145A TEST SET

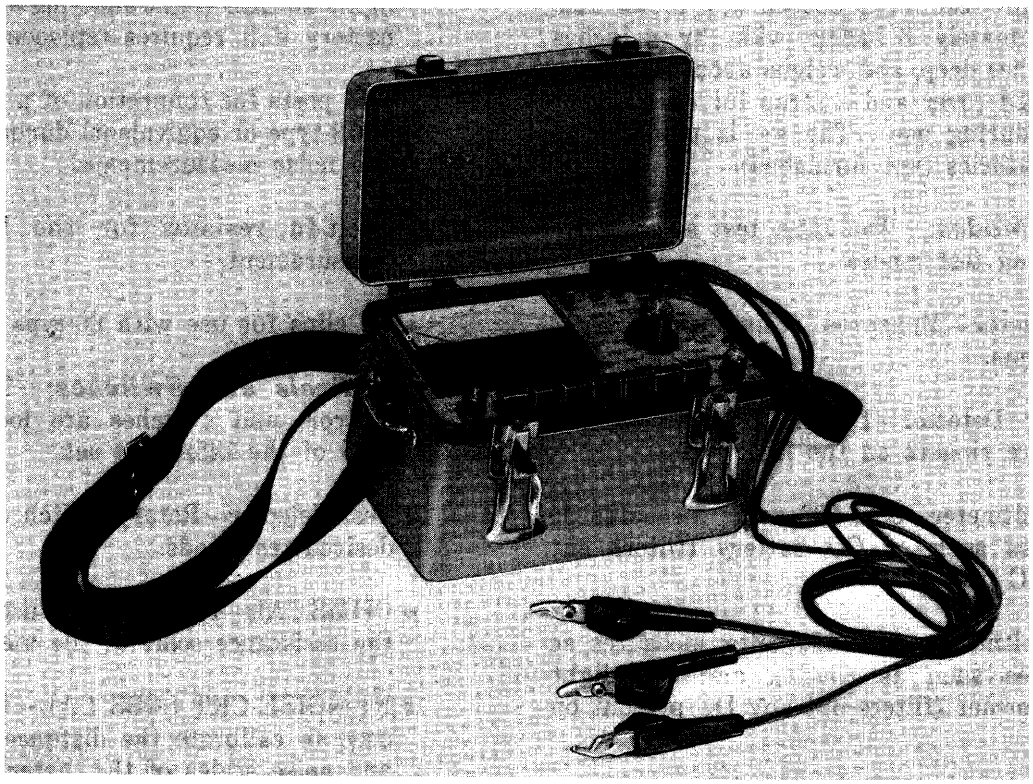


Fig. 1—145A Test Set

1. GENERAL

1.01 This section provides identification, operation, and maintenance information for the 145A test set (Fig. 1).

1.02 The reasons for reissuing this section are listed below:

- Show the new front panel design of the test set
- Add new Fig. 1 through 11
- Correct and clarify test procedures
- Provide instructions for installing batteries in a new test set
- Combine calibration procedures with the operational tests where they apply
- Add a procedure for determining cable pair length by resistance measurement.

Since this is a general revision, no revision arrows have been used to denote significant changes.

1.03 The 145A is a general purpose test set which combines several testing functions in a single compact unit. The 145A test set may be used for various testing operations associated with construction, installation, and repair of subscriber loop facilities.

2. IDENTIFICATION

FEATURES

2.01 The 145A test set is housed in a metal case approximately 8 inches wide by 4 inches high by 5 inches deep, and weighs about 3 pounds. It has a hinged cover and a strap for carrying or for hanging during use. The set is powered by two 9-volt batteries (not furnished).

2.02 ***Test Modes:*** The 145A test set has the following test modes:

- Ohmmeter—Measures resistance, 0 to 3 megohms.
- Ringer Detector—Detects presence of one or more ringers on the line.
- DC Voltmeter—0 to 200 volts; measures dc voltages such as CO battery (filters out any AC present).
- AC Voltmeter—0 to 200 volts; measures ac voltages such as ringing and dial light transformer (filters out any DC present on line).
- Pair Conductor Length Measurement—Measures length of conductor directly in feet, up to 20,000 feet.
- Open Fault Locator—Measures distance to open in one conductor of a cable pair directly in feet, up to 20,000 feet.
- Tone Source—Supplies a tone for cable pair identification.
- Line Current Meter—0 to 100 mA; measures CO line current.
- Circuit Loss Meter—0 to 30 dB; measures 1000 Hz loss of cable; has 40 dB attenuation for circuits with gain.
- Noise Meter—10 to 100 dBrnc; measures C message weighted noise, metallic (tip to ring) and longitudinal (tip or ring to ground).

The selection of each test mode is described in Part 3 of this section.

2.03 ***Miscellaneous Features:*** The 145A also has the following miscellaneous features:

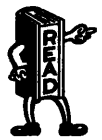
- A continuous battery monitor circuit which lights an LED (light emitting diode) for each battery if it requires replacement.
- Two posts for connection of a hand test set (1013-type or equivalent) during circuit loss and noise measurements.
- Built-in resistor for the line current measurement.
- 6A clips for use with 66-type terminals.

2.04 ***Controls and Switches:*** The following controls and switches are located on the front panel of the 145A test set:

- Test Selector—Rotary switch used to select desired test mode.
- OHMS CAL—Potentiometer used to calibrate the resistance scale of the meter.
- FT-NOISE-CKT LOSS CAL—Potentiometer used to calibrate the distance, circuit loss, and noise scales of the meter.

Note: The following seven switches are of the 2-position, push-to-operate, push-to-release type.

- OFF/ON—Power switch for test set.
- CAL/OPR—Conditions test set for meter calibration or normal test operation.



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

- DC/AC—Selects test set circuit for dc or ac voltage measurement.
- NOR/REV—Normal/reverse switch for reversing test set leads without disconnecting them. Used with ohmmeter to produce "capacitive kick" for ringer detection.

- NG—Used for making noise-to-ground measurements.
- +40 DB—Used to add 40 dB of attenuation during noise and circuit loss measurements.
- +20 DB—Used to add 20 dB of attenuation during noise measurements.

For noise measurement, when both attenuation switches are depressed, 60 dB is added to the measurement.

2.05 ***Test Leads:*** The 145A test set has three test leads terminated with alligator clips and permanently attached to the front panel: TIP (black), RING (red), and GRD (green).

Connect the green lead to cable shield or earth whenever the test set is in use.

3. OPERATION

3.01 Before using the 145A test set, find out if it has batteries and if they are supplying sufficient power. New test sets are not supplied with batteries.

3.02 ***Installation of Batteries in New Test Set:*** Remove the four screws on the front panel of the test set and lift the circuit out of its case. Install two EVEREADY* No. 226 batteries, or equivalent, carefully observing the polarities shown on the battery holder. Replace the circuit in the case and secure it with the four screws.

*Registered trademark of Union Carbide Corp.

3.03 ***Battery Tests:*** To determine if a test set contains batteries, put the OFF/ON switch to ON, the CAL/OPR switch to CAL, and the selector switch to OHMS X 1000. Now, if the meter needle can be moved from side to side by rotating the OHMS CAL knob, the test set does have batteries. If either or both of the BAT MON lamps are on, the batteries should be replaced.

The battery monitor feature is activated when the OFF/ON switch is ON and continually monitors the batteries.

3.04 ***Resistance Testing (Fig. 2):*** Perform the following steps to measure the resistance of a circuit.

(1) Connect the black and red test leads to the circuit being measured.

(2) Set the selector knob to OHMS X 1000.

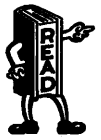
(3) Calibrate the meter:

(a) Set the OFF/ON switch to ON and the CAL/OPR switch to CAL.

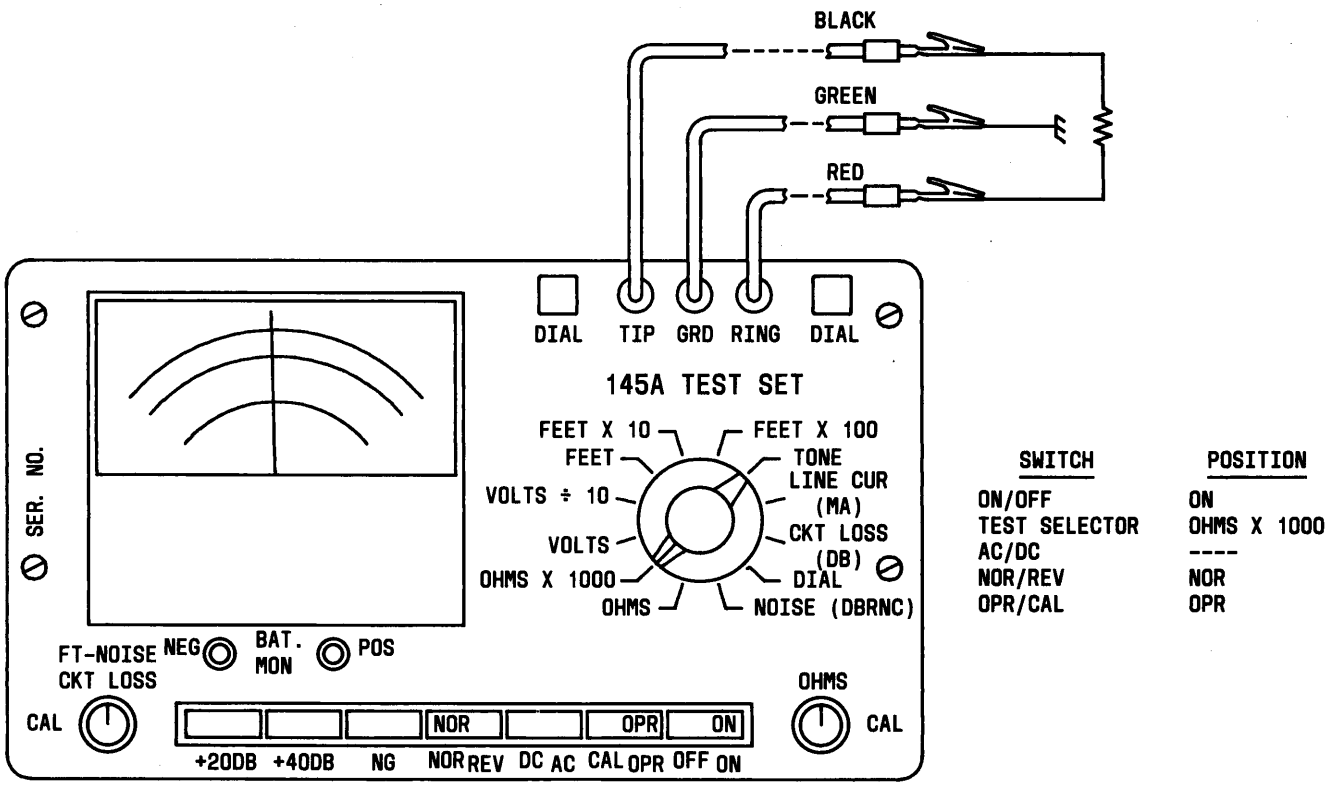
(b) Turn the OHMS CAL knob until the meter needle lines up exactly with the 0 mark on the right end of the scale.

(4) Return the CAL/OPR switch to the OPR position, and the needle will move up scale. The resistance being measured is the value on the scale multiplied by 1000.

(5) If the resistance is less than 3000 ohms, a more accurate reading is possible by changing the selector knob to OHMS, calibrating the meter again as described in Step (3), and making a new measurement. Read the resistance value directly from the OHMS scale.



It is meaningless to measure resistance if there is battery on the circuit. If the reading changes when the NOR/REV switch is operated, this condition exists, and the reading is not valid.



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

Fig. 2—Resistance Testing

3.05 ***Ringer Detection (Fig. 3):*** Perform this test to determine the presence of one or more ringers on a line.

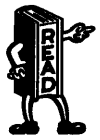
(1) Connect the black and red test leads to the pair being tested.

(2) Set the selector knob to OHMS X 1000.

