



Standard Specification for Temperature Monitoring Equipment¹

This standard is issued under the fixed designation F 2362; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers the requirements for equipment intended to provide control input and monitoring of temperatures in general applications. Equipment described in this specification includes temperature indicators, signal conditioners and power supplies, and temperature sensors such as thermocouples and resistance temperature element assemblies.

1.2 Special requirements for Naval shipboard applications are included in the Supplementary Requirements section.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 ASTM Standards:²

D 3951 Practice for Commercial Packaging

E 344 Terminology Relating to Thermometry and Hydrometry

3. Terminology

3.1 *Definitions*—Definitions of terminology shall be in accordance with Terminology E 344.

4. Classification

4.1 *General*—Temperature measuring devices are generally classified as either temperature sensors or thermometers. Thermometers are not covered by this specification. Temperature sensors are classified by design and construction. Sensors may also be classified by the manner of response, basically mechanical or electrical, to a change in temperature. Mechanical response is characterized by some mechanical action as temperature changes. Electrical response is characterized by the production or change of an electrical signal or property as temperature changes. The following describes the most common types of sensors:

4.2 *Thermocouples*—Thermocouples are constructed in a variety of designs to provide measurement of direct or differential temperature. Thermocouples are commonly installed using a thermowell which protects the thermocouple but also delays the rapid response time characteristic of thermocouples.

4.2.1 *Principle of Operation*—Most thermocouples utilize two wires fabricated from dissimilar metals joined at one end to form a measuring junction that is exposed to the process medium being measured. The other ends of the wires are usually terminated at a measuring instrument which forms a reference junction. When the two junctions are exposed to different temperatures, electrical current will flow through the circuit (Seebeck Effect). The measurement of millivoltage resulting from the current is proportional to the temperature being sensed.

4.2.2 *Types of Thermocouples*—Thermocouples can be divided into functional classes by materials and therefore, temperature ranges. The three classes are base metal, noble metal, and refractory metal. Although many types are commonly used in industrial applications, the Instrument Society of America (ISA) has assigned letter designations to seven types. By convention, the practice of using a slash mark to separate the materials of each thermocouple wire is widely accepted. Likewise, the order in which the materials appear also denotes polarity of the wires; positive/negative when the measuring junction is at a higher temperature than the reference junction. The following are examples of typical thermocouples:

Class	Type	Materials	Temperature (max)
Base metal	J	Iron/constantan	1000°C (1832°F)
Base metal	T	Copper/constantan	1000°C (1832°F)
Base metal	K	Chromel/Alumel	1000°C (1832°F)
Base metal	E	Chromel/constantan	1000°C (1832°F)
Base metal	---	Alloys of copper, nickel, iron, chromium, manganese, aluminum, and other metals	1000°C (1832°F)
Noble metal	---	Various noble metals	2000°C (3632°F)
Refractory metal	---	Tungsten-rhenium, tantalum, molybdenum, and their alloys	2600°C (4712°F)

4.3 *Resistance Temperature Measuring Devices*—Resistance thermometers measure changes in temperature based on changes in resistance of the sensor element exposed to the temperature. Two common types are resistance temperature detectors which have metal sensor elements and thermistors which have semiconductor sensor elements.

¹ This specification is under the jurisdiction of ASTM Committee F25 on Ships and Marine Technology and is the direct responsibility of Subcommittee F25.10 on Electrical.

Current edition approved Dec. 1, 2003. Published January 2004.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.