Procedure for Troubleshooting Powerpile Systems

POWERPILE

SELF GENERATING SYSTEMS

The ability to generate a ¾ of a volt DC (750 millivolts) using a flame applied to a device using two dissimilar metals joined at one point, referred to as the "Hot Junction" and in so doing the difference in temperature between that hot junction and what is referred to as the "Cold Junction" is able to operate a gas valve and associated switches designed to operate as safeties and operators of a heating system.

On Steam systems using gas it was the system of choice as they needed no power to operate so you had heat during power failures.

On other systems it could also be used and those systems could be put on gravity and have some heat during power losses.

In 1979 when the gas industry went over to dual seated gas valves that was the beginning of the end for Powerpile systems as they could not develop enough power to operate two gas valves (redundant valves they are called).

There are still many of them still working in many areas of the country. They are a difficult system to troubleshoot. This procedure will help to make the taking of millivolt readings a little easier. We include a chart for plotting the readings so that a more accurate decision can be made as to diagnoses.

LOOK FOR CHARTS FOR TROUBLESHOOTING THERMOCOUPLES AND POWERPILE SYSTEMS

HONEYWELL
POWERPILE
Readings with just a Valve Coil

Open Circuit	540 Millivolts Minimum
Closed Circuit (Controls Jumped Out)	175 Millivolts Minimum
Closed Circuit (Controls in the Circuit)	280 Millivolts Minimum
TH Reading	Reading will vary depending on the Thermostat used (This reading measures the total millivolt drop across all the controls in the circuit)
High limits, Pressuretrols, LWC, Aquastats and any other switches	10 Millivolts is the maximum drop across any switch in the circuit
* Thermostat (with Anticipator) (TS-86)	115 - 135 Millivolts
Pull In (Controls Jumped out)	95 - 179 Millivolts
Pull In (Controls in Circuit)	179 - 320 Millivolts
Drop Out	Below 95 Millivolts

Drop out is done by blowing out the pilot and waiting for an audible click or a slight jump in the meter needle. An other way to check this is to shut off the flow of gas to the pilot and have the main burner running. When the main burner goes out that is the drop out.

* This reading will vary with different thermostats and lengths of wire and wire size.

Refer to instructions for various millivolt drops across different controls and thermostats.

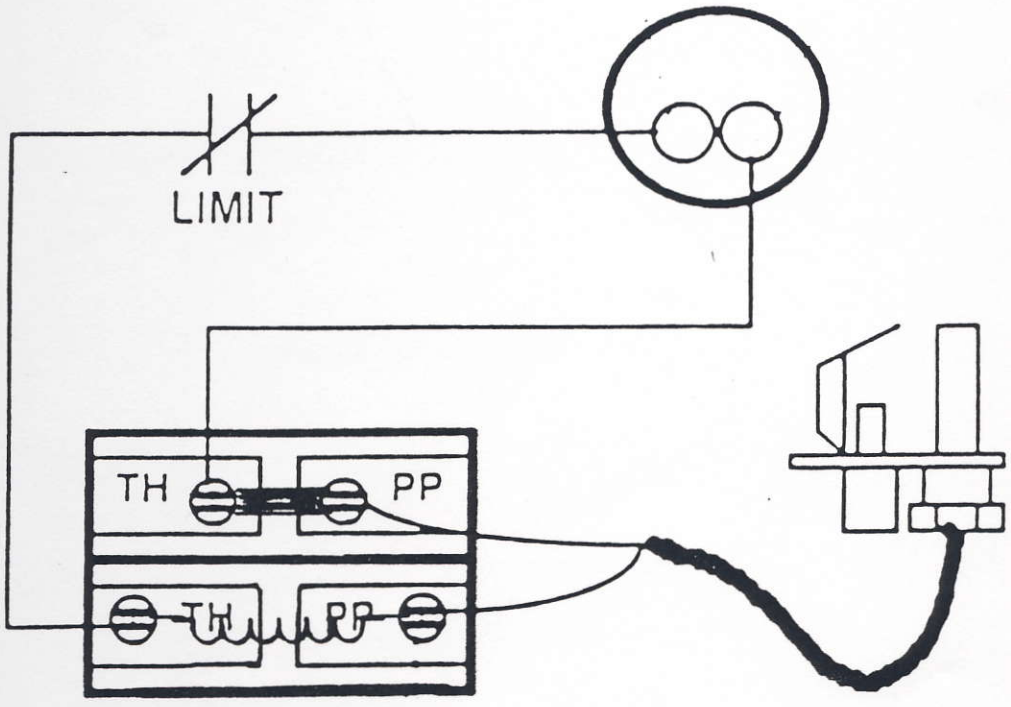
PROCEDURES

FOR TAKING

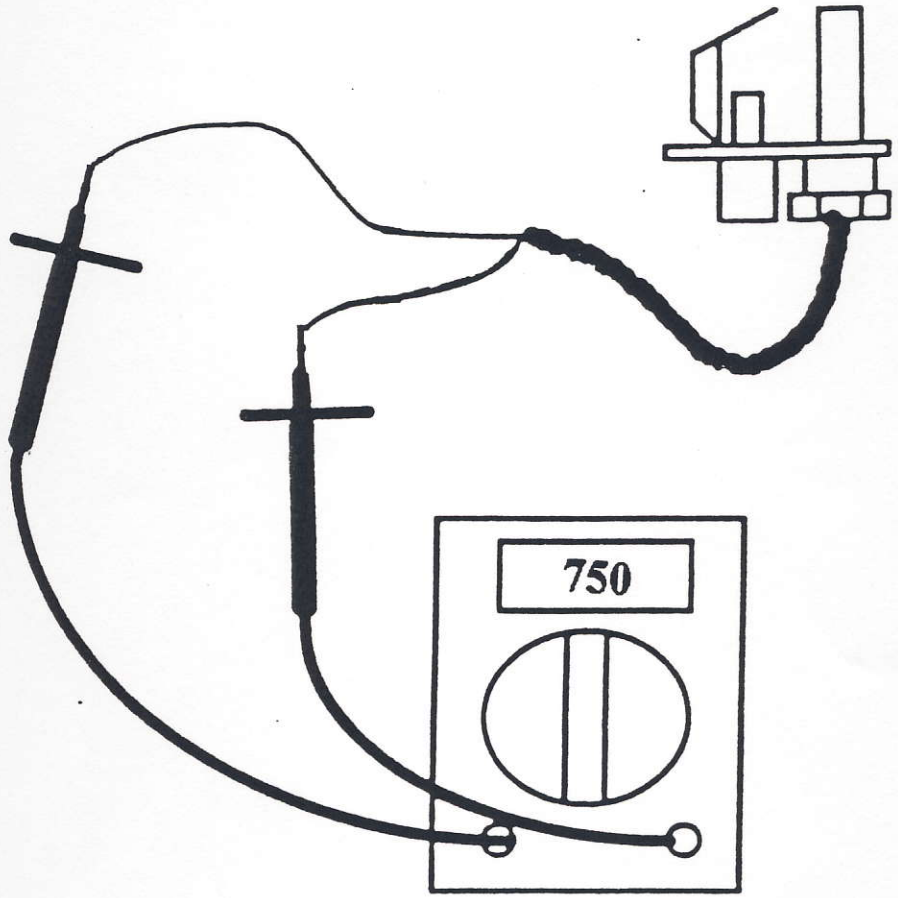
MILLIVOLT READINGS

ON A

POWERPILE SYSTEM

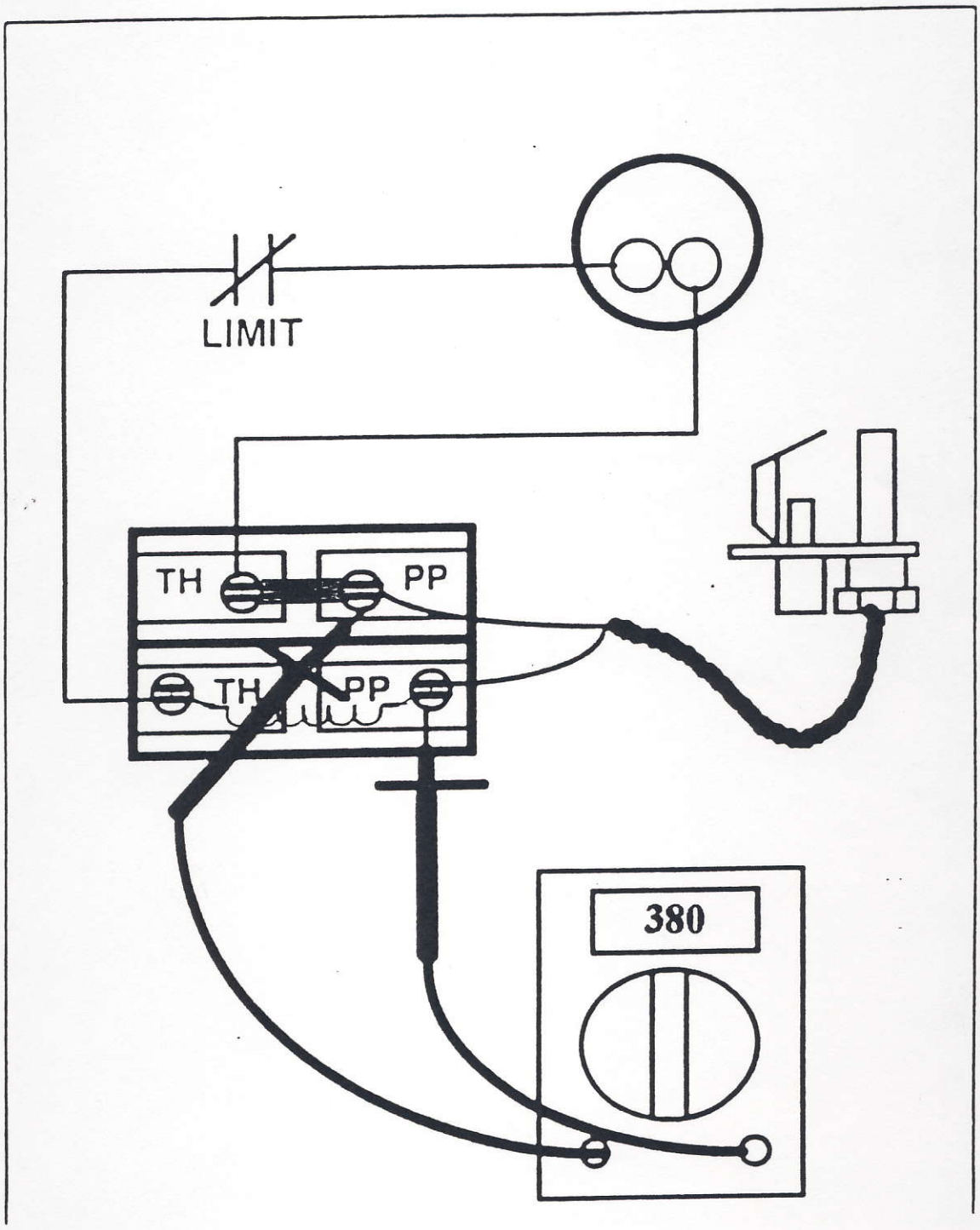


#1



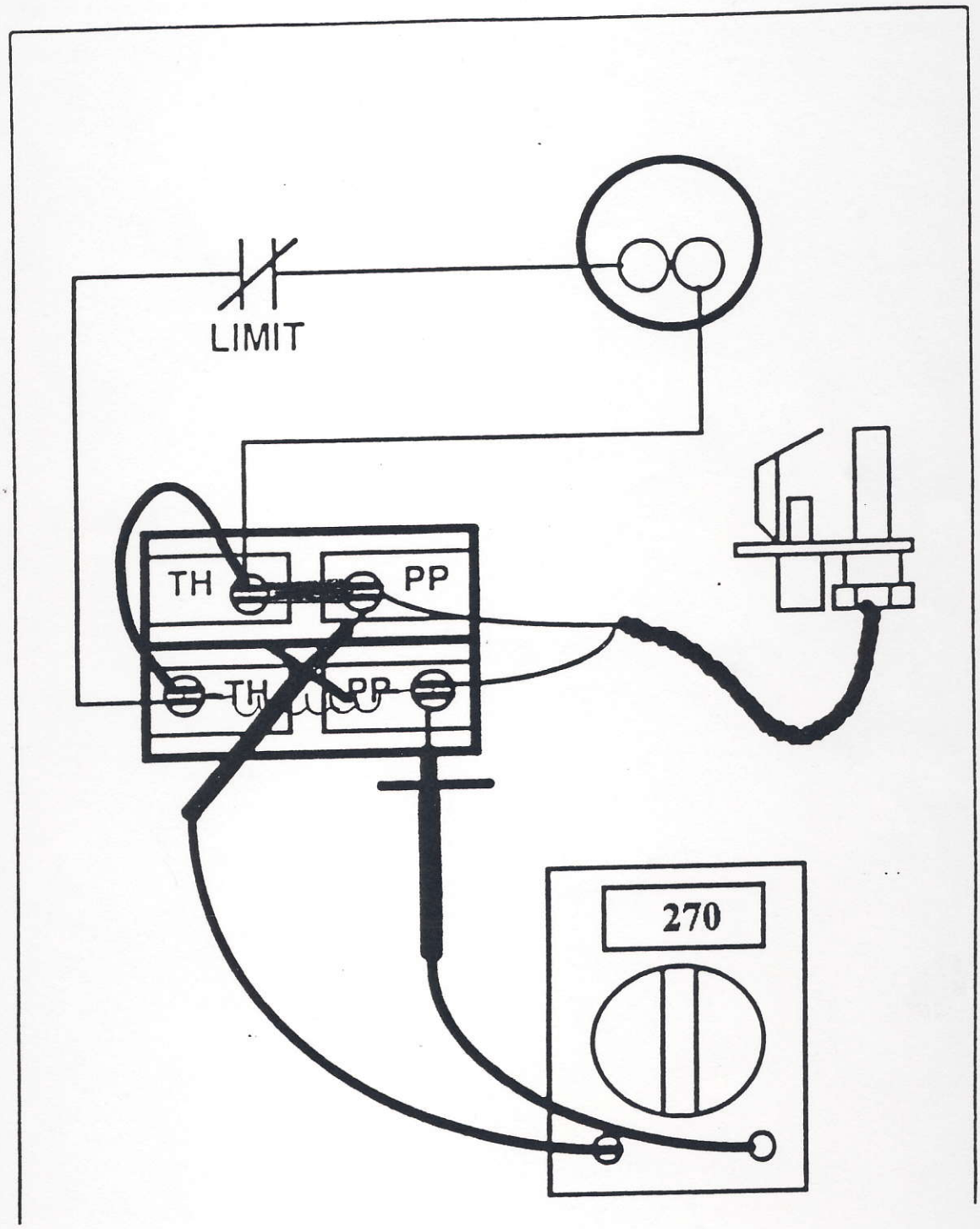
Open Circuit minimum 540 millivolts. It is taken with the generator disconnected from the valve.

