

G21/GSR21 SERIES UNITS

G21 and GSR21 units are condensing air heaters utilizing the pulse combustion process. Initially, combustion takes place in an enclosed chamber. Then, as combustion products pass through the heat exchanger system into a coil, the latent heat of combustion is extracted and water is condensed from the exhaust gas.

The unit uses a safety shut-off gas valve. The units are manufactured for natural gas application. Liquid Petroleum (Propane) kits are available for field change-over.

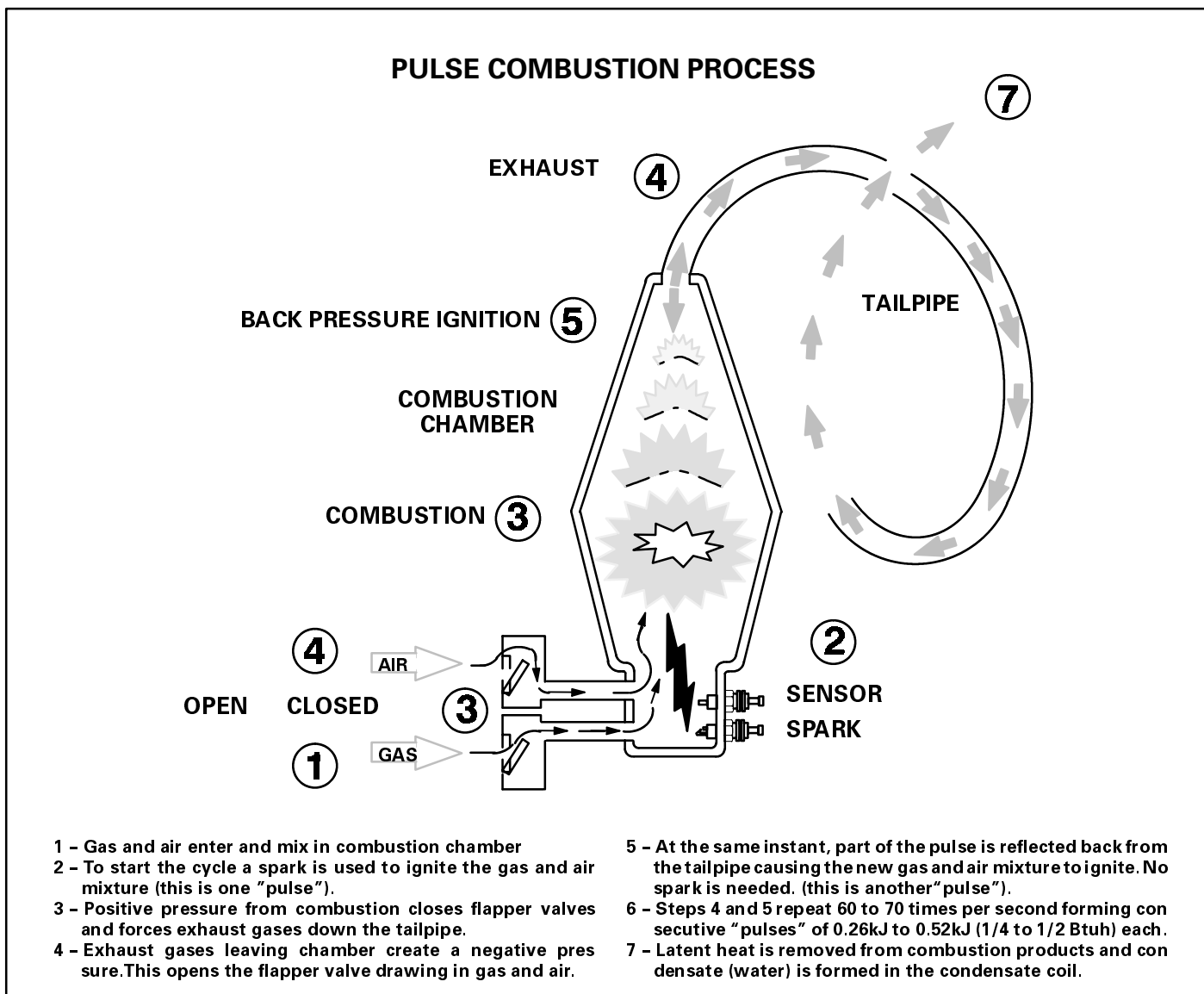
An electronic direct spark ignition control initiates combustion. The ignition control serves four func-

tions: pre-purge, ignition, flame sensing and post-purge. It also resets in the event of nuisance lockout. The control also verifies loss of combustion during a cycle, closing the gas valve. A differential pressure switch shuts down the unit immediately if there are obstructions in the exhaust outlet or air intake.

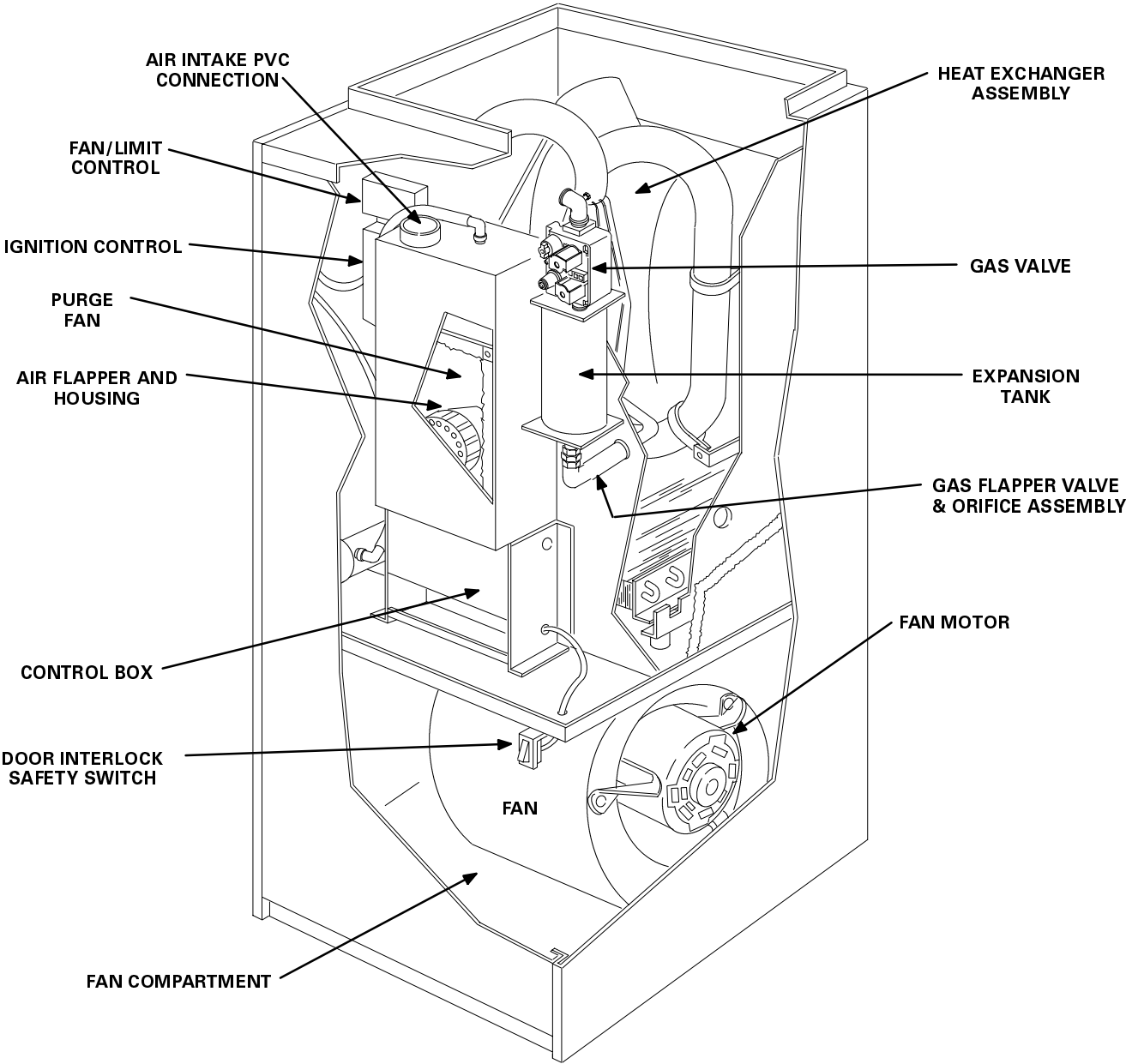
A purge fan clears the combustion chamber before and after each heating cycle to ensure proper air mixture for start-up.

All units feature direct drive multi-speed multi-tap fan motors.

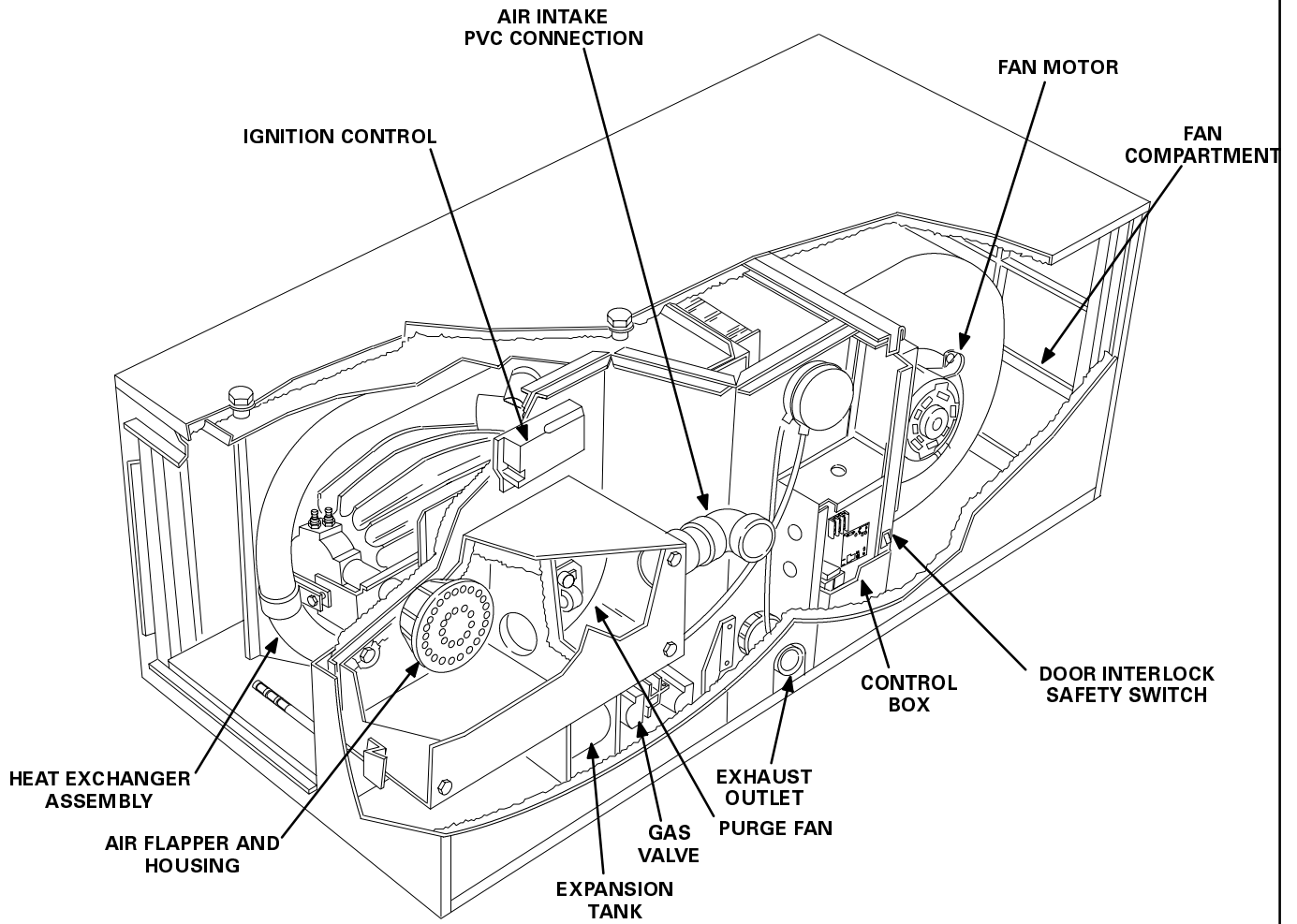
All specifications in this manual are subject to change.



PARTS ARRANGEMENT (G21 UPFLOW UNIT)



PARTS ARRANGEMENT (GSR21 DOWNFLOW HORIZONTAL UNIT)



SPECIFICATIONS

Model Number		G21Q3-40	G21Q3-60	G21Q3-80
Input — kW (Btuh)		11.7 (40 000)	17.6 (60 000)	23.4 (80 000)
Output — kW (Btuh)		11.4 (39 000)	16.3 (55 500)	21.7 (74 000)
Temperature rise range — °C (°F)		19 — 36 (35 — 65)	22 — 39 (40 — 70)	25 — 41 (45 — 75)
Maximum external static pressure — Pa (in. wg.)		124 (0.50)	124 (0.50)	124 (0.50)
Gas Connection — Natural or *Propane — iron pipe size — mm (in.)		15 (1/2)	15 (1/2)	15 (1/2)
Vent/Intake air pipe size connection — mm (in.)		50 (2)	50 (2)	50 (2)
Condensate drain connection — mm (in.) SDR11		15 (1/2)	15 (1/2)	15 (1/2)
Fan wheel diameter x width — mm (in.)		254 x 203 (10 x 8)	254 x 203 (10 x 8)	254 x 203 (10 x 8)
Fan motor output — W (hp)		373 (1/2)	373 (1/2)	373 (1/2)
Number and size of filters	mm	(1) 406 x 635 x 25	(1) 406 x 635 x 25	(1) 406 x 635 x 25
	in.	(1) 16 x 25 x 1	(1) 16 x 25 x 1	(1) 16 x 25 x 1
Nominal cooling that can be added — kW (Tons)		5.3 — 10.6 (1-1/2 — 3)	5.3 — 10.6 (1-1/2 — 3)	7.0 — 10.6 (2 — 3)
Shipping weight — kg (lbs.) 1 package		113 (250)	113 (250)	113 (250)
Electrical characteristics		220/240V — 50 hz — 1 Phase		
*Propane kit (optional)		LB-83176CR (76H95)	LB-83176CE (66H97)	LB-83176CF (66H98)
Continuous Low Speed Fan Switch Kit (optional)		LB-83611A (90H79) (All models — not used with twinning kit)		
Heater Twinning Kit (optional)		LB-63093CA (64H88) (All models)		
Continuous Low Speed Fan Switch (optional)		67H18 (All models — used with twinning kit only)		
External Filter Mounting Kit (optional)	Part No.	LB-81871CA (16H36)		
	*Filter size — mm (in.)	(1) 406 x 635 x 25 (16 x 25 x 1)		

•Filter is not furnished with kit. Filter kit utilizes existing filter supplied with G21 unit.

*Propane kit must be ordered extra for field changeover.

SPECIFICATIONS

Model Number		G21Q5-80	G21Q4/5-100
Input — kW (Btuh)		23.4 (80 000)	29.3 (100 000)
Output — kW (Btuh)		22.0 (75 000)	27.8 (95 000)
Temperature rise range — °C (°F)		22 — 39 (40 — 70)	22 — 39 (40 — 70)
Maximum external static pressure — Pa (in. wg.)		124 (0.50)	124 (0.50)
Gas Connection — Natural or *Propane — iron pipe size — mm (in.)		15 (1/2)	15 (1/2)
Vent/Intake air pipe size connection — mm (in.)		50 (2)	50 (2)
Condensate drain connection — mm (in.) SDR11		15 (1/2)	15 (1/2)
Fan wheel diameter x width — mm (in.)		279 x 229 (11 x 9)	305 x 305 (12 x 12)
Fan motor output — W (hp)		746 (1)	746 (1)
Number and size of filters	mm	(1) 406 x 635 x 25	(1) 508 x 635 x 25
	in.	(1) 16 x 25 x 1	(1) 20 x 25 x 1
Nominal cooling that can be added — kW (Tons)		8.8 — 14.1 (2-1/2 — 4)	12.3 — 17.6 (3-1/2 — 5)
Shipping weight — kg (lbs.) 1 package		116 (255)	135 (297)
Electrical characteristics		220/240V — 50 hz — 1 Phase	
*Propane kit (optional)		LB-83176CF (66H98)	LB-83176CP (73H62)
Continuous Low Speed Fan Switch Kit (optional)		LB-83611A (90H79) (All models — not used with twinning kit)	
Heater Twinning Kit (optional)		LB-63093CA (64H88) (All models)	
Continuous Low Speed Fan Switch (optional)		67H18 (All models — used with twinning kit only)	
External Filter Mounting Kit (optional)	Part No.	LB-81871CA (16H36)	LB-81871CB (16H37)
	*Filter size — mm (in.)	(1) 406 x 635 x 25 (16 x 25 x 1)	(1) 508 x 635 x 25 (20 x 25 x 1)

•Filter is not furnished with kit. Filter kit utilizes existing filter supplied with G21 unit.

*Propane kit must be ordered extra for field changeover.

SPECIFICATIONS (contd.)

Model Number	GSR21Q3-50	GSR21Q3-80
Input — kW (Btuh)	11.7 (40 000)	17.6 (60 000)
Output — kW (Btuh)	11.4 (39 000)	16.3 (55 500)
Temperature rise range — °C (°F)	19 — 36 (35 — 65)	22 — 39 (40 — 70)
Maximum external static pressure — Pa (in. wg.)	124 (0.50)	124 (0.50)
Gas Connection — Natural or *Propane — iron pipe size — mm (in.)	15 (1/2)	15 (1/2)
Vent/Intake air pipe size connection — mm (in.)	50 (2)	50 (2)
Condensate drain connection — mm (in.) SDR11	15 (1/2)	15 (1/2)
Fan wheel diameter x width — mm (in.)	254 x 203 (10 x 8)	254 x 203 (10 x 8)
Fan motor output — W (hp)	373 (1/2)	373 (1/2)
Number and size of filters	mm	(1) 406 x 635 x 25
	in.	(1) 16 x 25 x 1
Nominal cooling that can be added — kW (Tons)	5.3 — 10.6 (1-1/2 — 3)	5.3 — 10.6 (1-1/2 — 3)
Shipping weight — kg (lbs.) 1 package	113 (250)	113 (250)
Electrical characteristics	220/240V — 50 hz — 1 Phase	
*Propane kit (optional)	LB-83176CR (66H95)	LB-83176CE (66H97)
Continuous Low Speed Fan Switch Kit (optional)	LB-83611A (90H79) (All models — not used with twinning kit)	
Heater Twinning Kit (optional)	LB-63093CA (64H88) (All models)	
Continuous Low Speed Fan Switch (optional)	67H18 (All models — used with twinning kit only)	
External Filter Mounting Kit (optional)	Part No.	LB-81871CA (16H36)
	•Filter size — mm (in.)	(1) 406 x 635 x 25 (16 x 25 x 1)

•Filter is not furnished with kit. Filter kit utilizes existing filter supplied with G21 unit.

*Propane kit must be ordered extra for field changeover.

SPECIFICATIONS

Model Number	GSR21Q4/5-80	GSR21Q4/5-100
Input — kW (Btuh)	23.4 (80 000)	100,000 (29.3)
Output — kW (Btuh)	22.0 (75 000)	27.8 (95 000)
Temperature rise range — °C (°F)	22 — 39 (40 — 70)	22 — 39 (40 — 70)
Maximum external static pressure — Pa (in. wg.)	124 (0.50)	124 (0.50)
Gas Connection — Natural or *Propane — iron pipe size — mm (in.)	15 (1/2)	15 (1/2)
Vent/Intake air pipe size connection — mm (in.)	50 (2)	50 (2)
Condensate drain connection — mm (in.) SDR11	15 (1/2)	15 (1/2)
Fan wheel diameter x width — mm (in.)	279 x 229 (11 x 9)	305 x 305 (12 x 12)
Fan motor output — W (hp)	746 (1)	746 (1)
Number and size of filters	mm	(1) 406 x 635 x 25
	in.	(1) 16 x 25 x 1
Nominal cooling that can be added — kW (Tons)	8.8 - 14.1 (2-1/2 - 4)	12.3 - 17.6 (3-1/2 - 5)
Shipping weight — kg (lbs.) 1 package	116 (255)	135 (297)
Electrical characteristics	220/240V — 50 hz — 1 Phase	
*Propane kit (optional)	LB-83176CF (66H98)	LB-83176CP (73H62)
Continuous Low Speed Fan Switch Kit (optional)	LB-83611A (90H79) (All models — not used with twinning kit)	
Heater Twinning Kit (optional)	LB-63093CA (64H88) (All models)	
Continuous Low Speed Fan Switch (optional)	67H18 (All models — used with twinning kit only)	
External Filter Mounting Kit (optional)	Part No.	LB-81871CA (16H36)
	•Filter size — mm (in.)	(1) 406 x 635 x 25 (16 x 25 x 1)
		LB-81871CB (16H37)
	(1) 508 x 635 x 25 (20 x 25 x 1)	

•Filter is not furnished with kit. Filter kit utilizes existing filter supplied with G21 unit.

*Propane kit must be ordered extra for field changeover.

FAN DATA

G21Q3-40, G21Q3-60 AND G21Q3-80 FAN PERFORMANCE

External Static Pressure		Air Volume at Various Fan Speeds							
		High		Medium-High		Medium-Low		Low	
Pa	in. w.g.	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm
0	0	670	1420	550	1165	455	965	365	775
25	0.1	655	1390	540	1140	445	940	345	735
50	0.2	640	1360	525	1115	430	915	330	695
75	0.3	625	1320	510	1080	420	885	305	645
100	0.4	605	1280	495	1045	400	850	285	600
125	0.5	580	1230	475	1005	380	805	255	545
150	0.6	555	1180	450	950	355	750	230	490

NOTE — All air data is measured external to the unit with the air filter in place.

G21Q5-80 AND G21Q4/5-100 FAN PERFORMANCE

External Static Pressure		Air Volume at Various Fan Speeds					
		High		Medium		Low	
Pa	in. w.g.	L/s	cfm	L/s	cfm	L/s	cfm
0	0	1135	2405	1025	2170	885	1875
25	0.1	1115	2365	1005	2125	865	1830
50	0.2	1090	2315	980	2080	840	1780
75	0.3	1070	2265	960	2030	820	1735
100	0.4	1045	2215	935	1980	795	1680
125	0.5	1015	2155	910	1925	770	1630
150	0.6	990	2100	880	1870	745	1575

NOTE — All air data is measured external to the unit with the air filter in place.

GSR21Q3-50 FAN PERFORMANCE

External Static Pressure		Air Volume at Various Fan Speeds							
		High		Medium-High		Medium-Low		Low	
Pa	in. w.g.	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm
0	0	745	1575	595	1260	480	1020	375	795
25	0.1	725	1540	580	1230	470	995	360	765
50	0.2	710	1505	565	1200	455	965	345	730
75	0.3	695	1470	550	1170	445	940	330	700
100	0.4	675	1435	540	1140	425	905	315	670
125	0.5	660	1395	525	1110	410	870	295	630
150	0.6	640	1355	510	1075	395	835	280	590
175	0.7	620	1315	490	1040	380	800	260	550

NOTE — All air data is measured external to the unit with the air filter in place.

FAN DATA (contd.)

GSR21Q3-80 FAN PERFORMANCE

External Static Pressure		Air Volume at Various Fan Speeds							
		High		Medium-High		Medium-Low		Low	
Pa	in. w.g.	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm
0	0	800	1700	640	1355	510	1085	400	850
25	0.1	780	1655	615	1305	485	1030	370	785
50	0.2	750	1590	590	1245	460	980	340	725
75	0.3	715	1520	565	1200	440	935	320	675
100	0.4	690	1460	545	1155	420	890	295	630
125	0.5	670	1415	525	1110	400	850	275	585
150	0.6	640	1360	505	1065	380	800	250	525
175	0.7	615	1300	480	1020	355	755	215	460

NOTE — All air data is measured external to the unit with the air filter in place.

