*TB 9-5210-205-50

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR GAGE BLOCKS, GRADES 0, AS-1, AND AS-2

Headquarters, Department of the Army, Washington, DC
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REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

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*This bulletin supersedes TB 9-5210-205-50, dated 15 January 2003.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument identification. This bulletin provides instructions for the calibration of Gage Blocks, Grades 0, AS-1, and AS-2. ASME B89.1.9-2002 was used as the prime data source in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

a. Model Variations. Variations among models are described in text.

b. Time and Technique. The time required for this calibration is approximately 20 minutes per block, using the physical technique.

2. Forms, Records, and Reports. Forms, records, and reports required for calibration personnel at all levels are prescribed by TB 750-25.

3. Calibration Description. TI parameters and performance specifications which pertain to this calibration are listed in table 1.

Table 1. Calibration Description

Deviation from flatness tolerance t_f[1]			
Nominal length range for l_n	Deviation from flatness tolerance t_f in µm (µin.)		
	Style and grade		
	0 All styles former grade 2	AS-1 All styles former grade 3	AS-2 All styles
0.5 mm up to 50 mm	0.1	0.15	0.25
0.010 in. up to 2 in.	(4)	(6)	(10)
50 mm up to 150 mm	0.1	0.15	0.25
2 in. up to 6 in.	(4)	(6)	(10)
Over 150 mm up to 500 mm	0.15	0.18	0.25
Over 6 in. up to 20 in.	(6)	(7)	(10)

See footnote at end of table.

Table 1. Calibration Description – Continued

MAXIMUM PERMITTED DEVIATIONS OF THE LENGTH AT ANY POINT AND PARALLELISM TOLERANCES FOR METRIC GAGE BLOCKS								
Nominal Length Range, l_n (mm)	Grade 0 Former Grade 2 (µm)			Grade AS-1 Former Grade 3 (µm)			Grade AS-2 (µm)	
	$\pm t_e$[2]	t_v[3]		$\pm t_e$[2]	t_v[3]		$\pm t_e$[2]	t_v[3]
$l_n \leq 0.5$	0.14	0.10		0.30	0.16		0.60	0.30
$0.5 < l_n \leq 10$	0.12	0.10		0.20	0.16		0.45	0.30
$10 < l_n \leq 25$	0.14	0.10		0.30	0.16		0.60	0.30
$25 < l_n \leq 50$	0.20	0.10		0.40	0.18		0.80	0.30
$50 < l_n \leq 75$	0.25	0.12		0.50	0.18		1.00	0.35
$75 < l_n \leq 100$	0.30	0.12		0.60	0.20		1.20	0.35
$100 < l_n \leq 150$	0.40	0.14		0.80	0.20		1.60	0.40
$150 < l_n \leq 200$	0.50	0.16		1.00	0.25		2.00	0.40
$200 < l_n \leq 250$	0.60	0.16		1.20	0.25		2.40	0.45
$250 < l_n \leq 300$	0.70	0.18		1.40	0.25		2.80	0.50
$300 < l_n \leq 400$	0.90	0.20		1.80	0.30		3.60	0.50
$400 < l_n \leq 500$	1.10	0.25		2.20	0.35		4.40	0.60
MAXIMUM PERMITTED DEVIATIONS OF THE LENGTH AT ANY POINT AND PARALLELISM TOLERANCES FOR INCH GAGE BLOCKS								
Nominal Length Range, l_n (in)	Grade 0 Former Grade 2 (µin.)			Grade AS-1 Former Grade 3 (µin.)			Grade AS-2 (µin.)	
	$\pm t_e$[2]	t_v[3]		$\pm t_e$[2]	t_v[3]		$\pm t_e$[2]	t_v[3]
$l_n \leq 0.05$	6	4		12	6		24	12
$0.05 < l_n \leq 0.4$	5	4		8	6		18	12
$0.45 < l_n \leq 1$	6	4		12	6		24	12
$1 < l_n \leq 2$	8	4		16	6		32	12
$2 < l_n \leq 3$	10	4		20	6		40	14
$3 < l_n \leq 4$	12	5		24	8		48	14
$4 < l_n \leq 5$	16	5		32	8		64	16
$5 < l_n \leq 6$	16	5		32	8		64	16
$6 < l_n \leq 7$	20	6		40	10		80	16
$7 < l_n \leq 8$	20	6		40	10		80	16
$8 < l_n \leq 10$	24	6		48	10		104	18
$10 < l_n \leq 12$	28	7		56	10		112	20
$12 < l_n \leq 16$	36	8		72	12		144	20
$16 < l_n \leq 20$	44	10		88	14		176	24