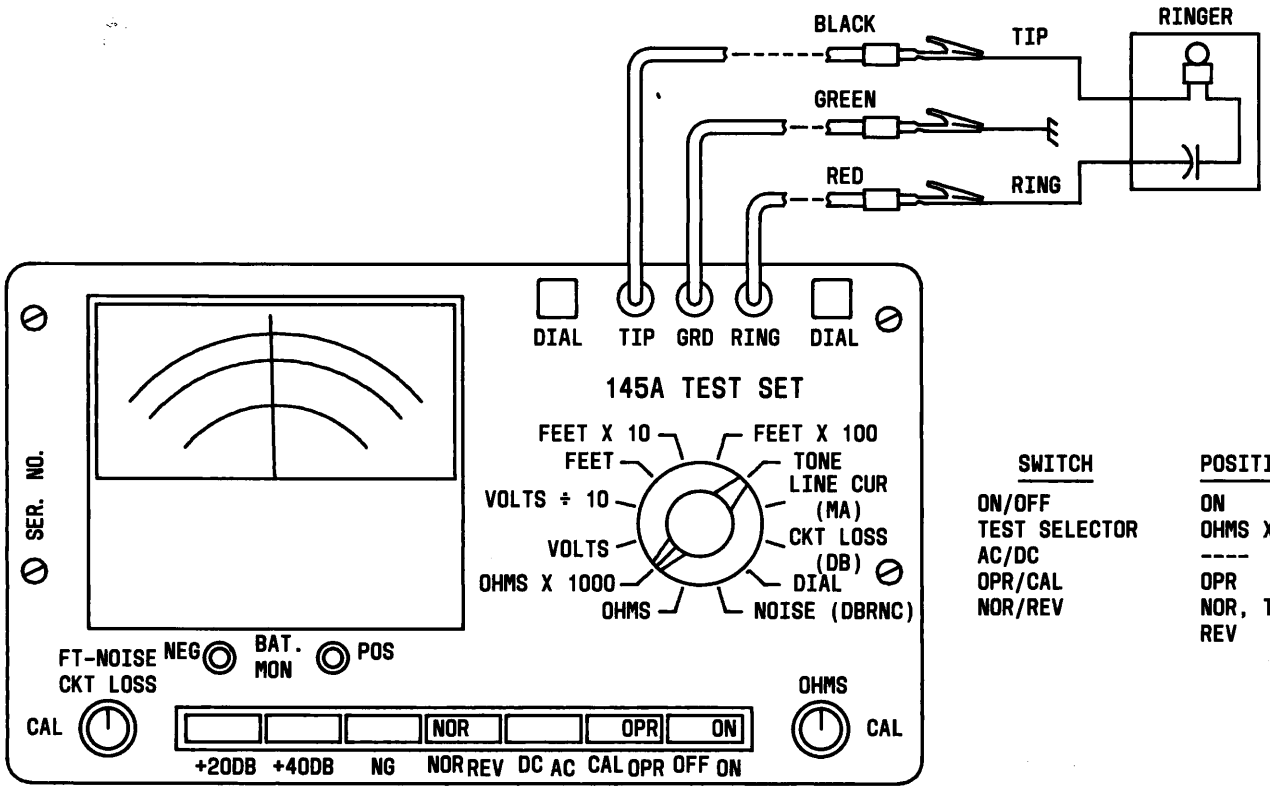
(3) Calibrate the meter as described in 3.04(3).

(4) Return the CAL/OPR switch to the OPR position.

(5) 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 "kick" from 0 to 10 or more on the MA scale.



To insure accurate readings, all meter movement must have stopped before changing 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. 3—Ringer Detection

3.06 ***DC Voltage Measurement (Fig. 4):*** Use the following procedure to measure dc voltage.

DANGER: Do not test circuits suspected of carrying more than 200 volts. Be extremely careful when attaching test leads to a circuit suspected of carrying more than 50 volts.

(1) Set the selector knob to VOLTS.

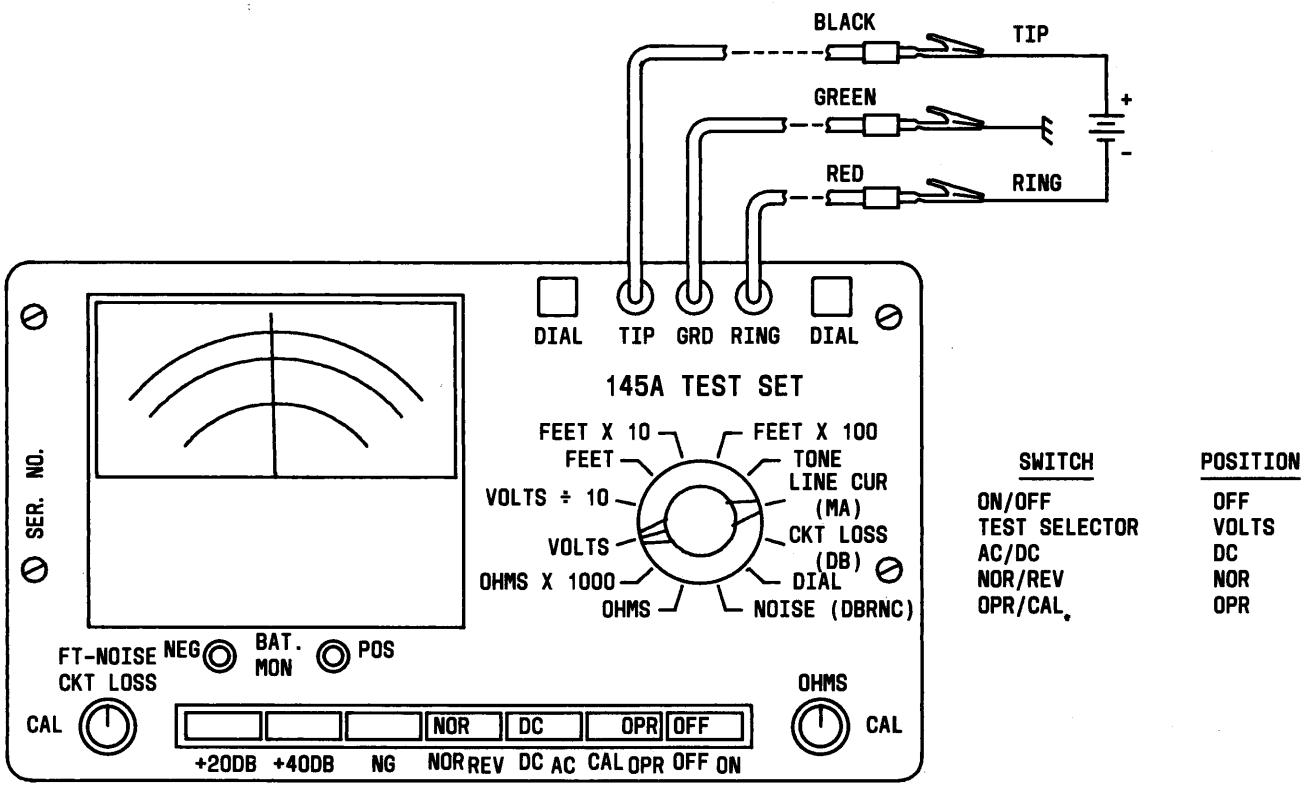
(2) Set the DC/AC switch to DC.

(3) Set the NOR/REV switch to NOR.

(4) Set the OPR/CAL switch to OPR.

(5) Connect the black lead of the test set to the tip side of the line being tested, and the red lead to the ring side.

(6) Read the voltage on the VOLTS/FEET scale. If the meter reads up-scale, the ring lead (red) is negative. If the needle deflects to the left, reverse the polarity of the meter by setting the NOR/REV switch to REV, and read the voltage.



SWITCH	POSITION
ON/OFF	OFF
TEST SELECTOR	VOLTS
AC/DC	DC
NOR/REV	NOR
OPR/CAL	OPR

Fig. 4—DC Voltage Measurement

3.07 ***AC Voltage Measurement (Fig. 5):*** Use the following procedure to measure ac voltage.

DANGER: Do not test circuits suspected of having ac potential of over 200 volts.

(1) Set the selector knob to VOLTS.

(2) Set the DC/AC switch to AC.

(3) Set the NOR/REV switch to NOR.

(4) Set the OPR/CAL switch to OPR.

(5) Connect the test leads to the circuit being tested.

(6) Read the voltage on the VOLTS/FEET scale.

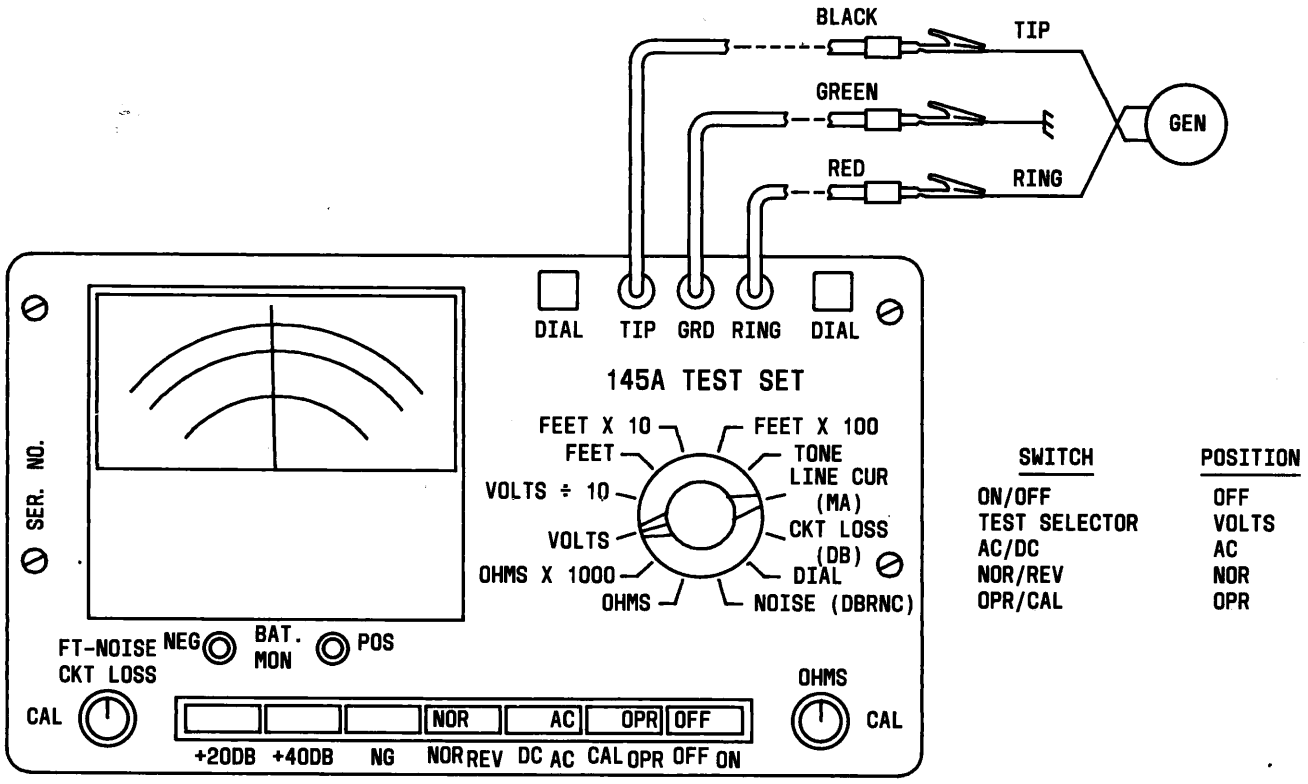


Fig. 5—AC Voltage Measurement

3.08 ***Cable Pair Length Measurement (Fig. 6):*** This test uses the tip to ring mutual capacitance of the cable pair to determine the length of the pair. It gives accurate results on new cable or wire sections or cable or wire pairs having the tip and ring open at the same point. The pair must be disconnected at both ends.

(1) Connect the black and red test leads to the pair being measured.

(2) Set the selector knob to OHMS X 1000.

(3) Calibrate the meter as described in 3.04(3).

(4) 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.

An accurate length measurement cannot be made in Step (8) if the resistance recorded in Step (4) or (5) does not exceed the minimum values shown in Table A for the lengths measured.

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

(a) Move the black 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 READ following Step (4). Operate the NOR/REV switch and repeat the check.

(b) Move the red 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 READ 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 lead to the tip side of the line and the red test lead to the ring side. Change the selector knob to the FEET X 100 position.

(7) Set the CAL/OPR switch to CAL, and calibrate the meter to read exactly 200(T-R) on the VOLTS/FEET scale using the FT-NOISE-CKT LOSS CAL knob.

Note: For wire or cable with capacitance other than 0.083 μF per mile, use the proper value in the **Tip To Ring** column of Table B for the calibration setting.

(8) After calibrating the meter, return the 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 selector knob to FEET X 10, and if below 200 feet, move selector knob to FEET.

3.09 ***Cable Pair Length Measurement (Secondary Method):*** The approximate length of a cable pair may be determined by shorting the tip and ring wires together at the far end and measuring the loop resistance at the near end. The length in feet is calculated by multiplying the resistance (in ohms) by the feet-per-ohm value in Table C. This method does not take into account load coils or the presence of 2 or more different wire gauges in the loop being measured.

TABLE A

	CABLE LENGTH MEASURED IN STEP 3.08(8)		
	50 TO 200 FT	200 TO 2000 FT	2000 TO 20,000 FT
Minimum fault resistance for accurate length measurement	3 MΩ	1 MΩ	100 KΩ

Note: If resistance is less than the value shown, fault must be cleared before accurate length measurement can be made.

TABLE B

TYPE WIRE OR CABLE	CALIBRATION SETTING	
	TIP TO RING	TIP OR RING TO GROUND*
B Service Wire	160	84
C Drop	68	62
C Multiple Drop	88	56
D Station (24 gauge)	200	106
D Station (22 gauge)	186	102
D Inside Wire (6 pair)	152	112
D Inside Wire (25 pair)	141	90
E Buried	198	114
F Drop	134	108
F Multiple Drop	198	124
JKT Station Wire	118	62
D Rural	—	168

* All other wires working or grounded.

TABLE C

GAUGE OF CABLE COPPER	APPROX LOOP FEET-PER-OHM
19	60
22	30
24	20
26	12

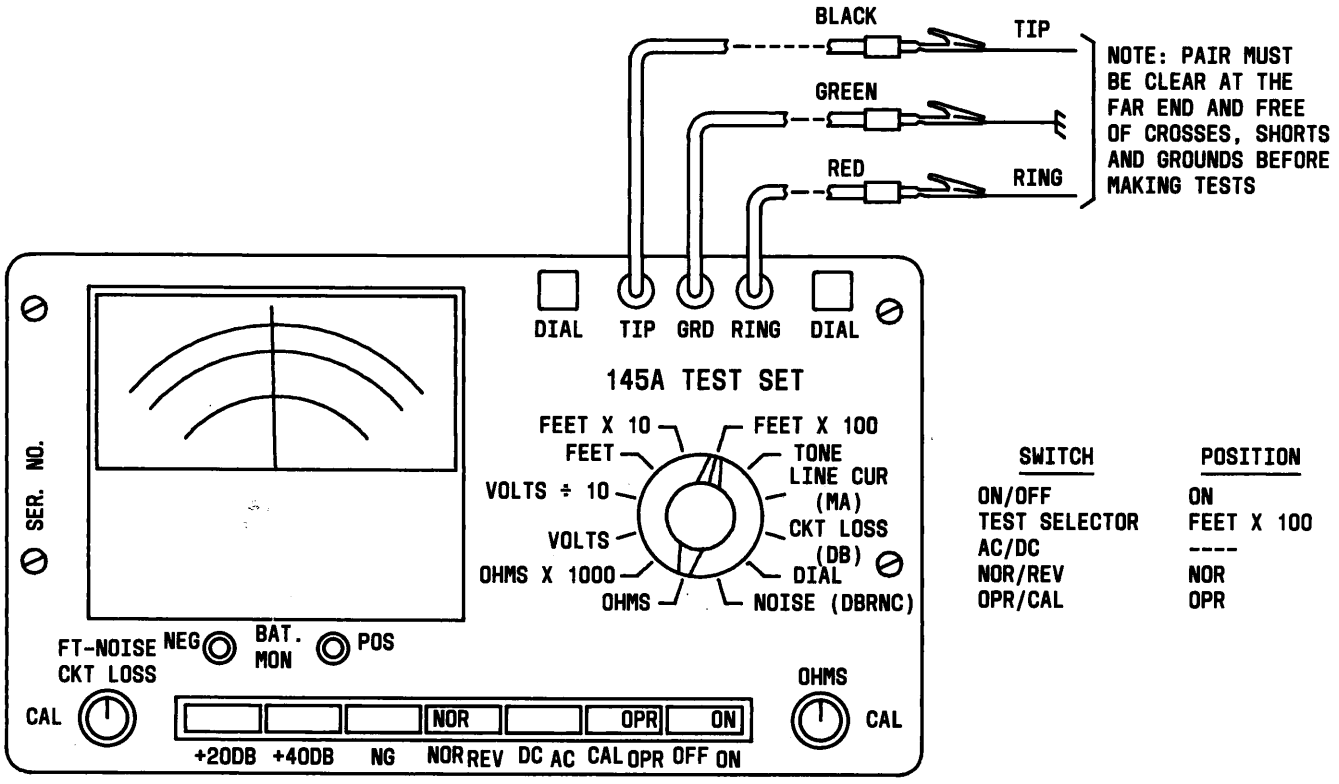


Fig. 6—Cable Pair Length

3.10 ***Open Conductor Location (Fig. 6):*** This test is used to determine the distance to an open in one conductor of a cable or wire pair.

(1) Test the pair for a low resistance fault as described in 3.08 (Cable Pair Length Measurement), Steps (1) through (5).

(2) If no unacceptable low resistance fault exists, turn selector knob to FEET X 100.

(3) Set CAL/OPR switch to CAL and, using the FT-NOISE-CKT LOSS CAL knob, calibrate the meter to the T-G, R-G mark which is located just above the 140 mark on the VOLTS/FEET scale.

Note: For wire or cable with capacitance other than 0.083 μF per mile, use the proper value in the **Tip or Ring to Ground** column in Table B for the calibration setting.

(4) Return the CAL/OPR switch to OPR.

(5) Measure the length of each conductor of the pair to determine which one is open:

(a) Connect the black test lead to ground.

(b) Connect the red test lead to the ring wire of the pair and ground the tip wire. Read the ring wire's length on the VOLTS/FEET scale.

(c) Move the red test lead to the tip wire of the pair and ground the ring wire. Read the tip wire's length on the VOLTS/FEET scale.

(d) Compare the lengths of the tip and ring wires. ***The shorter one is the open conductor.***

3.11 ***Use of Tone for Pair Identification (Fig. 7):*** The 145A test set produces a distinctive 2-frequency warbling tone of approximately 550 and 1000 Hz.

(1) Set the selector knob to the TONE position.

(2) Connect the red and black test set leads to the wire and ground, cable pair, or drop wire being tested.

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

(4) 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).

Note: The tone output of the test set will not operate satisfactorily in conjunction with a 1097A filter.

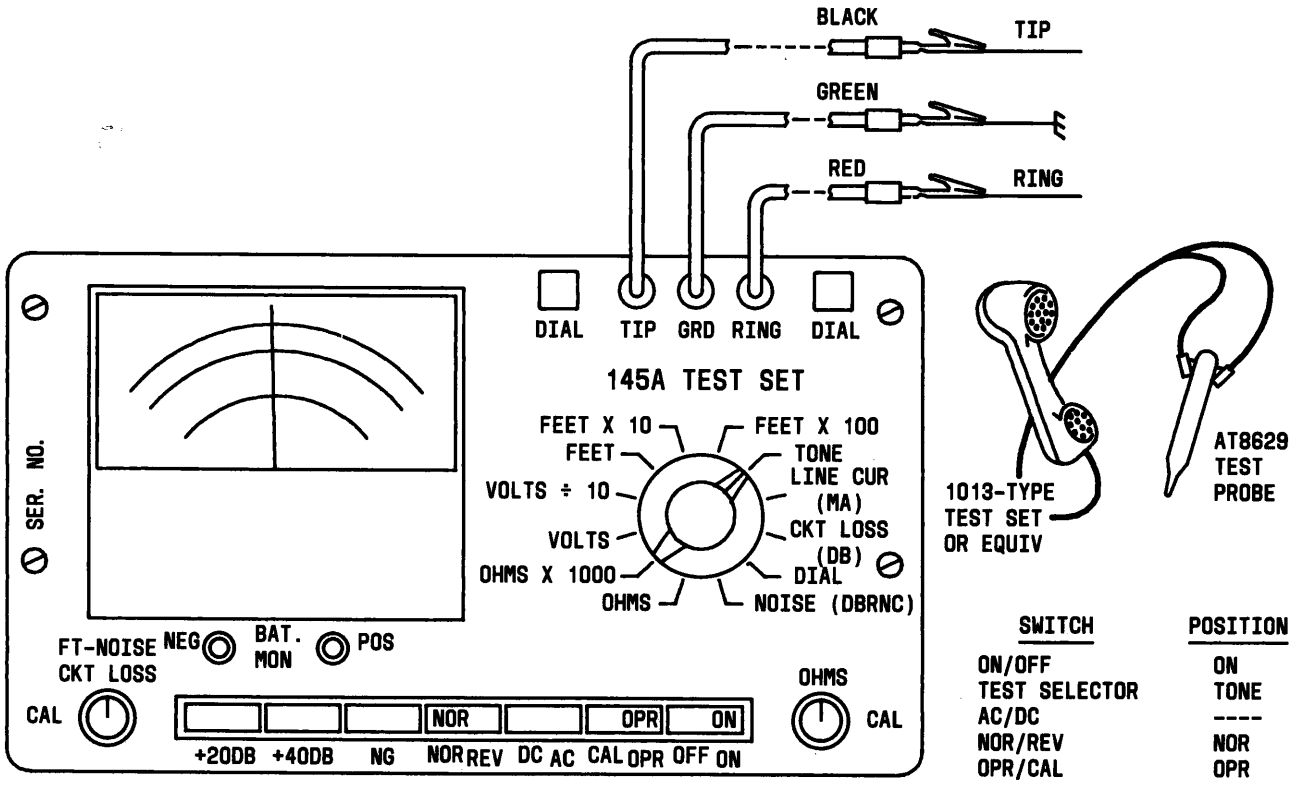


Fig. 7—Use of Tone for Pair Identification

3.12 ***Line Current Measurement (Fig. 8):***
The test set can be used to measure the line current being received from the CO for operation of a station telephone set.

The station set must either be on hook or disconnected. The measurement should be made at the customer's premises.

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

(2) Connect the black and red test leads to the line being tested.

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

(4) Read the line current in milliamperes on the MA scale of the meter.

(5) If the current is reversed, the needle will move to the extreme left of the meter. Change the NOR/REV switch to the REV position and read the line current again.

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

Notify the Repair Service Bureau if line current falls within the unacceptable range.

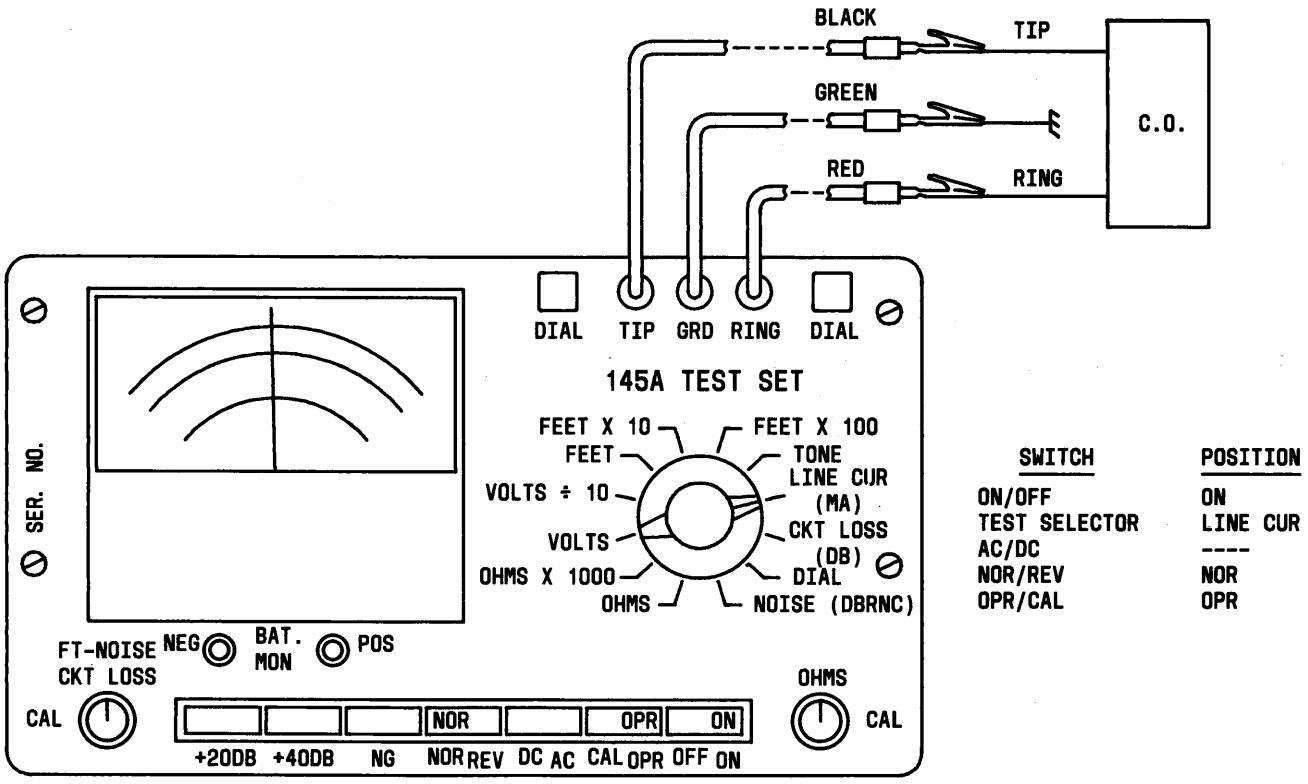


Fig. 8—Line Current Measurement

3.13 ***Circuit Loss Measurement (Fig. 9):*** This test measures the loop circuit loss in decibels (dB) at the subscriber end, using the 1000-Hz milliwatt (0 dBm) test tone from the CO. It will give accurate results on either 600- or 900-ohm circuits.

(1) Connect the black and red test leads to the line being tested.

(2) Turn the selector knob to the CKT LOSS (DB) position.

(3) Calibrate the meter:

(a) Set the CAL/OPR switch to CAL and the OFF/ON switch to ON.

Be sure that the +20DB, +40DB, and NG switches are each in the released position.

(b) Turn the FT-NOISE-CKT LOSS CAL knob until the meter needle lines up exactly with the 200 mark at the right end of the VOLTS/FEET scale (40 mark on the DBRNC scale or 0 on the DB scale).

(c) Return the CAL/OPR switch to OPR, and set the NOR/REV switch to NOR.

(4) Turn the selector knob to the DIAL position.

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

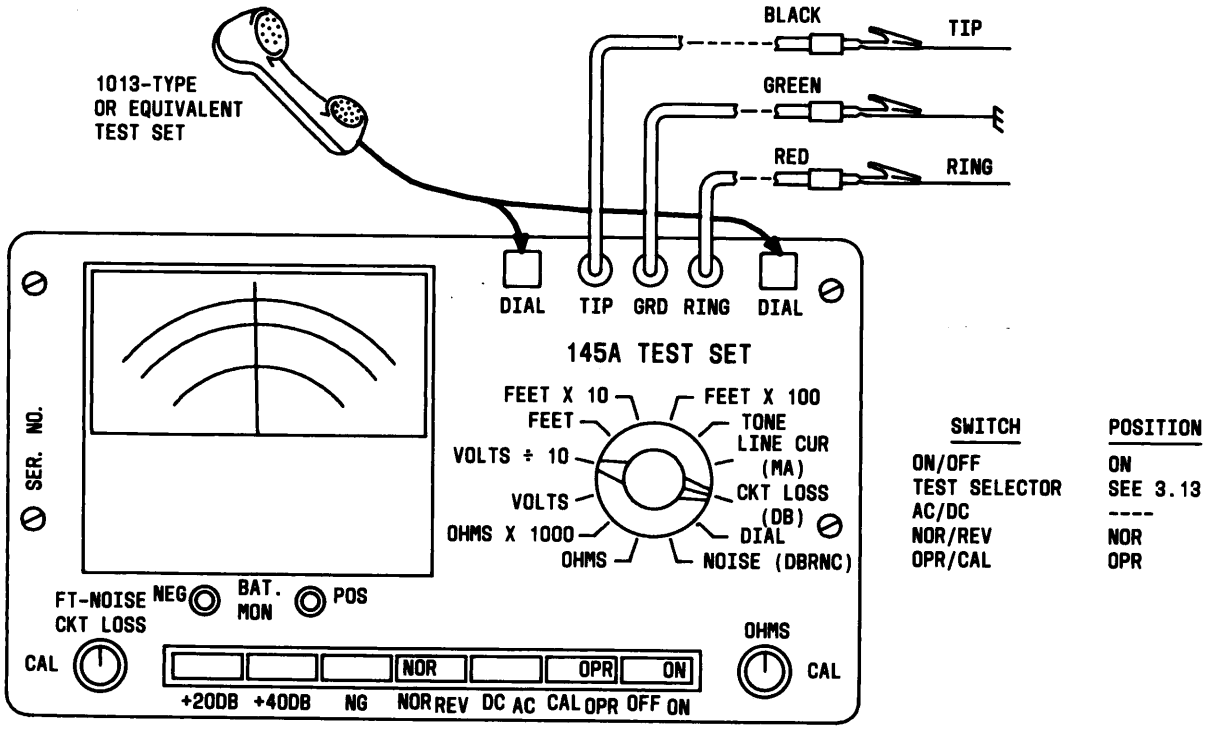
(6) Set the TALK/MON switch of the handset to the TALK position and listen for dial tone.

(7) Using the locally designated code, dial the CO 1000-Hz milliwatt supply.

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

(9) Read the circuit loss on the DB scale of the meter. ***The circuit loss of normal subscriber loops should not exceed 8.5 dB.***

If there is a gain device, the attenuators may be used to measure the gain. With the +40DB switch depressed, the actual gain of the circuit is 40 dB minus the reading on the meter.



SWITCH	POSITION
ON/OFF	ON
TEST SELECTOR	SEE 3.13
AC/DC	----
NOR/REV	NOR
OPR/CAL	OPR

Fig. 9—Circuit Loss Measurement

3.14 ***Metallic Noise Measurement (Fig. 10):*** This test measures metallic (tip to ring) noise of subscriber loops.

(1) Connect the black and red test leads to the pair being measured.

(2) Connect the green test lead to the cable sheath or building ground.

(3) Turn the selector knob to NOISE (DBRNC).

(4) Calibrate the meter:

(a) Set the CAL/OPR switch to CAL and the OFF/ON switch to ON.

Be sure that the +20DB, +40DB, and NG switches are each in the released position.

(b) Turn the FT-NOISE-CKT LOSS CAL knob until the meter needle lines up exactly with the 200 mark at the right end of the VOLTS/FEET scale (40 mark on the DBRNC scale or 0 on the DB scale).

(c) Return the CAL/OPR switch to OPR and set the NOR/REV switch to NOR.

(5) Turn the selector knob to the DIAL position.

