



Designation: D7542 – 21

Standard Test Method for Air Oxidation of Carbon and Graphite in the Kinetic Regime¹

This standard is issued under the fixed designation D7542; 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 recommends a standard procedure for measuring oxidation rates in air of various grades of nuclear graphite and/or manufactured carbon. Following the standard procedure recommended here, one can obtain kinetic parameters that characterize the oxidation resistance in standard conditions of tested materials and that can be used to for materials selection and qualification, and for quality control purposes in the fabrication process.

1.2 This test method covers the rate of oxidative weight loss per exposed nominal geometric surface area, or per initial weight of machined test specimens of standard size and shape, or both. The test is valid in the temperature range where the rate of air oxidation of graphite and manufactured carbon is limited by reaction kinetics.

1.3 This test method also provides a standard oxidation temperature (as defined in 3.1.7), and the kinetic parameters of the oxidation reaction, namely the apparent activation energy and the logarithm of pre-exponential factor in Arrhenius equation. The kinetic parameters of Arrhenius equation are calculated from the temperature dependence of oxidation rates measured over the temperature range where Arrhenius plots (as defined in 3.1.8) are linear, which is defined as the “kinetic” or “chemical control” oxidation regime. For typical nuclear grade graphite materials it was found that the practical range of testing temperatures is from about 500 °C to 550 °C up to about 700 °C to 750 °C.

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

1.5 *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 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.F0 on Manufactured Carbon and Graphite Products.

Current edition approved Nov. 1, 2021. Published November 2021. Originally approved in 2009. Last previous edition approved in 2015 as D7542 – 15. DOI: 10.1520/D7542-21.

1.6 *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. Referenced Documents

2.1 ASTM Standards:²

C559 Test Method for Bulk Density by Physical Measurements of Manufactured Carbon and Graphite Articles

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

E898 Practice for Calibration of Non-Automatic Weighing Instruments

E1582 Test Method for Temperature Calibration of Thermogravimetric Analyzers

E1970 Practice for Statistical Treatment of Thermoanalytical Data

3. Terminology

3.1 Definitions:

3.1.1 Definitions are ordered by oxidation rates first, followed by activation energy as calculated from oxidation rates.

3.1.2 *area-normalized oxidation rate (OR_a)*, n —rate of weight loss due to oxidation of a machined test specimen at a given temperature, divided by the nominal geometric surface area of the specimen.

3.1.2.1 *Discussion*—The rate of weight loss is determined by a linear fit of the weight loss plotted against time in the range from 5 % to 10 % loss of original specimen weight. The units of area-normalized oxidation rate, OR_a , are $g\ h^{-1}\ m^{-2}$.

3.1.3 *weight-normalized oxidation rate (OR_w)*, n —rate of weight loss due to oxidation of a machined specimen at a given temperature, divided by the initial weight of the specimen.

3.1.3.1 *Discussion*—The rate of weight loss is determined by a linear fit of the weight loss plotted against time in the range from 5 % to 10 % loss of original specimen weight. The units of weight-normalized oxidation rate, OR_w , are:

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.

*A Summary of Changes section appears at the end of this standard