

### Glossary of Temperature Sensing Terms

**Absolute Zero** — Theoretically, the lowest possible temperature. A body at absolute zero would have no molecular motion or heat energy. It is the zero point on the Kelvin and Rankine scales, and is estimated to be  $-273.15^{\circ}\text{C}$  or  $-459.67^{\circ}\text{F}$ .

**Accuracy** — A statement that is used to define the largest allowable error in a device or system. It is an indication of how close measured values are to true values. It can be expressed in both measured units and in percentages.

**Alloy #11** — A Harrison Alloys trademark for a low-cost negative thermoelement used with copper for a compensating extension wire used with thermocouple types R and S. The EMF characteristics are similar to R and S up to approximately  $204^{\circ}\text{C}$ .

**Alpha ( $\alpha$ )** — The temperature coefficient of resistance of a material, derived from measurements at  $0^{\circ}\text{C}$  and at  $100^{\circ}\text{C}$ :  $\{R_{\text{sub}(100)} - R_{\text{sub}(0)}\}$  over  $\{100 \text{ times } R_{\text{sub}(0)}\}$ . It indicates the basic change in resistance in a material for each  $^{\circ}\text{C}$  change in temperature. It is a defining parameter for resistance temperature detectors (RTDs).

**ANSI** — An abbreviation for American National Standards Institute.

**ASTM** — An abbreviation for American Society for Testing and Materials.

**AWG** — An abbreviation for American Wire Gauge.

**Boiling Point** — The equilibrium temperature between a liquid and its vapor. It is commonly associated with water at  $100^{\circ}\text{C}$ , and 1 standard atmosphere.

**Callendar - van Dusen Equation** — An interpolation equation that provides resistance values as a function of temperature for RTDs.

**Celsius Temperature Scale** — A temperature scale with the ice point at 0 and the boiling point of water at 100. The formula for conversion to the Fahrenheit scale is  $F = 1.8C + 32$ . Formerly referred to as "Centigrade."

**Ceramic Insulation** — Crystalline compounds of both metallic and nonmetallic elements that serve as dielectric insulators. Two of the most common single oxide ceramics are alumina ( $\text{Al}_2\text{O}_3$ ) and magnesium oxide ( $\text{MgO}$ ). Ceramics are the primary insulation used to isolate sheathed thermocouple alloys.

**Compensated Connector** — A thermocouple connector that utilizes either actual thermocouple material contacts or compensating alloy contacts. By maintaining uniform circuit properties throughout the connection systems, errors due to mismatched materials are reduced.

**Compensating Alloy** — An alloy that has similar EMF characteristics to an actual thermocouple alloy. It is usually a low-cost alternative for some types of thermocouple alloy extension lead wires. An example would be the use of Alloy #11 as compensating lead wire for platinum thermocouple sensors.

**Compensating Loop** — Utilized in RTDs, a compensating loop is an extra pair of lead wires that have the same resistance as the actual lead wires, but which are not connected to the RTD element. Its purpose is to correct for lead wire resistance errors when making temperature measurement.

**Connection Head** — A housing on a sensor assembly that provides a terminal block for electrical connections and allows the attachment of protection tubes and cable or conduit hookups.

**Constantan** — The negative leg of types E, J and T thermocouples. Constantan is 55% copper and 45% nickel. The emf values can be significantly different for this material depending upon with which type of thermocouple alloy it is intended to be matched.

**Copper** — The positive leg of type T thermocouple.

**Cryogenic** — A term that usually refers to temperatures in the range of  $-183^{\circ}\text{C}$  or lower.

**Dielectric Strength** — A measure of the voltage that an insulating material can withstand before an electrical breakdown occurs. It is sometimes referred to as breakdown potential.

**DIN 43760** — German Institute for Standards document that covers nickel and platinum resistance elements. This is the most popular specification for 100 ohm platinum RTDs with a resistance vs. temperature curve specified by 0.00385 ohms/ohm $^{\circ}\text{C}$ .

