



Standard Test Method for Determining the Opacity of a Plume in the Outdoor Ambient Atmosphere¹

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1. Scope

1.1 This test method describes the procedures to determine the opacity of a plume, using digital imagery and associated hardware and software. The aforementioned plume is caused by particulate matter emitted from a stationary point source in the outdoor ambient environment.

1.2 The opacity of emissions is determined by the application of a Digital Camera Opacity Technique (DCOT) that consists of a Digital Still Camera, Analysis Software, and the Output Function's content to obtain and interpret digital images to determine and report plume opacity.

1.3 This method is suitable to determine the opacity of plumes from zero (0) percent to one hundred (100) percent.

1.4 Conditions that shall be considered when using this method to obtain the digital image of the plume include the plume's background, the existence of condensed water in the plume, orientation of the Digital Still Camera to the plume and the sun (see Section 8).

1.5 This standard describes the procedures to certify the DCOT, hardware, software, and method to determine the opacity of the plumes.

1.6 *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

D1356 Terminology Relating to Sampling and Analysis of Atmospheres

¹ This test method is under the jurisdiction of ASTM Committee D22 on Air Quality and is the direct responsibility of Subcommittee D22.03 on Ambient Atmospheres and Source Emissions.

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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.

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

2.2 *U.S. Environmental Protection Agency (USEPA) Document:*³

USEPA Method 9 Visual Determination of the Opacity of Emissions from Stationary Sources, 40 CFR, Part 60, Appendix A-4

2.3 *Institute of Electrical and Electronics Engineers (IEEE) Document:*⁴

IEEE 12207-2008 Systems and Software Engineering—Software Life Cycle Processes (ISO/IEC 12207:2008(E)), Edition: 2nd, Institute of Electrical and Electronics Engineers, 01-Feb-2008, 138 pages, ISBN: 9780738156637

2.4 *Japanese Electronic and Information Technology Industries Association (JEITA) Document:*

Exchangeable Image File Format (EXIF) for Digital Still Cameras Joint Photographic Experts Group: JPEG file format version 2.21, JEITA CP-3451-1 (English version) dated 2003-09⁵

2.5 *International Organization for Standardization (ISO) Standard:*⁶

ISO 9001:2000(s) Quality Management Systems – Requirements

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, refer to Terminology **D1356**.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *analysis software*—software that when combined with a defined operating environment: (a) inputs images captured by the Digital Still Camera image capture devices; (b) produces opacity measurements from the combination of human

³ Available from United State Environmental Protection Agency (USEPA), Ariel Rios Bldg, 1200 Pennsylvania Ave., NW, Washington, DC 20460, <http://www.epa.org>.

⁴ Available from Institute of Electrical and Electronics Engineers, Inc., (IEEE), 1828 L St., NW, Suite 1202, Washington, DC 20036-5104, <http://www.ieee.org>.

⁵ Available from <http://www.jeita.or.jp/english/standard/list/list.asp?catid=1&subcatid=4>.

⁶ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.