LOCATING FAULTS USING THE DYNATEL 710A TEST SET DESCRIPTION AND USE

CONTENTS PAGE

1. GENERAL

1.01 This section covers the description and use of the Dynatel 710A Test Set (Fig. 1).

1.02 This portable, battery-operated test set can locate shorts, crosses, grounds, and battery crosses in buried, underground, or aerial PIC and pulp cables. A good pair or a good conductor, typical for bridge type measurements, used with the faulty conductor is necessary for measurement. A built-in FAULTMETER and LOOPMETER provide a quick method for determining the nature of the fault and for testing continuity of the conductor loop and strap between loop and faulted conductor. Both the distance-to-fault and strap-to-fault distance can be measured from one end of the cable.

2. DESCRIPTION

2.01 The Dynatel 710A test set is a lightweight solid state test set powered by two 4.5 volt batteries, two 9 volt batteries, and one 45 volt

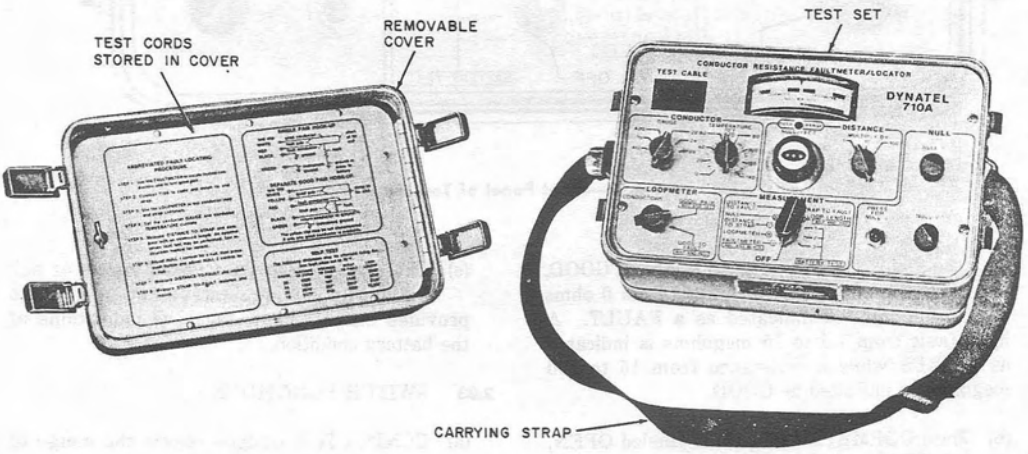


Fig. 1—Dyn .el 710A Test Set

battery. A separate battery compartment permits battery replacement without disassembly. The test set is housed in a fiberglass case that is 11 by 7 by 9 inches and weighs about 14 pounds with batteries, cover, and test cord.

