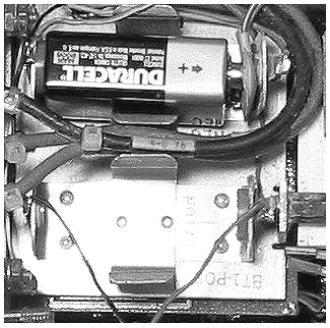
Western Electric 145A Test Set

This test set was used to test subscriber lines from the customer premises, generally after repairs were made. It measures Volts, Ohms, loop current, loss as well as balance, power influence, and circuit noise (these were measured in reference to the "quiet line" in the CO). The 145 also had a footage or "feet" function that served as a rough open locator in one position and a resistive fault locator when corrected for conductor gauge and temperature. A tone generator is included in the test set to aid in identification of wire pairs in conjunction with an AT-8629 probe and butt set.

One of these instruments was used some years ago to successfully trace a troublesome noise problem on my home line by the local telephone company.

The 145A test set is designed to use two Eveready 226, KS-2167 or NEDA #1600 batteries - these are no longer available, though expensive replacements are - but a simple modification will allow standard 9 volt batteries to work. Just solder two snap-on 9 volt battery connectors to the terminals of the 226 battery holders, bearing in mind each holder is opposite in polarity to the other. This done, snap in two modern 9 volt alkaline cells - to hold them in place, you can insert these in the 226 holders - they are a size which will mechanically hold the new batteries and their associated connectors in place quite nicely.



Battery 1 +/- shown.

Batteries & connectors will sit nicely in old 226 battery holders.

Battery 2 -/+ (not shown) mounts in empty 226 holder shown here.

***Note*: Prior to making the modification and to prevent any future problems, if there is any corrosion on the circuit board under the old battery holders clean it off with cotton swabs and alcohol. Also note the two led's under the meter face are indicators of battery condition. When the set is turned on, they should NOT light. If they light, it means the batteries should be replaced.**

Western Electric

145A TEST SET
OPERATOR'S MANUAL

Issue 1
October 1, 1977

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TEST SET FEATURES

The 145A is a general-purpose test set able to perform several functions. This set is useful to crafts personnel working in construction, installation, or repair of subscriber loop facilities.

For more detailed instruction on the 145A TEST SET, see BSP 105-245-100.

The selector knob on the 145A TEST SET may be positioned as follows:

OHMS: measures 100 ohms midscale, 300 ohms full scale.

OHMS x 1000: measures 1000 kilohms midscale, 3 megohms full scale.

VOLTS: measures 200 volts full scale.

VOLTS ÷ 10: measures 20 volts full scale.

FEET: measures 200 feet full scale.

FEET x 10: measures 2000 feet full scale.

FEET x 100: measures 20,000 feet full scale.

TONE: produces a distinctive two-frequency warbling tone of approximately 550 and 1000 hertz.

LINE CUR (MA): measures 100 milliamps full scale (measures line current from the central office for operation of an off-hook station telephone).

CKT LOSS (DB): measures 30 decibels full scale (measures loop circuit loss in dB using the 1000 Hz, 0 dbm tone from the central office; may also be used to measure gain by using the attenuator switches).

DIAL: provides a 1000 Hz, 0 dbm tone when a 1011 handset is connected to the dial terminals and the central office is dialed; provides a quiet termination for measuring circuit loss or noise when a 1013 handset is connected and the central office is dialed.

NOISE (DBRNC): measures metallic (tip to ring) noise or longitudinal (tip or ring to ground) noise of subscriber loops.

The switches on the lower face of the test set, from left to right, are as follows:

FT-NOISE CKT LOSS CAL: turn this knob to calibrate the feet, circuit loss, and noise scales on the meter.

+20DB: use this push-to-operate, push-to-release switch to add 20 dB of attenuation as you measure noise.

TEST SET FEATURES, continued

+40DB: use this push-to-operate, push-to-release switch to add 40 dB of attenuation as you measure noise.

NG: use this push-to-operate, push-to-release switch to measure longitudinal noise to ground.

NOR/REV: push this switch in (REV) to reverse the tip and ring when you make a "capacitive kick" test with the ohmmeter to determine the presence of one or more ringers on the line. Push the switch again to reach the normal out (NOR) position.