GSR21Q4/5-80 FAN PERFORMANCE

External Static Pressure		Air Volume at Various Fan Speeds					
		High		Medium		Low	
Pa	in. w.g.	L/s	cfm	L/s	cfm	L/s	cfm
0	0	1075	2275	985	2090	865	1835
25	0.1	1050	2220	960	2035	840	1785
50	0.2	1020	2165	935	1980	820	1735
75	0.3	1000	2115	910	1925	795	1680
100	0.4	975	2065	885	1875	765	1625
125	0.5	950	2010	855	1815	740	1570
150	0.6	925	1955	830	1760	715	1510
175	0.7	890	1890	800	1695	680	1445

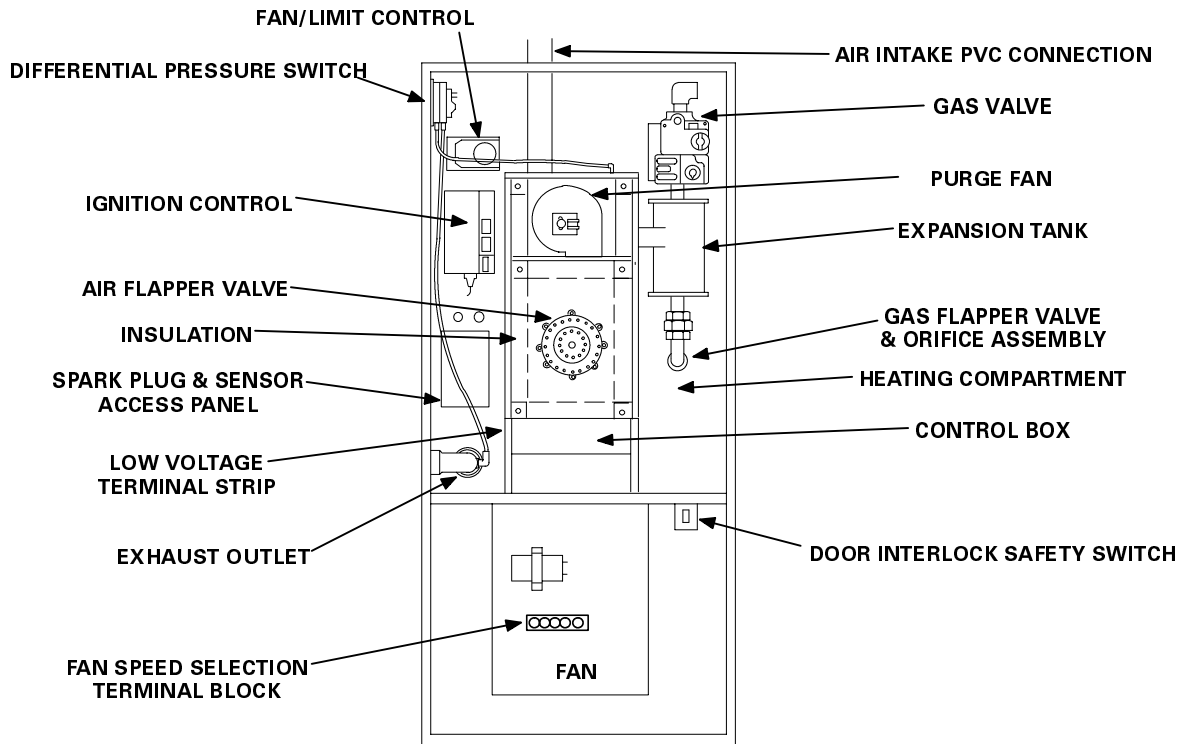
NOTE — All air data is measured external to the unit with the air filter in place.

GSR21Q4/5-100 FAN PERFORMANCE

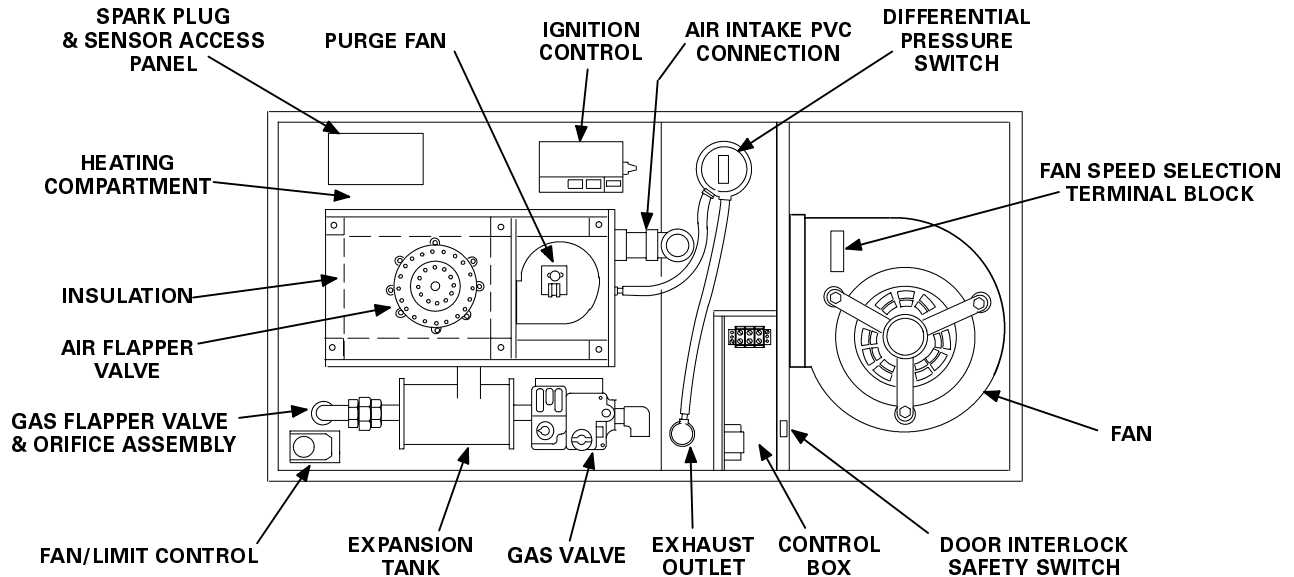
External Static Pressure		Air Volume at Various Fan Speeds					
		High		Medium		Low	
Pa	in. w.g.	L/s	cfm	L/s	cfm	L/s	cfm
0	0	1055	2240	965	2040	855	1810
25	0.1	1035	2195	945	2000	830	1760
50	0.2	1010	2140	920	1950	805	1705
75	0.3	985	2085	895	1895	780	1650
100	0.4	960	2030	870	1840	755	1590
125	0.5	930	1975	845	1790	725	1535
150	0.6	905	1920	820	1735	695	1475
175	0.7	880	1860	790	1675	670	1420

NOTE — All air data is measured external to the unit with the air filter in place.

UNIT COMPONENTS (UPFLOW UNITS)



UNIT COMPONENTS (HORIZONTAL/REVERSE FLOW UNITS)



I - APPLICATION

G21/GSR21 unit input range covers 11 through 29kW. See specifications table.

G21/GSR21 models use the same cabinet size as the existing G14/GSR14 heater line. All units in the G21/GSR21 series use direct drive fans and accept cooling coils in nominal tonnages up to 5 tons (17kW) for the -80, -100. Consult the Engineering Handbook for proper sizing.

Slab filters are used for either bottom or side return air in all unit sizes.

II - UNIT COMPONENTS

A - Control Box (Figure 1)

The G21 control box is located below the air intake chamber. -40, -60 and -80 control boxes are designed to open over the exhaust PVC line when the unit is set up for right-hand discharge of exhaust. -100 control boxes are designed to open over the exhaust PVC line when the unit is set up for left-hand discharge of exhaust.

The GSR21 control box is located in the lower right-hand corner of the heating compartment in horizontal installations and in the upper right-hand corner of the heating compartment in reverse flow applications.

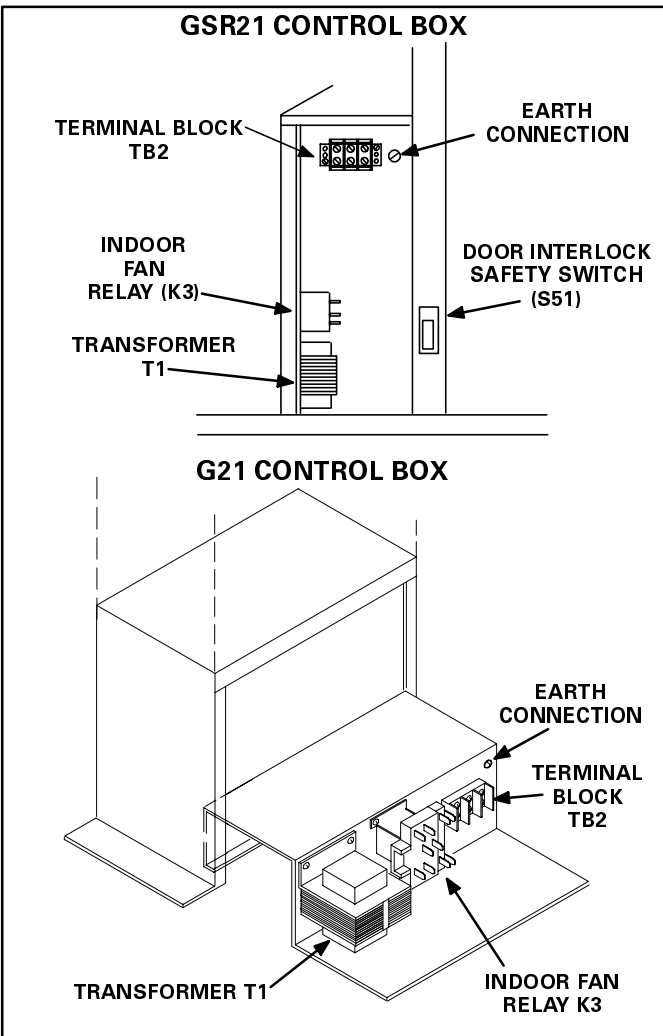


FIGURE 1

1 - Control Transformer T1

A transformer (T1) located inside the control box provides power to the low voltage section of the unit. Transformers are rated at 30VA with a 240V primary and 24V secondary.

2 - Low Voltage Terminal Strip TB1

A low voltage terminal strip (TB1) with thermostat markings is located outside the control box. See figure 2.

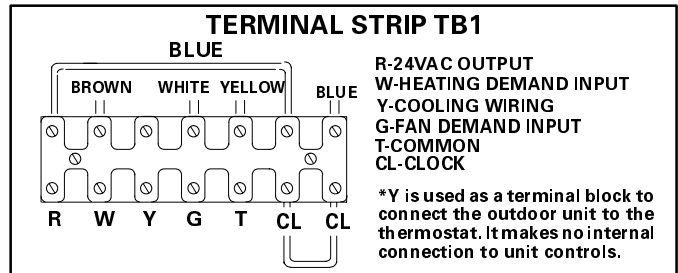


FIGURE 2

3 - Terminal Block TB2 (Figure 3)

Line voltage is routed to the unit through a power supply terminal block (TB2) located inside the control box. The terminal block is energized at all times.

The accessory terminal (ACC) is energized any time there is a fan demand.

The accessory terminal can be used for accessories such as an electronic air cleaner.

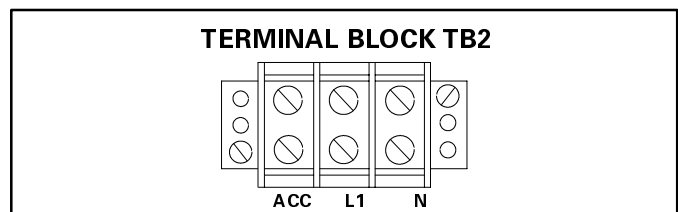


FIGURE 3

4 - K3 Indoor Fan Relay

A double-pole, double-throw indoor fan relay is located inside the control box to provide power to the fan. K3 relay contacts also control the 240V accessory terminal located on terminal strip TB2.

B - Fan/Limit Control: Primary Limit S10, Fan Control S57

A combination fan/limit control with a bimetal sure-start heater (figure 4) is used to control fan operation and protect unit from high temperature operation. It is located in the heating vest panel. See unit components illustration (page 8) for exact location. The fan control heater is a resistive type bi-metal heat relay (S57) used to reduce the time between fan demand and fan start-up. It is energized with the heating demand.

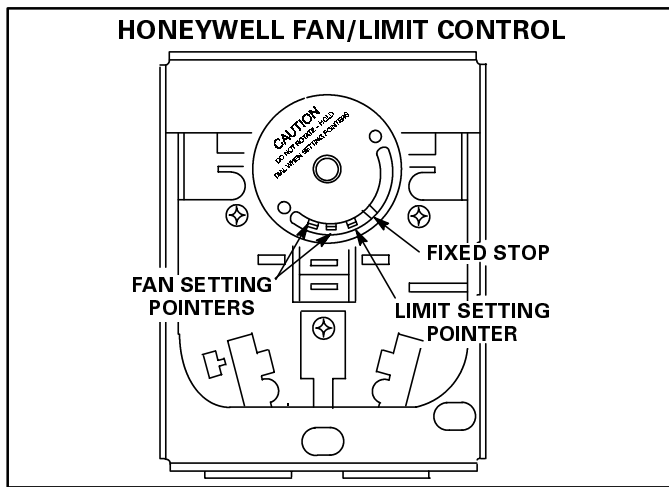


FIGURE 4

Internal contacts in fan control S57 are used to coordinate fan operation with the pulse combustion process. The N.O. contacts are actuated by a bimetal spring when temperature rise in the heating compartment (in addition to heat added by the sure-start heater) is sufficient. The fan cycles on 20 to 90 sec. after the start of a heating demand and cycles off 120 to 240 sec. after heat demand is satisfied (when bimetal switch cools). On-time will vary, depending on the voltage applied to the bimetal heater and on the temperature surrounding the S57 switch. The relay is SPST.

The fan control has a factory off setting of 38° C (90° F). This control can be field adjusted. In some cases, an unusual duct design can cause the indoor fan to cycle on after the heat demand is satisfied. If this situation occurs, the "Fan Off" setting on the fan/limit control should be set below 32° C. See figure 4.

! IMPORTANT

Fan "OFF" settings above 90° F will cause the fan to recycle frequently (after a heating cycle) due to residual heat in the heat exchange assembly. fan "OFF" settings above 90° F may also cause nuisance trips of secondary limit S10.

Primary limit S10 contacts de-energize the ignition control when excessive temperature is reached in the fan compartment. The N.C. limit is a SPST auto-reset switch. It is fixed in position for a maximum discharge air temperature. The limit is factory preset to trip on a temperature rise and automatically reset on a temperature fall. On a temperature rise terminals 1-3 open to de-energize the ignition circuit. Table 1 shows factory settings. This is a safety shut-down function of the unit.

TABLE 1

LIMIT CONTROL S10	
Unit	High Limit Cutout \pm 5.5° C
G21 SERIES	104.4° C (220° F)
GSR21-50,-80(Q3)	76.6° C (170° F)
GSR21-80(Q4/5),-100	71.1° C (160° F)

C - Secondary Limit S21 (GSR21 Units Only)

S21 is a SPST N.C. manual reset limit wired in series with ignition control A3. It is located on the fan housing. See Figure 5. If the fan should fail to operate or if return or supply airway becomes partially blocked, the fan housing would become warm causing S21 to "trip." S21 is set at 71° C (160° F) and cannot be adjusted. If S21 trips, it must be manually reset. Allow adequate time for S21 to cool before attempting to reset. Units made to meet Canadian Regulations (C.G.A.) use a self-resetting SPST N.C. limit that opens at 54° C (130° F) and closes at 43° C (110° F). Its function is the same. This is a safety shut down function of the unit.

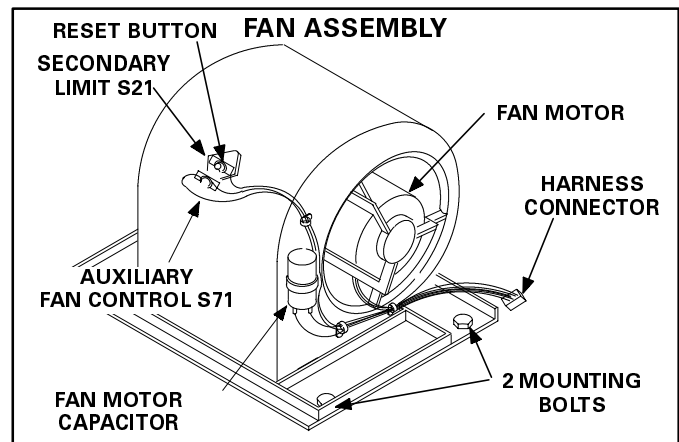


FIGURE 5

D - Auxiliary Fan Control (GSR21 Units Only)

An auxiliary fan control (S71) is located on the fan housing. See Figure 5. It protects secondary limit (S21) from "tripping." S71 actuates on a temperature rise 60° C (140° F). If S71 actuates (closes) the fan is forced to operate on heating speed tap.

Secondary limit (S21) and auxiliary fan control (S71) work together to reduce excessive temperature in the fan end of unit. First, as temperature rises in the fan compartment and nears 60° C (140° F), S71 actuates the fan in an attempt to reduce temperature. If temperatures continue to rise, S21 will "trip" and ignition control A3 is de energized.

! DANGER

Shock Hazard. Auxiliary fan control is connected to line voltage. Before servicing control, be sure to disconnect power to unit. Can cause injury or death.

E - Ignition Control (A3)

An electronic direct spark ignition control (A3) with flame rectification sensing is used on all G21/GSR21 units. The ignition control is manufactured by Lennox and is referred to as the GC-1 ignition control. See figure 6.

For additional safety and troubleshooting convenience, ignition control units self-test their internal safety circuits continuously and use the diagnostic LED to indicate control failure. The light helps the technician troubleshoot the unit by indicating an unusual condition.

⚠ IMPORTANT

When the GC-1 is operating normally the LED will not be lit. If it is lit refer to Ignition Control Troubleshooting Flowchart in the back of manual.

The GC-1 ignition control LED may be lit for the following reasons: lockout condition (lit), post-purge operation (lit) or control failure (lit). If the control is in lockout (lit) due to unsuccessful ignition (five tries), it must be reset by breaking and remaking thermostat demand or power to the unit. The GC-1 is equipped with a Safety Dormant Lockout circuit (sleep mode). This circuit continuously monitors the controller for internal circuit faults. In addition the Safety Dormant Lockout circuit senses potentially damaging frequency, voltage or current. If lockout is due to a self-test failure, or if damaging frequency, voltage or current has been sensed, the GC-1 will go into a Safety Dormant Lockout (LED lit). The controller will be shut off. The GC-1 controller may or may not have been damaged. The controller can only be reset by breaking and remaking power to the unit.

⚠ DANGER



Shock Hazard. Spark related components contain high voltage. Disconnect power before servicing unit. Ignition control is not field repairable. Can cause injury or death.

1 - Lennox GC-1 Ignition Control

The Lennox-built GC-1 ignition control (A3) is illustrated in figure 6. The unit wiring harness (P72) plugs directly into the jack (J72) at the corner of the control. A diagnostic lockout indicator light, a red LED, is visible through the GC-1 cover.

Spark wire connection is made to a spark plug type connector on the control. Sensor wire connection is made to a quick connect terminal.

⚠ IMPORTANT

A ceramic resistor spark plug must be used with the GC-1 ignition control.

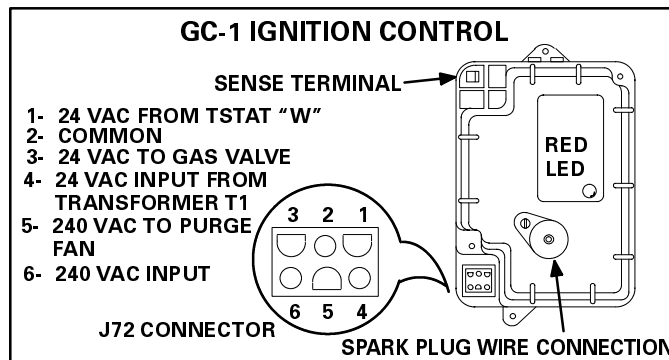


FIGURE 6

2 - Ignition Control Functions For GC-1 (Figures 7, 8 and 9)

The ignition control (A3) provides four main functions: prepurge, ignition, flame sensing and post-purge. The ignition attempt sequence of the control provides five trials for ignition before locking out. See figure 7 for a normal ignition sequence with nominal timings for simplicity.

Proper gas/air mixture is required for ignition on the first attempt. If there is a slight deviation, within tolerance of the unit, a second or third trial may be necessary for ignition.

The control will lock out the system if ignition is not obtained within five trials. Reset after lockout requires only breaking and re-making the thermostat demand. See figure 8 for the ignition attempt sequence for retries (nominal timings given for simplicity). Loss of combustion during a heating cycle is sensed through absence of flame signal causing the control to de-energize the gas valve and repeat the ignition sequence if a thermostat heating demand is present.

Ignition control timings (timing specific) are given in figure 9.

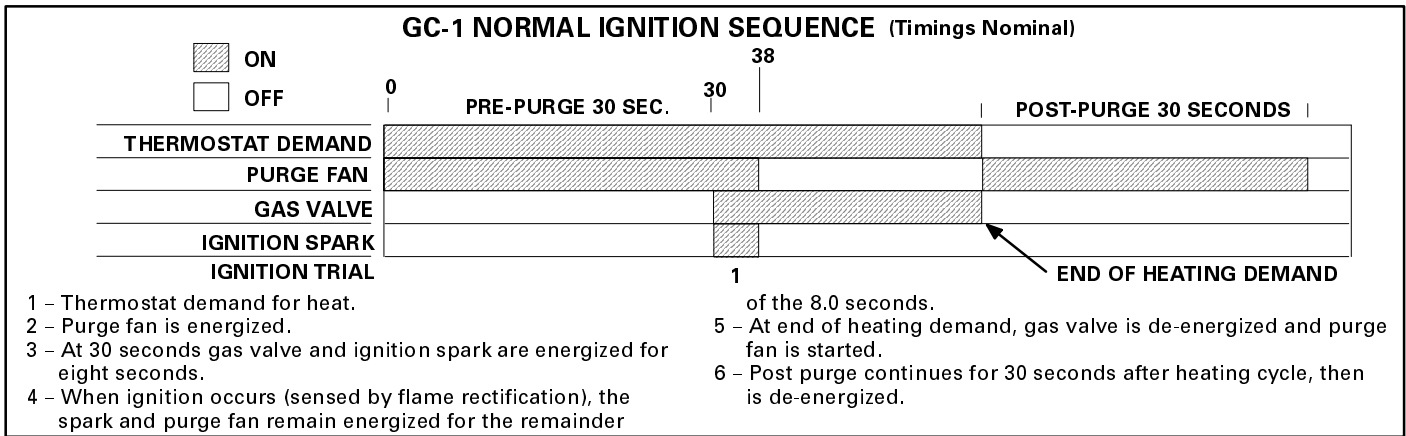


FIGURE 7

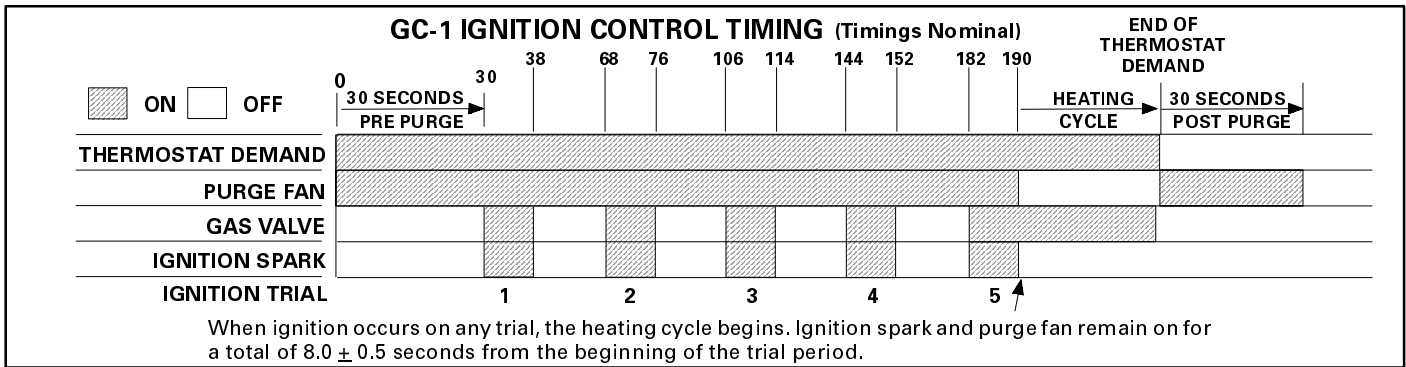


FIGURE 8

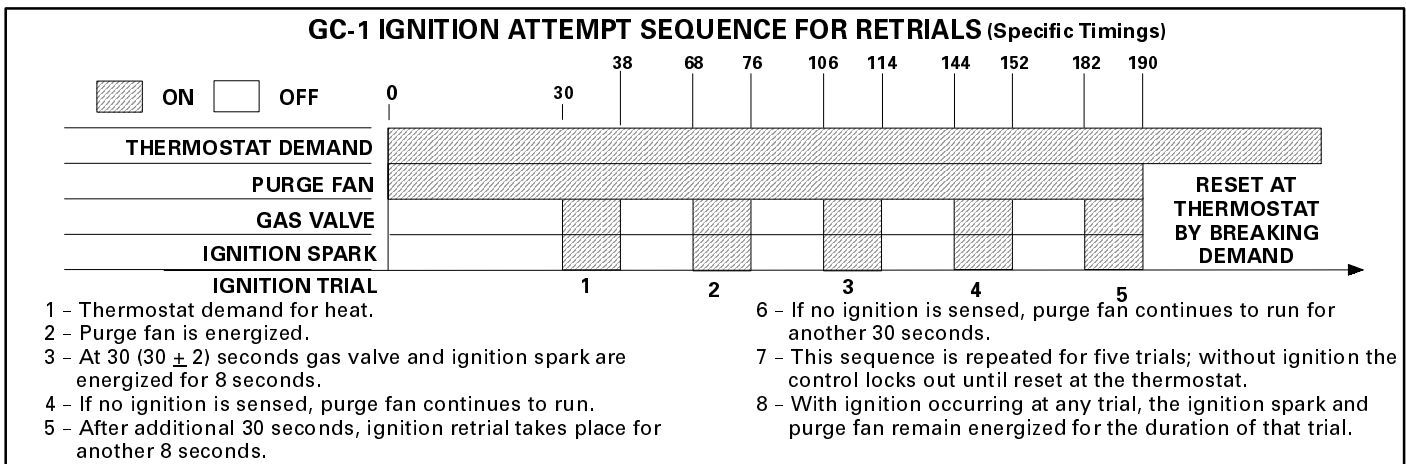


FIGURE 9

F - Differential Pressure Switch (Figure 10)

The differential pressure switch is mounted in the heating compartment [see unit components illustration (page 8) for exact location]. It is connected to the air intake and exhaust outlet by separate lengths of flexible plastic tubing. Note that each flexible hose connects to the barbed fitting at the differential pressure switch. See figure 10. Each fitting has a pop-in orifice of 0.016" I.D.

