145A TEST SET
DESCRIPTION AND USE

CONTENTS PAGE

1. GENERAL

1.01 This section covers the description and use of the 145A test set (Fig. 1).

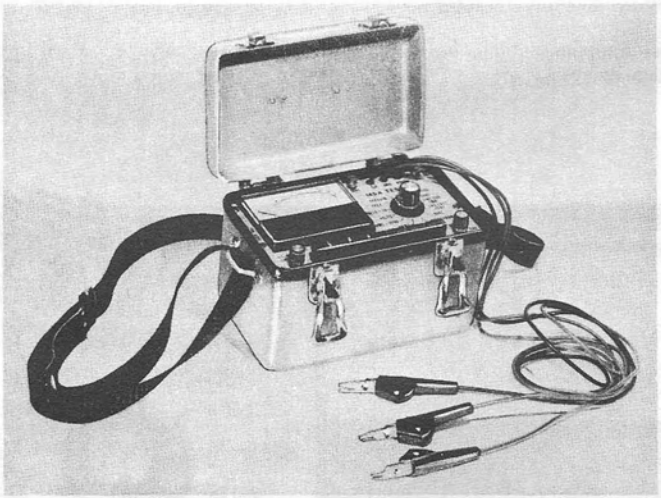


Fig. 1—145A Test Set

1.02 The 145A test set is a portable, battery powered test set used for testing operations associated with construction, installation, and repair. These testing operations include resistance measurement, detection of ringer on the line, measurement of dc voltage, pair conductor length measurement, direct reading open fault location, tone source generator, ac voltage measurements, line current measurements, circuit loss measurement at 1000 Hz, and circuit noise measurement.

2. DESCRIPTION

2.01 The 145A test set is battery powered and weighs approximately 3 pounds. It measures approximately 5 inches by 8 inches by 6 inches, and a strap is provided for carrying or hanging the test set during use.

2.02 The 145A test set incorporates the following test modes:

- Ohmmeter—Trouble-locating of crosses, shorts, and grounds.
- Detection of Ringer—Detects presence of one or more ringers on the line.
- DC Voltmeter—DC voltage readings; eg, 48V central office (CO) battery.
- Pair Conductor Length Measurement—Measures length of wire or cable pairs up to 20,000 feet.
- Direct Reading Open Fault Locator—Locates opens in one conductor of a pair.
- Tone Source—Supplies a tone for cable or wire pair identification.
- AC Voltmeter—AC voltage readings of lamp battery and ringing voltage.
- Line Current Meter—Measures CO line current in milliamperes.
- Circuit Loss Meter—Measures 1000 Hz loss of wire or cable.
- Noise Meter (DBRNC)—Measures noise metallic (tip to ring) and noise longitudinal (noise to ground).

2.03 The following switches are located on the front panel (Fig. 2):

- Test Selector—Used in selecting the desired test mode.

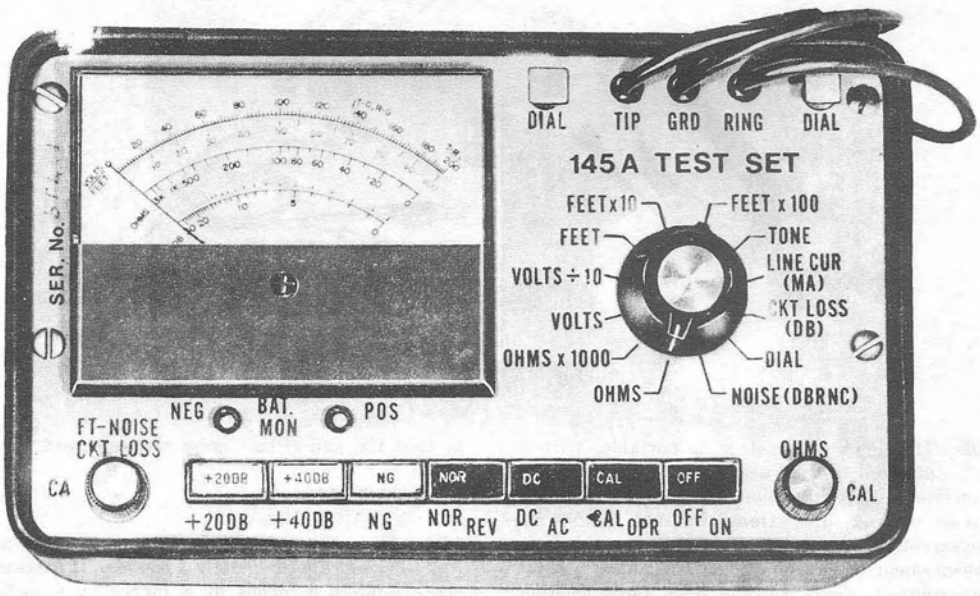


Fig. 2—Front Panel

- OFF/ON—Power switch for test set. Push-OFF, Push-ON switch.

To avoid depleting the batteries, the OFF/ON switch must be turned to the OFF position when test set is not in use.

- DC/AC—Selects either AC or DC measurement. Push-to-DC, Push-to-AC.

- OHMS-CAL—Used to calibrate the OHMS scale of the meter.

- FT-NOISE CKT LOSS CAL—Used to calibrate the feet, circuit loss, and noise scales of the meter.

- NOR/REV—A push-button switch used to reverse the tip and ring when making "capacitive kick" test with the ohmmeter to determine the presence of a ringer or ringers on the line.

- CAL/OPR—This push-button switch must be in the OPR (operate) position when making all tests and in the CAL (calibrate) position when calibrating the meter.

When the switch is in the CAL position, the test leads are internally disconnected from the meter. Always position CAL/OPR switch to CAL when test set is not in use.

- +20DB—A push-to-operate, push-to-release switch used to add 20 dB of attenuation during noise and circuit loss measurements.

- +40DB—A push-to-operate, push-to-release switch used to add 40 dB of attenuation during noise and circuit loss measurements.

- NG—A push-to-operate, push-to-release switch used when making longitudinal noise (noise-to-ground) measurements.

2.04 The 145A test set is provided with two LEDs (light emitting diodes) labeled BAT MON—NEG and POS—that function as follows:

NEG—Negative power supply indicator

POS—Positive power supply indicator.

The BAT MON (battery monitor) feature is activated when the OFF/ON switch is ON and continually monitors the positive (POS) and negative (NEG) power supplies. If either one or both LEDs come on, the batteries need replacing.

3. CALIBRATION

3.01 ***Calibrating meter when using OHMS scale:***

(a) Place the CAL/OPR switch in the CAL position and OFF/ON switch in ON position (Fig. 3).

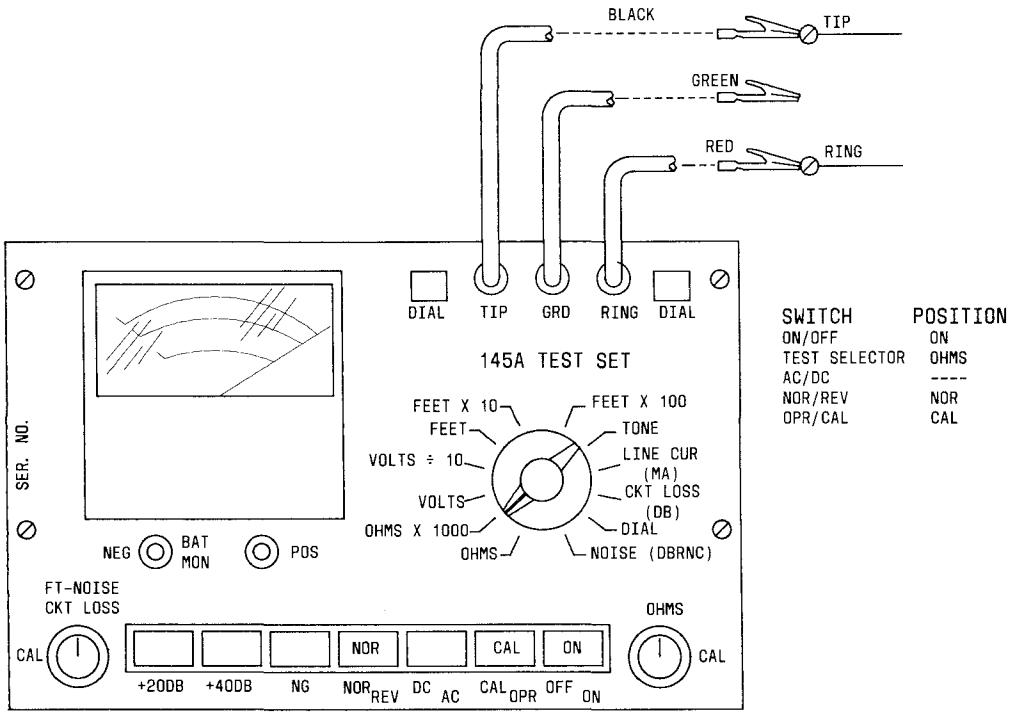


Fig. 3—Ohms Calibration

(b) Rotate TEST SELECTOR to the desired ohms position.

(c) Turn the OHMS-CAL knob until the needle of the meter is at the zero (0) mark on the right of the scale.

Note: The meter must be recalibrated each time the TEST SELECTOR is changed from OHMS to OHMS X 1000.

3.02 ***Calibrating meter when using the FT-NOISE CKT LOSS scale:***

(a) Place the CAL/OPR switch in the CAL position and OFF/ON switch in ON position.

(b) Rotate TEST SELECTOR to the desired function position.

(c) Turn the FT-NOISE CKT LOSS CAL knob until the needle of the meter is at the 200 mark at the right of the VOLTS/FEET scale or zero (0) mark of the DB scale.

When calibrating circuit loss and noise, check that the +20DB, +40DB, and NG switches are in the up position (not depressed). The meter must be recalibrated each time the TEST SELECTOR is moved to a new position.

3.03 ***Calibrating meter when using the FEET scale to measure other than 0.083 microfarad (μF) capacitance per mile exchange cable:***

(a) Place CAL/OPR switch at the CAL position and OFF/ON switch in ON position. Rotate TEST SELECTOR to any of FEET positions.

(b) Select proper calibration setting for the wire being tested from Table A and calibrate the meter to that setting by rotating the FT-NOISE CKT LOSS CAL knob until the proper setting is reached.

(c) After the meter is calibrated, return CAL/OPR switch to OPR and read the length on the VOLTS/FEET scale of the meter.

Note: It is not necessary to remove the test leads from the line when calibrating the meter, as the test set leads are internally disconnected from the meter when the CAL/OPR switch is in the CAL position.

TABLE A

CALIBRATION CHART

CABLE OR WIRE TYPE	TIP-TO-RING MEASUREMENT	ONE CONDUCTOR TO GROUND*
Standard Cable	200 (full scale)	135
LOCAP Cable	106 (multiply reading by 4)	134 (multiply reading by 2)
MAT Cable	158 (multiply reading by 2)	166
B-Service (2 pr)	160	84
C-Service (2 pr)	170	98
C-Service (5 pr)	180	102
C-Drop (1 pr)	93	94
C-Multiple (6 pr)	88	56
D-Inside (6 pr)	152	112
D-Inside (25 pr)	141	90
D-Station (24 ga)	204	106
D-Station (22 ga)	186	102
D-Rural (6 pr)	---	168
E-Buried (1 pr)	148	139
F-Drop (1 pr)	148	139
F-Multiple (6 pr)	198	124
F-Service (2 pr)	169	81
F-Service (5 pr)	138	78
JKT-Station (2 pr)	118	62

*Make sure other conductor is grounded to shield or earth ground.

4. USE

4.01 ***Resistance Testing (Fig. 4):*** The following steps must be used when making this test:

(a) Connect the test set leads to the circuit being measured.

(b) Turn test selector knob to the OHMS X 1000 position.

(c) Calibrate the meter as follows:

(1) Place OFF/ON switch in the ON position and the CAL/OPR switch in the CAL position.

(2) Turn the OHMS-CAL knob until the meter reads 0 on the OHMS scale.

(d) Place CAL/OPR switch in the OPR position and the resistance measured in ohms is shown on the meter.

(e) For resistance less than 3000 ohms, set the test selector knob to the OHMS position, recalibrate per (c), (1) and (2), above, and remeasure for a more accurate reading.

The presence of a battery cross on the pair being tested may cause resistance readings to change when the NOR/REV switch is operated.

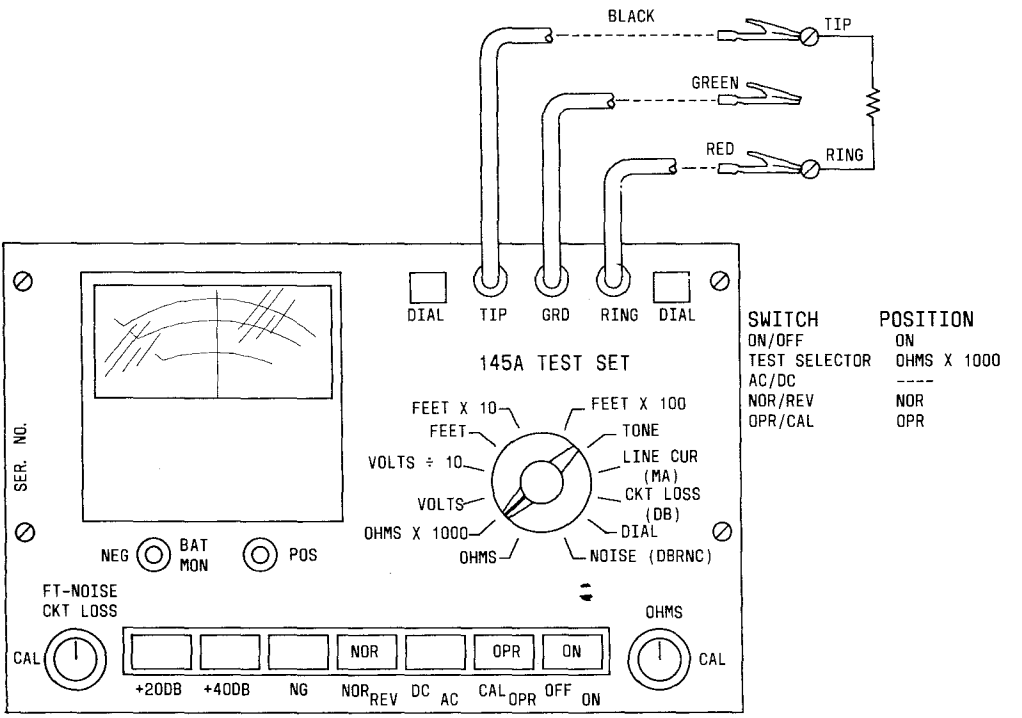


Fig. 4—Resistance Testing

4.02 ***Detection of Ringer (Fig. 5):*** This test is used to determine the presence of one or more ringers on a line or drop wire. The following steps must be used when making this test:

(a) Connect the test set leads to the circuit being tested

(b) Turn test selector knob to the OHMS X 1000 position.

(c) Calibrate the meter as follows:

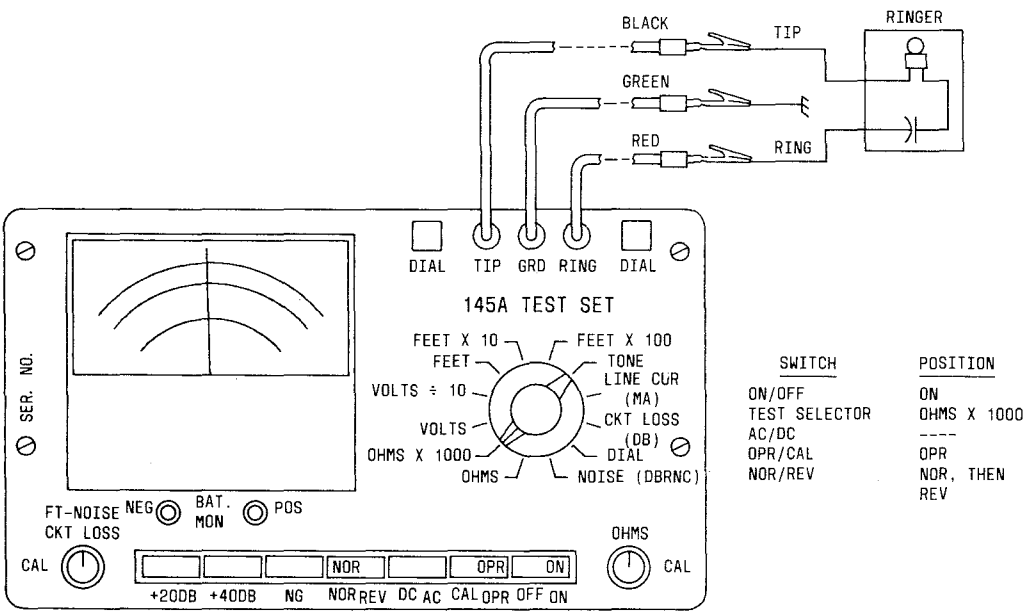
(1) Place OFF/ON switch in the ON position and the CAL/OPR switch in the CAL position.

(2) Turn the OHMS-CAL knob until the meter reads 0 on the OHMS scale.

(d) After calibrating meter, return CAL/OPR switch to the OPR position.

(e) Operate the NOR/REV switch to one position, then the other. When a ringer is present on the line, the needle of the meter will deflect (a kick) from 0 to 10 or more on the mA scale.

To ensure accurate readings, ALL meter movement must have stopped before moving the NOR/REV switch from one position to the other.



SWITCH	POSITION
ON/OFF	ON
TEST SELECTOR	OHMS X 1000
AC/DC	----
OPR/CAL	OPR
NOR/REV	NOR, THEN REV

Fig. 5—Detection of Ringer

4.03 ***DC Voltage Testing (Fig. 6):*** The following steps must be used when making this test:

(a) Turn the test selector knob to the VOLTS position.

(b) Position the DC/AC switch to DC.

(c) Position the NOR/REV switch to NOR.

(d) Connect the test set cords to the circuit being tested as follows:

(1) Connect the black (TIP) lead to the TIP side of the line.

(2) Connect the red (RING) lead to the RING of the pair.

DANGER: Do not test circuits suspected of having a voltage of over 200 volts. Extreme caution must be used when attaching the test set leads whenever there is reason to suspect the presence of voltage greater than 50 Vac (rms) or 135 Vdc.

(e) The CAL/OPR switch must be in the OPR position.

(f) Read the voltage on the VOLTS/FEET scale. If the needle deflects to the left, reverse the polarity of the meter by placing the NOR/REV switch in the REV position and read the voltage.

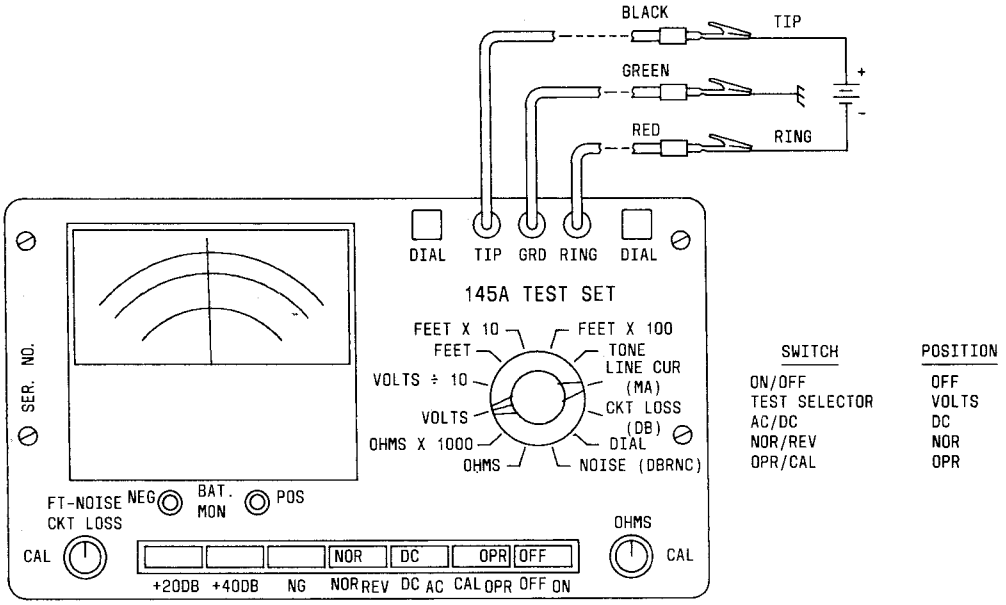


Fig. 6—DC Voltage Testing

4.04 ***Pair Length Measurement and Open Conductor Locating Tests (Fig. 7):***

(a) ***Pair Length Measurement Test:*** In this test, the length of a cable or wire pair is measured using the TIP to RING mutual capacitance. This measurement gives accurate results on cable or wire sections that are open circuited at the far end or cable or wire pairs having the TIP and RING open at the same point. The following steps must be used when making this test.

(1) Connect test set leads to pair being measured.

(2) Turn test selector knob to OHMS X 1000 position.

(3) Calibrate the meter as follows:

(a) Place OFF/ON switch in the ON position and the CAL/OPR switch in the CAL position.

(b) Turn the OHMS/CAL knob until the meter reads 0 on the OHMS scale.

(4) Check pair for a low resistance short as follows:

- While observing the meter, return the CAL/OPR switch to the OPR position. The needle should deflect completely up scale (to the left) and remain there. If the needle falls back to some resistance value, there is a fault between tip and ring. Operate the NOR/REV switch and repeat the test.

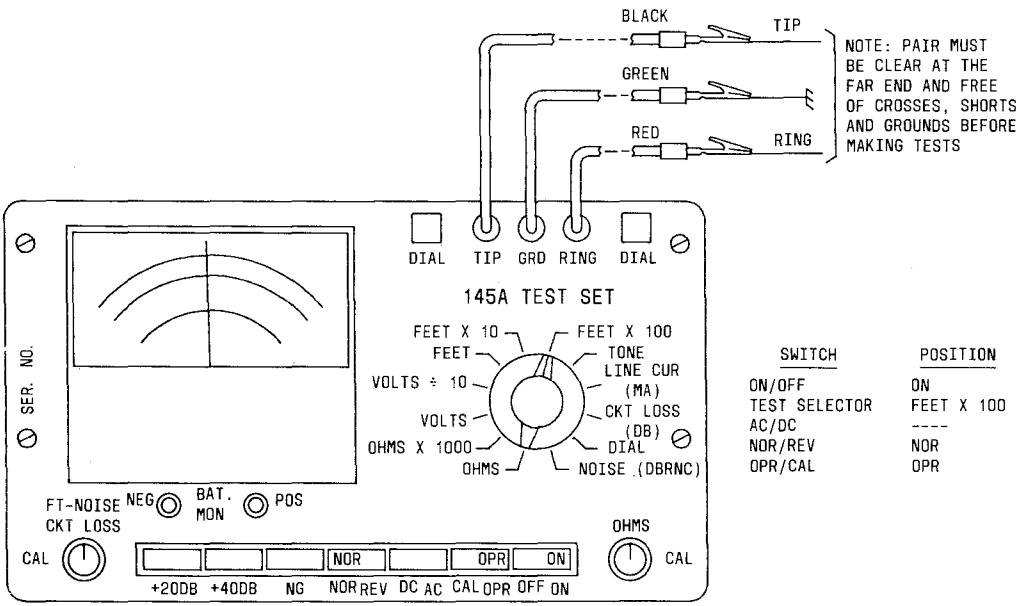


Fig. 7—Pair Length Measurement

Note: An accurate length measurement cannot be made if the intersection of the measured length and the measured resistance in Steps 4 or 5 fall in the inaccurate area on Chart A (Fig. 8).

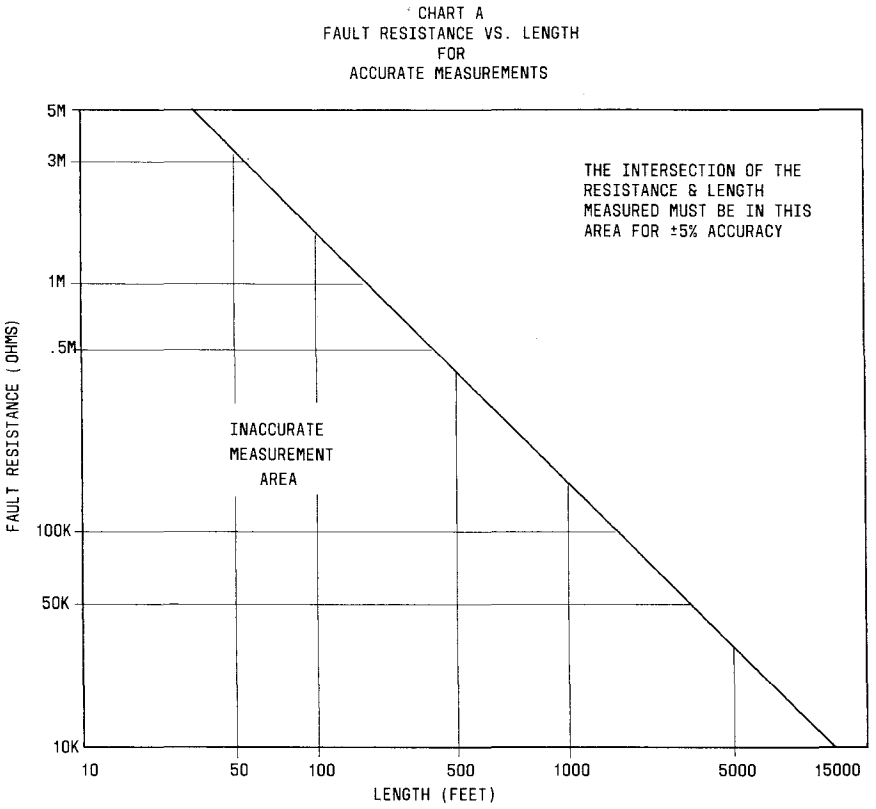


Fig. 8—Chart A—Fault Resistance Vs Length for Accurate Measurements

(5) Now check for a low resistance fault from tip or ring to ground:

(a) Move the black (TIP) test lead from the TIP conductor of the pair and connect it to ground. If the meter needle moves down from full scale to some resistance value, the RING lead of the pair is grounded. See Note following Step (4). Operate the NOR/REV switch and repeat the check.

(b) Move the red (RING) test lead from the RING conductor of the pair to the TIP conductor. Leave the black test lead on ground. If the meter needle moves down from full scale to some resistance value, the TIP lead of the pair is grounded. See Note following Step (4). Operate the NOR/REV switch and repeat the check.

(6) If the pair is free of low resistance shorts or grounds, return the black test set lead to the TIP side of the line and the red test set lead to the RING side of the line and change the test selector knob to the FEET X 1000 position.

(7) Place the CAL/OPR switch to the CAL position and calibrate meter to read 200 (T-R) on the VOLTS/FEET scale using the FT-NOISE CKT LOSS CAL knob. (For wire or cable with capacitance other than 0.083 μF per mile, see Table A for calibration setting.)

(8) After calibrating meter, restore CAL/OPR switch to the OPR position and read the length of the pair on the FEET scale of the meter.

Note: If reading is below 2000 feet, move test selector knob to FEET X 10 position and, if below 200 feet, move test selector knob to FEET.

(b) ***Open Conductor Locating Test:*** This test is used in determining the distance to an open in one conductor of a cable or wire pair. The following steps must be used when making this test:

(1) Connect the test set leads to the pair being measured.

(2) Turn test selector knob to the OHMS X 1000 position and test for resistance leakage as described in paragraph 4.04(a), (1) through (5).

(3) When it is determined that leakage is satisfactory, rotate test selector knob to FEET X 100 position.

(4) Place CAL/OPR switch in the CAL position and calibrate meter as follows:

- Calibrate the meter using the FT-NOISE CKT LOSS/CAL knob to the T-G or R-G mark which is located just above the 140-foot mark on the VOLTS/FEET scale. This calibration is for all cable with 0.083 Mfd/mile mutual capacitance. See Table A, Conductor TIP OR RING TO GROUND column, for the calibration setting for other type wire or cable.

- Move the CAL/OPR switch to the OPR position.

(5) With the TIP wire grounded, determine length of RING wire by connecting the black (TIP) test lead to ground and the red (RING) test lead to the ring wire and measure.

(6) With the RING wire grounded, determine length of TIP wire by connecting red (RING) test lead to ground and the black (TIP) test lead to the tip wire. The wire (TIP or RING) with the shortest length measurement is open.

Note: In the above procedure, the test set is correctly calibrated for cable in which most pairs are working or grounded. The test set readings will average about 7 percent shorter than the correct length in new construction.

4.05 ***Use of Tone for Pair Identification (Fig. 9):*** The following steps must be used when making this test:

(a) Turn test selector knob to TONE position.

(b) Connect the test set leads to the cable pair or drop wire being tested.

(c) Place CAL/OPR switch in OPR position.

(d) The tone may be detected at the far end of the cable pair or drop wire by using the AT-8629 test probe (Section 105-241-100) or a 147-type amplifier. The 145A test set is not intended to be used with the 1097A filter.

Note: The 145A test set produces a distinctive 2-frequency warbling tone of approximately 550 and 1000 Hz.

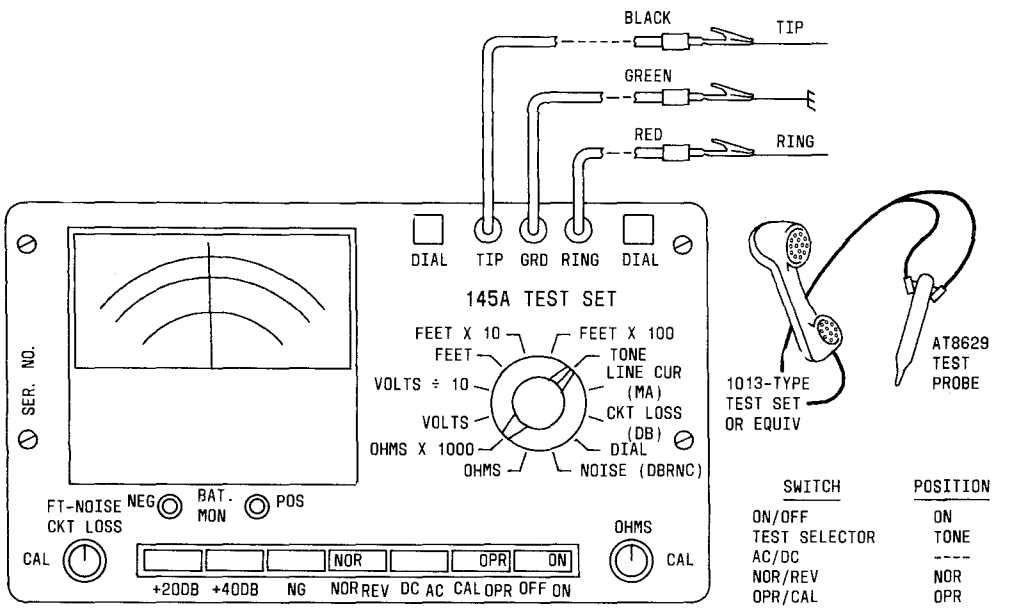


Fig. 9—Use of Tone for Pair Identification

4.06 ***AC Voltage Testing (Fig. 10):*** This test ***should not*** be made if it is suspected that the ac voltage of the circuit exceeds 200 Vac. The following steps must be used when making this test:

(a) Turn the test selector knob to the VOLTS position.

(b) Position the DC/AC switch to AC.

(c) Connect the test set leads to the facility to be tested.

DANGER: Extreme caution must be used when attaching the test set leads, whenever there is reason to suspect the presence of voltage greater than 50 Vac (VMS) or 135 Vdc.

(d) Place CAL/OPR switch in OPR position.

(e) Read the voltage on the VOLTS/FEET scale of the meter.

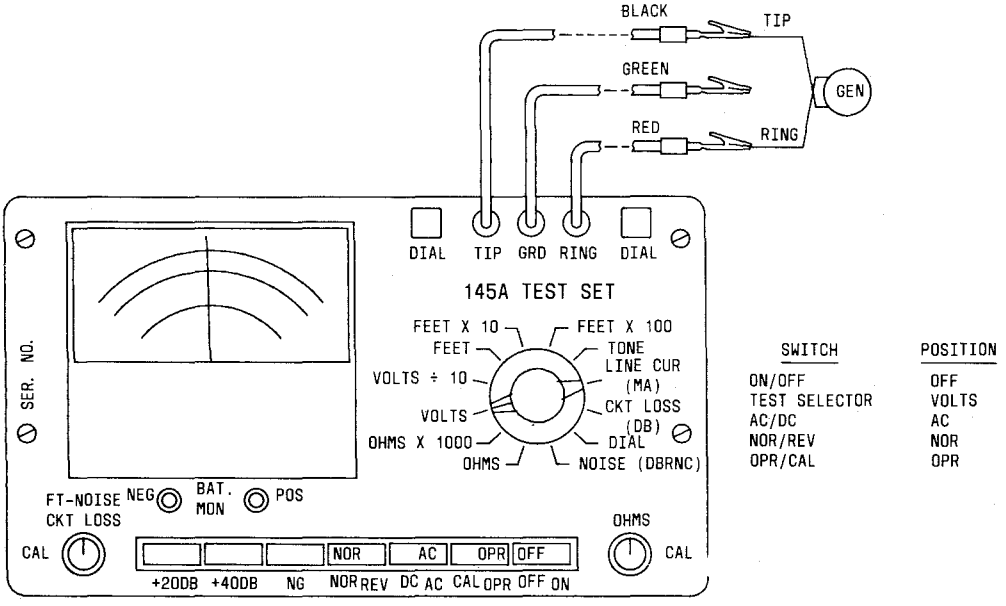


Fig. 10—AC Voltage Testing

4.07 ***Line Current Testing (Fig. 11):*** This test measures the amount of line current that is being received from the CO for operation of a station telephone set. The measurement should be made at the customer's premises. The following steps must be used when making this test:

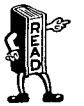
(a) The station set must be either on-hook or disconnected.

(b) Turn the test selector knob to the LINE CUR (MA) position.

(c) Connect 145A test set leads to the line being tested.

(d) Place the NOR/REV in the NOR position and the CAL/OPR in the OPR position.

(e) Read the line current in milliamperes on the mA scale of the meter.



If the current is reversed, the needle of the meter will move to the extreme left of the meter. Move the NOR/REV switch to the REV position, and read the line current.

(f) The following are the parameters for CO line current:

Unacceptable—0 mA to 26 mA

Acceptable—26 mA to 100 mA

Optimum—35 mA to 65 mA.

Note: When the test falls within the unacceptable range, report the reading to the Repair Service Bureau.

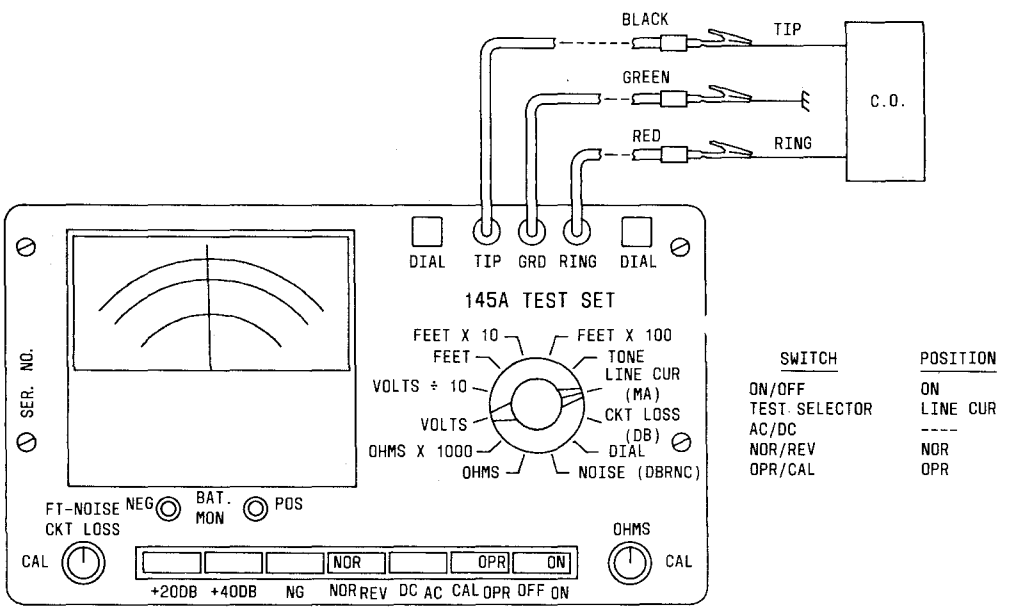


Fig. 11—Line Current Testing

4.08 ***Circuit Loss Test (Fig. 12):*** This test measures the loop circuit loss in decibels (dB) at the subscriber end, using the 1000 Hz milliwatt (0 dBm) tone from the central office (CO). The test set will read accurately on either 600- or 900-ohm circuits. The following steps must be used when making this test:

(a) Connect the TIP and RING test leads to line being tested.

(b) Turn test selector knob to CKT LOSS (DB) position.

(c) Calibrate meter as follows:

(1) Place the CAL/OPR switch in the CAL position and OFF/ON switch in ON position.

(2) Turn the FT-CKT LOSS-NOISE-CAL knob until the needle of the meter is at the 200 mark at the right of the VOLTS/FEET scale [zero (0) mark of the DB scale] and 40 mark of DBRNC scale. ***When calibrating, check that the +20DB, +40DB, and NG switches are in the UP position (not depressed).***

(3) Place CAL/OPR switch to OPR and the NOR/REV switch to NOR

(d) Turn selector knob to DIAL position.

(e) Connect cord clips of 1011- or 1013-type test set to the terminals marked DIAL on the 145A test set and dial the CO milliwatt (1000 Hz at 0 dBm) supply.

(f) When the milliwatt tone is heard, turn the test selector knob from the DIAL position to the CKT LOSS (DB) position.

Read the circuit loss on the DB scale of the meter. ***If there is a gain device, the attenuators may be used to measure the gain. With the +20DB switch depressed, the actual gain of the circuit is 20 dB minus the reading on the meter.***

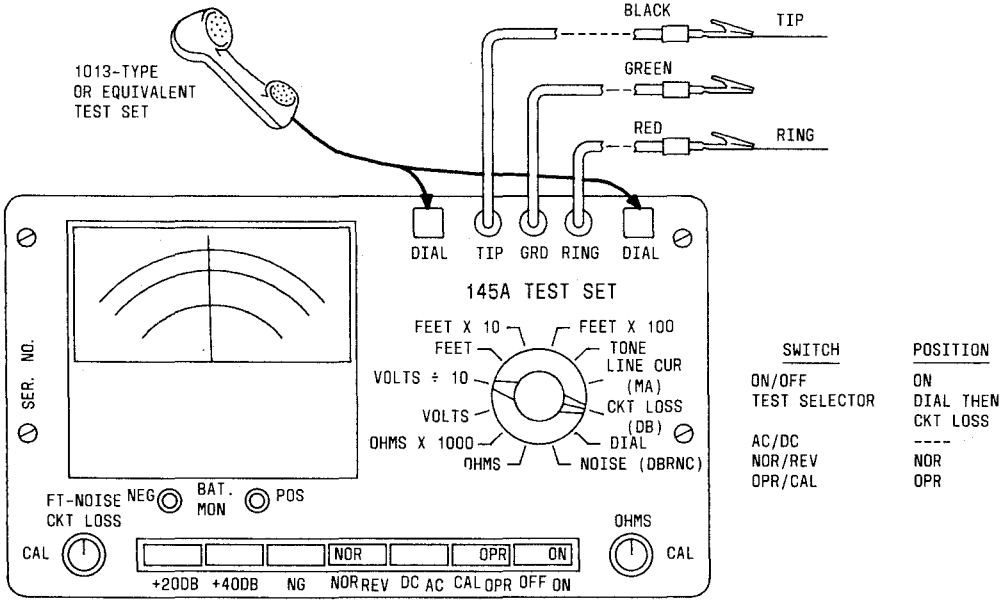


Fig. 12—Circuit Loss Measurement

4.09 ***Noise Measurement Test (Fig. 13):*** This test feature is designed to measure noise in decibels with C message weighing (DBRNC) on message circuits with a dynamic range of 20 to 100 dBrnC. The set uses a C message weighing network and is capable of measuring noise metallic (TIP to RING). The set also uses an internal 735 ohm termination which is satisfactory for either 600 or 900 ohm circuits. Direct readings of longitudinal noise (noise to ground) can also be made.

A. ***Noise Metallic (TIP to RING) Measurement Test:***

(1) Connect test set leads to pair being measured and ground lead to cable sheath.

(2) Turn selector knob of 145A test set to NOISE (DBRNC) position.

(3) Calibrate meter as follows:

(a) Place the CAL/OPR switch in the CAL position and OFF/ON switch in ON position.

(b) Turn the FT-CKT LOSS-NOISE-CAL knob until the needle of the meter is at the 200 mark at the right of the VOLTS/FEET scale [zero (0) mark of the DB scale] and 40 mark of the DBRNC scale. ***When calibrating, check that the +20DB, +40DB, and NG switches are in the UP position (not depressed).***

(4) Connect cord clips of 1011- or 1013-type test set to the terminals marked DIAL on the 145A test set.

(5) Turn selector knob of 145A test set to DIAL position.

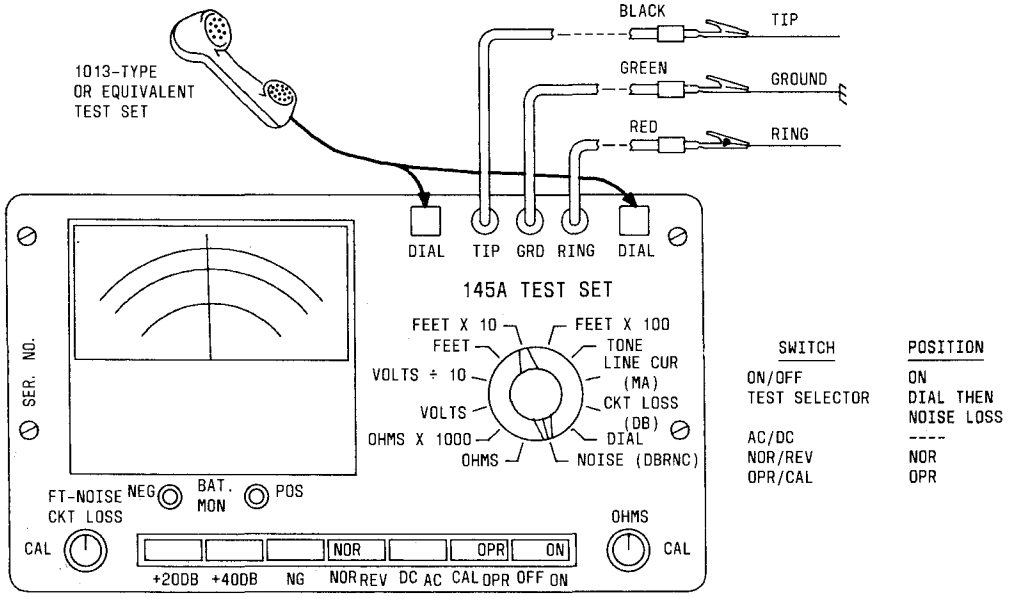


Fig. 13—Noise Measurement

(6) Place NOR/REV switch in NOR position and CAL/OPR switch in OPR position.

(7) Place TALK/MON key of 1011- or 1013-type test set in the TALK position and listen for dial tone.

(8) Using the locally designated code, dial up a CO quiet termination.

(9) When ringing stops, turn selector knob to NOISE (DBRNC) position.

(10) Read noise metallic on DBRNC scale of meter.

Note: The Bell System objective noise limit is 20 dBrnc. Loops having noise in excess of 30 dBrnc should be corrected.

If it is necessary to read noise levels exceeding 40 dBrnc, the +20DB switch will increase the range to 60 dBrnc and the +40DB switch will increase the range to 80 dBrnc. With both switches depressed (20 dB + 40 dB = 60 dB), the range will increase to 100 dBrnc. Add the numbers on the depressed switches to the meter reading for the correct result.

B. Noise Longitudinal (Noise to GRD) Measurement Test (Fig. 14):

(1) Turn selector knob of 145A test set to NOISE (DBRNC) position.

(2) Connect ground lead to cable sheath or building ground and the tip and ring test leads to pair being tested.

(3) Calibrate meter as follows:

(a) Place the CAL/OPR switch in the CAL position and OFF/ON switch to ON position.

(b) Turn the FT-NOISE CKT LOSS CAL knob until the needle of the meter is at the 200 mark at the right of the VOLTS/FEET scale (zero mark of the DB scale and 40 mark of the DBRNC scale). When calibrating, check that the +20DB, +40DB and NG switches are in the UP position (not depressed).

(4) Turn selector knob to DIAL position.

(5) Connect cord clips of 1011- or 1013-type test set to terminals marked DIAL.

(6) Place NOR/REV switch in NOR position and CAL/OPR switch in OPR position and dial up the CO quiet termination.

(7) When ringing stops, turn selector knob to NOISE (DBRNC) position.

(8) Depress NG switch and read noise to ground on DBRNC scale of meter.

Note: +20DB and +40DB switches may be used to increase the range.

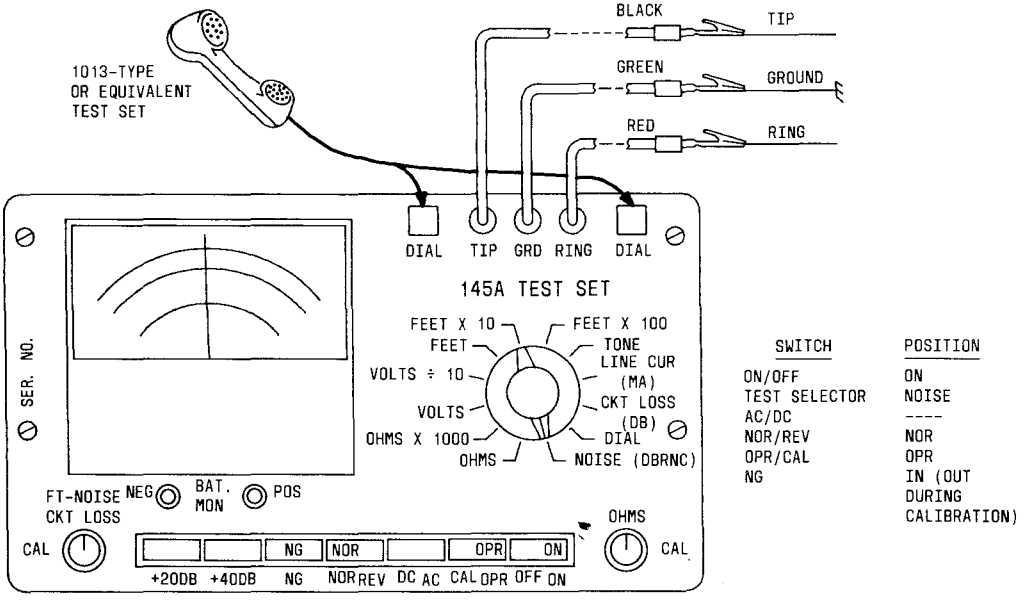


Fig. 14—Longitudinal Noise Measurement

5. MAINTENANCE

5.01 Under normal use, the 145A test set should not require repairs or maintenance except battery replacement and possible meter adjustment.

5.02 ***Battery Replacement:***

(a) Turn OFF/ON switch to the ON position.

(b) Observe LEDs of battery monitor (BAT MON) on panel.

(c) If either or both of the LEDs light, the batteries need replacement (Fig. 2).

(d) Turn OFF/ON switch to OFF position.

(e) Remove the four faceplate screws (Fig. 2) and remove the instrument from the case.

(f) Replace batteries with two KS-21617 9V batteries, Eveready* No. 226 batteries or equivalent (Fig. 15).

The following equivalents may be used:

NEDA 1600

BRIGHT STAR 0918

BURGESS† P6

MALLORY M1600

MARATHON 1600A

RCA US300A

RAY-0-VAC‡ 1600

CAUTION: Observe correct polarity when installing new batteries.

*Registered trademark of Union Carbide Corp.

†Registered trademark of Burgess Division of Gould, Inc.

‡Registered trademark of RAY-0-VAC Division of ESB, Inc.

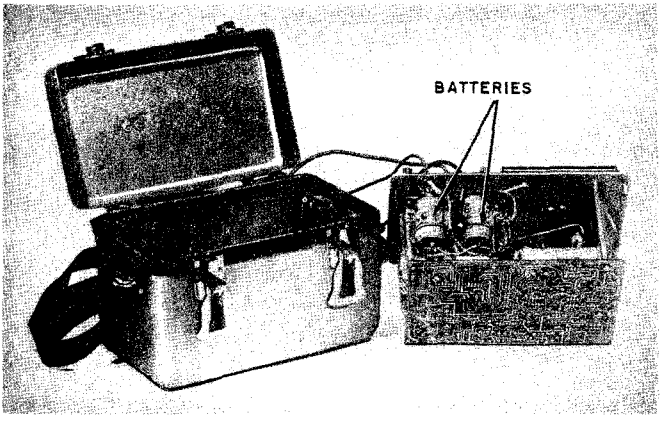


Fig. 15—Battery Replacement

5.03 ***Mechanical Zero Adjustment:*** The mechanical zero meter adjustment screw (Fig. 1) is used to adjust the meter needle to zero when the power is off. The zero meter adjustment was preadjusted at the factory and, under normal use, should not require readjustment.

This adjustment is very stable and should not be touched unless absolutely necessary.

However, if meter must be adjusted in the field, proceed as follows:

(a) Turn OFF/ON switch to the OFF position.

(b) Place the test set on a level surface with the meter facing up.

(c) Using a small screwdriver, adjust the mechanical zero adjustment screw (Fig. 1) until meter needle is aligned exactly over the zero calibration mark at the extreme left of the scale. Tap the meter gently with a finger while making this adjustment.