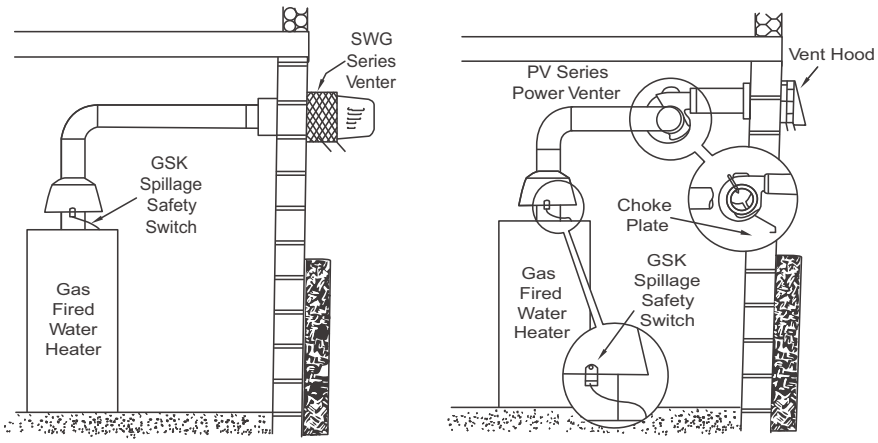
Troubleshooting pilot flame outages with power-vented residential (millivolt thermocouple-controlled) gas-fired water heater applications

Typical Installation Description:

Field Controls SWG or PV series power venter, CAS-series motorized combustion air system, or DI-series draft inducer, controlled by a CK-20FV/FG control kit mounted on a millivolt controlled gas-fired water heater.



Description of Proper Operation:

Venting/Combustion Air Equipment Motor Operation:

The venting/combustion air equipment motor is controlled directly by the CK-20FV/FG gas pressure switch, which senses gas pressure in the main burner when firing.

Safety Circuit Operation:

Two GSK-3 exhaust gas spillage switches (mounted on the water heater draft hood), one six foot length of 12 gauge wire and jumper wire, and one TCA-1 or TCA-2 thermocouple adapter block (all included in the control kit) are installed as a safety circuit to prevent gas flow if exhaust gas spillage around the draft hood occurs. When heated by the pilot flame, the thermocouple generates a millivolt electrical current that is routed through the GSK-3 safety circuit to the gas valve. If spillage is detected, this millivolt current is interrupted by the GSK-3 spillage switches and results in shutdown of the gas valve, whereupon the pilot and main burner flame are extinguished.

Causes of Pilot Flame Outage:

- Exhaust gas spillage, due to:
- Inadequate venting
- Slow response of gas pressure switch
- Excessive downdrafts (vertical venting) or wind loads (sidewall venting)
- Depressurization of surrounding area
- Excessive electrical resistance of the GSK safety circuit
- Inadequate thermocouple output

Diagnosis and Correction of Improper Operation Resulting in Pilot Outages:

CAUTION: If for any reason the system has shut down during operation, the cause of the system failure should be investigated and corrected before restarting the system!

1. Check GSK spill switches to see if one or both have tripped:

• **Using an ohmmeter/multimeter or continuity tester:** check continuity through the safety switches by removing the two wires from the TCA thermocouple adapter, and connecting the leads to the ends of the wires. Discontinuity will indicate that either or both switches have tripped, or faulty wiring.

• **Without ohmmeter or continuity tester:** Remove the metal covers from the switches and attempt to reset the switches by pushing the reset button in the center of the switch. If either switch has tripped, an audible click will usually be produced when the reset button is pushed inward.

Corrective Action:

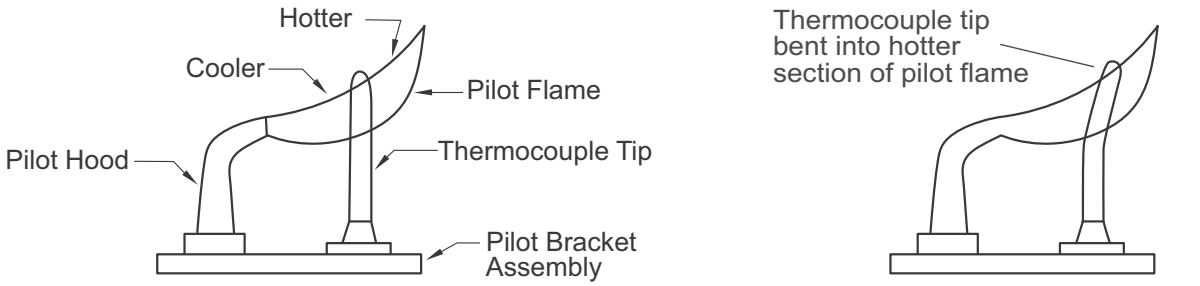
CAUTION: If either or both switches have tripped, the venting system must be thoroughly inspected for proper venting operation.

