Designation: E 977 – 84 (Reapproved 1999)

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

This standard is issued under the fixed designation E 977; 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Terminology

2.1 *Descriptions of Terms:*

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

2.1.2 *comparative instrumentation*—a system that uses electrode assemblies, associated electronics, and known standards to measure a thermoelectric response from a test specimen. 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 metal 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 of the junction between the two. 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 calibrated by placing standards of 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 tested 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 test system and the controls of the instrument are adjusted to obtain a voltage (or arbitrary unit) reading(s). The test is then continued by inserting the pieces to be sorted into the test system, and observing the instrument reading(s).

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

3.2 In both instruments, the range of the instrument response must be adjusted during calibration so that any anticipated deviation from the known standard(s) will be recognized as within the required acceptance limits.

3.3 The testing process may consist of manual insertion of one piece after another into the test system, or an automated feeding and classifying mechanism may be employed.

4. Application

4.1 Thermoelectric techniques provide a method for sorting large quantities of conductive materials. The ability to accomplish satisfactorily these types of separations is dependent upon

[1] This practice is under the jurisdiction of ASTM Committee E-7 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.10 on Emerging NDT Methods.

Current edition approved Jan. 27, 1984. Published May 1984.