EMPIRE
COMFORT SYSTEMS
SINCE 1932

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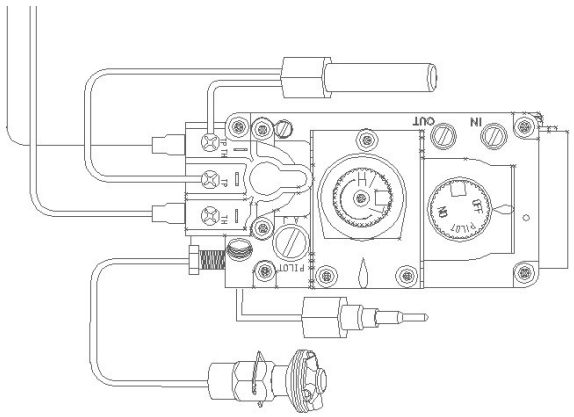


RECOMMENDED TOOLS

- Ground Adaptor Plug
- Touch Up Black Paint
- Nut Drivers 1/4”, 5/16”, 11/32”, 3/8”
- Screwdrivers
- Combination Wrenches 1/4” UP TO 3/4”
- Adjustable Wrenches 8”, 10” AND 14”
- Pipe Wrenches 8” AND 12”
- Needle Nose Pliers
- Slip Joint Pliers
- Wire Cutter/ Stripper
- Vaseline Petroleum Jelly
- Wire Connector/ Splicers
- Electrical Tape
- Small Flashlight
- Drop light
- Long Stem Lighters
- Inspection Mirror
- Hacksaw
- Shipping Blankets or Drop Cloths
- Glass Cleaner (Non- Ammonia Based)
- Paper Towels
- Surgical Booties
- Cleaner Wipes
- WD-40
- Leak Detector Bubbles
- 1/4” and 5/16” Gas Shutoff Keys
- Canned Air
- Flat Scraper
- Baby Nose Sucker
- Socket Sets - 1/4” and 3/8”
- Flat Gasket Stock
- Long Handle Needle nose
- Small Artist Paint Brush
- Blue Painters Tape
- Zoom Spout Oil
- Scrap 24 Gauge Sheet metal
- Shop Vacuum
- Duct Tape
- Band-aids
- Dog Bones and Rawhides
- Clean Trash Bags
- Calender or Strainer
- Wire Brush
- Small Cordless Drill
- Soft Paint Brush
- MilPropaneac Sealant
- Silicon Sealant
- Caulk Gun
- Ice Pick
- AA and AAA Batteries
- Camera
- 1/8” Heat Shrink Tubing
- Old Toothbrush
- Utility Knife
- Drill Bits
- Stubby Screwdrivers
- Offset Screwdrivers
- Micro Tip Screwdrivers
- Old Newspapers- Abrasive for cleaning dirty glass
- White-Off
- Lemon Pledge

CARBON DEPOSITS (SOOTING)

Some conditions can guarantee the production of soot. In most cases incomplete combustion starts with the inappropriate adjustment and setup of the appliance. However, several factors must be considered when attempting to diagnose a sooting fireplace condition. Remember that two or more of these factors could be involved.

- Is the log placement correct?
- Proper primary air adjustment for each burner
- Excessive ember material
- Improper placement of the lava rock
- Is the fireplace over or under fire?
- Direct-Venting not properly sealed or blocked
- Direct-Vent gasket leaking flue gas
- Atmospheric effects on B-Vent and Insert models
- Improper orifice alignment
- Valve and orifices not matched with fuel type

CHECK THE LOG PLACEMENT

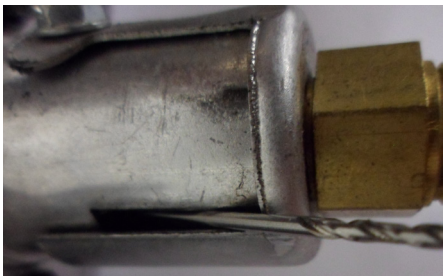
Most logs in Empire Comfort Systems Inc. gas appliances are designed to be placed in a particular pattern on the burner log grate. Any time flame touches a log it creates a condition called flame impingement, which can cause sooting if the logs and burner are not designed for impingement.

Some models have been designed so that the front log (the larger log just behind the front portion of the burner) will interact with the front burner to result in a glowing action. The front log is the most sensitive when it comes to positioning. Aside from it being desirable for the front log to be situated partially in the flame, it is critical that the air space between the burner and the log not be completely blocked. Restricting or closing that gap will create a taller, yellow flame that, in extreme conditions, may cause carbon.

It is important that the logs are arranged according to the installation instructions for each appliance model. The logs have been designed with holes or flat spots with notches, depending on the model you are working on. The logs are either numbered or have arrows that point towards the front window. Refer to the installation instructions for proper placement. If you find signs of soot build-up on the logs, the solution is most likely correcting the log placement. Remove any soot from logs with a vacuum and a small paint brush.

CHECK THE PRIMARY AIR SHUTTERS

The primary air shutters are factory set, but it is good practice to check the settings at the time of installation while consulting the manual for the correct setting. On any sooting call this should be the first place to start. Also check for any type of debris in the primary air openings. In some instances you may need to increase or decrease primary air depending on the type of installation. It is best to consult the technical department before making these adjustments. Also keep in mind that propane requires more primary air than natural gas.



CHECK ORIFICE ALIGNMENT

The burner orifice must be aligned perpendicular to the centerline of the burner housing. Never drill out an orifice. In case of a problem a new one must be ordered. The proper orifice, factory drilled and aligned, should allow the gas to shoot down the middle of the venturi, draw the correct volume of primary air and allow the air and gas to mix properly for combustion. When reinstalling an orifice, use pipe joint compound and do not cross thread it into the gas manifold, as leakage and misalignment will occur. Always use a back-up wrench when removing or installing an orifice.

EMBER FIBERS, CERAMIC FIBERS, AND LAVA ROCK PLACEMENT

Ember fibers are used on most fireplaces. If compressed and packed onto the burner, they may cause incomplete combustion. Keep the burner portholes free by placing the embers in a loose and fluffy manner. Always try and keep the pieces about the size of a dime. These embers can also be rubbed into the logs to add a glowing effect where the flame impinges the log. When replacing existing ember material it is always best to use a small brush or vacuum to clean off the burner first before placing new embers.

Lava rocks are used for decorative purposes ONLY and must not be placed on any part of the burner. Lava rocks should only be placed on the bottom of the firebox around the burner assembly. Be careful that they do not interrupt airflow into the primary air inlets for the burner.

Gloves are recommended when handling logs to prevent skin irritation. Logs are fragile - Handle with care.

DETERMINING THE CORRECT FIRING RATE: IS THE APPLIANCE OVER-FIRED OR UNDER-FIRED?

All gas appliances need fuel and air for the combustion process. A balance between fuel and air has been established for each appliance. If the amount of fuel to the burner is too great you will possibly experience sooting and other cosmetic symptoms. If insufficient fuel is combusted, you will possibly observe a low flame condition. For under-fired conditions with the correct manifold pressure, it will be necessary to remove the orifice and inspect for burrs or debris caught in the orifice opening.

The three factors that govern the fireplace firing rate are:

1. Orifice size
2. Manifold pressure
3. Gas type

ORIFICE SIZE IDENTIFICATION

The correct orifice size(s) for each appliance can be found on the rating plate. The orifice size is identified by locating the orifice number stamped onto the orifice brass body. If you are unable to read this number, the size can be determined using a drill index set.

CAUTION: Over-firing an appliance may cause soot production, broken glass, discolored trim, valve damage and excessive temperatures and may result in personal and property damage.

GAS PRESSURE

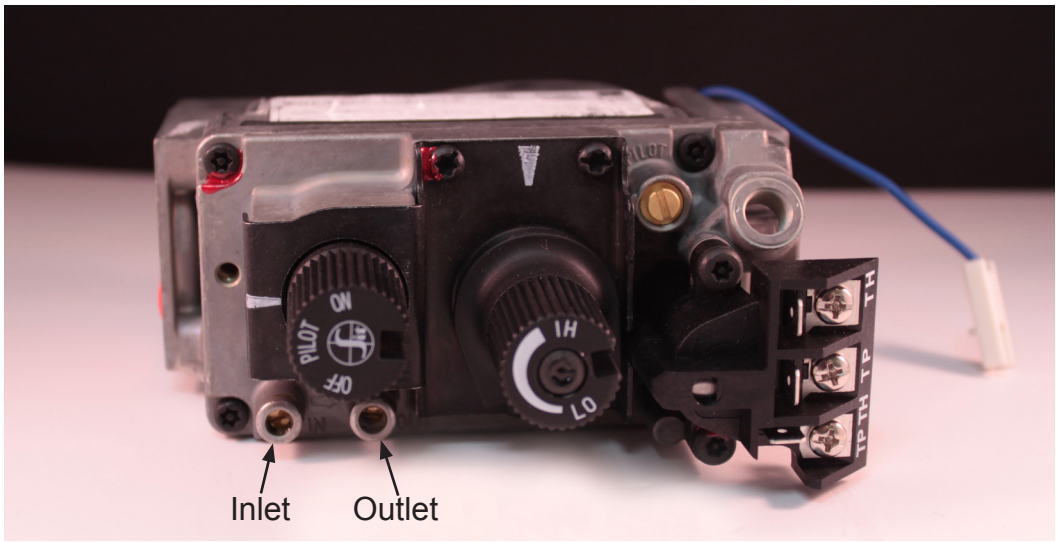
Fireplaces and stoves operate at different manifold pressures and may also require differing inlet pressures, so always check the appliance rating plate for the correct inlet and manifold pressures. While the manifold pressure for Natural is typically 3.5” WC, minimum inlet pressures may be anywhere from 4.5” to 7” WC, depending on the appliance. For Propane, manifold pressure is now 10” WC, while some older products operated at 11” WC. Inlet pressure for Propane is typically around 14” WC.

IMPORTANT: When checking gas pressure always check both the inlet and manifold pressure. Always soap pressure taps when you are finished.

Turn OFF the shut off valve for the appliances. The inlet pressure test port is located on the front of the valve closest to the gas inlet to the valve and should be labeled 'IN'. Insert a small standard screwdriver into the test port and turn the screw counter-clockwise about 1/4 turn. This screw is a 'captive' screw that can not be removed from the valve. This opens the test port to the inlet pressure side of the valve.

Slide the rubber hose of the manometer over the post where the screw was turned, then slowly turn ON the gas shut off valve, light the appliance main burner and set to high fire using the HI/LO regulator knob. This will determine that the gas supply line to the appliance has been properly sized. If there are other gas appliances in the house and there are complaints of fireplace pilot outage, turn on the main burners of all other gas appliances as well to verify you still have the correct minimum inlet pressure. If this pressure is too low, you will have to examine the sizing of all gas lines and the setting on the service regulator. Read the inlet pressure and record, then when finished turn OFF the shut off valve. Remove the rubber hose from the inlet port, tighten the screw and then turn the shut off valve back to the ON position and test for leaks.

The manifold pressure test port is only live when the main burner is on, so with the main burner turned OFF, turn the captive screw in the manifold pressure test port (marked 'OUT') counter-clockwise about 1 I 4 turn and slide the rubber hose from your manometer over the post. Turn ON the main burner making sure that the appliance regulator is set to the high position. Once you have obtained your reading, turn OFF the main burner, remove the hose, tighten the screw and test for leaks.



HIGH ALTITUDE DE-RATING

Input ratings are shown in BTU's/hour and are certified for elevations up to 4,500 feet above sea level. At elevations above 4,500 feet (1372m), installations must be in accordance with local authorities having jurisdiction. Empire Comfort Systems Inc does not supply de-rating kits for its appliances, but individual orifices can be ordered.

CLOCKING THE APPLIANCE INPUT

Natural gas burner inputs can be determined by clocking the gas meter. The test dials of the gas meter may be used to determine the gas appliance input by measuring the time it takes to deliver a known volume of gas to an appliance. This technique is referred to as clocking the meter and is very important to assure input accuracy. Use either the calculation below or the following clocking chart to check the input of the appliance. The calculation of the appliance input using the clocking data is performed using the following equation:

$$Q = \frac{3600}{T} \times D$$

Where:

3600 = the number of seconds in one hour
T = the time in seconds for one revolution of the test dial
D =the size of the test dial (e.g. 1.0 ft^3 or .01 m^3)
Q = the gas flow rate (e.g. CFH or CMH)

When using a meter to clock gas inputs, the following steps must be performed to ensure accurate results:

- Run appliance for at least 15 minutes to warm up
- Shut off the gas flow to all other gas appliances
- Make sure the appliance regulator knob is set to high fire
- Time one complete revolution of the dial instead of a quarter or half revolution and then multiplying
- Clock the meter two or three times and use the average

When checking propane gas appliances for input rates you will need to check orifice size and manifold pressure as propane systems do not have gas meters.

To convert cubic feet per hour (CFH) to Btu's/hour, remember that 1 ft^3 of natural gas, when burned, will produce approximately 1,000 Btu's. Therefore 35 CFH will produce about 35,000 Btu's/hr.

There are 35.3145 cubic feet in 1 cubic meter, so for every cubic meter consumed, the appliance will produce about 35,315 Btu's. This is why we use the .01 cubic meter per revolution dial for clocking the appliance.