#2



Closed Circuit with the controls in the circuit. This will measure the ability of the system to work with every resistance in the circuit.

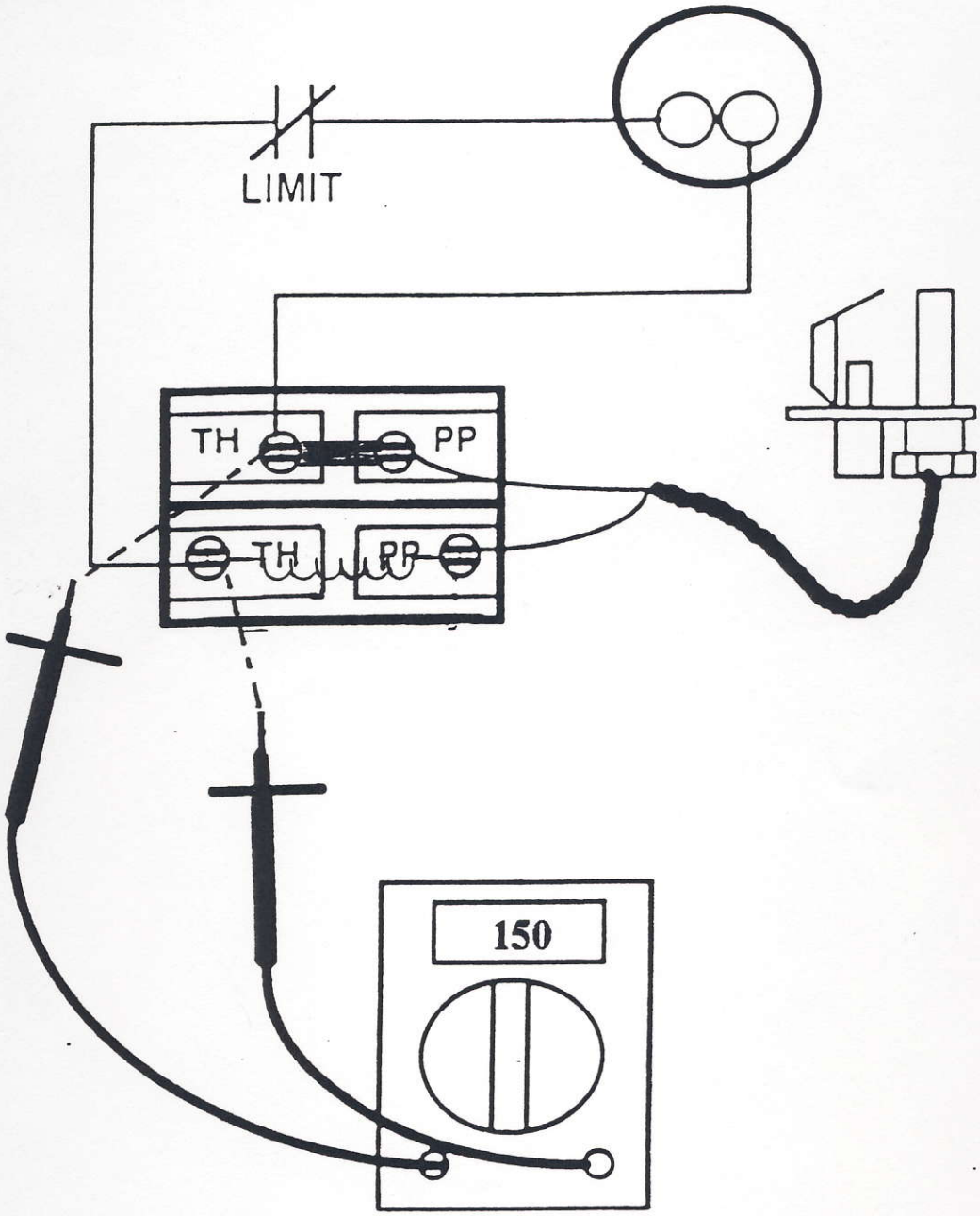
#3



Closed Circuit with the controls "Jumped Out". This will measure the voltage drop across just the coil in the valve.

The reading taken across the TH/TH terminals with a TS-86 fixed anticipator thermostat will vary between a maximum of 175 millivolts to 205 millivolts. Anything less than 175 is very good.
(Thermostat 115 to 135 allowed, 30' of 18 gauge wire 60 millivolts, limit 0 to 10 millivolts maximum gives you the total allowed).