• Check for exhaust gas spillage around the draft hood when the venting/combustion air equipment and water heater are operating, and at the time the venter shuts off. If spillage occurs during operation, adjust the air flow damper on the venter (or air flow adjustment plate on the draft inducer) to increase the draft provided.

• If spillage occurs when the venter shuts off, negative pressure exists in the building. Negative pressure problems can be corrected by providing make-up air and/or combustion air.

• Check for exhaust gas spillage around the draft hood when the main burner ignites: the gas pressure switch may be responding too slowly due to damage or blockage of the ports. If the venting/combustion air equipment motor is not activated by the gas pressure switch within 15-30 seconds (or as otherwise specified in the CK-kit installation instructions), temporary spillage may be sufficient to trip the GSK spill switches. Inspect the gas pressure switch, and check the main burner manifold pressure and verify that it is within manufacturer's specification. Replace the pressure switch or gas valve as necessary.

Figure 2: Thermocouple Tip Location



Original
Pilot/Thermocouple Orientation

Modified
Pilot/Thermocouple Orientation

2. If the GSK-3 switches have not tripped:

• **Inspect the GSK-3 and 12 gauge wire safety circuit for loose or dirty electrical connections.** Clean and tighten all connections of corrosion or other contaminants, and apply dielectric grease as necessary to prevent corrosion.

• **Check the GSK-3 and 12 gauge wire safety circuit for excessive electrical resistance using an ohmmeter/multimeter** by removing the two wires from the TCA thermocouple adapter, and connecting the test leads to the ends of the wires and across each individual component of the circuit. All parts of the circuit should indicate near zero ohms resistance when measured with a multimeter. Any parts that have a high resistance are defective and should be replaced.

• **Check the thermocouple for sufficient output:** Refer to Figures 3 and 4 for technique description. Millivolt output should be between 8 and 14 millivolts when measured as shown in Figure 3, and between 17 and 25 millivolts when measured as shown in Figure 4.

• **If thermocouple output is within or above the stated ranges,** there may be a problem with the gas supply of the gas valve. Check gas supply pressure and gas valve operation.

• **If thermocouple output is below the stated ranges:** relocating the thermocouple tip as illustrated in Figures 2 and 8 increases the heat impingement on the thermocouple tip, which results in an increase in the millivolt output. Application of the technique can result in an increase in millivolt output from a range of 8 to 11.5 millivolts to a range of 17 to 20 millivolts, as measured as shown in Figure 4.

Figure 3: Closed Circuit Voltage
GSK-3 Switches included

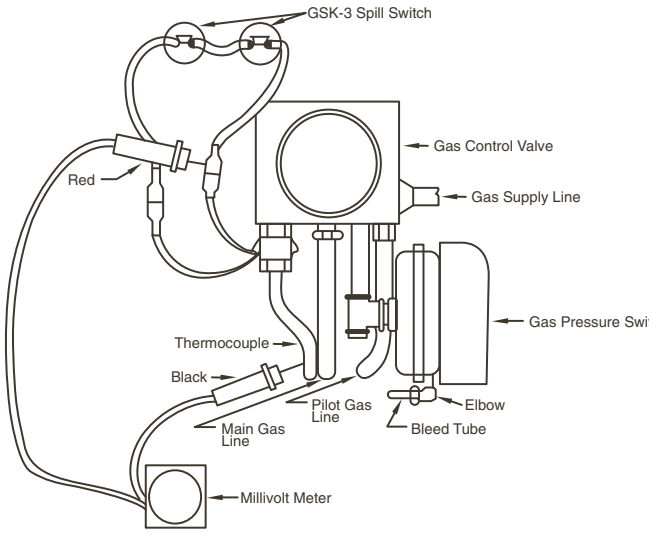
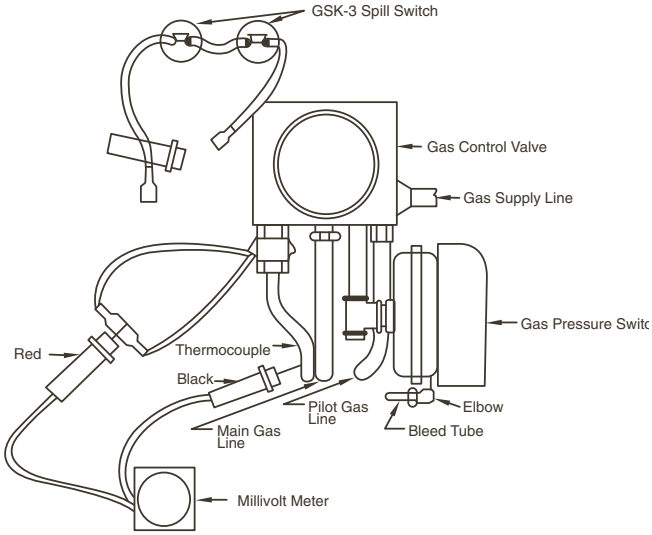


Figure 4: Closed Circuit Voltage
GSK-3 Switches **NOT** included



• **If relocation of the thermocouple is unsuccessful,** replacement of the thermocouple or thermocouple assembly may be necessary.

