TB 9-5210-205-50

CHANGE 1

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR GAGE BLOCKS GRADES 1, 2, AND 3 (GGG-G-15B)

Headquarters, Department of the Army, Washington, DC
11 September 2001

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TB 9-5210-205-50, 10 January 1986, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the margin of the page.

Remove pages	Insert pages
1 and 2	1 and 2
8 and 9	8 and 9

2. File this change sheet in front of the publication for reference purposes.

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10 January 1986

REPORTING OF ERRORS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedure, please let us know. Mail your letter or DA Form 2028 to: Commander, U. S. Army Aviation and Missile Command, ATTN: AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5230. A reply will be furnished to you. You may also send in your comments electronically to our e-mail address: 2028@redstone.army.mil, or FAX 256-842-6546/DSN 788-6546

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CHANGE 1

*This bulletin supersedes TB 9-5210-205-50, 11 February 1975, including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument identification. This bulletin provides instructions for the calibration of Gage Blocks, Grades 1, 2, and 3 (GGG-G-15B). National Bureau of Standards Handbook 77, Volume III, and Federal Specification GGG-G-15B were used as the prime data sources 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. DA Form 2416 (Calibration Data Card). Forms, records, and reports required for calibration personnel at all levels are prescribed by TB 750-25. DA Form 2416 must be annotated in accordance with TB 750-25 for each calibration performed.

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

Table 1. Calibration Description

Grade	Characteristic	Calibration tolerances
"1" - Laboratory reference (formerly grade AA)	Size	±0.000004 in. up to 1 in. of length increased 0.000004 in. for each additional in. of length
	Flatness and parallelism	In accordance with FED SPEC GGG-G-15B for grade "1" blocks.
	Surface finish	Based upon wringing qualities and definitions of fringe pattern as produced by interferometer
"2" - Laboratory reference (formerly grade A)	Size	±0.000010 in. up to 1 in. of length, increased 0.000010 in. for each additional in. of length
	Flatness and parallelism	In accordance with FED SPEC GGG-G-15B for grade "2" blocks
	Surface finish	Based upon wringing qualities and definitions of fringe pattern as produced by interferometer
"3" - Laboratory inspection (formerly Grade A)	Size	±0.000010 in. up to 1 in. of length, increased 0.000010 in. for each additional in. of length
	Flatness and parallelism	0.000010 in.
	Surface finish	Based upon wringing qualities

Table 1. Calibration Description

Grade	Characteristic	Calibration tolerances
"3" - Shop working (formerly grade B and Transfer Team standard)	Size	±0.000020 in. up to 1 in of length, increased 0.000020 in. for each additional in.
	Flatness and parallelism	0.000012 in
	Surface finish	Based upon wringing qualities

NOTE

At recalibration periods, replacement is necessary for individual blocks which deviate more than twice in length, and tolerances double for flatness and parallelism for new blocks, or which have lost their wringing quality. Blocks which have only undergone a length change do not need replacement if corrections from a calibration report are applied. When recalibration indicates that 25 percent or more of the blocks in a set should be replaced, the entire set will be assigned to lower accuracy work.

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 when the equipment listed in table 2 is not available. The items selected must be verified to perform satisfactory prior to use and must bear evidence of current calibration. The equipment must meet of exceed minimum use specifications listed in table 2. The accuracies listed in table 2 provide a four-to-one ratio between the standard and TI.

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 2. Minimum Specifications of Equipment Required

Item	Common name	Minimum use specifications	Manufacturer and model (part number)
A1	COMPARATOR	Range: 0 to 4 in. Accuracy: ±0.000002 in	Sheffield, Model SHC 700-100 (7913365)
A2	OPTICAL FLAT	Range: Double reference Accuracy: ±0.000002 in.	Van Keuren Co. (7902794)
A3	GAGE BLOCKS	Range: 0.050 to 20 in. Accuracy: +0.000006 in., -0.000002 in. up to 1 in. and for each additional in.	Pratt & Whitney, Fonda, Starrett, Doall (7900787, 7900512, 7901765, 7901267, 7901763, and 7910634)
A4	HEIGHT GAGE	Range: 4 to 20 in.	Airborne Inst. Lab

		Accuracy: ±0.000010 in.	(7904823)

Table 3. Accessories Required

Item	Common name	Description (part number)
B1	ALCOHOL	Ethyl, 1-gallon container (MIL-E-463A) (95% USP) 51-A-1965
B2	BARRIER MATERIAL	Polyethylene (MIL-B-121)
B3	BEAKER	Glass, capacity 1000 ml (6640-240-6829)
B4	BRUSH	1-1/16-in. length; 3/4-in. diameter ferrule (8020-224-8024)
B5	BRUSH	8-1/2-in. o/a length; 1/2-in. diameter x 3 in. long (7920-223-8002)
B6	CAN[1]	Bench, safety, 9-1/2 x 4-1/2 in. (Justrite No. 10370)
B7	CAN[1]	Safety (w/screen), 5-gallon capacity (McMasters Can No. 429lX3, Screen No. 429lX8)
B8	ULTRASONIC CLEANER	Crest Company (4931-682-1027)
B9	CUSHIONING MATERIAL[1]	Kimpac or equivalent
B10	DEMAGNITIZER	Taft-Pierce, No. 9801-2 (7910422)
B11	DEBURRING KIT	Various abrasive tools w/case (7913148)
B12	FORCEPS	Straight, 5 in.
B13	FORCEPS	Straight, 10 in.
B14	GLOVES[1]	Rubber or plastic, insulated
B15	HEATSEALER WITH THERMOSTATIC CONTROL	115 V ac
B16	MONOCHROMATIC LIGHT	Van Keuren, No. C-2 or equivalent (7902779)
B17	OIL	Fed Spec W.-L-800 (9150-231-6689)
B18	POLISHING CLOTH	Cotton, batiste, white, 4 x 6 inch (7920-263-2765)
B19	POLYETHYLENE TUBING[1]	Lay flat, Fed Spec L-F-378b. Packaging aids Corp. Stock numbers, 1CT, 11/2CT, 2CT, and 21/2 CT
B20	RUST REMOVER	"Noxon" nonabrasive polish or equivalent (7930-266-7136)
B21	SCISSORS	6- or 8-in. size
B22	SOLVENT	P-D-680 dry cleaning or equivalent P-D-680 (6850-281-1986)
B23	SURFACE PLATE	Varied (Fed. Spec GGG-P-463B) (7900123)
B24	TAPE	Pressure sensitive masking tape (PPP-T-60)
B25	WOODEN TRAY[1]	15 x 10 x 3/4 in.

[1]Procure locally.

SECTION III
CALIBRATION PROCESS

6. General Information

a. Grade 1 Blocks. Subparagraphs (1) through (3) below pertain only to those activities having gage blocks of grade 1 accuracy.

NOTE

Grade 1 blocks will be calibrated with an interferometer at primary level.

(1) A master set of grade 1 gage blocks must be used in mechanical comparison check of other grade 1 gage blocks requiring calibration.

(2) Optical flats with a monochromatic light or interferometer may be used for flatness tests. If the interferometer is used, place blocks on the platen and adjust alignment screw until the desired fringe patterns appear. Refer to figure 1 for interpretation of fringe lines and table 1 for allowable tolerances.

(3) Tolerances for surface finish, flatness and parallelism, and size will be within those specified for grade 1 gage blocks.

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.

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 1 for tolerance.

(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 worksheets.

d. Establishing Stability

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

(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.

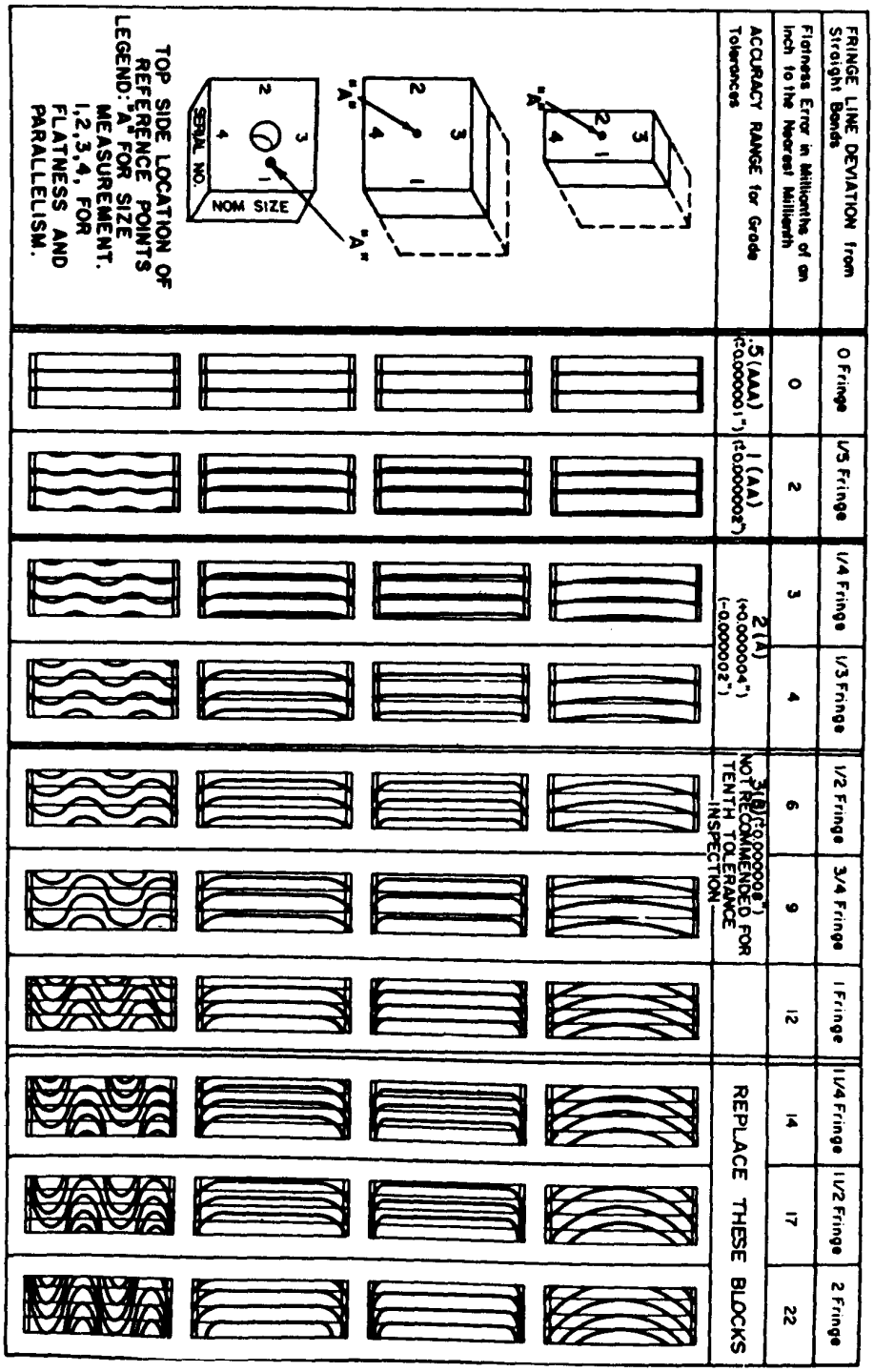

Figure 1. Typical gage block calibration data.

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 and item identification number as listed in tables 2 and 3. For the identification of equipment referenced by item numbers prefixed with A, see table 2, and for prefix B, see table 3.

NOTE

Unless otherwise specified, verify the result of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in the manufacturer's manual for this TI.

NOTE

Unless otherwise specified, all controls and control settings refer to the TI.

8. Equipment Setup

a. Clean the TI, using light duty cycle of ultrasonic cleaner (B8). Place a beaker (B3) of alcohol (B1) into an energized tank of warm water. Wait approximately 5 minutes and insert TI into beaker. If necessary, use a soft brush (B4) to remove dirt, grime, or grease. If ultrasonic cleaner is not available, use the following alternate method:

b. Clean TI with solvent (B22) and wipe dry with polishing cloth (B18). Use brush (B5) for cleaning holes in square TI.

c. Remove any rust or stains with nonabrasive rust remover (B20). Discard all blocks containing pits which will prevent accurate calibration.

d. Clean TI with alcohol and place on polishing cloth in a wooden tray (B25).

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 (B10).

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

i. If necessary, slide the wringing surfaces of each TI across a deburring plate (part of B11), applying light pressure to shear off any large burrs that may be present.

j. Repeat (2) above, using a deburring stone (part of B11).

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

l. To insure good wringing quality and complete removal of burrs, use an optical flat (A2) to check TI for wringing quality.

m. Place monochromatic light (B16) on bench, preferably at an inside wall, away from windows or bright lights. If a semi-lighted space is not available, place monochromatic light within a screen of dark cloth. Connect monochromatic light to ac source.

n. Allow gage blocks to normalize at room temperature 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 (B14) or forceps (B12 or B13).

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

(a) Place TI under monochromatic light (B16) and lay the principal face of optical flat (A2) on surface to be tested. Apply light pressure directly above one of the edges 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) on a calibration worksheet.

NOTE

Record data on worksheet for TIs that exceed the applicable flatness error listed in table 1.

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

NOTE

Since the majority of tolerance grades 2 and 3 blocks under 0.100 inch (2.5 mm) in length are not precisely flat, the test for parallelism is considered sufficient. Therefore, in this instance, no flatness entries will be recorded on the worksheet for these gage blocks. The optical flat will be used to examine blocks under 0100 (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 (A3) (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.

(3) Using comparator (A1) for blocks up to 4 inches or height gage (A4), and surface plate (B23) for blocks greater than 4 inches, measure parallelism and size at five reference points (A, fig. 1) on each block.

NOTE

Handle blocks with forceps (B12 or B13). Gloves (B14) may be used for blocks over 4 inches.

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

(5) Zero the gage head. Remove master block and insert TI.

(6) Take readings at the five reference points (A, fig. 1).

(7) Record meter reading in millionths of an inch with proper signs on calibration worksheet, as observed when gage points were contacting the designated reference point for length measurement.

(8) Record the four meter readings in respective columns on calibration worksheet in millionths of an inch with proper signs, as observed when gage point was oriented at designated positions across width and along length of TI.

(9) Remove TI and again insert master block to insure that proper setting of instrument was maintained during measurement.

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

(11) Compute length deviation of gage block as follows:

(a) Record deviation and proper sign, shown on certificate for master block on calibration worksheet.

(b) Compute the algebraic sum of values recorded on calibration worksheets. Enter the values computed, with proper sign, in separate area of calibration worksheet. These entries will be the calibrated deviations from nominal size of newly calibrated blocks.

(12) Compute parallelism as follows:

(a) Compute difference between entries made on calibration worksheets under parallelism observations; give strict attention to signs.

(b) Enter appropriate value obtained in (a) above as "Crosswise Error" in parallelism. This is total parallelism error and requires no sign.

(c) Enter appropriate value obtained in (a) above as "Lengthwise Error" in parallelism. This is total parallelism error and requires no sign. The TI will not exceed the applicable parallelism value listed in table 1.

b. Adjustments. No adjustments can be made.

11. Final Procedure

a. Transfer individual block identification and size deviation on two typed copies of calibration worksheets. One copy will be maintained by the calibration facility and one will be packaged with the TI. Add all pertinent information.

b. Submit typed worksheets prepared for signature.

c. Preserve TI as follows:

(1) Wipe each TI with clean polishing cloth (B18) and apply thin coat of oil (B17). Insure that all surfaces are covered.

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

(a) Select appropriate size polyethylene tubing (B19) and cut length of tubing long enough to completely sheath TI, using scissors (B21).

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

(c) Insert TI in tubing and seal close to TI with heatsealer with thermostatic control (B15).

(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 (B9) to protect TI's as required.

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

(1) Place smooth side of barrier material (B2) directly on top of TI in opened case.

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

(3) Place calibration worksheets 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 (B24) to prevent case from coming open during transit.

e. 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. Calibration labels will reflect the interval designated for the operation. 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.

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By Order of the Secretary of the Army:

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General, United States Army
Chief of Staff

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