

TECHNICAL MANUAL
CALIBRATION PROCEDURE
FOR
MICROMETERS, MICROMETER HEADS AND
DEPTH MICROMETERS
GENERAL

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**MICROMETERS, MICROMETER HEADS AND
DEPTH MICROMETERS**

GENERAL

1 CALIBRATION DESCRIPTION:

Table 1.

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
Anvil and Spindle Flatness	Range: 0 to 3 in	Measured with an Optical Flat and Monochromatic Light
	Accuracy: within 50 μ in TIR	
	Range: 4 to 9 in	
	Accuracy: within 80 μ in TIR	
	Range: 10 in and above	
	Accuracy: within 0.0001 in TIR	
Base Flatness	Range: All with a resolution of 50 μ in	Measured using Gage Blocks
	Accuracy: within 25 μ in TIR	
	Range: All with a resolution of 0.0001 in and 50 μ in	
	Accuracy: within 0.0001 in/in TIR	
	Range: All with a resolution of 0.0005 in	
	Accuracy: within 0.0005 in TIR over entire base length	
Linearity	Range: *	Compared to Gage Blocks or Thread Plug Gages
	Accuracy: *	

* See step 3.12.

2 EQUIPMENT REQUIREMENTS:

Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.1 GAGE BLOCK SET	Range: 0 to 4 in Accuracy: $\pm 20 \mu\text{in}$ from stated value for 0.0001 in range TI; $\pm 12 \mu\text{in}$ from stated value for 50 μin range TI *	Pratt & Whitney 81	
2.2 GAGE BLOCK SET	Range: 5 to 20 in Accuracy: 5 $\mu\text{in/in}$ from stated value *	L. S. Starrett 8	
2.3 OPTICAL FLAT	Range: 1 in Accuracy: Flat within 6 μin	As Available	
2.4 MONOCHROMATIC LIGHT	Range: Helium Neon Accuracy: N/A	Van Keuren C2	
2.5 SURFACE PLATE	Range: 36 \times 72 in Accuracy: within 25 μin over entire measurement area	Brown & Sharpe 701-157	
2.6 V BLOCK	Range: 2.875 \times 4.000 \times 2.875 in Accuracy: N/A	Taft Peirce 9130	
2.7 THREAD PLUG GAGES	Range: 0 to 6 in Accuracy: Class X for TIs with a resolution of 0.001 in and Class W for TIs with a resolution of 0.0001 in, as per ANSI B _{47.1}	As Available	
2.8 THREADWIRES **	Range: As required Accuracy: $\pm 25 \mu\text{in}$	Van Keuren 30HS	

* The combined TAR of (2.1) and (2.2) is 1.7:1 and 1.5:1 for the 50 μin and 0.0001 inch ranges, respectively, for the Linearity Calibration.

** Alternate method.

3 PRELIMINARY OPERATIONS:

3.1 Review and become familiar with the entire procedure before beginning the Calibration Process.

WARNING

Unless otherwise designated, and prior to beginning the Calibration Process, ensure that all test equipment voltage and/or current outputs are set to zero (0) or turned off, where applicable. Ensure that all equipment switches are set to the proper position before making connections or applying power.

NOTE

1 microinch (μin)	=	0.000001 inch
1 millimeter (mm)	=	0.03937 inch
1 inch	=	25.40 millimeters (mm)

- 3.2 Use only those portions of the procedure applicable to the TI being calibrated.
- 3.3 Ensure the TI is clean and free from damage which could affect calibration or use.
- 3.4 The TI must be brought into the calibration area at least 8 hours prior to beginning the calibration.
- 3.5 The temperature of the calibration area must be within 73 ± 6 °F.
- 3.6 If applicable, connect the TI and test equipment to an appropriate power source. Set POWER switches to ON and allow warm-up as required by the manufacturer. Ensure Electronic Digital TIs are set to measure in inches.
- 3.7 For Caliper TIs with fixed anvils: Standard End Measuring Rods or Zero Setting Standards that accompany the TI will not be calibrated. Annotate the Special Block of the Certification Label: Standard End Measuring Rods or Zero Setting Standards not calibrated. This will not require the use of a Limited Certification Label.
- 3.8 For Caliper TIs with interchangeable anvils and Electronic Digital TIs: Calibrate the Standard End Measuring Rods IAW T.O. 33K6-4-369-1. Verify T.O. 33K6-4-369-1 still meets the requirement. If the supporting TMDE Laboratory can not meet the environmental or equipment requirements as per T.O. 33K6-4-369-1, the TI must be transferred to a Type IIA or Type IIC TMDE Laboratory for calibration.
- 3.9 Thread Type TIs with a resolution of 0.0001 inch or more: Due to standards limitations, the TI will be certified to ± 0.001 inch. A Limited Certification Label will be required, annotated with an accuracy of ± 0.001 inch.
- 3.10 Perform Linearity Calibration using para 4.3 for all TIs except for Thread Type TIs. For Thread Type TIs, perform Linearity Calibration using para 4.4.
- 3.11 When the TI is graduated such that the accuracy or limits cannot be read, use the next greater division or digit. If this is applicable, a Limited Certification Label will be used stating the actual accuracy to which the TI was calibrated.
- 3.12 If there are no specifications listed in AFCAV and manufacturers specifications cannot be found, then use the general specifications listed in Appendix A.