Meter Clocking Chart

SECONDS FOR ONE REVOLUTION	SIZE OF TEST DIAL		
	IMPERIAL		METRIC
	0.5 FT3/rev	1.0 ft3/rev	.01 m3/rev
	cubic feet of gas per hour		
20	90	180	63
21	86	171	61
22	82	164	58
23	78	156	55
24	75	150	53
25	72	144	51
26	69	138	49
27	67	133	47
28	64	128	45
29	62	124	44
30	60	120	42
32	56	113	40
34	53	105	37
36	50	100	35
38	47	95	33
40	45	95	32
42	43	86	32
44	41	82	29
46	39	78	28
48	38	75	26
50	36	72	25
52	35	69	24
54	33	67	23
56	32	64	32
58	31	62	22
60	30	60	21
85	28	55	20
70	26	51	18
75	24	48	17
80	23	45	16
90	20	40	14
100	18	36	13
110	16	32	12
120	15	30	11
130	14	28	10
140	13	26	9
150	12	24	8
160	11	23	
170		21	
180	10	20	7

ORIFICE BIT SIZING AND CAPACITY

		Natural Gas					Propane
Inches of H2O		3.0	3.5	4.0	4.5	7.0	11.0
Drill Size	Decimal Size	BTU	BTU	BTU	BTU	BTU	BTU
39	0.0995	23272	25137	26872	28502	35549	69156
38	1.1015	24217	26157	27963	29660	36992	71964
37	0.104	25425	27462	29358	31139	38837	75553
36	0.1065	26662	28798	30786	32654	40726	79229
7/64	0.1094	28133	30388	32486	34456	42975	83603
35	0.11	28443	30722	32843	34835	43447	84522
34	0.111	28962	31283	33443	35472	44241	86066
33	0.113	30015	32420	34659	36761	45849	89195
32	0.116	31630	34165	36524	38739	48316	93994
31	0.12	33849	36562	39086	41457	51706	100588
1/8	0.125	36729	39672	42411	44984	56104	109145
30	0.1285	38815	41924	44819	47538	59290	115343
29	0.136	43478	46961	50204	53249	66413	129200
28	0.1405	46402	50120	53581	56831	70881	137892
9/64	0.1406	46469	50192	53657	56912	70982	138088
27	0.144	48743	52649	56284	59698	74456	144847
26	0.147	50795	54865	58653	62211	77591	150946
25	0.1495	52538	56747	60665	64345	80253	156123
24	0.152	54309	58661	62711	66515	82959	161389
23	0.154	55748	60215	64372	68277	85157	165664
5/32	0.1563	57426	62027	66309	70332	87719	170649
22	0.157	57941	62584	66905	70963	88507	172181
21	0.159	59427	64188	68620	72783	90776	176596
20	0.161	60931	65813	70357	74625	93074	181066
19	0.166	64775	69965	74795	79332	98945	192487
18	0.1695	67535	72946	77982	82713	103161	200690
11/64	0.1719	69461	75026	80206	85072	106103	206413
17	0.173	70353	75990	81236	86164	107465	209063
16	0.177	73644	79544	85036	90195	112492	218843
15	0.18	76161	82263	87943	93278	116338	226324
14	0.182	77863	84102	89908	95362	118938	213381
13	0.185	80451	86897	92897	98532	122891	239072
3/16	0.1875	82640	89261	95425	101213	126235	245577
12	0.189	83968	90695	96957	102839	128263	249522
11	0.191	85754	92625	99020	105027	130992	254831
10	0.1935	88014	95066	101629	107794	134443	261546
9	0.196	90303	97538	104272	110598	137940	268348
8	0.199	93088	100547	107489	114009	142194	276625
7	0.201	94969	102578	109660	116312	145067	282213
13/64	0.2031	96963	104732	111964	118755	148114	2588141
6	0.204	97825	105663	112958	119810	149430	290701
5	0.2055	99269	107222	114626	121579	151635	294991
4	0.209	102679	110906	118563	125755	156844	305125
3	0.213	106647	115192	123145	130615	162906	316916
7/32	0.2188	112534	121550	129943	137825	171898	334411
2	0.221	114808	124007	132569	140611	175372	341169
1	0.228	122196	131987	141100	149659	186658	36124

ORIFICE BIT SIZING AND CAPACITY

		Natural Gas					Propane
Inches of H2O		3.0	3.5	4.0	4.5	7.0	11.0
Drill Size	Decimal Size	BTU	BTU	BTU	BTU	BTU	BTU
80	0.0135	428	463	495	525	654	1273
79	0.0145	494	534	571	605	755	1469
1/64	0.0156	572	618	661	701	874	1700
78	0.016	602	650	695	737	919	1788
77	0.018	762	823	879	933	1163	2263
76	0.02	940	1016	1086	1152	1436	2794
75	0.021	1037	1120	1197	1270	1583	3081
74	0.0225	1190	1285	1374	1457	1818	3536
73	0.024	1354	1462	1563	1658	2068	4024
72	0.025	1469	1587	1696	1799	2244	4366
71	0.026	1589	1716	1835	1946	2427	4722
70	0.028	1843	1991	2128	2257	2815	5476
69	0.0292	2004	2165	2314	2455	3062	5956
68	0.031	2259	2440	2608	2767	3451	6713
1/32	0.0313	2303	2487	2659	2820	3518	6843
67	0.032	2407	2600	2779	2948	3677	7153
66	0.033	2560	2765	2956	3135	3910	7607
65	0.035	2880	3110	3325	3527	4399	8557
64	0.036	3046	3291	3518	3731	4654	9053
63	0.037	3218	3476	3716	3941	4916	9563
62	0.038	3394	3666	3919	4157	5185	10087
61	0.039	3575	3862	4128	4379	5461	10625
60	0.04	3761	4062	4343	4606	5745	11176
59	0.041	3951	4268	4563	4840	6036	11742
58	0.042	4147	4479	4788	5078	6334	12322
57	0.043	4346	4695	5019	5323	6639	12916
56	0.0465	5083	5490	5869	6225	7764	15104
3/64	0.0469	5171	5585	5970	6333	7898	15365
55	0.052	6356	6865	7339	7785	9709	18888
54	0.055	7111	7680	8211	8709	10862	21131
53	0.0595	8322	8989	9609	10192	12712	24730
1/16	0.0625	9182	9918	10603	11246	14026	27286
52	0.0635	9478	10238	10945	11609	14479	28167
51	0.067	10552	11398	12184	12924	16119	31357
50	0.07	11518	12441	13300	14107	17594	34228
49	0.073	12527	13530	14464	15342	19135	37225
48	0.076	13577	14665	15678	16629	20740	40347
5/64	0.0781	14338	15487	16556	17560	21902	42608
47	0.0785	14485	15646	16726	17741	22127	43045
46	0.081	15423	16658	17809	18889	23558	45931
45	0.082	15806	17072	18251	19358	24144	46969
44	0.086	17385	18778	20075	21293	26557	51663
43	0.089	18620	20111	21500	22804	28442	55331
42	0.0935	20550	22197	23729	25168	31391	61067
3/32	0.0938	20682	22339	23882	25330	31592	61460
41	0.096	21664	23399	25015	26532	33092	64337
40	0.098	22576	24384	26068	27646	34485	67087

DIRECT-VENTING NOT SEALED

Empire Comfort Systems Inc. direct-vent appliances are only approved for use with direct-vent pipe listed below; a rigid coaxial vent system consisting of a 4” aluminum inner flue pipe within a 7” galvanized outer combustion air inlet pipe. The following are the approved pipe systems that can be used:

- Security Secure Vent ®
- Duravent ® Direct-Vent Pro
- American Metal Products
- Selkirk Direct-Temp ®
- Excel BDM
- Empire Flexvent Kit DVVK-4F
- Metal Fab Sure Seal ®
- Olympia Ventis®

Check the manual for approved venting.

All direct vent appliances rely on a balance between fuel, combustion air inlet and exhaust. If venting is not installed properly, flue gases (inner pipe) may leak back into the fresh air passage (outer pipe) and displace combustion air, thereby depleting the amount of oxygen to the burner. This condition will either cause a dirty flame that may soot, or in extreme cases will displace enough oxygen to cause the flame to extinguish. Remember to check the termination to ensure it is not blocked and that the correct sidewall termination has been used for the application. Always refer to the installation instructions for the proper venting layout and assembly. Remember to always activate the direct vent unit and do all proper checks prior to permanently covering in the unit. For oxygen-starved units some of the following flame characteristics can be observed:

- Flame lifting off of the burner.
- Flame color staying blue minutes after burner ignition.
- Pilot lifting and going out after burner ignition.
- Tall, wispy, orange-colored flames that may impinge on the top of the firebox.
- Sooting from impingement or from the flame tips.

DIRECT-VENT LEAKING AT THE FIREBOX

Proper direct vent combustion can also be compromised due to the loss of combustion air and flue products at the firebox. While a Carbon Dioxide Analyzer is the best tool for locating leaks, there are other ways to look for problem areas. Look for heat causing discoloration of paint or brass around the window for possible leaks. Soot on the window gasket is also an indication of a bad seal. Use a flashlight in the control compartment aiming it up towards the burner tray gasketing and pilot assembly pass-through and look for any light penetration through to the combustion chamber.

Something as small as a missing or mis-aligned screw can cause sooting. These screws can be found at the base of the firebox securing the burner tray to the fireplace/stove and may be underneath lava rock or refractory. Also check the pressure relief plate(s) on top of the firebox to ensure they are properly seated and the gasket is in good condition. When components of the fireplace have been removed for cleaning or servicing, care must be taken to protect the gasketing when re-attaching. It is imperative that, when replacing any pilot assembly components, the hole in the burner tray is completely re-siliconed.

EXPANSION NOISE

It is normal for appliances fabricated of steel to give off expansion noises during the heat up and cool down cycles. Similar ‘ticking’ noises can be heard from your furnace ductwork and car exhaust system. Banging, or ‘oil canning’ is typically caused when a metal panel is under stress and expands and contracts as it heats up and cools down. The stress will eventually give with one or two loud bangs as the metal buckles. In most cases, this stress is a result of improper venting (e.g. forcing a rear vent DV fireplace into position when the pipe is not completely lined up with the firestop, forcing a top vent termination onto a rear vented fireplace, shifting an appliance after it has been installed, etc.).

FIREPLACE TOO HOT

A common complaint from customers is that their appliance gets too hot while operating. Depending on the appliance and the venting, the header above the fireplace may get too hot to keep your hand on. Whether the material is wood or marble, this will not cause an unsafe situation as long as it is designed and installed as per the installation manual for the fireplace. Standards allow for temperatures up to 190°F on wooden cabinets, but you will require a digital thermometer with a surface probe or an infrared thermometer to measure this accurately.

⚠WARNING

HOT GLASS WILL CAUSE BURNS.
DO NOT TOUCH GLASS UNTIL COOLED.
NEVER ALLOW CHILDREN TO TOUCH GLASS.

A barrier designed to reduce the risk of burns from the hot viewing glass is provided with this appliance and shall be installed for the protection of children and other at-risk individuals.

NOTE: Barrier required, but may be sold separately.

ODORS

It is normal for a gas fireplace to give off some odor the first time it is burned. This is due to the curing of paint, adhesives and the burning off of oils necessary for the manufacturing process. It is recommended that the gas appliance be burned for at least 10 continuous hours on high flame setting the first time it is fired up. If the appliance is controlled by a thermostat, the thermostat should be by-passed. If a fan is installed, place the fan in the off position during this time. Some gas appliances may require additional curing time depending on the venting configuration and model, so be sure to tell the homeowner this before you leave the installation. On any odor call, first ensure the appliance has gone through a suitable curing period. This can be verified by removing the window frame and examining the gasket material. The paint and oils will burn off or cure in the first hour of use, while the gasket adhesive will take longer. The last areas of gasket adhesive to cure will be the two bottom corners, so pull back the gasket to check the adhesive. If it is still tacky, the appliance needs to be burnt for a longer period. Other things to watch for are:

- Check the chimney draft on naturally vented fireplaces.
- Look for debris and dust in the air outlet passage on top of the firebox.
- Inspect the pressure relief doors and gaskets on direct vents to be sure they are properly seated and nothing is obstructing them.
- Check finishing materials on adjacent surfaces (mantel finishes, caulking) to ensure they can withstand the operating temperatures of the fireplace
- Check clearances to any combustibles
- Vacuum all air passages and then clean with a damp cloth to remove dust, etc.

Vent-free appliances are often associated with odors, but are rarely the cause. Existing elements within the dwelling will change as they undergo the combustion process and are then exhausted back into the house. Because these odors are noticed once the vent free fireplace is installed, many people point at the fireplace as the culprit. For the original source of the odor look toward pets, cooking habits, cleaning products, ‘new’ man-made building materials (off-gasing from carpets, engineered wood products, finishes, dirt on the burner and logs, etc.) and even such obvious items as ash trays and sports gear.

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APPEARANCE MAINTENANCE

Trim Maintenance

Clean trim using a soft cotton cloth and lemon oil. Do not use water or household cleaners on any components. Tarnished trim could be the result of:

- Improper cleaning.
- Leaking window gasket or pressure relief door.
- Over-heating of the appliance (overfiring, draft problems on natural vent, improper venting on direct vent).
- Installations near chlorinated pools or spas.
- Incorrect installation of the brass components or appliance unit itself.

Window Maintenance

It will be necessary to clean the glass window periodically. It is recommended that the window be cleaned at least 2 or 3 times per season with Gas Fireplace Glass Cleaner, following the manufacturer's instructions. This is a special window cleaner (there are many different manufacturers) that polishes the surface and leaves a protective coating behind. Do not use any ammonia compounds to clean the glass as they will cause 'crazing' (small spider cracks) to appear in the glass. The need for more frequent cleaning will be caused by excessive silicone use or improper venting on direct vent fireplaces, and poor drafting on natural vent fireplaces. It is a good idea to show the customer how to clean the glass properly when you are finished the installation.

Paint Repairs

The firebox walls are painted with high temperature paint. This painted surface will assume it's own character over time. In the event the fireplace paint is flaking or peeling a method of touch-up has been established.

Warning: Shut off the pilot before painting

Paint will only stick to a properly prepared surface. If there is soot, oil or foreign material on the surface, it must be cleaned off. Loose flaky paint and any dust or dirt should be removed with a synthetic steel wool. Experience has shown us that lacquer thinner does the best job of cleaning the surface.

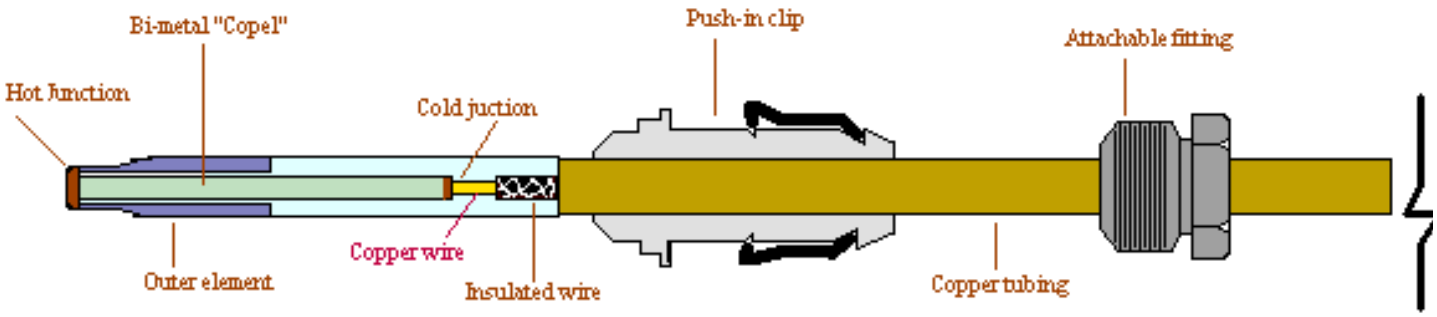
CAUTION: Lacquer thinner is highly flammable and gives off vapors, which are dangerous to your health. Obtain proper advice prior to use and use extreme care while using it.

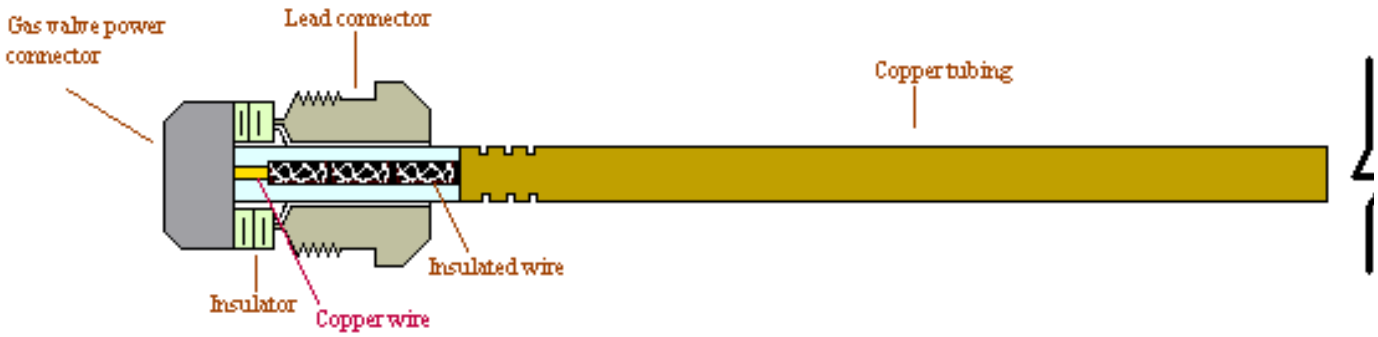
When solvents cannot be used, a good detergent can be substituted. Tri-sodium phosphate (available at most hardware stores) and water followed by a good rinse works well on less oily surfaces.

