TB 9-6625-2348-35

CHANGE 1

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR DIGITAL MULTIMETER JOHN FLUKE, MODELS 87 AND 87 III

Headquarters, Department of the Army, Washington, DC
5 February 2004

TB 9-6625-2348-35, 23 October 2003, 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
7 and 8	7 and 8
11 and 12	11 and 12

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

By Order of the Secretary of the Army:

Official:

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

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Administrative Assistant to the Secretary of the Army

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Headquarters, Department of the Army, Washington, DC
23 October 2003

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can improve this manual. If you find any mistakes or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also provide DA Form 2028 information to AMCOM via e-mail, fax, or the World Wide Web. Our fax number is DSN 788-6546 or Commercial 256-842-6546. Our e-mail address is: 2028@redstone.army.mil. Instructions for sending an electronic 2028 may be found at the back of this manual. For the World Wide Web, use https://amcom2028.redstone.army.mil.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Digital Multimeter, John Fluke, Models 87 and 87 III. The manufacturers' manuals 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 1 hour, 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. Adjustments to be reported 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 table 1.

Table 1. Calibration Description

Test instrument parameters	Performance specifications
Frequency	Range: 0.5 Hz to 200 kHz Accuracy: ± 0.005% + 1 count
Dc voltage Model 87 Model 87 III	 Range: 0 to 1000 V in 5 ranges Accuracy: ±0.1% of input +1 count Accuracy: ±0.1% of input + 1 count for 400 mV range ±0.05% of input + 1 count for all other ranges
Dc current Model 87 Model 87 III	 Range: 0 to 10 A in 6 ranges Accuracy: ±0.2% of input +2 counts Accuracy: ±0.2% of input + 2 counts in 4000 μA, 400 mA and 10.00 A ranges; ±0.2% of input + 4 counts in 400 μA, 40 mA and 4000 mA ranges

Table 1. Calibration Description Continued

Ac voltage Model 87	Range: 0 to 1000 V in 5 ranges Accuracy: ± (% of input + counts) Frequency 50 – 60 Hz 45 Hz – 5 kHz 5 – 20 kHz 400 mV; (0.7 + 4) (1.0 + 4) (2.0 + 4) 4000 V; (0.7 + 2) (1.0 + 4) (2.0 + 4) 40.00 V; (0.7 + 2) (1.0 + 4) (2.0 + 4) 400.0 V; (0.7 + 2) (1.0 + 4) (2.0 + 4) 1000 V; (0.7 + 2) (1.0 + 4)[1]
Model 87 III	Accuracy: ± (% of input + counts) Frequency 50-60 Hz 45 Hz-1kHz 1-5 kHz 5-20 kHz[2] 400 mV; (0.7 + 4) (1.0 + 4) (2.0 + 4) (2.0 + 20)

Table 1. Calibration Description Continued

	4.000 V; (0.7 + 2) (1.0 + 4) (2.0 + 4) (2.0 + 20) 40.00 V; (0.7 + 2) (1.0 + 4) (2.0 + 4) (2.0 + 20) 400.0 V; (0.7 + 2) (1.0 + 4) (2.0 + 4) 1000 V; (0.7 + 2) (1.0 + 4)[3]
Ac current	Range: 0 to 10.00 A in 6 ranges Accuracy: ±1.0% of input + 2 counts
Resistance Model 87	Range: 0 to 40 MΩ in 6 ranges Accuracy: 400 Ω, 4 kΩ, 40 kΩ, 400 kΩ and 4 MΩ ranges; ±0.2% of input + 1 count 40 MΩ range; ±1% of input + 3 counts
Model 87 III	Accuracy: 400 Ω range; ±0.2% of input +2 counts 4 kΩ and 40 kΩ ranges; ±0.2% of input +1 count 400 kΩ and 4 MΩ ranges; ±0.6% of input +1 count 40 MΩ range; ±1% of input + 3 counts
Conductance	Range: 40.00 nS Accuracy: ±1% of input +10 counts
Capacitance Model 87	Range: 0 to 5 μF Accuracy: Relative mode used; ±1% of input + 2 counts Relative mode not used; ±1% 0f input + 35 counts
Model 87 III	Accuracy: Relative mode used; 5.00 nF, 0.0500 μF, 0.500 μF ranges; ±1% of input + 3 counts 5.00 μF range; ±1.9% of input + 3 counts

[1] Below 10% of range, add 10 counts
[2] Below 10% of range, add 6 counts
[3] Below 10 % of range, add 16 counts

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 Calibration Standards Set AN/GSM-286, AN/GSM-287 and AN/GSM-705. 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 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 required for this calibration are common usage accessories issued as indicated in **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 voltage: Range: 0 to 1000 V Accuracy: ±.012% Dc current: Range: 1.9 mA to 1.9 A Accuracy: ±.2% Ac voltage Range: 0 to 1000V Frequency: 45 Hz to 5 kHz Accuracy: ±.175%	John Fluke, Model 5720A/CT (p/o MIS-35947), w/power amplifier, John Fluke, Model 5725A/CT (5725A/CT)
CAPACITANCE STANDARD	Range: 5 nF to 1 μF Accuracy: 5 nF ±0.4%, 0.05 μF ±0.35%, 0.5 μF ±0.35%, 1 μF ±0.75%	Arco Electronic, Model SS32 (7907233)
FUNCTION/ARBITRARY WAVEFORM GENERATOR	Range: 20 Hz, 10 MHz 1 V rms Accuracy: ±0.00125%	Agilent, Model 33250A (MIS-45853)

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. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in the manufacturers' manuals for this TI.

d. Unless otherwise specified, all control 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. Remove protective cover as needed to make adjustments. Replace cover after completing the adjustments.

b. Set function switch to **V**~.

8. Frequency

a. Performance Check

(1) Connect function/arbitrary waveform generator to TI **V Ω** ⏚ and **COM** inputs.

(2) Press TI **Hz** button.

(3) Set function/arbitrary waveform generator for an output of 150 mV rms at a frequency of 19.000 kHz. TI will indicate within limits specified in first row of table 3.

(4) Repeat technique of (3) above for settings and indications listed in table 3. TI will indicate within limits specified in first row of table 3.

Table 3. Frequency accuracy

Function/arbitrary waveform generator output		Test instrument indication (kHz)	
Amplitude (rms)	Frequency (kHz)	Min	Max
150 mV	19.000	18.998	19.002
150 mV	190.00	189.98	190.02

(5) Set calibrator output to minimum and disconnect equipment setup.

b. Adjustments. No adjustments can be made.

9. Dc Voltage

a. Performance Check

(1) Connect calibrator to TI **V Ω** ⏚ and **COM** inputs.

(2) Set function switch to **mV**⎓.

(3) Set calibrator output for 390.0 mV. If TI does not indicate within limits specified for appropriate model in first row of table 3, perform **b** below.

(4) Set function switch to **V⎓**.

(5) Repeat technique of (3) above, using settings and indications listed in table 3. TI will indicate within limits specified for appropriate model in table 4.

Table 4. Dc Voltage Accuracy

Calibrator output (Dc)	Test instrument				
	Range	Indications			
		Model 87		Model 87 III	
		Min	Max	Min	Max
390 mV	400 mV	389.5 mV	390.5 mV	389.5 mV	390.5 mV
3.9 V	4 V	3.895 V	3.905 V	3.897 V	3.903 V
39 V	40 V	38.95 V	39.05 V	38.97 V	39.03 V
390 V	400 V	389.5 V	390.5 V	389.7 V	390.3 V
–390 V	400 V	–389.5 V	–390.5 V	–389.7 V	–390.3 V
1000 V	1000 V	998 V	1002 V	998 V	1002 V
–1000 V	1000 V	–998 V	–1002 V	–998 V	–1002 V

(6) Set calibrator output to minimum and disconnect equipment setup.

b. Adjustments

(1) Set function switch to **V⎓**.

(2) Set calibrator for an output of 3.900 V dc.

(3) Adjust R21 (fig. 1) until TI indicates 3.900 V dc (R).

(4) Repeat **a** (1) through (4) above.

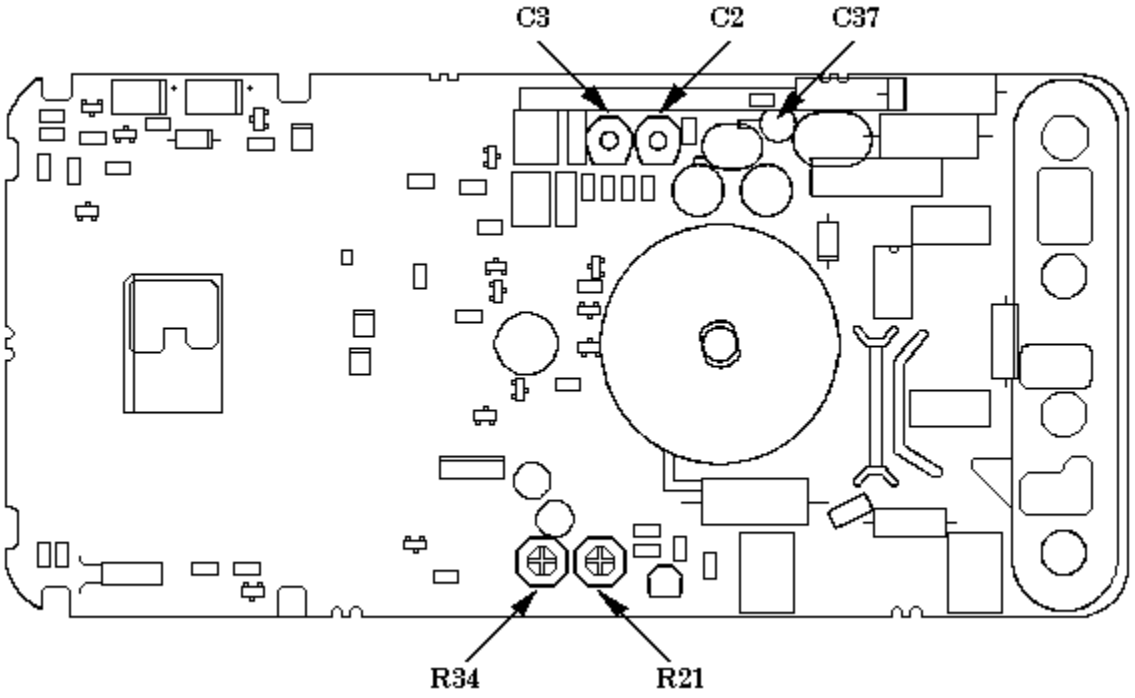

Figure 1. Adjustment locations.

10. Dc Current

a. Performance Check

(1) Connect TI **mA/µA** and **COM** to calibrator.

(2) Set function switch to **µA**⎓.

(3) Set calibrator output for 350.0 µA. TI will indicate within limits specified for appropriate model in first row of table 5.

(4) Repeat technique of (3) above, using settings and indications listed in table 5. TI will indicate within limits specified for appropriate model in table 5.

Table 5. Dc Current Accuracy (µA)

Calibrator output (Dc)	Range	Test instrument			
		Indications			
		Model 87		Model 87 III	
		Min	Max	Min	Max
350 µA	400 µA	349.1 µA	350.9 µA	348.9 µA	351.1 µA
3.5 mA	4000 µA	3491 µA	3509 µA	3491 µA	3509 µA

(5) Set function switch to **mA/A**⎓.

(6) Set calibrator output for 35 mA. TI will indicate within limits specified for appropriate model in first row of table 6.

(7) Repeat technique of (6) above, using settings and indications listed in table 6. TI will indicate within limits specified for appropriate model in table 6.

Table 6. Dc Current Accuracy (mA)

Calibrator output (Dc)	Range	Test instrument			
		Indications			
		Model 87		Model 87 III	
		Min	Max	Min	Max
35 mA	40 mA	34.91 mA	35.09 µA	34.89 µA	35.11 µA
350 mA	400 mA	349.1 mA	350.9 mA	349.1 mA	350.9 mA

(8) Set calibrator output to minimum.

(9) Move connection from TI **mA/µA** input to TI **A** input.

(10) Set calibrator output for 3.5 A. TI will indicate within limits specified for appropriate model in first row of table 7.

(11) Repeat technique of (10) above, using settings and indications listed in table 7. TI will indicate within limits specified for appropriate model in table 7.

Table 7. Dc Current Accuracy (A)

Calibrator output (Dc)	Range	Test instrument			
		Indications			
		Model 87		Model 87 III	
		Min	Max	Min	Max
3.5 A	4000 mA	3491 mA	3509 mA	3489 mA	3511 mA
10 A	10 A	9.96 A	10.04 A	9.96 A	10.04 A

(12) Set calibrator output to minimum and disconnect equipment setup.

b. Adjustments. No adjustments can be made.

11. Ac Voltage

a. Performance Check

(1) Connect calibrator to TI **V Ω** ⊣⊢ and **COM** inputs.

(2) Set TI function switch to **V**~.

(3) Set calibrator for an output of 390 mV at a frequency of 60 Hz. If TI does not indicate within limits specified in first row of table 8, perform **b** below.

(4) Repeat technique of (3) above for settings and indications listed in table 8. If TI does not indicate within limits specified in table 8, perform **b** below.

Table 8. Ac Voltage Accuracy

Calibrator output		Test instrument			
Amplitude	Frequency	Indications			
		Model 87		Model 87 III	
		Min	Max	Min	Max
390 mV	60 Hz	386.8 mV	393.2 mV	386.8 mV	393.2 mV
390 mV	1 kHz	385.7 mV	394.3 mV	385.7 mV	394.3 mV
390 mV	5 kHz	381.8 mV	398.2 mV	381.8 mV	398.2 mV
390 mV	20 kHz	381.8 mV	398.2 mV	380.2 mV	399.8 mV
3.900 V	60 Hz	3.870 V	3.930 V	3.870 V	3.930 V
3.900 V	1 kHz	3.857 V	3.943 V	3.857 V	3.943 V
3.900 V	5 kHz	3.818 V	3.982 V	3.818 V	3.982 V
3.900 V	20 kHz	3.818 V	3.982 V	3.802 V	3.998 V
39.00 V	60 Hz	38.70 V	39.30 V	38.70 V	39.30 V
39.00 V	1 kHz	38.57 V	39.43 V	38.57 V	39.43 V
39.00 V	5 kHz	38.18 V	39.82 V	38.18 V	39.82 V
39.00 V	20 kHz	38.18 V	39.82 V	38.02 V	39.98 V
390.0 V	60 Hz	387.0 V	393.0 V	387.0 V	393.0 V
390.0 V	1 kHz	385.7 V	394.3 V	385.7 V	394.3 V
390.0 V	5 kHz	381.8 V	398.2 V	381.8 V	398.2 V
1000 V	60 Hz	991 V	1009 V	991 V	1009 V
1000 V	1 kHz	986 V	1014 V	986 V	1014 V

(5) Set calibrator output to minimum and disconnect equipment setup.

b. Adjustments

(1) Set calibrator for an output of 3.513 V at a frequency of 50 Hz.

(2) Adjust R34 (fig. 1) until TI indicates 3.500 V ac (R).

NOTE

The disparity between an input of 3.513 and an indication of 3.500 is due to compensation for the RMS converter linearity.

(3) Change calibrator output amplitude to 100.0 V at a frequency of 20 k Hz.

(4) Adjust C37 (fig. 1) until TI indicates 100.0 V ac (R).

(5) Change calibrator output amplitude to 3.500 V at a frequency of 10 kHz.

(6) Adjust C2 (fig. 1) until TI indicates 3.500 V ac (R).

(7) Change calibrator output amplitude to 35.00 V at a frequency of 10 kHz.

(8) Adjust C3 (fig. 1) until TI indicates 35.00 V ac (R).

12. Ac Current

a. Performance Check

(1) Connect TI **mA/µA** and **COM** to calibrator.

(2) Set TI function switch to **µA**⎓ and push blue button.

(3) Set calibrator output for 350.0 µA at a frequency of 60 Hz. TI will indicate within limits specified in first row of table 9.

(4) Repeat technique of (3) above, using calibrator outputs and indications listed in table 9. TI will indicate within limits specified in table 9.

Table 9. Ac Current Accuracy (µA)

Calibrator output		Test instrument	
Amplitude	Frequency	Indications	
		Min	Max
350 µA	60 Hz	346.3 µA	353.7 A
350 µA	1 kHz	346.3 µA	353.7 A
3.5 mA	60 Hz	3463 µA	3537 µA
3.5 mA	1 kHz	3463 µA	3537 µA

(5) Set function switch to **mA/A**⎓.

(6) Set calibrator output for 35 mA at a frequency of 60 Hz. TI will indicate within limits specified in first row of table 10.

(7) Repeat technique of (6) above, using calibrator outputs and indications listed in table 10. TI will indicate within limits specified in table 10.

Table 10. Ac Current Accuracy (mA)

Calibrator output		Test instrument	
Amplitude	Frequency	Indications	
		Min	Max
35 mA	60 Hz	34.63 mA	35.37 mA
35 mA	1 kHz	34.63 mA	35.37 mA
350 mA	60 Hz	346.3 mA	353.7 mA
350 mA	1 kHz	346.3 mA	353.7 mA

(8) Set calibrator output to minimum.

(9) Move connection from TI **mA/µA** input to TI **A** input.

(10) Set calibrator output for 3.5 A at a frequency of 60 Hz. TI will indicate within limits specified in first row of table 11.

(11) Repeat technique of (10) above, using calibrator outputs and indications listed in table 11. TI will indicate within limits specified in table 11.

Table 11. Ac Current Accuracy (A)

Calibrator output		Test instrument	
Amplitude	Frequency	Indications	
		Min	Max
3.5 A	60 Hz	3463 mA	3537 mA
3.5 A	1 kHz	3463 mA	3537 mA
10 A	60 Hz	9.88 A	10.12 A
10 A	1 kHz	9.88 A	10.12 A

(12) Set calibrator output to minimum and disconnect equipment setup.

b. Adjustments. No adjustments can be made.

13. Resistance/Conductance

a. Performance Check

(1) Connect calibrator to TI **V Ω** ⊣⊢ and **COM** inputs.

(2) Set TI function switch to **Ω**.

(3) Set calibrator for a 0 Ω (**2-wire Comp**: **ON**) output and press TI **REL Δ** pushbutton.

(4) Press TI **RANGE** pushbutton for 400 Ω range.

(5) Set calibrator for a 190 Ω nominal output.

(6) Rotate calibrator knob below **EDIT FIELD** pushbutton to adjust calibrator display indication to equal TI indication. Calibrator **Err** display will indicate within limits specified for appropriate model in first row of table 12.

(7) Repeat technique of (4) through (6) above, using calibrator outputs and TI indications listed in table 12. Calibrator **Err** display will indicate within limits specified for appropriate model in table 12.

Table 12. Resistance Accuracy

Test instrument	Calibrator		
		Err indication ±(%)	
Range	Nominal output	Model 87	Model 87 III
400 Ω	190 Ω	0.2632	0.3158
4 kΩ	1.9 kΩ	0.2632	0.2632
40 kΩ	19 kΩ	0.2632	0.2632
400 kΩ	190 kΩ[1]	0.2632	0.6316
4 MΩ	1.9 MΩ	0.2632	0.6316
40 MΩ	19 MΩ	1.1579	1.1579

[1] Calibrator **2-wire Comp**: **OFF**

(8) Press TI **RANGE** pushbutton to enter 40 nanosiemens range.

(9) Set calibrator output to 100 MΩ.

(10) TI will indicate between 9.80 and 10.20 nS.

(11) Set calibrator output to minimum and disconnect equipment setup.

b. Adjustments. No adjustments can be made.

14. Capacitance

a. Performance Check

(1) Connect short leads (6 inches or less) to TI **V Ω** ⏚ and **COM** inputs.

(2) Set TI function switch to **Ω** and press **BLUE** button.

(3) Position leads parallel to one another and separated by 2 to 3 inches.

(4) Allow TI readings to stabilize below 1 nF, then press **REL Δ** pushbutton.

(5) Connect open ends of leads to 5 nF capacitor. TI will indicate within limits specified for appropriate model in first row of table 13.

(6) Disconnect capacitor.

(7) Repeat technique of (3) through (6) above, using capacitor nominal values and TI indications listed in table 13. TI will indicate within limits specified for appropriate model in table 13.

Table 13. Capacitance Accuracy

Capacitor	Test instrument indications			
	Model 87		Model 87 III	
Nominal value	Min	Max	Min	Max
5 nF	4.93 nF	5.07 nF	4.92 nF	5.08 nF
0.05 μF	0.0493 μF	0.0507 μF	0.0492 μF	0.0508 μF
0.5 μF	0.493 μF	0.507 μF	0.492 μF	0.508 μF
1 μF	0.97 μF	1.03 μF	0.87 μF	1.13 μF

15. 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:

Official:

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

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

0323905

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INSTRUCTIONS FOR SUBMITTING AN ELECTRONIC 2028

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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.

PIN: 081024-000