National Institute of Standards and Technology
U.S. Department of Commerce

Date of Issue:
22 May 2023

Standard Reference Material® 2723b

Sulfur in Diesel Fuel Oil

(Nominal Mass Fraction 10 mg/kg)

CERTIFICATE OF ANALYSIS

Purpose: 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.

Description: SRM 2723b is a commercial "No. 2-D S15" distillate fuel oil as defined by ASTM D 975-22a *Standard Specification for Diesel Fuel* [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 ± 0.25 mg/kg

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.

Additional Information: Values of potential interest and additional information is provided in Appendix A.

Period of Validity: The certified value delivered by **SRM 2723b** is valid within the measurement uncertainty specified until **31 December 2029**. The certified value is nullified if the material is stored or used improperly, damaged, contaminated, or otherwise modified.

Maintenance of Certified Values: NIST will monitor this SRM over the period of its validity. If substantive technical changes occur that affect the certification, NIST will issue an amended certificate through the NIST SRM website (https://www.nist.gov/srm) and notify registered users. SRM users can register online from a link available on the NIST SRM website or fill out the user registration form that is supplied with the SRM. Registration will facilitate notification. Before making use of any of the values delivered by this material, users should verify they have the most recent version of this documentation, available through the NIST SRM website (https://www.nist.gov/srm).

Carlos A. Gonzalez, Chief
Chemical Sciences Division

Steven J. Choquette, Director
Office of Reference Materials

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Safety: Please consult the Safety Data Sheet provided with this material.

Storage: The SRM should be stored under normal laboratory conditions away from direct sunlight.

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.

REFERENCES

[1] ASTM D 975-22a, *Standard Specification for Diesel Fuel*; Annual Book of ASTM Standards, Vol. 05.01, West Conshohocken, PA (2022).

[2] Epstein, M.S.; Kline, M.C.; Lippa, K.A.; Lucon, E.; Molloy, J.; Nelson, M.A.; Phinney, K.W.; Polakoski, M.; Possolo, A.; Sander, L.C.; Schiel, J.E.; Sharpless, K.E.; Toman, B.; Winchester, M.R.; Windover, D.; *Metrological Tools for the Reference Materials and Reference Instruments of the NIST Material Measurement Laboratory*; NIST Special Publication 260-136, 2021 edition; U.S. Government Printing Office: Washington, DC (2021); available at https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.260-136-2021.pdf (accessed May 2023).

[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 https://physics.nist.gov/cuu/pdf/sp811.pdf (accessed May 2023).

[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 https://www.bipm.org/en/committees/jc/jcgm/publications (accessed May 2023); 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 https://www.nist.gov/pml/nist-technical-note-1297 (accessed May 2023).

Certificate Revision History: 22 May 2023 (Updated period of validity; updated format; editorial changes); 3 November 2015 (Corrected density temperature scale in Table 1; editorial changes); 18 June 2013 (Original certification date).

Certain commercial equipment, instruments, or materials may be identified in this Certificate of Analysis to adequately specify the experimental procedure. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.

Users of this SRM should ensure that the Certificate of Analysis in their possession is current. This can be accomplished by contacting the Office of Reference Materials 100 Bureau Drive, Stop 2300, Gaithersburg, MD 20899-2300; telephone (301) 975-2200; e-mail srminfo@nist.gov; or the Internet at https://www.nist.gov/srm.

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APPENDIX A

Table A1. Physical Properties 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	2.757×10^{-6} m^2/s
Hydrogen	D 5291	13.3 % (mass fraction)
Carbon	D 5291	87.0 % (mass fraction)

Table A2. 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

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.

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