Part Number	Color	Size	Where paint is used
R7892	Beta Black	12 oz spray	Fireplace faces, inside, trims and louvers, Mantis face, Log grates and Log supports, Cast Iron stove chassis
R9283	Satin Black	12 oz spray	Cast Iron (Flat Black Casting). Slope burner tops, Space heater (heat exchangers) Mantis interior
7820118	Satin Black	4 oz spray	Cast Iron (Flat Black Casting). Slope burner tops, Space heater (heat exchangers) Mantis interior
R8111	Beige	6 oz spray	Space Heaters
782090	Beige	12 oz spray	Space Heaters
R11722	White	12 oz spray	PVS units, White GWT units
R11723	White	1 oz touch-up brush in bottle	PVS units, White GWT units
DPA18BL	Black	12 oz spray	Broilmaster castings
B100364	Black Guard III	12 oz spray	Broilmaster posts and carts

THERMOCOUPLES

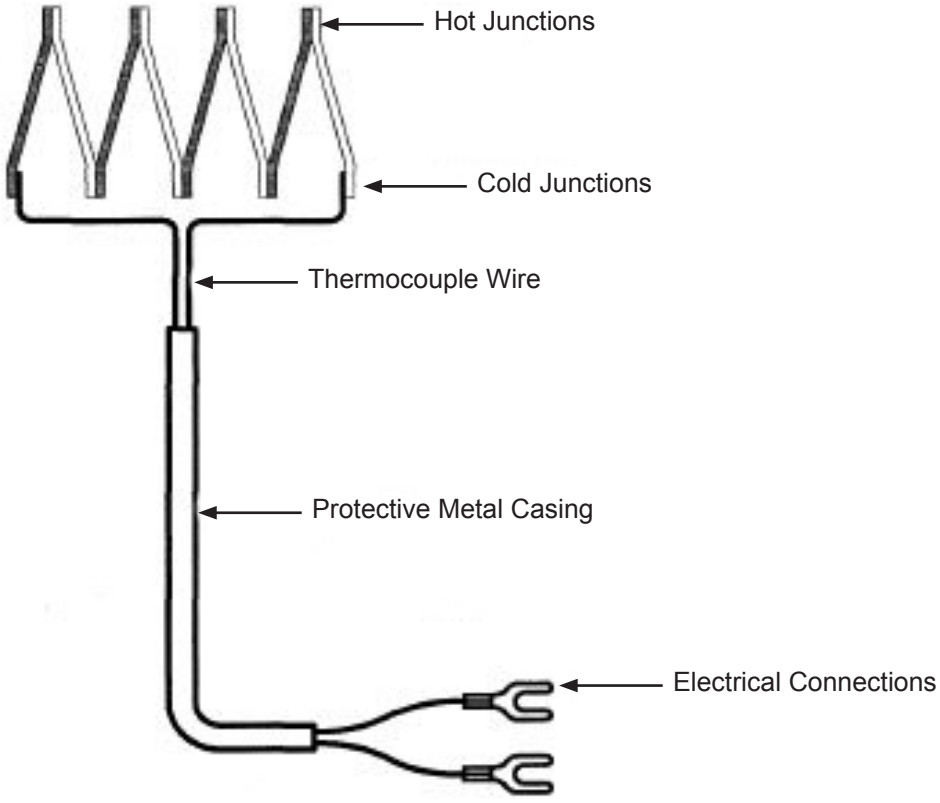
A thermocouple is a device that generates electricity when heated. It consists of two dissimilar metals joined together at a ‘hot junction’ or welded tip. When the hot junction is heated by the pilot light to approximately 1200°F and the ‘cold junction’ is held around 700°F, this temperature difference will produce a small electrical current. This is why flame impingement is so critical; the pilot flame should be hitting the top 3/8” of the thermocouple. This current travels along an insulated wire to the safety magnet in the gas valve and then returns via the outside copper casing. The thermocouple connector nut is part of the electrical circuit and must be properly secured (hand tight+ 1 I 4 turn) in order to complete the circuit. When the magnet is energized by the thermocouple, it allows gas flow to the pilot assembly. Should anything happen to the pilot flame, the hot junction will cool off, decreasing the temperature difference and causing the voltage output of the thermocouple to drop. A thermocouple should produce anywhere from 18 to 30 mVDC. Should the reading stay below 18 mVDC open circuit after pilot adjustment, replace the thermocouple.





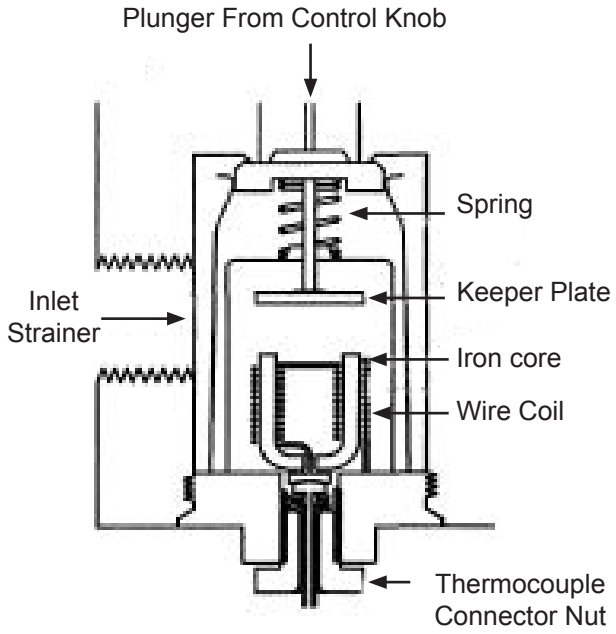
THERMOPILES

By connecting many thermocouples together in series, the voltage produced can be multiplied by the number of thermocouples. This device is known as a thermopile or powerpile and it is capable of producing up to 750 mVDC. This higher voltage allows us to open the main gas valve from a remotely located switch (wall switch, thermostat); unlike the safety magnet, which can only be held open once the keeper plate is manually depressed against the magnet. This is also because the main operator coil in the valve has more wire wrapped around the iron core which, coupled with the higher voltage, turns it into a stronger magnet.

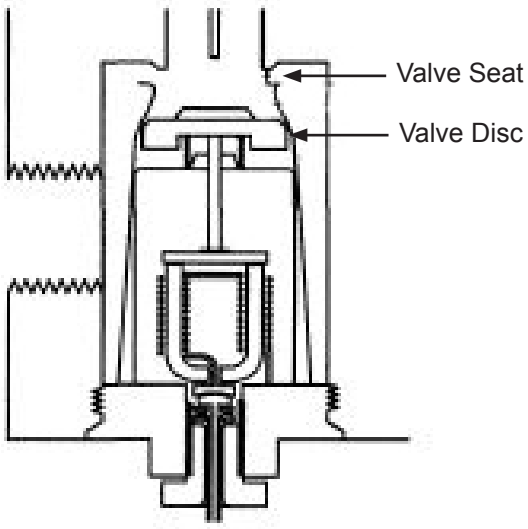


PILOT SAFETY MAGNET

The safety magnet, also known as the safety pilot shut off or EPU (electromagnetic power unit), is the component of the gas valve which allows gas to flow through the valve to the pilot. Electricity generated by the thermocouple travels through the contact into the safety magnet. It then passes through the wire coiled around the u-shaped iron core before grounding back to the thermocouple through the valve body. This current will turn the iron core into an electromagnet that will, when energized, hold the valve open only after the control knob is fully depressed in the 'pilot' position. Once this valve is open, gas flows through to the pilot burner, as well as the main burner when the main switch is closed. Should the thermocouple cool off, the voltage output will drop resulting in less magnetic force. The spring pressure will then overcome the magnetic force and the valve will close shut.



