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.

Any or all of the CalPro procedures can be imported into GAGEtrak\textsuperscript{®} using the import utility or printed as hard copy from the DOC files included on the CalPro media.

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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CalPro 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).
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.

<table>
<thead>
<tr>
<th>Item</th>
<th>Test Characteristics</th>
<th>Acceptance Limits</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Thimble rotation</td>
<td>Must rotate smoothly through its entire range</td>
<td>Visual</td>
</tr>
<tr>
<td>2</td>
<td>Thread free play</td>
<td>No perceptible free play (adjust threads if required)</td>
<td>Visual</td>
</tr>
<tr>
<td>3</td>
<td>Flat on round anvil</td>
<td>No visible flat</td>
<td>Magnifying glass or microscope</td>
</tr>
<tr>
<td></td>
<td>(for tube or ball micrometers)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Constant-force mechanism</td>
<td>Uniform pressure</td>
<td>Visual</td>
</tr>
<tr>
<td></td>
<td>(if applicable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Anvil and spindle flatness</td>
<td>see Table1</td>
<td>Optical parallel flat and monochromatic light, apply sufficient force to obtain 3 to 5 fringes across the TI anvil face</td>
</tr>
<tr>
<td></td>
<td>(for flat anvil only) TI's used in precision work or with relapped anvil or spindle. Not required on general purpose tools.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6. Anvil and spindle parallelism
   (for flat anvil only)
   For blade type TI, verify at both
   sides of the blades

   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

7. Scale linearity
   Verify at:
   DOD: in.: 0.210, 0.420, 0.605, 0.815, and 1.000
   NAVY: in.: 0.195, 0.390, 0.585, 0.780, and 1.000
   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

<table>
<thead>
<tr>
<th>Micrometer Resolution</th>
<th>Contact Faces</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flatness max.</td>
<td>Parallelism max.</td>
</tr>
<tr>
<td></td>
<td>Navy</td>
<td>DOD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.00005</td>
<td>0 to 1</td>
<td>0.00004</td>
</tr>
<tr>
<td>0.00005</td>
<td>1 to 2</td>
<td>0.00004</td>
</tr>
<tr>
<td>0.00005</td>
<td>2 to 9</td>
<td>0.00004</td>
</tr>
<tr>
<td>0.00005</td>
<td>9 to 12</td>
<td>0.00004</td>
</tr>
<tr>
<td>0.00005</td>
<td>12 to 18</td>
<td>0.00004</td>
</tr>
<tr>
<td>0.00005</td>
<td>18 to 24</td>
<td>0.00004</td>
</tr>
<tr>
<td>0.00005</td>
<td>24 to 30</td>
<td>0.00004</td>
</tr>
<tr>
<td>0.00005</td>
<td>30 to 36</td>
<td>0.00004</td>
</tr>
<tr>
<td>0.0001</td>
<td>0 to 1</td>
<td>0.00004</td>
</tr>
<tr>
<td>0.0001</td>
<td>1 to 6</td>
<td>0.00004</td>
</tr>
<tr>
<td>0.0001</td>
<td>6 to 12</td>
<td>0.00004</td>
</tr>
<tr>
<td>0.0001</td>
<td>12 to 18</td>
<td>0.00004</td>
</tr>
<tr>
<td>0.0001</td>
<td>18 to 24</td>
<td>0.00004</td>
</tr>
<tr>
<td>0.0001</td>
<td>24 to 30</td>
<td>0.00010</td>
</tr>
<tr>
<td>0.001</td>
<td>0 to 36</td>
<td>not required</td>
</tr>
<tr>
<td>0.001</td>
<td>36 to 54</td>
<td>not required</td>
</tr>
</tbody>
</table>

Millimeters

<table>
<thead>
<tr>
<th>Micrometer Resolution</th>
<th>Contact Faces</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flatness max.</td>
<td>Parallelism max.</td>
</tr>
<tr>
<td></td>
<td>Navy</td>
<td>DOD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.001 or 0.002</td>
<td>0 to 50</td>
<td>0.001</td>
</tr>
<tr>
<td>0.001 or 0.002</td>
<td>50 to 150</td>
<td>0.001</td>
</tr>
<tr>
<td>0.001 or 0.002</td>
<td>150 to 300</td>
<td>0.001</td>
</tr>
<tr>
<td>0.001 or 0.002</td>
<td>300 to 1000</td>
<td>0.002</td>
</tr>
<tr>
<td>0.01</td>
<td>0 to 300</td>
<td>not required</td>
</tr>
<tr>
<td>0.01</td>
<td>300 to 1000</td>
<td>not required</td>
</tr>
</tbody>
</table>
8.0 Figure 1: