

## THEORY

A thermocouple is a device formed by the junction between two dissimilar metals, which transforms heat energy into electrical energy. Aviation EGT and CHT systems use thermocouples, lead wires composed of the same two dissimilar metals, and an indicator, which is basically a millivolt meter.

Most aviation EGT/TIT and CHT systems are based on three types of thermocouples, Type K, E and J. The most common, Type K, has red (-) and yellow (+) wires and is used on most high temperature EGT/TIT (1200-1700F) applications. It uses chromel and alumel wires in the both the thermocouple element and lead to the meter. Type E thermocouples were used on earlier EGT systems and produce about twice the millivolts for a given temperature as Type K. They have red (-) and brown or tan (+) color codes and are composed of chromel and constantan wires and elements. Many CHT systems use a type J system of iron and constantan metals which is more accurate at lower temperatures (0-500F). They have either black (+) and yellow (-), or red (-) and white (+) color codes.

Thermocouples also come in both ungrounded and grounded styles. Grounded means that the tip or thermocouple junction is part of and ground to the outer sheath, clamp, wires, etc. Most thermocouples are of the grounded type which are easier to produce than ungrounded. Ungrounded thermocouples are used on amplified meters with circuits requiring those types (easier to design). Ungrounded means the thermocouple wire junction is isolated from the rest of the outer sheath, wires, etc. and must maintain a certain insulation resistance value to work correctly.

## TESTING

Thermocouples are simple to troubleshoot with a good quality digital multi-meter providing you know what the loop resistance ohms are. The multi-meter should preferably be a digital style fitted with alligator clips on the test leads.

**Integrity check:** Inspect the entire system for loose connections, broken wires or connectors, or mismatched color codes. Color codes must match throughout the entire system from the meter to the thermocouple, including the lead wires. The thermocouple wires as they exit the thermocouple body are especially prone to internal breakage (ensure wires are gently moved back and forth while conducting the following tests).

**Resistance check:** **CAUTION** - voltage from a multi-meter can damage an EGT/TIT or CHT indicator. Care should be taken to ensure the meter and lead is disconnected from the thermocouple before checking for loop resistance (unless entire lead and thermocouple are tested together and then the lead must be disconnected) of a thermocouple. A typical **Alcor** grounded type K or type E thermocouple will normally show from 0.6 to 1.0 ohms. The Type J

thermocouples will show a reading of about 0.24 ohms. **A CHT thermocouple with no color codes or only one wire probably works on resistance rather than millivolt output.** Consult the manufacturer for details.

**Millivolt output check, (EGT/TIT ONLY):** Using a propane torch, carefully heat the tip of the probe until it begins to glow a dark cherry red. At this point, the probe should put out between 33 to 36 millivolts (1500°F to 1650°F) for red/yellow, Type K and 61 to 67 millivolts for Type E. **Always use appropriate safety practices when using high temperature heat sources.**

If your thermocouple passes these tests, check with the manufacturer of your indicator (if not made by **Alcor**) for calibration or repair information. If your probe did not pass, call **Alcor**. Our grounded probes carry a three-year warranty and will support most modern EGT and CHT systems.

Please call **ALCOR, INC.** toll free (800-354-7233) if you have any questions about your EGT/TIT or CHT system.