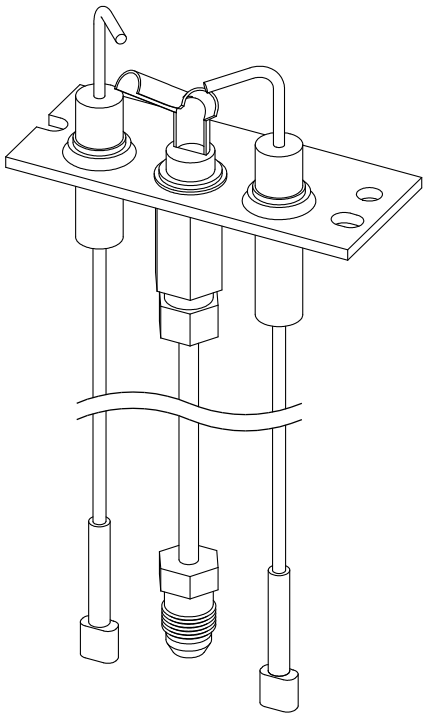
Safety Magnet Closed



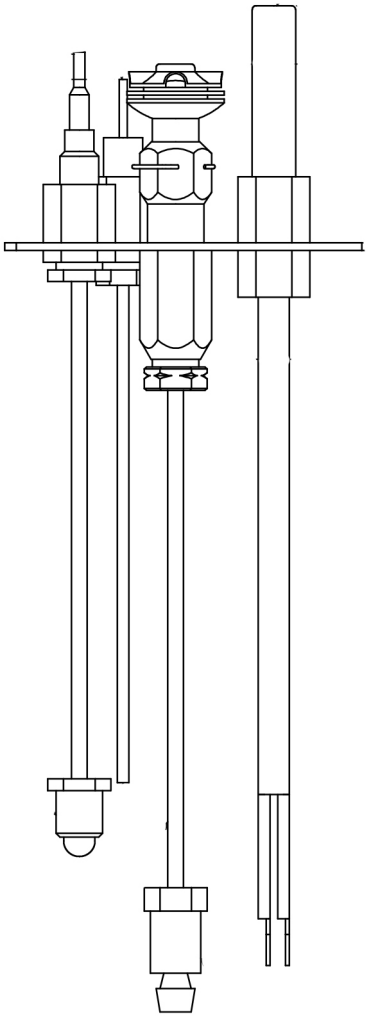
Safety Magnet Open

PILOT ASSEMBLY

PSE Pilot Assembly

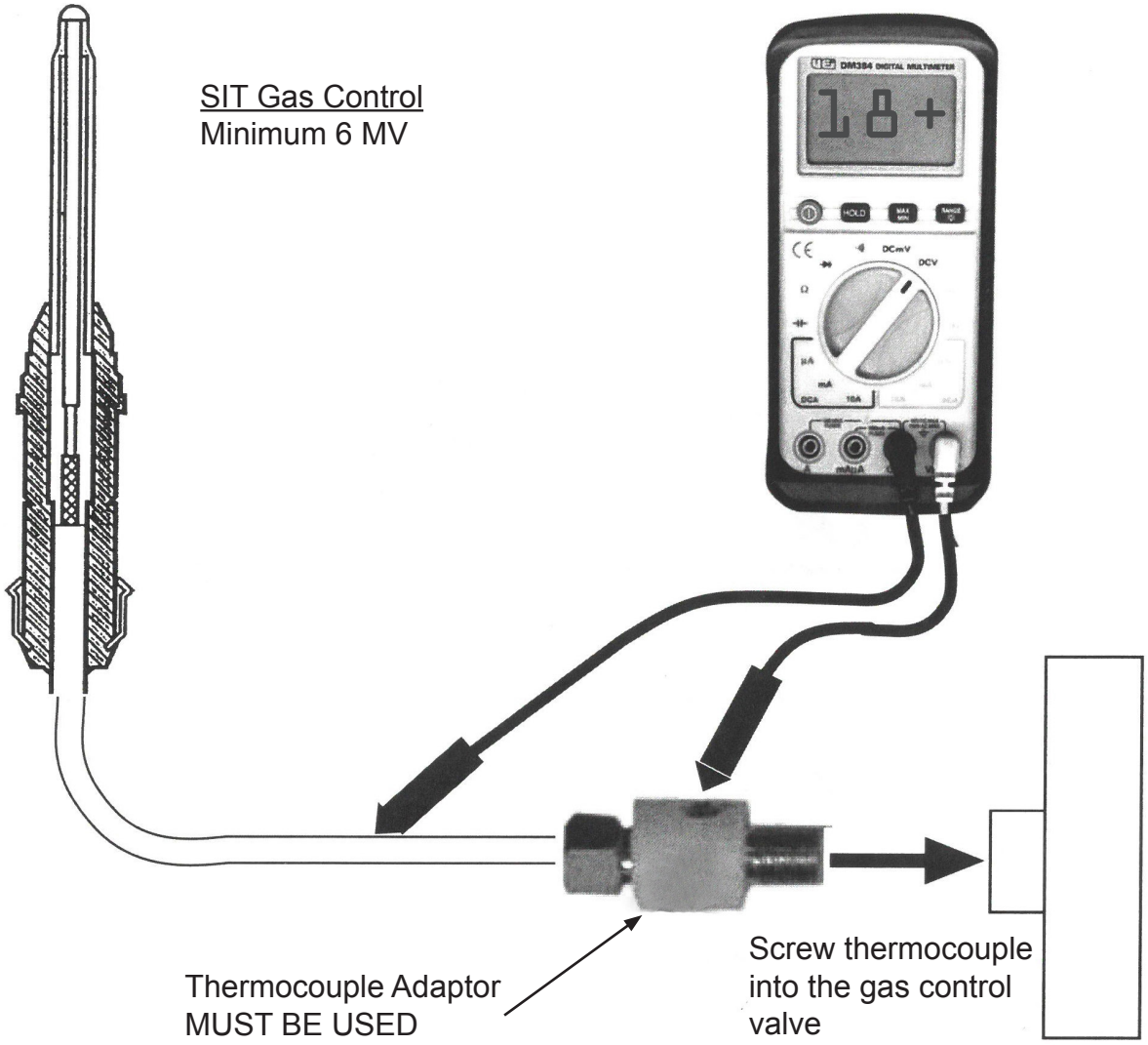


SIT Pilot Assembly



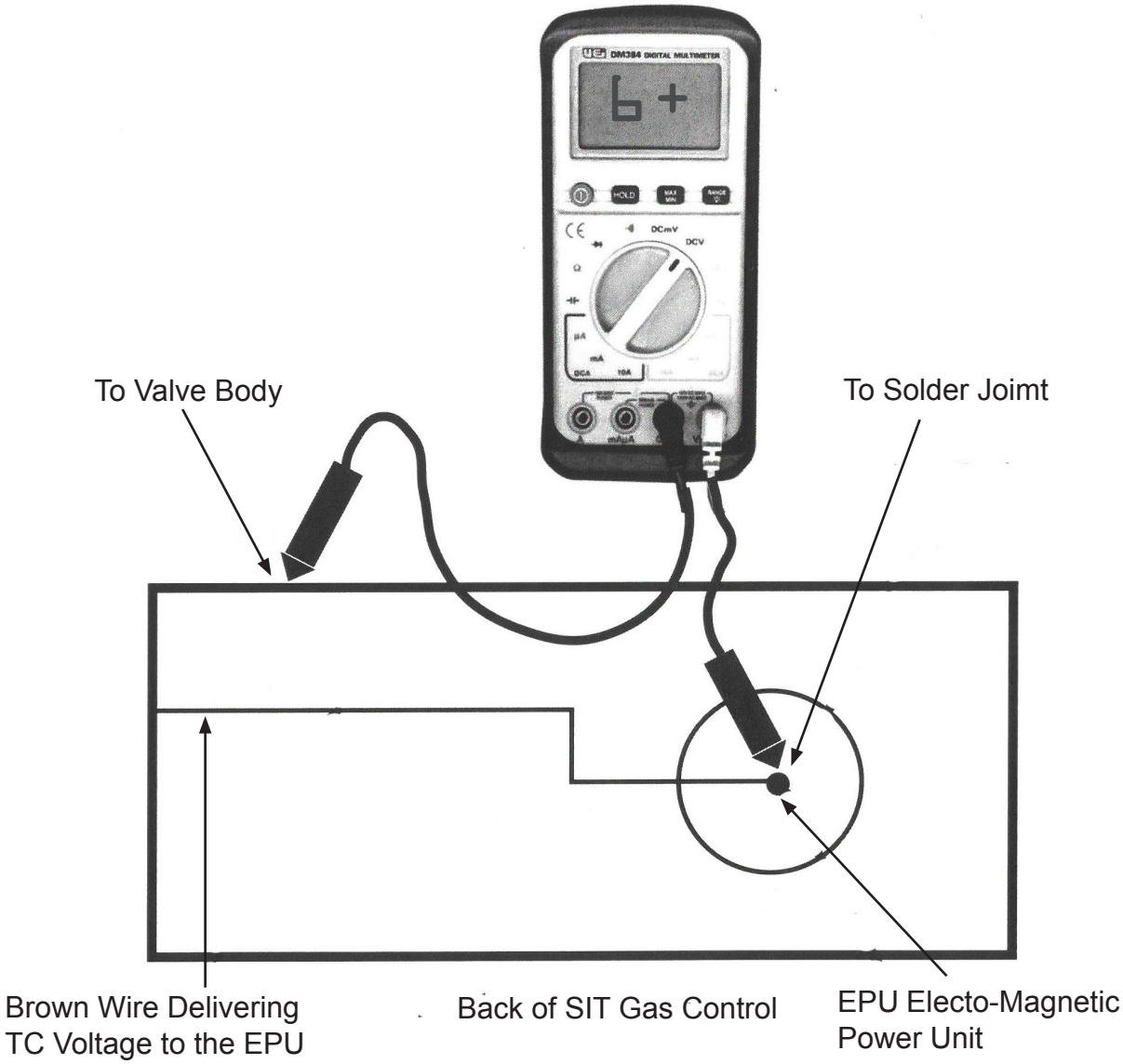
TESTING THERMOCOUPLE

Voltage on a SIT or RobertShaw Gas Control Valve. Testing MV Production



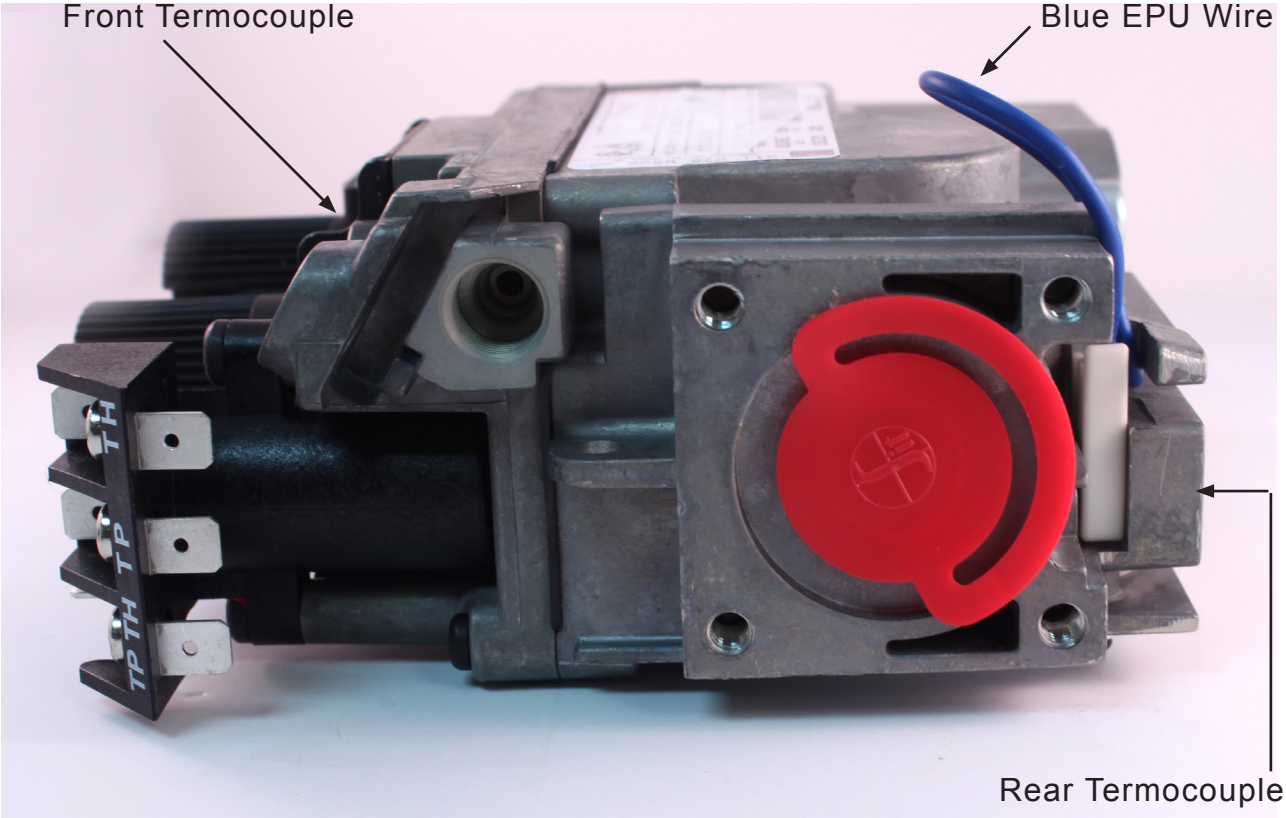
The open circuit test will tell you the amount of voltage that the thermocouple is capable of producing without any load, or when it is disconnected. Depending on the type of fireplace you are looking at, there is more than one way to obtain this reading. The most common way of obtaining it is to disconnect the thermocouple from the valve by unthreading the thermocouple connector nut with a 3/8” open end wrench. Next attach the leads of your multimeter to the end positive contact and the copper casing using alligator clips. After ensuring that your multimeter is on the proper range, light the pilot and hold in the control knob until the readings on the multimeter stabilize. This should take about 45 seconds. A reading of 18 to 30 mVDC should be expected. Your reading may be negative or positive depending on the polarity, but this is not important. Should your reading be low, check your pilot flame before replacing the thermocouple.

Voltage on a SIT Gas Control Valve. Minimum 6 MV



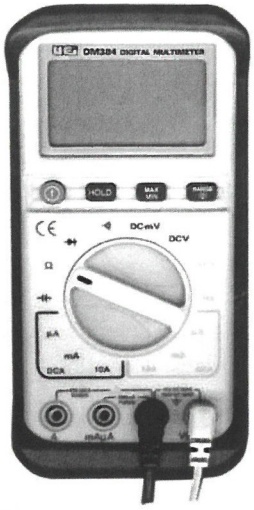
CLOSED CIRCUIT ON SIT 820

It is easy to perform a closed circuit test on an SIT 820 valve due to it's construction. There are two separate ports that the thermocouple can tie into, one on the face of the valve and the other at the rear. The current from the thermocouple is carried to the safety magnet on the blue wire that the thermocouple connector nut tightens the contact against. If you follow this wire to the rear of the valve, it will end at a solder joint in the center of a brass disc. This is the safety magnet; and the closed circuit reading can be found by touching one meter lead against this joint and the other to the thermocouple. This can either be done by feel, or by using an inspection mirror to ensure your lead is on the right point. While inserts are too small to do this, free standing stoves and zero clearance fireplaces are large enough to get your hands behind the valve.