▲ IMPORTANT

Each orifice is critical to switch operation. The orifice reduces extreme positive and negative pressure "peaks" and must be used to prevent erratic switch operation. Do not remove orifice from barbed fitting in pressure switch.

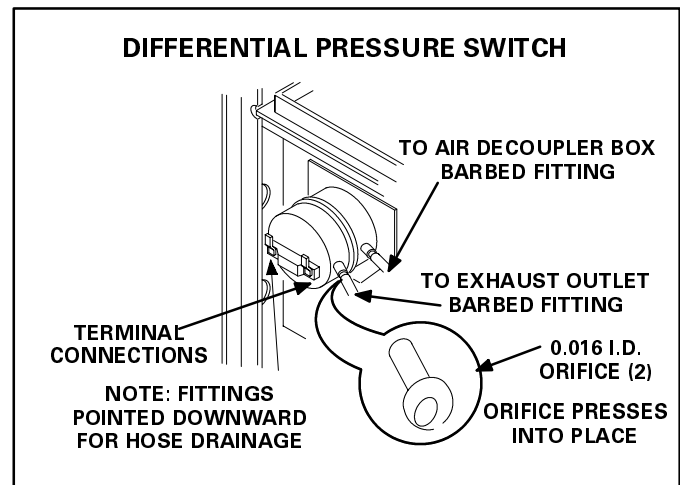


FIGURE 10

G - Gas Valve and Expansion Tank

1 - Gas Valve

Gas valves used on G21/GSR21 series units have various opening times. All gas valves are internally redundant to assure safety shutoff. If replacement is necessary, the valve must be replaced with the same type of valve. For example, replace a White Rodgers as shown in figure 11 with a White Rodgers valve.

2 - Expansion Tank

An expansion tank downstream of the gas valve absorbs back pressure created during combustion to prevent damage to gas valve diaphragm.

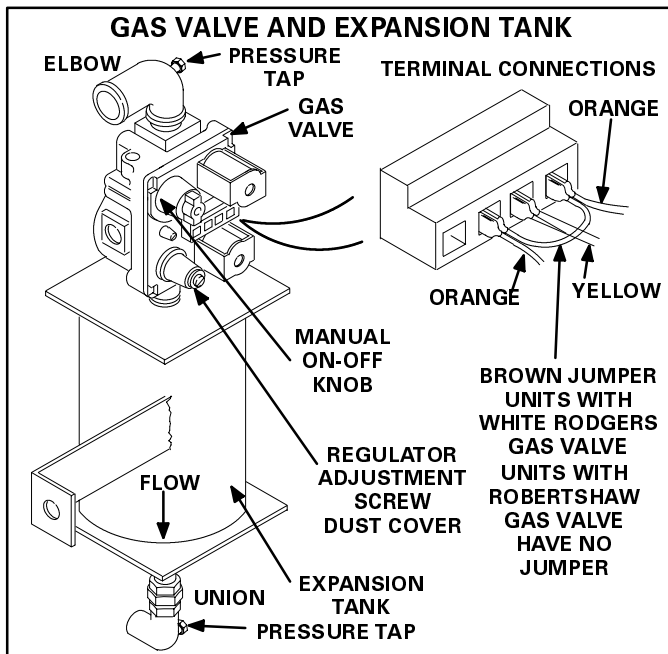


FIGURE 11

3 - Gas Valve Conversion (Figure 12)

A gas changeover kit is available to convert natural gas units to Liquid Petroleum Gas (Propane). Refer to the instructions provided in each specific kit for proper installation procedures.

C.G.A. G21/GSR21 units are not field convertible, but may be purchased already converted for L.P. operation. GSR21 (-50,-80) units are shipped with the components required for field conversion to L.P. gas.

GSR21-100 units are not shipped with the required components for field conversion to Liquid Petroleum Gas (Propane). An optional L.P. gas changeover kit is available from Lennox Repair Parts.

G21 (upflow) units are not shipped with the required components for field conversion to L.P. gas. An optional L.P. gas changeover kit is available from Lennox Repair Parts.

The kit includes one orifice, one gas valve conversion kit with heavy spring, one air diaphragm assembly (if necessary with that model) and changeover nameplate.

The following is a general guide for conversion to L.P. Refer to the instructions provided in each specific kit for proper installation procedures.

The existing gas orifice located in the elbow/gas flapper assembly must be removed and replaced with the orifice provided in the kit. GSR21 (-50,-80) use orifice provided with unit. See figure 12.

A spring behind the adjusting screw and governor cover screw must be replaced by a heavier spring also included in the kit.

GSR21 -50 and -80 units governor screw must be rotated so that end labeled "L.P." points toward regulator. See figures 12 and 13.

In G21/GSR21-100 and G21-40 units the air diaphragm must be replaced (supplied with kit). For G21-60/80 and GSR21-50/80 units, use existing air diaphragm assembly.

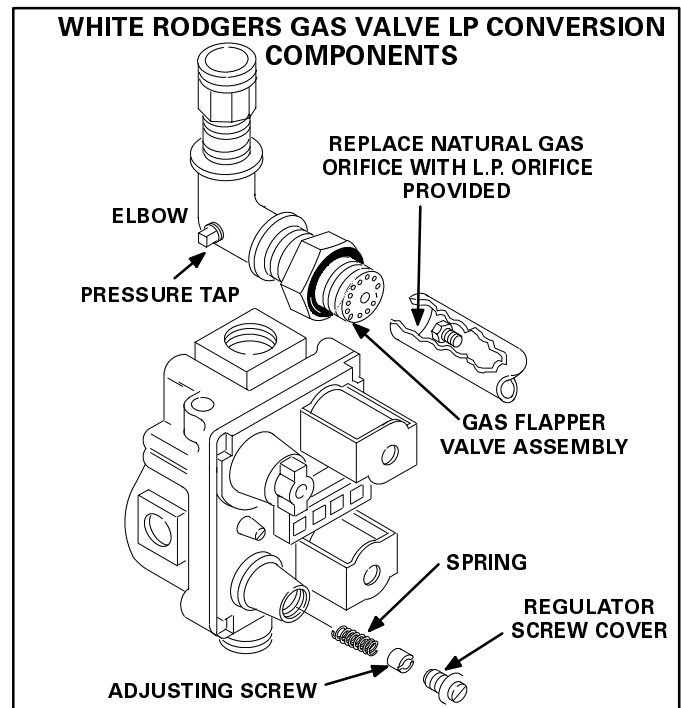


FIGURE 12

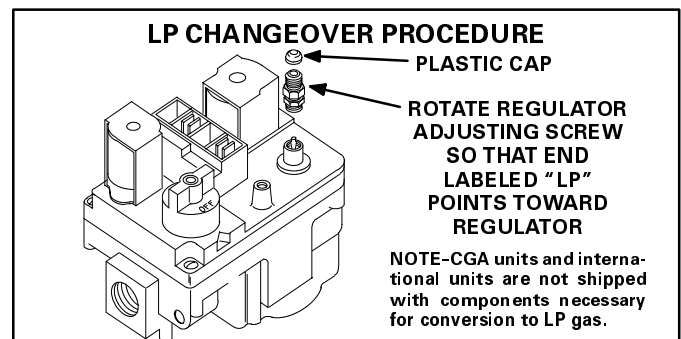


FIGURE 13

H - Gas Intake Flapper Valve & Orifice (Figure 14)

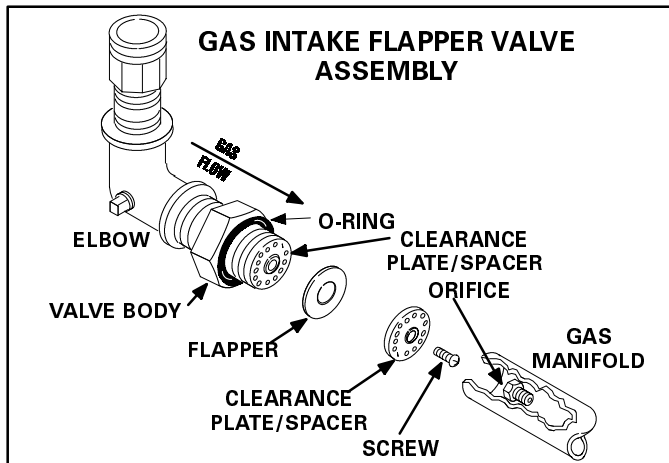


FIGURE 14

1 - Gas Intake Flapper Valve & Assembly

A union at the bottom of the expansion tank provides for removal of gas flapper valve assembly and orifice access. The flapper moves freely over a spacer and is opened against the clearance plate by incoming gas pressure. Back pressure from each combustion pulse forces the flapper against the valve body closing off gas supply. Refer to troubleshooting section for specific information about flapper valve inspection and conditions requiring replacement.

! IMPORTANT

Disconnect gas pipe at union. Tighten until bushing seats in orifice housing and gas pipe is in vertical position.

2 - Orifice

! WARNING

Standard atmospheric burner orifices or orifice blanks cannot be used as replacements in G21/GSR21 units.

Each G21/GSR21 unit uses only one orifice located downstream of the flapper valve and sized specifically for each unit. Refer to Service and Application notes for specific orifice size for each unit.

I - Air Intake Chamber & Purge Fan

1 - Air Intake Chamber

An air intake chamber houses the purge fan and air intake flapper valve assembly. Air enters through the air intake pipe (see parts arrangement on page 8), passes through the purge fan and the flapper valve to the combustion chamber. The entire air intake chamber is mounted on a large seal pad to eliminate vibration.

2 - Purge Fan

The purge fan has a 240 volt motor and is permanently lubricated. It is powered during pre- and post-purge and ignition. After the sensor proves flame, the purge fan is de-energized and air is drawn through the fan by negative pressure. During combustion the fan is not powered.

J - Air Intake Flapper Valve

The air intake flapper valve is similar to the gas flapper valve in operation. A flapper moves freely over a spacer between two plates. In actual operation, the flapper is forced against the clearance plate by the purge fan allowing air to enter the combustion chamber. Next, back pressure from combustion forces the flapper against the cover plate closing off the air supply. Finally, as a negative pressure is created in the combustion chamber, the flapper is drawn to the clearance plate and air enters. Once ignition has occurred, back pressure and negative pressure control the flapper valve with each combustion pulse.

K - Spark Plug & Sensor (Figure 15)

! IMPORTANT

GSR21 series units require a ceramic resistor spark plug.

! IMPORTANT

The spark plug is torqued to 28 ± 2 foot/lbs. The sensor is torqued to 14 ± 1 foot/lbs. Allow metal to cool before measuring torque.

The spark plug is used in conjunction with the primary control for igniting the initial gas and air mixture and is only used during startup.

Figure 15 gives the proper spark gap setting. Note the unusual electrode angle in comparison to other spark plug applications. A feeler gauge can be used to check the gap.

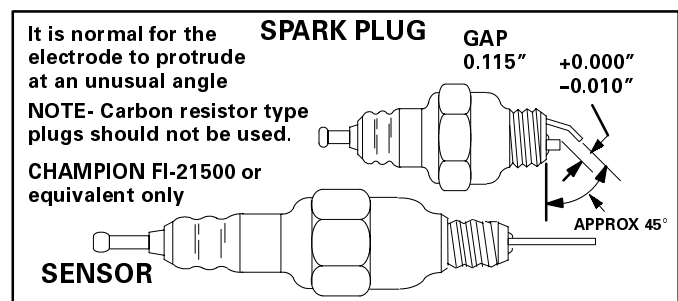


FIGURE 15

Temperatures in the combustion chamber keep the plug free from oxides. It should not need regular maintenance. Compression rings are used to form a seal to the chamber.

The spark plug type sensor has a single electrode (no earth strap). Compression rings are used to form a seal to the chamber. It also should not need regular maintenance. Removal of the plug/sensor is aided by a Lennox spark plug/sensor removal tool. See figure 16. It is available from Lennox Repair Parts, part #20H43.

The spark plug and sensor are located on the left side of the combustion chamber, see figures 17 and 18 for exact location. The sensor is the top plug and is longer than the spark plug. The spark plug is in the lower position. Plugs cannot be interchanged due to different thread diameters.

L - Combustion Chamber & Heat Exchanger Assembly (Figures 17 and 18)

1 - Combustion Chamber

The combustion chamber has gas and air intake manifolds. See figures 17 and 18 for exact location. Exhaust gas leaves through the tailpipe at the top of the chamber.

2 - Tailpipe

The tailpipe connects the combustion chamber to the exhaust gas decoupler. The tailpipe and decoupler create the proper amount of back pressure for combustion to continue and are major heat exchanger components. The resonator provides attenuation for acoustic frequencies. See figures 17 and 18 for exact location.

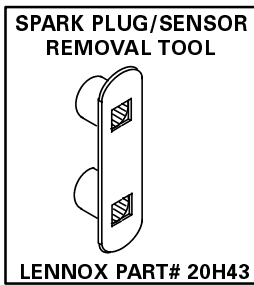


FIGURE 16

3 - Exhaust Decoupler

The exhaust decoupler is manifolded into the condenser coil. Latent heat of combustion is extracted from exhaust gas in the condenser coil. When this is done, condensate (moisture) is produced. The circuiting of the coil allows for proper drainage of condensate to the exhaust outlet line. See figures 17 and 18 for exact location.

4 - Heat Exchange Assembly

Each unit input size uses a specific heat exchanger assembly. Externally, they may appear the same, but **THEY MUST NOT BE INTERCHANGED** between unit input sizes. Internal characteristics related to unit input properly match each assembly for unit input rating. See figures 17 and 18 for exact location.

The entire heat exchange assembly is mounted on rubber isolation mounts to eliminate vibration.

! IMPORTANT

If heat exchanger must be replaced, keep orifice from the old heat exchanger. New orifices are not supplied with replacement heat exchangers.

M - Gas & Air Components Applied to Heat Exchanger (Figures 17 and 18)

Figures 17 and 18 identify all of the components of the basic heating assembly.

Combustion Procedure in G21/GSR21 Units:

- 1 - Gas flows through the valve, expansion tank, flapper valve and orifice into the combustion chamber.
- 2 - Air flows through the air flapper valve and directly into the combustion chamber. Spark occurs.
- 3 - Combustion takes place and exhaust gas flows through the tailpipe, exhaust decoupler and condenser coil to the exhaust outlet.

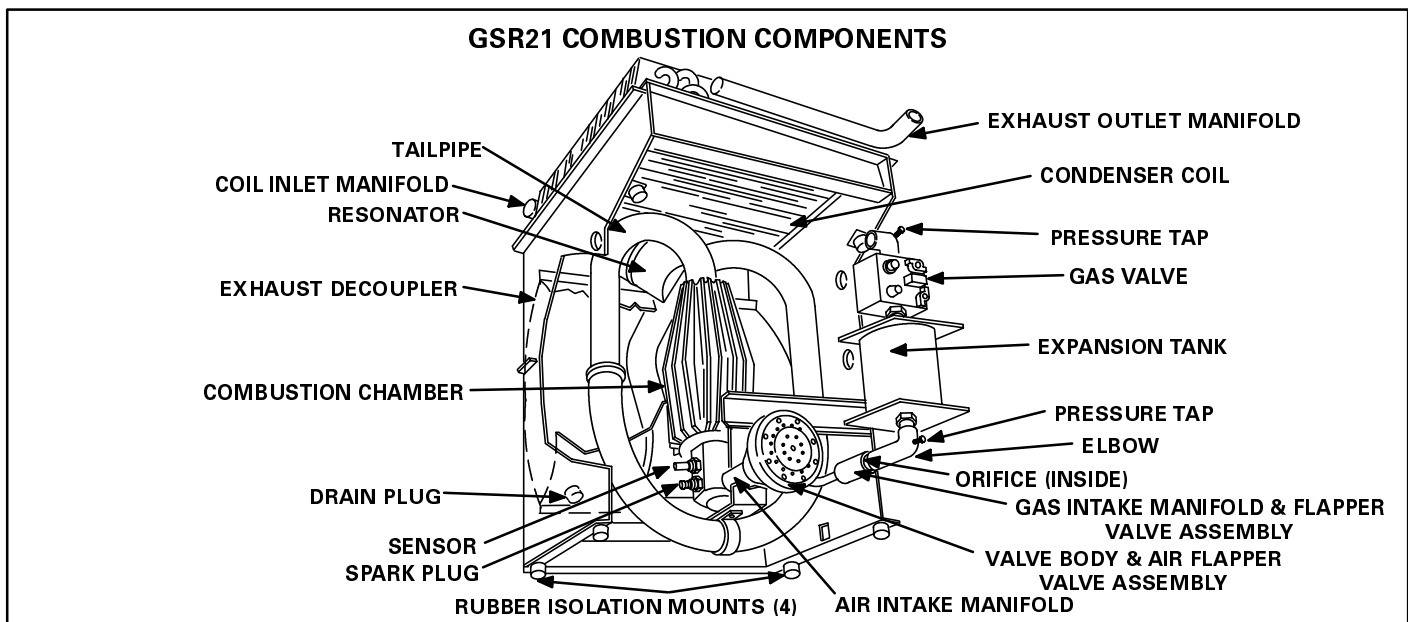


FIGURE 17

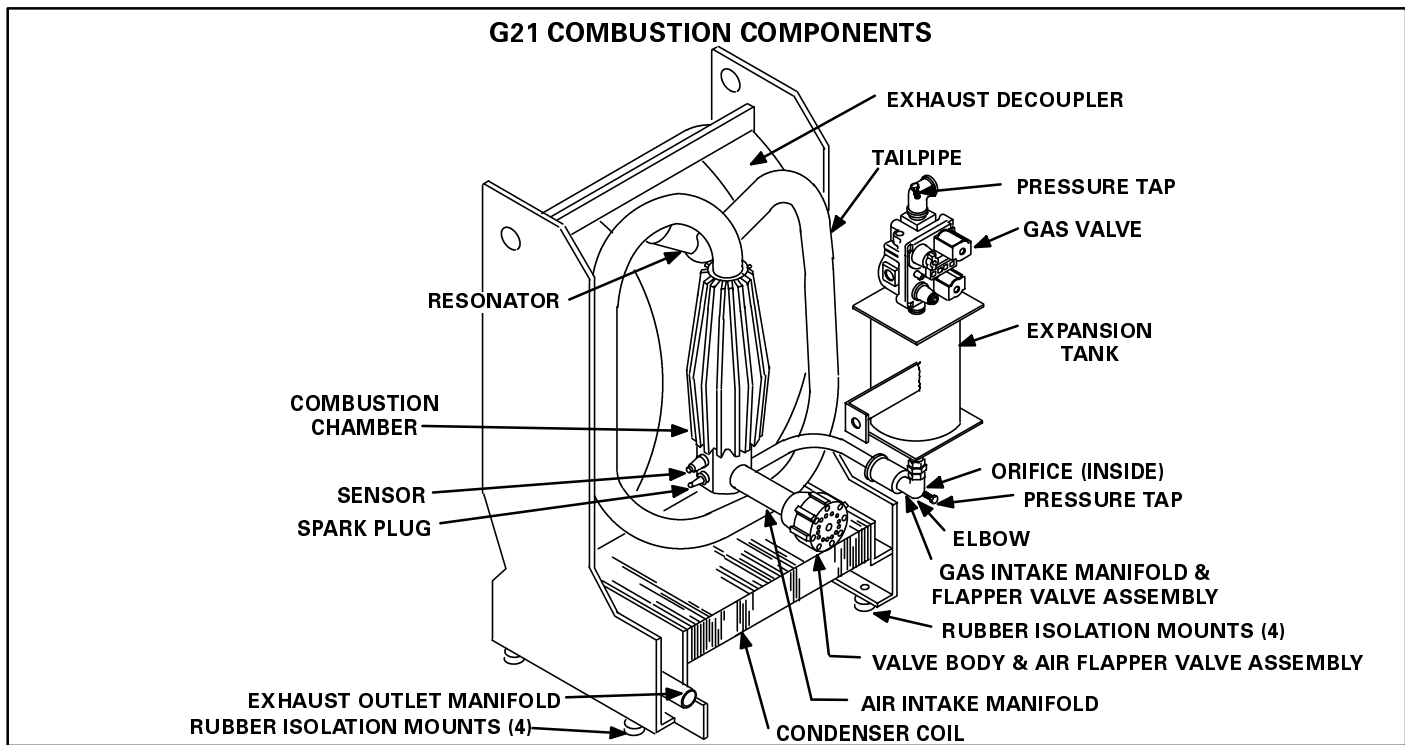


FIGURE 18

N - Fan Motors and Capacitors

All G21/GSR21 units use direct drive fan motors. All motors are 240V permanent split capacitor motors to ensure maximum efficiency. See table 2 for ratings. Multi speed fan motors are factory wired for low speed (red tap) heating. GSR21Q3-80 are wired for medium speed (yellow tap) heating.

TABLE 2

FAN RATINGS 240V 1PH			
FAN MOTOR	HP	Watts	Capacitor
Q3	1/2	248W	5 MFD 370V
Q4	1	373W	7.5 MFD 370V
Q5	1	559W	40 MFD 370V

1 - Fan Speed Taps

Fan speed tap selection is accomplished by changing taps on the fan speed terminal block. See table 3 for fan speed selections.

TABLE 3

FAN SPEED SELECTION					
UNIT	Factory Connected Speed Taps		Motor Speeds Available		
	Cool	Heat			
Q3-40	2	4	3		
Q3-60		4			
Q3-80		3			
Q3-100		4			
Q4		5			
Q4/5,5		6			
FAN SPEED SELECTION					
	HI ← → LOW				
SPEED TAPS	2	3	5	3	
	2	3	4	5	4
	2	3	4	5	6

To Change Fan Speed:

- 1 - Turn off electric power to heater.
- 2 - Remove fan compartment access door.
- 3 - Fan speed terminal block is located on the fan housing. It is in the vertical position in downflow and horizontal units (GSR21) and in the horizontal position in upflow models (G21).
- 4 - Refer to unit Fan Performance Data to determine fan speed required to obtain air volume against system static pressure.
- 5 - Loosen screw securing fan speed selection lead. The red wire is for heating speed selection, the black lead is for cooling speed selection.
- 6 - Remove wire and reposition to desired speed. (L, ML, M, MH, H). Refer to figure 19.

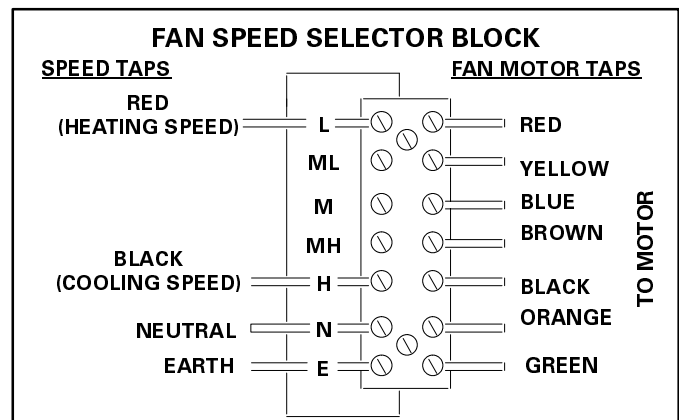


FIGURE 19

NOTE-In some applications it may be desirable to operate the the fan on high speed in both heating and cooling applications. In these instances connect the red lead and the black lead to the (H) terminal on the fan speed selector block. Refer to figure 20.

