Voltage Present - check limit, auxiliary limit and rollout (S-300, S-301 and S-302). If limit, auxiliary limit and rollout are closed, then check for 24 VAC at the gas valve terminals.

      No 24 VAC at gas valve - replace Control board.

B1809918 Ignition Board Fault Codes		
Status Light	Equipment Status	Check
On	Normal Operation	
Off	No Power or Internal Control Fault	Check Input Power, Check Fuse on Control, Replace Control
1 Blink	Ignition Failure, Open Rollout Switch, or Open Aux. Limit Switch	Check Gas Flow, Check Gas Pressure, Check Gas Valve, Check Flame Sensor, Check Flame Rollout, Check Aux. Limit.
2 Blinks	Pressure Switch Open	Check Pressure Switch
3 Blinks	Pressure Switch Closed	Check Pressure Switch
4 Blinks	Open Main Limit Switch	Main Limit Switch Open
5 Blinks	False Flame Sensed	Sticking Gas Valve
6 Blinks	Compressor Output Delay	3 Minute Compressor Anti-Cycle Timer

NOTE: The flash rate is 0.25 seconds on, 0.25 seconds off, with a 2-second pause between codes.

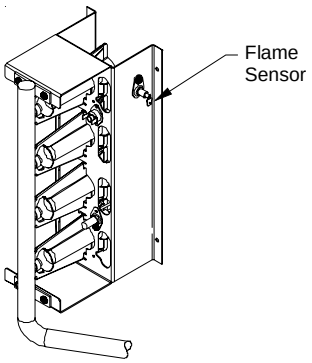
S-314 CHECKING FLAME SENSOR

A flame sensing device is used in conjunction with the ignition control module to prove combustion. If a microamp signal is not present the control will de-energize the gas valve and "retry" for ignition or lockout.

DSI Direct Spark Ignition Systems

⚠ WARNING
HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

1. Disconnect the flame sensor wire from terminal FS on the ignition control module.



Flame Sensor

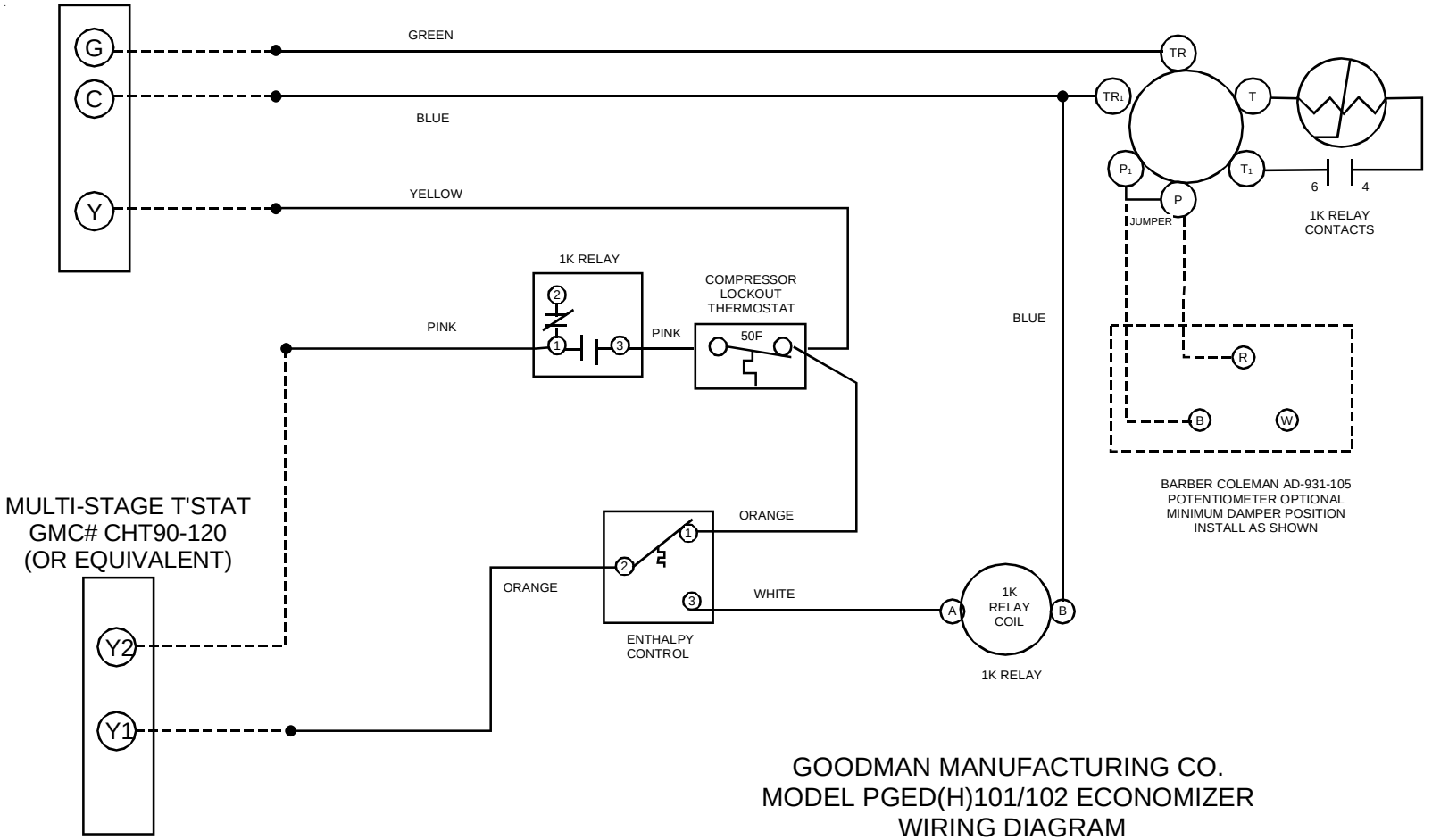
2. Connect a microamp meter in series with this wire and the terminal FS on the ignition control.
3. Be sure the negative side of the meter is to the wire and the positive of the meter is to terminal FS on the ignition control.
4. Turn on Power.

⚠ WARNING
LINE VOLTAGE NOW PRESENT.

5. With Power ON, place the unit into a heating cycle.
6. As soon as flame is established a microamp reading should be evident once proof of flame (microamp reading) is established, the direct spark ignitor will be de-energized.
7. The microamp reading should be 4 - 6 microamps.
8. If the microamp current is less than 0.5 microamp the control will lockout and flash a code of 1 flash after attempting to reestablish flame sense.
9. If the microamp reading is less than the minimum specified, check for high resistance wiring connections, the distance (3/16") between the sensor and burner, flame sensor connections, dirty flame sensor or poor grounding.
10. If no reading, check for continuity on all components and if good - replace ignition control module.

NOTE: Contaminated fuel or combustion air can create a nearly invisible coating on the flame sensor. This coating works as an insulator causing a loss in the flame sense signal. If this situation occurs the flame sensor must be cleaned with steel wool. Do not use sand paper, the silicone in sand paper will further contaminate the sensor.

WARNING **TO AVOID POSSIBLE ELECTRICAL SHOCK, PERSONAL INJURY, OR DEATH, DISCONNECT THE POWER BEFORE SERVICING.**



GOODMAN MANUFACTURING CO.
MODEL PGED(H)101/102 ECONOMIZER
WIRING DIAGRAM

NOTE: RECOMMEND MULTI-STAGE T'STAT
GMC(CHT90-120 OR EQUIVALENT)

Wiring is subject to change, always refer to the wiring diagram on the unit for the most up-to-date wiring.