TESTING PILOT COIL (EPU) FOR CONTINUITY

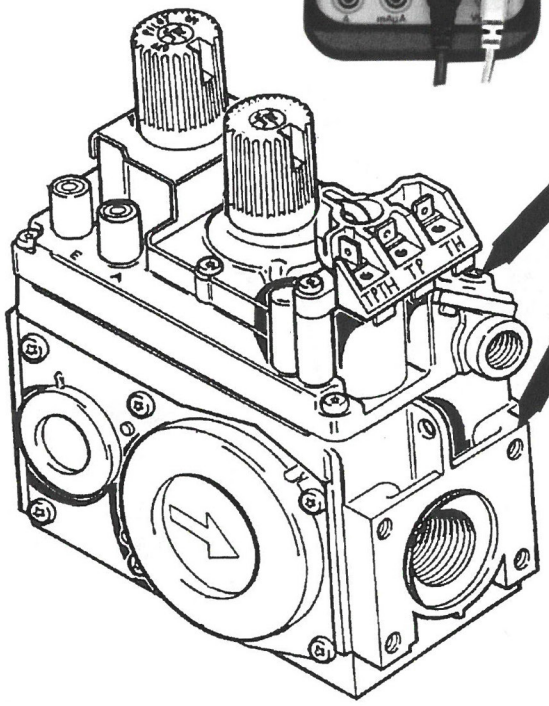
EPU Coil Test



1. Socket Center to any ground point*

OR

2. Ground to solder joint on the bottom of the valve** - Disconnect Thermocouple from valve

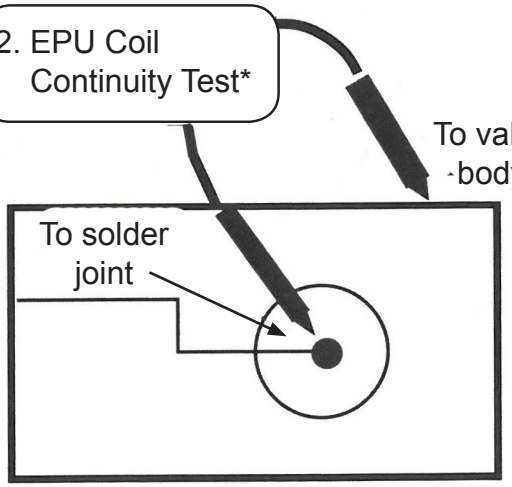


1. EPU Coil Continuity Test*

*Make sure your test lead does not touch the side of the socket

** Disconnect Thermocouple from unit

2. EPU Coil Continuity Test*

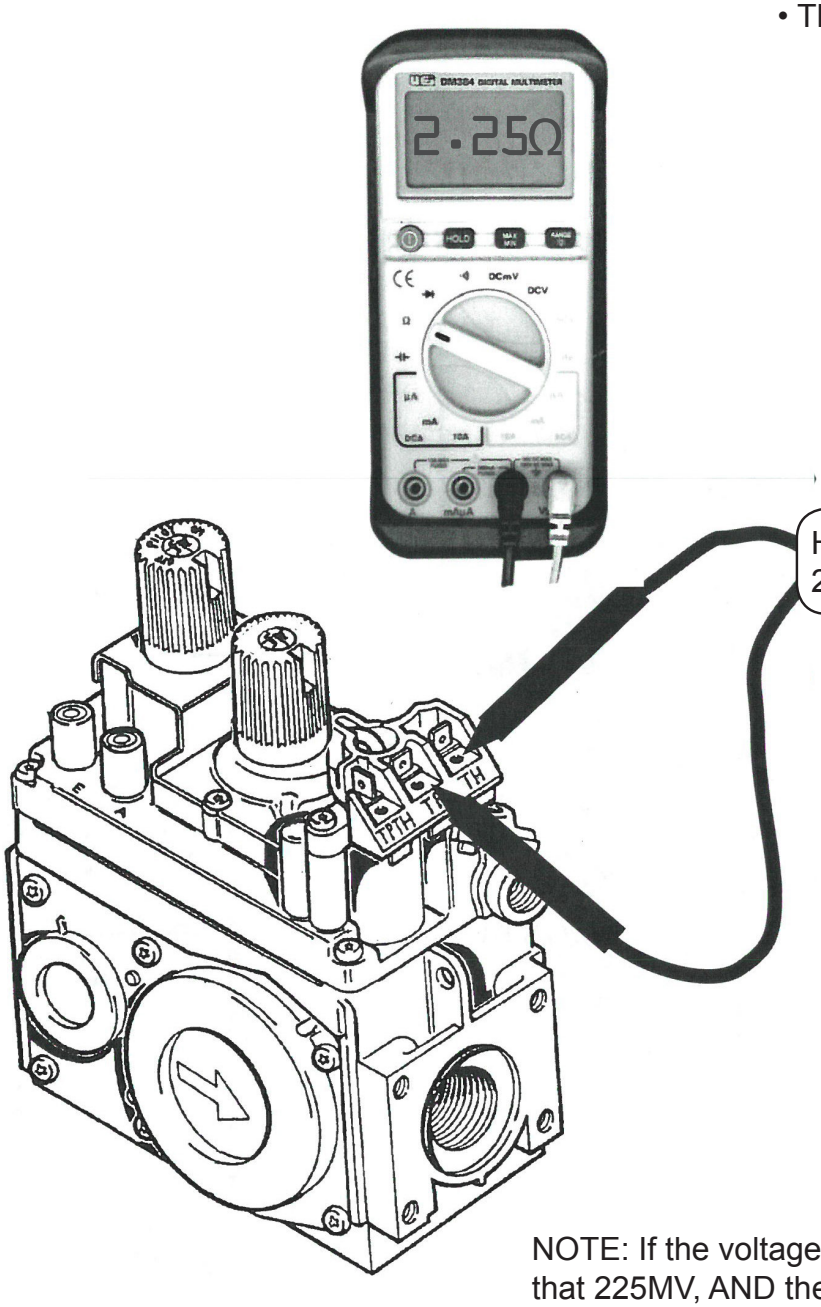


Back of SIT Gas Control

COIL OPERATOR HEAD TEST FOR CONTINUITY

Operator Head Test 1

• TP to TH Terminals



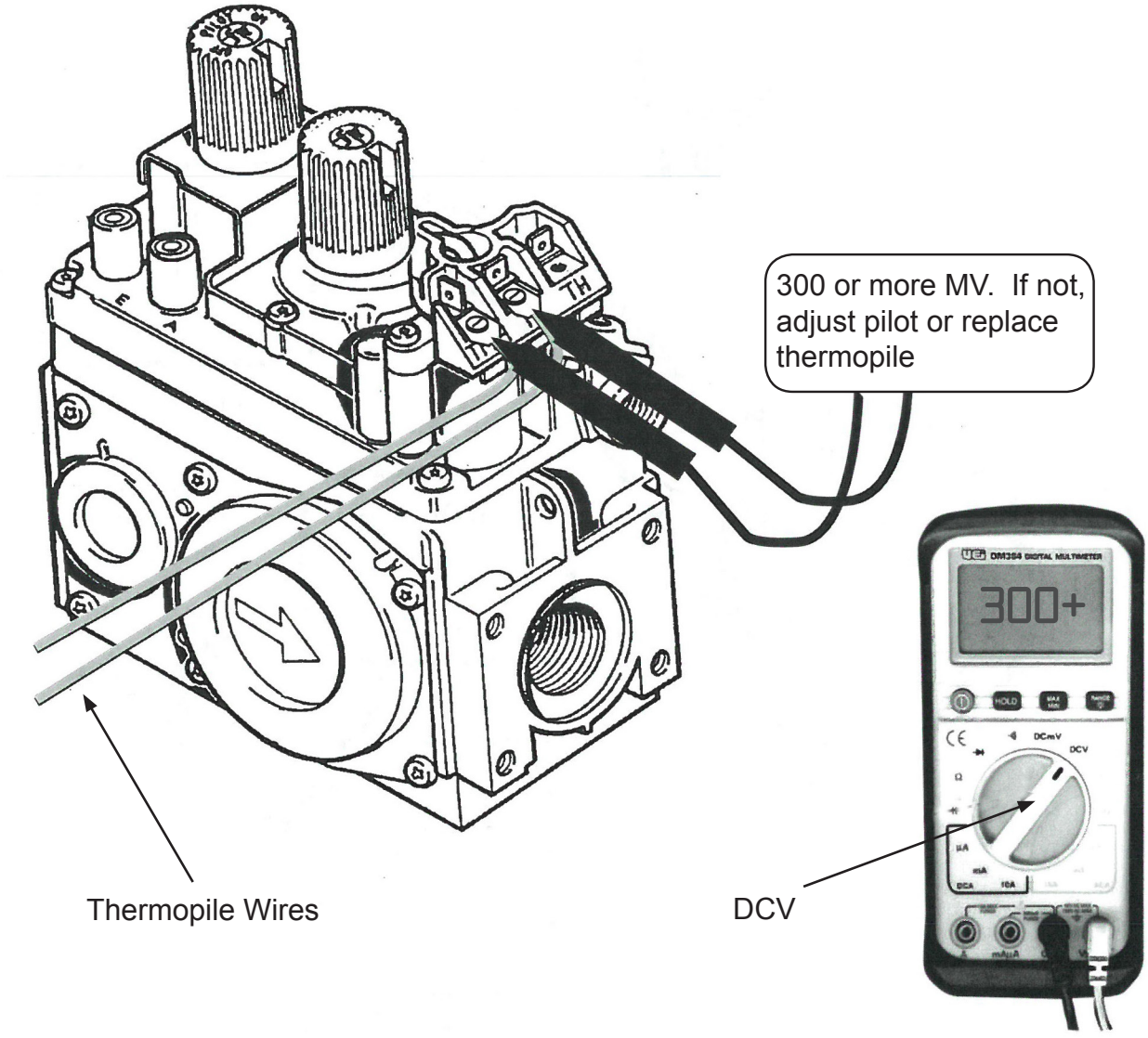
Head Coil Continuity Test
2.25 OHMS ± .5 OHMS

NOTE: If the voltage on Test #2 (page 29) is less that 225MV, AND the gas control operating head does not meet the above OHMS specification, it should be replaced.

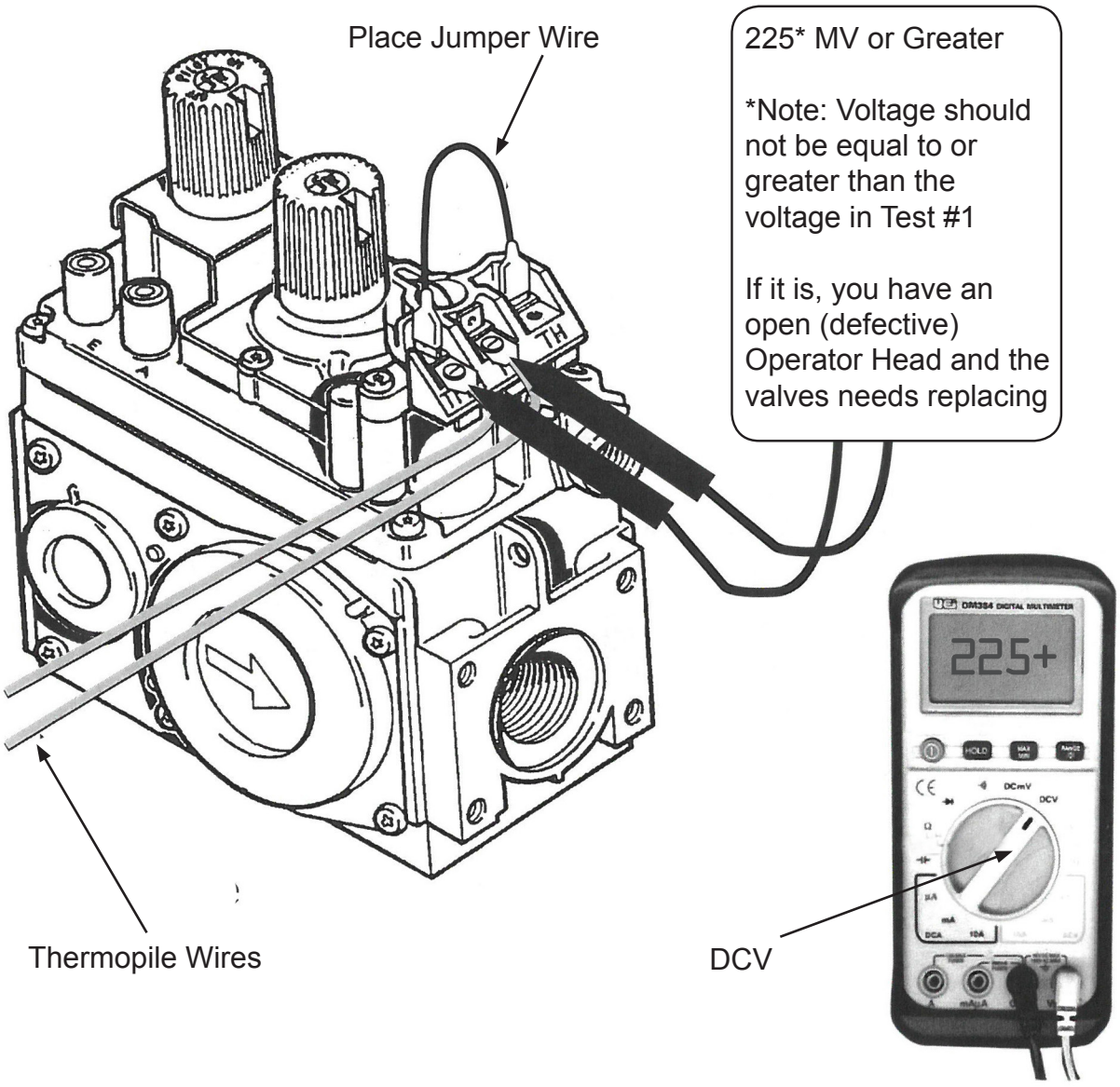
Thermopile Test 1
Control Knob in Pilot Position

1. Pilot Lit for approximately 3 minutes

2. Disconnect all wires **EXCEPT** the Thermopile wires

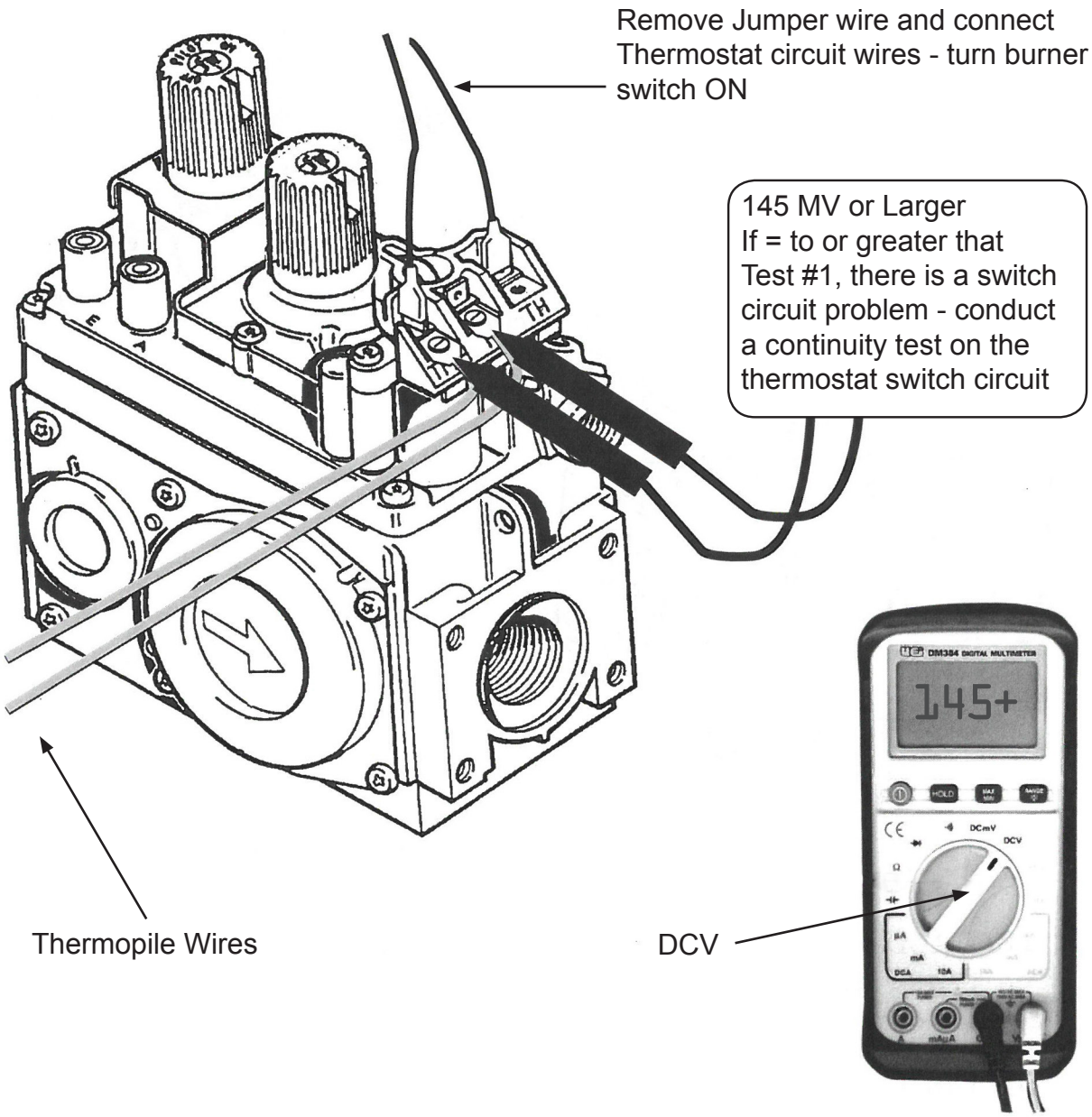


Operator Head Test 2
Control Know in Pilot Position



*If less that 225 MV, this indicates Operator Head has too much resistance - replace Gas Control Valve

Thermostat Circuit Test 3
Control Knob in Pilot Position



DROP OUT AND RESPONSE TEST

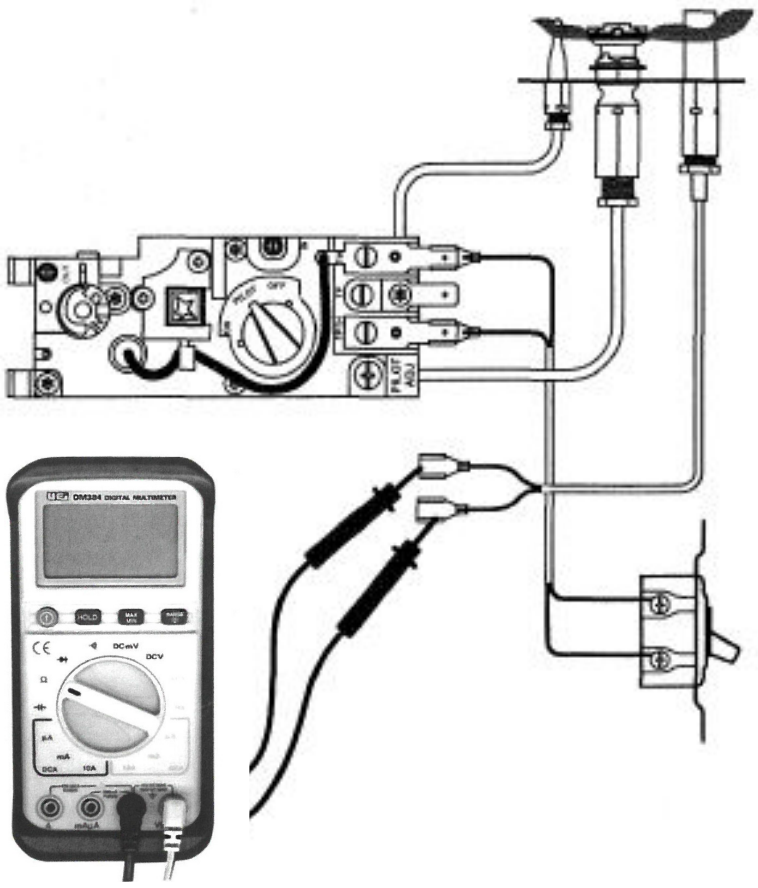
The drop out test will tell us the minimum voltage required to keep the safety magnet engaged. You should expect to see a reading of 1 to 3 mVDC. The closer the drop out reading is to the closed circuit reading, the more likely the occurrence of pilot outage. In order to get this reading, position your meter leads exactly as you would for the closed circuit test and then extinguish the pilot by either blowing it out or turning the control knob to ‘off’. Note the reading on your multimeter when the safety magnet closes with an audible ‘click’.

The response test is done by timing the closing of the safety magnet after the pilot light has been extinguished. By code, direct vent appliances must drop out within 30 seconds; vented gas fireplaces within 60 seconds; vented gas log sets within 180 seconds; and unvented appliances within 3 minutes. By design, all vented Empire Comfort Systems Inc. fireplaces will drop out within 30 seconds of the pilot light being extinguished.