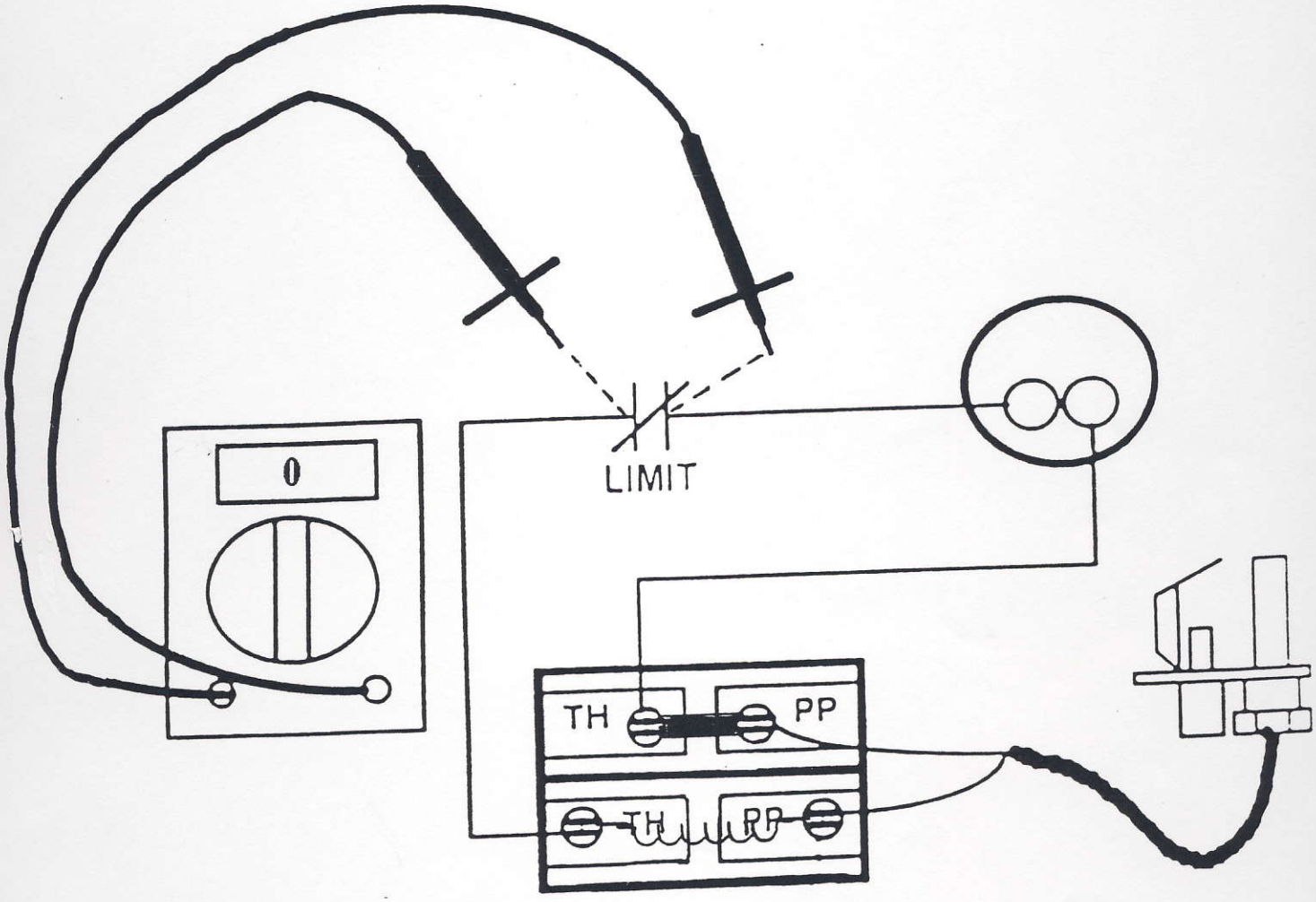
#4



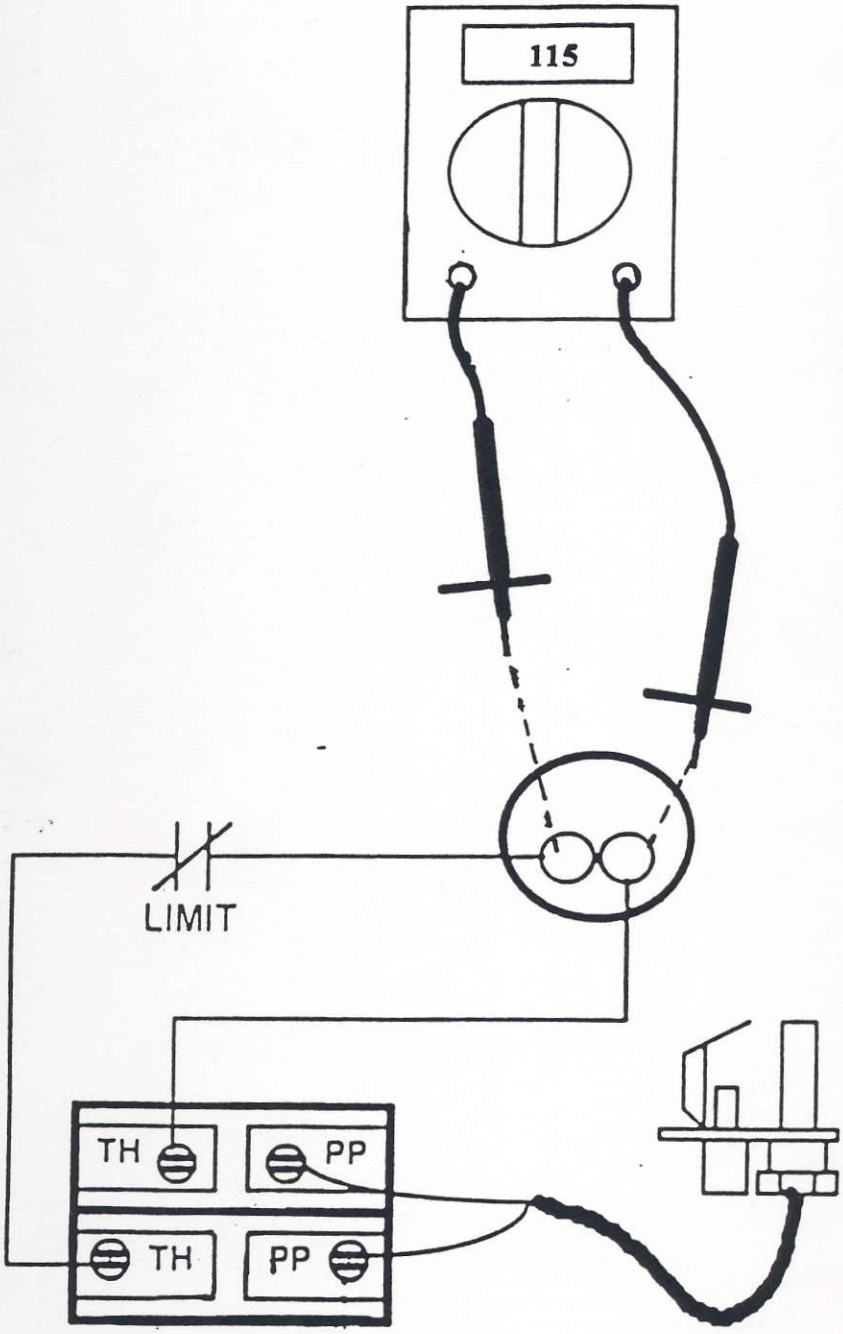
* This reading will vary with different thermostats and lengths of wire and wire size.