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

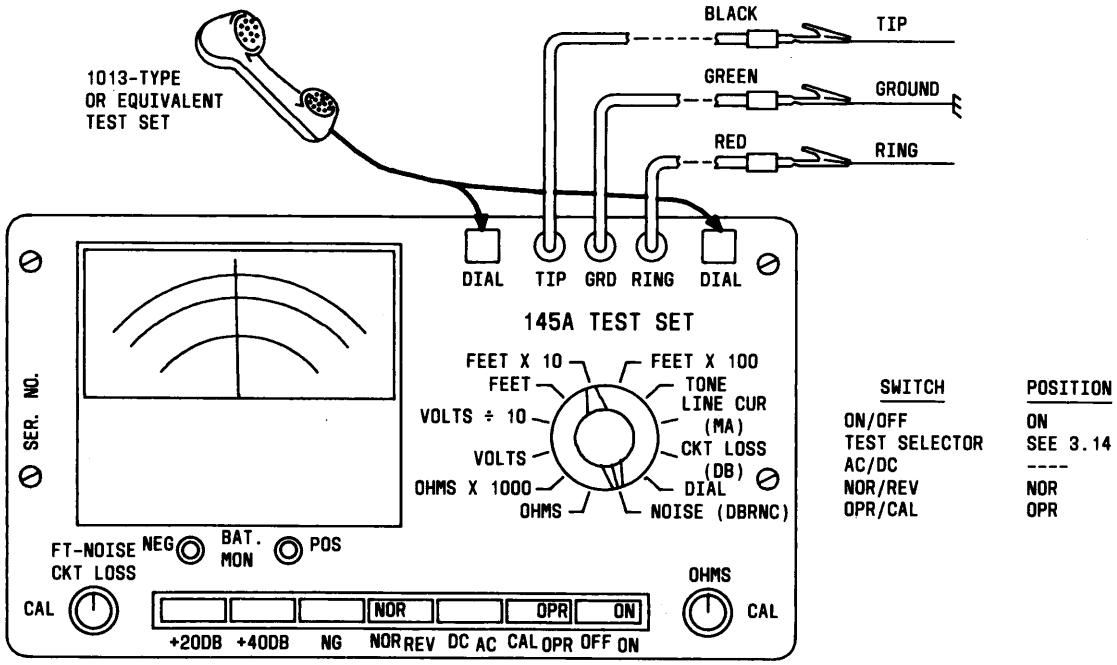
(7) Set the TALK/MON switch of the handset to the TALK position and listen for dial tone.

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

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

(10) Read metallic noise on DBRNC scale of the meter. ***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, or 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.



SWITCH	POSITION
ON/OFF	ON
TEST SELECTOR	SEE 3.14
AC/DC	----
NOR/REV	NOR
OPR/CAL	OPR

Fig. 10—Metallic Noise Measurement

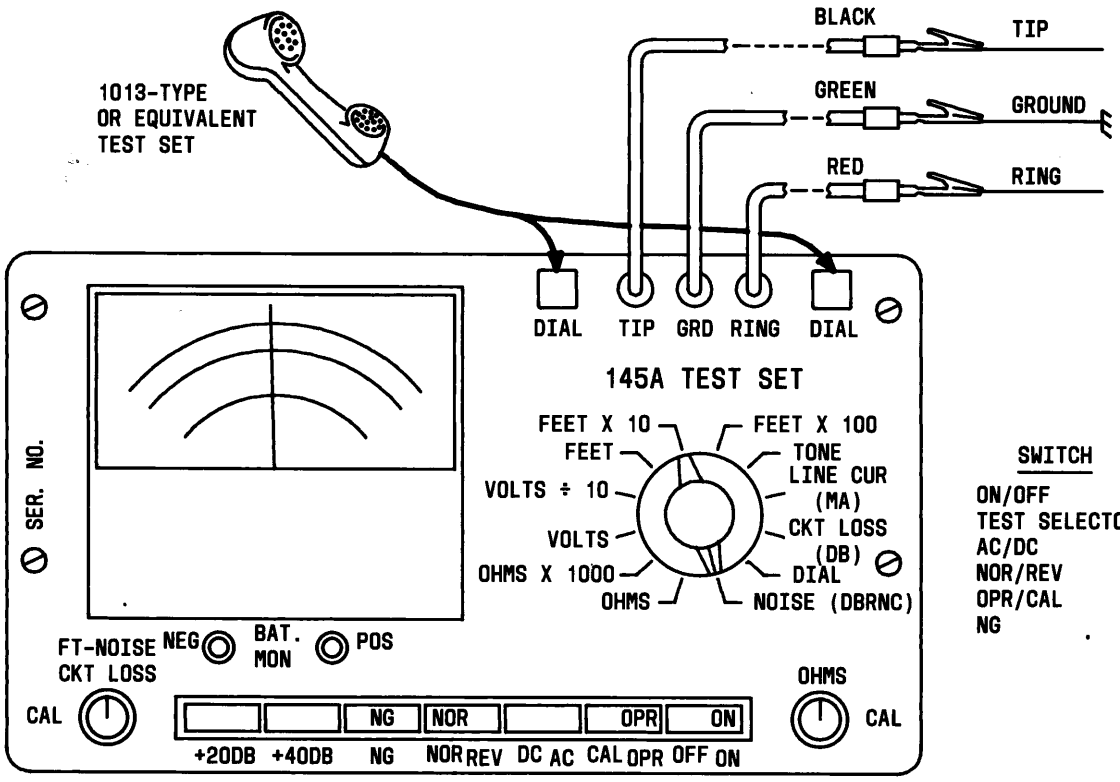
3.15 ***Longitudinal Noise Measurement (Fig. 11):*** This test measures noise to ground of subscriber loops.

(1) Connect the black and red test leads to the pair being tested.

(2) Connect the green test lead to the cable sheath or building ground.

(3) Perform Steps 3.14(3) through (9) as given for metallic noise measurement.

(4) Depress NG switch and read noise to ground on DBRNC scale of meter. ***The +20DB and +40DB switches may be used to increase the test set range as described in the READ following Step 3.14(10).***



SWITCH	POSITION
ON/OFF	ON
TEST SELECTOR	SEE 3.15
AC/DC	----
NOR/REV	NOR
OPR/CAL	OPR
NG	IN

Fig. 11—Longitudinal Noise Measurement

4. MAINTENANCE

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

4.02 ***Battery Replacement:***

(1) Set OFF/ON switch to ON.

(2) Observe the BAT. MON NEG and POS LEDs on the front panel of the test set. If either or both of them light, the batteries need replacement.

(3) Set the OFF/ON switch to OFF.

(4) Remove the four screws on the front panel and lift the test set out of its case.

Warning: Observe correct polarity when installing new batteries.

(5) Remove the depleted batteries and replace them with two EVEREADY No. 226 (9-volt) or equivalent batteries obtained from a local source. Install the new batteries in accordance with the polarities shown on the battery holder.

(6) Replace the test set in its case and secure it with the four screws.

4.03 ***Mechanical Zero Adjustment:***

(a) The mechanical zero meter adjustment screw is located near the lower edge of the meter face. It is used to adjust the meter needle to zero when the power is off. It was preadjusted at the factory and, under normal use, should not require any change. ***Do not adjust it unless the needle does not line up exactly with 0 on the left end of the VOLTS/FEET scale when the test set power is turned off.***

(b) The procedure for mechanical zero adjustment is as follows:

(1) Set the OFF/ON switch to OFF.

(2) Place the test set on its back on a level surface with the meter facing upward.

(3) Using a small-blade screwdriver, adjust the mechanical zero adjustment screw until the meter needle is aligned ***exactly*** with the 0 at the left end of the VOLTS/FEET scale.