*TB 9-6695-294-35

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR DIGITAL MULTIMETER, JOHN FLUKE, MODEL 8506A/CT

Headquarters, Department of the Army, Washington, DC

6 July 2001

Approved for public release, distribution is unlimited.

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

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: ls-lp@redstone.army.mil or by FAX (256) 842-6546/DSN 788-6546.

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This bulletin supersedes TB 9-6695-294-50, dated 28 May 1991, which has been rescinded.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Digital Multimeter, John Fluke, Model 8506A/CT. The manufacturer's manual and MIS-35947 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. None.

   b. Time and Technique. The time required for this calibration is approximately 2 hours, using the dc and low frequency technique.

2. Forms, Records, and Reports

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

   b. Software corrections to be reported are designated (R) at the end of the sentence in which they appear. Report only those software corrections made and designated with (R). Use the range or parameter being corrected to report software corrections; i.e., V dc, 100 V ac.

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

Table 1. Calibration Description

Test instrument parameters	Performance specifications[1]		
Dc voltage	Range: 0 to 1000 V Range Accuracy: ±(% of reading + % of range) 100 .004 +.001 1 V through 1000 V .005 + 0		
Ac voltage	Range: 0 to 1000 V rms (in 9 ranges) Frequency: 20 Hz through 100 kHz[2] Accuracy: ±(% of reading + % of range)		
	Frequency	Range	
		100 mV, 500 V, and 1000 V	300 mV through 100 V
	20 to 50 Hz	.1 + .01	.1 + .004
	50 Hz to 2 kHz	.05 + .015	.04 + .01
	2 to 20 kHz	.14 + .025	.07 + .02
	20 to 100 kHz	.24 + .05	.2 + .04

    See footnotes at end of table.

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications[1]
Resistance	Range: 0 to 10 MΩ Range (in ohms): Accuracy: ±(% of reading + % of range) 10 .006 + .01 100 through 1 M .01 + 0 10 M .02 + .001

[1]Listed specifications are in accordance with MIS- 35947 and do not agree with manufacturer's published specifications.

[2]Not to exceed a volts-hertz product of 10^7.

SECTION II
EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 2 identifies the specific equipment to be used in this calibration procedure. This equipment is issued with Secondary Transfer Standards Set, AN/GSM-286. Alternate items may be used by the calibrating activity. 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 specification listed in table 2. 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 required for this calibration are common usage accessories, issued as indicated in paragraph **4** above, and are not listed in this calibration procedure.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)

CALIBRATOR	Dc volts: ±100 mV to ±1000 V
	Accuracy: ±12.5 ppm(±17 ppm at 100 mV)
	
	Resistance: 10 Ω to 10 MΩ
	Accuracy: 10 Ω: ± 40 ppm
	          100 Ω to 1 MΩ: ± 25 ppm
	          10 MΩ: ± 52.5 ppm
		John Fluke, Model 5700A/CT (P/O MIS-35947) w/amplifier, John Fluke, Model 5725A (5725A)

Ac Volts	Frequency: → (Hz) Accuracy: ↓ (±%)					
	30	40	1 k	10 k	30 k	90 k
100 mV	(0.034)	- - -	(0.021)	0.0412	0.07	(0.12)
300 mV	(0.028)	- - -	0.0125	0.0225	0.06	0.06
1 V	0.026	- - -	0.0125	0.0225	0.06	0.06
3 V	(0.028)	- - -	0.0125	0.0225	0.06	0.06
10 V	0.026	- - -	0.0125	0.0225	0.06	0.06
100 V	0.026	- - -	0.0125	0.0225	0.06	(0.07)
500 V	- - -	0.0275	0.0163	0.0412	- - -	- - -
600 V	- - -	- - -	0.0187	- - -	- - -	- - -
1000 V	- - -	0.0275	- - -	0.0412	- - -	- - -

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 as listed in table 2.

    c. 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. Additional maintenance information is contained in the manufacturer's manual for this TI.

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

7. Equipment Setup

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. REDUCE OUTPUT(S) to minimum after each step within the performance check where applicable.

    a. Press **POWER** pushbutton to **ON**. The TI should momentarily display **C25A 8** showing correct configuration. The TI automatically assumes the control positions listed in (1) through (12) below:

        (1) **FUNCTION** to **V DC.**
        (2) **RANGE** to **1000 V** (manual).
        (3) **TRIGGER** to **AUTO**.
        (4) **FILTER** to off.
        (5) **SAMPLE** to slow reading rate (7).
        (6) **OFFSET** to off
        (7) **SCALING** to off.
        (8) **EXT REF** to off.
        (9) **LIMITS** to off.
      (10) **PEAK** to off.