4 CALIBRATION PROCESS:**NOTE**

Unless otherwise specified, verify the results of each test and take corrective action whenever the test requirement is not met, before proceeding.

4.1 ANVIL AND SPINDLE FLATNESS CALIBRATION:

NOTE

This does not apply to Depth Micrometer Rods.

4.1.1 Use the Optical Flat and Monochromatic Light to measure the TI anvil and spindle flatness.

4.1.2 The TI anvil and spindle must be flat within the corresponding values listed in the Limits column of Table 2.

Table 2.

Range	Limits
0 to 3 in	within 50 μ in
4 to 9 in	within 80 μ in
10 and above	within 0.0001 in
All with a resolution of 50 μ in	within 25 μ in

4.1.3 For TIs with interchangeable anvils or spindles, repeat steps 4.1.1 and 4.1.2 for each anvil or spindle.

4.2 BASE FLATNESS CALIBRATION:

CAUTION

Do not lock TI head without a rod in place. Locking the TI head without a rod in place could damage the TI lock and cause the rods to bind.

NOTE

An Optical Flat may be substituted to verify Base Flatness, as appropriate.

4.2.1 Select and wring Gage Blocks necessary to form two Gage Block stacks equal to the full scale value of the TI.

4.2.2 Place the two Gage Block stacks on the Surface Plate about 1/4 inch from each end of the TI base (1/2 inch for TIs with a 5 inch base, and 1 inch for TIs with a 6 inch base).

4.2.3 Place the TI on top of the Gage Block stacks with the TI base measuring surface contacting and straddling both stacks equally.

4.2.4 Rotate the TI thimble to extend the measuring rod until the measuring rod just contacts the Surface Plate. Record the indication. Perform this operation two more times and record the average of the three indications.

4.2.5 Retract the TI thimble about 1/2 turn and place the TI on one of the Gage Block stacks with the TI measuring rod extending into the center hole of the Gage Block stack. Repeat step 4.2.4 and record the average of the indications.

4.2.6 Algebraically subtract the average value recorded in step 4.2.4 from the value recorded in step 4.2.5. Record the value.

4.2.7 The value recorded in step 4.2.6 must be within the corresponding value listed in the Limits column of Table 3.

Table 3.

Range	Limits
All with a resolution of 0.0001 in and 50 μin	within 0.0001 in/in
All with a resolution of 0.0005 in	within 0.0005 in over entire base length
All with a resolution of 0.001 in	within 0.001 in over entire base length

4.3 LINEARITY CALIBRATION:

4.3.1 Set the TI to indicate zero using the appropriate size Gage Block if required. For Depth TIs, set zero with the shortest available rod. For Micrometer Head TIs, mount the TI shank vertically in the V Block and set zero against the Surface Plate as shown in Figure 1.

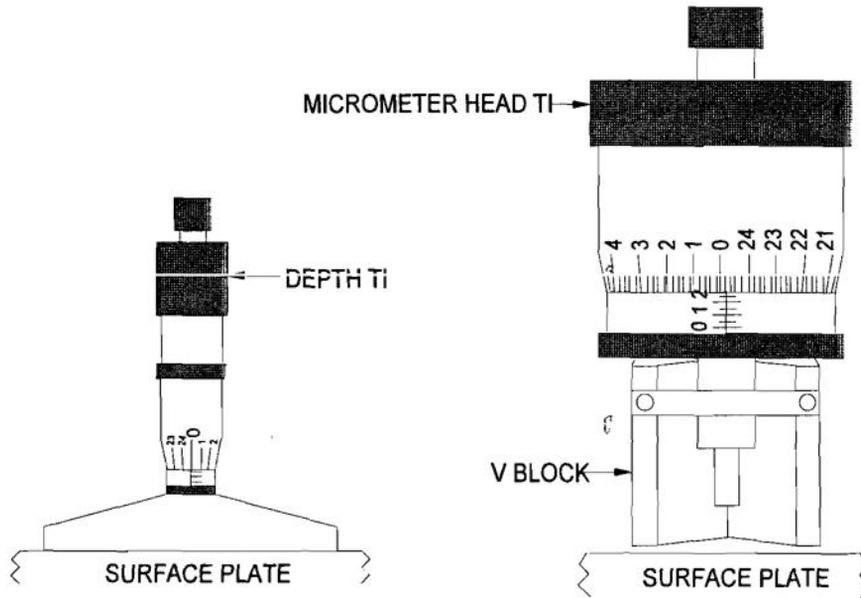


Figure 1.