[1]Individual blocks which deviate more than twice the length, flatness or parallelism tolerances for new blocks or which have lost their wringing qualities should be replaced. Blocks that have only undergone a length change do not need replacement if corrections from a calibration report are applied in usage. When recalibration indicates that 25 percent or more of the blocks in a set should be replaced, the entire set normally should be assigned to lower accuracy work.

[2]$\pm t_e$ = Limit deviations of length at any point from nominal length.

[3] t_v = Tolerances for parallelism.

SECTION II
EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 2 identifies the specific equipment to be used in this calibration procedure. This equipment issued is with Secondary Reference Calibration Standards Set NSN 4931-00-621-7878. Alternate items may be used by the calibrating activity. The items selected must be verified to perform satisfactory prior to use and must bear evidence of current calibration. The equipment must meet or exceed minimum use specifications listed in table 2.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
COMPARATOR	Range: 0 to 20 in. Resolution: 0.1 µ in.	Edmunds 20″ Gage Block comparator 5022000 (5022000)
GAGE BLOCKS	Range: 0.050 to 20 in. Accuracy: See test report	(7901765), (7901267), (7901363), (7901961), (13534020), and (13534021)
INTERFEROMETER	Flatness Accuracy: 1 µin.	Davidson Optronics Inc., Model D327-100 (13440047)
OPTICAL FLATS	Flatness Accuracy: 3 µin.	(7902794)

5. Accessories Required. The accessories listed in table 3 are issued as indicated in paragraph **4** above and are used in this calibration procedure. When necessary, these items may be substituted by equivalent items, unless specifically prohibited.

Table 3. Accessories Required

Common name	Description (part number)
ALCOHOL	Ethyl, 1-gallon container (MIL-E-463A) (95% USP) 51-A-1965
BARRIER MATERIAL	Polyethylene (MIL-B-121)
BEAKER	Glass, capacity 1000 ml (6640-240-6829)
BRUSH	1-1/16-in. length; 3/4-in. diameter ferrule (8020-224-8024)
BRUSH	8-1/2-in. o/a length; 1/2-in. diameter x 3 in. long (7920-223-8002)
CAN[1]	Bench, safety, 9-1/2 x 4-1/2 in. (Justrite No. 10370)
CAN[1]	Safety (w/screen), 5-gallon capacity (McMasters Can No. 429lX3, Screen No. 429lX8)
ULTRASONIC CLEANER	Crest Company (4931-682-1027)
CUSHIONING MATERIAL[1]	Kimpac or equivalent
DEMAGNITIZER	Taft-Pierce, No. 9801-2 (7910422)
DEBURRING KIT	Various abrasive tools w/case (7913148)
FORCEPS	Straight, 5 in.
FORCEPS	Straight, 10 in.
GLOVES[1]	Rubber or plastic, insulated
HEATSEALER WITH THERMOSTATIC CONTROL	115 V ac
MONOCHROMATIC LIGHT	Van Keurin, Model C-2 (7902779)
OIL	Fed Spec W.-L-800 (9150-231-6689)

See footnote at end of table.

Table 3. Accessories Required - Continued

Common name	Description (part number)
POLISHING CLOTH	Cotton, batiste, white, 4 x 6 inch (7920-263-2765)
POLYETHYLENE TUBING[1]	Lay flat, Fed Spec L-F-378b. Packaging aids Corp. Stock numbers, 1CT, 11/2CT, 2CT, and 21/2 CT
SCISSORS	6- or 8-in. size
SOLVENT	Mineral spirits
TAPE	Pressure sensitive masking tape (PPP-T-60)
WOODEN TRAY[1]	15 x 10 x 3/4 in.

[1]Procure locally.

SECTION III
CALIBRATION PROCESS

6. General Information

a. Acceptance Convention

(1) Tolerances for surface finish, flatness, parallelism, and size will be within those specified for gage blocks and accessories found in table 1.

(2) Optical flats with a monochromatic light or interferometer may be used for flatness tests. Refer to figure 1 for interpretation of fringe lines for allowable tolerances.

b. Requirements. To reduce the quantity of gage blocks being recalibrated without adversely affecting accuracy, adhere to the following requirements:

(1) Documentary evidence of stability.

(2) Positive evidence of non-use. For example: blocks remain sealed in polyethylene.

c. Definitions

(1) **Stability.** The property of remaining constant in size as determined by an accurate measurement over a designated interval.

(2) **Stability Criteria.** Documentary evidence in the form of two or more certificates or reports, covering a minimum interval of 1 year, revealing no size difference reasonably attributable to growth or shrinkage. See table 4.

(3) **Calibration Interval.** The calibration interval will be extended to 6 years from the date of sealing for those gage blocks which meet the stability requirements and are unused. A certificate of the date of initial sealing will be completed and retained with calibration worksheets.

d. Establishing Stability

(1) Calibration laboratories will maintain gage block calibration data until stability criteria is established. See table 4.

Table 4. Dimensional Stability

Grade	Maximum permissible change in length per year (ln in meters)
0	$\pm$ (0.02 μm + 0.25 x 10^{-6} ln)
AS-1, AS-2	$\pm$ (0.05 μm + 0.5 x 10^{-6} ln)