(11) **AVG** to off.

(12) **ZERO** to on.

b. Press **EXT GD IN** pushbutton to in.

c. Allow at least 2 hours for TI to warm up and stabilize.

8. Dc Voltage

a. Performance Check

(1) Connect calibrator **OUTPUT HI**, **LO** and **V-GUARD** to TI **VOLTS INPUT/OHMS SENSE HI**, **LO** and **GD**.

(2) Press TI **RANGE -** or ⁻ pushbutton to select the 100 mV range.

(3) Set calibrator for a 100 mV dc output. If TI does not indicate between 99.995 (-3) and 100.005 (-3), perform **b** below.

(4) Repeat technique of (2) and (3) above using settings listed in table 3. If TI does not indicate within limits specified, perform **b** below.

Table 3. Dc Voltage

Test instrument range settings	Calibrator output settings	Test instrument indications	
		Min	Max
100 mV	-100 mV	-99.995 (-3)	-100.005 (-3)
1 V	1 V	0.99995	1.00005
1 V	-1 V	-0.99995	-1.00005
10 V	10 V	9.9995	10.0005
10 V	-10 V	-9.9995	-10.0005
100 V	100 V	99.995	100.005
100 V	-100 V	-99.995	-100.005
1000 V	1000 V	999.95	1000.05
1000 V	-1000 V	-999.95	-1000.05

b. Dc Software Corrections

(1) Set calibrator to **STANDBY** and disconnect from TI.

(2) Slide rear panel **CALIBRATION** switch to **ON** and verify that **AVG/(CAL)** annunciator is flashing.

NOTE

When in the calibration mode, input power must not be cycled **ON** or **OFF.** Before cycling power **OFF,** verify that **AVG/(CAL)** annunciator is not flashing. Before cycling power **ON,** check that rear panel calibration switch is **OFF.**

(3) Press TI **RANGE ⁻** pushbutton to select 100 mV range.

(4) Short TI **VOLTS INPUT/OHMS SENSE HI** and **LO** terminals using a good quality, low-thermal shorting bar. Allow sufficient thermal settling time before proceeding.

(5) Press **ZERO V DC/W** pushbutton (**ZERO** annunciator off).

(6) Allow TI to take at least one reading then press **ZERO V DC/W** pushbutton (**ZERO** annunciator on). This operation stores new **ZERO** correction factors.

(7) Press **RANGE -** pushbutton and repeat (5) and (6) above.

(8) Repeat (7) above for remaining ranges.

(9) Disconnect shorting bar from TI.

(10) Connect calibrator **OUTPUT HI**, **LO** and **V-GUARD** to TI **VOLTS INPUT/OHMS SENSE HI**, **LO** and **GD**.

(11) Press TI **RANGE ⁻** pushbutton to select 10 V range.

NOTE
When the **CALIBRATION** switch is set to **ON,** some of the pushbuttons on the front panel are used to enter and store new numeric calibration constants. Example: to enter the 10.000000 in **b**(12) below, you would press the **EXT REF (1)** pushbutton, **LCL/RMT (0)** pushbutton, **MANUAL/EXTERNAL (.)** pushbutton and then the **LCL/RMT (0)** pushbutton six times.

(12) Set calibrator for a 10 V dc output. Allow TI to take at least one measurement, then press **STORE (10.000000) (CAL COR).**

(13) Set calibrator for a 100 mV dc output.

(14) Press TI **RANGE ⁻** pushbutton to select 100 mV range.

(15) Allow TI to take at least one measurement, then press **STORE (100.00000 EXP-3) (CAL COR).**

(16) Press TI **RANGE -** pushbutton to select 1 V range.

(17) Set calibrator for a 1 V dc output. Allow TI to take at least one measurement, then press **STORE (1.000000) (CAL COR)**.

(18) Press TI **RANGE -** pushbutton to select 100 V range.

(19) Set calibrator for a 100 V dc output. Allow TI to take at least one measurement, then press **STORE (100.0000) (CAL COR)**.

(20) Press TI **RANGE -** pushbutton to select 1000 V range.

(21) Set calibrator for a 1000 V dc output. Allow TI to take at least one measurement, then press **STORE (1000.000) (CAL COR)**.

(22) Set calibrator to **STANDBY**.

(23) Repeat technique of (11) through (22) above using negative voltages. Ignore the polarity sign when entering numeric calibration constants.

(24) Slide rear panel **CALIBRATION** switch to off (R).

9. Ac Voltage

a. Performance Check

(1) Connect calibrator **OUTPUT HI**, **LO** and **V-GUARD** to TI **VOLTS INPUT/OHMS SENSE HI**, **LO** and **GD**.

(2) Press TI pushbuttons as listed in (a) through (c) below:

    (a)   (a)   **4T W IN** to in.
    (b)   (b)   **FUNCTION V AC HI ACCUR**.
    (c)   (c) **RANGE -** or ⁻ to select 100 mV range.

(3) Set calibrator for a 100 mV, 1 kHz output.

(4) Allow TI to take several measurements. If TI does not indicate between 99.935 (-3) and 100.065 (-3), perform **b**(1) through (3) and (12) below.

(5) Repeat technique of (2) through (4) above using settings in table 4. If TI does not indicate within limits specified, perform corresponding software corrections.

Table 4. Ac Voltage (1 kHz)

Test instrument range settings	Calibrator output settings		Test instrument indications		Software corrections
	Voltage	Frequency	Min	Max	
300 mV	300 mV	1 kHz	299.850 (-3)	300.150 (-3)	**b**(l),(2),(4) and (12)
1 V	1 V	1 kHz	.99950	1.00050	**b**(l),(2),(5) and (12)
3 V	3 V	1 kHz	2.99850	3.00150	**b**(l),(2),(6) and (12)
10 V	10 V	1 kHz	9.9950	10.0050	**b**(l),(2),(7) and (12)
30 V	30 V	1 kHz	29.9850	30.0150	**b**(l),(2),(8) and (12)
100 V	100 V	1 kHz	99.950	100.050	**b**(l),(2),(9) and (12)
500 V	500 V	1 kHz	499.675	500.325	**b**(l),(2),(10) and (12)
1000 V	600 V	1 kHz	599.55	600.45	**b**(l),(2),(11) and (12)

(6) Press calibrator **RESET** key.

NOTE

Ac software corrections are only made at 1 kHz. If an out-of-tolerance condition exists in (9) below or in table 5, perform the software correction in **b** below which corresponds to the range that is out of tolerance, using the 1 kHz technique of (2) through (4) above and/or table 4. If the software correction had previously been completed for the range in question, repair action may be required.

(7) Press TI **RANGE -** or ⁻ pushbutton to select the 100 mV range.

(8) Set calibrator for a 100 mV, 30 Hz output.

(9) Allow TI to take several measurements. TI will indicate between 99.890 (-3) and 100.110 (-3).

(10) Repeat technique of (7) through (9) above using settings listed in table 5. TI will indicate within the specified limits.

CAUTION

Do not exceed 600 V ac with TI in **AUTO RANGE**.

Table 5. Ac Voltage

Test instrument range settings	Calibrator output settings		Test instrument indications	
	Voltage	Frequency	Min	Max
100 mV	100 mV	10 kHz	99.835 (-3)	100.165 (-3)
100 mV	100 mV	30 kHz	99.710 (-3)	100.290 (-3)
100 mV	100 mV	90 kHz	99.710 (-3)	100.290 (-3)
300 mV	300 mV	30 Hz	299.688 (-3)	300.312 (-3)
300 mV	300 mV	10 kHz	299.730 (-3)	300.270 (-3)
300 mV	300 mV	30 kHz	299.280 (-3)	300.720 (-3)
300 mV	300 mV	90 kHz	299.280 (-3)	300.720 (-3)
1 V	1 V	30 Hz	.99896	1.00104
1 V	1 V	10 kHz	.99910	1.00090
1 V	1 V	30 kHz	.99760	1.00240
1 V	1 V	90 kHz	.99760	1.00240
3 V	3 V	30 Hz	2.99688	3.00312
3 V	3 V	10 kHz	2.99730	3.00270
3 V	3 V	30 kHz	2.99280	3.00720
3 V	3 V	90 kHz	2.99280	3.00720
10 V	10 V	30 Hz	9.9896	10.0104
10 V	10 V	10 kHz	9.9910	10.0090
10 V	10 V	30 kHz	9.9760	10.0240
10 V	10 V	90 kHz	9.9760	10.0240
30 V	30 V	30 Hz	29.9688	30.0312
30 V	30 V	10 kHz	29.9730	30.0270
30 V	30 V	30 kHz	29.9280	30.0720
30 V	30 V	90 kHz	29.9280	30.0720

Table 5. Ac Voltage - Continued

Test instrument range settings	Calibrator output settings		Test instrument indications	
	Voltage	Frequency	Min	Max
100 V	100 V	30 Hz	99.896	100.104
100 V	100 V	10 kHz	99.910	100.090
100 V	100 V	30 kHz	99.760	100.240
100 V	100 V	90 kHz	99.760	100.240
500 V	500 V	40 Hz	499.450	500.550
500 V	500 V	10 kHz	499.175	500.825
1000 V	1000 V	40 Hz	998.90	1001.10
1000 V	1000 V	10 kHz	998.35	1001.65

b. Ac Software Corrections

(1) Slide rear panel **CALIBRATION** switch to **ON** and verify that **AVG/(CAL)** annunciator is flashing.

NOTE
When the **CALIBRATION** switch is set to **ON,** some of the pushbuttons on the front panel are used to enter and store new numeric calibration constants. Example: to enter the **100.0 EXP-3** in **b**(3) below, you would press the **EXT REF (1)** pushbutton, **LCL/RMT (0)** pushbutton twice, **MANUAL/EXTERNAL (.)** pushbutton, **LCL/RMT (0)** again, **AUTO (EXP), ENH'D (±)** and **PEAK (3)** pushbuttons.

(2) Allow TI to take at least one measurement.

(3) Press **STORE (100.0 EXP-3) (CAL COR)** (R).

(4) Press **STORE (300.0 EXP-3) (CAL COR)** (R).

(5) Press **STORE (1.0) (CAL COR)** (R).

(6) Press **STORE (3.0) (CAL COR)** (R).

(7) Press **STORE (10.0) (CAL COR)** (R).

(8) Press **STORE (30.0) (CAL COR)** (R).

(9) Press **STORE (100.0) (CAL CO R)** (R).

(10) Press **STORE (500.0) (CAL COR)** (R).

(11) Press **STORE (600.0) (CAL COR)** (R).

(12) Slide rear panel **CALIBRATION** switch to off.

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10. Resistance

a. Performance Check

(1) Connect calibrator **OUTPUT HI** and **LO** to TI **VOLTS INPUT/OHMS SENSE HI** and **LO**.

(2) Connect calibrator **SENSE HI** and **LO** to TI **AMPS INPUT/OHMS SOURCE HI** and **LO**.

(3) Connect calibrator **V-GUARD** to TI **GD**.

(4) Press TI pushbuttons as listed in (a) through (c) below:

    (a)   (a)   **4T W IN** to in.

    (b)   (b)   **FUNCTION OHMS W**.

    (c)   (c) **RANGE** - or ⁻ to select 10 Ω range.

(5) Set calibrator for a 0 Ω output.

(6) Press calibrator **EX SNS** key to on.

(7) Press TI **ZERO V DC/W** pushbutton (**ZERO** annunciator off).

(8) Allow TI to take at least one measurement then press **ZERO V DC/W** pushbutton (**ZERO** annunciator on).

(9) Set calibrator for a 10 Ω output then, using output adjustment controls, set calibrator control display **Reading** equal to TI indication. If calibrator control display **Error** does not indicate within ±0.016%, perform **b**(1) through (13) and (20) below.

(10) Repeat technique of (4) through (9) above using settings listed in table 6. If calibrator control display **Error** does not indicate within limits specified, perform the corresponding software corrections.

Table 6. Resistance

Test instrument range settings	Calibrator		Software corrections
	Output settings	Control display **Error** indications (±%)	
100 Ω	100 Ω	.01	**b**(1) through (12), (14) and (20)
1kΩ	1kΩ	.01	**b**(1) through (12), (15) and (20)
10 kΩ	10 kΩ	.01	**b**(1) through (12), (16) and (20)
100 kΩ	100 kΩ	.01	**b**(1) through (12), (17) and (20)

(11) Press **RANGE -** pushbutton to select 1 MΩ range and release **4T W IN** pushbutton to out.

(12) Press calibrator **EX SNS** key to off.

(13) Set calibrator for a 0 Ω output.

(14) Repeat (7) and (8) above.

(15) Set calibrator for a 1 MΩ output then, using output adjustment controls, set calibrator control display **Reading** equal to TI indication. If calibrator control display **Error** does not indicate within ±0.01%, perform **b**(1) through (9), (11), (12), (18) and (20) below.

(16) Press TI **RANGE -** pushbutton to select 10 MΩ range.

(17) Set calibrator for a 0 Ω output.

(18) Repeat (7) and (8) above.

(19) Set calibrator for a 10 MΩ output then, using output adjustment controls, set calibrator control display **Reading** equal to TI indication. If calibrator control display **Error** does not indicate within ±0.021%, perform **b**(1) through (9), (11), (12), (19) and (20) below.

b. Ohms Software Corrections

(1) Disconnect calibrator from TI.

(2) Slide rear panel **CALIBRATION** switch to **ON** and verify that **AVG/(CAL)** annunciator is flashing.

(3) Release **EXT GD IN** pushbutton to out.

(4) Short TI **VOLTS INPUT/OHMS SENSE HI** and **LO** and **AMPS INPUT/OHMS SOURCE HI** and **LO** in a four wire configuration using high quality, low-thermal, shorting bars.

(5) Allow sufficient thermal voltage settling time before proceeding.

(6) Press **ZERO V DC/W** pushbutton (**ZERO** annunciator off).

(7) Allow TI to take at least one measurement then press **ZERO V DC/W** pushbutton (**ZERO** annunciator on). This operation stores new **ZERO** correction factors.

(8) Disconnect shorting bars from TI.

(9) Connect calibrator **OUTPUT HI** and **LO** to TI **VOLTS INPUT/OHMS SENSE HI** and **LO**.

(10) Connect calibrator **SENSE HI** and **LO** to TI **AMPS INPUT/OHMS SOURCE HI** and **LO**.

(11) Connect calibrator **V-GUARD** to TI **GD**.

(12) Press **EXT GD IN** pushbutton to in.

NOTE
When the **CALIBRATION** switch is set to **ON,** some of the pushbuttons on the front panel are used to enter and store new numeric calibration constants. Example: To enter a calibrator output display indication of 9.999467 in **b**(13) below, press **STORE** pushbutton, **OHMS W (9)** pushbutton, **MANUAL/EXTERNAL (.)** pushbutton, **OHMS W (9)** pushbutton thrice, **AUTO (4)** pushbutton, **RANGE ⁻ (6)** pushbutton, and **NORMAL (7)** pushbutton.

(13) Set calibrator for a 10 Ω output. Allow TI to take at least one measurement, then press **STORE** (calibrator output display indication) (**CAL COR**) (R).

(14) Set calibrator for a 100 Ω output. Allow TI to take at least one measurement, then press **STORE** (calibrator output display indication) (**CAL COR**) (R). Example: **STORE** (**99.9987**) (**CAL COR**)

(15) Set calibrator for a 1 kΩ output. Allow TI to take at least one measurement, then press **STORE** (calibrator output display indication) (**CAL COR**) (R). Example: **STORE** (**1000.003**) (**CAL COR**)

(16) Set calibrator for a 10 kΩ output. Allow TI to take at least one measurement, then press **STORE** (calibrator output display indication) (**CAL COR**) (R). Example: **STORE** (**9999.95**) (**CAL COR**)

(17) Set calibrator for a 100 kΩ output. Allow TI to take at least one measurement, then press **STORE** (calibrator output display indication) (**CAL COR**) (R). Example: **STORE** (**99997.9**) (**CAL COR**)

(18) Set calibrator for a 1 MΩ output. Allow TI to take at least one measurement, then press **STORE** (calibrator output display indication) (**CAL COR**) (R). Example: **STORE** (**1.000004 EXP 6**) (**CAL COR**)

(19) Set calibrator for a 10 MΩ output. Allow TI to take at least one measurement, then press **STORE** (calibrator output display indication) (**CAL COR**) (R). Example: **STORE** (**9.99699 EXP 6**) (**CAL COR**)

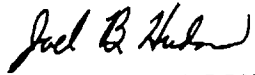(20) Slide rear panel **CALIBRATION** switch to off.

11. Final Procedure

a. Deenergize and disconnect all equipment.

b. Annotate and affix DA Label/Form in accordance with TB 750-25.

By Order of the Secretary of the Army:

ERIC K. SHINSEKI
General, United States Army
Chief of Staff

OFFICIAL:

JOEL B. HUDSON
Administrative Assistant to the
Secretary of the Army
0115604

Distribution:

To be distributed in accordance with IDN 344713, requirements for calibration procedure TB 9-6695-294-35.

THESE ARE THE INSTRUCTIONS FOR SENDING AN ELECTRONIC 2028

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@avma27.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**: TB 9-6625-xxxx-35
9. **Pub Title**: Calibration Procedure for …
10. **Publication Date**:
11. Change Number:
12. **Submitted Rank**: MSG
13. **Sumitter 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.