4.3.2 Select appropriate size Gage Block stacks for Caliper, Depth or Micrometer Head TIs. The recommended sizes for Gage Blocks are X.210, X.420, X.605 and X.815 inch and full range, where X represents the applicable length for the TI range. When wringing Gage Block sizes together to form desired lengths, the stack must soak for at least 1 hour for sizes over 8 inches. This soak time does not apply to sizes above 8 inches which do not require wringing. This soak time only applies to TIs with a 0.0001 inch resolution.

NOTE

The recommended sizes for Gage Blocks are 7.7, 12.9, 17.6 and 22.8 mm for metric TIs.

4.3.3 Use the TI to measure the first Gage Block stack.

4.3.4 The TI must indicate the appropriate length within the manufacturers specifications, Table 1 specifications or AFCAV specifications.

4.3.5 Repeat steps 4.3.3 and 4.3.4 for each remaining Gage Block stack. For center scale Micrometer Head TIs that indicate in both a negative and positive direction from zero, linearity must be measured from zero in each direction.

4.3.6 For TIs with interchangeable anvils, spindles or rods, repeat steps 4.3.3 and 4.3.4 at or near the applicable zero value for the TI for each anvil, spindle or rod.

4.3.7 Calibration complete. Set POWER switches to OFF, disconnect and secure all equipment

4.3.8 Annotate and attach a Certification Label or Limited Certification Label as per steps 3.7 and 3.11, if applicable.

4.4 LINEARITY CALIBRATION: (For Thread Type TIs)

4.4.1 Set the zero indication on the TI. For a 0 to 1 inch TI, bring the spindle and anvil together. For TIs larger than 1 inch place an appropriate Thread Plug Gage between the spindle and anvil, then zero. Set the TI to indicate zero. If the appropriate Thread Plug Gage is not available to set the TI zero and the owning organization uses the item for comparison type measurement only, accomplish the Linearity Calibration IAW steps 4.4.3 and 4.4.4. Annotate a Limited Certification Label: Linearity Calibrated Only.

4.4.2 For TIs with a Zero Setting Standard, insert the Zero Setting Standard and obtain an indication. Annotate this value on the appropriate Certification Label.

4.4.3 Check TI near 25 and 75% using the appropriate size Thread Plug Gages to verify TI pitch indication. All indications must indicate the appropriate length within the manufacturers specifications, Table 1 specifications or AFCAV specifications.

4.4.4 If the appropriate Thread Plug Gages are not available to check linearity, it can be verified using the appropriate size Gage Block and Threadwire in the TI V-anvil.

4.4.5 Calibration complete. Set POWER switches to OFF, disconnect and secure all equipment.

4.4.6 Annotate and attach a Certification Label or Limited Certification Label as per steps 3.7, 3.9, 3.11, 4.4.1 and 4.4.2, if applicable.

4.5 DIAL DEPTH GAGE CALIBRATION:

4.5.1 Ensure the TI plunger is perpendicular to the Surface Plate.

4.5.2 For unidirectional TIs, preload the TI plunger to approximately 1/4 dial revolution or 1/2 of the overtravel, whichever is greater. For center scale TIs that indicate both a negative and positive direction from zero, preload the TI to approximately 1/2 the total travel.

4.5.3 For unidirectional TIs, check four equal increments per revolution for the first two revolutions, then two equal increments for each remaining revolution. Approximate values may be used.

4.5.5 For center scale TIs, once zero has been established, place the TI on a 0.120 inch Gage Block and re-adjust the TI bezel for zero.

4.5.6 Select appropriate size Gage Blocks, in order to check the TI in both the positive and negative directions. The recommended sizes for Gage Blocks are 0.100 and 0.110 inch (negative direction) and 0.130 and 0.140 inch (positive direction).

4.5.7 The TI must indicate the appropriate length within the manufacturers specifications, Table 1 specifications or AFCAV specifications.

4.5.8 If applicable, annotate and attach a Limited Certification Label as per step 3.11.

4.5.9 Calibration is complete, secure all equipment.

CALIBRATION PERFORMANCE TABLE

Not Required

APPENDIX A

Table A-1.