METER FUNCTIONS

2.02 The switches, controls and meter are located on the front panel of the test set (Fig. 2).

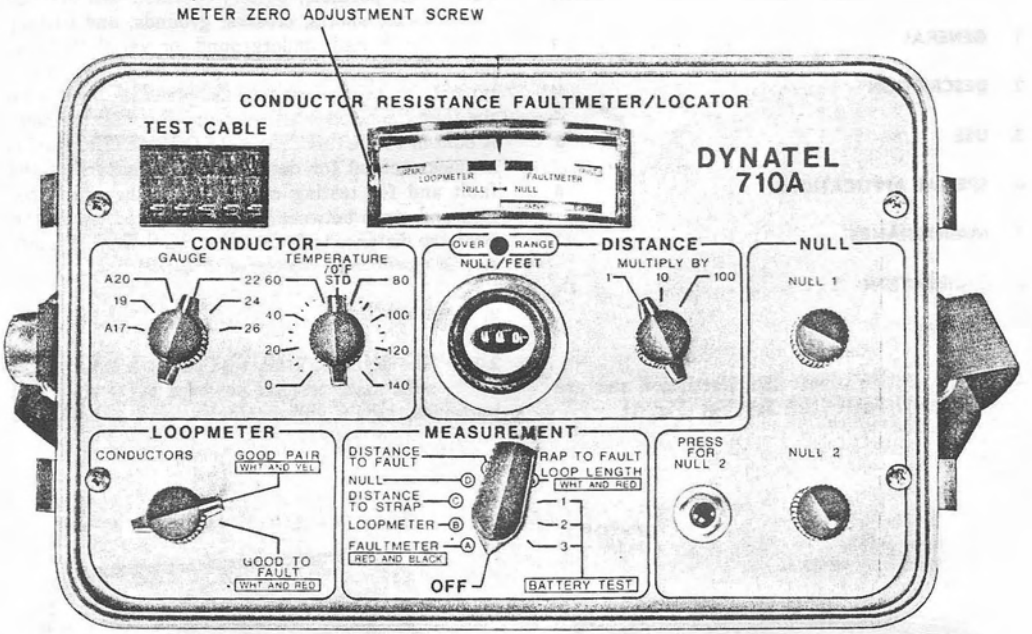


Fig. 2—Front Panel of Test Set

(a) The FAULTMETER (Fig. 3) is labeled GOOD, HI RES, and FAULT. A fault from 0 ohms to 1.5 megohms is indicated as a FAULT. A light fault from 1.5 to 15 megohms is indicated as HI RES while a resistance from 15 to 200 megohms is indicated as GOOD.

(b) The LOOPMETER (Fig. 3) is labeled OPEN, HI RES, and GOOD. A series loop and strap resistance of less than 1500 ohms indicates GOOD. A resistance from 1500 ohms to 30K ohms indicates a HI RES and from 30K ohms to infinity as an OPEN.

(c) The meter serves as a visual means of null indication during instrument use. Also provided on the meter face are indications of the battery condition.

2.03 SWITCH FUNCTIONS

(a) CONDUCTOR Gauge—selects the gauge of the faulted conductor to be tested.

(b) CONDUCTOR Temperature—Adjustment for the approximate temperature of the faulted conductor to be tested. For a precise temperature

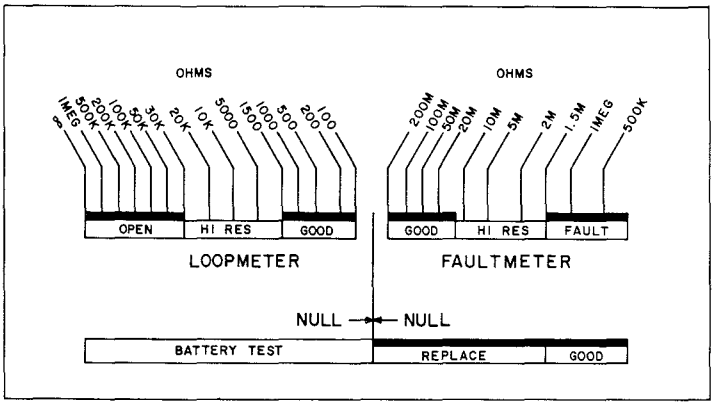


Fig. 3—Meter

input, use the accessory THERMO-CALIBRATOR (See 3.16) which can be plugged into the TEST CABLE socket.

(c) LOOPMETER Switch—Provides a means for checking the continuity of the good conductor and faulted conductor and whether they are correctly strapped together at the far end.

(d) MEASUREMENT Switch—Selects for the appropriate test to be made.

(e) DISTANCE Multiply By—Selects the distance range multiplier for the Null Feet.

(f) DISTANCE Null Feet Digital Control—Provides the distance in feet for all of the tests to be made.

(g) OVER RANGE Lamp—Indicates when total length of conductor exceeds the limits of circuitry within test set when the internal protection fuse may be open, or when the far end strap becomes disconnected.

(h) NULL Controls—Provide adjustment to obtain a null indication on the meter.

2.04 Test Cable—This test cable (Fig. 4) is used to connect the test set to the good and faulted pairs. The cable also has a test fault built into the plug. Connecting the test clips to the terminals of the same color on top of the plug provides a means for checking the complete operation and calibration of the test set, test cable and when used, the extension cable.

2.05 Extension Cable—This extension cable (Fig. 5) is available as an accessory cable for use with the test set. The extension cable is 33 feet long and may be used to extend the length of the test cable or Thermo calibrator cable. ALL TESTS MAY BE PERFORMED USING THE EXTENSION CABLE WITHOUT CORRECTION OR ALLOWANCE SINCE ALL DISTANCE MEASUREMENTS ARE MADE FROM THE TEST CLIPS ON THE TEST CABLE. Several extension cables may be used in series if a longer reach is required.

2.06 THERMO-CALIBRATOR—The thermo calibrator (Fig. 5) is available as an accessory item for use with the test set and is furnished with a 15-foot cable. The thermo-calibrator provides a means of determining the precise temperature at the location of the calibrator tip.

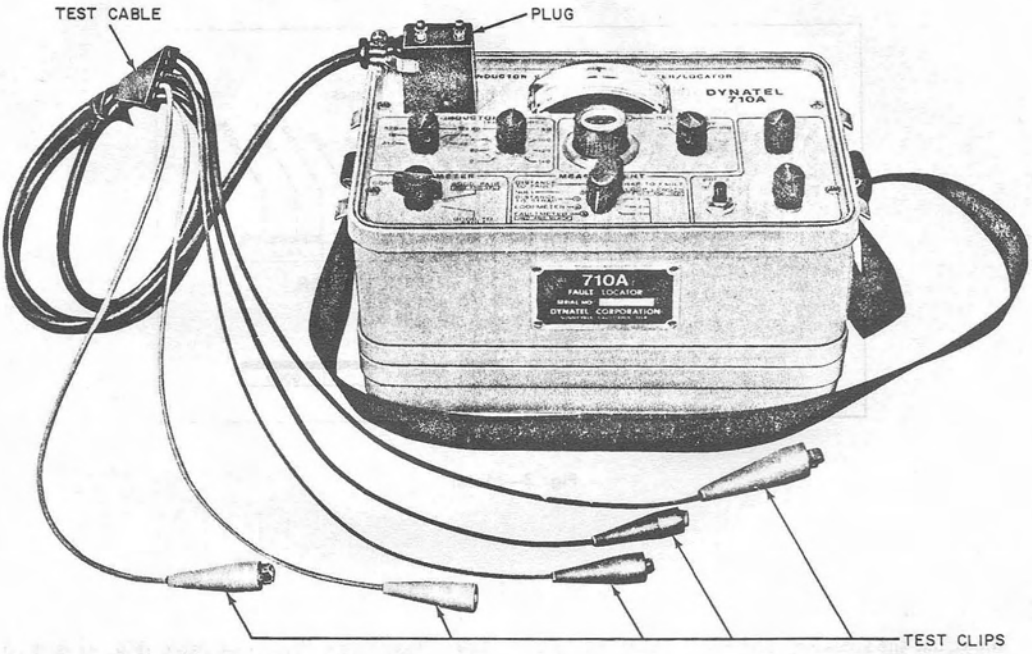


Fig. 4—Test Cable Attached to Test Set

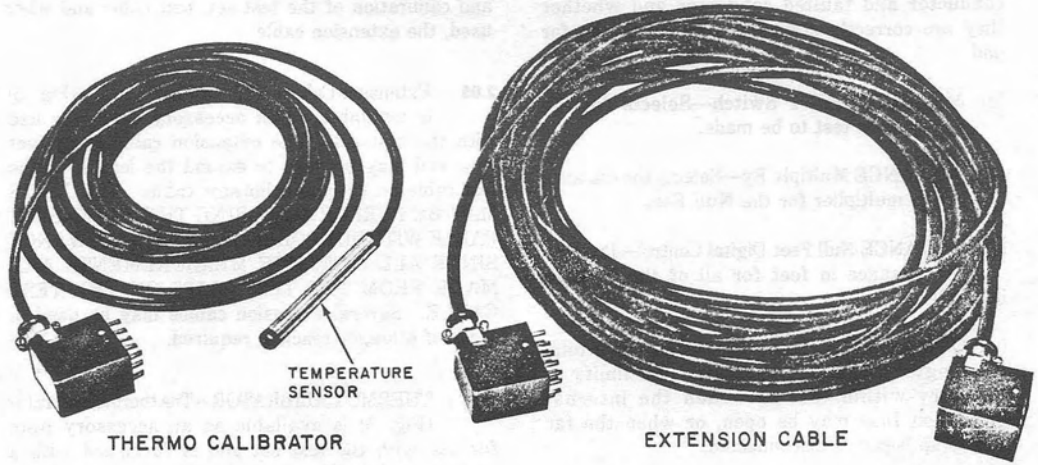


Fig. 5—Extension Cord and Thermo Calibrator

3. USE

BATTERY TEST

3.01 Plug the cable into the instrument and test the batteries. Set the MEASUREMENT switch to BATTERY TEST 1 and read the condition of the 4.5-volt batteries on the meter. Set the switch to BATTERY TEST 2 to test the 9-volt batteries and to BATTERY TEST 3 to test the 45-volt battery.

3.02 All batteries are tested under full operating load and should provide up to 500 hours of operation.

FAULT IDENTIFICATION METHOD

3.03 Set the MEASUREMENT switch to the FAULTMETER position. Connect the black test clip to ground and the red test clip to the tip conductor of a pair and note FAULTMETER indication. Next, move the red test clip to the ring conductor and note FAULTMETER indication. These two measurements will have detected any tip or ring grounds. With the red test clip still connected to the ring side, touch the tip conductor to ground and note FAULTMETER indication. The FAULTMETER will indicate the presence of any tip-ring shorts as a result of conduction through the FAULT to ground. Now all FAULTS to working pairs will have been detected. If it is desired to detect crosses to nonworking pairs, then all nonworking pairs must be alternately grounded while monitoring tip to ground and then while monitoring ring to ground.

3.04 Once faults have been determined, test and clear the lowest value faults first before proceeding to the higher value faults.

3.05 The current from the FAULTMETER is limited to approximately 50 microamperes in order to minimize the "drying effect" on conductor faults.

3.06 Check as many conductors as are available in order to obtain a clear understanding of the trouble in the cable. ***NEVER*** dig a hole on the basis of a single trouble reading if additional pairs are available for test.

INSTRUMENT HOOK-UP

3.07 There are two basic hook-ups; a single pair hook-up and a separate good pair hook-up (Fig. 6). The separate good pair hook-up allows a series fault (3.29) test to be performed and in some cases provides an improvement in accuracy when the fault is near the far-end strap.

3.08 When locating faults, the good conductor or good pair must indicate on the FAULTMETER in the good zone. In general, the quality required of the good pair is determined by the magnitude of the FAULT resistance. For example, for a 1.5-M ohm fault (Fig. 3) a good pair that reads 200M ohms or higher should be used for best results. For a fault resistance of less than 500 K ohms, a good pair that reads only 20M ohms is acceptable. The yellow test clip may be left disconnected if only one good conductor is available. THE GREEN TEST CLIP IS THE INSTRUMENT PROTECTIVE GROUND AND SHOULD ALWAYS BE CONNECTED TO EARTH GROUND.

STRAP CONNECTION

3.09 A STRAP, OR TIE, MUST BE INSTALLED BETWEEN THE FAULTED CONDUCTOR AND THE GOOD PAIR AT THE FAR END OF THE CABLE SECTION TO BE TESTED. MAKE A DIRECT TWISTED CONNECTION OR USE B CONNECTORS. IF WIRE IS USED, SELECT 19-GAUGE COPPER, MAKE IT AS SHORT AS POSSIBLE AND MAKE A GOOD CONNECTION.

3.10 ***DO NOT USE TINSEL TRANSFER CLIP LEADS WHEN MAKING THE STRAP CONNECTION.*** SOME TINSEL TRANSFER CLIP LEADS ARE ELECTRICALLY EQUIVALENT TO 600 FEET OF 19-GAUGE COPPER. A POSITIVE STRAP CONNECTION IS VERY IMPORTANT.

USING THE LOOPMETER

3.11 Set the measurement switch to LOOPMETER and the loopmeter switch to GOOD PAIR. A GOOD indication means that the good pair has continuity and is strapped at the far end. A HIGH RESISTANCE indication means the loop resistance is higher than allowable for a normal telephone circuit. An OPEN indication means that the strap is not connected properly, or an open circuit exists somewhere in the loop.