DC/AC: push this switch in to measure AC current; push again to measure DC current with the switch in the out position.

CAL/OPR: push this switch in to the OPR (operate) position when you perform any tests. Push the switch again to release it to the CAL or out position when you calibrate the meter.

NOTE: When the switch is in the CAL position, the test leads are disconnected from the cable pair. Always leave the switch in the out or CAL position when the test set is not in use.

OFF/ON: push this switch in to turn the power switch ON; push again to put the switch in the out or OFF position.

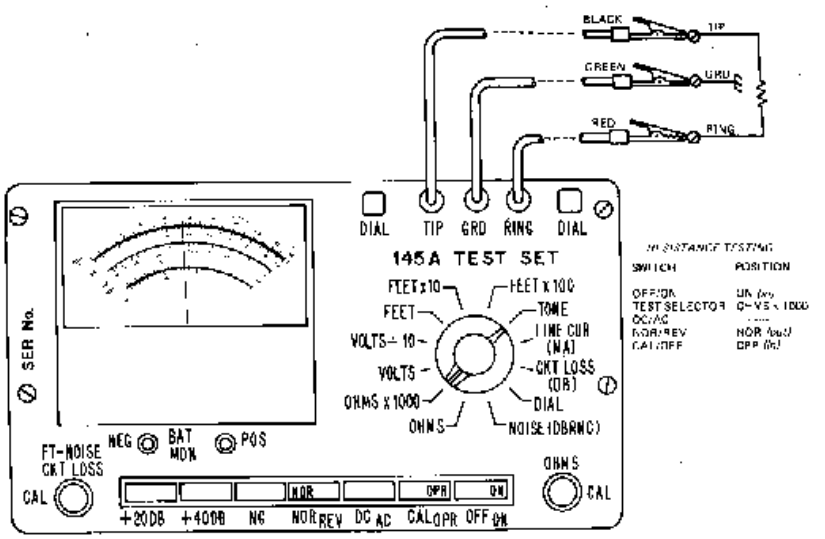
NOTE: To avoid depleting the batteries, be sure the switch is in the OFF position when the test set is not in use.

TEST SET CHECK

New 145A TEST SETS are shipped without batteries. Loosen the four front panel mounting screws and lift the instrument out of the case. Install two KS-21617 9-volt batteries (or equivalent NEDA #1600) in the battery holders, observing the proper polarity.

The BAT. MON (battery monitor) lamps indicate the condition of the batteries. If either one or both lamps light (the OFF/ON switch must be ON), the batteries need to be replaced.

To determine if the set has batteries, push the OFF/ON switch ON and the CAL/OPR switch out to CAL. Then, with the selector switch in the OHMS x 1000 position, the meter needle should move to the right.