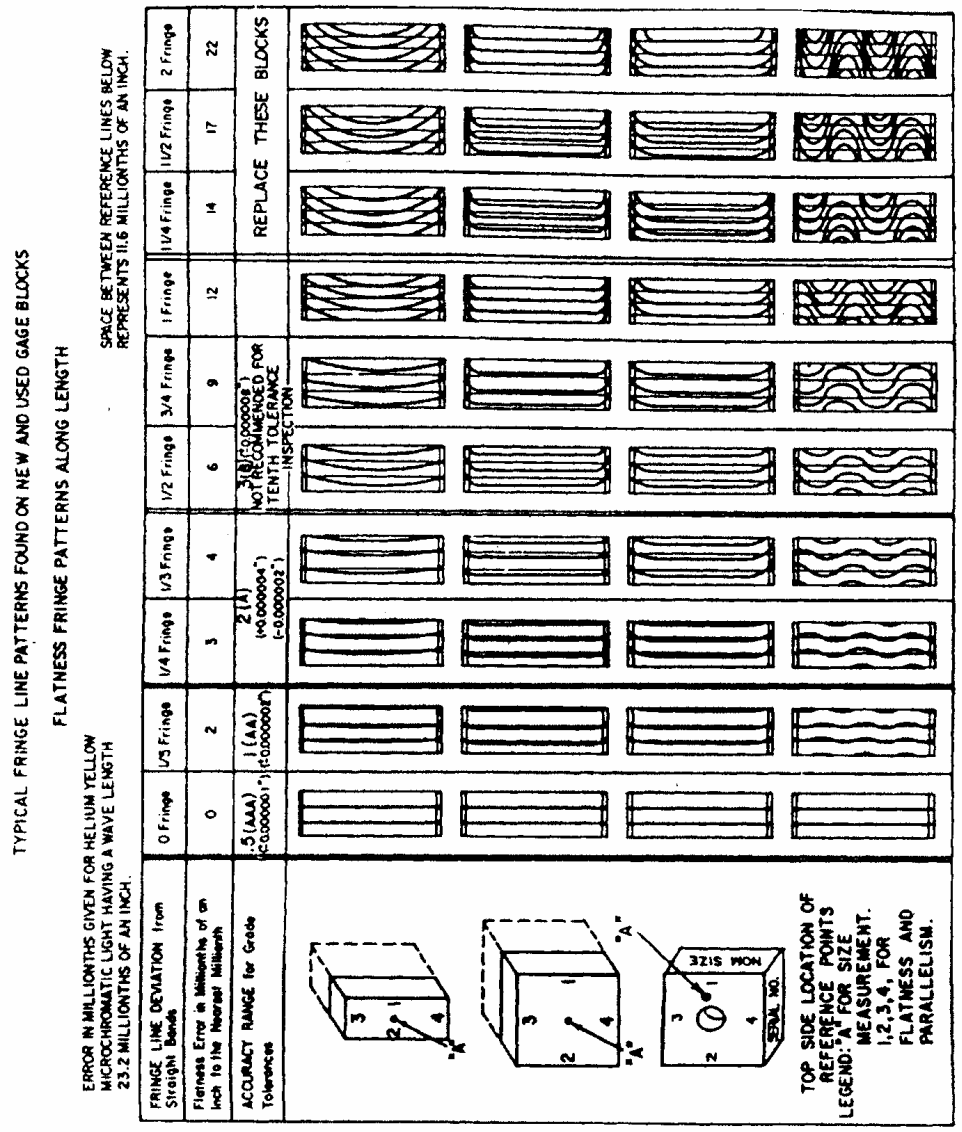

Figure 1. Typical gage block calibration data.

(2) If the calibration data accumulated for a period of at least 1 year reveals that the stability criteria is satisfied, the gage block will be sealed as outlined in this bulletin. If stability criteria is not established, or sufficient data is not available, the gage block will not be sealed.

NOTE

Gage blocks that are reserved for use as reference standards for calibration of other gage blocks need not be sealed.

7. Preliminary Instructions

a. The instructions outlined in paragraphs **7** and **8** are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.

b. Items of equipment used in this procedure are referenced within the text by common name.

8. Equipment Setup

a. Clean the TI, using light duty cycle of an ultrasonic cleaner. Place a beaker of alcohol or mineral spirits into an energized tank of water. Wait approximately 5 minutes and insert TI into beaker. If necessary, use a soft brush to remove dirt, grime, or grease. If ultrasonic cleaner is not available, use the alternate in paragraph **b** below.

b. Clean TI with solvent and wipe dry with a soft polishing cloth. Use brush for cleaning holes in square TI.

c. Discard all blocks containing pits that might prevent accurate calibration.

d. Clean TI with alcohol or mineral spirits and place on polishing cloth in a wooden tray.

e. Clean inside of TI case.

f. Check for residual magnetism by holding each TI near a suspended, very light piece of steel with low permeability.

g. Demagnetize if residual magnetism is perceptible, using demagnetizer.

h. Visually inspect each TI for scratches, burrs, nicks, and other surface defects.

i. If necessary, slide the wringing surfaces of each TI across a deburring plate, applying light pressure to shear off any large burrs that may be present.

j. Small burrs may be removed by using a deburring stone.

k. Clean TI with alcohol or mineral spirits, wipe dry, and place on cloth in wooden tray.

l. To ensure good wringing quality completely remove burrs. Questionable blocks may be tested for ringing quality by barely wetting the surface in question with oil and ringing it to a known good block from the TI set.

m. Allow gage blocks to normalize at a controlled room temperature of 68°F (20°C) for at least 8 hours with an additional 1 hour per inch for gage blocks larger than 1 inch.

9. Calibration for Flatness

a. Performance Check

NOTE
Handle blocks with gloves or forceps.

(1) Test the wringing surfaces of TI for flatness, as follows:

(a) Place TI on the platen of the interferometer and adjust until the desired fringe pattern appears (B, fig.1)

(b) Arrange the fringes to appear first in one direction on TI and then the other.

(c) Interpret flatness errors from fringe patterns (B, fig. 1) and record four results from each block (two from each wringing surface).

(2) The TI will not exceed the applicable flatness value listed in table 1.

NOTE
Since the majority of tolerance grades 0 and AS-1 blocks under 0.100 inch (2.5 mm) in length are not precisely flat, the test for parallelism is considered sufficient. The interferometer will be used to examine blocks under 0.100 inch (2.5 mm) in length for scratches, dents, or other damage that would prevent accurate calibration or usage. Blocks showing such damage will be rejected.

10. Parallelism and Size Measurement

a. Performance Check

(1) Arrange TI and gage blocks (hereafter called master block) side by side according to size on soaking area.

(2) Allow sufficient time for normalizing of TI. Observe such factors as elapsed time between handling and stability of room temperature.

NOTE
Handle blocks with forceps. Gloves may be used for blocks over 4 inches.