**Drain Wire** — An uninsulated wire used in a cable construction as a ground connection.

**Duplex Construction** — A cable or wire constructed with two insulated conductors running parallel or twisted together.

**Exposed Junction** — A specific type of thermocouple junction where the measuring junction is exposed to the environment without any protecting sheath or outer tube. An exposed junction offers the fastest response time.

**Extension Wire** — A pair of wires connecting a thermocouple sensor to its reference junction or instrumentation. The emf characteristics of the extension wire must be similar to the thermocouple emf characteristics.

**Fahrenheit Temperature Scale** — A temperature scale with the ice point at 32 and the boiling point of water at 212. The formula for conversion to the Celsius scale is  $C = 5/9 (F - 32)$ .

**FEP** — An abbreviation for Fluorinated Ethylene Propylene. This component is commonly referred to as "Teflon®."

**Fixed Point** — A very reproducible temperature at the equilibrium point between phase changes in a material. The triple point of water ( $0.01^{\circ}\text{C}$ ) is an example of a fixed point.

**Freezing Point** — The fixed temperature point of a material that occurs during the transition from a liquid to a solid state. This is also known as the melting point for pure materials.

**Giga-** — A prefix meaning billion, or  $10^9$ . The symbol is G.

**Ground** — A conducting connection to earth or to some other large conducting object. Its purpose is to maintain an earth potential on the conductors connected to it, and to conduct the ground current to and from the earth.

**Grounded Junction** — A specific type of thermocouple junction in which the sheath and conductors are welded together, forming a completely sealed integral junction. A grounded junction is recommended for use in liquids, gas, and high pressure environments.

**Hi-Pot Test** — A test that determines the largest potential that can be applied to a conductor without breaking down the insulation (see Dielectric Strength).

**Ice Point** — The melting (and freezing) point of ice,  $0^{\circ}\text{C}$ . The ice point is frequently used as a calibration check point on resistance temperature detectors and as the reference junction for thermocouples.

**Initial Calibration Tolerances** — The allowable deviation from the theoretical emf value generated by any particular calibration thermocouple at a given temperature (previously referred to as limits of error).

**Insulation Resistance** — A ratio of the applied voltage to the total current flow between two conductors separated by insulation or any conductor and the sheath.

**Interchangeability** — A statement that describes how closely a sensor adheres to its defining equation, and the maximum variation that would exist in the readings of identical sensors mounted side-by-side under identical conditions.

**IPTS- 68, 48** — Abbreviations for the International Practical Temperature Scales of 1968 and 1948. IPTS-68 is the most recent revision of the temperature scale, which is a standard scale made up of fixed points that closely approximate thermodynamic temperatures. All temperatures between the fixed points are derived by interpolation using the assigned interpolation instrument.

**Iron** — The positive leg of a type J thermocouple.

**ISA** — An abbreviation for the Instrument Society of America.

**Junction (thermocouple)** — The point at which two thermocouple alloys are joined. In a typical thermocouple circuit there is a measuring junction and a reference junction.

**Kelvin Temperature Scale** — Also known as the thermodynamic temperature scale, the Kelvin Scale is an absolute temperature scale in which temperature differences are proportional to the amount of heat energy converted to mechanical work by a Carnot engine. The ice point on the Kelvin Scale is  $273.15\text{K}$ . A useful approximation for conversion of the Kelvin Scale to the Celsius scale is  $T(\text{K}) = T(\text{C}) + 273.15$ .

**KN** — The negative leg of a type K thermocouple. It is predominantly nickel with small added amounts of aluminum, manganese, and silicon. Company trade names are Alumel, Nial, and HAI-KN.

**KP** — The positive leg of a type K thermocouple. It is predominantly nickel with added chromium. Company trade names are Chromel, Tophel, and HAI-KP.

**Limit of Error** — The allowable error in a thermocouple, expressed as a percentage or a specific degree value throughout defined temperature ranges. See Initial Calibration Tolerances.

