



# National Institute of Standards & Technology

## Certificate of Analysis

### Standard Reference Material<sup>®</sup> 1358a

#### Coating Thickness Standard

#### (Nonmagnetic Coating on Steel)

#### Set Serial No. Sample

This Standard Reference Material (SRM) is designed for calibrating coating thickness gauges that employ magnetic principles. These gauges are used to measure the thickness of nonmagnetic coatings on steel including paint and other organic coatings, as well as nonmagnetic metallic coatings. A unit of SRM 1358a consists of a preconfigured set of four 45 mm × 45 mm coupons: a bare substrate, and three coupons with metallic coatings certified for total coating thickness (nominal coating thicknesses of 80 μm, 255 μm, and 1000 μm). Each coupon consists of an AISI 1010 cold-rolled sheet-steel substrate with the coated coupons possessing an additional uniform coating of copper that is overlaid with a thin protective layer of chromium. This SRM is one in a series of SRMs prepared to cover a coating thickness range from 6 μm to 1935 μm.

**Certified Coating Thickness Values:** Certified coating thickness values are provided in Table 1. A NIST certified value is a value for which NIST has the highest confidence in its accuracy in that all known or suspected sources of bias have been investigated or taken into account [1]. The analytical methods used for the characterization and subsequent certification of this SRM included flame atomic absorption spectrometry, optical microscopy, and magnetic induction. The resulting certified values are based upon results from the magnetic induction method and are reported as the mean coating thickness of each coupon of the SRM unit. The uncertainty in the certified value for each coupon is expressed as the expanded uncertainty,  $U$ , of the mean at the 95 % level of confidence and is calculated according to the GUM Guide [2], where  $U = ku_c$ , with a coverage factor,  $k = 2$ , and  $u_c$ , a combined uncertainty including the estimated uncertainty of the primary standards and the imprecision of the intercomparison of the primary standards to the coupon.

**Information Coating Thickness Values:** Information coating thickness values reported in Table 2 were obtained by converting the coating thickness values reported in micrometers from Table 1 to mils. An information value is considered to be a value that will be of interest to the SRM user, but insufficient information is available to assess the uncertainty associated with the value.

Certified and information coating thickness values listed in Tables 1 and 2 of this certificate are considered the official values, should a discrepancy exist between the values listed in the certificate and the label affixed to the sleeve holding the coupon.

**Expiration of Certification:** The certification of **SRM 1358a** is valid indefinitely, within the uncertainty specified, provided the SRM is used infrequently as a primary standard and the unit is handled and stored in accordance with the guidelines given in this certificate (see "Notice and Warnings to Users"). The wear induced by the contact measurement of the magnetic gauges will alter the thickness values stated in this certificate. The frequency of replacement or verification of this SRM is determined by the user, based upon the number of uses and the severity of wear. If excessive wear is suspected, the SRM may be returned to NIST for verification. To verify certification of this SRM unit, contact the NIST Thin Film and Nanostructure Processing Group by e-mail at [Coating.Thickness@nist.gov](mailto:Coating.Thickness@nist.gov), by telephone at (301) 975-6400, or by fax at (301) 926-7679.

**Maintenance of SRM Certification:** NIST will monitor this SRM over the period of its certification. If substantive technical changes occur that affect the certification, NIST will notify the purchaser. Registration (see attached sheet) will facilitate notification.

Eric K. Lin, Chief  
Materials Science and Engineering Division

Gaithersburg, MD 20899  
Certificate Issue Date: 24 May 2013  
*Certificate Revision History on Last Page*

Robert L. Watters, Jr., Director  
Office of Reference Materials

The overall direction of the technical measurements leading to the certification of this SRM was provided by C.R. Beauchamp of the Thin Film and Nanostructure Processing Group of the NIST Materials Science and Engineering Division.

This SRM was produced by D.R. Kelley and measured by H.B. Gates of the Thin Film and Nanostructure Processing Group of the NIST Materials Science and Engineering Division.

Statistical analysis was provided by S.D. Leigh of the NIST Statistical Engineering Division.

Support aspects involved in the issuance of this SRM were coordinated through the NIST Office of Reference Materials.