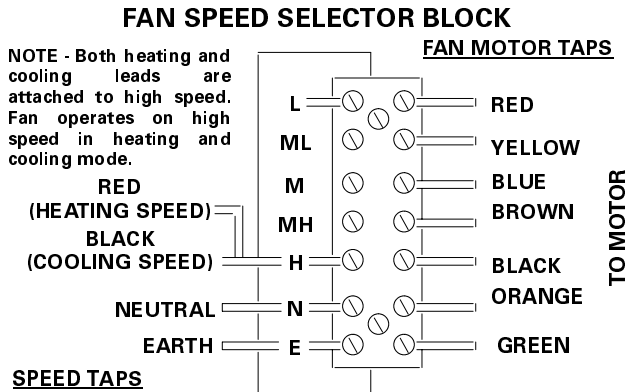


FIGURE 20

III - PROPER INSTALLATION

Refer to the G21/GSR21 series units Installation-Operation-Maintenance Instruction Manual for complete installation instructions. Also see figures 21, 22 and 23.

On units equipped with a GC-1 ignition control, on initial power-up of the ignition control, it is possible to get a spark from the spark plug without any heating demand from the thermostat. This is an inherent property of ignition controls used in all air heaters. A spark could ignite any PVC glue fumes accumulated in the combustion chamber and could result in drain tap or intake line damage.

⚠ DANGER

Due to highly volatile and inflammable nature of PVC glue fumes used to connect intake and exhaust lines, some safety precautions should be used if the air heater is to be started immediately after completing PVC line hookup. If it is necessary to start the unit immediately, remove spark plug wire from ignition control and allow several purge cycles to remove glue fumes from heat exchanger.

A - Proper Earthing

G21/GSR21 units are equipped with an earth lug located in the control box. Connection to earth is made here.

B - Isolation Mount Pads (Isomode)

If leveling bolts are not used, vibration isolating pads should be used especially when installed on wood flooring. Isomode pads or equivalent should be used.

C - Flexible Connector (Supply and Return Air Plenum)

A flexible canvas connector or equivalent should be used in the supply air plenum, above the cooling coil or future coil location. For the return air plenum a flexible canvas connector or equivalent should be used and located as close to the heater as possible. It is preferred to locate the connector between the heater and the external electronic air cleaner, if used.

D - Supply Air Plenum or Return Air Plenum Insulation Past First Elbow

A 1.5 to 3 lb. density, matte face, 25mm (1") thick insulation should be used internally up to the first elbow or take-off and all exposed edges protected from air flow. Thereafter, insulation should be applied to the exterior of the duct system to conserve heat.

E - Transporting the Unit

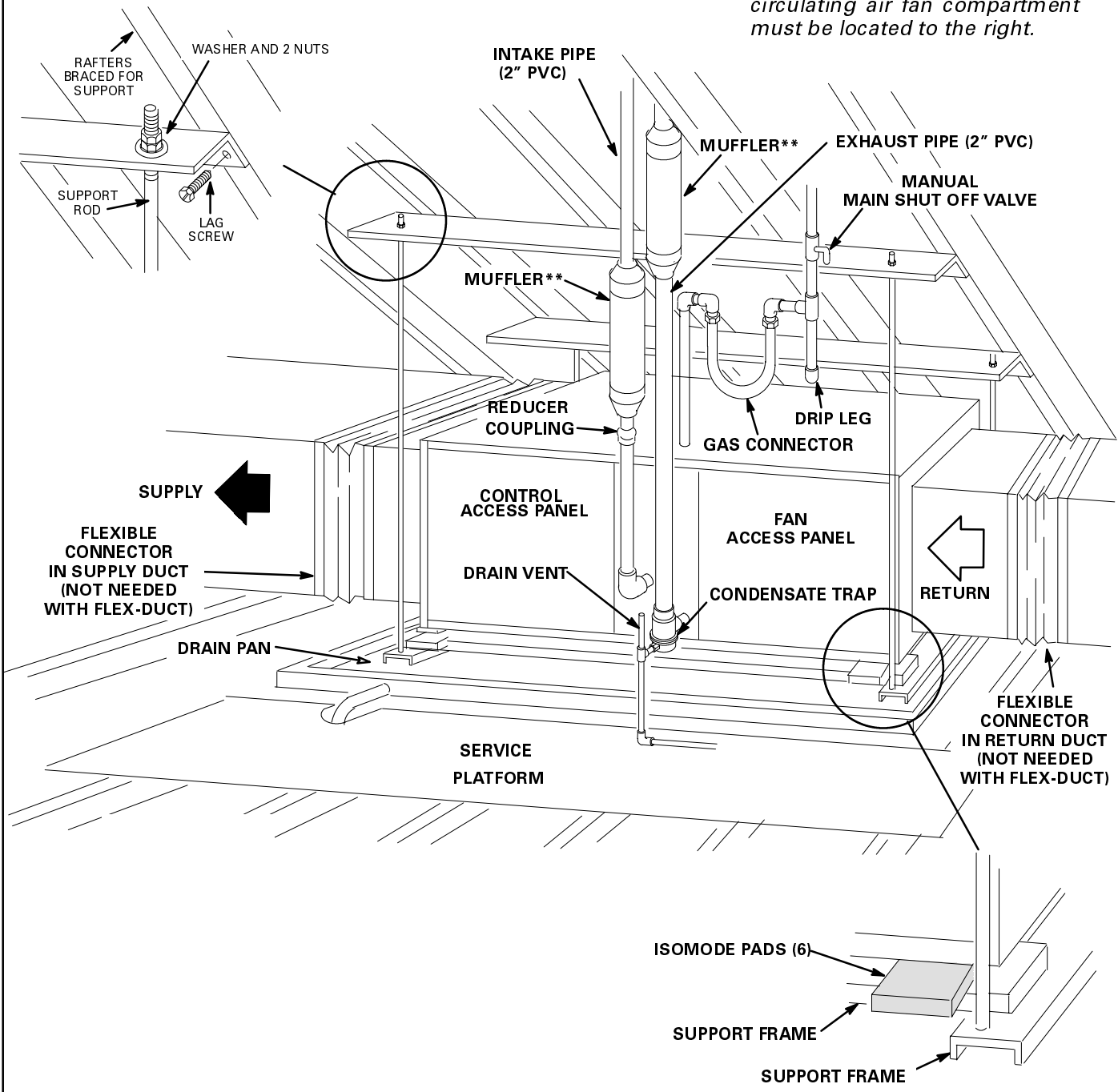
When moving or lifting the unit all access panels must be in place to prevent damage (sagging) to the unit. The fan may be removed to reduce the unit weight while moving.

F - Electrical Conduit Isolated from Duct System and Joists

The electrical conduit can transmit vibration from the cabinet to the duct system or joists if clamped to either one. It may be clamped tightly to the unit cabinet but should not touch ductwork or joists.

TYPICAL GSR21 HORIZONTAL INSTALLATION*

When viewing unit from front, circulating air fan compartment must be located to the right.

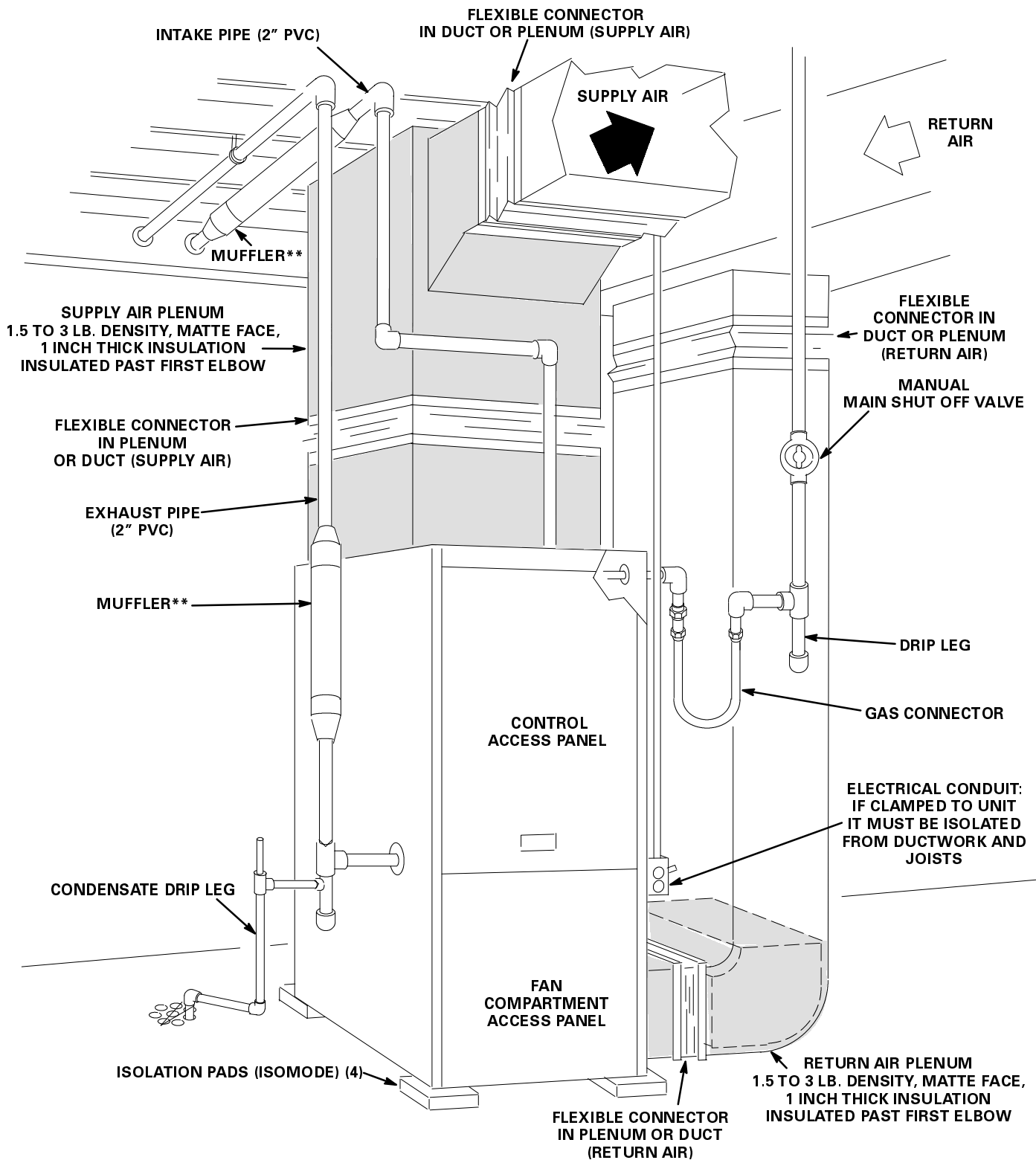


*INSTALLATION PROCEDURES OUTLINED IN THIS MANUAL ARE PRESENTED AS RECOMMENDATION ONLY AND DO NOT SUPERSEDE OR REPLACE LOCAL CODE. IF LOCAL CODES DO NOT EXIST, THE PROCEDURES OUTLINED IN THIS MANUAL ARE RECOMMENDED ONLY AND DO NOT CONSTITUTE CODE.

**ALL G21/GSR21 UNITS REQUIRE THE USE OF MUFFLERS.

FIGURE 21

TYPICAL G21 INSTALLATION*

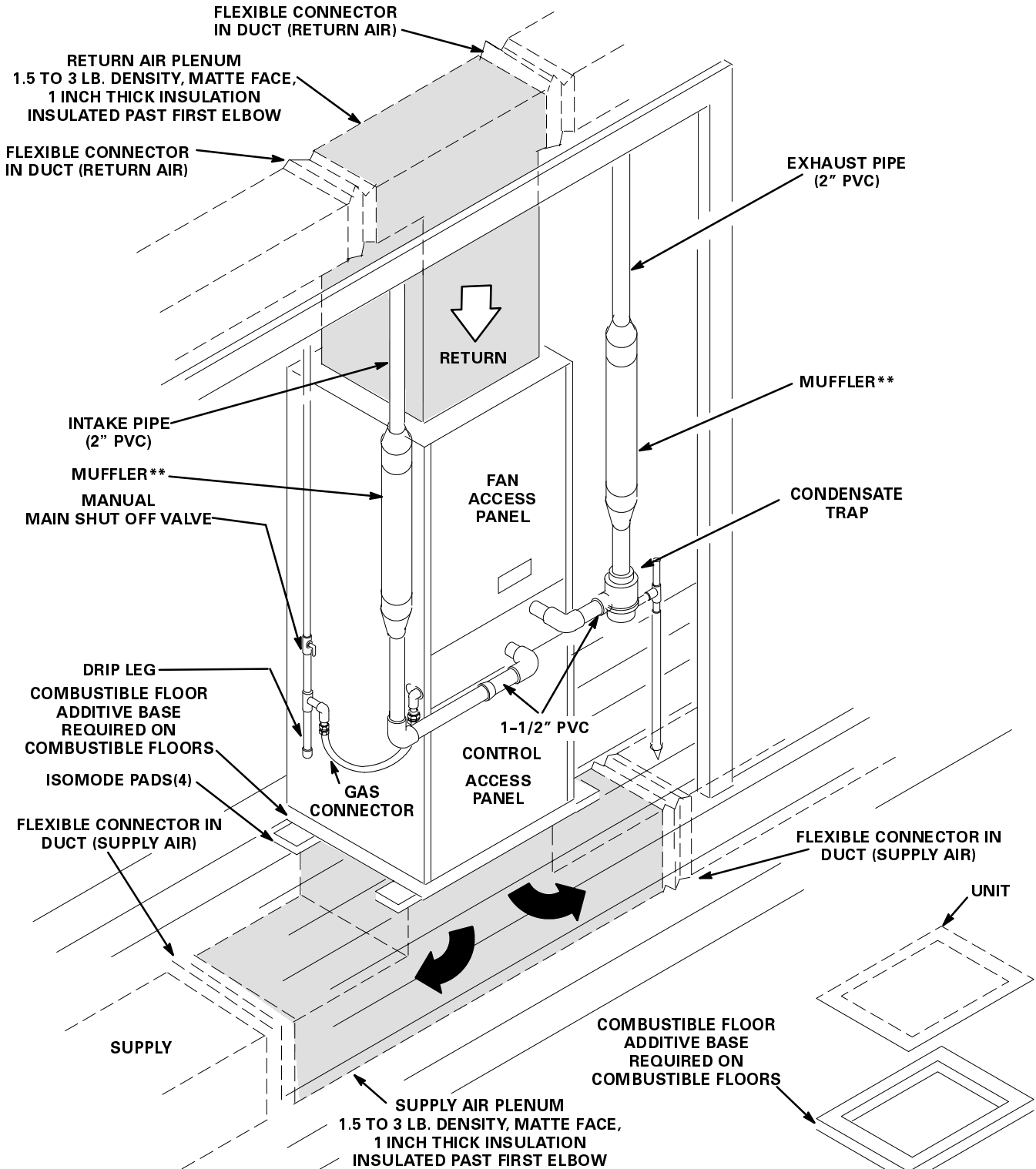


*INSTALLATION PROCEDURES OUTLINED IN THIS MANUAL ARE PRESENTED AS RECOMMENDATION ONLY AND DO NOT SUPERSEDE OR REPLACE LOCAL CODE. IF LOCAL CODES DO NOT EXIST, THE PROCEDURES OUTLINED IN THIS MANUAL ARE RECOMMENDED ONLY AND DO NOT CONSTITUTE CODE.

**ALL G21/GSR21 UNITS REQUIRE THE USE OF MUFFLERS.

FIGURE 22

TYPICAL GSR21 DOWNFLOW INSTALLATION*



*INSTALLATION PROCEDURES OUTLINED IN THIS MANUAL ARE PRESENTED AS RECOMMENDATION ONLY AND DO NOT SUPERSEDE OR REPLACE LOCAL CODE. IF LOCAL CODES DO NOT EXIST, THE PROCEDURES OUTLINED IN THIS MANUAL ARE RECOMMENDED ONLY AND DO NOT CONSTITUTE CODE.

**ALL G21/GSR21 UNITS REQUIRE THE USE OF MUFFLERS.

FIGURE 23

G - Condensate Line (Figure 24)

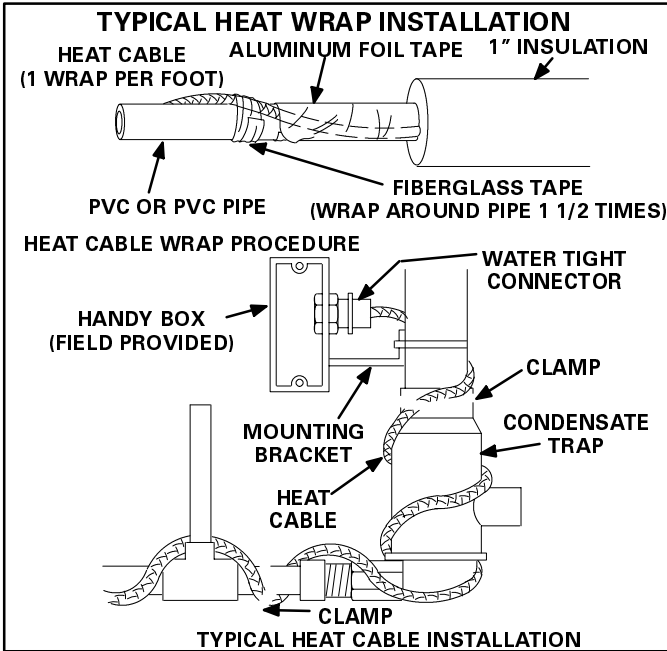


FIGURE 24

When installing the unit in areas subjected to freezing temperature, the condensate trap and condensate line must be wrapped with electrical heat cable to prevent the condensate from freezing. A heat cable kit, which is approved for use with PVC pipe is available from Lennox Repair Parts. Refer to G21/GSR21 heat cable kit installation instructions for proper application.

H - Gas Supply Piping Centered In Inlet Hole (Figure 25)

A 600mm length of flexible reinforced hose that meets BS-6501 or similar code should be used. Gas supply pipe should not rest on the unit cabinet. See figure 25. The gas supply connector should be hung as shown in figure 26.

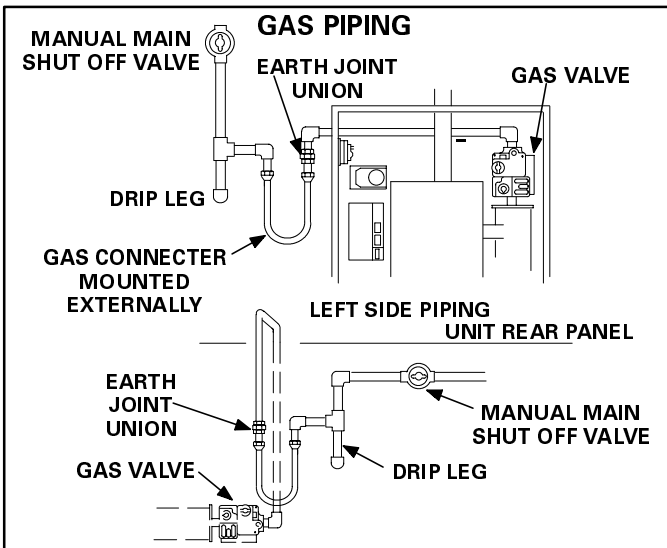


FIGURE 25

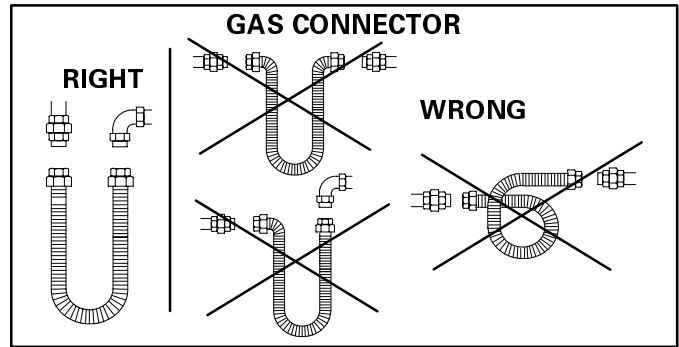


FIGURE 26

⚠ WARNING

The flexible gas connector must be mounted external to the unit. The connector must hang freely and must not contact or rub outside objects. The flexible connector must not enter the unit. See figure 25.

I - Mufflers

All G21/GSR21 units require the use of mufflers.

⚠ IMPORTANT

Any time an exhaust muffler is used in areas subjected to freezing temperature, a heat cable kit must be used on the muffler to prevent condensate from freezing.

Use only Lennox heat cable kits which are approved for use with PVC pipe.

J - Exhaust Insulation

In areas subject to freezing temperature, exhaust pipe must be insulated with 1/2" Armaflex or equivalent when run through unconditioned space. In extreme cold climate areas, 3/4" Armaflex insulation is recommended.

K - Isolation Hangers (Figure 27)

PVC piping for intake and exhaust lines should be suspended (supported) from hangers every five feet. A suitable hanger can be fabricated from a 25mm (1") wide strip of 26 ga. metal covered with "Armaflex" or equivalent. See figure 27.

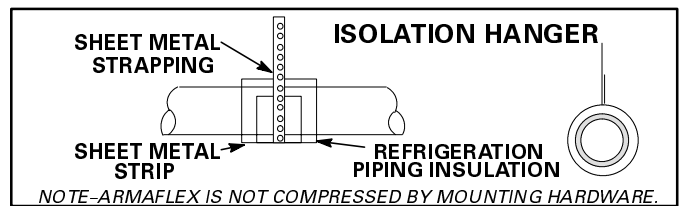


FIGURE 27



FIGURE 28

L - Horizontal Mounting (Figure 28)

When mounting unit horizontally it must be placed so that when facing the unit the airflow is from right to left. This placement is necessary so moisture can drain from the condensing coil. This must not be changed. If installed in any other position, such as inverted or on its back, the condensing coil will fill with condensate and make the unit inoperable. See figure 28.

M - Support Frame and Suspension Rods (Figure 28)

A support frame must be used to prevent damage anytime a unit is to be suspended. A support frame kit is available from Lennox.

N - Raised Platform

When installed in under a suspended floor or on attic beams it is important that the unit be supported by a flat base to prevent damage (sagging) to unit.

O - Combustible Floor Additive Base

A combustible floor additive base (figure 23) must be used when the unit is installed on a combustible floor (downflow installations). It must be constructed to provide a non-combustible barrier between the heater and the floor.

P - Drain Pan

A drain pan should be used in all applications where surrounding structures, such as walls or ceilings, might be damaged by potential condensate leakage. If an evaporator coil is used, the drain pan should be extended under the coil to catch potential condensate leakage.

In any installation where the unit is mounted horizontally a drain pan can be used to catch potential condensate leakage.

Q - Drip Leg Assembly (G21 only) Figure 29

A drip leg must be used to remove condensate and exhaust from the unit. A drip leg assembly may be used on the G21 only. If unit condensate line is clogged or obstructed, excess water may shut down the unit.

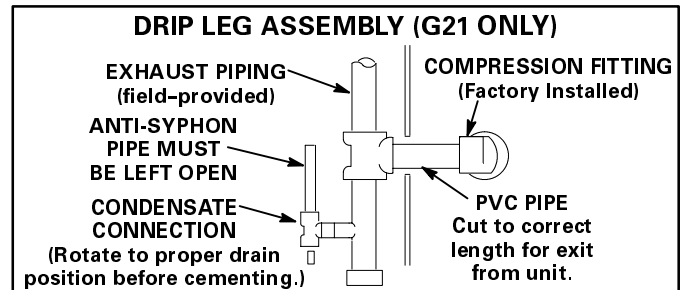


FIGURE 29

R - Ball Float Condensate Trap Assembly (G21/GSR21) Figures 30, 31 and 32

A ball float condensate trap must be used on GSR21 and may be used on G21 units. It was designed to save room below GSR21 units in horizontal installations. The float trap serves a dual purpose. It is a means of removing condensate and exhaust gasses from the unit.

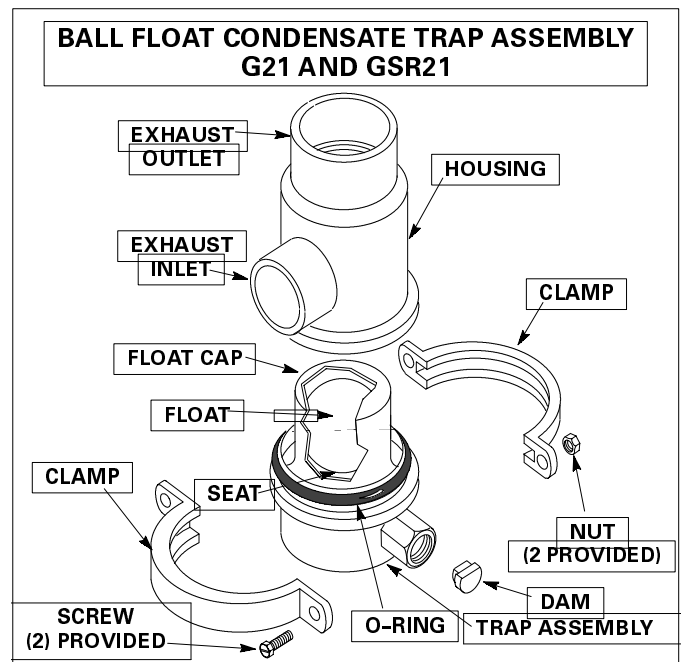


FIGURE 30

When installing a ball float trap, certain precautions should be taken. Condensate trap housing must be cemented to both inlet and outlet exhaust pipes perpendicular with the bottom of unit to ensure proper operation of trap float. Complete installation procedures are outlined in GSR21 installation and operation instructions.

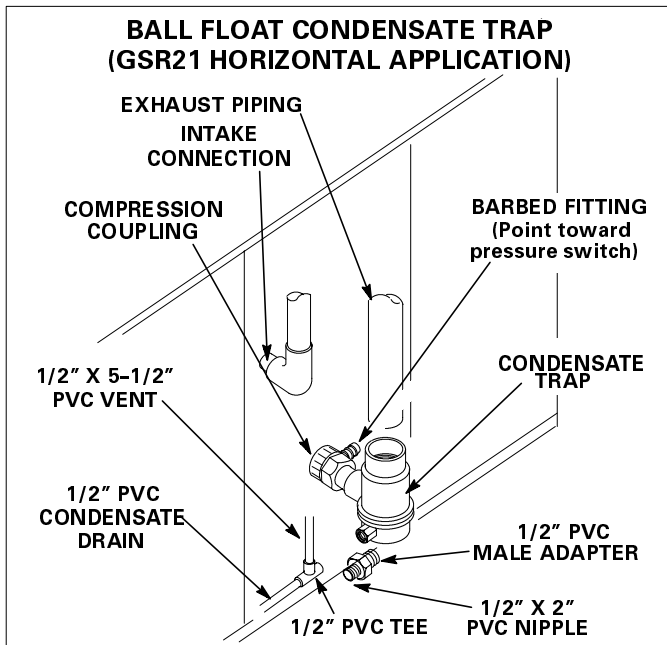


FIGURE 31

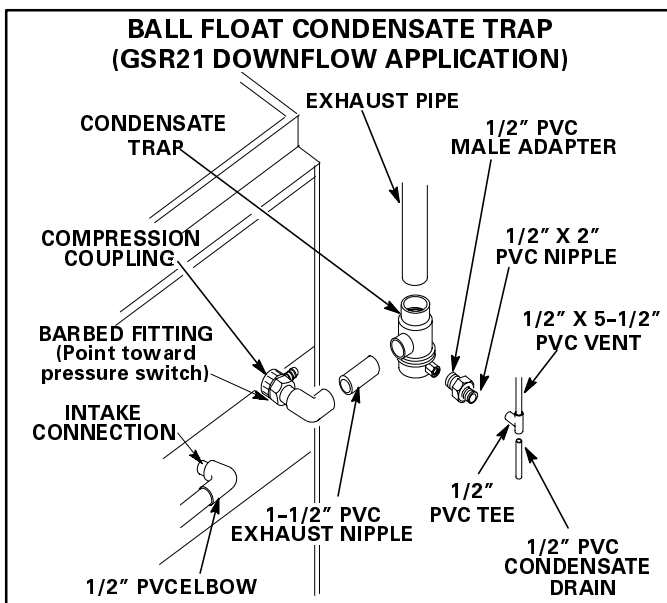


FIGURE 32

Service Procedures for Ball Float Condensate Trap

- 1 - Remove screws and clamps from condensate trap assembly.
- 2 - Lower trap assembly from housing. Care should be taken not to crack seal from housing to exhaust pipe and compression coupling.
- 3 - Disconnect trap assembly from condensate line.
- 4 - Remove float cap, float, seat, and o-ring and visually inspect for cuts or breakdown of material. If seat, float or o-ring are worn, a G21/GSR21 Condensate Trap Parts Replacement Kit is available from Lennox Repair Parts.
- 5 - Use a 1/4" hex wrench, remove plastic dam located in condensate line connection of trap assembly. Check interior of trap assembly for debris.

- 6 - Clean trap assembly with a mild soap and rinse thoroughly.
- 7 - Carefully reinstall dam, seat, float, float cap, and o-ring to trap assembly. If float cap does not snap closed, the entire trap assembly must be replaced.
- 8 - Connect trap assembly to condensate line.
- 9 - Lubricate o-ring with water or silicone based lubricant and reinstall trap assembly to housing. Using existing clamps and screws, secure trap assembly to housing.

⚠ WARNING

After reassembly, double check all connections to prevent exhaust products from entering living space.

S - Concentric Termination (Figures 33, 34 and 35)

In concentric termination, intake and exhaust piping are centrally located. See figures 33 and 34. See figure 35 for a detailed cutaway.

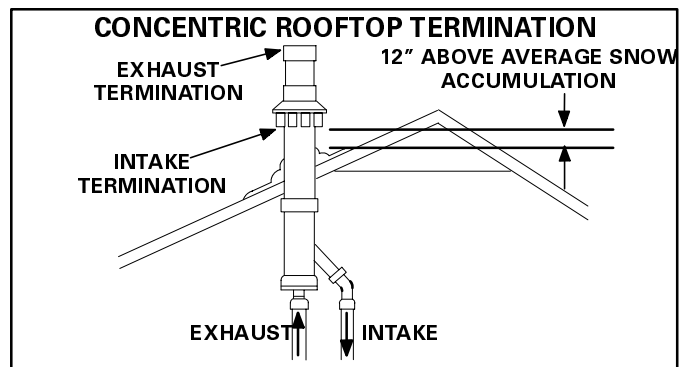


FIGURE 33

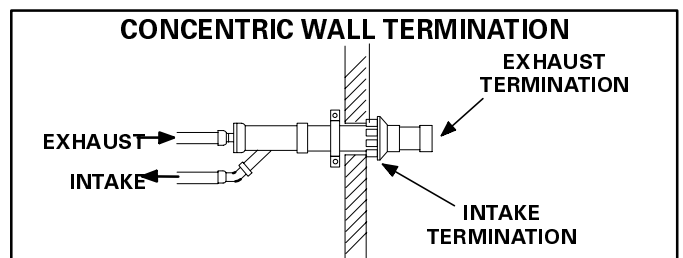


FIGURE 34

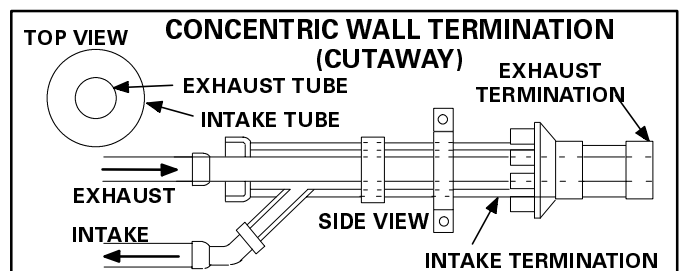


FIGURE 35

Exhaust piping must terminate straight out or up at a level 305mm (12 in.) above normal snow accumulation. Termination must not be within 2m (6ft.) of other vents or 1m (3ft.) of structure openings. For proper vent sizes see table 4.

TABLE 4

MINIMUM DIAMETER FOR G21/GSR21 VENTING mm (in.)					
Maximum Pipe Length m. (ft)	Number of 90° Elbows				
	0	2	4	6	8
1.5 (5)	50 (2)	50 (2)	50 (2)	50 (2)	50 (2)
3.0 (10)	50 (2)	50 (2)	50 (2)	50 (2)	50 (2)
6.0 (20)	50 (2)	50 (2)	50 (2)	50 (2)	64 (2-1/2)
9.1 (30)	50 (2)	50 (2)	50 (2)	2-1/2	64 (2-1/2)
12.2 (40)	50 (2)	50 (2)	64 (2-1/2)	64 (2-1/2)	64 (2-1/2)
15.2 (50)	50 (2)	64 (2-1/2)	64 (2-1/2)	64 (2-1/2)	64 (2-1/2)
18.3 (60)	64 (2-1/2)	64 (2-1/2)	64 (2-1/2)	64 (2-1/2)	75 (3)
21.3 (70)	64 (2-1/2)	64 (2-1/2)	64 (2-1/2)	75 (3)	75 (3)
24.4 (80)	64 (2-1/2)	64 (2-1/2)	75 (3)	75 (3)	75 (3)
27.4 (90)	64 (2-1/2)	75 (3)	75 (3)	75 (3)	75 (3)

Refer to GSR21/GSR14 Exhaust/Intake Air Termination Kits installation instructions for installation procedures which meet local and national codes.

! IMPORTANT

The exhaust line must be reduced at wall termination to 38mm (1-1/2").

T - Standard Intake/Exhaust Termination (Figures 36, 37, 38, 39)

Intake and exhaust pipes should be placed as close together as possible at termination end. MAXIMUM SEPARATION IS 75mm (3 IN.) ON ROOF TERMINATION AND 152mm (6 IN.) ON SIDE WALL TERMINATIONS. END OF EXHAUST PIPE MUST EXTEND AT LEAST 203mm (8 IN.) PAST END OF INTAKE PIPE.

The INTAKE must be upwind of the exhaust pipe and both pipes MUST be in the same pressure zone (do not terminate one pipe through the roof and one through the side of the building). These precautions are to ensure that the pressure difference under which the unit operates is within the range required by the unit. It is in effect a balanced flue unit. It also ensures that no recirculation of the exhaust gasses can take place.

Exhaust piping must terminate straight out or up and termination must not be within 1.8m (six feet) of other vents or three feet of structure openings. For proper sizing see table 4.

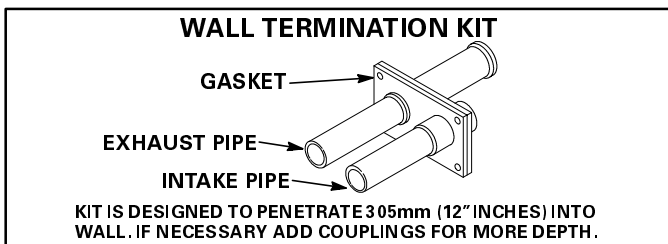


FIGURE 36

! WARNING

Solvent cements for plastic pipe are flammable liquids and should be kept away from all sources of ignition. Good ventilation should be maintained to reduce fire hazard and to minimize breathing of solvent vapors. Avoid contact with skin and eyes.

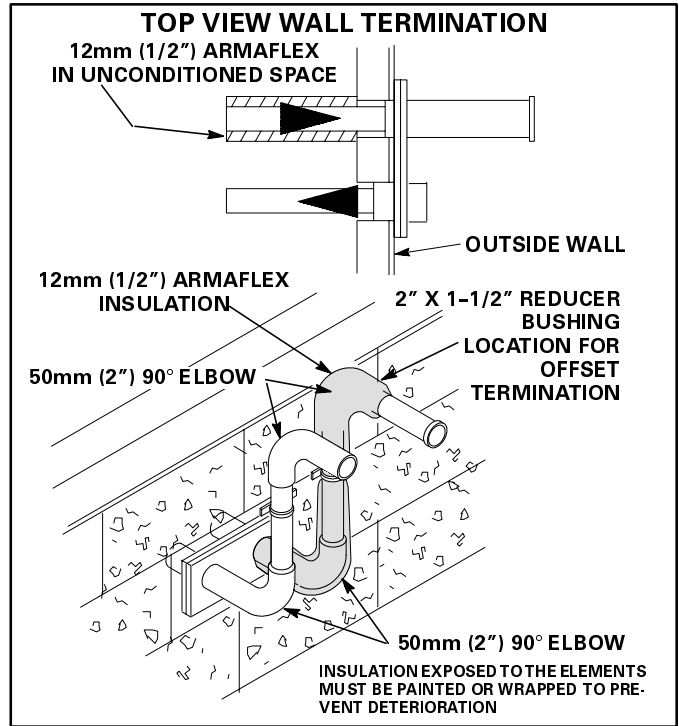


FIGURE 37

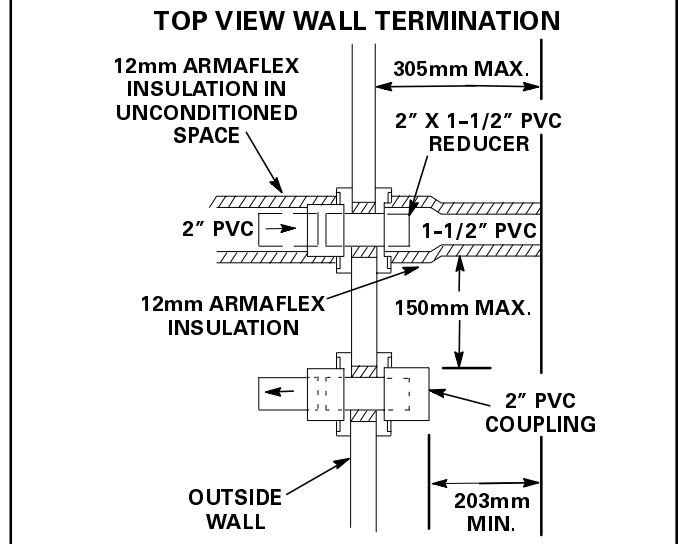
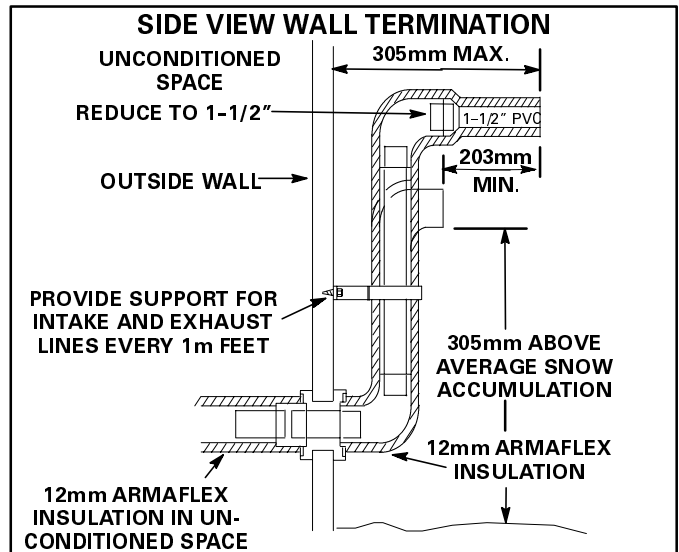


FIGURE 38

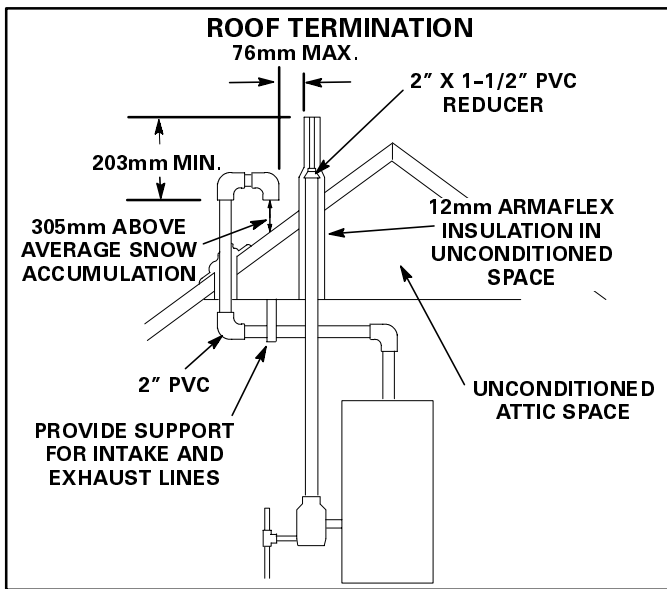


FIGURE 39

IV – SEASONAL MAINTENANCE

At the beginning of each heating season, the system should be checked as follows:

A – Supply Air Fan

- 1 – Check and clean fan wheel
- 2 – Motor Lubrication- Always lubricate the fan motor according to the manufacturer’s lubrication instructions on each motor. If no instructions are provided, use the following as a guide:
 - a – Motors without oiling ports - Pre-lubricated and sealed no further lubrication needed.
 - b – Direct drive motors with oiling ports - Pre-lubricated for an extended period of operation. For extended bearing life, use a few drops of a good grade of electric motor oil or SAE10 or SAE20 non-detergent motor oil every two years. It may be necessary to remove the fan assembly for access to oiling ports.

B – Filters

- 1 – Filters must be cleaned or replaced when dirty to assure proper unit operation. Clean as necessary.
- 2 – The filters supplied with the G21/GSR21 can be washed with water and mild detergent. When dry, they should be sprayed with Filter Handicoater before reinstalling in the unit. Filter Handicoater is RP Products coating no. 418 and is available from Lennox Repair Parts (No. P-8-5069).

C – Fan Controls & Limit Controls

Check fan and limit controls for proper operation and setting. For settings, refer to the sections on the Fan Motor and Capacitor and Limit Control in this manual.

D – Purge Fan

Periodically inspect and clean purge fan wheel.

- 1 – Disconnect power to the unit.

- 2 – Remove upper heating compartment access panel.
- 3 – Remove air decoupler box cover.
- 4 – Remove wires that power purge fan.
- 5 – Remove screws holding purge fan housing together.
- 6 – Check and clean fan wheel.
- 7 – Reassemble in reverse order.

E – Intake/Exhaust Lines

Check intake and exhaust PVC lines and all connections for tightness and make sure there are no leaks or blockage. Also check condensate line for free flowing operation and complete drainage.

F – ELECTRICAL

- 1 – Check all wiring for loose connections.
- 2 – Check for correct voltage.
- 3 – Select fuse and wire size according to fan motor amps.
- 4 – Access openings are provided on both sides of cabinet to facilitate wiring.
- 5 – Install room thermostat according to instructions provided with thermostat.

G – Cleaning Heat Exchanger Assembly

! IMPORTANT

Use papers or protective covering in front of air heater while removing heat exchanger assembly.

! WARNING

If unit has been operating, internal components will be HOT. Allow unit to cool for at least 15 minutes before placing hands into the heat section opening. To completely cool to room temperature, the fan should run continuously for about 40 minutes.

- 1– Turn off both electrical and gas power supplies to air heater.
- 2– Remove upper and lower air heater access panels.
- 3– Remove air decoupler box cover.
- 4– Remove insulation pieces from lower section of air decoupler box.
- 5– Unscrew air valve housing, using your hand. Use either a strap or basin wrench if necessary.
- 6– Disconnect wiring to purge fan.
- 7– Remove nut from PVC air inlet fitting.
- 8– Remove nuts from air decoupler box mounting bolts and gas decoupler bracket.
- 9– Remove air decoupler box from unit.
- 10– Remove rubber gaskets and pad from air pipe.
- 11– Detach PVC exhaust pipe from coil manifold outlet.

- 12- Disconnect gas to unit.
- 13- Disconnect wiring to gas valve.
- 14- Break union in gas line just below gas decoupler. Remove gas valve / gas decoupler / piping assembly.
- 15- Remove remaining gas piping from fitting at vestibule panel.

⚠ IMPORTANT

Hex head fitting contains gas diaphragm valve. Care must be taken when handling this portion of piping assembly.

- 16- Disconnect fan motor wires from control box.
- 17- Disconnect spark plug and sensor wires from plugs in combustion chamber. (Access plate is provided.)
- 18- Remove vest panel.
- 19- From underside of fan deck, remove four nuts holding rubber heat exchanger assembly mounts.
- 20- Lift heat exchanger assembly from unit.
- 21- Backflush heat exchanger with a soapy water solution or steam clean.

⚠ IMPORTANT

If unit is backflushed with water, make sure all water is drained from heat train before replacing. Use papers or protective covering in front of air heater.

- 22- Reverse above steps to replace heat exchanger assembly. Be sure rubber seal pad and gasket are in place on air pipe and that earth wire on gas valve is put back on. Air flapper valve housing should be hand tightened only.

V - UNIT CHECKOUT

A - Temperature Rise

Temperature rise for G21/GSR21 units depends on unit output, fan speed and static pressure of duct system. Fan speed must be set for unit operation within range of "AIR TEMP. RISE ° F" listed on unit rating plate.

To Measure Temperature Rise:

- 1 - Place plenum thermometers in supply and return air plenums. Locate thermometers in the first horizontal run of the warm air plenum where it will not pick up radiant heat from the heat exchanger.
- 2 - Set thermostat to highest setting.
- 3 - After plenum thermometers have reached their highest and steadiest readings, subtract the two readings. The difference should be in the range listed on the unit rating plate. First check the firing rate. If temperature is too high, provided the firing rate is acceptable, increase fan speed to reduce temperature.

If the temperature is too low, decrease fan speed. To change fan speed taps see Fan Motor and Capacitor section in this manual.

B - External Static Pressure

- 1 - Measure tap locations as shown in figure 40.

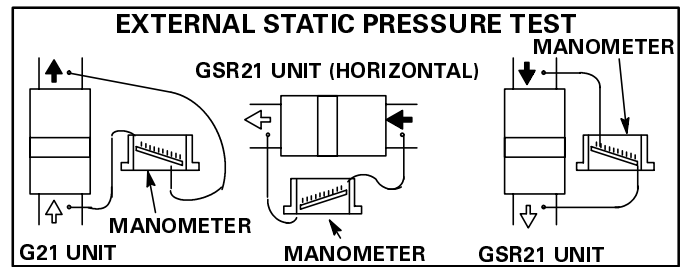


FIGURE 40

- 2 - Punch a 1/4" diameter hole in supply and return air plenums. Insert manometer hose flush with inside edge of hole or insulation. Seal around the hose with permagum. Connect the zero end of the manometer to the discharge (supply) side of the system. On ducted systems, connect the other end of manometer to the return duct as above. For systems with non-ducted returns, leave the other end of the manometer open to the atmosphere.
- 3 - With only the fan motor running and a dry evaporator coil, observe manometer reading. Adjust fan motor speed to deliver required amount of air.
- 4 - External static pressure drop must not be more than 125 Pa (0.5" W.C.).
- 5 - Seal around the hole when check is complete.

C - Manifold Pressure

Checks of manifold pressure are made as verification of proper regulator adjustment. Manifold pressure for the G21/GSR21 can be measured at any time the gas valve is open and is supplying gas to the unit. Normal manifold pressure is 495 ± 50 Pa (2.0 ± 0.2 in. W.C.) for natural gas and 2240 ± 50 Pa (9.0 ± 0.2 in. W.C.) for Liquid Petroleum (Propane).

To Measure Manifold Pressure:

- 1 - Remove 1/8" screw cap from pressure nipple on elbow below expansion tank. See figure 11 for location.

⚠ WARNING

For safety, connect a shut-off valve between the manometer and the gas tap to shut off gas pressure to manometer if desired.

- 2 - Place hose over nipple and connect to gauge or "U" tube.
- 3 - Set thermostat for heating demand (the demand can be started at the unit by jumping "R" and "W" on the low voltage terminal strip). **BE SURE TO REMOVE THE JUMPER AFTER THE TEST IS COMPLETE.**

- 4 – Check the manifold pressure after the unit has ignited and is operating normally.
- 5 – If the unit is not operational SEE CAUTIONS AND WARNINGS BELOW. Check the manifold pressure immediately after the gas valve fully opens.
- 6 – Gas valve can be adjusted using the governor adjustment screw. This screw is located under the dust cover screw on the face of the valve next to the electrical terminals and manual on/off knob. Refer to figure 12.

⚠ WARNING

Disconnect heating demand as soon as an accurate reading is obtained and allow unit to post-purge heat exchanger before proceeding.

⚠ DANGER

Combustion chamber access panel and air decoupler box cover must be in place for this test. Do not allow long periods of trial for ignition. Unsafe conditions could result.

⚠ WARNING

If unit is not operational, a manifold pressure check should be used only to verify that gas is flowing to combustion chamber at correct manifold pressure. Always allow purge fan to evacuate combustion chamber before proceeding.