TI Resolution	Range	± Accuracy
50 μ in	0 to 1 in	50 μ in
	1 to 2 in	0.0002 in
	2 to 3 in	0.0002 in
	3 to 4 in	0.0002 in
	4 to 5 in	0.0002 in
	5 to 6 in	0.0002 in
	6 to 7 in	0.0003 in
	7 to 8 in	0.0003 in
	8 to 9 in	0.0003 in
	9 to 10 in	0.0003 in
	10 to 11 in	0.0003 in
	11 to 12 in	0.0003 in
	12 to 18 in	0.0004 in
	18 to 24 in	0.0005 in
	24 to 30 in	0.0006 in
30 to 36 in	0.0007 in	
0.0001 in	0 to 0.250 in	0.0001 in
	0 to 0.500 in	0.0001 in
	0 to 1 in	0.0001 in
	1 to 2 in	0.0002 in
	2 to 3 in	0.0002 in
	3 to 4 in	0.0002 in
	4 to 5 in	0.0002 in
	5 to 6 in	0.0002 in
	6 to 7 in	0.0003 in
7 to 8 in	0.0003 in	
8 to 9 in	0.0003 in	

APPENDIX A (Cont.)

Table A-1. (Cont.)

TI Resolution	Range	± Accuracy
0.0001 in	9 to 10 in	0.0003 in
	10 to 11 in	0.0003 in
	11 to 12 in	0.0003 in
	12 to 18 in	0.0004 in
	18 to 24 in	0.0005 in
	24 to 30 in	0.0006 in
	30 to 36 in	0.0007 in
0.0002 in	0 to 1 in	0.0002 in
	1 to 2 in	0.0002 in
	2 to 3 in	0.0002 in
	3 to 4 in	0.0002 in
	4 to 5 in	0.0002 in
	5 to 6 in	0.0002 in
	6 to 7 in	0.0004 in
	7 to 8 in	0.0004 in
	8 to 9 in	0.0004 in
	9 to 10 in	0.0004 in
	10 to 11 in	0.0004 in
	11 to 12 in	0.0004 in
	12 to 18 in	0.0004 in
	18 to 24 in	0.0006 in
24 to 30 in	0.0006 in	
30 to 36 in	0.0008 in	
0.0005 in	0 to 0.5 in	0.0005 in

APPENDIX A (Cont.)

Table A-1. (Cont.)

TI Resolution	Range	± Accuracy
0.001 in	0 to 0.250 in	0.001 in
	0 to 0.500 in	0.001 in
	0 to 1 in	0.001 in
	1 to 2 in	0.001 in
	2 to 3 in	0.001 in
	3 to 4 in	0.001 in
	4 to 5 in	0.001 in
	5 to 6 in	0.001 in
	6 to 7 in	0.001 in
	7 to 8 in	0.001 in
	8 to 9 in	0.001 in
	9 to 10 in	0.001 in
	10 to 11 in	0.001 in
	11 to 12 in	0.001 in
	12 to 18 in	0.001 in
	18 to 24 in	0.001 in
	24 to 30 in	0.001 in
30 to 36 in	0.001 in	
>36 in	0.002 in	
0.001 mm	0 to 13 mm	0.003 mm
	0 to 25 mm	0.003 mm
	25 to 50 mm	0.003 mm
	50 to 75 mm	0.005 mm
	75 to 100 mm	0.005 mm

APPENDIX A (Cont.)

Table A-1. (Cont.)

TI Resolution	Range	± Accuracy
0.001 mm	100 to 125 mm	0.005 mm
	125 to 150 mm	0.005 mm
	150 to 175 mm	0.008 mm
	175 to 200 mm	0.008 mm
	200 to 225 mm	0.008 mm
	225 to 250 mm	0.008 mm
	250 to 275 mm	0.008 mm
	275 to 300 mm	0.008 mm
0.002 mm	0 to 13 mm	0.004 mm
	0 to 25 mm	0.004 mm
	25 to 50 mm	0.004 mm
	50 to 75 mm	0.006 mm
	75 to 100 mm	0.006 mm
	100 to 125 mm	0.006 mm
	125 to 150 mm	0.006 mm
	150 to 175 mm	0.008 mm
	175 to 200 mm	0.008 mm
	200 to 225 mm	0.008 mm
0.01 mm	0 to 13 mm	0.01 mm
	0 to 25 mm	0.01 mm
	25 to 50 mm	0.01 mm

APPENDIX A (Cont.)

Table A-1. (Cont.)

TI Resolution	Range	± Accuracy
0.01 mm	50 to 75 mm	0.01 mm
	75 to 100 mm	0.01 mm
	100 to 125 mm	0.01 mm
	125 to 150 mm	0.01 mm
	150 to 175 mm	0.01 mm
	175 to 200 mm	0.01 mm
	200 to 225 mm	0.01 mm
	225 to 250 mm	0.01 mm
	250 to 275 mm	0.01 mm
	275 to 300 mm	0.01 mm