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RESISTANCE TESTING

1. Connect the TIP and RING test leads to the circuit and the GRD test lead to ground.

2. Set the test selector knob to the OHMS x 1000 position.

3. Calibrate the meter as follows:

   A. Push the OFF/ON switch in to the ON position.

   B. Push the CAL/OPR switch out to the CAL position.

   C. Turn the OHMS CAL knob until the meter reads 0 on the OHMS scale.

4. Push the CAL/OPR switch in to the OPR position.

5. Measure the resistance, in ohms, on the meter.

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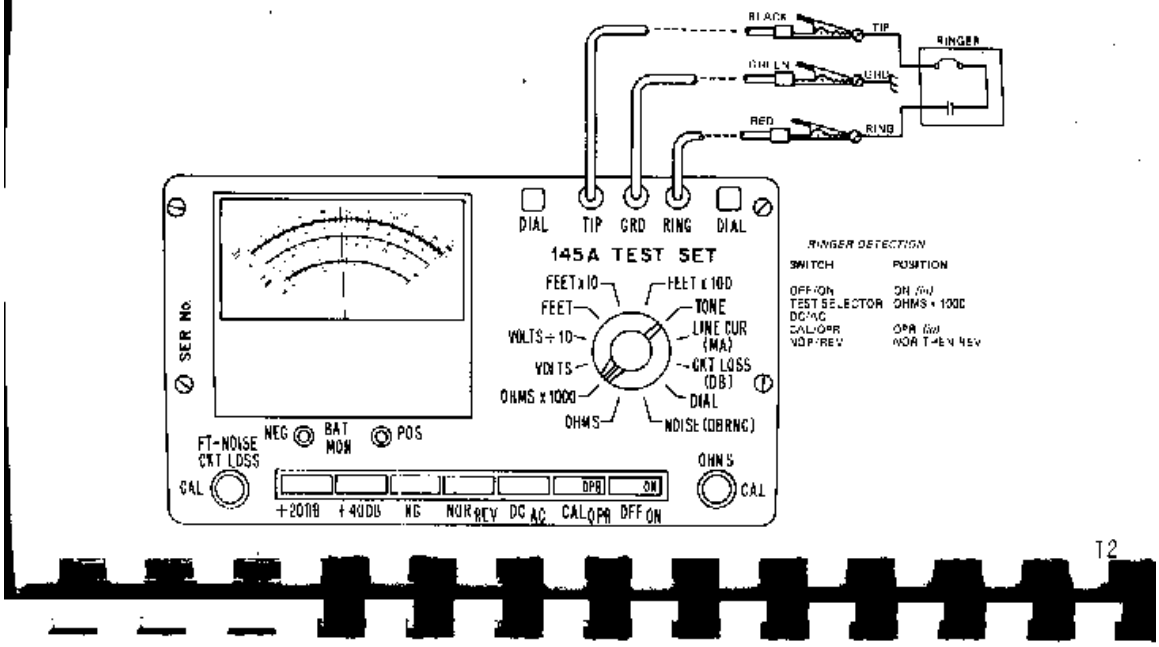
RESISTANCE TESTING, continued

For a resistance of less than 3000 ohms, obtain a more accurate reading as follows: set the test selector knob to the OHMS position, recalibrate as in step 3 above, and remeasure.

NOTE: A resistance measurement is meaningless if there is battery on the pair. Operate the NOR/REV switch. A change in reading indicates the presence of battery.



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RINGER DETECTION

1. Connect the TIP and RING test leads to the circuit and the GRD test lead to ground.

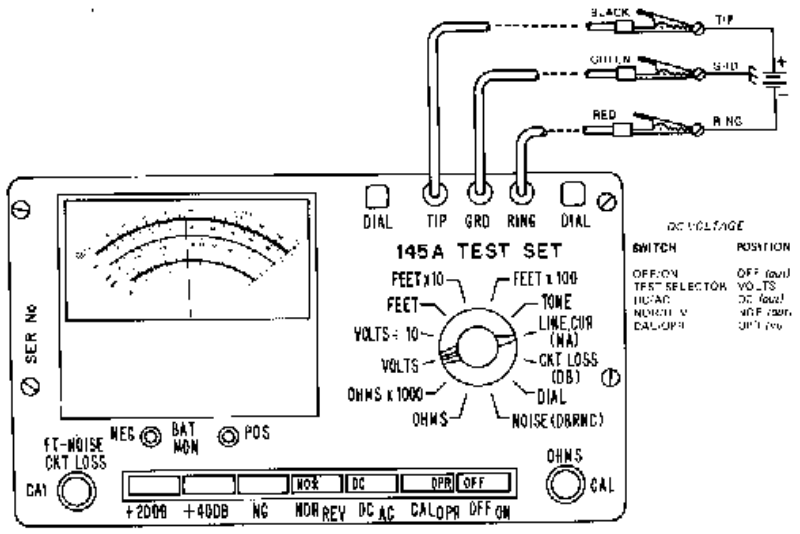
2. Set the test selector knob to the OHMS x 1000 position.

3. Calibrate the meter as described in step 3 on page 9.

4. Push the CAL/OPR switch in to the OPR position.

5. Move the NOR/REV switch to one position, then to the other. When a ringer is present on the line, the needle will kick from 0 to 10 or more on the MA scale.

   NOTE: To ensure accurate readings, wait until all meter movement has stopped before moving the NOR/REV switch.



DC VOLTAGE MEASUREMENT

CAUTION: DO NOT TEST CIRCUITS SUSPECTED TO BE OVER 200 VOLTS. EXTREME CAUTION MUST BE USED WHEN ATTACHING THE TEST SET LEADS WHENEVER THERE IS REASON TO SUSPECT THE PRESENCE OF MORE THAN 50 VOLTS.

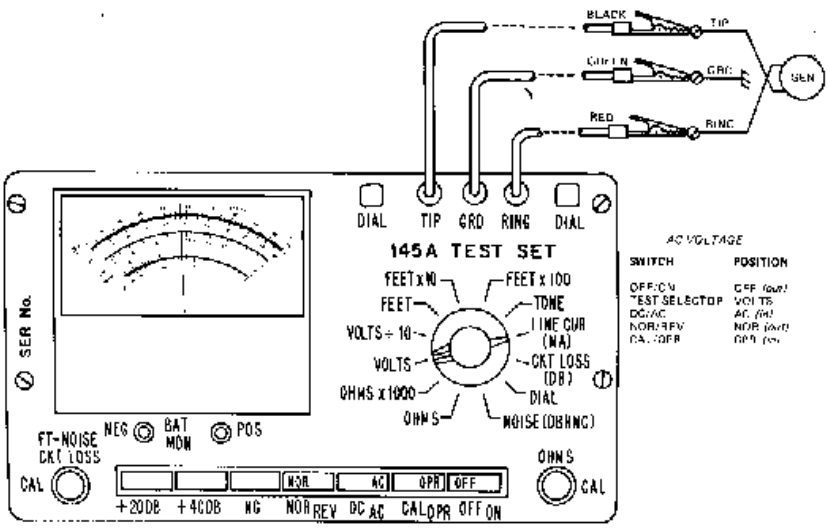
1. Turn the test selector knob to the VOLTS position.
2. Release the DC/AC switch to the out or DC position.
3. Release the NOR/REV switch to the out or NOR position.
4. Connect the test set cords to the circuit being tested as follows:
   A. Connect the black (TIP) lead to the TIP of the pair.
   B. Connect the red (RING) lead to the RING of the pair.

DC VOLTAGE MEASUREMENT, continued

C. Connect the green (GRD) lead to ground.

5. Push the CAL/OPR switch in to the OPR position.

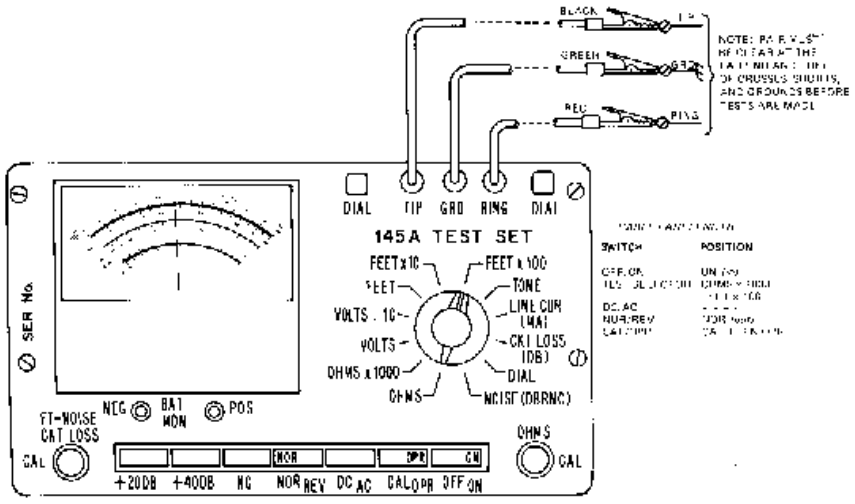
6. Read the voltage on the VOLTS/FEET scale on the meter. If the needle deflects to the left, reverse the polarity of the meter by placing the NOR/REV switch in the in or REV position and then read the voltage.



AC VOLTAGE MEASUREMENT

CAUTION: DO NOT TEST CIRCUITS SUSPECTED OF HAVING AN AC POTENTIAL OF OVER 200 VOLTS.

1. Turn the test selector knob to the VOLTS position.
2. Push the DC/AC switch in to the AC position.
3. Connect the TIP and RING test leads to the facility being tested and the GRD test lead to ground.
4. Push the CAL/OPR switch in to the OPR position.
5. Read the voltage on the VOLTS/FEET scale.



CABLE PAIR LENGTH MEASUREMENT

This measurement gives accurate results for new cable or wire sections or for cable or wire pairs having the TIP and RING open at the same point.

1. Check the pair for shorts and grounds as follows:

   A. Connect the TIP and RING leads to the cable pair and the GRD test lead to ground.

   B. Turn the test selector knob to the OHMS x 1000 position.

2. Calibrate the meter as described in step 3 on page 9.

3. Push the CAL/OPR switch in to the OPR position.

4. Move the black (TIP) test lead from the tip conductor and connect it to ground. If the needle moves up scale but fails to drop back all the

way, the RING side of the line is grounded. Use the following guide if there is a resistance fault. To ensure an accuracy of five percent in your length measurements, the resistance must exceed the values below:

Length	Fault resistance must be greater than
50 - 200 feet	3.0 megohms
200 - 2,000 feet	1.0 megohm
2000 - 20,000 feet	0.1 megohm

5. Move the red (RING) test lead from the RING conductor to the TIP conductor. Leave the black test lead on ground. If the needle moves up scale and fails to drop back all the way, the TIP side of the line is grounded.

6. If the pair is free of shorts and grounds, return the black test lead to the TIP side of the line and the red lead to the RING side of the line.

7. Move the test selector knob to the FEET x 100 position.

8. Move the CAL/OPR switch to the out or CAL position.

9. Use the FT-NOISE CKT LOSS CAL knob to calibrate the meter to read 200 (tip to ring) on the VOLTS/FEET scale.

   NOTE: For wire or cable with a capacitance of other than 0.083 μF/mile, see the table on page 25 below for the correct calibration setting.

10. Push the CAL/OPR switch in to the OPR position.

11. Read the length of the pair on the FEET scale of the meter.

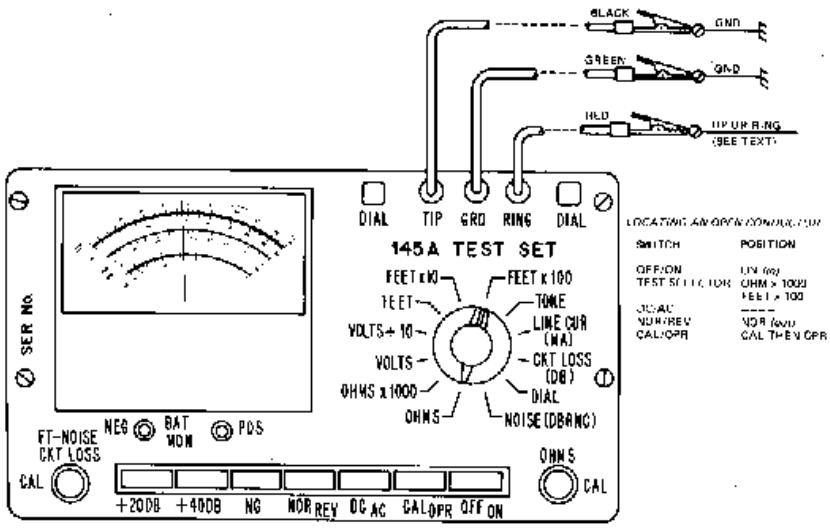
NOTE: If the reading is less than 2000 feet, move the test selector knob to the FEET x 10 position; if the reading is less than 200 feet, move to the FEET position. Recalibrate the meter and read the facility length on the FEET scale.

CALIBRATION TABLE

Use this table for wire or cable with a capacitance other than 0.083 uF/mile.

TYPE OF WIRE OR CABLE	CALIBRATION SETTING	
	Tip to Ring	Tip or Ring to Ground*
B-Service Wire	160 volts/feet	84 volts/feet
C-Drop	68	62
C-Multiple Drop	88	56
D-Station (24 gauge)	204†	106
D-Station (22 gauge)	186	102
D-Inside Wire (6 pairs)	152	112
D-Inside Wire (25 pairs)	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 are working or grounded.
† Calibrate to mark at the right of the 200-foot mark.



LOCATING AN OPEN CONDUCTOR

1. Connect the TIP and RING test leads to the cable pair and the GRD test lead to ground.

2. Turn the test selector knob to the OHMS x 1000 position and test for a low resistance fault as described in steps 1 through 4 on pages 21 and 22.

3. When you have determined that no low resistance fault exists, rotate the test selector knob to the FEET x 100 position.

4. Place the CAL/OPR switch in the out or CAL position and calibrate the meter as follows:

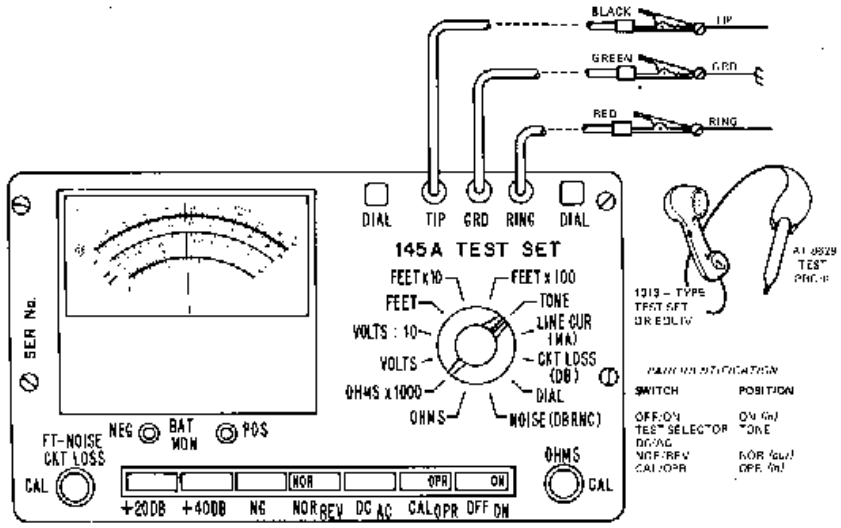
   A. Use the FT-NOISE CKT LOSS CAL knob to calibrate the meter to the T-G, R-G mark located just above the 140-foot mark on the VOLTS/FEET scale. This calibration is for all cable with 0.083 μF/mile

capacitance. Use the table on page 25 for other types of wire or cable.

B. Push the CAL/OPR switch in to the OPR position.

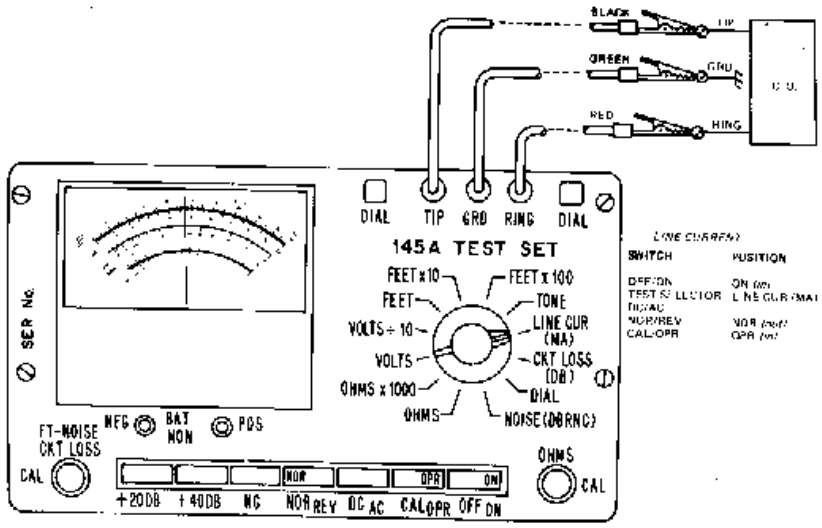
5. With the TIP wire grounded, measure the length of RING wire by connecting the black (TIP) test lead to ground and the red (RING) test lead to the RING wire.

6. With the RING wire grounded, measure the length of TIP wire by connecting the red (RING) test lead to the TIP wire. The wire (TIP or RING) with the shorter length measurement is open.



PAIR IDENTIFICATION

1. Turn the test selector knob to TONE.
2. Push the OFF/ON switch in to the ON position.
3. Connect the TIP and RING test leads to the cable pair or drop wire being tested. Connect the GRD test lead to ground.
4. Push the CAL/OPR switch in to the OPR position.
5. Use the AT-8629 test probe to detect the tone at the far end of the cable pair or drop wire (see BSP 105-241-100).



LINE CURRENT MEASUREMENT

This measurement should be made at the customer's premises, where the station set must be either on-hook or disconnected.

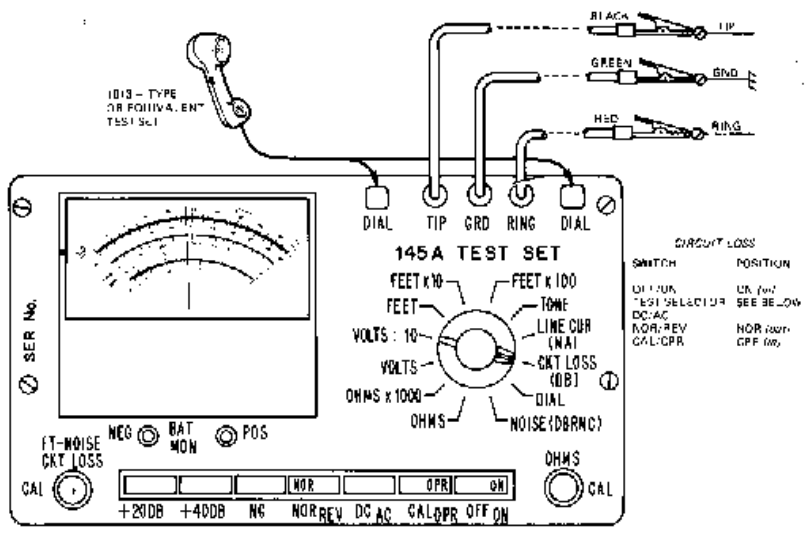
1. Turn the test selector knob to LINE CUR (MA).
2. Connect the TIP and RING test leads to the line being tested and the GRD test lead to ground.
3. Place the NOR/REV switch to the out or NOR position.
4. Push the CAL/OPR switch in to the OPR position.
5. Read the line current in milliamperes on the MA scale.

LINE CURRENT MEASUREMENT, continued

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

6. The following are the parameters for central office line current:

unacceptable:	0 - 26 milliamperes
acceptable:	26 - 100 milliamperes
optimum:	35 - 65 milliamperes



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CIRCUIT LOSS MEASUREMENT

1. Connect the TIP and RING test leads to the line being tested and the GRD test lead to ground.

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

3. Calibrate the meter as follows:

   A. Push the CAL/OPR switch out to the CAL position.

   B. Push the OFF/ON switch in to the ON position.

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

NOTE: When you calibrate, check that the +20DB, +40DB, and NG switches are not depressed.

D. Push the CAL/OPR switch in to the OPR position.

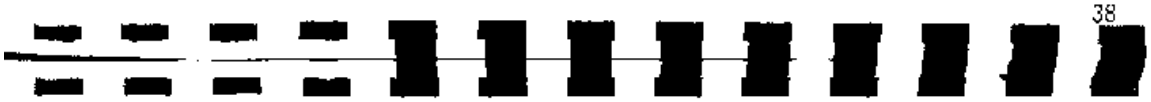
E. Push the NOR/REV switch out to the NOR position.

4. Turn the test selector knob to DIAL.

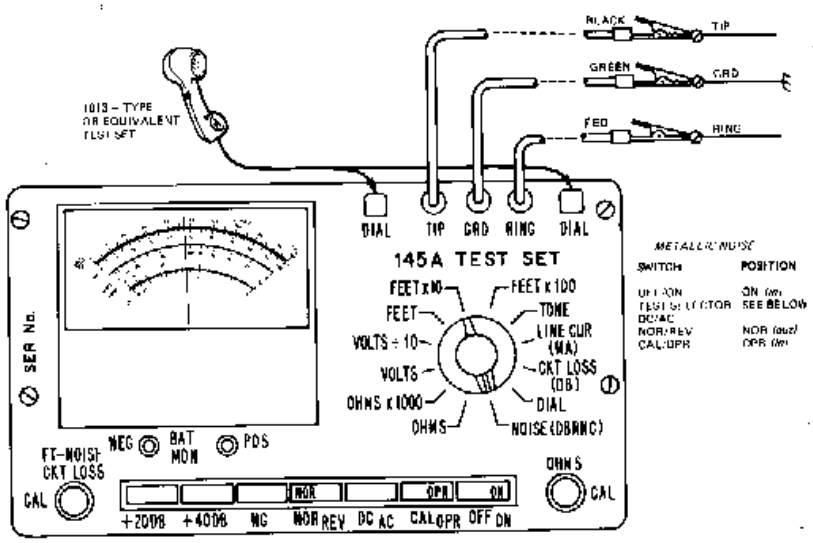
5. Connect the cord clips of a 1011 or 1013 Test Set to the terminals marked DIAL on the 145A TEST SET. Dial the central office milliwatt (1000 Hz to 0 dBm) supply.

6. When you hear the milliwatt tone, turn the test selector knob from the DIAL position to the CKT LOSS (DB) position.

7. Read the circuit loss on the DB scale.



NOTE: If there is a gain device, use the attenuators to measure the gain. With the +40DB switch depressed, the actual gain of the circuit is 40 decibels minus the reading on the meter.



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METALLIC NOISE MEASUREMENT

1. Connect the TIP and RING test leads to the pair being measured. Connect the green (GRD) lead to the sheath or building ground.

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

3. Calibrate the meter as follows:

   A. Move the CAL/OPR switch out to the CAL position.

   B. Push the OFF/ON switch in to the ON position.

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

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METALLIC NOISE MEASUREMENT, continued

NOTE: When you calibrate, check that the +20DB, +40DB, and NC switches are not depressed.

4. Turn the test selector knob to DIAL.

5. Connect the cord clips of a 1011 or 1013 Test Set to the terminals marked DIAL.

6. Place the NOR/REV switch in the out or NOR position.

7. Push the CAL/OPR switch in to the OPR position.

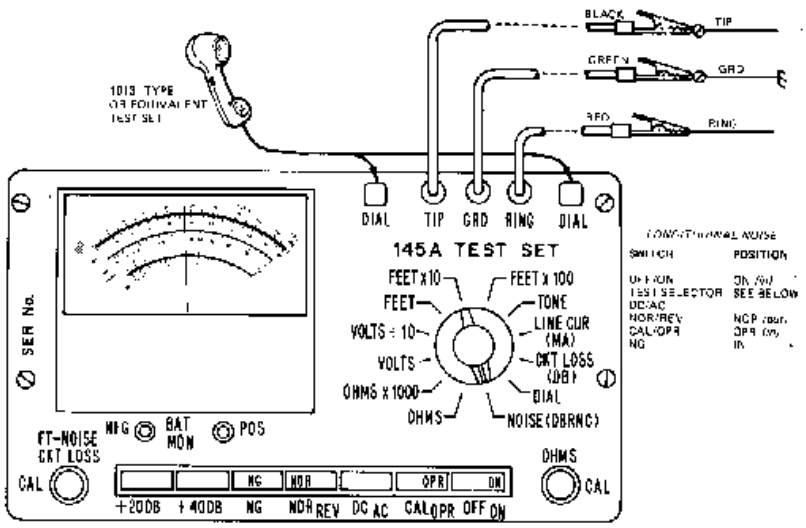
8. Dial the central office quiet termination.

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

10. Read metallic noise on the DBRNC scale.

The Bell System objective noise limit is 20 dbrnc. Loops with noise in excess of 30 dbrnc should be corrected.

NOTE: If it is necessary to read noise levels exceeding 40 dbrnc, use the +20DB switch to increase the range to 60 dbrnc or the +40DB switch to increase the range to 80 dbrnc. With both switches depressed (20DB + 40DB = 60DB) the range will increase to 100 dbrnc.



LONGITUDINAL NOISE MEASUREMENT

1. Connect the ground test lead to either the building ground or the cable sheath. Connect the TIP and RING test leads to the pair being tested.

2. Follow steps 2 through 7 as given for metallic noise measurement on pages 41 and 42.

3. Depress the NG switch.

4. Read the noise to ground on the DBRNC scale.

   NOTE: Use the +20DB and/or the +40DB switches to increase the range.

DETERMINING CABLE PAIR LENGTH BY RESISTANCE MEASUREMENT

1. Short the TIP and RING wires together at the far end of the circuit.
2. Measure the loop resistance in ohms.
3. Multiply the resistance in ohms by the feet-per-ohm value given in the following table. This will give you the length in feet.

Gauge of Copper Cable	Loop Feet per Ohm
19	60
22	30
24	20
26	12

NOTE: The loop feet per ohm is one-half the single conductor feet per ohm.

Do not use the table to determine loop length if there are load coils or if the loop contains more than one wire gauge.