D – Line Pressure

Gas supply pressure should not exceed 3235 Pa (13.0 in. W.C.) and should not drop below 870 Pa (3.5 in. W.C.) Normal natural gas level for G21/GSR21 units is 1740 Pa (7.0 in. W.C.) and 2735 Pa (11.0 in. W.C) for Liquid Petroleum (Propane) units. Supply pressure should only be checked with unit running. A 1/8" pressure nipple is provided in the elbow on the inlet supply of the gas valve. Line pressure ratings are listed on unit rating plate.

E – Flame Signal

A microamp flame signal passes from the ignition control through the sensor electrode during unit operation. Current passes from the sensor through the flame to earth to complete a safety circuit. A 50 microamp DC meter is needed to check flame signal.

In a standard gas heater, flame sensing is measured in a steady flame. A "Pulse" air heater does not have a steady flame to measure. Current can only be measured during pulse cycles. Between cycles, no current can be measured. Since the pulse rate approximates 60 pulses per second, the flame sensor measures an electrical average of the flame pulses.

To Measure Flame Signal:

⚠ WARNING

Fire and explosion hazard.

These instructions **MUST** be followed exactly.

Can cause a fire or explosion resulting in property damage, personal injury or loss of life.

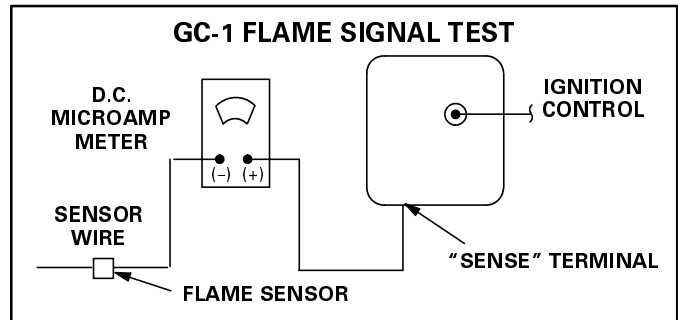


FIGURE 41

- 1 – Place meter in series between ignition control and sensor wire. Connect positive (+) lead of meter to ignition control sensor connection and negative (-) lead of the meter to sensor wire. See figure 41.
- 2 – Set thermostat for a heating demand and check flame signal with unit operating. A reading of 3 to 5 microamps DC is typical. The control will operate between 1 and 5 microamps DC.

Flame signal may rise above 3 to 5 microamps for the first few seconds after ignition and then level off.

F – Exhaust CO₂ (Carbon Dioxide) Content

Carbon Dioxide is a colorless and odorless gas produced in small amounts by all air heaters during the combustion process. When the unit is properly installed and operating normally CO₂ content of the exhaust gas is within 8.0-10.0 percent for natural gas and 9.0-11.5 percent for L.P. gases. If the unit appears to be operating normally at or beyond the upper limit of the CO₂ range, the unit should be checked for abnormally high CO (Carbon Monoxide) output which might indicate other problems in the system.

One method of measuring the CO₂ content is to use the Bacharach CO₂ test with a Fyrite CO₂ indicator. Other methods of testing CO₂ are available. Closely follow the instructions included with the test kit that you choose. A method for connecting the CO₂ test kit to the GSR21 is outlined in the next section.

G – Exhaust CO (Carbon Monoxide) Content

If the unit appears to be operating normally with the CO₂ levels at or near the upper limits listed in section F, the unit should be checked for abnormally high CO content. When the unit is properly installed and operating normally, the CO content of the exhaust gas is less than 0.04 percent regardless of the type of gas used.

⚠ WARNING

High CO output may be fatal. Do not allow unit to operate at CO output levels above 0.04 percent. The source of improper combustion must be located and corrected.

Conditions Which May Cause Abnormally High CO:

- 1 - Partial blockage of exhaust pipe and intake pipe;
- 2 - Abnormally high exhaust back pressure and intake restriction due to pipe length or routing;
- 3 - Dirty or worn air flapper. (Air flapper should be checked and replaced if needed.)

H - Testing Exhaust CO₂/CO Content

Use the following as a guide to test for abnormally high CO₂/CO content.

To Measure CO₂/CO Content:

- 1 - Drill a 11/32" in. hole on top of the exhaust outlet PVC elbow (inside unit cabinet) and tap 1/8-27 NPT as shown in figure 42. This hole is used as the CO₂/CO test port.
- 2 - Install a hose barb into the test port. See figure 42.
- 3 - Attach end of Fyrite sampling tube to hose barb on exhaust outlet elbow.
- 4 - Set unit to highest setting and allow unit to run for 15 minutes.
- 5 - When CO₂/CO testing is complete, turn off unit, remove hose barb from exhaust outlet elbow and use a 1/8" pipe plug to close off the test port.

⚠ WARNING

The exhaust vent pipe operates under positive pressure. Completely seal 1/8" NPT plug to prevent leakage of combustion products into the living space.

CO₂/CO SAMPLING PROCEDURE (GSR21 SHOWN)

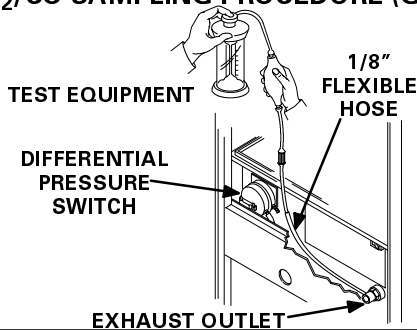


FIGURE 42

I - Exhaust Temperature Range

Exhaust temperature range should not exceed 57 °C for any of the G21/GSR21 series units. If it does, the high exhaust temperature may cause the unit to trip out on limit. Most units run with a maximum exhaust temperature of 43° C to 57° C for lower to higher unit inputs. Maximum temperatures are listed in table 5.

TABLE 5

MAXIMUM EXHAUST TEMPERATURES		
UNIT	LIMIT SETTING	
G21/GSR21-50	46.1° C	115° F
G21/GSR21-60	48.8° C	120° F
G21/GSR21-80	51.6° C	125° F
GSR21-100	54.4° C	130° F
G21-100	57.2° C	135° F

J - Heat Exchanger Temperatures

During operation, temperature at the top of the combustion chamber and tailpipe is 538 to 649 °C. At the tailpipe entrance to the exhaust decoupler, temperature has dropped to approximately 330 °C. Temperature from the exhaust decoupler outlet to coil intake manifold is 177 °C. At the coil exhaust outlet manifold, temperature range is approximately 38 to 49 °C. These are average temperatures and will vary with fan speed input.

K - Condensate pH Range (Figure 43)

Unit condensate is mildly acidic and can be measured with pH indicators. The pH scale as shown in figure 43 is a measurement of acidity or alkalinity.

Concentration of acidity of all these fluids including condensate is very low and harmless.

The following scale shows relative pH of some common liquids as compared with G21/GSR21 condensate.

pH RANGE	
Increasing Acidity	0
	1
	2- Vinegar
	3- Wine
	4- Orange Juice
G21/GSR21 Condensate Range	5- Tomato Juice
	6
	7- tap water
Increasing Alkalinity	8
	9
	10
	11
	12
	13
	14

FIGURE 43

L - Acceptable Operating Input

Field adjustments to the unit are not normally needed due to specifically sized components for each input rating.

Unit may run up to ± 3 to 4 percent of rated input (listed on unit nameplate) due to installation variables such as temperature rise, external static pressure and return air temperature combined with allowable tolerances of components within unit. This is an acceptable operating range.

Operation of the G21/GSR21 above or below this acceptable operating range may cause continuity, start-up and lock-out problems (erratic operation). Overfiring the unit can shorten the life of the heat exchanger assembly. Overfiring can be checked by measuring unit's input.

⚠ IMPORTANT

Overfiring the unit can shorten the life of the heat exchanger assembly

For new units, approximate input measurements may be obtained after allowing unit to run continuously for 15 minutes. If accurate input measurements are required, the following procedure may be used. Accurate input measurements requires time for the unit to "run in."

Run in time allows flapper valves to seat and combustion to clean the protective layer of oil residue that may be present from inside surfaces of the heat exchanger assembly. This process stabilizes combustion rate and may take one to two hours of continuous operation. Since it is impractical to operate an installed unit for one to two hours continuously, the unit should be allowed to operate normally, (cycle on demand) for a period to accumulate several total hours of run time to obtain an accurate measurement of input. Overnight operation should provide enough total run time to obtain an accurate measurement of input. Just prior to any input check, run unit continuously for 15 minutes.

M – Checking Gas Input-Determine Gas Flow at Meter

- 1 – Turn off all other gas appliances, including pilot lights or appliances if used.
- 2 – Set thermostat to highest setting and allow unit to run continuously for 15 minutes. A 15 minute run time is needed to allow unit operating rate to stabilize.

- 3 – At the gas supply meter and using either one-, two-, three- or five-foot dial on the meter, time one full revolution (in seconds) with a watch. See figure 44.

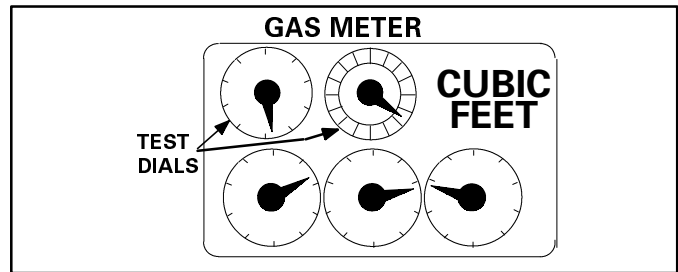


FIGURE 44

- 4 – Find the number of seconds for one revolution on the Gas Rate chart, see table 6. Read the cubic feet for matching one-, two-, three- or five-foot dial size from table 6, multiply this times Btuh per cubic foot content of the gas. The result is total gas Btuh input.
- 5 – Check Btuh input figure against Btuh listed on unit nameplate.

EXAMPLE:

- a – One revolution of two-foot dial = 90 seconds.
- b – Using the gas rate chart, table 6, note that 90 seconds = 80 cubic feet of gas per hour.
- c – 80 cu. ft./hr. x 1000 Btuh/cu. ft. = 80,000 Btuh input.
- d – Normally there are 1000 Btuh in each cubic foot of gas. Make adjustment to this figure where the gas heating value is other than 1000 Btuh per cubic foot (contact the local gas supplier for local Btuh per cubic foot ratings).

NOTE– To convert Btuh to kW divide Btuh by 3412. Example 80,000 Btuh ÷ 3412 = 23.4 kW

TABLE 6

METER FLOW RATE													
GAS RATE- CUBIC FEET PER HOUR													
Secs for One Rev.	Size of Test Dial			Secs for One Rev.	Size of Test Dial			Secs for One Rev.	Size of Test Dial		Secs for One Rev.	Size of Test Dial	
	1 cu. ft.	2 cu. ft.	3 cu. ft.		1 cu. ft.	2 cu. ft.	3 cu. ft.		2 cu. ft.	5 cu. ft.		2 cu. ft.	5 cu. ft.
10	360	720	1800	34	106	212	529	62	116	290	110	-	164
11	327	655	1636	35	103	206	514	64	112	281	112	64	161
12	300	600	1500	36	100	200	500	66	109	273	116	62	155
13	277	555	1385	37	97	195	486	68	106	265	120	60	150
14	257	514	1286	38	95	189	479	70	103	257	125	-	144
15	240	480	1200	39	92	185	462	72	100	250	130	-	138
16	225	450	1125	40	90	180	450	74	97	243	135	-	132
17	212	424	1059	41	-	176	439	76	95	237	140	-	129
18	200	400	1000	42	86	172	429	78	92	231	145	-	124
19	189	379	947	43	-	167	419	80	90	225	150	-	120
20	180	360	900	44	82	164	409	82	88	220	155	-	116
21	171	343	857	45	80	160	400	84	86	214	160	-	113
22	164	327	818	46	78	157	391	86	84	209	165	-	109
23	157	313	783	47	-	153	383	88	82	205	170	-	106
24	150	300	750	48	75	150	375	90	80	200	175	-	103
25	144	288	720	49	-	147	367	92	78	196	180	-	100
26	138	277	692	50	72	144	360	94	-	192	-	-	-
27	133	267	667	-	-	-	-	96	75	188	51	141	353
28	129	257	643	52	69	138	346	98	-	184	53	136	340
29	124	248	621	54	67	133	333	100	72	180	55	131	327
30	120	240	600	56	64	129	321	102	-	176	57	126	316
31	116	232	581	58	62	124	310	104	69	173	59	122	305
32	113	225	563	60	60	120	300	106	-	170	-	-	-
33	109	218	545	-	-	-	-	108	67	167	-	-	-

N - Checking Air Intake and Flapper Valve Figures 45 and 46

! WARNING

When servicing the air intake flapper valve, keep in mind that it is only moderately warm during unit operation. After unit cycles off, residual heat in combustion chamber will transfer back to valve causing it to become very hot. Allow it to cool 10 to 15 minutes before handling. The fan can also be run to cool air intake.

- 1 - Remove air intake chamber cover and check for foreign materials that may have accumulated, clean purge fan and upper and lower chamber compartment if necessary.
- 2 - Do not remove air flapper valve unless it is suspected of being faulty.
If valve must be removed, carefully remove the eight screws holding air intake flapper valve to valve body. DO NOT TURN OR REMOVE CENTER SCREW. Remove valve from unit. CAUTION-DO NOT DROP.
- 3 - EXTREME CARE SHOULD BE TAKEN WHEN DISASSEMBLING INTERNAL COMPONENTS OF THE VALVE. If taken apart, plates could be rotated out of phase or reversed. Spacer thickness has an extremely low tolerance. Note each plate has a stamp of the spacer thickness and a star or the words "THIS SIDE OUT." These stamps should all lie in the same quadrant (figure 45 and 46) and face the outside of unit.

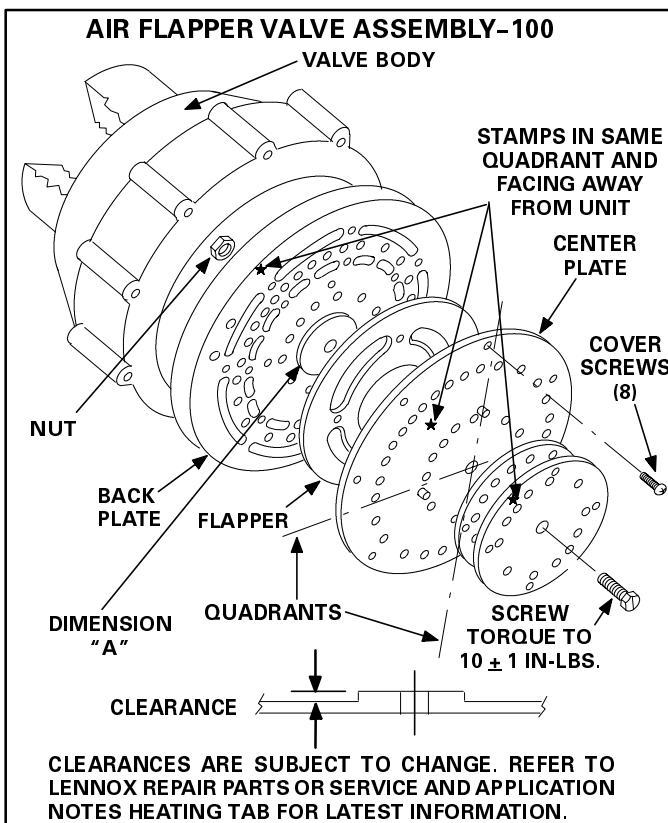


FIGURE 46

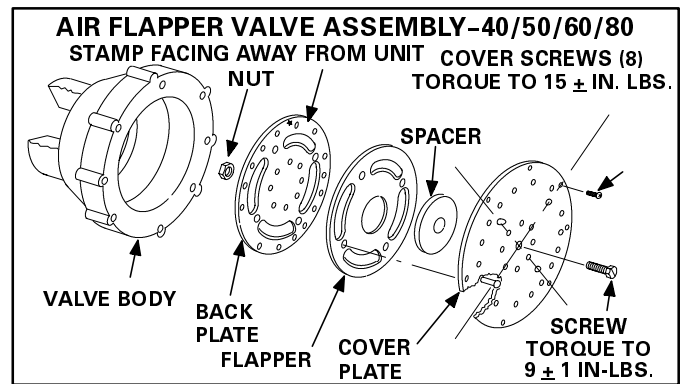


FIGURE 45

- 4 - Visually inspect flapper. On new units, the flapper may not be perfectly flat, it may be curved or dished between the plates. This is normal. On units that have had sufficient run in time, the flapper will be flat. If the flapper is torn, creased or has uneven (frayed) edges, the material must be replaced. A flapper material is available from Lennox Repair Parts.
- 5 - To find potential warpage in the plates, check for the required clearance between the flapper and back plate in several places around the circumference of the valve. See figure 47. Use a feeler gauge, starting small and working up to the clearance dimension until the gauge is just about snug.

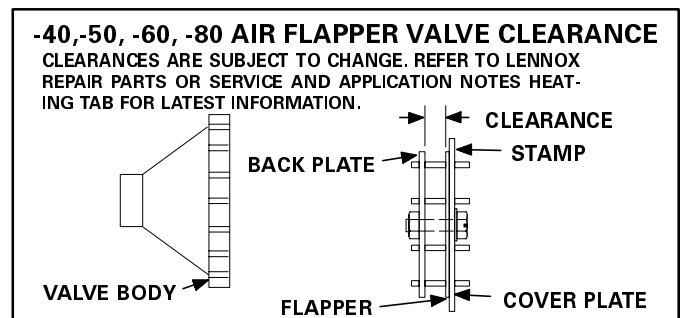


FIGURE 47

! WARNING

Do not force feeler gauge between flapper and back plate. Damage to flapper material will occur.

Clearance should be checked in six or eight places around the valve. If valve is out of clearance at any one point, replace the assembly. Required clearance values are listed in table 7. Clearances are updated regularly in Service and Application Notes.

TABLE 7

AIR FLAPPER VALVE CLEARANCES mm. (In.)		
Unit	Natural	L.P.G.
G21-40	.79 (.031)	1.02 (.040)
G21-60	.89 (.035)	.89 (.035)
G21-80	1.14 (.045)	1.14 (.045)
G21-100	.99 (.039)	1.22 (.048)
GSR21-50	.89 (.035)	.89 (.035)
GSR21-80	1.14 (.045)	1.14 (.045)
GSR21-100	1.00 (.039)	1.12 (.044)

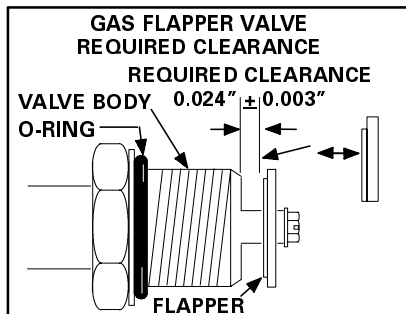
- When placing a new or old valve back into the unit, start all eight screws in place by hand. Tighten screws evenly to a maximum of 15 in./lbs. Do not overtighten screws; if threads are damaged the entire valve body will have to be replaced. All eight screws must be in place for proper operation.

⚠ IMPORTANT

Special screws are used in the air flapper valve. Replacement screws are available in kit form from Lennox Repair Parts. Do not use Loctite or similar thread seizing compounds to secure screws.

O - Checking the Gas Flapper Valve

- Using a plumber's basin wrench, disconnect union at bottom of expansion tank and remove entire gas flapper valve, nipple and elbow assembly as one piece. It is not recommended to remove elbow and nipple from flapper unless the valve is being replaced. Use care not to damage o-ring when handling valve out of unit. DO NOT DROP.
- Do not turn or remove center screw of valve assembly. Visually inspect the flapper. The flapper may be dished or curved on new units, this is normal. In units with "run in" time, the flapper will be flat. If the flapper is torn, creased or has uneven (frayed) edges, the valve assembly must be replaced.
- Check for free movement of the flapper over spacer. Use a feeler gauge blade to carefully move the flapper between the plates. Be sure the flapper is not trapped between the spacer and the other clearance plate. If flapper does not move freely or is trapped under spacer, the valve assembly must be replaced.
- Check for the required clearance between the flapper and valve body. Required clearance values for G21/GSR21 units are 0.60 ± 0.008 mm (0.024 ± 0.003 in). Use a feeler gauge, starting small and working up to the clearance dimensions until the gauge is just about snug. Do not force gauge. Check clearance around the valve in several places. If the valve is out of the required clearance dimension given in figure 48 at any point around the valve, it must be replaced.



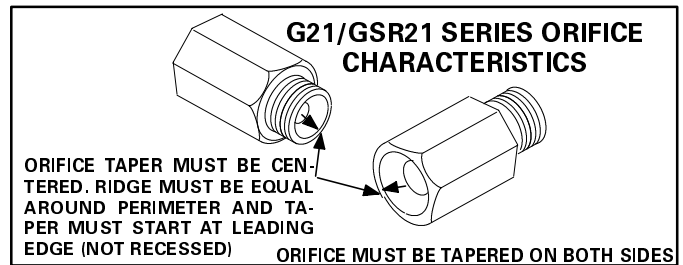
⚠ WARNING

Do not force feeler gauge between flapper and valve body. Damage to flapper material will occur.

- When placing a new or old valve back into the unit, use care not to damage the o-ring. DO NOT USE PIPE SEALERS ON THE FLAPPER VALVE THREADS.

P - Checking Gas Orifice

- With gas flapper valve assembly removed, use a flashlight to check for blockage of the orifice in the manifold. To remove the orifice, most units take a 1/2 inch shallow socket with an extension.
- Check the orifice drill size for the unit as given in the Service and Application notes. Make sure orifice diameter matches the drill size stamped on the orifice. If the orifice is incorrect it must be replaced.
- Refer to figure 49 for the physical characteristics of the orifice. The surface must be flat and the orifice opening must not be chamfered. The orifice taper must be centered and not recessed. G21/GSR21 units use a double-coned orifice to improve operating characteristics. If any defects are found the orifice must be replaced.



- Standard atmospheric burner orifices or orifice blanks cannot be used as replacements for the G21/ GSR21. Only replacement orifices supplied through Lennox should be used.
- When threading the orifice into the manifold use a socket to hold threads beyond end of socket.

⚠ IMPORTANT

To avoid cross threading, carefully align threads by hand turning socket extension until orifice is in place.

VI - TROUBLESHOOTING

⚠ IMPORTANT

Normal set-up conditions of a new unit installation require running the unit through several tries for ignition before the unit will run continuously. Initially the unit may start and die several times until air bleeds from gas piping. Break and remake thermostat demand to restart ignition sequence at 2 to 3 minute intervals until continuous operation is obtained.

Effective troubleshooting of the G21/GSR21 depends on a thorough understanding of all unit components and their function as described in this manual. The main troubleshooting categories are:

- Unit Will Not Run Electrical Checks
- Unit Will Not Run Ignition Control Checkout
- Unit Will Not Run Gas, Spark and Air Checks
- Unit Sputter Starts And Dies.
- Unit Starts Clean But Runs Less Than 10 Seconds.

EACH OF THE PROBLEM CATEGORIES ARE BROKEN DOWN INTO TROUBLESHOOTING FLOWCHARTS LOCATED IN section VII - TROUBLESHOOTING FLOWCHARTS in the back of this manual, with additional information provided to explain certain checks. Steps in the flow charts for measuring manifold pressure, flame signal, exhaust CO₂ content and exhaust CO content and operating input are explained in previous sections.

CHOOSE THE FLOW CHART THAT BEST DESCRIBES THE UNIT'S PROBLEM. FOLLOW THE FLOW CHART STEP BY STEP. At any point a "NO" answer is reached and a repair is made, reassemble the unit and retest for operation. If unit does not operate, recheck that point and then continue through the chart. Occasionally more than one specific problem may exist.

When troubleshooting a unit, be sure that all basic checks are covered carefully. Double check your diagnosis before replacing components. DO AS LITTLE DISASSEMBLY AS POSSIBLE during troubleshooting to prevent introducing additional problems such as gas or air leaks or damage to components.

WARNING

If unit has been operating, internal components will be HOT. Allow unit to cool for at least 15 minutes before placing hands into the heat section opening. To completely cool to room temperature, the fan should run continuously for about 40 minutes.

A – Safety Shutdown

Safety shutdown occurs when any of the problems are encountered.

- 1 – Loss of combustion during a heating cycle caused by:
 - a – Obstruction to air intake or exhaust outlet piping;
 - b – Low gas pressure;
 - c – Failure of gas or air flapper valve;
 - d – Failure of main gas valve;
 - e – Loose spark plug or sensor creating pressure loss;
 - f – Loose sensor wire;
- 2 – High limit cutout:
 - a – Fan failure;

- b – Temperature rise too high;
- c – Restricted filter or return air;
- d – Restricted supply air plenum.

B – Supply Air Fan Runs Continuously

- 1 – Is thermostat fan switch set to "ON?" If so, switch to "AUTO."
- 2 – Is fan control "OFF" setting below ambient air temperature? If so, readjust to 32 °C (90 °F).
- 3 – Is primary fan control operating normally? Replace if necessary.
- 4 – Are fan relay contacts operating normally? Replace if necessary.

