



Certificate of Analysis

Standard Reference Material[®] 2723b

Sulfur in Diesel Fuel Oil (Nominal Mass Fraction 10 mg/kg)

This Standard Reference Material (SRM) is intended for the evaluation of methods and the calibration of instruments used in the determination of total sulfur in fuel oils or materials of similar matrix. SRM 2723b is a commercial “No. 2-D” distillate fuel oil as defined by ASTM D 975-11 *Standard Specification for Diesel Fuel Oils* [1]. A unit of SRM 2723b consists of a 100 mL bottle of diesel fuel oil.

Certified Mass Fraction Value: A NIST certified value is a value in 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 [2]. For this SRM, the certified value is the present best estimate of the true value based on the results of analyses performed at NIST using instrumental and classical test methods. The measurand is the sulfur content. Metrological traceability is to the SI derived units of mass fraction [3] (expressed as milligrams per kilogram). The certified value for the sulfur content in SRM 2723b is as follows:

Sulfur Mass Fraction: 9.06 mg/kg \pm 0.25 mg/kg

Value Assignment: A Bayesian statistical analysis was used to establish the certified value and its expanded uncertainty, U , from analyses of the material using wavelength dispersive X-ray fluorescence spectrometry and isotope dilution inductively coupled plasma mass spectrometry, resulting in a symmetric 95 % probability interval for the certified sulfur mass fraction [4]. Although the expanded uncertainty of the certified value was not computed using the methods outlined in the ISO/JCGM Guide [5], the uncertainty from the Bayesian analysis can be interpreted similarly to results from the ISO/JCGM approach. For this purpose, the expanded uncertainty can be expressed as $U = ku_c$, where $u_c = 0.125$ mg/kg is the combined standard uncertainty, and the coverage factor, $k = 2$, is determined from the normal distribution.

Homogeneity Assessment: Homogeneity testing was performed using wavelength dispersive X-ray fluorescence spectrometry. An analysis of variance did not show inhomogeneity for the test portions analyzed.

Expiration of Certification: The certification of **SRM 2723b** is valid, within the measurement uncertainty specified, until **01 October 2021**, provided the SRM is handled and stored in accordance with the instructions given in this certificate (see “Instructions for Storage, Handling, and Use”). The certification is nullified if the SRM is damaged, contaminated, or otherwise modified.

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

The coordination of technical measurements for certification was performed by J.L. Molloy and G.C. Turk of the NIST Chemical Sciences Division.

Analyses leading to the certification of this SRM were performed by S.J. Christopher and J.L. Molloy of the Chemical Sciences Division and Renata Amais (NIST Guest Researcher) of the Federal University of São Carlos, Brazil.

Data for physical properties and carbon and hydrogen mass fractions were provided by an ASTM round robin and SGS Baltimore (Baltimore, MD), respectively.

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

Statistical consultation for this SRM was provided by S. Lund of the NIST Statistical Engineering Division.

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

INSTRUCTIONS FOR STORAGE, HANDLING, AND USE

Each SRM bottle should only be opened for the minimum time required to dispense the material. To relate analytical determinations to the certified value in this Certificate of Analysis, a minimum sample mass of 150 mg should be used. The SRM should be stored under normal laboratory conditions away from direct sunlight.

SUPPLEMENTAL INFORMATION

The physical property values given below are NOT certified but are provided as additional information on the diesel fuel matrix.

Table 1. Physical Properties of and Mass Fractions of Hydrogen and Carbon in SRM 2723b

Test	ASTM Method	Value
Density at 60 °F	D 1298	35.12 API
Flash Point	D 93	68 °C
Viscosity, Kinematic at 40 °C	D 445	$2.757 \times 10^{-6} \text{ m}^2/\text{s}$
Hydrogen	D 5291	13.3 % (mass fraction)
Carbon	D 5291	87.0 % (mass fraction)

ASTM METHODS USED FOR PHYSICAL TESTS

D 1298-99 (2005)	Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
D 93 - 10a	Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester Test Method for Flash Point by Tag Closed Tester
D 445-06	Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)
D 5291-10	Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants

REFERENCES

- [1] ASTM D 975-11, *Standard Specification for Diesel Fuel Oils*; Annual Book of ASTM Standards, Vol. 05.01, West Conshohocken, PA (2011).
- [2] May, W.; Parris, R.; Beck, 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/upload/SP260-136.PDF> (accessed Nov 2015).
- [3] Thompson, A.; Taylor, B.N.; *Guide for the Use of the International System of Units (SI)*; NIST Special Publication 811; U.S. Government Printing Office: Washington, DC (2008); available at http://www.nist.gov/customcf/get_pdf.cfm?pub_id=200349 (accessed Nov 2015).
- [4] Gelman, A.; Carlin, J.B.; Stern, H.S.; Rubin, D.B.; *Bayesian Data Analysis*; Chapman and Hall, London, (1995).
- [5] 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/utls/common/documents/jcgm/JCGM_100_2008_E.pdf (accessed Nov 2015); 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/tn1297/index.cfm> (accessed Nov 2015).

Certificate Revision History: 03 November 2015 (Corrected density temperature scale in Table 1; editorial changes); 18 June 2013 (Original certification date).

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; or via the Internet at <http://www.nist.gov/srm>.