Thermocouple Slip Ring Circuits

Michigan Scientific end of shaft slip ring assemblies provide accurate temperature data with any thermocouple materials.

Thermocouples function because voltages result from differential temperature from end-to-end of a length of wire. The voltage/temperature relationship is peculiar to the wire metal. It is impractical to measure the end-to-end voltage of the wire directly. We can, however, connect a dissimilar wire at one end and measure the difference in thermally induced voltages in the two dissimilar wires at the unconnected end.

Consider the case of an iron-constantan thermocouple. If we introduce a length of copper in the constantine lead wire it will change the output (differential voltage) at the readout instrument only if there is a temperature differential from end-to-end of the copper insert. If both ends of the copper are at the same temperature, it has no influence on the thermocouple output. We could do the same in the iron lead wire. Thus if the slip ring stator and rotor terminals are at essentially the same temperature, there is no significant error due to the introduction of different metals into the circuit. The indicated temperature will be in error only by the difference in stator and rotor terminal temperatures. Therefore, it is important to arrange the installation so rotor and stator temperatures do not differ by more than the acceptable measurement error.

Another potential source of error is differential heating at the ring-brush interfaces. Measurements show this to be insignificant with Michigan Scientific slip ring assemblies.

Slip ring performance with thermocouples can be checked quite convincingly. The slip ring rotor may be mounted at the top of a hollow vertical shaft on bearings. A small motor with a hollow shaft is convenient for this. An open container of hot or cold liquid can be placed just under the bottom of the shaft. A thermocouple is connected through the slip ring and located in the hollow shaft so the junction protrudes slightly into the liquid. Another thermocouple is immersed directly into the liquid and the outputs are compared to evaluate the effect of the slip ring.

Resistance temperature sensors which are available from strain gage manufacturers can be used if for any reason they are preferred to thermocouples. The slip ring circuit considerations are identical to those that apply with strain gages.

The reader is invited to contact Michigan Scientific Corporation for further information regarding the use of thermocouples with slip rings.

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