C – Supply Air Fan Does Not Run

- 1 – Check the voltage at the fan motor taps after about 45 seconds.
- 2 – Check for loose wiring.
- 3 – Is fan relay operating properly? Check for 240 VAC between terminal 2 and neutral immediately after ignition. See electrical schematic.
- 4 – Is fan time control relay K36 operating properly? Check for 240VAC between terminal "NO" (normally open) and neutral after the unit has been operating 45 seconds. See electrical schematic.
- 5 – Fan motor and /or capacitor operating normally? Check 240 VAC between the heating motor tap and neutral after the unit has been operating 45 seconds. See electrical schematic. Use standard motor troubleshooting techniques if voltage reaches this point and fan does not operate.

D – Unit Does Not Shut Off

- 1 – Is thermostat operating normally?
 - a – Check for shorted 24 VAC control circuit wiring. Repair or replace if necessary.
- 2 – Is the gas valve stuck open?

E – Abnormal Sounds

Corrective action is required if abnormal hissing sounds around the air decoupler are heard. This problem may be caused by:

- 1 – Air leakage around decoupler box cover.
- 2 – Air leakage around air decoupler box cover mounting screws.
- 3 – Air leakage out of the purge fan lead strain relief.
- 4 – Air leakage around the intake air connection to the air decoupler box.
- 5 – Air leakage out of the back of the air decoupler box around the air intake pipe or the air decoupler box rear mounting bolts.

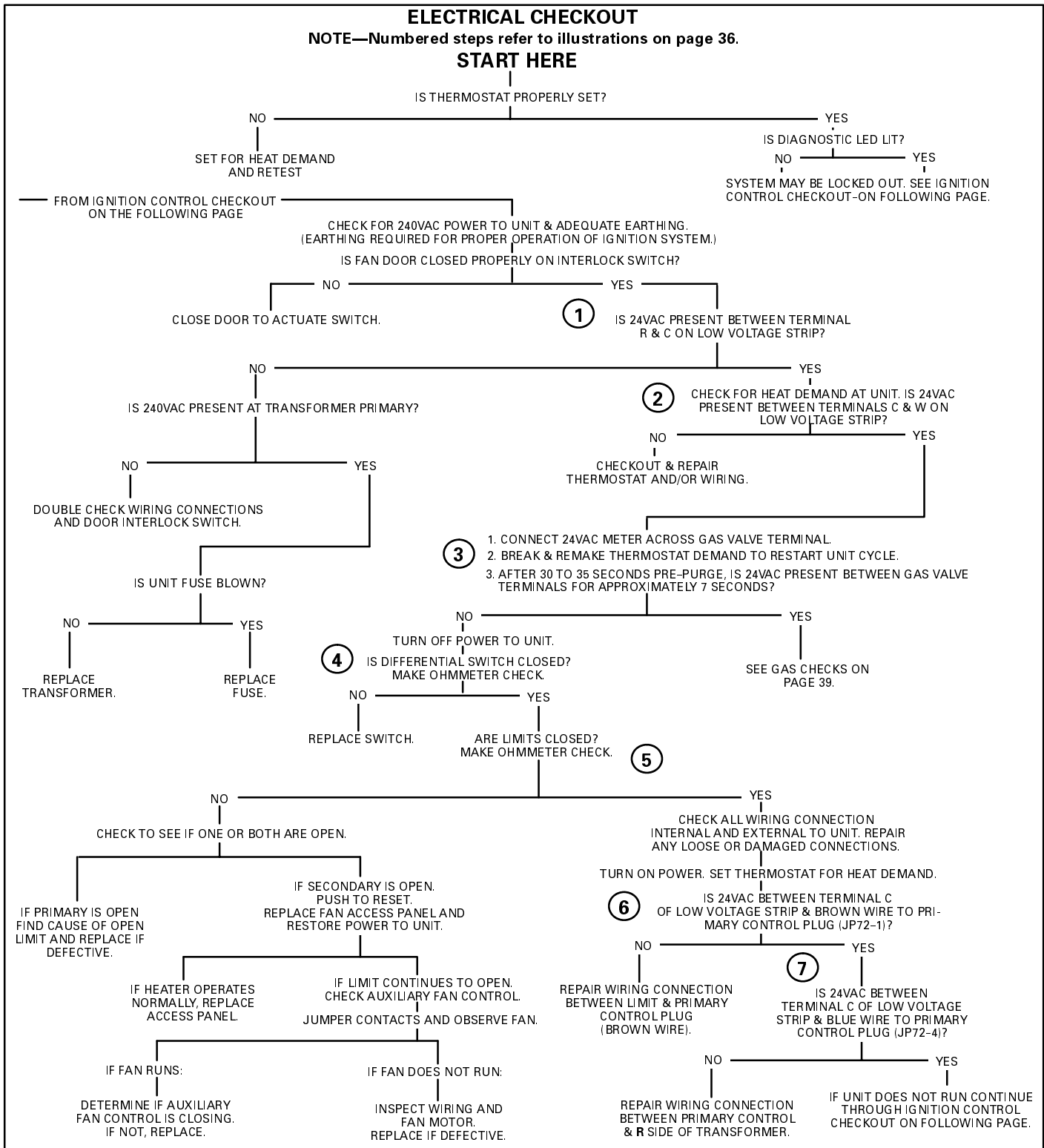
The unit should be examined visually for unusual amounts of condensate in any areas other than the condensing coil outlet which might indicate a system leak.

Abnormal rattling and casing vibration other than obvious loose parts may indicate metal-to-metal contact of components which are normally separated during operation. Gas piping, condensing coil outlet and air intake pipe areas should be checked. Combustion chamber to exhaust decoupler area should also be checked.

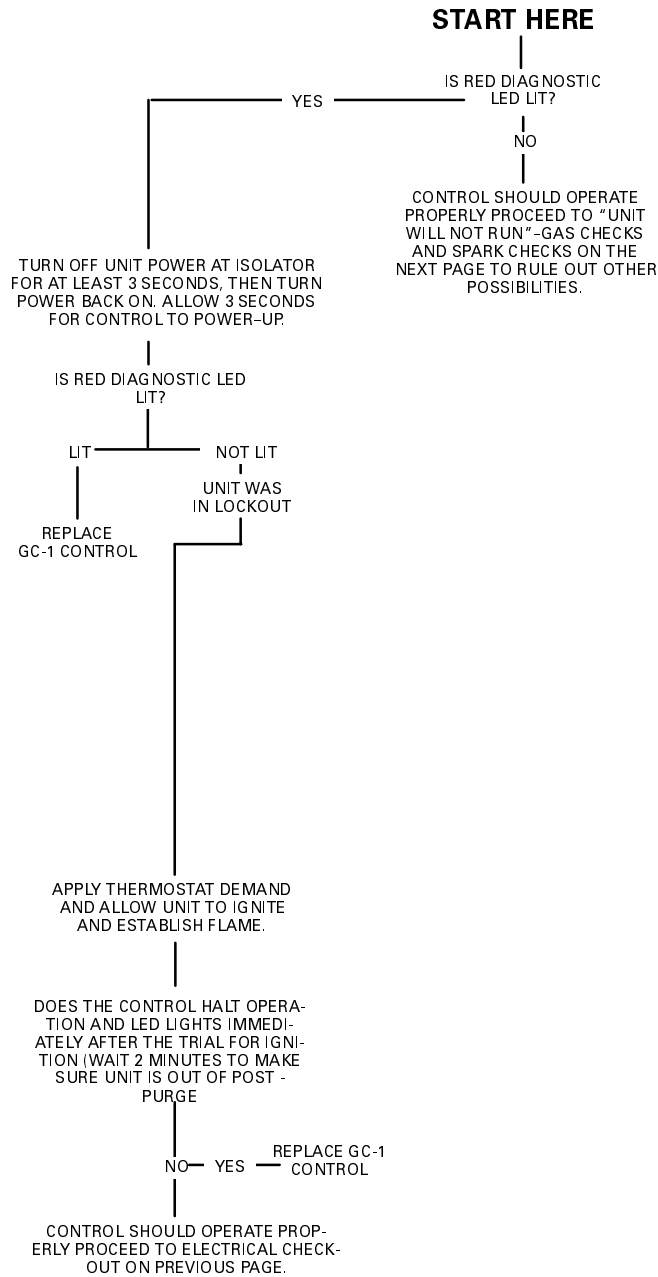
⚠ DANGER

Extremely loud "pulse" sounds, which can be easily heard through the supply or return air ducts, may indicate a combustion chamber or tailpipe leak. Locate and correct combustion chamber or tailpipe leak before allowing unit to operate.

VII - TROUBLESHOOTING FLOWCHARTS



IGNITION CONTROL CHECKOUT



GAS, AIR AND SPARK CHECKS

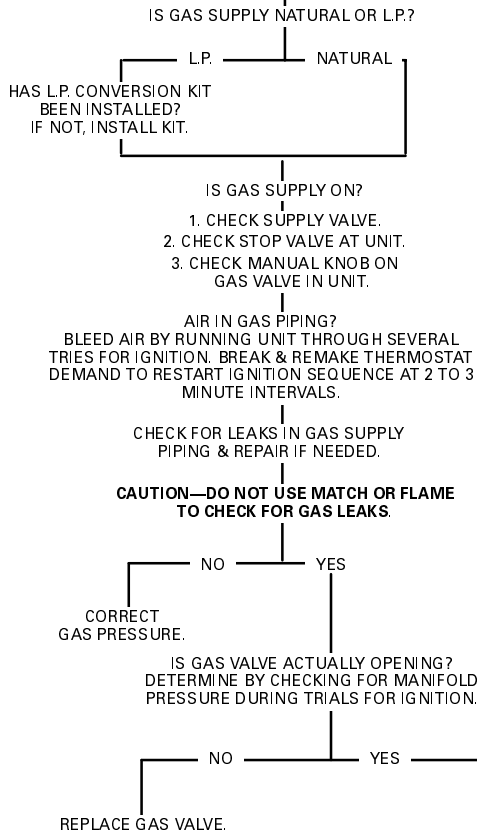
(continued from page 33.)

NOTE—Numbered steps refer to illustrations on page 36.

START HERE

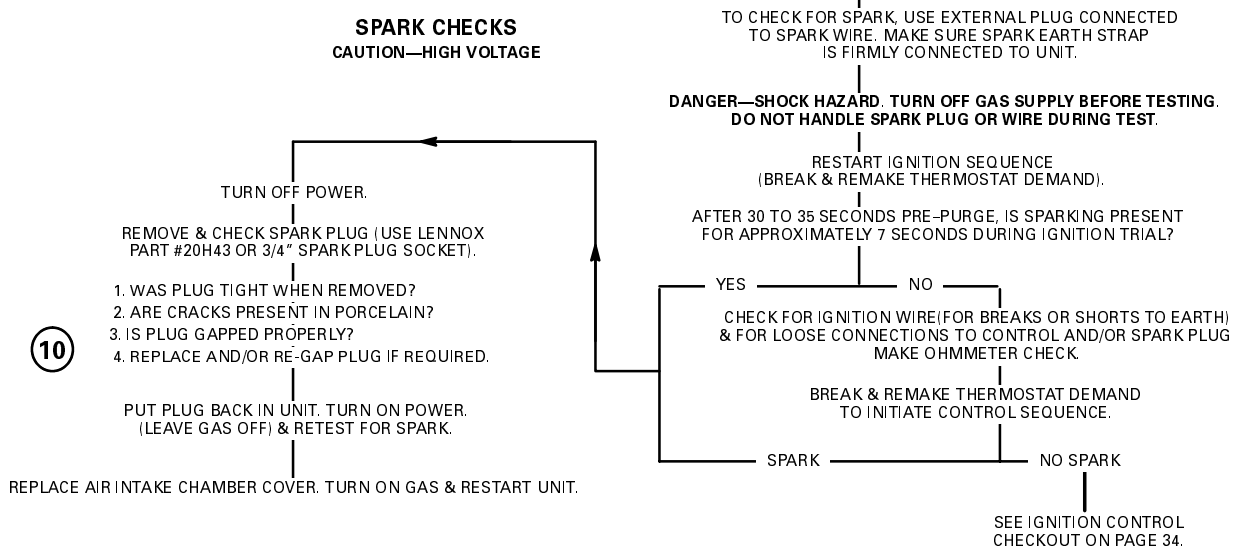
CONTINUED FROM PAGE 33.

GAS CHECKS



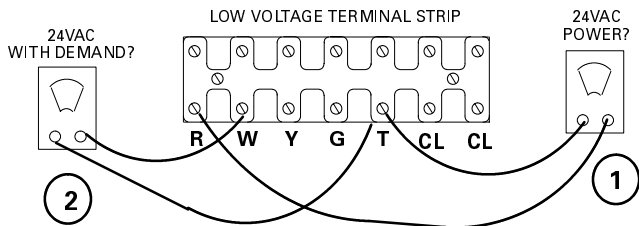
SPARK CHECKS

CAUTION—HIGH VOLTAGE

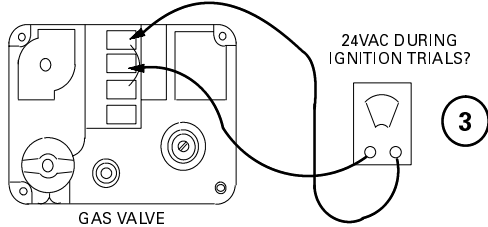


ELECTRICAL TESTING

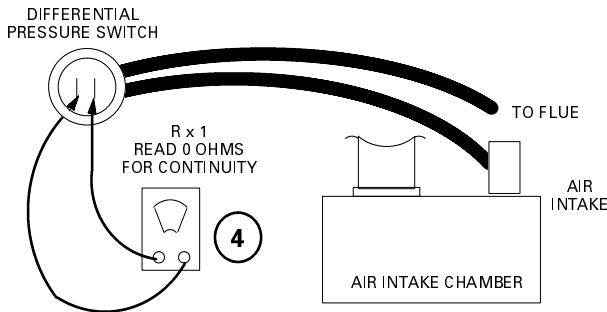
CHECK VOLTAGE AT TERMINAL AND CHECKING THERMOSTAT DEMAND



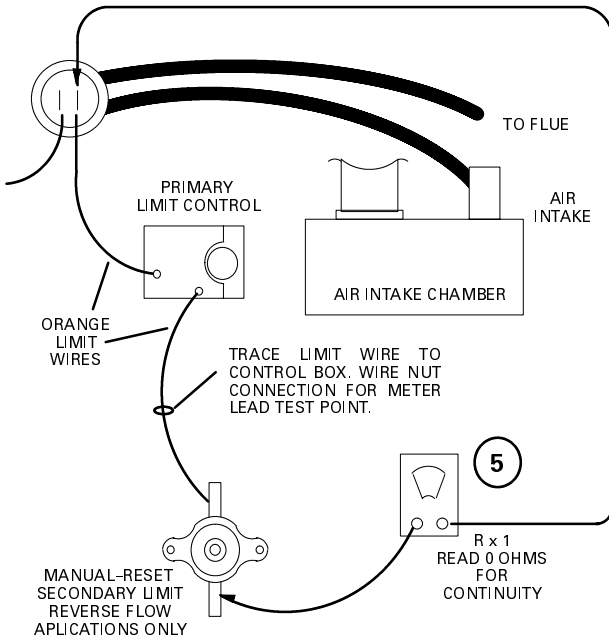
CHECKING VOLTAGE AT GAS VALVE



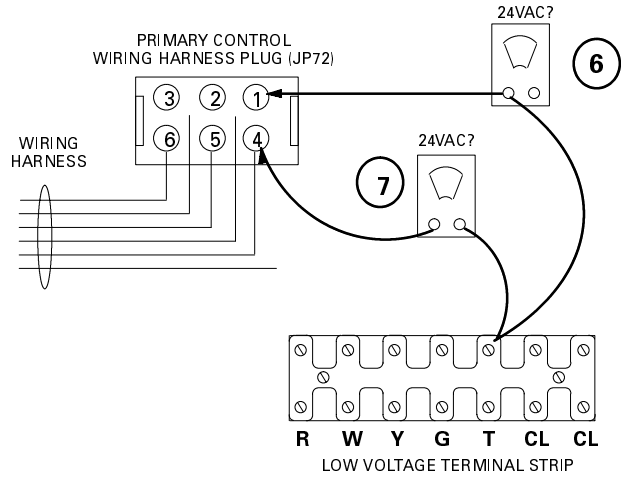
CHECKING FOR OPEN SWITCH



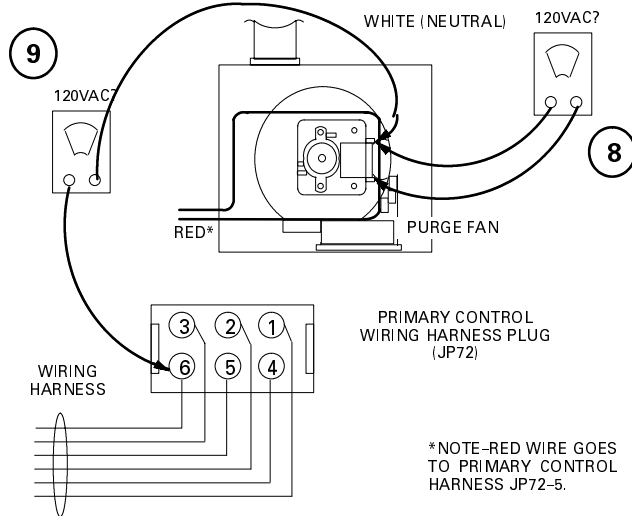
CHECKING FOR OPEN SWITCH IN LIMIT CONTROL



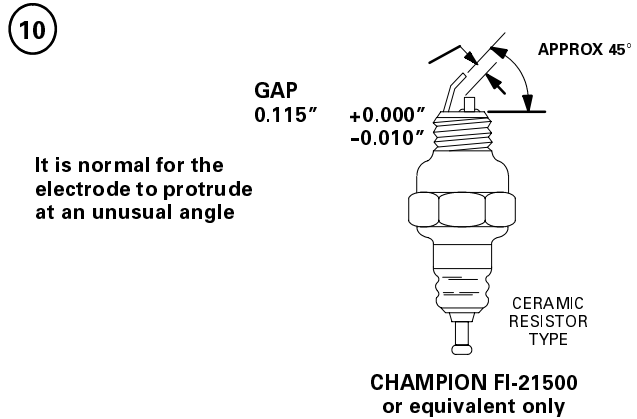
CHECKING VOLTAGE AT PRIMARY CONTROL



CHECKING VOLTAGE AT PURGE FAN

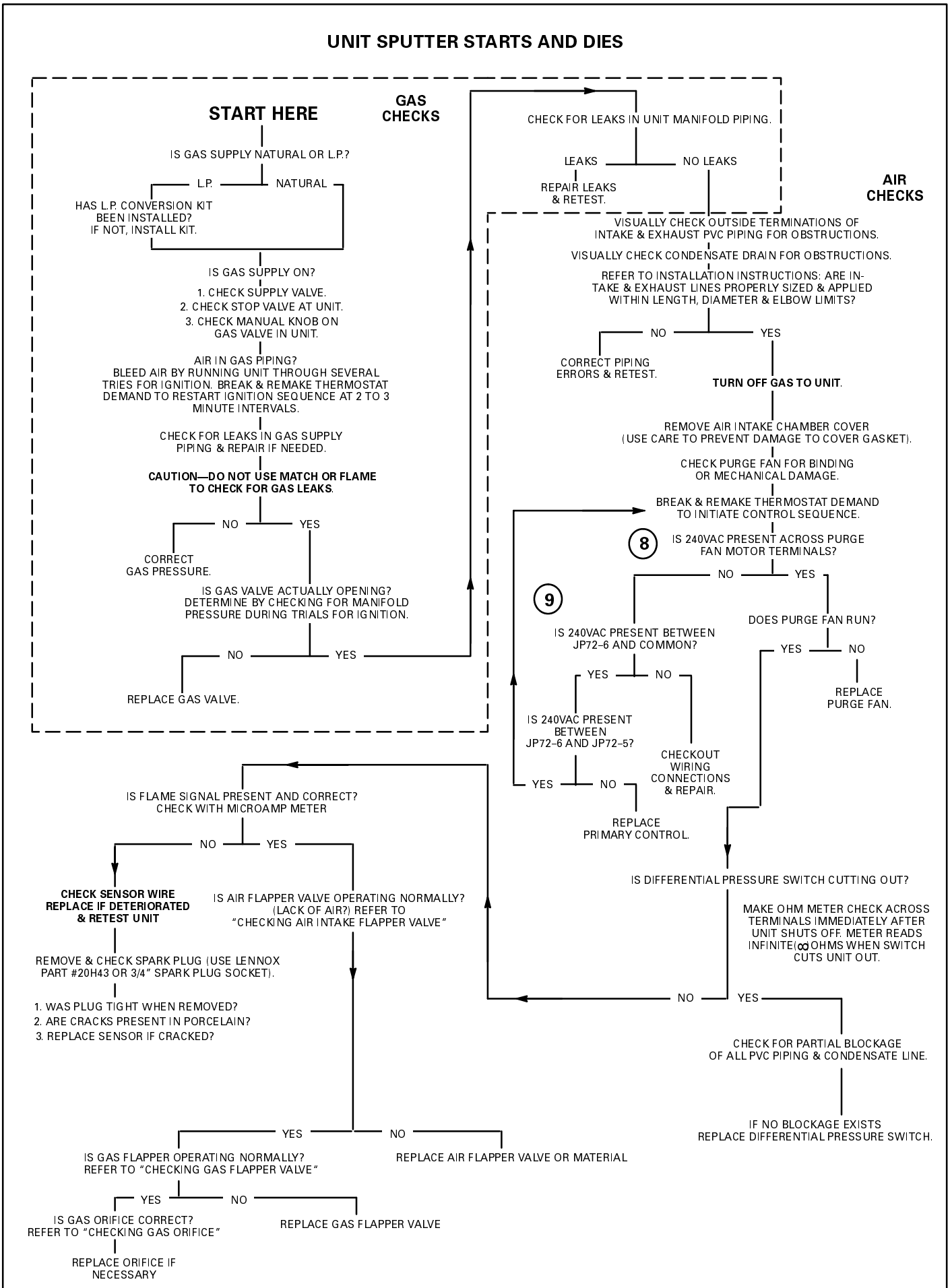


SPARK PLUG



NOTE - CARBON RESISTOR TYPE PLUGS SHOULD NOT BE USED.

UNIT SPUTTER STARTS AND DIES



UNIT STARTS CLEAN BUT RUNS LESS THAN 10 SECONDS

START HERE

RESET UNIT IF LOCKED OUT, LISTEN FOR CHANGE IN SOUND OF UNIT BEFORE IT STOPS.

UNIT OPERATES LABORIOUSLY BEFORE STOPPING.

UNIT STOPS WITHOUT ANY CHANGE IN SOUND BEFORE STOPPING.

CHECK FOR RECIRCULATION OF EXHAUST GASES TO AIR INTAKE AT THE OUTSIDE TERMINATIONS OF PVC PIPING.

RECIRCULATION CHECKS

ARE INTAKE AND EXHAUST PVC LINES SEPARATED NO MORE THAN 3" AT OUTSIDE TERMINATION? DOES EXHAUST TERMINATION EXTEND AT LEAST 8" PAST INTAKE TERMINATION?

NO

YES

MODIFY OR CORRECT SEPARATION TO A MAXIMUM OF 3".

ARE INTAKE AND EXHAUST PVC LINES TERMINATED INTO A WINDOW WELL, ALCOVE OR CORNER WHERE VARYING CONDITIONS CAUSE RECIRCULATION?

NO

YES

IF OUTSIDE TEMPERATURE IS LOW ENOUGH, OBSERVE EXHAUST OUTLET VAPOR WHEN UNIT IS RUNNING. RECIRCULATION WILL EASILY BE SEEN.

MODIFY OR CORRECT TERMINATIONS TO ELIMINATE RECIRCULATION.

MODIFY OR CORRECT TERMINATIONS TO ELIMINATE RECIRCULATION.

NOTE: RECIRCULATION IS ALSO POSSIBLE WHEN EXHAUST CO2 CONTENT IS ABOVE 10%. THIS IS DIFFICULT TO MEASURE AS AN INDICATION IN THIS CASE IF UNIT WILL ONLY RUN FOR 10 SECONDS OR LESS.

5

ARE LIMITS CUTTING OUT UNIT? CHECK FOR OPEN LIMIT IMMEDIATELY FOLLOWING UNIT CUTOFF. SHUT OFF POWER AND MAKE OHM METER CHECK.

