



CalPro[®]

Calibration Procedures

An indispensable asset for any calibration department, CalPro is a database of step-by-step calibration procedures for more than sixty commonly used inspection gages, instruments and reference standards.

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CalPro can also be used without GAGEtrak as a library of work instructions for inclusion within your company's quality manual.



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CP02E Outside Micrometer and Micrometer Head (Sample Procedure)

Revision Date: 01/01/2010

Calibration Interval: 12 months (can be modified according to stability, purpose and usage)

1.0 Scope:

This procedure describes the calibration of outside micrometer and micrometer head (English / metric) including such types as solid anvil, interchangeable anvil, ball anvil, tubing-upright anvil, blade, hub, point and flange.

Instrument resolution: English 0.001, 0.0001 or 0.00005 inch and metric (0.01 and 0.001 mm).

Measuring range: 0 to 54 in. (0 to 1000 mm).

2.0 References: This document is based on the NAVAIR and DOD procedures.

3.0 Definitions:

- TI : Test Instrument
- DOD : Department of Defense
- NAVAIR : Navy Air Force

4.0 General Requirements:

Environment:

- Temperature : Change should not exceed 2 deg. F/h (1 deg. C/h).
- Humidity : No excessive humidity.
- Air quality : N/A.

Stabilization:

- Stabilize equipment and standards at ambient temperature.
- NAVY: a minimum of eight hours is recommended for TI exceeding a length of 10 in.
DOD : two hours on 0.001 inch (0.01mm) micrometers.
four hours on 0.0001 inch (0.001 mm) micrometers.

Preliminary Operations:

- Clean TI.
- Verify TI for damage such as nicks or burrs.
- Slowly rotate the TI micrometer thimble and ensure that it operates smoothly through its entire range (clean and lubricate if required).
- Zero TI.

Standards and Calibrating Equipment:

- They shall be calibrated or verified at specified intervals or prior to use, against measurement standards traceable to international or national standards.

5.0 Equipment: The following equipment is considered a minimal requirement and any equivalent equipment may be used.

1. Grade 2 gage blocks (see CP01, Item 1.0 and tables 1 and 2 for more info on grade).
2. Magnifying glass or microscope may be required to inspect spherical components.
3. Optical parallel flat, uncertainty, DOD = 6 microinches, NAVY = 4 microinches and monochromatic light. A ball could replace optical parallel flat if the micrometer resolution is 0.001 inch (0.01 mm).
4. Vise (optional).
5. Lapping kit.

6.0 Calibration Process: Use only the portion of the calibration method applicable to the TI and use manufacturer specifications and limits when available.

Item	Test Characteristics	Acceptance Limits	Test Method
1	Thimble rotation	Must rotate smoothly through its entire range	Visual
2	Thread free play	No perceptible free play (adjust threads if required)	Visual
3	Flat on round anvil (for tube or ball micrometers)	No visible flat	Magnifying glass or microscope
4	Constant-force mechanism (if applicable)	Uniform pressure	Visual
5	Anvil and spindle flatness (for flat anvil only) TIs used in precision work or with relapped anvil or spindle. Not required on general purpose tools.	see Table1	Optical parallel flat and monochromatic light, apply sufficient force to obtain 3 to 5 fringes across the TI anvil face

6	Anvil and spindle parallelism (for flat anvil only)	see Table1 see Note2	Optical parallel flat and monochromatic light or gage blocks at four positions or spherical standard or inside micrometer at four positions or ball and gage blocks at five positions
	For blade type TI, verify at both sides of the blades		

7	Scale linearity Verify at:		Gage Blocks or appropriate steps of the Mike Master for a resolution less than 0.001 in (0.01mm)
	DOD: in.: 0.210, 0.420, 0.605, 0.815, and 1.000	see Table1	
	NAVY: in.: 0.195, 0.390, 0.585, 0.780 and 1.000	see Table1	
	mm: 5.10, 10.20, 15.30, 20.40 and 25.00		

For micrometer head calibration, apply gage block stacks equivalent to 25, 50, 75 and 95% of the TI range. (see Figure 1.).

8 If end standard(s) are supplied with the micrometer, calibrate standard following CP06E.

7.0 Notes:

1. For digital micrometer with both English and metric units, one Gage Block should be checked within the calibration range to ensure the metric conversion is working correctly.
2. Verification of parallelism with optical parallel is recommended at two dimensions, 0.500 and 0.5125 or with balls at diameters 0.1875 and 0.250.
3. For precise calibration, it is recommended to wear cotton gloves when handling gage blocks to prevent transfer of body heat.
4. Record readings, maintenance such as servicing, adjustment, repairs or modifications.
5. For TIs with interchangeable anvils, spindles or rods, calibrate zero value for each anvil, spindle or rod.

TABLE 1 - Tolerances

Micrometer Resolution	Range	Contact Faces				Scale
		Flatness max. Navy	DOD	Parallelism max. Navy	Navy	Linearity max. +/-
Inches				Fixed	Interchang.	
0.00005	0 to 1	0.00004	0.00005	0.00005	0.0004	0.00005
0.00005	1 to 2	0.00004	0.00005	0.0001	0.0004	0.0001
0.00005	2 to 9	0.00004	0.00008	0.0002	0.0004	0.0002
0.00005	9 to 12	0.00004	0.0001	0.0003	0.0006	0.0003
0.00005	12 to 18	0.00004	0.0001	0.0004	0.0008	0.0004
0.00005	18 to 24	0.00004	0.0001	0.0005	0.0008	0.0005
0.00005	24 to 30	0.00004	0.0001	0.0006	0.0010	0.0006
0.00005	30 to 36	0.00004	0.0001	0.0007	0.0010	0.0007
0.0001	0 to 1	0.00004	0.00005	0.0001	0.0004	0.0001
0.0001	1 to 6	0.00004	0.00008	0.0002	0.0004	0.0002
0.0001	6 to 12	0.00004	0.0001	0.0003	0.0006	0.0003
0.0001	12 to 18	0.00004	0.0001	0.0004	0.0008	0.0004
0.0001	18 to 24	0.00004	0.0001	0.0005	0.0008	0.0005
0.0001	24 to 30	0.00010	0.0001	0.0007	0.0010	0.0006
0.001	0 to 36	not required		0.001		0.001
0.001	36 to 54	not required		0.001		0.002
Millimeters						
0.001 or 0.002	0 to 50	0.001		0.003	0.010	0.004
0.001 or 0.002	50 to 150	0.001		0.005	0.010	0.006
0.001 or 0.002	150 to 300	0.001		0.007	0.015	0.008
0.001 or 0.002	300 to 1000	0.002		0.009	0.030	0.020
0.01	0 to 300	not required		0.010	0.02	0.01
0.01	300 to 1000	not required		0.010	0.02	0.02

8.0 Figure 1:

