TB 9-6670-254-50

CHANGE 3

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR WEIGHTS (MASS) (GENERAL)

Headquarters, Department of the Army, Washington, DC
5 November 1990

TB 9-6670-254-50, 1 November 1984, 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***
13 and 14	13 and 14

2. File this change in front of the publication for reference purposes. **This change incorporates DA Form(s) 2028 dated 24 July 1990**.

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

THOMAS F. SIKORA
Brigadier General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with STD IDS No. RLC-1500, 25 January 1989.

PIN: 011463-003

TB 9-6670-254-50

CHANGE 2

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR WEIGHTS (MASS) (GENERAL)

Headquarters, Department of the Army, Washington, DC
18 June 1987

TB 9-6670-254-50, 1 November 1984, 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***
3 and 4	3 and 4

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

By Order of the Secretary of the Army:

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Distribution:
To be distributed in accordance with STD IDS No. RLC-1500, 25 January 1989.

PIN: 011463-002

TB 9-6670-254-50

CHANGE 1

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR WEIGHTS (MASS) (GENERAL)

Headquarters, Department of the Army, Washington, DC
25 July 1985

TB 9-6670-254-50, 1 November 1984, 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
15 through 18	15 through 18

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

By Order of the Secretary of the Army:

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General, United States Army
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Official:

DON J. DELANDRO
Brigadier General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with Std. IDS No. RLC-1500, 9 September 1982.

PIN: 011463-001

REPRINT INCLUDES CHANGES 1 THROUGH 3

*TB 9-6670-254-50

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR WEIGHTS (MASS) (GENERAL)

Headquarters, Department of the Army, Washington, DC
1 November 1984

♦REPORTING OF ERRORS♦

You can help improve this publication by calling attention to errors and by recommending improvements and stating your reasons for the recommendations. Your letter or DA Form 2028, Recommended Changes to Publications, should be mailed directly to Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-TMD-EP, Redstone Arsenal, AL 35898-5000. FAX to DSN 788-2313 (commercial 205-842-2313). A reply will be furnished directly to you.

*This bulletin supersedes TB 9-6670-254-50, 12 November 1974, including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Weights (Mass) General within the range up to 200 pounds. NBS Circular 3, Section V, and NBS Circular 547, Section 1, 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, except in paragraph 12. The J5000S will be referred to as TI.

a. Model Variations. None.

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

2. DA Form 2416 (Calibration Data Card)

a. 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.

b. Adjustments to be reported on DA Form 2416 are designated (R) at the end of the sentence in which they appear. When adjustments are in tables, the (R) follows the designated adjustment. Report only those adjustments made and designated with (R).

3. Calibration Description. TI parameters and performance specifications which pertain to this calibration are listed in tables 1 through 6.

NOTE

Secondary Reference Laboratories are not equipped to calibrate Class S and S-1 weights over the entire range. Tables 4 through 6 are included to allow calibration and intercomparison of weights where the tolerances can be met.

Table 1. Tolerance of 1/128-Ounce to 200-Pound Weights, Class C, Q, and T

Test instrument pound	Gram equivalent[1]	Tolerance (Mg)		
		C	Q	T
200	90718.474	N/A	9000	28,000
100	45359.237	N/A	4600	14,000
50	22679.619	1296	2200	8200
25	11339.809	778	1140	4800
20	9071.847	778	900	4000
15	6803.886	648	680	3400
10	4535.924	518	460	2600
9.5[1]	4309.128	486	435	---
8	3628.739	390	360	2200

See footnote at end of table.

Table 1. Tolerance of 1/128-Ounce to 200-Pound Weights, Class C, Q, and T - Continued.

Test instrument	Gram equivalent[1]	Tolerance (Mg)		
		C	Q	T
5	2267.962	390	220	1620
5 (APN 7916702)[1]	2267.962	- - -	- - -	9000
4	1814.369	260	182	1400
3	1360.777	260	136	1160
2	907.185	194	92	880
1	453.592	130	54	540
Ounce				
10	283.495	130	38	400
8	226.796	64	32	340
5	141.748	64	24	260
4	113.398	64	19	220
2	56.699	39	12	140
1	28.350	26	8	84
1/2	14.175	26	5	54
1/4	7.087	13	3	34
1/8	3.544	6	2	20
1/16	1.772	6	N/A	13
1/32	0.886	6	N/A	9
1/64	0.443	3	N/A	6
1/128	0.221	3	N/A	4

[1]Special application.

Table 2. Tolerance of 1 mg to 25 kg Gram Weights, Class P, Q, C, and T

Test instrument	Tolerance (Mg)			
	P	Q	C	T
25 kg	1000	2400	- - -	9000
20 kg	800	2000	1200	7600
10 kg	400	1000	800	4400
5 kg	200	500	500	2800
3 kg	120	300	- - -	2000
2 kg	80	200	300	1500
1 kg	40	100	200	940
500 g	20	60	140	600
300 g	12	40	- - -	420
200 g	8.0	30	80	320
100 g	4.0	18	60	200
50 g	2.4	11.2	40	124
30 g	1.8	8.0	- - -	88
20 g	1.4	6.0	20	66
10 g	1.0	4.0	14	42
5 g	.72	2.6	10	26
3 g	.60	1.95	- - -	18.8
2	.52	1.50	6.0	14.0
1 g	.40	1.00	4.0	9.0
500 mg	.32	.76	3.0	6.0
300 mg	.28	.60	- - -	4.4
200 mg	.24	.52	1.4	3.6
100 mg	.20	.40	1.0	2.4
50 mg	.17	.30	.70	1.36

Table 2. Tolerance of 1 mg to 25 kg Gram Weights, Class P, Q, C, and T - Continued.

Test instrument	Tolerance (mg)			
	P	Q	C	T
30 mg	.15	.28	- - -	1.36
20 mg	.14	.24	.40	1.12
10 mg	.12	.20	.30	.80
5 mg	.11	.16	.20	- - -
3 mg	.104	.14	- - -	- - -
2 mg	.100	.14	.10	- - -
1 mg	.100	.10	.08	- - -

Table 3. Tolerance of 1 to 100-Grain Weights, Class C

Test instrument grain	Tolerance (mg)
1	0.3
2	0.6
5	1.0
10	1.3
20	1.9
50	3.2
100	6.5

Table 4. Tolerances for Class S-1 Weights[1]

Avoirdupois		Troy		Apothecary	
Test instrument pound	Tolerance (mg)	Test instrument ounce	Tolerance (mg)	Test instrument ounce	Tolerance (mg)
100	450	1000	310	12	3.8
- - -	- - -	- - -	- - -	10	3.1
50	230	500	160	8	2.5
25	110	300	91	- - -	- - -
20	91	200	62	6	1.9
10	45	100	31	5	1.6
- - -	- - -	- - -	- - -	4	1.2
8	36	50	16	- - -	- - -
5	23	30	9.1	3	0.91
4	18	20	6.2	2	.70
- - -	- - -	10	3.1	1	.45
3	14	- - -	- - -	- - -	- - -
2	9.1	5	1.6	Dram	- - -
1	4.5	3	0.91	- - -	- - -
0.5	2.3	2	0.70	6	.38
0.2	0.91	1	0.45	5	.34
0.1	0.58	- - -	- - -	4	.31
- - -	- - -	0.5	0.31	- - -	- - -
0.5	0.38	0.3	0.24	3	.27
0.02	0.24	0.2	0.20	2	.22
0.01	0.17	0.1	0.15	1	.16
0.005	0.13	0.05	0.12	Scruple	- - -
- - -	- - -	0.03	0.097	- - -	- - -
Ounce	- - -	0.02	0.085	2	.14
10	2.8	0.01	0.070	1	.11

See footnote at end of table.

Table 4. Tolerances for Class S-1 Weights[1] - Continued.

Avoirdupois		Troy		Apothecary	
Test instrument	Tolerance (mg)	Test instrument	Tolerance (mg)	Test instrument	Tolerance (mg)
8	2.3	- - -	- - -	- - -	- - -
5	1.4	Pennyweight	- - -	- - -	- - -
- - -	- - -	10,000	160	- - -	- - -
4	1.1	- - -	- - -	- - -	- - -
2	0.65	5000	78	- - -	- - -
1	0.43	3000	47	- - -	- - -
- - -	- - -	2000	31	- - -	- - -
1/2	0.30	1000	16	- - -	- - -
1/4	0.21	- - -	- - -	- - -	- - -
1/8	0.16	500	7.8	- - -	- - -
- - -	- - -	300	4.7	- - -	- - -
1/16	0.12	200	3.1	- - -	- - -
1/32	0.095	100	1.6	- - -	- - -
1/64	0.078	- - -	- - -	- - -	- - -
- - -	- - -	50	0.80	- - -	- - -
- - -	- - -	30	0.58	- - -	- - -
- - -	- - -	20	0.45	- - -	- - -
0.5	0.30	10	0.31	- - -	- - -
0.3	0.23	- - -	- - -	- - -	- - -
0.2	0.19	5	0.22	- - -	- - -
0.1	0.14	3	0.17	- - -	- - -
- - -	- - -	2	0.15	- - -	- - -
0.05	0.11	1	0.12	- - -	- - -
0.03	0.095	- - -	- - -	- - -	- - -
0.02	0.080	- - -	- - -	- - -	- - -
0.01	0.066	- - -	- - -	- - -	- - -

[1]Not more than one-third of the weights of a set of new or newly adjusted weights may be in error by more than one-half of these tolerances, and all weights must be correct within these tolerances.

Table 5. Tolerances for Class S-1 Weights

Grain		Metric		Carat	
Test instrument	Tolerance (mg)	Test instrument kilogram	Tolerance (mg)	Test instrument	Tolerance (mg)
10,000	6.5	50	500	2500	5.0
- - -	- - -	25	250	2000	4.0
5000	3.2	20	200	1000	2.0
2000	1.3	10	100	- - -	- - -
1000	0.72	- - -	- - -	500	1.0
- - -	- - -	5	50	200	0.52
500	0.48	3	30	100	0.35
200	0.28	2	20	- - -	- - -
100	0.20	1	10	50	0.25
- - -	- - -	- - -	- - -	20	0.16
50	0.15	Gram	- - -	10	0.13
20	0.11	- - -	- - -	- - -	- - -
10	0.086	500	5.0	5	0.10
- - -	- - -	300	3.0	2	0.075
- - -	- - -	200	2.0	1	0.060

Table 5. Tolerances for Class S-1 Weights - Continued.

Grain		Metric		Carat	
Test instrument	Tolerance (mg)	Test instrument	Tolerance (mg)	Test instrument	Tolerance (mg)
- - -	- - -	100	1.0	- - -	- - -
- - -	- - -	50	0.60	- - -	- - -
- - -	- - -	30	0.45	- - -	- - -
- - -	- - -	20	0.35	- - -	- - -
- - -	- - -	10	0.25	- - -	- - -
- - -	- - -	5	0.18	- - -	- - -
- - -	- - -	3	0.15	- - -	- - -
- - -	- - -	2	0.13	- - -	- - -
- - -	- - -	1	0.10	- - -	- - -

Table 6. Acceptance Tolerances for Class S Weights[1]

Test instrument kilogram	Tolerance (mg)
25	62
20	50
10	25
5	12
3	7.5
2	5.0
1	2.5
Gram	
500	1.2
300	0.75
200	.50
100	.25
50	.12
30	.074
20	.074
10	.074
5	.054
3	.054
2	.054
1	.054

[1]Maintenance tolerances for weights below 100 mg are the same as the acceptance tolerances. For weights 100 mg and above, the maintenance tolerances are twice the acceptance tolerances.

SECTION II
EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 7 identifies the specific equipment to be used in this calibration procedure. This equipment is issued with Secondary Reference Calibration Standards Set NSN 4931-00-6217878. Alternate items may be used by the calibrating activity when the equipment listed in table 7 is not available. The items selected must be verified to perform satisfactorily prior to use and must bear evidence of current calibration. The equipment must meet or exceed the minimum use specifications listed in table 7. The accuracies listed in table 2 provide a four-to-one ratio between the standard and TI. Where

the four-to-one ratio cannot be met, the actual accuracy of the equipment selected is shown in parenthesis.

5. Accessories Required. The accessories listed in table 8 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 7. Minimum Specifications of Equipment Required

Item	Common name	Minimum use specifications	Manufacturer and model (part number)
A1	BALANCE (DOUBLE PAN)	Range: 10 to 200 lbs Accuracy: 65 mg at full load	Tromner, Model 175G (7910450)
A2	BALANCE (SINGLE PAN)	Range: 1 mg to 5 kg Accuracy: 1.5 mg (4.5 mg)	Voland Corp., Model J5000S (MIS-10410)
A3	BALANCE (DOUBLE PAN)	Range: 0.1 mg to 250 g (0.3 mg)[1] Accuracy: 0.1 mg at full load	Voland Corp., Model 200-B (7907117)
A4	DIGITAL VOLTMETER	Range: 0 to 1100 mV Accuracy: ±0.5%	Hewlett-Packard, Model 3490AOPT060 (3490AOPT060)
A5	WEIGHT	Range: 50 lbs (1 each) Accuracy: NBS Class S-1	(7909945)
A6	WEIGHT	Range: 20 lbs (1 each) Accuracy: NBS Class S-1	(7910453)
A7	WEIGHT SET	Range: 0.001 to 0.5 lb (1 each 0.001, 0.005, 0.01, 0.05, 0.1, 0.5 lb) (2 each 0.002, 0.02, 0.2 lb) Accuracy: NBS Class S-1	(7907377)
A8	WEIGHT SET	Range: 1 to 25 lbs (1 each 1, 5, 25 lbs) (2 each 2, 10 lbs) Accuracy: NBS Class S-1	(7907378)
A9	WEIGHT SET	Range: 1/64 to 10 oz (1 each 1/32, 1/16, 1/8, 1/4, 1/2, 1, 2, 4, 5, 10 oz) (2 each 1/64 oz) Accuracy: NBS Class S-1	(7909971)

See footnote at end of table.

Table 7. Minimum Specifications of Equipment Required - Continued.

Item	Common name (official nomenclature)	Minimum use specifications	Manufacturer and model (part number)
A10	WEIGHT SET	Range: 1 mg to 100 g (1 each 1, 2, 3, 5, 10, 20, 30, 50, 100 g) (1 each 1, 2, 3, 5, 10, 20, 30, 50, 100, 200, 300, 500 mg) Accuracy: NBS Class S	(7907068)
A11	WEIGHT SET	Range: 100 g to 1 kg (1 each 100 g, 500 g, 1 kg) (2 each 200 g) Accuracy: NBS Class S	(7907379)

[1]This balance should not be used to calibrate weights which have a tolerance less than 0.3 mg.

Table 8. Accessories Required

Item	Common name (official nomenclature)	Description (part number)
B1	LEAD[1]	32-in., single banana plug to test hook (red) (7915941-1)

[1]Two required.

SECTION III
CALIBRATION PROCESS

6. Preliminary Instructions

a. The instructions outlined in paragraphs **6** and **7** 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 7 and 8. For the identification of equipment referenced by item numbers prefixed with A, see table 7, and for prefix B, see table

WARNING

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions.

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. Adjustment required to calibrate the TI are included in this procedure. Additional maintenance information is contained in NBS Circular 3, Section V, and NBS Circular 547, Section I, for this TI.

NOTE

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

7. Equipment Setup

NOTE

In order to have an accurate mass calibration, the accuracy of the standard should be considered since the amount of error in the standard may determine whether the TI is within tolerance. For this reason, the Primary Laboratory Report for the Class S and S-1 reference standard weights must be used.

a. Insure that balances (A1 through A3) are visually clean, free of obvious vibration, direct sunlight, draft, and direct heat radiation.

NOTE

To perform calibration, establish center rest point on balance before each TI weighing.

b. Clean TI with methyl alcohol and allow ambient stabilization of 4 hours for weights 1 pound or less, and 12 hours for weights over 1 pound.

c. The direct weighing method is to be used to check Class C, Q, and T commercial weights. This method consists of using both double and single pan balances for comparing the weights to Class S or S-1 standard weights.

NOTE

For convenience, table 1 shows the avoirdupois and gram equivalent for the size weights utilized by Army calibration teams (1 pound mass 453.59237 grams).

NOTE

Balance (A2) should not be used for direct weighing of lower class weights (Class C, Q, and T) with a minimum tolerance value better than 18 mg, if a four-to-one accuracy ratio is desired.

d. Balance (A2) is to be used, when performing the double substitution method, for weights up to 5000 grams (11 pounds) which have a tolerance above 4.5 mg. Balance (A1) is to be used for weights above 5000 g. Balance (A3) is to be used for weights which have a tolerance of 0.3 to 4.5 mg. Balance (A3) should not be used for calibration of weights which have a tolerance of less than 0.3 mg.

e. Class C, Q, and T weights may be calibrated by the direct weighing method (without comparison to standard weight), using balance (A2), provided it has been calibrated and minimum tolerance exceeds 18 mg (see note above). Paragraph 13 provides the procedure for calibrating the balance.

8. Direct Weighing - Double Pan Balance

a. Performance Check

NOTE

Balance (A1 or A3) must be arrested before placing or removing weights. Balance (A2) must be arrested before changing the 100g or 1 kg knobs.

(1) Place TI on left pan of appropriate balance, depending on value of weight being measured.

(2) Place standard weight of nominal value (appropriate weight set (A5 through A11), if possible, on right pan of balance. Pans should be near balance.

NOTE

Balances (A1 and A3) are not equipped with dampening mechanisms. The pan arrestment handles may be used to manually dampen balance as much as possible to decrease settling time to equilibrium. Small, approximately equal, oscillations on both sides of scale can be considered as an equilibrium position.

(3) Place incremental weights from appropriate standard weight set, on lighter pan to bring balance to equilibrium position.

(4) Transpose just the standard weight and TI, keeping incremental weight on same pan as before. As necessary, add additional incremental weight to lighter pan to

return balance to equilibrium. if weights are added to pan containing the standard, then weight value of TI is equal to total of standard and one half the added weight values from primary test report. If weights are added to pan containing TI, then weight value of TI is equal to difference of standard, and one half the added weight values from primary test report. The additional weight required will not exceed tolerance listed in the appropriate tolerance table. If tolerance is exceeded, perform **b** below (R).

(5) Repeat (1) through (4) above for each weight being calibrated, using tolerance listed in appropriate tolerance table.

b. Adjustments. Adjust weight, using appropriate procedure of paragraph **14** below.

9. Direct Weighing-Single Pan Balance

a. Performance Check

(1) Lock dials on balance (A2) and zero adjust balance.

NOTE

A false zero will result if dials are between any two numbers.

(2) Place standard weight (A7 through A11) (of value corresponding to value of TI) on balance pan.

(3) Dial weights on balance until indication is on scale (IN-RANGE marker is illuminated). Record weight reading.

NOTE

If necessary, to bring balance in range and illuminate the automatic milligram scale IN-RANGE marker, the same amount of incremental weight may be added to pan for both weightings. For larger differences, between standard and TI, a standard weight may be added to lighter weight to bring balance in range.

(4) Remove standard weight.

(5) Place TI on balance pan and record weight reading. If value read for TI is greater than the standard (recorded in (3) above), add difference to weight value of standard from primary report to obtain calibrated value of TI. If value read for TI is less than standard, subtract difference from standard weight value. Weight difference will not exceed tolerance listed in appropriate tolerance table. If tolerance is exceeded, perform **b** below (R).

(6) Repeat (2) through (5) above f or each weight being calibrated, using tolerance listed in appropriate tolerance table.

b. Adjustments. Adjust weight, using appropriate procedure of paragraph **14**.

10. Single Transposition

a. Performance Check

NOTE

Balances (A1 or A3) are to be used for the single transposition method.

(1) Place TI weight on left pan of appropriate double pan balance.

(2) Place standard weight of same nominal value (from appropriate weight set) (A5 through A11) on right pan of balance

NOTE

Several smaller weights may be summed to make up the standard.

(3) Observe oscillations. Record five turning points of balance pointer, using worksheet similar to table 9.

Table 9. Worksheet (Single Transposition)

Observation number	Load		Turning points (5 points) R L R L R
	Left pan	Right pan	
(0_1) A-B	A (TI)	B (Std)	- - -
(0_2) B-A	B	A	- - -
(0_3) B + M-A	B + M	A	- - -
(0_4) A+M-B[1]	A + M	B	- - -

[1]When necessary, an additional check (04) which makes up the double transposition method, may be used, resulting in the following formula:

$$A = B + K \frac{(0_1 - 0_2 + 0_4 - 0_3)}{4}$$

NOTE

The recorded value for each turning point may be estimated in tenths of smallest division. Oscillations to left of center are used in calculations with a minus (-) sign and oscillations to right of center are used with a plus +) sign.

(4) Transpose TI and standard weights and repeat (3) above.

(5) Select sensitivity weight of value large enough to be significant in weighing procedure but small enough that balance pointer will remain on scale when it is added to balance

NOTE

A sensitivity weight must be chosen for each different weight to be calibrated since sensitivity of balance changes with different weight loads.

(6) Place sensitivity weight on appropriate pan so that balance pointer will oscillate and remain on scale.

NOTE

If necessary, a small incremental weight may-be added to appropriate pan to cause oscillations. This weight is to remain with weight added to, when transposed.

(7) Repeat (3) above. A total of three observations is now recorded with five turning points for each observation

(8) Select last three turning points of each observation recorded on worksheet and average, using formula below:

Equilibrium position = $\frac{T1+T_3+2T_2}{4}$ for each observation (0_1, 0_2, 0_3). Subscripts 0_1, 0_2, and 0_3 indicate the order in which observations occurred).

(9) Compute value of TI weight, using the following formula:

$$A = B + K \frac{(0_1 - 0_2)}{2}$$

Where A = Value of TI weight
B = Value of standard weight
$K = \frac{m}{0_3 - 0_2}$
M = Value of sensitivity weight

EXAMPLE:
The following example was taken from a special purpose weight calibration problem using the single transposition method with a large double pan balance.
Standard weight (B) made by summing standard S-1 weights was equal to 44.800 lbs, the approximate nominal value of the test weight. An S-1 sensitivity weight (M) of 0.005 lb was chosen.

$$0_1 = \frac{T_1 \pm T_3 \pm 2T_2}{4} = \frac{R_1 \pm R_2 - 2L_1}{4}$$

$$\frac{3.5 \pm 3 - 2(3)}{4} = 0.125$$

Similarly: $0_2 = -0.25$ and
$0_3 = 0.3125$

(continued)

Therefore:

$$A = B + K \frac{(0_1 - 0_2)}{2}\ ;\ K = \frac{M}{0_3 - 0_2}$$

$$A = 44.800 + \frac{0.005}{\frac{0.3125 - (-0.250)}{2}} \text{ X (times)}$$

A = 44.8000 + 0.0088889 X 0.1875
A = 44.800 + 0.00167 = 44.80167
A = 44.80167 lbs.

(10) Determine difference between TI and nominal value. Difference will not exceed the tolerance table. If tolerance is exceeded, perform **b** below (R).

(11) Repeat (1) through (10) above for each weight being calibrated, using tolerance listed in appropriate tolerance table.

b. Adjustments. Adjust weight, using appropriate procedure of paragraph 14 below.

11. Double Substitution

a. Performance Check

NOTE

Balance (A2) is to be used for double substitution method.

(1) Lock dials on balance and zero adjust.

NOTE

A false zero will result if dials are between any two numbers. Balance (A2) must be arrested before changing 100 g or 1 kg knobs.

(2) Place standard weight (A5 through A11) (of value corresponding to value of TI) on balance pan.

NOTE

Several smaller weights may be summed up to make up the standard.

(3) Dial weights on balance until indication is on scale (IN-RANGE marker is illuminated). Record indication on worksheet similar to table 10.

(4) Remove standard weight.

(5) Place TI on balance pan and record indication on worksheet.

Table 10. Worksheet (Double Substitution)

Observation nmber	Load	Balance idications
0_1	B (Std)	- - -
0_2	A (TI)	- - -
0_3	A + M	- - -
0_4	B + M	- - -

(6) Select sensitivity weight of value large enough so that balance remains on scale when it is added to both standard and TI weighings.

NOTE

If necessary, add the same amount of incremental weight to pan for each weighing to bring balance in range marker.

(7) Place sensitivity weight on balance pan and record indication.

(8) Replace TI with standard and record indication (a total of four readings is now recorded). Do not remove sensitivity weight.

(9) Compute weight value of TI, using the following formula:

$$A = B + K \frac{(0_2 - 0_1 \pm 0_3 - 0_4)}{2}$$

Where: A = Value of TI weight
B = Value of standard weight
$K = \frac{M}{0_3 - 0_2}$
M = Value of sensitivity weight

Subscripts indicate the order of weighings.

EXAMPLE:
TI weight (A) = 5 lbs or 2267.9619 g nominal value

Standard weight (B) = 4.9999902 lbs or 2267.957405 g from Primary Calibration Report

Sensitivity weight (M) = 100 mg

NOTE

A 500-mg IW (incremental weight) is used during all weighings to bring milligram scale IN-RANGE, between 2268 and 2269 g.

0_1 = B + IW = 2268.445 g
0_2 = A + IW = 2268.449 g
0_3 = A + M + IW = 2268.549 g
0_4 = B + M + IW = 2268.546 g

$$A = B + K \frac{(0_2 - 0_1 \pm 0_3 - 0_4)}{2}$$

$$K = \frac{M}{(0_3 - 0_2)} \quad M = 0.100 \text{ g}$$

$$A = 2267.957 + \frac{0.100}{(2268.549 - 2268.449)} \left(\frac{(2268.449 - 2268.445 \pm 2268.549 - 2268.546)}{2} \right)$$

A = 2267.961 g

(10) Determine deference between TI and nominal value. Difference will not exceed tolerance value listed in appropriate tolerance table. If tolerance is exceeded, perform **b** below (R).

(11) Repeat (2) through (10) above for each weight being calibrated, using tolerance listed in appropriate tolerance table.

b. Adjustments. Adjust weight, using appropriate procedure of paragraph **14** below.

12. J5000S Balance Calibration

a. Performance Check

NOTE

TI is to be checked at cardinal points listed in tables 1 and 2 within TI range. Use table 2 for 500 grams and lower cardinal points.

(1) Select weight combination (from appropriate weight set (A4 through A10), Class S or S-1) for each cardinal point of TI listed in tables 1 and 2.

(2) Energize TI and allow sufficient warm-up time.

(3) Zero and calibrate TI as indicated in **(a)** through **(h)** below.

(a) Adjust dials until indicator reads 0000.

(b) Turn arrest-release lever fully ccw (released). Pilot light (inside chamber) will illuminate.

(c) Press ZERO pushbutton momentarily. Digital display will indicate .000-IN-RANGE.

NOTE

If there are interferences to pan, indication may vary ± 1 digit.

(d) Turn arrest-release lever to stop or locked position.

(e) Rotate STANDARD WEIGHT 1 GM knob so that 1 GM standard is applied to balance.

(f) Release beam with arrest release lever (fully ccw).

(g) Press CALIBRATE pushbutton momentarily. The indicator will read .000-OVER.

NOTE

If there are interferences to pan, indication may vary ± digits and number displayed may be .999-IN RANGE, .000-OVER, .001-OVER.

NOTE

Pan must be located before placing or removing weights.

(h) Turn arrest-release lever cw to stop or locked position and rotate STANDARD WEIGHT 1 GM knob to remove 1 GM standard from balance.

(4) Connect digital voltmeter (A4) to blue and green wires on output terminals or connecting plug of TI transducer, using test lead (B1). (Terminal strip is located in TI beam chamber). If digital voltmeter does not indicate between 50 and 100 mV, perform **b**(1) below.

(5) Turn control knob on side of TI until yellow strip is visible for 1 gram standard on beam. If digital voltmeter does not indicate between 800 and 1100 mV, perform **b**(2) below.

(6) Lift TI pan upward against stop. Digital voltmeter will indicate at least 100 mV less than value observed in (4) above.

(7) Press pan downward to stop. Digital voltmeter will indicate at least 100 mV more than value observed in (5) above.

(8) Dial in weight value on balance corresponding to standard weight value, and release pan. The IN-RANGE marker should illuminate. More or less weight may be required to bring in range.

(9) Record weight reading. Value recorded should agree with value of standard weight combination from primary report (R).

(10) Prepare a chart showing deviation of TI indication and standard weight and affix to TI.

(11) Repeat (4) through (7) above for each cardinal point to be checked.

NOTE

The balance can only be used as a calibration standard for calibration. of Class C, Q, and T weights.

b. Adjustments

(1) Adjust one of the three trimming nuts (fig. 1), which move horizontally on beam, for an indication of 75 ±25 mV on digital voltmeter (R).

(2) Adjust either or both of the two trimming nuts (fig. 1), which move vertically on the beam, for an indication of 950 ± 150 mV on digital voltmeter (R).