Refer to instructions for various millivolt drops across different controls and thermostats.

#5



Limit is 0 to 10 millivolts and is the same for any switch.

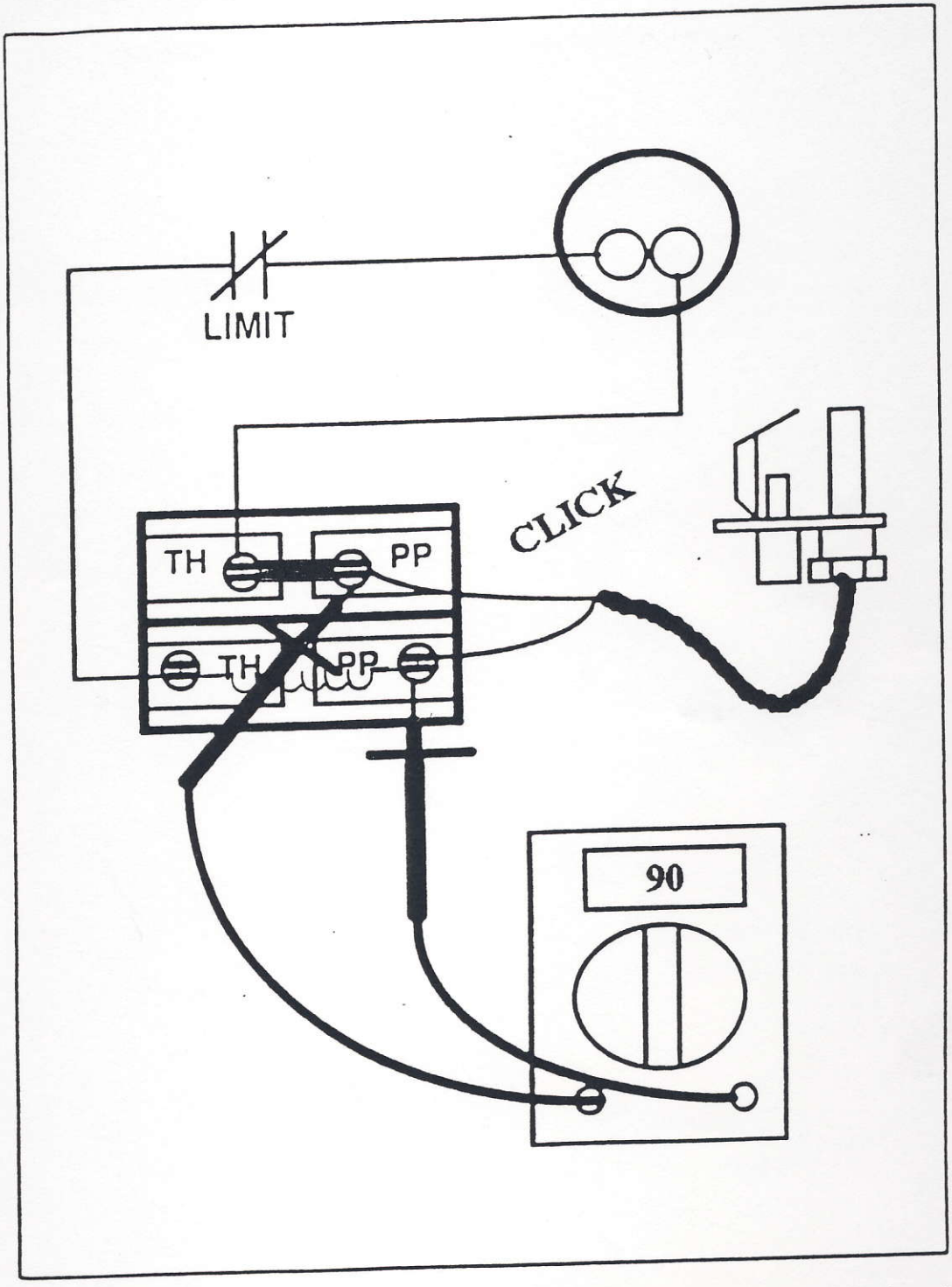


The reading taken directly across the thermostat is 115 millivolts.
This reading added to the drop across the limit will be

Thermostat	**115**
Limit	**+ 0**
	115

Then take the TH reading and subtract 150
-115
35 is the millivolt drop across the wire.