A fireplace that drops out too fast will generally have a higher drop out reading. This can be attributed to a deteriorating coil and may be indicative of existing pilot problems, or a warning of upcoming pilot problems. Too stow of a drop out will indicate a weakened spring and a low drop out reading. While this fireplace will not likely experience pilot outage, it now becomes a safety concern where the valve may continue to pass unburnt fuel into the firebox longer than the standard allows. In both cases the valve must be changed.

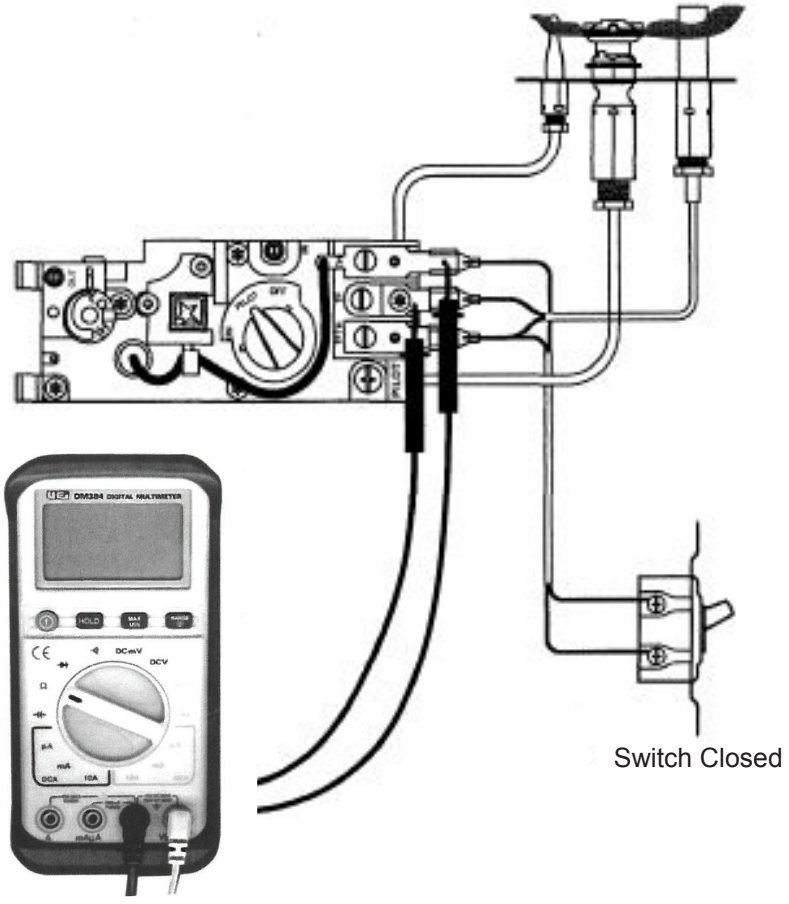
OPEN CIRCUIT TESTING

As with the thermocouple, the open circuit test will tell us the potential output of the thermopile. While the thermopiles Empire Comfort Systems Inc. uses are designed to produce up to 750 mVDC, a minimum reading of 325 mVDC open circuit is generally acceptable as long as the switch is located close to the appliance and connected with properly sized wire. The one exception to this is the Comfort Control System which will require at least 500 mVDC from each thermopile. The test is carried out by removing the thermopile leads from the TPTH and TP terminals and then placing your meter leads on the two wire terminals. Once again, your reading may be negative or positive depending on polarity, but it does not matter as we are concerned with the actual number.



CLOSED CIRCUIT TESTING

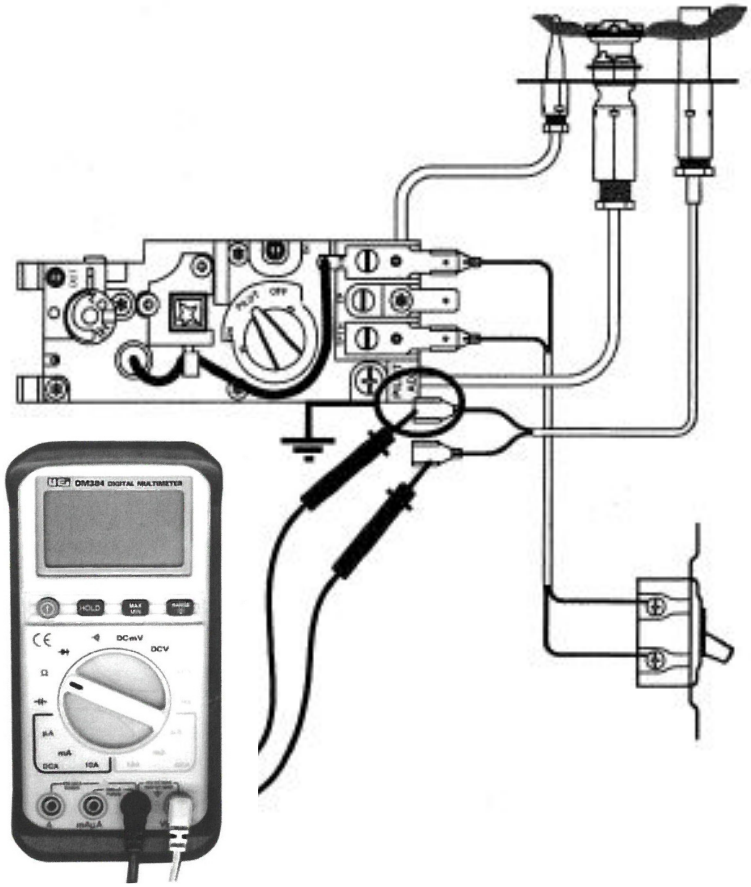
The closed circuit test will tell you the voltage drop across the main operator coil. With the switch or thermostat closed, place your meter leads on the TH and TP terminals and measure your drop in mVDC. A SIT 820 valve will require 145 mVDC to pull in while the Honeywell VS8420/21 valve should have a minimum of 155 mVDC. It is also a good idea to measure the voltage drop across the control circuit to ensure that it is not excessive. This could be caused by a poor pilot flame, a worn out switch, long wire run, undersized wire or loose connections. By placing your meter leads on the TH and TPTH terminals, you should get a small reading that, when added to the closed circuit, should be well below your open circuit reading.



Switch Closed

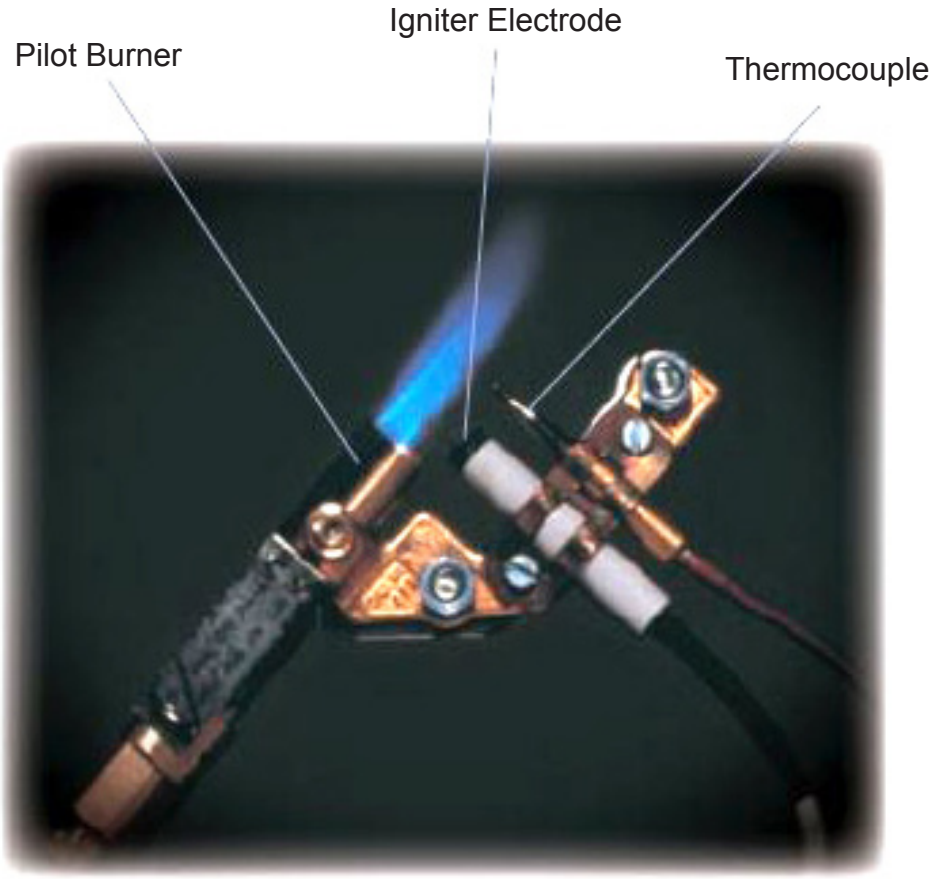
SHORT TO GROUND TEST

Whenever you experience main burner problems, it is important that you check the thermopile for internal shorting before you condemn the gas valve. This can be done with the short to ground test, which should be done along with the open circuit test. The procedure is the same, but should be done once the pilot light has been on for 15 or 20 minutes to ensure the thermopile is hot. Then, with the meter leads still attached to the thermopile leads, touch them one at a time against the valve to ground it out. The meter reading should stay fairly constant. If it drops any appreciable amount, there is a short somewhere in the thermopile and it should be replaced.



THE OXYGEN DEPLETION SENSOR

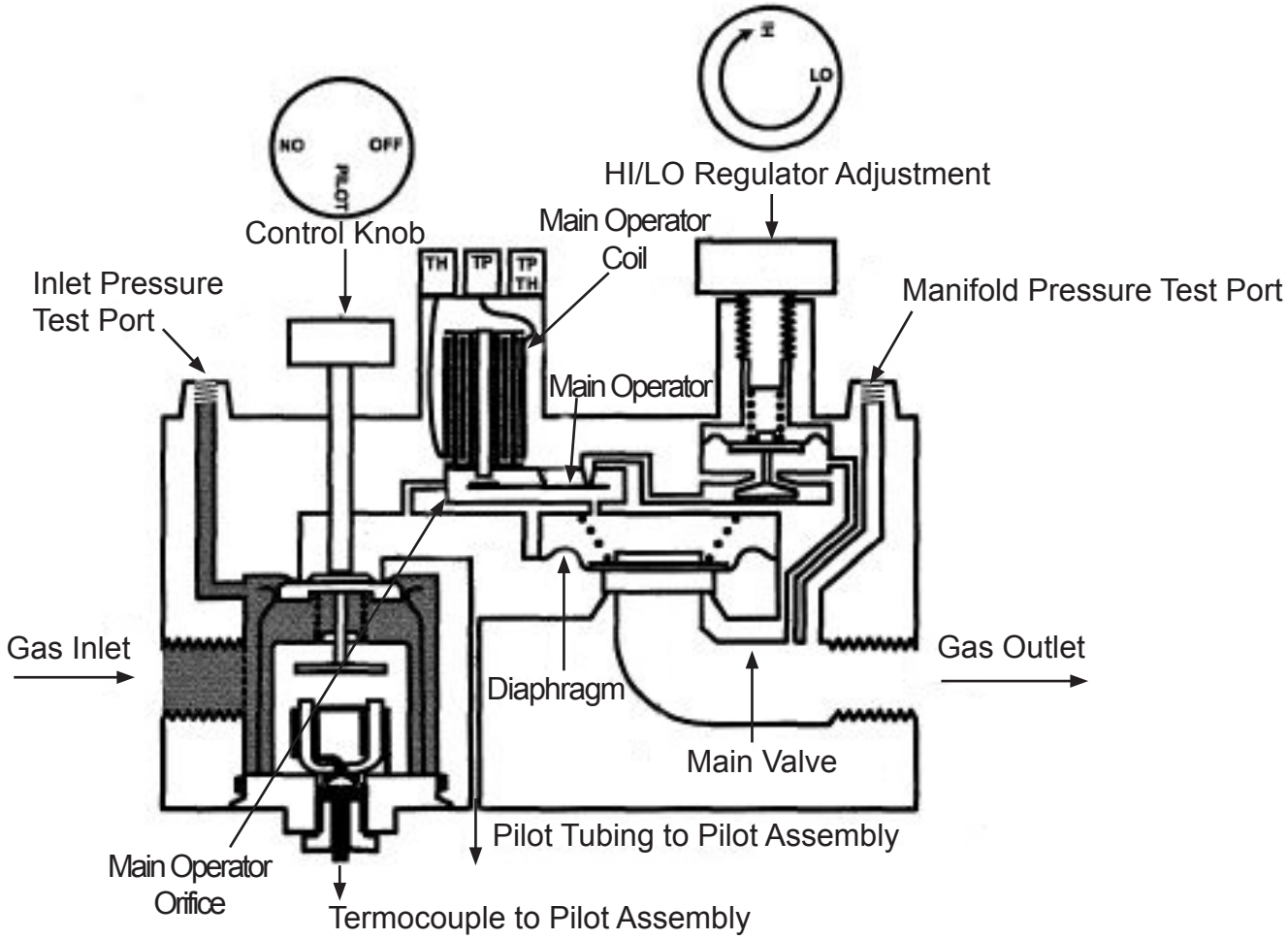
The oxygen depletion sensor (ODS) is a pilot burner for vent free products with a precision design that requires a specific amount of oxygen (0^2) to maintain proper combustion. At normal 0^2 levels (approximately 21%), the pilot flame impinges properly on the thermocouple, keeping the safety magnet energized and gas flowing to the pilot assembly. When oxygen levels drop, the pilot flame becomes unstable and lifts off the pilot burner. If 0^2 levels drop below 18%, the ODS is designed so that the pilot flame can not combust on the surface of the thermocouple, cooling off the hot junction which then closes the safety valve. Because of the ODS' critical design, it is neither field adjustable nor fuel convertible and must be replaced if not working. It is also, due to it's nature, susceptible to pilot outage problems if it becomes dirty; therefore cleaning becomes a part of regular maintenance service. ODS's in dusty environments, at altitudes above 2500', or in houses with animals will require more frequent maintenance. Cleaning requires undoing the pilot nut and mounting screws for the ODS, removal of the ODS assembly, and then blowing it out with 'canned air', commonly available at many wholesalers and computer shops. Air should be directed through the pilot orifice in the direction of gas flow as well as through the primary air holes.