NOTE: Only copper thermocouples should be used. In addition, the length of the thermocouple tip can vary. Thermocouples with a 2½" tip should be used.

NOTE: The thermocouple should be screwed only finger tight plus one turn into the TCA-1 or TCA- 2. Damage to the TCA-1 or TCA-2 will occur if the thermocouple is over tightened.

• **Check hole depths in gas valve and TCA adapter thermocouple fitting** for proper fit of the TCA adapter into the gas valve, and of the thermocouple into the TCA. In both cases, the tip of the mating male part must make firm and solid contact with the center of the mating female part when installed.

Figure 5: Unmodified Thermocouple

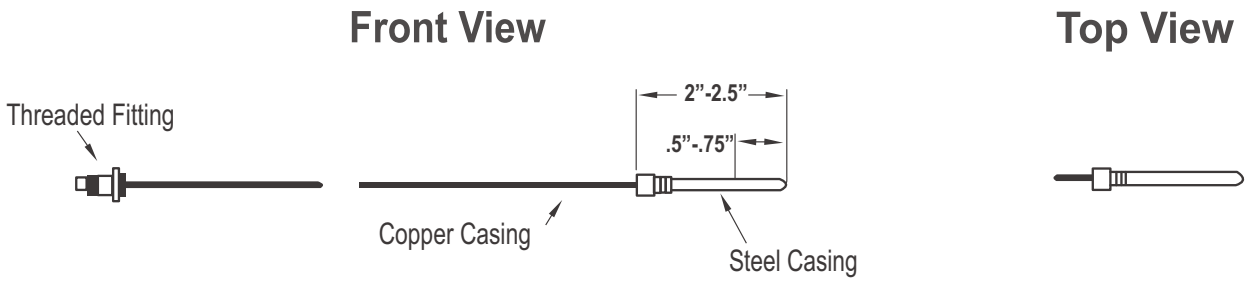


Figure 6: Modified Thermocouple

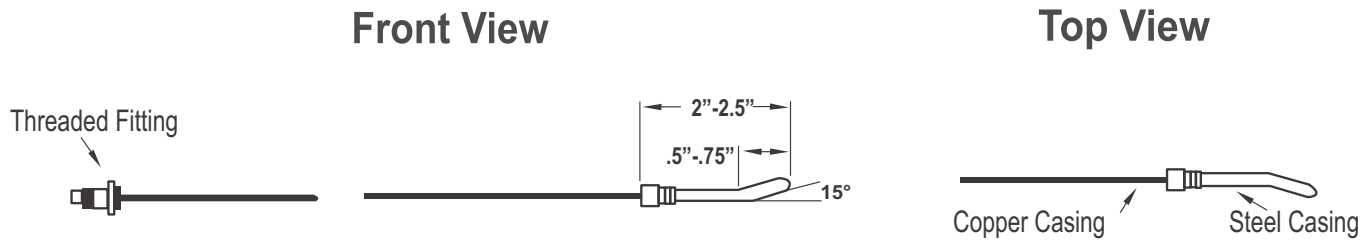


Figure 7: Unmodified Thermocouple orientation

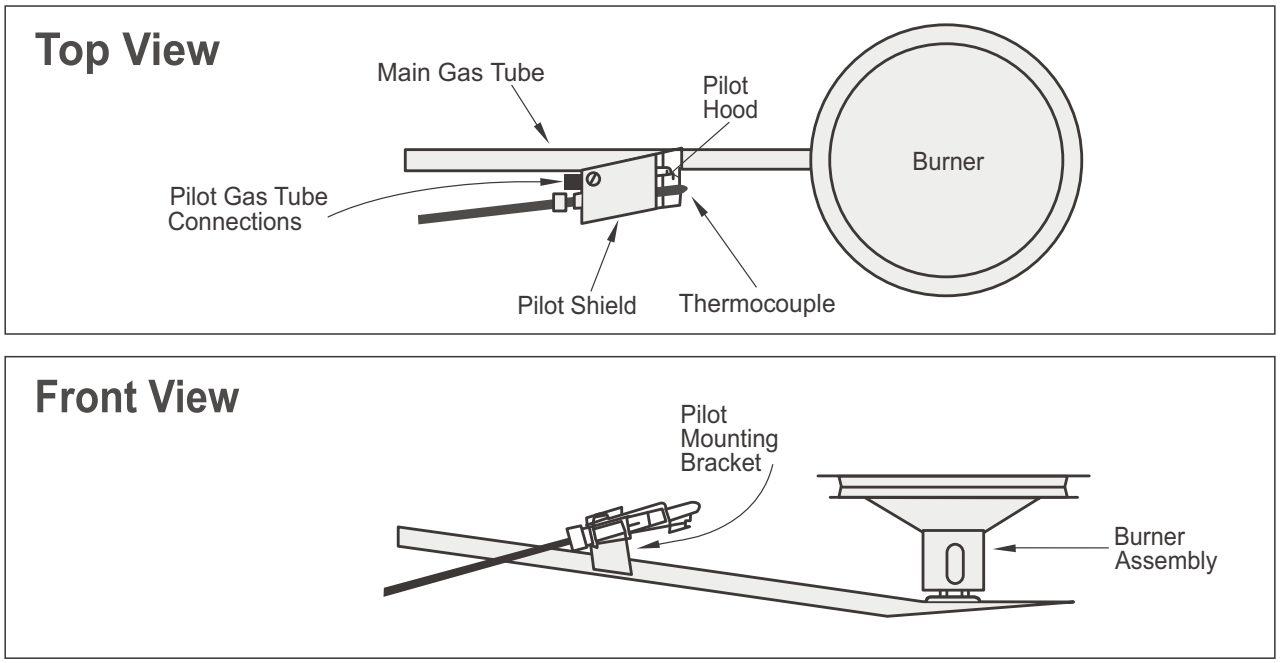
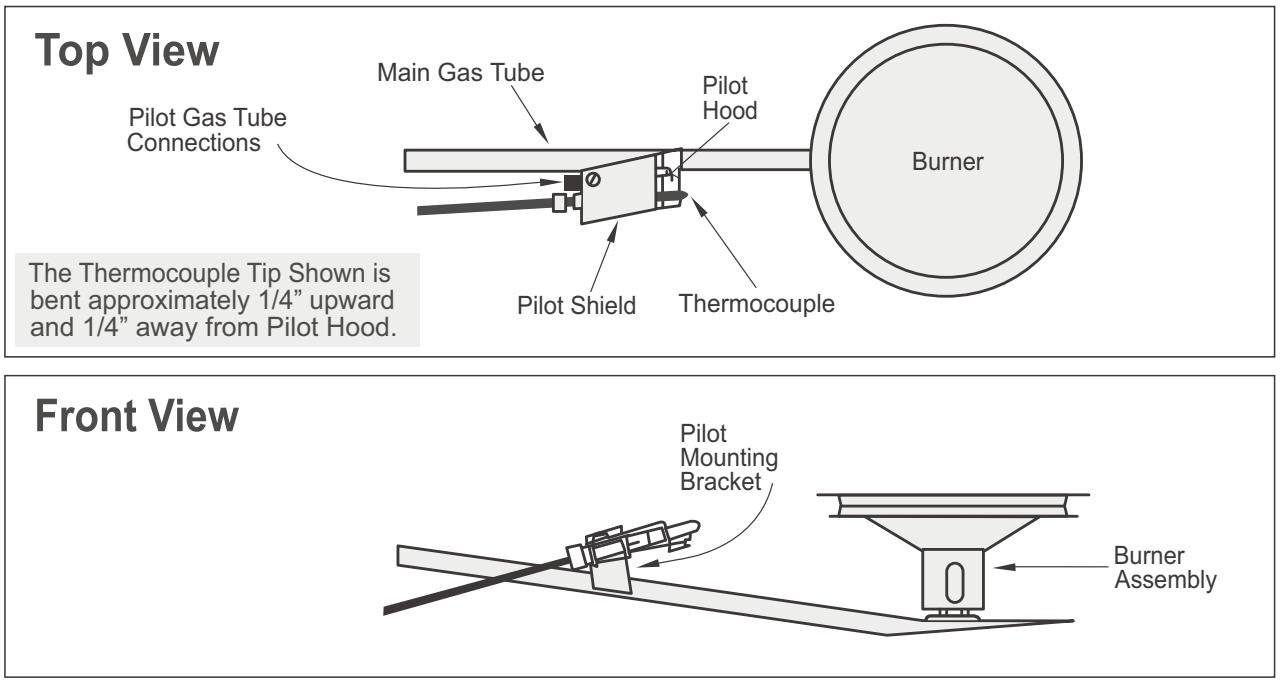


Figure 8: Modified Thermocouple orientation



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