U. S. Department of Commerce
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Secretary

National Bureau of Standards
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National Bureau of Standards

Certificate

Standard Reference Material 2083

Socketed Ball Bar

Set No.

This Standard Reference Material (SRM) is designed for application in measuring the performance of coordinate measuring machines (CMM's) in accordance with the proposed ASME Standard B89.1.12. [1]

SRM 2083 is a socketed ball bar set comprised of a set of three precision balls, pinned and cemented onto threaded shafts, one table-mount magnetic socket, one ram-mount magnetic socket, and five partially-insulated extension tubes of lengths 50, 100, 200, 400, and 800 millimeters. The assembly of two balls and any of the thirty-three possible combinations of extension tubes provide ball bar measuring lengths from 100 to 1650 millimeters, in 50 millimeter increments. The nominal coefficient of thermal expansion of the steel extension tubes is 11.5 x 10 °C (±10 percent).

The performance evaluation of a CMM using SRM 2083 depends on many factors (see Reference 1). Among these factors are the roundness of the balls and truth of rotation of the balls in their magnetic sockets. The balls furnished with this SRM have been measured for roundness after each ball was pinned and cemented to its shaft and thermally cycled for ten days. The deviation from roundness for each ball is less than 0.25 micrometers (10 microinches) around three diameters.

Three roundness traces for each ball accompany this Certificate. Trace number 1 is an equatorial trace, with the "south pole" of the ball defined by the shaft and the ball front defined by the ball number stamped in the shaft. Trace number 2 is as nearly circumpolar as practical, making its nearest approach to the "south pole" in the front of the ball. Trace number 3 is similar to trace number 2, but it makes its nearest approach to the "south pole" in the back of the ball. These traces, though not required by ASME Standard B89.1.12, provide a reference for precise verification of continued ball roundness and, in situations where the magnetic sockets are not utilized, provide the user with assurance that the true ball center may be readily obtainable from a minimal number of measurements.

Besides the measurements for ball roundness, each ball is subjected to a functional test in the magnetic sockets. The combination of ball and socket is certified to provide effective ball rotation about a point with measured deviations less than 0.25 micrometers (10 microinches) measured by contacting the ball with an indicator, as it is rotated through its full range of possible orientations.

The detailed method for use of the socketed ball bar in testing the performance of CMM's is provided in Section 5.5 of ASME Standard B89.1.12. Additional information on socketed ball bars has been published separately by Bryan [2] and Kunzmann. [3]

The design of NBS SRM 2083 was developed by R.J. Hocken, T. Charlton, and W.C. Haight, of the NBS Automated Production Technology Division, and S. Gerner, S. Wiser, and M. Osti, of the NBS Fabrication Technology Division.

The ball roundness was measured by S. Gerner and J. Zimmerman of the Automated Production Technology Division, using a roundness measuring instrument.

Final functional testing and quality assurance was performed by J. Zimmerman.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R. W. Seward.

Gaithersburg, MD 20899
August 8, 1985
(Revision of Certificate
dated 12-19-83)

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

(Over)

Recertification of this SRM is not required by ASME Standard B89.1.12. NBS recommends that the truth of rotation of the balls in the sockets be tested before each use and that the SRM be recertified if the deviation measured exceeds one half of the working tolerance of the machine under test.

References

1. Proposed Standard for Performance Evaluation of Coordinate Measuring Machines, B89.1.12M, The American Society of Mechanical Engineers, New York, N.Y.
2. Bryan, J.B., Precision Engineering, Vol. 4, No. 2 (April 1982), Butterworth Scientific Ltd., Guildford, Surrey, U.K.
3. Kunzmann, H., Waldele, F., CIRP Annals, 1983, Hallwag Ltd., Berne, Switzerland.