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Standard Practice for Thermoelectric Sorting of Electrically Conductive Materials[1]

This standard is issued under the fixed designation E977; 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 practice covers the procedure for sorting materials using the thermoelectric method, which is based on the Seebeck effect. The procedure relates to the use of direct- and comparator-type thermoelectric instruments for distinguishing variations in materials which affect the thermoelectric properties of those materials.

1.2 While the practice is most commonly applied to the sorting of metals, it may be applied to other electrically conductive materials.

1.3 Thermoelectric sorting may also be applied to the sorting of materials on the basis of plating thickness, case depth, and hardness.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Terminology

2.1 *Descriptions of Terms:*

2.1.1 *acceptance limits*—the thermoelectric response that establishes the group into which the material being examined belongs.

2.1.2 *comparative instrumentation*—a system that uses electrode assemblies (probes), associated electronics, and known standards to measure a thermoelectric response from an electrically-conductive material; this response is compared with that of the reference standard.

2.1.3 *direct instrumentation*—a system that specifically measures and displays the voltage (or an arbitrary unit) generated between the electrodes when they are at different temperatures and in contact with the material.

2.1.4 *electrode*—the conductors used in thermoelectric sorting instruments used to generate the Seebeck effect with the material under test.

2.1.5 *Seebeck effect*—the thermoelectric electromotive force (emf) produced in a circuit connecting two dissimilar conductors at two points of different temperatures; the magnitude of this emf is a function of the chemistry of the materials, surface metallurgical structure, and the temperature at the junctions. See Fig. 1.

3. Summary of Practice

3.1 The two techniques that are primarily used in thermoelectric sorting are direct and comparative instrumentation. In the direct instruments, equipment is standardized by placing materials with known chemistry and metallurgical structure in the test system. The value of the thermoelectric voltage (or arbitrary unit) is read on the scale of an indicator. In the comparative instruments, the thermoelectric response of the test piece is compared with that of a known standard(s) and the response indicates whether the piece is within the acceptance limits.

3.1.1 Both kinds of instrumentation require comparing the pieces to be examined with the known standard(s). Two or more samples representing the acceptance limits may be required.

3.1.2 *Direct Thermoelectric Instrumentation*—A known standard(s) is inserted in the system and the controls of the instrument are adjusted to obtain a voltage (or arbitrary unit) reading(s). The process is then continued by inserting the pieces to be sorted into the system, and observing the instrument reading(s).

3.1.3 *Comparative Instrumentation*—Known standards representing the acceptance limits are inserted into the system. The instrument controls are adjusted for appropriate response. The process is then continued by inserting the pieces to be sorted in the system, and observing the instrument response.

3.2 In both instruments, the range of the instrument response must be adjusted during standardization so that any

[1] This practice is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.10 on Specialized NDT Methods.

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