NO

YES

DETERMINE CAUSE OF LIMIT CUT OUT AND CORRECT PROBLEM.

IS DIFFERENTIAL SWITCH CUTTING OUT UNIT?

4

MAKE OHM METER CHECK ACROSS TERMINALS IMMEDIATELY AFTER UNIT SHUTS OFF. METER READS ∞ OHMS WHEN SWITCH CUTS UNIT OUT.

NO

YES

CHECK FOR PARTIAL BLOCKAGE OF ALL PVC PIPING & CONDENSATE LINE.

IF NO BLOCKAGE EXISTS REPLACE DIFFERENTIAL PRESSURE SWITCH

IS FLAME SIGNAL PRESENT AND CORRECT? CHECK WITH MICROAMP METER

NO

YES

CHECK SENSOR WIRE REPLACE IF DETERIORATED & RETEST UNIT

REMOVE & CHECK SPARK PLUG (USE LENNOX PART #20H43 OR 3/4" SPARK PLUG SOCKET).

1. WAS PLUG TIGHT WHEN REMOVED?
2. ARE CRACKS PRESENT IN PORCELAIN?
3. REPLACE SENSOR IF CRACKED?

MAKE RECIRCULATION CHECKS.

IF RECIRCULATION IS NOT PRESENT, CHECK FOR ADEQUATE CONNECTION OF EARTH TO UNIT AND PRIMARY CONTROL. IF OK, CHECK PRIMARY CONTROL TIMING:

MONITOR MANIFOLD PRESSURE OR GAS VALVE COIL, PURGE FAN (120 VAC), SPARK PLUG WIRE WITH SPARK TESTER AND FLAME SIGNAL. USE THE TIMING CHARTS (FIGURE 9) TO DETERMINE IF THE CONTROL IS DEFECTIVE.

IF DEFECTIVE REPLACE PRIMARY CONTROL.

UNIT RUNS BUT SHUTS OFF BEFORE THERMOSTAT IS SATISFIED-INSUFFICIENT HEAT

START HERE

5

ARE LIMITS CUTTING OUT UNIT? CHECK FOR OPEN LIMIT IMMEDIATELY FOLLOWING UNIT CUTOUT. SHUT OFF POWER AND MAKE OHM METER CHECK.

MAKE OHM METER CHECK ACROSS TERMINALS IMMEDIATELY AFTER UNIT SHUTS OFF. METER READS (∞) OHMS WHEN SWITCH CUTS UNIT OUT.

IS GAS PRESSURE LOW? CHECK FOR INTERMITTENT LOW GAS PRESSURE. (MONITOR LOW GAS PRESSURE)

YES
CORRECT GAS PRESSURE.

NO
IS EXHAUST, INTAKE OR CONDENSATE PVC PIPING PARTIALLY BLOCKED OR RESTRICTED?

NO
YES
ELIMINATE BLOCKAGE AND RETEST.

IS FILTER CLEAN AND PROPERLY INSTALLED?
ARE SUPPLY AND RETURN AIR DUCTS UNRESTRICTED? CORRECT IF NECESSARY AND RETEST.

CHECK GAS BTUH INPUT.

IS INPUT HIGH? OUT OF ACCEPTABLE RANGE?

IS MANIFOLD PRESSURE TOO HIGH?

YES
ADJUST GAS VALVE REGULATOR (GOVERNOR).

NO
IS TEMPERATURE RISE AND STATIC PRESSURE WITHIN PROPER RANGE?

REPLACE LIMIT.

NO
ADJUST FAN SPEED.

CHECK FOR RECIRCULATION OF EXHAUST GASES TO AIR INTAKE AT THE OUTSIDE TERMINATIONS OF PVC PIPING.

RECIRCULATION CHECKS

ARE INTAKE AND EXHAUST PVC LINES SEPARATED AT OUTSIDE TERMINATION? DOES EXHAUST TERMINATION EXTEND AT LEAST 203mm (8") PAST INTAKE TERMINATION?

NO
MODIFY OR CORRECT SEPARATION TO A MAXIMUM OF 3".

YES
ARE INTAKE AND EXHAUST PVC LINES TERMINATED INTO A WINDOW WELL, ALCOVE OR CORNER WHERE VARYING CONDITIONS CAUSE RECIRCULATION?

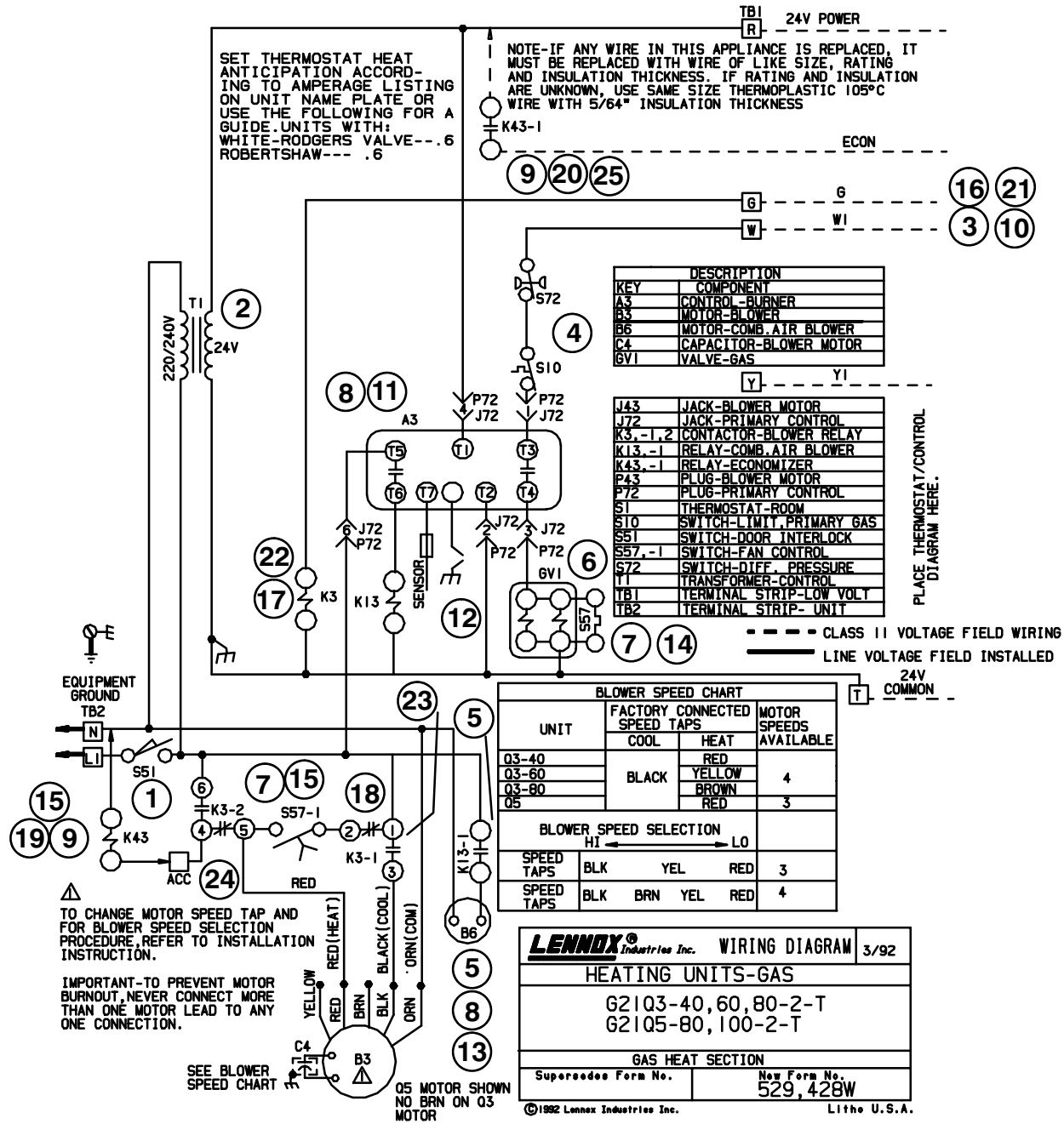
NO
IF OUTSIDE TEMPERATURE IS LOW ENOUGH, OBSERVE EXHAUST OUTLET VAPOR WHEN UNIT IS RUNNING. RECIRCULATION WILL EASILY BE SEEN.

MODIFY OR CORRECT TERMINATIONS TO ELIMINATE RECIRCULATION.

YES
MODIFY OR CORRECT TERMINATIONS TO ELIMINATE RECIRCULATION.

NOTE: RECIRCULATION IS ALSO POSSIBLE WHEN EXHAUST CO2 CONTENT IS ABOVE 10%. THIS IS DIFFICULT TO MEASURE AS AN INDICATION IN THIS CASE IF UNIT WILL ONLY RUN FOR 10 SECONDS OR LESS.

G21Q



BLOWER SPEED CHART

UNIT	FACTORY CONNECTED SPEED TAPS		MOTOR SPEEDS AVAILABLE
	COOL	HEAT	
Q3-40	BLACK	RED	4
Q3-60		YELLOW	
Q3-80		BROWN	
Q5		RED	3

BLOWER SPEED SELECTION

HI ← → LO

SPEED TAPS	BLK	YEL	RED	
SPEED TAPS	BLK	BRN	YEL	RED
SPEED TAPS	BLK	BRN	YEL	RED

LENNOX® Industries Inc. WIRING DIAGRAM 3/92

HEATING UNITS-GAS

G21Q3-40, 60, 80-2-T
 G21Q5-80, 100-2-T

GAS HEAT SECTION

Supersedes Form No.	New Form No.
	529, 428W

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Sequence of Operation G21

A-APPLICATION OF G21.

This flowchart is used to show the step by step sequence that takes place when thermostat demand is sent to a G21. The sequence describes the actions of devices in the unit which control fans, gas valve and other components in the system. The sequence is outlined by numbered steps which correspond to circled numbers on the adjacent diagram.

NOTE-This is a basic operation sequence for the G21. The thermostat shown is a basic electromechanical thermostat .

Operation Sequence:

- 1- Line voltage feeds through door interlock switch S51. The fan access panel must be in place to energize the unit.
- 2- Line voltage energizes transformer T1. Transformer T1 provides 24VAC power to all unit controls, terminal strip and thermostat.

Heating:

- 3- Heating demand initiates at W1 in the thermostat.
- 4- Heating demand continues through primary gas limit S10 through the differential pressure switch S72 enabling ignition control A3.
- 5- Ignition control A3 energizes combustion air fan relay K13 for 30 ± 2 seconds. N.O. K13-1 closes energizing B6 for 30 ± 2 seconds.
- 6- Gas valve opens and attempts for ignition occur.
- 7- The sure-start heater in S57 is energized. As temperature rises in the heating compartment with the addition of the heat from the sure-start heater N.O. S57-1 close energizing fan B3 on heating speed.
- 8- After ignition is sensed, A3 continues sparking and the purge fan is energized for the remaining time of the ignition attempt.
- 9- ACC terminal of TB2 is energized. K43, economizer relay is energized. N.O. K43-1 closes energizing economizer.

End of Heating Demand:

- 10- Heating demand is satisfied.
- 11- Ignition control A3 is de-energized.
- 12- Gas valve GV1 closes. Pulse cycle stops.

- 13- Purge fan is energized for 30 ± 2 seconds post purge by ignition control A3.
- 14- Fan continues to operate until bi-metal switch in S57 cools (120-240 seconds).
- 15- As temperatures in the heating compartment reduces, S57-1 opens, fan B3 is de-energized and economizer relay K43 is de-energized.

Fan Only:

- 16- Fan demand originates in the thermostat terminal G.
- 17- Fan contactor K3 is energized.
- 18- K3-1 N.O. closes energizing fan (black tap).
- 19- K3-2 N.O. closes energizing ACC terminal on TB2 terminal strip and economizer relay K43.
- 20- N.O. K43-1 closes energizing economizer.

Cooling Demand:

NOTE: Y TERMINAL ON LOW VOLTAGE TERMINAL STRIP IS USED FOR CONNECTING THERMOSTAT TO OUTDOOR UNIT (JUNCTION BLOCK). THE Y TERMINAL HAS NO INTERNAL CONNECTIONS TO THE UNIT.

- 21- Fan demand originates in the thermostat terminal G.
- 22- Fan contactor K3 is energized.
- 23- K3-1 N.O. closes energizing fan on cooling speed (black tap).
- 24- K3-2 N.O. closes energizing accessories terminal on TB2 terminal strip and economizer relay K43.
- 25- N.O. K43-1 closes, energizing economizer.

Single-Stage or Two-Stage Cooling With CCB1 (EBR1 Required)

See Table 8 for operating characteristics.

Continuous Low Fan Kit-Optional

- 26- S68 is a DPST switch.
- 27- One pole (S68-1) is connected to the fan (low speed tap).
- 28- The other pole (S68-2) is connected to the ACC terminal of the TB2 terminal block.
- 29- When the switch is energized S68-1,2 both close energizing the fan on low speed and the ACC terminal. This assures a fan supply when optional accessories such as an electronic cleaner operate.

GSR210

TB1 24V POWER
R

SET THERMOSTAT HEAT ANTICIPATION ACCORDING TO AMPERAGE LISTING ON UNIT NAME PLATE OR USE THE FOLLOWING FOR A GUIDE. UNITS WITH:
WHITE-RODGERS VALVE---.6
ROBERTSHAW---.6

NOTE-IF ANY WIRE IN THIS APPLIANCE IS REPLACED, IT MUST BE REPLACED WITH WIRE OF LIKE SIZE, RATING AND INSULATION THICKNESS.

WARNING-ELECTRIC SHOCK HAZARD,CAN CAUSE INJURY OR DEATH.UNIT MUST BE GROUNDED IN ACCORDANCE WITH NATIONAL AND LOCAL CODES.

K43-1
ECON

9 15 19 24

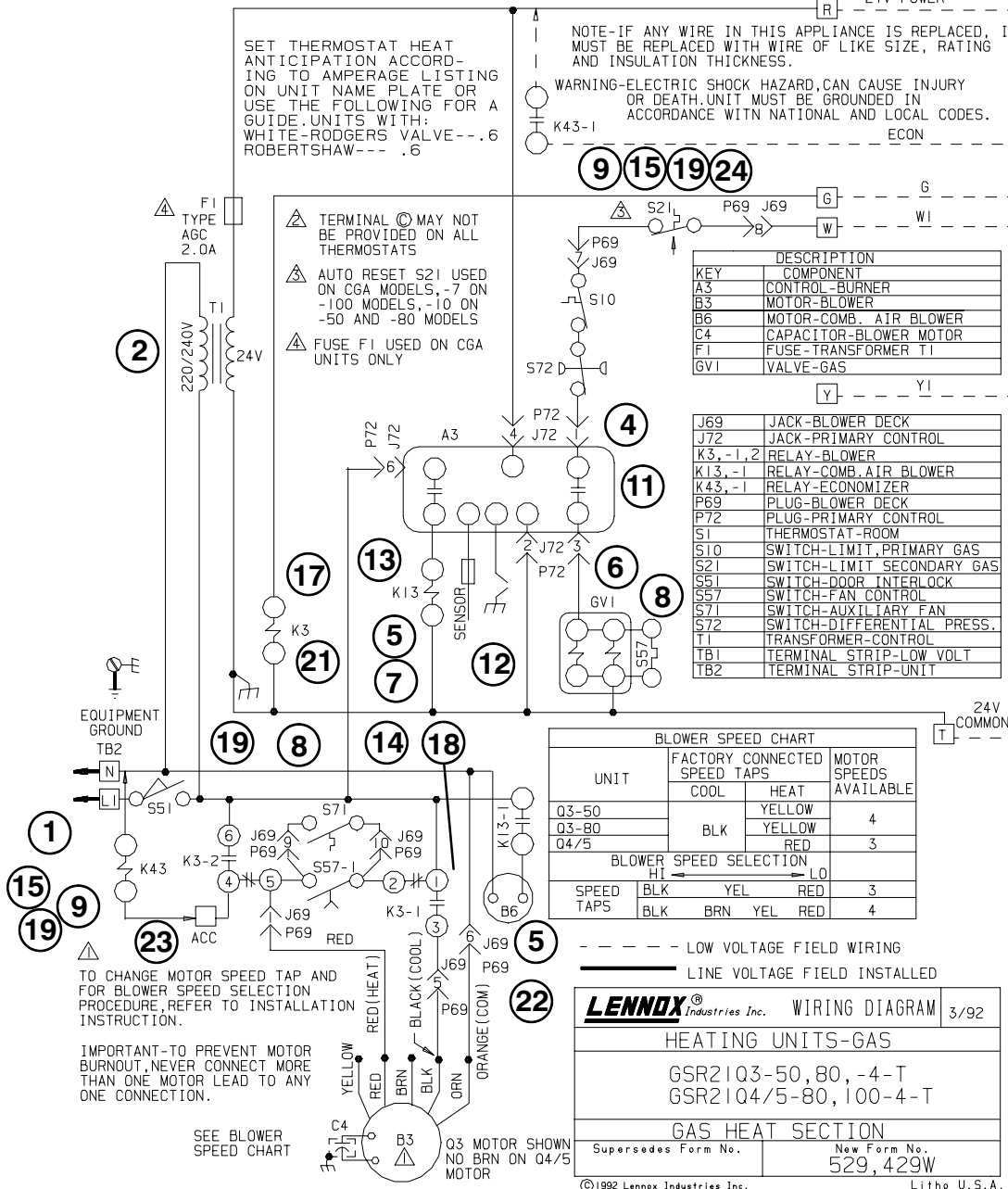
16 20
3 10

- ⚠ TERMINAL Ⓞ MAY NOT BE PROVIDED ON ALL THERMOSTATS
- ⚠ AUTO RESET S21 USED ON CGA MODELS, -7 ON -100 MODELS, -10 ON -50 AND -80 MODELS
- ⚠ FUSE F1 USED ON CGA UNITS ONLY

KEY	COMPONENT
A3	CONTROL-BURNER
B3	MOTOR-BLOWER
B6	MOTOR-COMB. AIR BLOWER
C4	CAPACITOR-BLOWER MOTOR
F1	FUSE-TRANSFORMER T1
GVI	VALVE-GAS

J69	JACK-BLOWER DECK
J72	JACK-PRIMARY CONTROL
K3, -1, 2	RELAY-BLOWER
K13, -1	RELAY-COMB. AIR BLOWER
K43, -1	RELAY-ECONOMIZER
P69	PLUG-BLOWER DECK
P72	PLUG-PRIMARY CONTROL
S1	THERMOSTAT-ROOM
S10	SWITCH-LIMIT, PRIMARY GAS
S21	SWITCH-LIMIT, SECONDARY GAS
S51	SWITCH-DOOR INTERLOCK
S57	SWITCH-FAN CONTROL
S71	SWITCH-AUXILIARY FAN
S72	SWITCH-DIFFERENTIAL PRESS.
T1	TRANSFORMER-CONTROL
TB1	TERMINAL STRIP-LOW VOLT
TB2	TERMINAL STRIP-UNIT

PLACE OUTDOOR UNIT AND/OR TEMPERATURE CONTROL DIAGRAM HERE



UNIT	FACTORY CONNECTED SPEED TAPS		MOTOR SPEEDS AVAILABLE	
	COOL	HEAT		
Q3-50	BLK	YELLOW	4	
Q3-80		YELLOW		
Q4/5		RED		
BLOWER SPEED SELECTION				
SPEED TAPS	BLK	YEL	RED	3
	BLK	BRN	YEL	RED

TO CHANGE MOTOR SPEED TAP AND FOR BLOWER SPEED SELECTION PROCEDURE, REFER TO INSTALLATION INSTRUCTION.

IMPORTANT-TO PREVENT MOTOR BURNOUT, NEVER CONNECT MORE THAN ONE MOTOR LEAD TO ANY ONE CONNECTION.

SEE BLOWER SPEED CHART

Q3 MOTOR SHOWN NO BRN ON Q4/5 MOTOR

--- LOW VOLTAGE FIELD WIRING
— LINE VOLTAGE FIELD INSTALLED

LENNOX Industries Inc. WIRING DIAGRAM 3/92

HEATING UNITS-GAS

GSR21Q3-50, 80, -4-T
GSR21Q4/5-80, 100-4-T

GAS HEAT SECTION

Supersedes Form No.	New Form No.
	529, 429W

Sequence of Operation GSR21

B-APPLICATION OF GSR21

This flowchart is used to show the step by step sequence that takes place when thermostat demand is sent to the GSR21. The sequence describes the actions of devices in the unit which control fans, gas valve and other components in the system. The sequence is outlined by numbered steps which correspond to circled numbers on the adjacent diagram.

NOTE-This is a basic operation sequence for the GSR21Q. The thermostat shown is a basic electromechanical thermostat .

Operation Sequence:

- 1- Line voltage feeds through door interlock switch S51. The fan access panel must be in place to energize the unit.
- 2- Line voltage energizes transformer T1. Transformer T1 provides 24VAC power to all unit controls, terminal strip and thermostat.

Heating:

- 3- Heating demand initiates at W1 in the thermostat.
- 4- Heating demand continues through secondary gas limit S21 to primary gas limit S10 through the differential pressure switch S72 enabling ignition control A3.
- 5- Ignition control A3 energizes combustion air fan relay K13 for 30 ± 2 seconds. N.O. K13-1 closes energizing B6 for 30 ± 2 seconds.
- 6- Gas valve opens and attempts for ignition occur.
- 7- After ignition is sensed, A3 continues sparking and the purge fan is energized for the remaining time of the ignition attempt.
- 8- The sure-start heater in S57 is energized. As temperature rises in the heating compartment with the addition of the heat from the sure-start heater N.O. S57-1 close energizing fan B3 on heating speed.
- 9- ACC terminal of TB2 is energized. K43, economizer relay is energized. N.O. K43-1 closes energizing economizer.

End of Heating Demand:

- 10- Heating demand is satisfied.
- 11- Ignition control A3 is de-energized.

- 12- Gas valve GV1 closes. Pulse cycle stops.
- 13- Purge fan B6 is energized for 30 ± 2 seconds post purge by ignition control A3.
- 14- Fan continues to operate until bi-metal switch in S57 cools (120-240 seconds).
- 15- As temperatures in the heating compartment reduce, S57-1 opens, fan B3 is de-energized and economizer relay K43 is de-energized.

Fan Only:

- 16- Fan demand originates in the thermostat terminal G.
- 17- Fan contactor K3 is energized.
- 18- K3-1 N.O closes energizing fan (black tap).
- 19- K3-2 N.O. closes energizing ACC terminal on TB2 terminal strip and economizer relay K43.

Cooling Demand:

NOTE: Y TERMINAL ON LOW VOLTAGE TERMINAL STRIP IS USED FOR CONNECTING THERMOSTAT TO OUTDOOR UNIT (JUNCTION BLOCK). THE Y TERMINAL HAS NO INTERNAL CONNECTIONS TO THE UNIT.

- 20- Fan demand originates in the thermostat terminal G.
- 21- Fan contactor K3 is energized.
- 22- K3-1 N.O closes energizing fan on cooling speed (black tap).
- 23- K3-2 N.O. closes energizing accessories terminal on TB2 terminal strip and economizer relay K43.

- 24- N.O. K43-1 closes energizing economizer.

Single-Stage or Two-Stage Cooling With CCB1 (EBR1 Required)

See Table 8 for operating characteristics.

Continuous Low Speed Fan Kit-Optional

- 25- S68 is a DPST switch.
- 26- One pole (S68-1) is connected to the fan (low speed tap).
- 27- The other pole (S68-2) is connected to the ACC terminal of the TB2 terminal block.
- 28- When the switch is energized S68-1,2 both close energizing the fan on low speed and the ACC terminal. This assures a fan supply when optional accessories such as an electronic cleaner operate.

TABLE 8

G21/GSR21 OPERATION SEQUENCE AND JUMPERS SUMMARY (OPTIONAL COOLING ACCESSORIES)

MATCH UP	JUMPER	COMMENTS OR SEQUENCE	WIRING CONNECTIONS
<p>EBR1 With CCB1 And Single-Speed Compressor</p>	<p>No Jumpers Additional Wiring Re- quired inside Unit. Refer to EBR1 Fan Relay Kit Installation Instructions</p>	<p>Fan operates on a lower speed tap during dehumidifi- cation. Otherwise, fan oper- ates on cooling tap during cooling cycle.</p>	<p>--- CLASS II VOLTAGE FIELD WIRING</p>
<p>EBR1 With CCB1 And Two-Speed Compressor</p>	<p>No Jumpers Additional Wiring Re- quired inside Unit. Refer to EBR1 Fan Relay Kit Installation Instructions</p>	<p>Fan operates on a lower speed tap during dehumidifi- cation. Otherwise, fan oper- ates on cooling tap during cooling cycle.</p>	<p>--- CLASS II VOLTAGE FIELD WIRING</p>