



Standard Test Method for Fusibility of Coal and Coke Ash¹

This standard is issued under the fixed designation D 1857; 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 test method covers the observation of the temperatures at which triangular pyramids (cones) prepared from coal and coke ash attain and pass through certain defined stages of fusing and flow when heated at a specified rate in controlled, mildly reducing, and where desired, oxidizing atmospheres.

1.2 The test method is empirical, and strict observance of the requirements and conditions is necessary to obtain reproducible temperatures and enable different laboratories to obtain concordant results.

1.3 The values stated in inch-pound units are to be regarded as the standard.

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. Referenced Documents

2.1 ASTM Standards:

D 2013 Method of Preparing Coal Samples for Analysis²

D 3174 Test Method for Ash in the Analysis Sample of Coal and Coke from Coal²

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 The critical temperature points to be observed are as follows, denoting the atmosphere used:

3.1.2 *fluid temperature, FT*—the temperature at which the fused mass has spread out in a nearly flat layer with a maximum height of $\frac{1}{16}$ in. (1.6 mm) as shown by the fifth cone, FT, in Fig. 1.

3.1.3 *hemispherical temperature, HT*—the temperature at which the cone has fused down to a hemispherical lump at which point the height is one half the width of the base as shown by the fourth cone, HT, in Fig. 1.

3.1.4 *initial deformation temperature, IT*—the temperature at which the first rounding of the apex of the cone occurs. Shrinkage or warping of the cone ignored if the tip remains sharp. In Fig. 1, the first cone shown is an unheated one; the

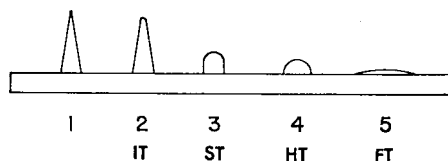


FIG. 1 Critical Temperature Points

second cone IT is a typical cone at the initial deformation stage.

3.1.5 *softening temperature, ST*—the temperature at which the cone has fused down to a spherical lump in which the height is equal to the width at the base as shown by the third cone, ST, in Fig. 1.

4. Significance and Use

4.1 Design of most coal combustion and coal conversion equipment anticipates that the ash either remain solid or assume some degree of fluidity, depending on the particular design. Ash fusibility temperatures predict whether the ash will perform properly in the process for which the coal was chosen.

5. Apparatus and Materials

5.1 *Furnace*—Any gas-fired or electric furnace conforming to the following requirements may be used:

5.1.1 Capable of maintaining a uniform temperature zone in which to heat the ash cones. This zone shall be such that the difference in the melting point of $\frac{1}{2}$ -in. (12.7-mm) pieces of pure gold wire when mounted in place of the ash cones on the cone support shall be not greater than 20°F (11°C) in a reducing atmosphere test run.

5.1.2 Capable of maintaining the desired atmosphere surrounding the cones during heating. The composition of the atmosphere, reducing or oxidizing, shall be maintained within the limits specified in Section 6. The desired atmosphere in the gas-fired furnace surrounding the cones shall be obtained by regulation of the ratio of gas to air in the combustion mixture. The desired atmosphere in the electric furnace shall be obtained by means of gases introduced into the heating chamber. The muffle shall be gas-impervious, free from cracks, and the closure-plug tight fitting. The gas supply tube shall be sealed to the back wall of the preheating chamber and shall not extend to the front of the preheating chamber against the perforated baffle.

5.1.3 Capable of regulation so that the rate of temperature rise shall be $15 \pm 5^\circ\text{F}$ ($8 \pm 3^\circ\text{C}$)/min.

5.1.4 Providing means of observing the ash cones during the heating. Observation on the same horizontal plane as the

¹ This test method is under the jurisdiction of ASTM Committee D-5 on Coal and Coke, and is the direct responsibility of D05.21 on Methods of Analysis.

Current edition approved Feb. 10, 1987. Published April 1987. Originally published as D 1857 – 61 T. Last previous edition D 1857 – 68 (1980)^ε.

² *Annual Book of ASTM Standards*, Vol 05.05.