Control Knob in ‘Off’ Position

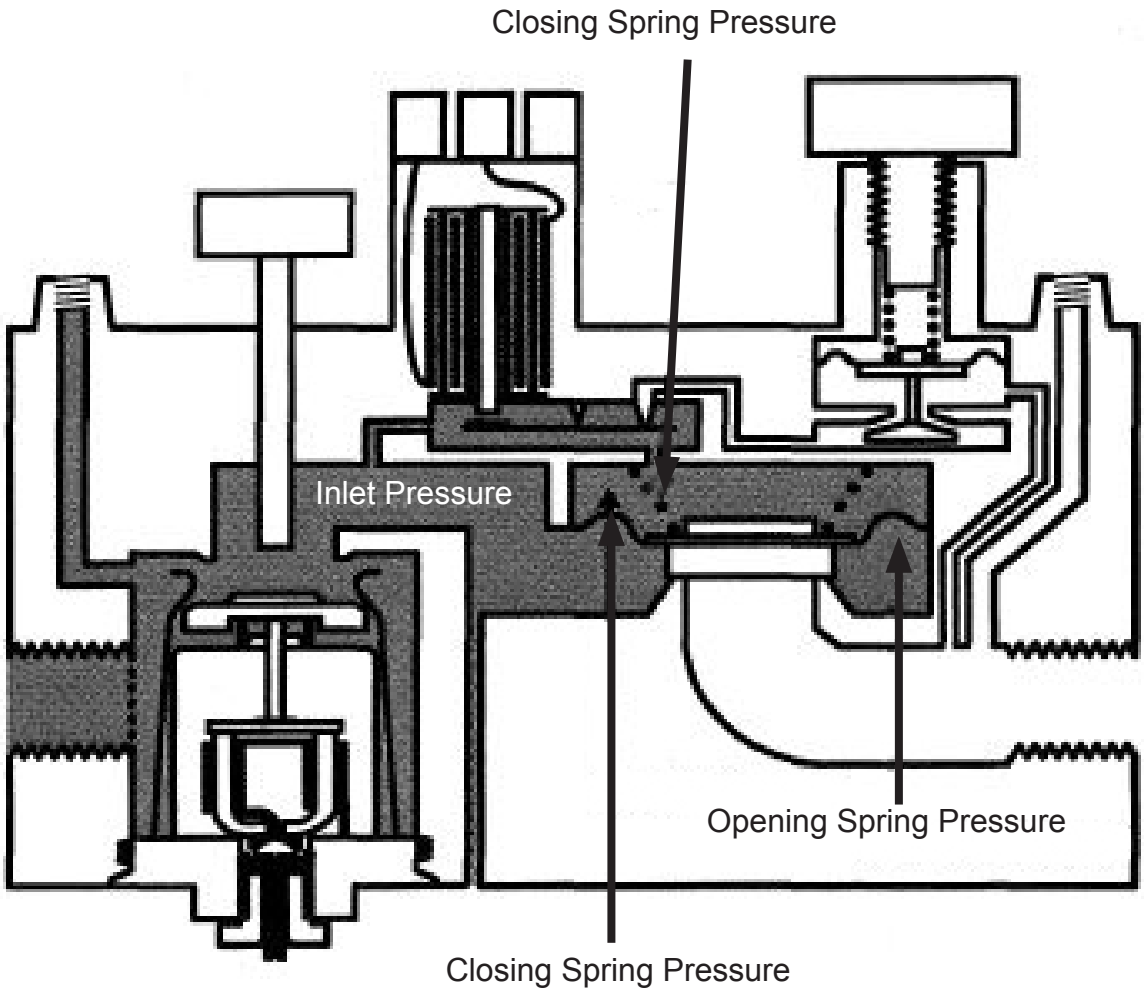
With the gas cock turned on and the gas control knob on the valve at the off position, the safety magnet is closed. Gas can enter the valve and flow through to the inlet pressure test port, but is restricted from passing any further into the valve by the pilot valve. The main valve is held closed by the spring pressure behind it.

-



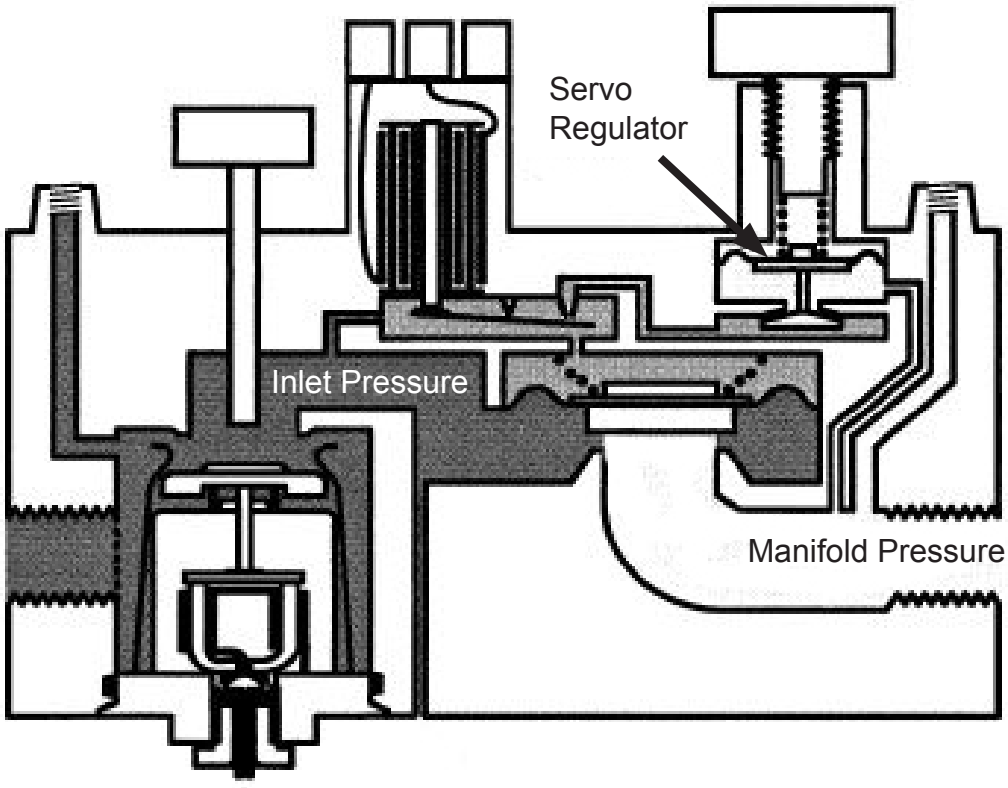
Control Knob in ‘Pilot’ Position

Depress the control knob in the ‘pilot’ position. Gas will flow past the pilot valve and through internal porting to the pilot tubing where the pilot can be lit by depressing the piezo. Gas will also enter the valve body, but the main valve will remain closed due to equal gas pressure on either side of the diaphragm cancelling out, leaving the spring pressure as the closing force.



Control Knob in ‘On’ Position

Turn the control knob to the ‘on’ position and close the main switch. Current generated by the thermopile flows through the main operator coil, magnetizing it and opening the main operator valve. Gas (metered by the main operator orifice) flows through this valve to the servo regulator, lowering the gas pressure on the closing side of the main diaphragm. The opening gas pressure now overpowers the combined force of the closing gas and spring pressures and the main valve will open, allowing gas to flow through. Turning the hi/low adjustor from low to high will increase the spring pressure on the servo regulator; increasing the bleed rate through the main operator valve; causing the closing pressure on the diaphragm to decrease; causing the valve to open further; resulting in an increase in the manifold or outlet pressure. This pressure can be measured at the manifold test port.



MAIN OPERATOR RESISTANCE

There are two instances where you will measure resistance when checking a valve for faulty main burner operation. The first is measuring the main operator resistance in order to verify that there may be a problem with the gas valve. By disconnecting all wires from the TP and TH terminals, and then placing your meter leads on these terminals with your multi meter set to resistance (Ω) you will get a reading that should fall within the following parameters:

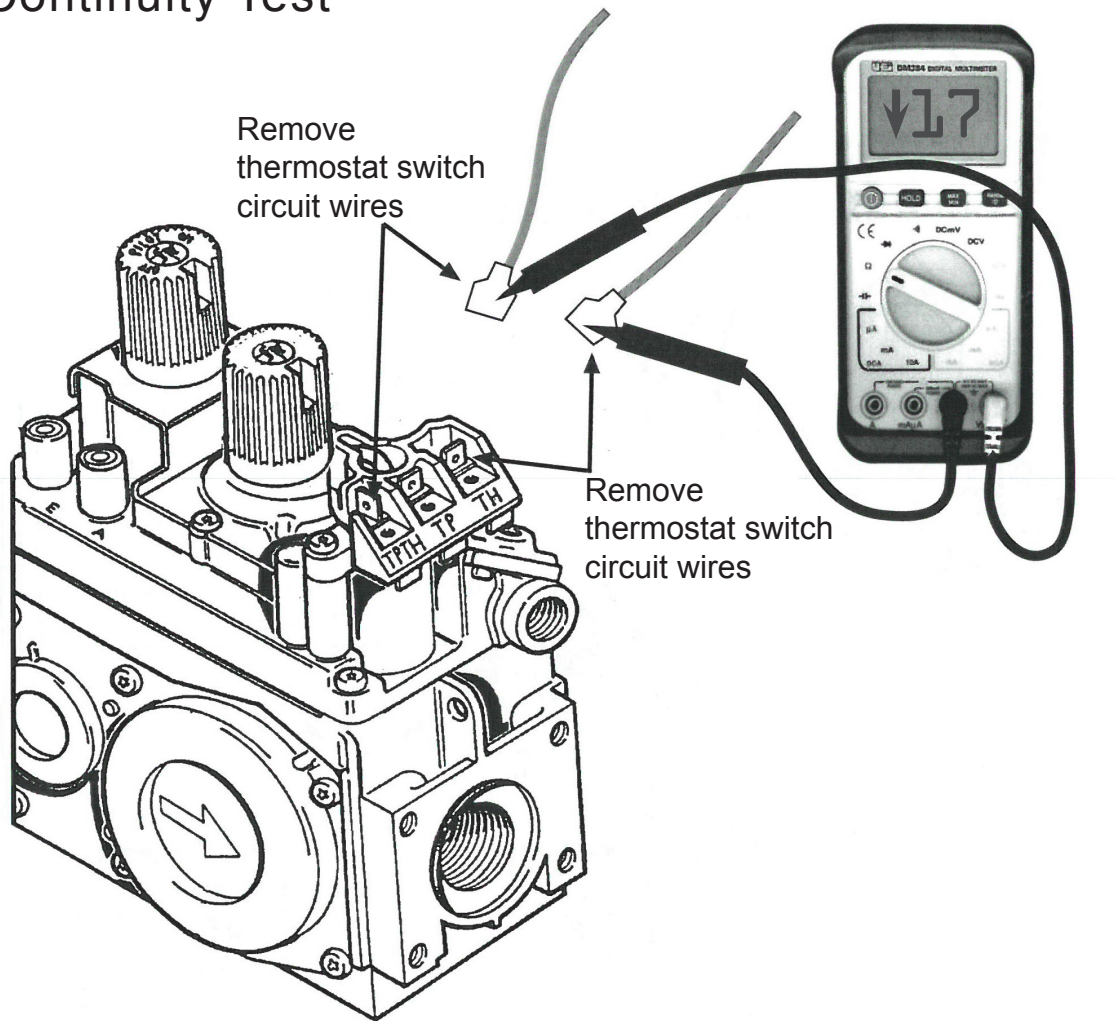
- SIT 820- 1.75 to 2.75 Ω
- Honeywell V$8420- 3.1 to 3.6 Ω

Before taking a resistance reading,zero your meter by touching the two leads together. If the reading is not ‘0’, subtract this number from the number you get when measuring the resistance.

SYSTEM RESISTANCE

Another quick check you can carry out is the system resistance check. This will verify whether your control circuit has too much resistance in it. Simply disconnect the control wires from the TH and TPTH terminals, close the switch (thermostat, remote control) and note the reading you get. It should be less than 1. 7 Ω. If it is greater, check that all connections are tight, that the wire gauge is heavy enough for the length, and that the switch itself does not offer too much resistance.

Thermostat/Switch Circuit Continuity Test



- Test Continuity of the thermostat switch circuit
- Test rocker switch to ON or make sure thermostat contacts are closed
- NO continuity - Bad wires or defective thermostat/switch

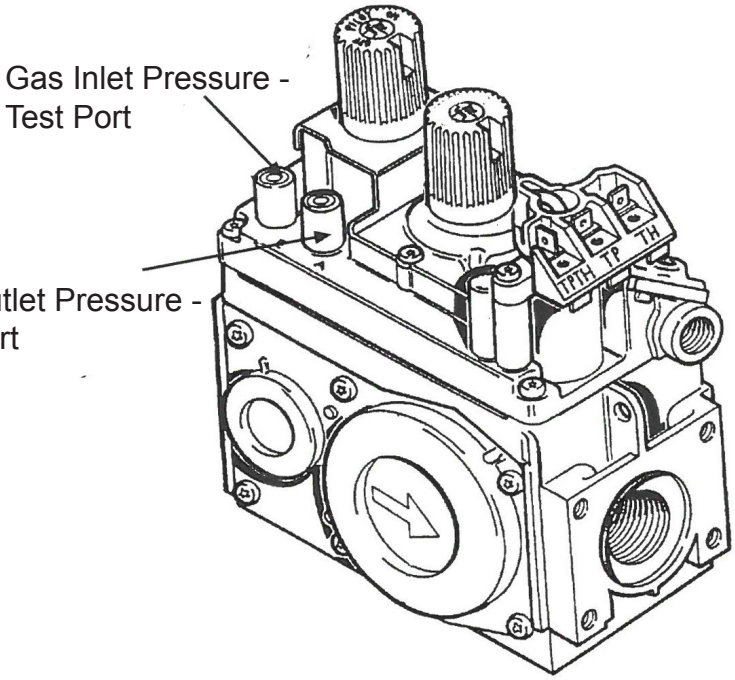
USING A MANOMETER

When checking inlet and manifold pressure, there are many different tools that will do the job. The manometer is one of the least expensive and also one of the best because it allows you to calibrate it every time you use it, ensuring an accurate reading. The manometer is a U shaped tube filled with liquid which has a valve or stopper at the top of each riser. In between these risers is an adjustable scale that is measured in inches which allows calibration of the manometer. When both ends of the tube are open to the atmosphere, the liquid level in both vertical risers should be equal. The scale is then adjusted up or down so that the '0' on the scale is level with the top of the liquid. When pressure is exerted on one side of the tube it forces the water level down and therefore up the other side of the tube. The pressure reading is the difference between the two liquid levels, measured in inches water column (" WC). The main point to be aware of when purchasing a manometer is that the range must be able to accommodate the pressures you will be working with (typically 8-0-8" WC).

Other tools available for measuring pressure are magnahelics, dial gauges and digital manometers. All 3 are sensitive instruments that will require re-calibration at set intervals, but only the magnahelic and digital manometers can be zeroed before use. As well, they both have high and low pressure ports, so it is important that after zeroing, you connect the port marked high or+ to the valve. Range selection is important as well; you will want to make sure with a dial that the full scale is about twice the expected working pressure. The digital manometer, while more expensive, can also function as a draft gauge as well as a gauge for measuring small differential pressures found when checking for negative pressures due to building depressurization.

MEASURING OUTGOING GAS PRESSURE

Digital Pressure Gauge



SIT Control Valve

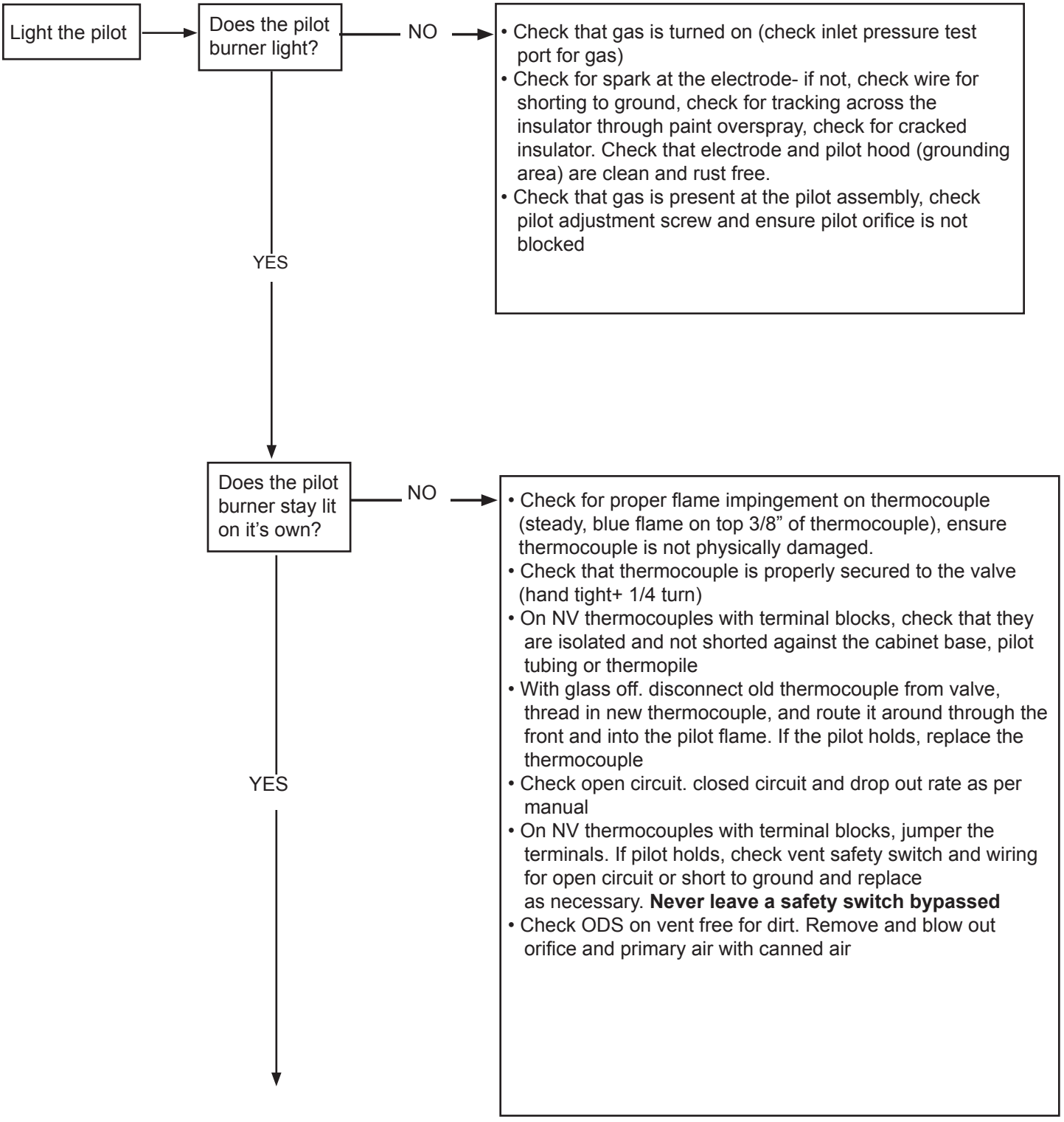
1. Loosen output pressure tap (about two or three turns)
2. Zero out digital pressure gauge
3. Slip pressure hose over the outlet port
4. Light the pilot (knob on pilot)
5. Turn control knob to ON
6. Turn ON the main burner (high)
7. Read pressure (see chart)
8. Turn OFF burner
9. Turn control knob to OFF
10. Remove pressure hose
11. Tighen pressure port screw

Output Pressures	
NG	LP
1.8	2.7
3.5 W.C	11 W.C.

NO OUTGOING PRESSURE
Replace regulator body - then if necessary, gas control valve

OUTGOING PRESSURE
But still no flame?
- Check burner orifice for blockage
- Check burner supply tube

MILLIVOLT TROUBLE-SHOOTING FLOW CHART



YES

Does the main burner light off when the switch is closed?

NO →

- Cycle ON/OFF switch up and down rapidly a number of times. It burner comes on replace the switch
- Make sure wall thermostat is millivolt- if it has a heat anticipator, replace with a proper thermostat. If thermostat has open contacts, make sure contacts are clean
- Check batteries in remote control and the receiving unit.
- Check that all electrical connections are tight
- Jumper across TPTH and TH terminals on valve. If burner lights, check wire and switch for open circuit. Check resistance of control circuit as per the manual
- With glass off, disconnect the thermopile from TPTH and TP terminals on valve, connect a new one and route it around the front and into the pilot flame. If the main burner comes on after the thermopile heats up, replace the thermopile
- Check open and closed circuit readings and perform short to ground test as per the manual
- Check main operator resistance across TH and TP as per the manual
- On stoves equipped with an FSDHAG draft hood adaptor, reset the vent safety switch and try the main burner again

YES

Does the main burner stay lit until the switch is shut off?

NO →

- Check pilot flame for proper impingement on thermopile when main burner is on
- Turn on all other appliances and recheck pilot flame - check inlet pressure
- Check that appliance shut off valve is fully open
- On DVRT, ensure that all insulation has been removed for top vent conversion
- On DV, check for any leaks in the firebox with a CO Detector or even a flashlight
- On DV, burn fireplace with the glass off- if the main burner stays lit, check the venting, termination
- On NV, try opening window in room with fireplace if the flame settles down, make up air will need to be introduced
- Check resistance of main operator coil as per the manual when valve is at operating temperature
- Perform short to ground test as per the manual

YES

System is functioning normally

GV60 TROUBLE SHOOTTING GUIDE

1. One single spark heard at pilot and then unit stops

a. Test resistance from yellow wire in harness going into control module to the ground lug on the top left of the valve

b. Should read no more that .6Ω

c. If higher, resistance is found back out ground lug, clean connectors and reinstall lug.

2. Pilot sparks and ignites but goes out before burner lights

a. Test voltage DC at the last pin not used on the control module and the ground lug

b. Voltage should ge greater than 5.5VDC, any less, replace the batteries in the control module.

3. Testing the mV produced by the thermocouple

a. Test DC Millivolts at the red wire coming into the control module and the ground lug

b. Millivolts should be between 8-15 mV
c. If less than 8mV, loosen interrupter block, remove 2 leads, clean, then reinstall. Finger tighten interrupter block and then a 3/4 turn with a wrench

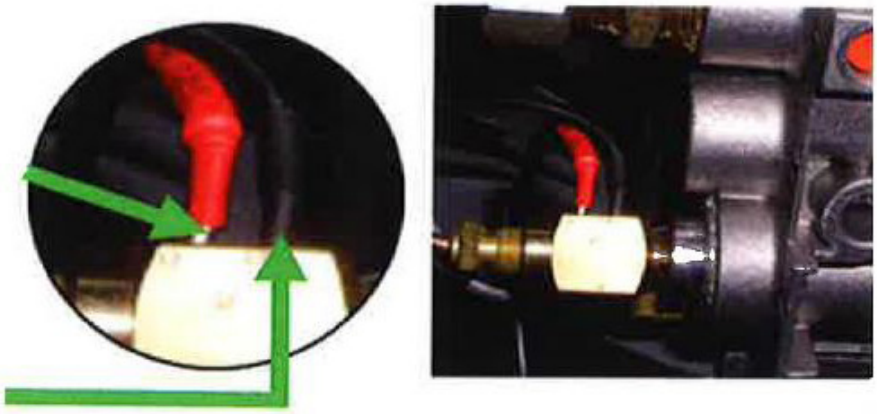
4. Testing the voltage draw of the control module

a. Test DC Millivolts at the yellow wire coming into the control module and the ground lug

b. Subtract this reading from the one in step 3c, the difference should not be greater than 2mV
c. If greater that 2mV, replace the control module

5. Testing the voltage going into the valve

a. Test DC Millivolts at the black wire on the interrupter block closest to the valve and the ground lug

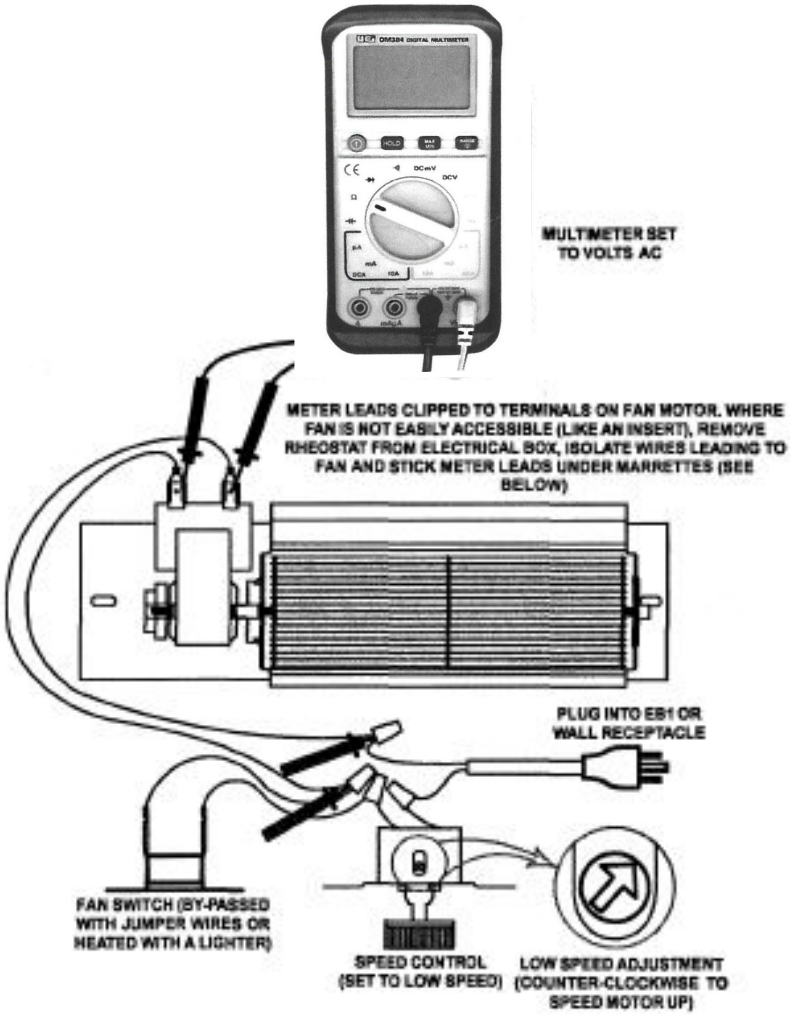


b. Test resistance across switch mounted on valve, should be very low Ω.
c. Voltage should be greater than 5mV, if less that 5mV, go back to step 4c.

SERVICING CIRCULATING FANS

Cleaning the fan compartment, as well as the fan itself, is an integral part of annual maintenance. This cleaning is best carried out with a smooth paint brush and a vacuum cleaner. High pressure air is too hard and could damage the impellers. Because the fan is typically located level with the floor, it is in perfect position to pull in and trap dust and hair. Houses with pets are even more prone to this as animals love to sit in front of a warm fireplace/stove. As debris accumulates on the squirrel cage, it adds weight and load to the motor. The increased load means the motor runs hotter and this heat begins to break down the epoxies that bind the rotor to the motor shaft.

To check that the rheostat is set properly the voltage must be checked under load (when the fan is running). Clip your meter leads with alligator clips to the two terminals on the motor, turn on the fan (either bypass or jump out the fan switch) and adjust the speed control all the way clockwise to low speed. You should note a minimum reading of 93 VAC. If it is lower, remove the rheostat from the electrical box and use a small standard screwdriver or knife to turn the small dial on the side of the controller while watching your multimeter. As you turn it counter-clockwise, the fan will speed up and the voltage will also rise. Continue to do this until the meter registers at least 93 VAC.



Fireplace Sooting

1. Check for flame impingement on logs, firebox.
2. Make sure primary air shutter is open and not blocked with lava rock, masking tape, embers, etc.
3. Fireplace over-fired -check firing rate and compare to rating plate.
4. Clock meter if natural gas.
5. Check manifold pressure and orifice size(s) if propane.
6. Check orifice:
    - For physical alignment- should be parallel to burner.
    - For burrs, pipe dope, debris.
    - Make sure hole is drilled straight through center.

Sooting With Direct Vent Fireplaces:

- Horizontal vent run is too long or has too many elbows for the application - refer to vent graphs.
- Horizontal vent has downward slope.
- Wrong termination type (centered top vent termination on a direct vented rear vent).
- Check for restrictor plate in flue collar- should not be used with sidewall terminations.
- Recirculation of flue products in vent- poor seal on 4” pipe
- Poor seal on 7” pipe - air for combustion being robbed from fireplace and drawn into house by negative pressure.
- Restrictor plate being used on vertical terminations with less than 20’ of rise.
- Recirculation of flue products at termination - check outside for obstructions (stored building products, boats, bushes, etc.), wind and clearances above the termination (soffit, deck, any overhang). Look inside termination on intake pipe for moisture from exhaust or use smoke stick. Note wind direction and strength.
- Major snowstorm piling snow or ice on termination faster than it can melt.
- Leak in the firebox - check with CO detector or check the window gasket and frame for soot, use flashlight to check for leaks at burner tray gasket and pilot assembly pass-thru, check pressure relief door gasket on top of firebox (don’t forget spring loaded relief door under burner).

Lazy Blue Lifting Flame or Flame Ghosting on DV

- Same symptoms as sooting, but they will be more severe.

Pilot Won’t Light or Stay Lit (Vented)

- Check pilot adjustment screw.
- Check for arc at ignitor when piezo is pushed
- Check ignitor cable for shorting to ground, especially where it passes through the burner tray on a direct vent fireplace.
- Ensure ignitor cable connector is pushed fully onto piezo and ignitor.
- Check for gas at valve (inlet pressure tap).
- Check that pilot line has been bled.
- Check for gas at pilot- listen for gas flow to make sure pilot line is not plugged, kinked or broken, orifice not plugged.
- Check that thermocouple nut is properly secured to the valve (hand tight+ 1/4 turn)
- Check thermocouple open circuit and closed circuit for proper readings

Pilot Flame Outage

- Check if pilot flame goes out on its own or when main burner is on.
- Check pilot flame for proper characteristics (should be blue and not wavering, lifting or blowing) and impingement on thermopile and thermocouple (top 3/8” in pilot flame).
- Re-check pilot flame with main burner on and then all other gas appliances on to ensure properly sized gas line (check inlet pressure if possible).
- Check to make sure pilot shield is on and pilot assembly is tight against the burner.
- Ensure that area where pilot components pass thru burner tray on Direct Vent is sealed with gasket or silicone.
- On SIT 820 (RN) valve, check that blue safety magnet wire is making good contact with thermocouple and insulator is in place, make sure thermocouple is tight in valve (hand tight plus Y4 turn).
- Check thermocouple for physical damage- make sure there are no overly sharp bends, burnt out tips.
- Check thermocouple - open circuit, closed circuit and drop out.
- For fireplaces with an ODS, make sure pilot assembly is clean.