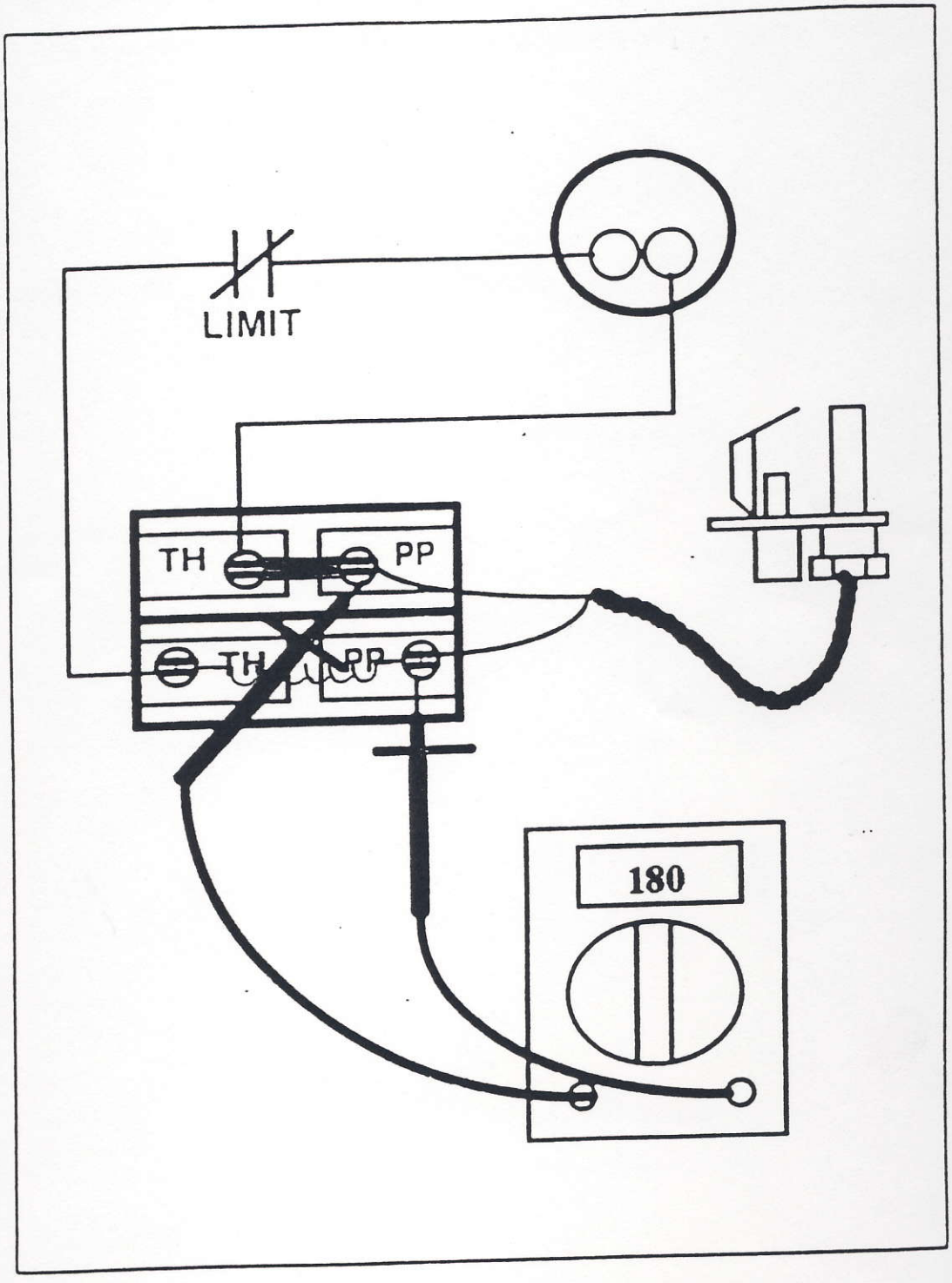
The drop out is typically below 95 millivolts. This is the measure of the coil to hold the valve open. If this reading is above 95 the valve should be changed. If it does not drop out it means the valve is passing.



Drop out is done by blowing out the pilot and waiting for an audible click or a slight jump in the meter needle. An other way to check this is to shut off the flow of gas to the pilot and have the main burner running. When the main burner goes out that is the drop out.

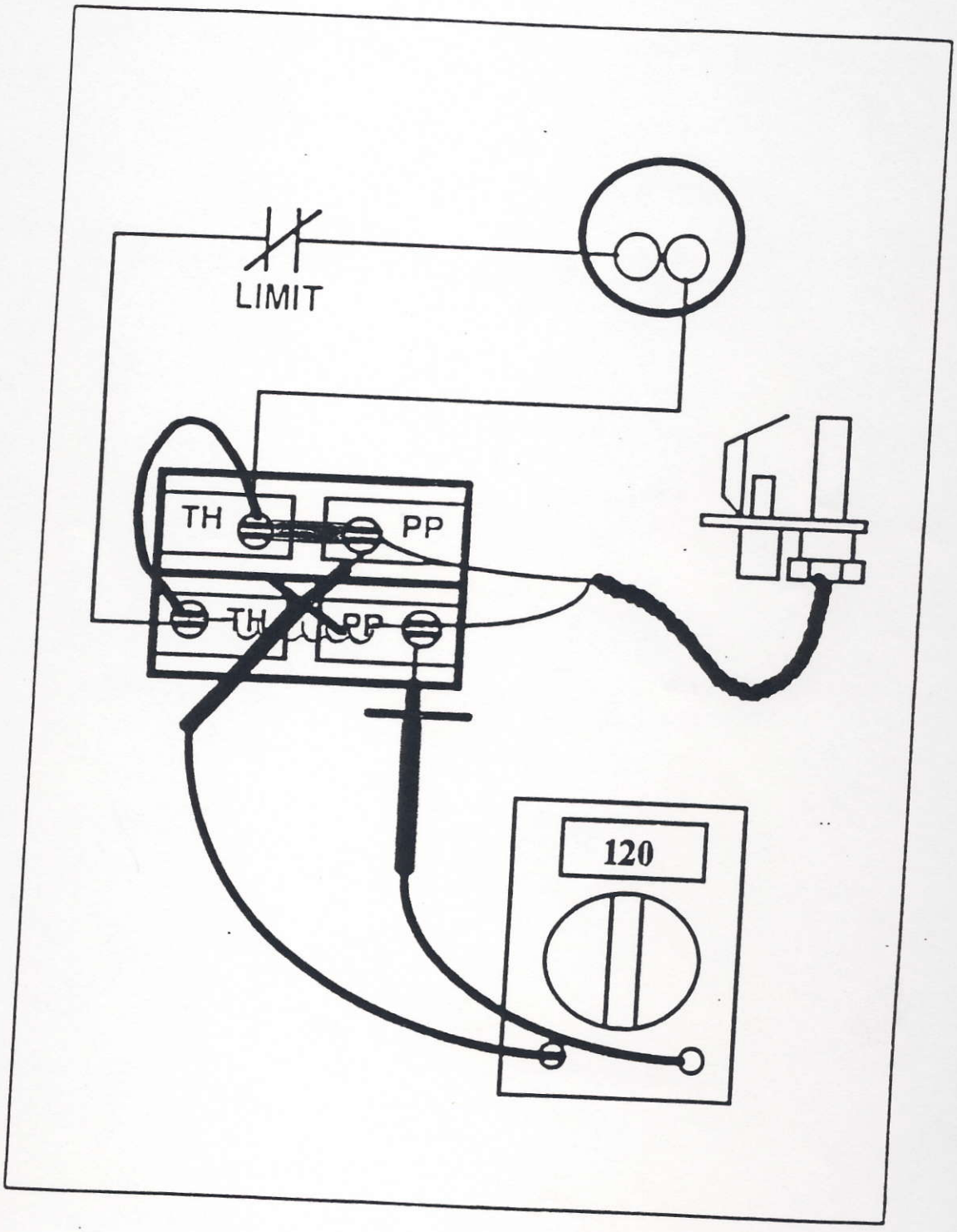
Pull in is the measure of the coils ability to open the valve either with a load or without. With the controls in the circuit it should pull in from 179 to 320. A high pull in would mean that the valve would perhaps operate intermittently and the controls or valve may need to be changed. Taking the reading with the controls jumped out will prove which one is the problem.

#7



The pull in with the controls jumped out is usually taken when the valve will not open with the controls in the circuit, or when the pull in with controls in the circuit is high. It will help you to see if the problem is in the controls or valve coil. This reading should be between 95 to 179. A high reading would indicate a bad valve coil.