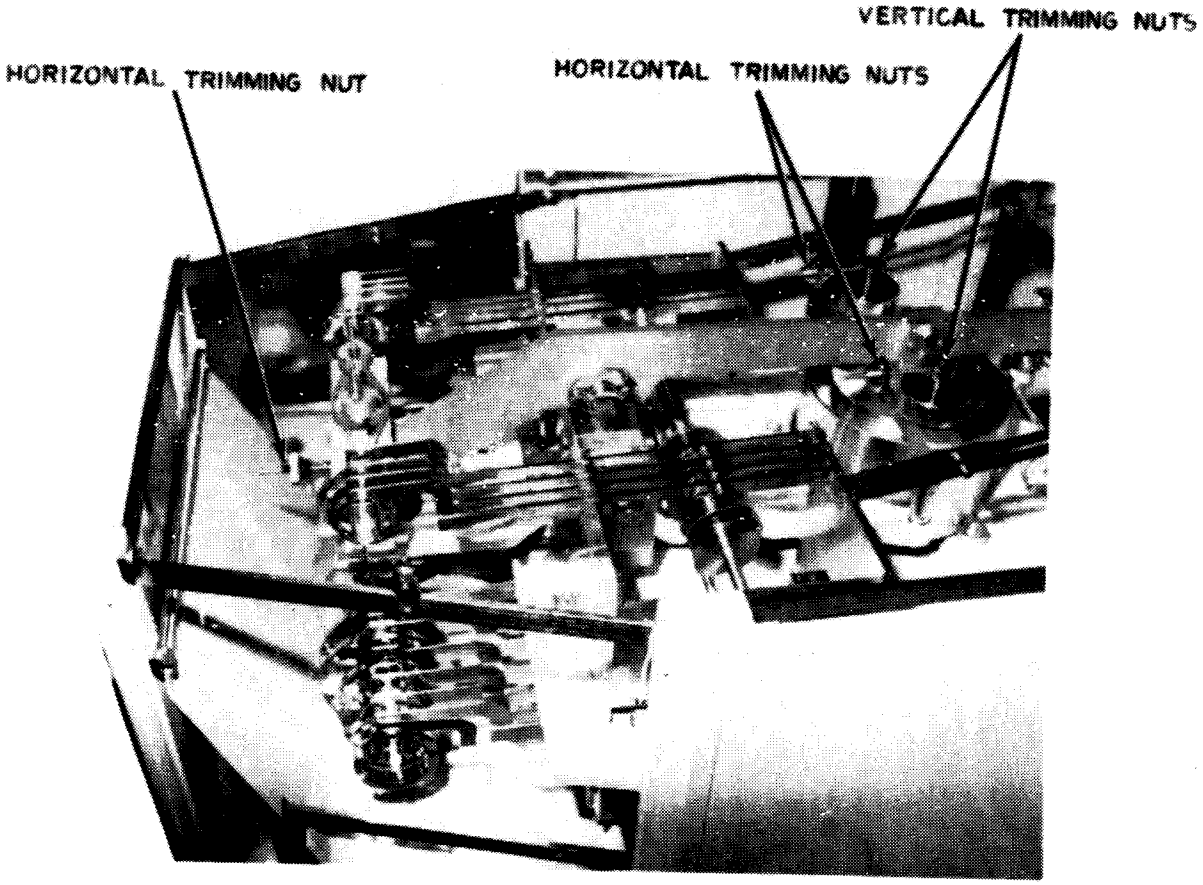

Figure 1. Adjustment location.

13. Weight Adjustments. Adjustments may be made where applicable, as follows:

a. Knob-Type Weights. Unscrew knob and remove excess weights from threaded end of knob; to increase weight, add to cavity.

b. Sealer-Type Weights. Remove or add weight as necessary and reseal.

c. Round-Type Weights. Remove weight by drilling holes. Add weight by using solder or lead.

d. Flat-Thin Weights. Weight should be removed from edges of weights. No weight can be added.

14. Final Procedure

a. Deenergize and disconnect all equipment and reinstall protective cover on TI.

b. When all parameters are within tolerance, annotate and affix DA Label 80 (US Army Calibrated Instrument). When the TI receives limited or special calibration, annotate and affix DA Label 163 (US Army Limited or Special Calibration). When the TI cannot be adjusted within tolerance, repair the TI in accordance with the maintenance manual. When repair is delayed for any reason or the TI cannot be repaired with local resources, annotate and affix DA Form 2417 (US Army Calibration System Rejected Instrument) and inform the owner/user accordingly in accordance with TB 750-25.

TB 9-6670-254-50

By Order of the Secretary of the Army:

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General, United States Army
Chief Of Staff

Official:

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The Adjutant General

Distribution:
To be distributed in accordance with Std. IDS No. RLC-1500, 9 September 1982.

US GOVERNMENT PRINTING OFFICE: 1 985 - 544-007/20128

PIN: 011463-000