



National Institute of Standards & Technology

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)

$$\mu\text{m} \pm 0.042 \mu\text{m}$$

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 have the certification of SRM 2522 unit verified contact the Office of Physical Measurement Services 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]. 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 is a 52100 hardened steel wire that has been specially selected to minimize fluctuations of diameter, taper, and roundness over the certified portion. Each wire 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 comprising 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 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
March 7, 1996

Thomas E. Gills, Chief
Standard Reference Materials Program

Determination of Pin Gage Diameter: The diameter of each SRM 2522 unit has been measured using a contact laser micrometer. At each load, nine measurements were made 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 (8 ounces), 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 isopropyl alcohol or acetone before and after each use. It is recommended to carefully coat the SRM with a clean light oil also, if the laboratory atmosphere in which the SRM is stored is subject to humidity levels above 45 %, it is recommended that between uses, the SRM be coated with a clean light oil and stored in its case. This will inhibit corrosion from forming on the wire surface. The case should then be placed inside an airtight plastic bag.

| Table 1. Uncertainty Budget | | |
|--------------------------------|---|-------------------------------------|
| Source of Uncertainty | Analysis Method | 1 σ Equivalent Value (in nm) |
| Wire geometry: central 10 mm | rectangular dist. of data | 18 |
| 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 °C | <0.1 |
| Air pressure measurement | ± 10 Pa | <0.1 |
| Vapor pressure measurement | ± 5 % | <0.1 |
| Instrument motion error | pitch error < .1 sec | 0.1 |
| Abbe offset | 0.5 mm x <.1 sec | 0.1 |
| Micrometer contact geometry | rectangular dist. of contact form errors | 10 |
| Thermal expansion uncertainty | $[(0.5 \text{ ppm})(.1^\circ\text{C}) L] = .05 L$ | <0.1 |
| Thermometer calibration | rectangular dist. of 0.02 °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 |

REFERENCE

- [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).