

**Procedure Title:** Mechanical Calibration of Thread Wires and Cylinders (11010)  
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## **1.0 Scope**

The procedure is designed to provide a checklist of the proper steps in calibrating thread wires and cylinders by mechanical comparison to NIST Masters. This calibration is limited to diameter standards of 1 inch (25.4mm) and under.

## **2.0 References**

- (1) Stoup, John. Assembly & Operations Manual for Laser Micrometer; Vol. 1, September 6, 1995. NIST
- (2) HP 5528A Laser Measurement System Service Manual
- (3) Zimmerman, Jay H. The NIST Gage Block Calibration Software Systems User's Manual, NISTIR 6387
- (4) Doiron, Ted and John Stoup. Uncertainty and Dimensional Calibrations. Journal of Research of the National Institute of Standards and Technology; Vol. 102, Number 6, November-December 1997.

## **3.0 Equipment**

- Laser Micrometer
- Cylindrical Masters
- Holding Trays
- Cleaning Towels
- 0.01°C Temperature Indicator

## **4.0 General**

All customer artifacts are unpacked and logged into the MEL Calibration Database prior to beginning measurements. After a test folder is received the calibration may be started. Cylindrical artifacts are listed as various items; thread wires, pin gages, plug gages, and cylinders. For the purpose of this procedure all artifacts will be referred to a cylindrical since they are all cylindrical in nature and a measurement of diameter is being performed.

## **5.0 Calibration**

- 5.1 Clean all cylinders with alcohol and lint free tissue and place them in the appropriate holding trays to allow for thermalization. Since nearly all cylinders are steel and this calibration is for those 25.4 mm and under, a couple of hours is sufficient time.
- 5.2 Create a set up file using the SETUP Program in the WIRE software (reference NISTIR 6387). Be sure to include all sizes and select the particular type of wire or cylinder that these artifacts are. Generally, method 3 or 5 is used for measurement 3 or 4 cylinders (2 masters, 1 customer or 2 masters, 2 customers) with 4 measurements each. Save the file with a sensible name (preferably the set serial number) with a maximum of 8 characters.
- 5.3 Clean the flat contact and the cylinder with alcohol and lint free tissue. An air puffer can be used to remove dust.
- 5.4 Check the contact alignment using a small master (the 20 pitch is sufficient). Observe the variation in laser reading with the wire at various positions horizontally between the contacts. The alignment should be better than 50 nanometers from top to bottom. If the alignment is not satisfactory make the appropriate adjustment according to the Assembly & Operations Manual for Laser Micrometer, or seek assistance from the lab manager.
- 5.5 Obtain a pressure reading from one of the barometers in the labs nearby. Use the pressure and temperature to find the V.O.L. compensation factor from the chart located in the Assembly & Operations Manual for Laser Micrometer. Input this value into the laser.
- 5.6 Be sure that the laser system is set up to measure in the metric system with a resolution of 5 decimal places (maximum obtainable). Also check that the part coefficient of expansion is at 0.0 for the laser since the temperature corrections are made in the measurement software.
- 5.7 Using the WIRE program in the WIRE software, select the previously made set up file.
- 5.8 Input the force to be used. Typically 3 ounces is used for the majority of the cylindrical measurements but more or less may be used as needed.
- 5.9 Input the temperature of the cylinders. The thermocouple to be read should be near the micrometer and inside a steel gage block. Make the appropriate temperature corrections from the digital readout and enter the temperature into the computer.
- 5.10 Follow the measurement sequence indicated by the software and be sure to use the proper master the program calls for. *Note: The program will call to use master that are closest to the size you are measuring.*
- 5.11 Measure the cylinders midway between the ends. In the case of a cylinder with a marked diameter, only measure along that diameter. For cylinders without a marked diameter, each of the measurements throughout the measurement scheme should be along a different diameter so that an average value midway between the ends can be reported. *Note: Some of the larger master have marked diameters and should only be measured along the marked diameter.*
- 5.12 Measure all cylinders in the set. Cylinders do not have to be measured in order of size, but make sure the program is expecting the size to be measured.

- 5.13 Check the history of the cylinders using the HISTORY program. If not history disk exists for the set you are working on, one will need to be created, archived, and stored in the proper file cabinet in the laboratory. If the cylinders have been calibrated previously at NIST, perform a history analysis on the data you have from previous years to your new data.
- 5.14 Re-measure any cylinder that deviated from history by more than the current uncertainty. If there is still some question about the measurement, measure the cylinder again against a different master pair. If questions still exist, seek the assistance from the lab manager about possibly having measured by absolute measurements instead of mechanical comparison.

## **6.0 Report and Close out of the Folder**

- 6.1 After completing the measurements of all of the cylinders, create a report using the FOLDER and REPORT Programs.
- 6.2 Sign the report and have it reviewed and signed by the Group Leader.
- 6.3 Close out the test folder and return the gages to the customer with a copy of the report. Be sure packing of the artifacts is such that damage will not occur in the shipment. Also be certain cylinders are clean and have some rust prohibiting paper in the case or a small amount of light mineral oil applied to prevent corrosion.

## **7.0 Uncertainty**

- 7.1 Uncertainty documentation for thread wires and cylinders is covered in Uncertainty and Dimensional Calibrations (See References).