(3) Place master block on anvil of comparator and align master block so that gauging head contact tips of comparator will contact reference point for length measurement.

(4) Adjust the **ZERO** control to read the same as the recorded value found in the test report for the master block you are using. Remove master block and insert TI.

(5) Take reading at reference point A (fig. 1).

(6) Record meter reading in millionths of an inch with proper signs on calibration worksheet, this will be the length deviation of the TI.

(7) Remove TI and insert master block to ensure that proper setting of instrument was maintained during measurement; remove master block and insert TI.

(8) Take readings at reference points 1, 2, 3 and 4 A (fig.1) avoiding the area of block 0.020″ from edge of the block, back to the edge. Record the four readings in respective columns on calibration worksheet in millionths of an inch with proper signs. The algebraic difference will be within limits found in table 1 t_v column.

(9) Repeat (3) through (8) above for each TI in set being calibrated.

b. Adjustments. No adjustments can be made.

11. Final Procedure

a. Transfer individual block identification and size deviation to a test results report. One copy will be maintained by the calibration facility and one will be packaged with the TI. Add all pertinent information.

b. Preserve TI as follows:

(1) Wipe each TI with clean polishing cloth and apply thin coat of oil. Ensure that all surfaces are covered.

(2) Wrap and seal TI as described in (a) through (d) below:

(a) Select appropriate size polyethylene tubing and cut length of tubing long enough to completely sheath TI.

(b) Seal one end of tubing prior to inserting TI.

(c) Insert TI in tubing and seal close to TI with heat sealer.

(d) Remove excess overhang to approximately 1/16 inch from seal line to minimize bulkiness. Check seams for adherence to assure effective sealing.

(3) Insert TI in appropriate place in carrying case. Use cushioning material to protect TIs as required.

c. Package TIs listed in (1) through (6) below:

(1) Place smooth side of barrier material directly on top of TI in opened case.

(2) Package calibration worksheets in suitable envelope and place in clear polyethylene.

(3) Place a copy of test results on top of barrier material.

(4) Place the following notice conspicuously on inside lid of storage box.

NOTE

The polyethylene protective cover on gage block is a control measure. Break seal on protective cover only on those gage blocks which are required to perform an operation or measurement. Do not break seals on any gage block unless absolutely necessary.

(5) Close lid and make sure that clasps are secure.

(6) Bind the closed case with tape to prevent case from coming open during transit.

d. When all steps have been completed, annotate and affix calibration DA Label 80 to carrying case in accordance with TB 750-25. When TIs are not within tolerance, replace with same size gage block and return unserviceable blocks to unserviceable stock. When more than 25 percent of the TIs calibrated are not within tolerance, annotate and affix DA Form 2417 (Unserviceable or Limited use tag) to the entire set. At the end of the extended interval, all TIs (regardless of last calibration date) will be recalibrated. If TIs are within tolerance, they will be resealed and the cycle repeated.

By Order of the Secretary of the Army:

PETER J. SCHOOMAKER
General, United States Army
Chief of Staff

Official

SANDRA R. RILEY
Administrative Assistant to the
Secretary of the Army

0524202

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To be distributed in accordance with STD IDS No. RLC-1500, 2 January 2003, requirements for calibration procedure TB 9-5210-205-50.

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The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however, only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17, and 27.

From: "Whomever" whomever@redstone.army.mil
To: <2028@redstone.army.mil

Subject: DA Form 2028

1. **From**: Joe Smith
2. Unit: home
3. **Address**: 4300 Park
4. **City**: Hometown
5. **St**: MO
6. **Zip**: 77777
7. **Date Sent**: 19-OCT –93
8. **Pub no:** 55-2840-229-23
9. **Pub Title**: TM
10. **Publication Date**: 04-JUL-85
11. Change Number: 7
12. Submitter Rank: MSG
13. **Submitter FName**: Joe
14. Submitter MName: T
15. **Submitter LName**: Smith
16. **Submitter Phone**: 123-123-1234
17. **Problem**: 1
18. Page: 2
19. Paragraph: 3
20. Line: 4
21. NSN: 5
22. Reference: 6
23. Figure: 7
24. Table: 8
25. Item: 9
26. Total: 123
27. **Text**

This is the text for the problem below line 27.