



# National Institute of Standards & Technology

## Certificate

### Standard Reference Material<sup>®</sup> 1006d

#### Smoke Density Chamber Standard for Non-flaming Exposure Condition

This Standard Reference Material consists of paper sheets, principally  $\alpha$ -cellulose, derived from wood chips. The SRM is intended primarily for checking the operation of smoke density chambers under non-flaming exposure conditions in accordance with the prescribed calibration and standardization techniques outlined in the American Society for Testing and Materials (ASTM) Standard Test Method E 662-95 "Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials" [1], and in National Fire Protection Association (NFPA) 258-1998, "Standard Research Test Method for Determining Smoke Generation of Solid Materials" [2]. A unit consists of nine single layer sheets, each 172 mm x 254 mm x 165 mm thick.

The certified value and expanded uncertainty [3] for maximum specific optical density of a single layer thickness is:

$$\begin{aligned}D_m &= 210 \pm 18 \text{ (without correction for window deposit)} \\D_{m \text{ corr.}} &= 193 \pm 20\end{aligned}$$

**Expiration of Certification:** The certification of this SRM is valid indefinitely within the measurement uncertainties specified, provided the SRM is stored and handled in accordance with the Storage and Caution to User sections of this certificate. This material degrades with exposure to humidity and light. If exposure has occurred or is suspected, discontinue use.

**Certified Values and Uncertainties:** The certified values and uncertainties are the result of 30 tests on **single** layer thickness of representative samples of the SRM lot. A **single** 76.2 mm x 76.2 mm x 1.65 mm sheet was used for each test. The series of 30 tests resulted in a mean maximum specific optical density,  $D_m$ , of 210 with a standard deviation of 8, when uncorrected for window deposit, and a mean corrected maximum specific optical density,  $D_{m \text{ corr.}}$ , of 193 with a standard deviation of 9.

The uncertainty analysis included component standard uncertainties for repeatability, chart recorder reading, pathlength, sample thickness, distance from heater to sample, photometric system, radiant flux, sample area, chamber volume, chamber temperature, and chamber pressure. After estimating uncertainties by either Type A or B analysis, the uncertainties were combined in quadrature to yield the combined standard uncertainty. Multiplying the combined standard uncertainty by a coverage factor of two results in the expanded uncertainty which corresponds to a 95 % confidence interval ( $2\sigma$ ). The total expanded uncertainties for  $D_m$  and  $D_{m \text{ corr.}}$  were 18 and 20 respectively.

Engineering testing and statistical analysis leading to the certification of this SRM were performed by N.P. Bryner, J. Lee, and R.L. Vettori of the NIST Fire Safety Engineering Division.

The support aspects involved in the certification and issuance of this SRM were coordinated through the NIST Standard Reference Materials Program by R.J. Gettings.

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**NIST Measurement Procedure:** Tests of optical density were conducted in a commercially available smoke density chamber. Smoke density measurements were made under non-flaming exposure conditions in accordance with the detailed procedure given in ASTM Standard E 662-95, and in NFPA Standard 258-1998.

**Caution to User:** Prior to test, the material must be dried for 24 h at 60 °C and then conditioned to equilibrium at 23 °C ± 3 °C and 50 % ± 5 % relative humidity.

**Storage:** SRM 1006d is packaged in a resealable light-resistant bag purged with nitrogen to protect against humidity and light. When not in use, the unused sheets inside the original packaging should be stored in a cool, dry environment, or in a manner that assures protection against humidity and light.

#### REFERENCES

- [1] ASTM Standard E 662-95, "Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials," Annual Book of Standards, Vol. 04.07, ASTM, West Conshohocken, PA, (1995).
- [2] NFPA Standard 258-1998, "Standard Research Test Method for Determining Smoke Generation of Solid Materials," National Fire Codes, Vol. 6, 1997 Ed., National Fire Protection Association, Quincy, MA, pp. 258-1 to 258-19, (1998).
- [3] *Guide to the Expression of Uncertainty in Measurement*, ISBN 92-67-10188-9, 1st Ed. ISO, Geneva, Switzerland, (1993); see also Taylor B.N. and Kuyatt, C.E., "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results," NIST Technical Note 1297, U.S. Government Printing Office, Washington DC, (1994); (available at <http://physics.nist.gov/Pubs/>).

*Users of this SRM should ensure that the report in their possession is current. This can be accomplished by contacting the SRM Program at: Telephone (301) 975-6776 (select "Certificates"), Fax (301) 926-4751, e-mail [srminfo@nist.gov](mailto:srminfo@nist.gov), or via the Internet <http://ts.nist.gov/srm>.*