#8



Millivolt System Control Resistance

Q 313 (32" long)	3.38 OHMS
Power Unit used on	23.1 OHMS

CS434 VS-8190
CS591 VS-8194
CS5133 VS-8233
CS5134 VS-8238
CS5230 VS-8262
CS5278 VS-8279
CS5281 VS-8291
CS5296

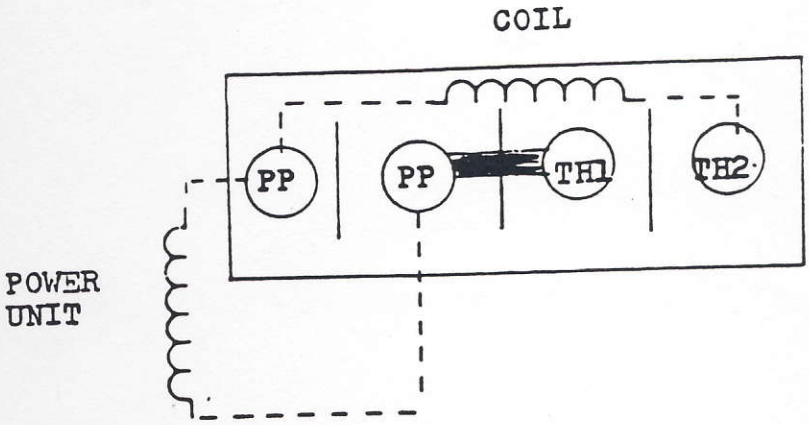
Power Unit used on	11.0 OHMS

VS8133 R'Shaw
VS8141 VH700-500 (series)
VS8204 W.R. 36C 03U-433
VS820
VS821

Powerpile Valve Coil	2 OHMS + or - 5 percent
Thermostat with anticipator and 30 feet of 18 guage wire	1.68 OHMS

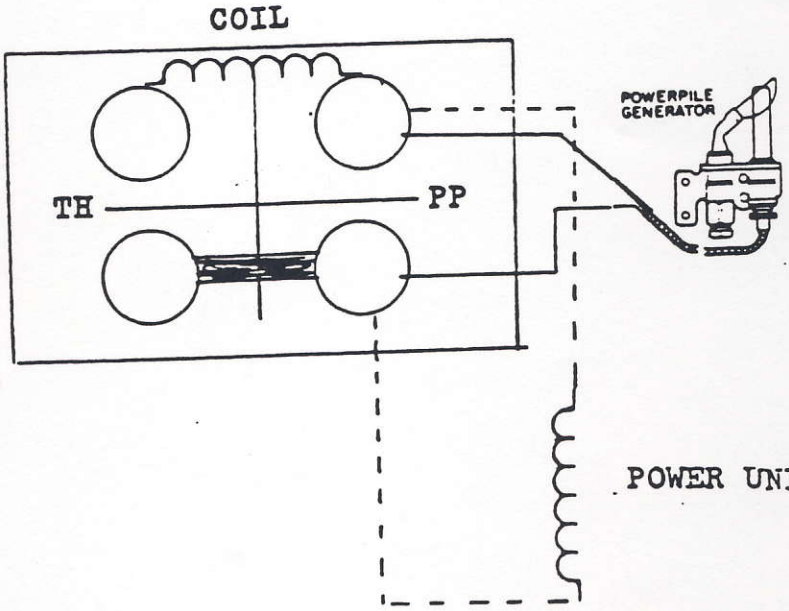
HONEYWELL COMBINATION VALVES

(Internal Wiring)



