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PRACTICAL THERMOCOUPLE TROUBLESHOOTING

A thermocouple is a simple device. Two dissimilar metals are joined together; the junction produces a small voltage when heated. The voltage produced is determined by the make up of the metals in the junction – not the quality of the junction. They either work or they do not work. They will not give an inaccurate reading.

If you check them with an ohmmeter they will show resistance or open. An "open" will not work at all. If there is continuity it will give the correct output because it is a characteristic of the wire that the thermocouple is made of. The lead wire is also made of the same wire that the thermocouple is made from.

Some CHT systems are operated by the voltage output of the thermocouple alone. An example of this type of system is the Alcor 2 ¼" gauge. These self-powered units must have a certain total resistance of the thermocouple and lead wire. This resistance is marked on the back of the gauge (usually 2,4, or 8 ohms). The resistance of the total system is a function of the diameter of the lead wire. Lead wire is rated in number of ohms per foot. For this reason never shorten the wiring harness on one of these systems.

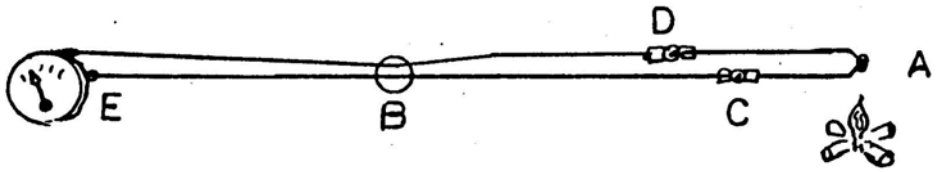
Another type of system is the amplified gauge. In this system the power for operation comes from the aircraft electrical system. The thermocouple voltage output is used only to provide a reference voltage at very low current. On this type of system the lead length is not important – they can be shortened or lengthened. Examples of this type of gauge are: the Insight, JPI and Electronics International.

Thermocouples are made in many types. Each type has a different voltage output. Because of this the wire type in the lead, instrument and thermocouple must be matched. Common aircraft types are Type J (Iron-Constantan) and Type K. Thermocouple systems may also require grounded or non-grounded thermocouple junctions.

Thermocouples have the leads color marked. Type J wires are red and white (or yellow and black on old military units). Type K are red and yellow. The negative lead is always red. Harness and thermocouple leads should always connect to the same color wire.

Things that can make a thermocouple read incorrectly.

Below is a thermocouple system with the junction at “A”. The leads pass through a baffle hole at “B”, “C”, and “D” are lead connectors and “E” is the instrument.

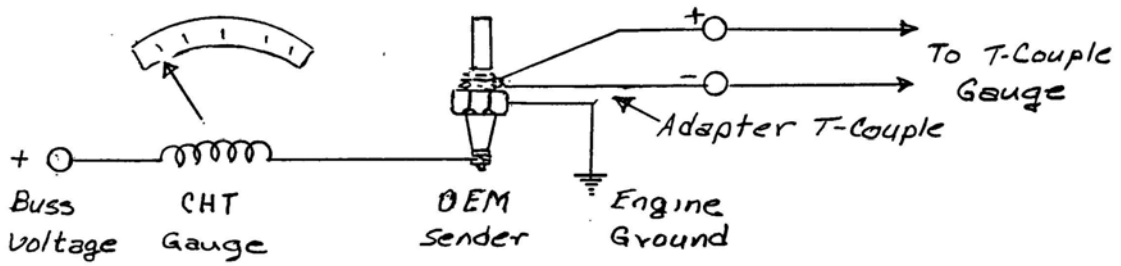


1. The instrument reads the voltage output of the closest junction of the wires. If the wire insulation chafes through at “B” then the temperature indicated will be the temperature at “B” and not that at “A”. If a cylinder thermocouple probe has the lead so badly abused that the insulation is damaged then it will read the temperature where the wires touch and not the probe tip. This can be avoided by not bending the wires sharply where they exit the probe and by securing the leads properly.

