National Institute of Standards and Technology

Sample Certificate

Standard Reference Material® 2522

Pin Gage Standard for Optical Fiber Ferrules

Serial Number: _____

This Standard Reference Material (SRM) is intended primarily for use in calibrating instruments which measure small diameter artifacts, such as pin gages, used for optical fiber ferrule hole calibration. Each SRM unit is individually certified and consists of a 60 mm long steel wire. The diameter of the central 10 mm region of the wire has been measured and certified to the value listed on this certificate.

Certified diameter (for the central 10 mm region):

_____ µm ± 0.042 µm

Expiration of Certification: The period of certification for this SRM is two years from the date of shipment if proper handling, storage, and measurement procedures are followed under the proper conditions. After this time period, the SRM will need to be replaced or may be returned to NIST for verification. To verify certification of this SRM 2522 unit, contact the NIST Calibration Program Office at (301) 975-2002.

Discussion of Uncertainties: The uncertainty assigned to the certified value for this SRM unit was calculated according to the procedures outlined in Reference [1,2]. Readily measured (Type A) uncertainties were assumed to be normally distributed. Estimated (Type B) uncertainties were assumed to be described by a rectangular probability distribution function. These uncertainties were combined by adding their variances in quadrature, where the variance of a rectangular distribution is one-third the square of its half-width. Table 1 lists all identifiable sources of uncertainty.

Description of SRM: The SRM unit is a 52100 hardened steel wire that has been specially selected to minimize fluctuations of diameter, taper, and roundness over the certified portion. Each unit has been measured at various positions along and around the central 10 mm region, and an average diameter is reported from these measurements.

The wire samples used in the production of SRM 2522 were donated by Van Keuren, Framingham, MA.

The technical direction, measurement process development and analysis, and physical measurements leading to certification were provided by T.D. Doiron and J.R. Stoup of the NIST Precision Engineering Division.

The graphical method of analysis used in this certification was developed by M. Young of the NIST Optoelectronics Division.

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

Gaithersburg, MD 20899
Thomas E. Gills, Chief
Standard Reference Materials Program
(Revision of certificate dated 3-7-96)

Determination of Pin Gage Diameter: The diameter of each SRM 2522 unit has been measured according to the method described in Reference [3]. At each load, nine measurements were made using a contact laser micrometer at three separate positions along the certified region; the middle of the wire, and at 5 mm on either side of this central position. At each of the three positions, the diameter was measured at four or more places along the circumference to determine roundness characteristics. This measurement process was repeated at various loads and the final undeformed diameter was determined by projecting the result to zero load. No attempt was made to locate the maximum or minimum diameter positions on each wire.

Instructions for Use: The SRM can be used at any position along the central 10 mm region. However, repeated use of the same exact position on the wire is not recommended as it will cause wear at this position. For best results, the SRM should be used at random positions within the certified 10 mm area in order to extend the life of the SRM and to properly include the variations in diameter of the standard.

CAUTION: This SRM should not be subjected to measurement configurations that may result in application of instantaneous loads exceeding 2.2 N (7.9 oz), or permanent damage may result.

Handling and Care: Handling of the SRM must be carefully controlled. The wire is flexible; however, since it is steel, it can be permanently bent or deformed. Care must be taken when moving the SRM around the laboratory and during positioning in the test equipment to avoid deformation. The SRM should not be dropped or touched within the certified area of the wire.

The SRM **is also subject to rust.** Therefore, the wire should be carefully cleaned with isopropol

alcohol or acetone **before and after** each use. It is recommended to carefully coat the SRM with a clean light oil for long term storage. If the laboratory atmosphere in which the SRM is used is subject to humidity levels above 45 %, the SRM should also be coated with oil, placed in its case, and the case then placed inside an airtight plastic bag between uses. This will inhibit corrosion from forming on the wire surface.

Table 1. Uncertainty Budget

Source of Uncertainty	Analysis Method	1 sigma Equivalent Value (nm)
Wire geometry: central 10 mm	rectangular dist. of data	18
Wire geometry: central 5 mm	rectangular dist. of data	13
Elastic deformation correction	slope analysis	5
Laser wavelength	2×10^{-8} m	<0.1
Index of refraction equation	uncertainty of calculation	<0.1
Temperature measurement	± 0.02 deg C	<0.1
Air pressure measurement	± 10 Pa	<0.1
Vapor pressure measurement	± 5 %	<0.1
Instrument motion error	pitch error < 0.1"	0.1
Abbe offset	0.5 mm x < 0.1"	0.1
Micrometer contact geometry	rectangular dist. of contact form errors	10
Thermal expansion uncertainty*	[(0.5 ppm)(0.1 deg C) L] = 0.05 L	<0.1

Thermometer calibration	rectangular dist. of 0.02 deg C range	0.1
Combined uncertainty	u_c (central 10 mm)	21
Combined uncertainty	u_c (central 5 mm)	17
Expanded uncertainty	k = 2 (central 10 mm)	42
Expanded uncertainty	k = 2 (central 5 mm)	34

*L = diameter of wire SRM unit

REFERENCES

[1] 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, D.C., (1994).

[2] *Guide to the Expression of Uncertainty in Measurement*, ISBN 92-67-10188-9, lst Ed. ISO, Geneva, Switzerland, (1993).

[3] Young, M., Mechels, S.E., and Hale, P.D., "Optical Fiber Geometry: Accurate Measurement of Cladding Diameter," J. Res. Natl. Inst. Stand. Technol., Vol. **98**, pp. 203-216, (1993).

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