VS-8194

VS-8233



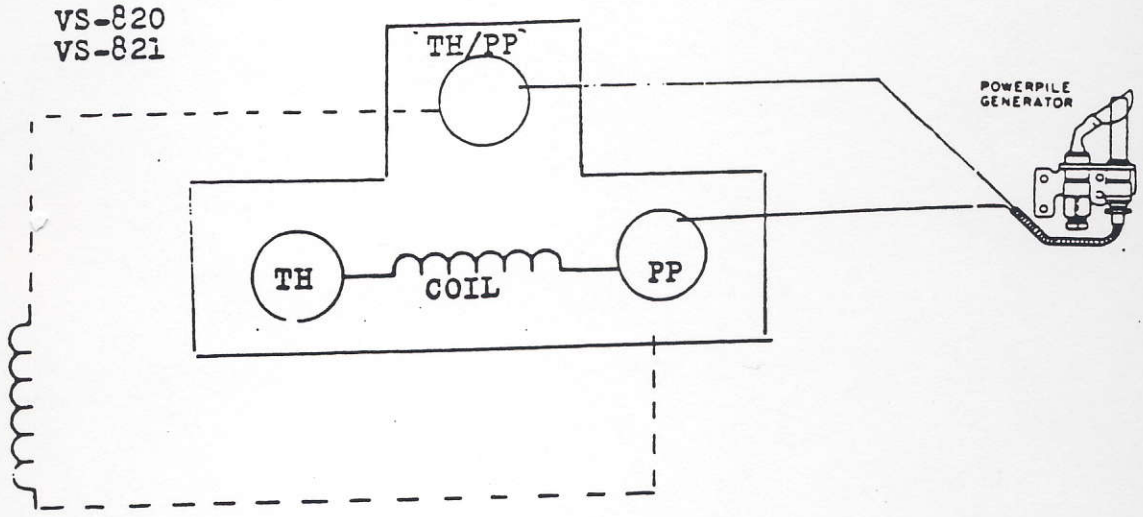
WW SERIES

VS-8138

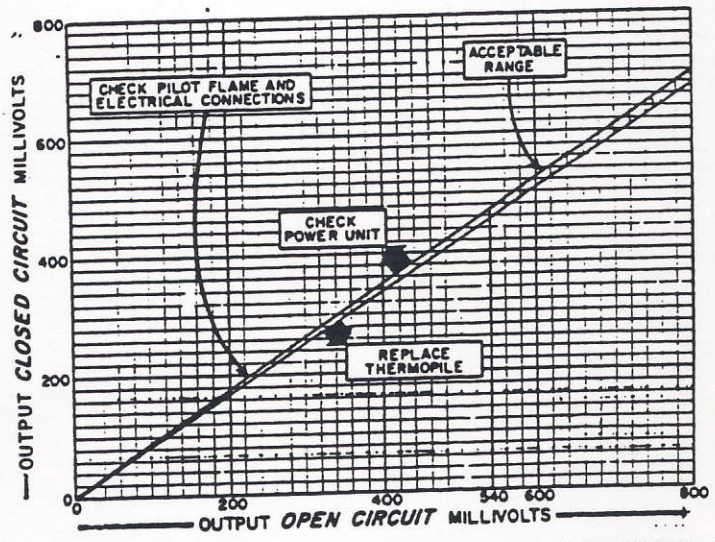
VS-8133

HONEYWELL COMBINATION VALVES

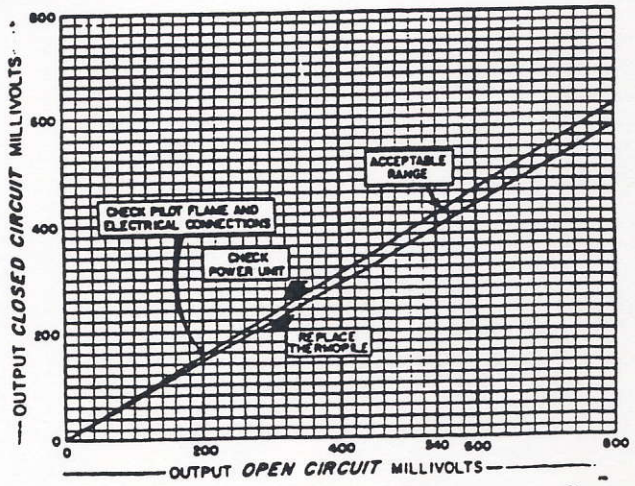
VS-820
VS-821



—STANDARD POWER UNIT (23 OHM)



23 OHM POWER UNIT (CS434, CS591, CS5133, CS5134, CS5230, CS5278, CS5281, CS5296, VS8190, V8194, VS8233, VS8238, VS8262, VS8279, VS8291)



11 OHM POWER UNIT (VS8133, VS8138, VS8141, VS8204) VS-820, VS-821

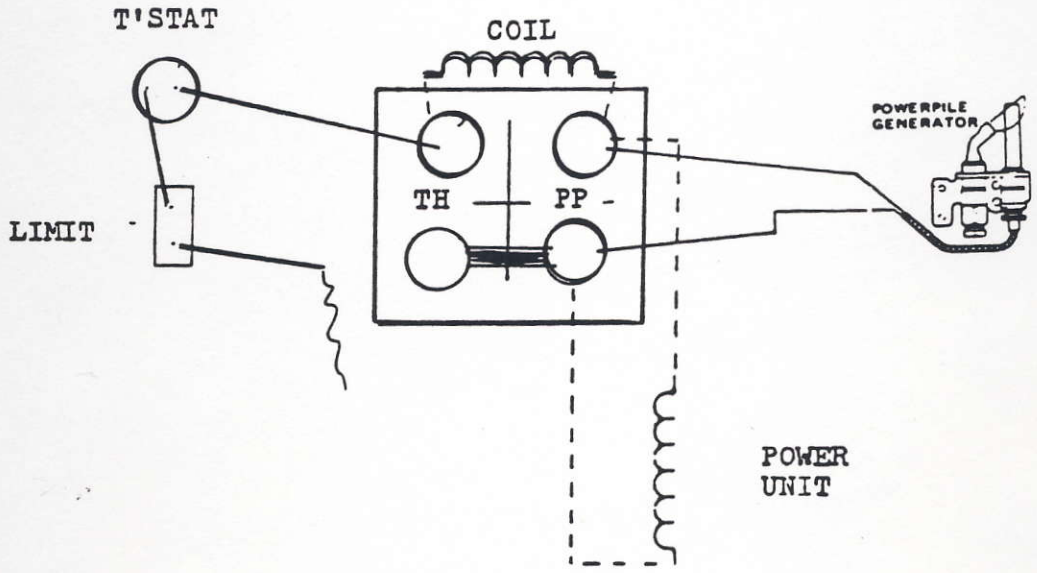
HONEYWELL COMBINATION VALVES

(Millivolt Checkout)

VALVES

Honeywell: VS 8138, 8133, 820 and 821

White Rodgers: 36C03 and 36C10



Take your normal Open Circuit reading. Then take your Closed Circuit reading. You are now ready to take a reading through the Power Unit. To do this , disconnect one thermostat lead from the valve. This removes all the controls from the circuit. The multimeter should be connected across the PP terminals on the valve. With this hookup you will read the millivolt drop across the power unit only. (This is very necessary if you have had constant pilot outage). The leads from the thermostat should now be reconnected. Proceed to take all the other normal readings. The other readings will be the same as they were for readings taken on valves with just a valve coil (no power unit). There are two circuits that have to be checked on a combination valve.

1. **The Valve Coil**

2. **The Power Unit**

This type of valve also has two drop outs, the valve coil will drop out and then the power unit. The valve coil dropping out will cause the meter to jump slightly (you must keep your eyes on the meter at all times to observe this) The power unit will drop out with an audible click and the pilot gas will cease to flow.

Drop out is done by blowing out the pilot and waiting for an audible click or a slight jump in the meter needle. An other way to check this is to shut off the flow of gas to the pilot and have the main burner running. When the main burner goes out that is the drop out.

The pull in can be a little tricky, it is best done after doing the drop out. The reading obtained as drop out for the power unit should also be the point that brings in the power unit. At this point release the pilot -on-off lever and quickly turn to on, the pilot should stay on and the point were the main burner comes on is the pull in for the valve coil.

COMBINATION VALVES

(Sample set of readings)

	VALVE	POWER UNIT
Open Circuit	700 mv's	600 mv's (Thermostat leads disconnected)
Closed Circuit (Controls in)	360 mv's	
Closed Circuit (Controls out)	250 mv's	
Pull In (Controls in)	200 mv's	
Pull In (Controls out)	100 mv's	
Drop Out	Below 95	Between 63-162 (23 Ohm) 44-105 (11 Ohm)

ALL OTHER READINGS WILL BE THE SAME AS THEY WERE WITH JUST A VALVE COIL.

RELAY WITH A COMBINATION POWERPILE VALVE

There will be no millivolt drop across the controls when you have an isolated burner circuit type relay used with a powerpile valve. Such as X X terminals on RA-832 or B1 B2 on other relays.The reason there is no drop is because the only thing in the circuit is a set of clappers in the relay, the relay is brought in by a 24 volt thermostat, the clappers make and bring in the powerpile valve. The only other thing in the circuit is the built in Hi-limit in the relay. The boiler is usually factory wired so you have a short run of low resistance wire. The pull in should fall within the range of 95-179 millivolts because there are no controls. In charting out the readings both Closed Circuit readings should fall in the lower diagonal line of chart.

A TYPICAL SET OF READINGS:

Open Circuit	**720 mv's**
Closed Circuit (Controls in)	**260 mv's**
Closed Circuit (Controls out)	**250 - 255 mv's (5 to 10 mv's drop across clappers, wire and hi-limit)**
Drop out - Valve	**Below 95**
Drop out - Power unit	**Between 44 - 105**
Pull In	**Between 95 - 179**