## NOTICE TO USERS

**Notice to users:** This SRM should not be left unprotected in a corrosive laboratory environment or undergo any treatment that would scratch or remove material from the surface of the coupon. The surfaces of these coupons require careful preservation and care during storage and use in order to maintain the stated coating thickness within the uncertainty reported on this certificate. The SRM unit may be cleaned with ethyl alcohol and soft wipe materials. The surface polish should be protected from abuse. The certification is nullified if the coupons are repolished.

**Instrument Calibration:** The current published standard magnetic methods for measuring coating thicknesses [3,4] should be used as guidelines to maximize the accuracy in coating thickness measurements. In general, it is not possible for the user to achieve the same uncertainty as reported in Table 1 of this certificate when using magnetic-type coating thickness gauges calibrated with this SRM. The overall uncertainty of the measurement by the user will include the contribution due to the uncertainty of this SRM, as well as the uncertainty inherent in the measurements performed by the user. The standard deviation of the measurements performed during the certification process is listed on the label affixed to the sleeve containing each coupon. It is reported to enable the user to gauge the contribution due to non-uniformity of the coating, since this will be a major contributor to the uncertainty of the values. This standard deviation should not be used when performing an error analysis. Instead, the user is instructed to use the expanded uncertainty listed in Table 1, since all known or suspected sources of bias have been investigated or taken into account in this uncertainty.

Table 1. Certified Coating Thickness Values for Each Coupon

Individual Coupon Serial Number	Certified Coating Thickness Values ( $\mu\text{m}$ )
22222222222	$77.0 \pm 1.2$
33333333333	$249.7 \pm 3.7$
44444444444	$902.5 \pm 9.0$

Table 2. Information Coating Thickness Values for Each Coupon

Individual Coupon Serial Number	Coating Thickness (mils)
22222222222	$\approx 3.03$
33333333333	$\approx 9.83$
44444444444	$\approx 35.53$

Assembly Date: Wednesday, July 28, 1999

All sets also include an uncoated steel coupon that originated from the same lot of the steel used as the substrate for these SRMs. The coupon is intended for instruments that have the capability of adjusting their internal calibration based on the substrate material used. When applicable, please refer to the appropriate manufacturer's instrument manual for instructions on how to perform the adjustment.

## REFERENCES

- [1] May, W.; Parris, R.; Beck II, C.; Fassett, J.; Greenberg, R.; Guenther, F.; Kramer, G.; Wise, S.; Gills, T.; Colbert, J.; Gettings, R.; MacDonald, B.; *Definitions of Terms and Modes Used at NIST for Value-Assignment of Reference Materials for Chemical Measurements*; NIST Special Publication 260-136; U.S. Government Printing Office: Washington, DC (2000); available at: <http://www.nist.gov/srm/publications.cfm> (accessed May 2013).
- [2] JCGM 100:2008; *Evaluation of Measurement Data - Guide to the Expression of Uncertainty in Measurement*; (GUM 1995 with Minor Corrections), Joint Committee for Guides in Metrology (JCGM) (2008); available at [http://www.bipm.org/utis/common/documents/jcgm/JCGM\\_100\\_2008\\_E.pdf](http://www.bipm.org/utis/common/documents/jcgm/JCGM_100_2008_E.pdf) (accessed May 2013); see also Taylor, B.N.; 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://www.nist.gov/pml/pubs/index.cfm> (accessed May 2013).
- [3] ASTM B 499; *Standard Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals*; Annu. Book of ASTM Stand., Vol. 02.05.
- [4] ISO 2178; *Nonmagnetic Coatings on Magnetic Substrate-Measurement of Coating Thickness-Magnetic Method*; available at <http://www.ansi.org/> (accessed May 2013).

<p><b>Certificate Revision History:</b> <b>24 May 2013</b> (Revision history corrected; editorial changes); <b>19 October 2012</b> (Moved coating thickness information values [in mils] in Table 1 to a new table [Table 2] and removed the uncertainty; added additional reference; editorial changes); <b>17 September 1999</b> (Editorial changes); <b>18 June 1999</b> (Original certificate date).</p>
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*Users of this SRM should ensure that the Certificate of Analysis in their possession is current. This can be accomplished by contacting the SRM Program: telephone (301) 975-2200; fax (301) 948-3730; e-mail [srminfo@nist.gov](mailto:srminfo@nist.gov); or via the Internet at <http://www.nist.gov/srm>.*