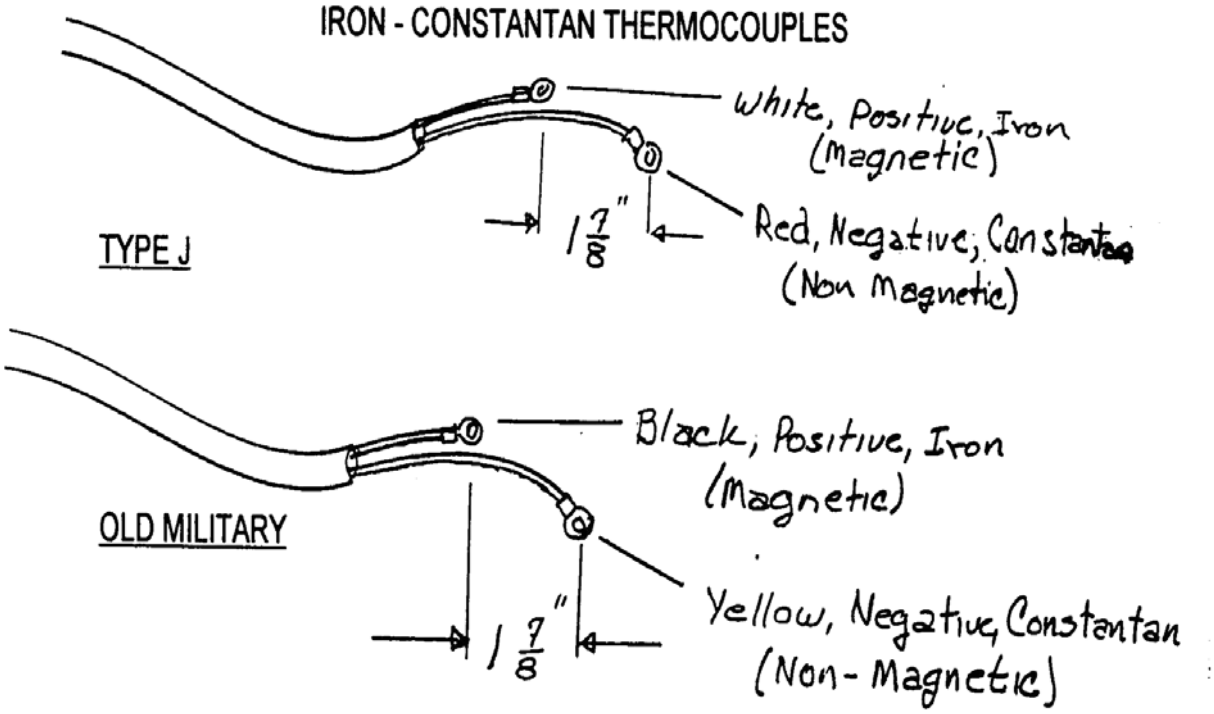
2. If there is an “open” in any of the wires, such as a bad crimp in any of the connectors at “C” or “D”, then the system will not read at all. Again handling the wires roughly when installing the CHT probes or improper securing can result in broken wires.

3 In inexpensive self powered systems the connectors at “C” and “D” are made from the same material as the wire they are used on. However, in most aircraft systems the connectors are common electrical terminals. Each place different metals join, such as in these connectors, another thermocouple is formed which puts out voltage. These terminals are in series with the sensing thermocouple and add to or subtract from the output. It is fortunate that these put our a negative voltage on one lead and a positive voltage on the other, so that the net result is no change in the reading of the sensing thermocouple “A”. An inaccurate reading can occur if one connector is hotter than the other. This can occur when one of the junctions at “C” or “D” is close to an exhaust stack and the other one is somewhat removed. They must both be in the same temperature environment.

4. If a thread “adapter” thermocouple is placed under an OEM resistive CHT sender and the OEM sender is loose or not properly grounded, voltage may be placed on the thermocouple lead resulting in problems with both systems.



The OEM CHT sender is a resistive unit that changes resistance with temperature. The gauge reads the current flow to ground which changes as the resistance changes. The center terminal of the sender has a positive voltage on it. If the body is not grounded to the engine properly (and the engine grounded) the cockpit gauge will not work properly and the thermocouple that you've placed under is may be the path back to ground. Be sure the sender is grounded to the engine and the engine ground has continuity to the airframe.



(an "old military" may be replaced with a J type thermocouple by connecting black lead to white and yellow lead to red)