**DEPARTMENT OF THE ARMY TECHNICAL BULLETIN**

# CALIBRATION PROCEDURE FOR FORCE MEASURING SYSTEM EMERY MODEL SS-3660

HEADQUARTERS, DEPARTMENT OF THE ARMY, WASHINGTON, DC

*1 April 1981*

## REPORTING OF ERRORS

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## SECTION I. IDENTIFICATION AND DESCRIPTION

**1. Test Instrument Identification**. This bulletin provides instructions for the calibration of force measuring system, Emery Model SS-3660. 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 1 hour using the prescribed technique.

**2. Calibration Data Card, DA Form 2416.** Forms, records and reports required for calibration personnel at all levels are prescribed by TM 38-750. DA Form 2416 must be annotated in accordance with TM 38-750 for each calibration performed.

**3. Calibration Description**. TI parameters and performance specifications which pertain to this calibration are listed in table 1. Minor variations by the calibration specialist are authorized to accomplish the calibration.

*Table 1. Calibration Description*

| Test instrument parameters | Performance specifications |
|---|---|
| Pounds (lb) force | Range: 200 to 20,000 lb<br>(90.72 to 9072.00 kg)<br>Accuracy: 200 to 5000 lb<br>(90.72 to 2268.00 kg)<br>±6 minor div<br>(±0.6% FS)<br><br>5000 to 20,000 lb<br>(2268.00 to 9072.00 kg)<br>±3 minor div<br>(± 0.3% FS)<br><br>Not to exceed 90% of TI scale |

## SECTION II. EQUIPMENT REQUIREMENTS

**4. Equipment Required**. Table 2 identifies the specific equipment used in this calibration procedure. This equipment is issued with the secondary transfer calibration standards set and is to be used in performing this procedure. 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 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 three-to-one accuracy ratio between the standard and TI. Where the three-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 3 are issued with the secondary transfer calibration standards set and are to be 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, model, and part number |
|---|---|---|---|
| A1 | Force calibration kit C-48400 (load cell) | Range: 0 to 20,000 lb (0 to 9072.00 kg)<br>Accuracy: 200 to 5000 lb (90.72 to 2268.00 kg) ±30 lb (±13.608 kg)<br>5000 to 20,000 lb (2268.00 to 9072.00 kg) ±15 lb (± 6.804 kg) | Revere USPI-20B (Part of MIS-10254) |
| A2 | Force calibrator (load cell) | ••• | Revere, Model R-160 (MIS-10254) 6670-00-198-7591 |

*Table 3. Accessories Required*

| Item | Common name | Description and part number |
|---|---|---|
| B1 | Adapters | Supplied as accessory kit of the APE 1299 AC31299-E017 |
| B2 | Feeler gage | Feeler gage set with range 0.020 to 0.040 in. (0.0508 to 0.1016 cm) |
| B3 | Hydraulic fluid | Emery hydraulic cell fluid BL-15 |
| B4 | Lever gun | Lincoln lever gun model 1140 and Adams hydraulic coupler, model HY 107 |

## SECTION III. PRELIMINARY OPERATIONS

### 6. Preliminary Instructions.

**a.** The instructions outlined in this section are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before performing 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 (p 4), and prefix B, see table 3 (p 5).

### 7. Equipment Setup.

**a.** Remove cartridge case holding shoe from TI load cell.

**b.** Remove projectile holding jaws from TI.

**c.** Connect equipment as shown in figure 1 (p 8).

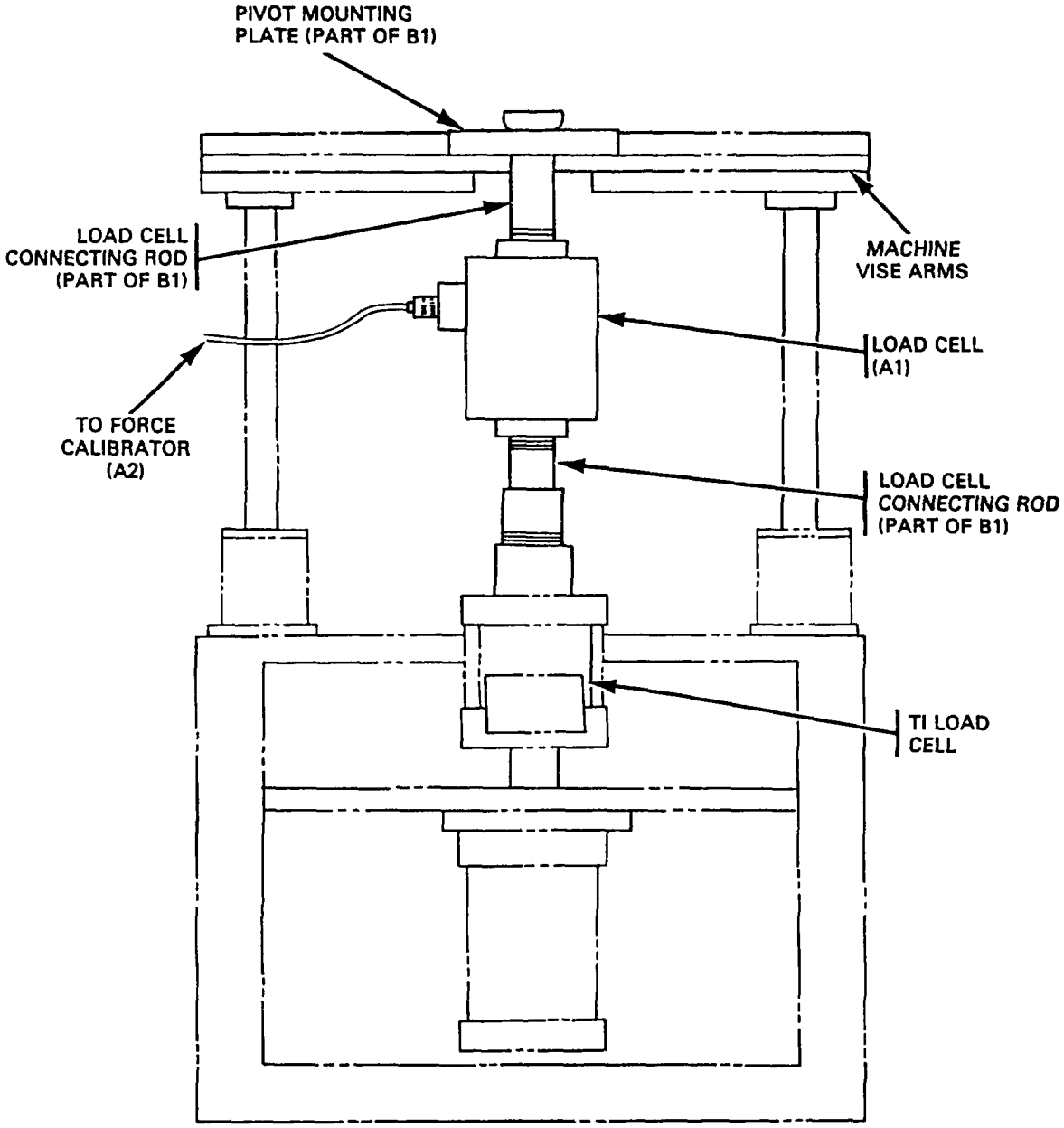


*Figure 1. Test Instrument-Overall Equipment Setup.*

## SECTION IV. CALIBRATION PROCESS

**NOTE**

**Unless otherwise specified, verify the results 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.**

**8. Initial Procedure.**

**a. Performance Check.**

**(1)** Assure equipment is set up in accordance with paragraph 7.

**(2)** Connect force calibrator (A2) and load cell (A1) to operate in tension.

**(3)** Set approximately 750 pounds/square inch (psi) (52.50 kilograms/centimeters squared ($kg/cm^2$)) on TI pump pressure gage using adjustment on relief valve. See figure 2 (p 10).

**8. Initial Procedure.-Continued**

**b. Adjustments.-Continued**

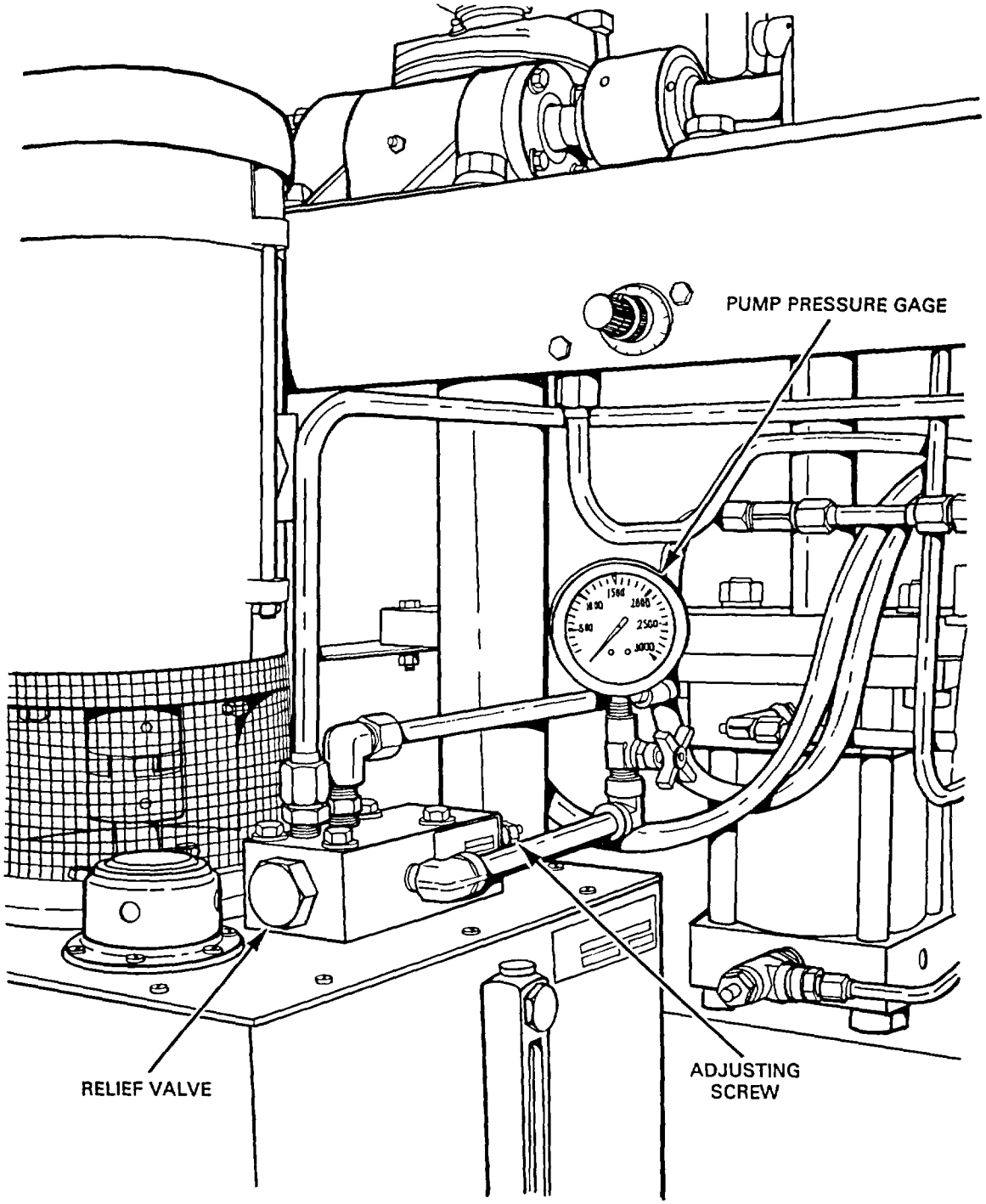


*Figure 2. Pressure Pump Adjustment.*

**(4)** Exercise machine three times from zero to approximately 90 percent of scale.

**(5)** With system unloaded, check gap at the three gaging holes on the TI load cell with feeler gage (B2). See figure 3 (p 12). If gap is not approximately 0.030 inch (in.) (0.0762 centimeters (cm) ), perform b(1) and (2) on page 13. Record gap measurement.

**8. Initial Procedure.-Continued**

**a. Performance Check.-Continued**

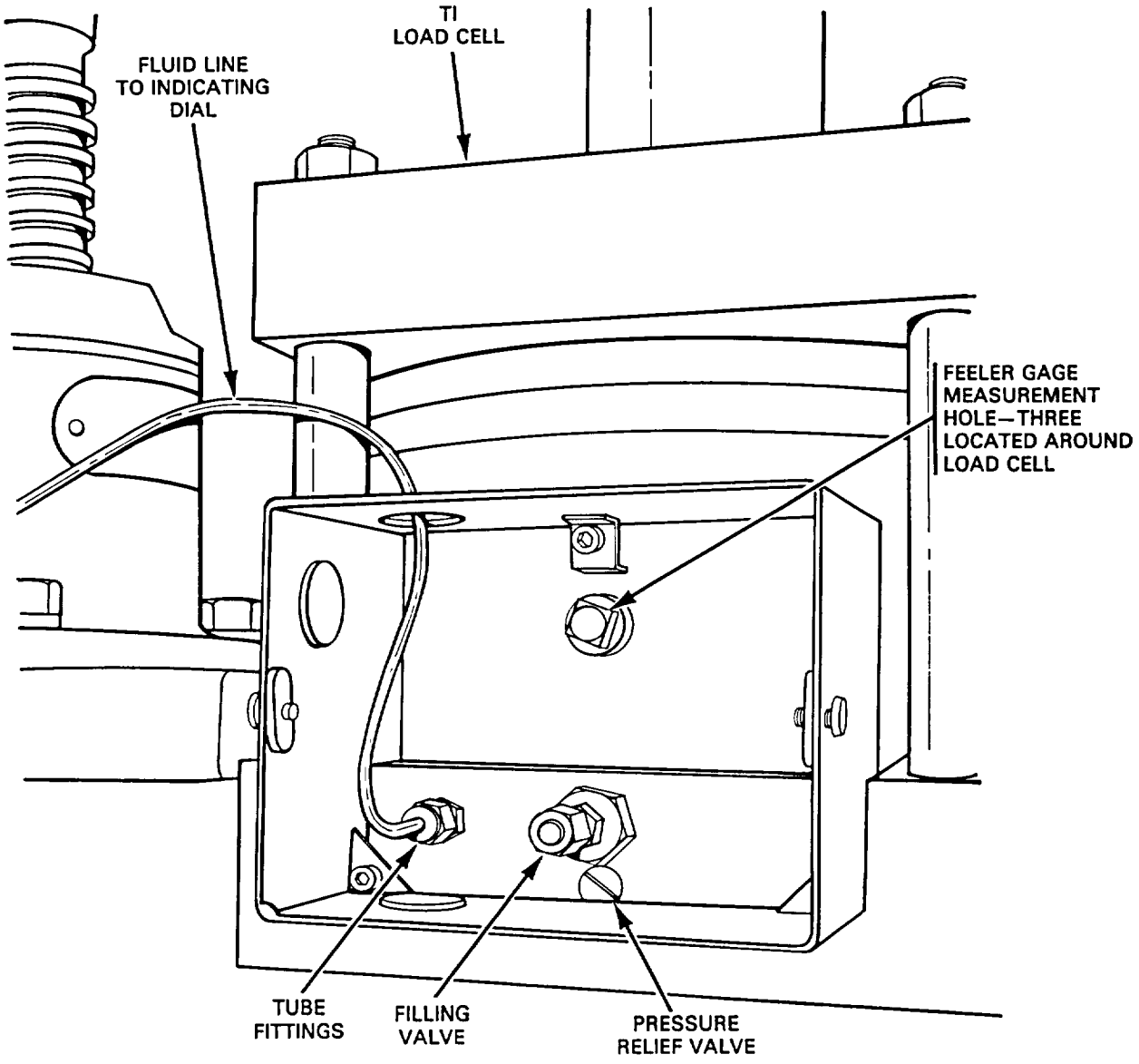


*Figure 3. TI Load Cell.*

**(6)** Load system and measure gap at each gaging hole. If gap has changed more than 0.004 in. (0.01016 cm) from gap recorded in (5) on page 11, perform b(1) thru (7) below.

**(7)** Check zero setting of TI indicating dial with system unloaded. If TI indicating dial does not indicate zero, perform b(3) below.

**(8)** Adjust relief valve on pump for approximately 100 psi (7.00 kg/cm$^2$) indication on pump pressure gage. See figure 2 (p 10).

**(9)** Operate TI and record indication of TI and force calibrator.

**(10)** Repeat (8) and (9) above at approximately 100-psi (7.00-kg/cm$^2$) increments up to 700 psi (49.00 kg/cm$^2$), and also at approximately 750 psi (52.50 kg/cm$^2$).

**(11)** Repeat (8), (9), and (10) above for a series of three readings for each 100-psi (7.00-kg/cm$^2$) pump pressure. The average values for these readings should be within the limits specified in table 1 (p 2). If not, perform b(4) and (7) below.

**b. Adjustments.**

**CAUTION**

**Use only the hydraulic fluid specified. Use of automotive engine oil or hydraulic brake fluid will cause damage to equipment.**

**(1)** Fill lever gun (B4) with hydraulic fluid (B3) to within 1/2 in. (1.270 cm) of top. Release air bubbles by opening air vent slightly and pumping handle.

**NOTE**

**Use of an empty lever gun will fill the system with air and cause improper calibration results.**

**(2)** Check lever gun follower rod free travel. If free travel is 1 in. (2.54 cm) or less, refill lever gun.

**(3)** Turn TI filling valve 1/4 turn counterclockwise (Fig. 3 (p 12)) and attach nozzle of lever gun.

**(4)** Using full strokes, pump lever gun handle. Measure gap at all three measurement holes with feeler gage (82) until they average 0.030 in. (0.0762 cm). The gap will increase as more fluid is pumped into the TI. Excess fluid may be released by loosening one of the tube fittings.

**(5)** Close the filling valve and check all tubing connections after filling the system.

**(6)** The cell has a pressure relief valve that is adjacent to and connected to the filling valve. See figure 3 (p 12). A suitable relief spring is installed at the factory that will release the oil pressure when it exceeds the peak operating pressure of the system by approximately 20 percent. (The purpose of the relief valve is to avoid any accidental over pressurizing of the system that might occur during the filling of the system.) When the filling valve is closed, the relief valve is isolated from the hydraulic circuit.

**(7)** Load system and measure gaps at each gaging hole. If the gap has decreased more than 0.004 in. (0.01016 cm), air is entrapped in TI load cell, tubing, and indicating dial. Perform steps (a) thru (c) below to remove air from the system.

**8. Initial Procedure.-Continued**

**b. Adjustments.-Continued**

**(a)** Disconnect the tubing line from the cell and pump fluid through filling valve until no further evidence of air bubbles appears at tube connection. Effective purging of air from the cell can also be accomplished by first filling the cell to approximately its normal gaging, then loosening the tube connection and allowing the oil to purge out through the loose connection. Repeat several times until there is no further evidence of air bubbles.

**(b)** With the tubing line connected to the cell, loosen the tubing connection at the indicator end. Pump fluid into the filling valve of the cell until there is no further evidence of air bubbles at the loose connection. Retighten connection while pressure is applied.

**NOTE**

**If indicator does not have a plug door on the back of the case, then vent screw must be serviced from the front by removing bezel, pointer and dial.**

**(c)** Remove plug door on back of TI load indicator case and remove vent screw. Pump fluid into the cell until no further bubbles appear out of the vent screw opening. Reinstall the vent screw and clean thoroughly.

**CAUTION**

**A damping valve has been installed in the pressure fluid line to the indicating dial to protect the dial from sudden decrease of line pressure. Misadjustment of this valve can cause error in dial readings and possible damage to indicating dial.**

**(8)** When gap setting are approximately 0.030 in. (0.0762 cm) and air has been removed from TI, adjust TI indicating dial pointer to zero by rotating the dial until the pointer indicates zero. The zero setting is achieved by means of an external knurled knob at the bottom of the bezel; the knob operates a pinion which engages a rack on the dial face; zero adjustment is equal to 15 percent of the range.

**(9)** Repeat calibration procedure as outlined in paragraph 8a (p 9).

**(10)** If TI does not fall within the required tolerance, individual calibration of the indicating dial should be followed as outlined in TB 9-6685-319-50 using the manufacturer's calibration record of cell output pressure in psi (fluid pressure vs indicating dial reading in lb force) for each individual TI load cell. See figure 4 (p 16). Approximately 40 psi (2.80 $kg/cm^2$) will be zero on dial and 1000 psi (70.00 $kg/cm^2$) will be 20,000 pounds (lb) (9072.00 kg) force on dial.

**8. Initial Procedure.-Continued**

**a. Performance Check.-Continued**

TYPICAL SUPPLIED CALIBRATION RECORD OF SS-3660

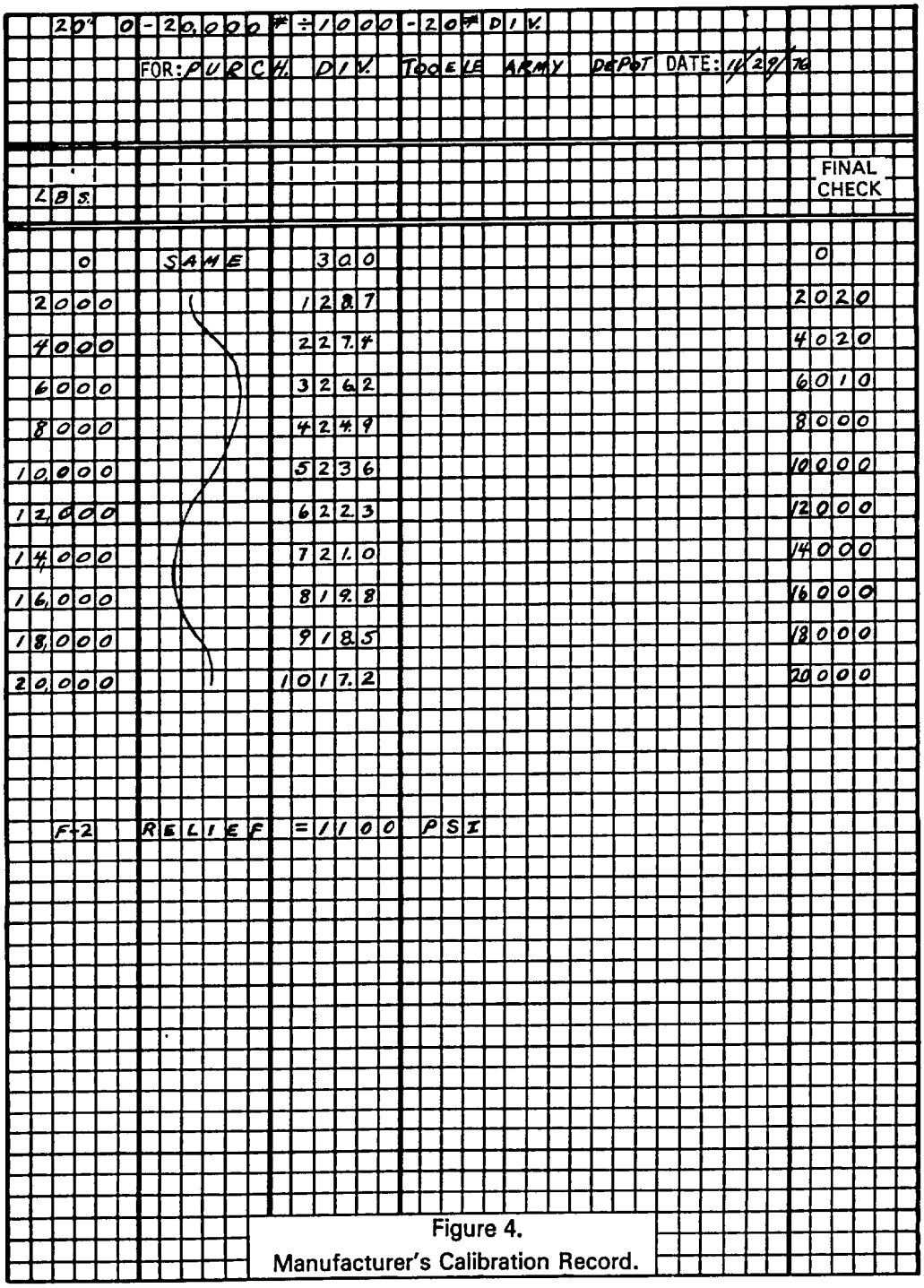


Figure 4.
Manufacturer's Calibration Record.

*Figure 4. Manufacturer's Calibration Record.*

**(11)** If the TI indicating dial is within tolerance, the TI manufacturer should be consulted for factory check of probable defective load cell.

**9. Final Procedure.**

**a.** Deenergize and disconnect equipment.

**b.** In accordance with TM 38-750, 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 tolerence, annotate and affix DA Form 2417 (US Army Calibration System Rejected Instrument).

**By Order of the Secretary of the Army:**

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