



Standard Test Method for Determination of TGA CO₂ Reactivity of Baked Carbon Anodes and Cathode Blocks¹

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^{ε1} NOTE—SI unit formatting was corrected editorially in December 2015.

1. Scope

1.1 This test method covers the thermogravimetric (TGA) determination of CO₂ reactivity and dusting of shaped carbon anodes and cathode blocks used in the aluminum reduction industry. The apparatus selection covers a significant variety of types with various thermal conditions, sample size capability, materials of construction, and procedures for determining the mass loss and subsequent rate of reaction. This test method standardizes the variables of sample dimensions, reaction temperature, gas velocity over the exposed surfaces, and reaction time such that results obtained on different apparatuses are correlatable.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *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:²

D6353 Guide for Sampling Plan and Core Sampling for Prebaked Anodes Used in Aluminum Production

D6354 Guide for Sampling Plan and Core Sampling of Carbon Cathode Blocks Used in Aluminum Production

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.05 on Properties of Fuels, Petroleum Coke and Carbon Material.

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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.

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *dusting, n*—that quantity of carbon that falls off the carbon artifact while in the reaction chamber and is collected in the container at the bottom of the reaction chamber.

3.1.2 *final CO₂ reactivity, n*—the mass loss of the carbon artifact during the final 30 min of exposure to CO₂ in the reaction chamber divided by the initial geometric (right cylindrical) exposed surface area of the sample, expressed as milligrams per centimetre squared per hour.

3.1.3 *initial CO₂ reactivity, n*—the mass loss of the carbon artifact during the first 30 min of exposure to CO₂ in the reaction chamber divided by the initial geometric (right cylindrical) exposed surface area of the sample, expressed as milligrams per centimetre squared per hour.

3.1.4 *total CO₂ reactivity, n*—the total mass loss of the carbon artifact (including dusting) during the total time that the sample is exposed to CO₂ (420 min) in the reaction chamber divided by the initial geometric (right cylindrical) exposed surface area of the sample, expressed as milligrams per centimetre squared per hour.

4. Summary of Test Method

4.1 Initial, final, and total CO₂ reactivity and dusting are determined by passing carbon dioxide gas at flow rates giving a standard velocity of reactant gas around cylindrically shaped carbon artifacts under isothermal conditions for a specified length of time. The reactivity is determined by continuously monitoring the sample mass loss. The dusting term is determined by collecting and determining the mass of carbon particles that fall off the sample during reaction.

5. Significance and Use

5.1 The CO₂ reactivity rates are used to quantify the tendency of a carbon artifact to react with carbon dioxide. Carbon consumed by these unwanted side reactions is unavailable for the primary reactions of reducing alumina to the primary metal. CO₂ dusting rates are used to quantify the tendency of the coke aggregate or binder coke of a carbon artifact to selectively react with these gases. Preferential attack