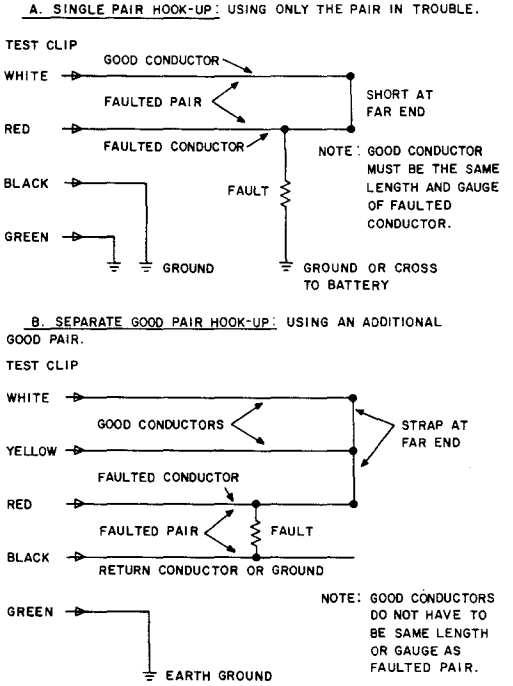


Fig. 6—Basic Hook-up

3.12 When using a single pair hook-up, without a good pair, the good pair will indicate OPEN.

3.13 Set the loopmeter switch to GOOD TO FAULT. A GOOD indication means the good conductor and the faulted conductor have continuity and are correctly strapped at the far end. This completes the hook-up test.

CONDUCTOR GAUGE

3.14 Set the GAUGE switch to the gauge of the fault conductor being tested. For multiple gauge combinations, see Part 4, Special Applications.

CONDUCTOR TEMPERATURE

3.15 Set the TEMPERATURE control to the temperature of the faulted conductor being tested. The temperature for underground and buried cable may vary from 30° to 80°F. A typical temperature is 55°F depending upon the depth, the geographic location, and the season of the year. The approximate temperature of buried or underground cables may be obtained by either measuring the temperature of water running from an undergroud pipe or by use of the 9004 Thermo-Calibrator. The temperature sensing portion of the Thermo-Calibrator can be buried at the work center at the standard buried cable depth. The temperature of the buried probe is found by the craftsman by adjusting the meter on the 710A to a null condition utilizing the temperature knob on the 710A. This value of temperature may then be used as a guide for buried/underground cable temperatures in the immediate geographical area.

3.16 The temperature of aerial cable will be close to the temperature of the air, depending upon the time of day and exposure to the sun and may be as high as 120°F in direct sunlight in the summer. For aerial cables exposed to direct sunshine set the temperature knob of the 710A to 10 to 15° above the ambient air temperature.

3.17 To obtain a precise temperature, plug the Thermo-Calibrator into the test cable socket and set the controls as follows:

CONTROL	POSITION
GAUGE:	26 gauge
FEET DIAL:	1000 feet (000 full clockwise)
MULTIPLY BY:	1
MEASUREMENT:	LOOP LENGTH

Adjust the temperature dial for a null. The instrument is now set to the exact temperature of the thermo-calibrator. The temperature may be read from the temperature dial of the 710A.

DISTANCE TO STRAP MEASUREMENT

3.18 The DISTANCE TO STRAP measurement serves as a check on conductor gauge and cable routing, if one or the other is known.

3.19 Set the measurement switch to DISTANCE TO STRAP and rotate the digital dial to obtain a null on the meter. Set the MULTIPLY BY switch as required in order to obtain a null. For multiple gauge combinations, see Part 4.

> *Note:* A good strap connection is very IMPORTANT. The length of wire used to strap the fault conductor to the good pair is included in all distance measurements.

READING THE DISTANCE DIAL

3.20 With the MULTIPLY BY switch set to 1, the three digits on the digital dial read directly in feet. A reading of 023 indicates 23 feet and 123 indicates 123 feet.

(a) Placing the MULTIPLY BY switch in the 10 position multiplies the distance reading by 10. A reading of 123 now indicates 1230 feet.

(b) The MULTIPLY BY switch selects three distance ranges as follows: 0 to 1000 feet, 0 to 10,000 feet and 0 to 100,000 feet.

DOWN-RANGE FOR ACCURACY

3.21 In the event the first number on the digital dial is 0 and the MULTIPLY BY switch is set to 10 or 100, the MULTIPLY BY switch may be down-ranged for added readability and increased accuracy.

THE OVER-RANGE LIGHT

3.22 The OVER-RANGE light will flash whenever the total length of conductor between the red and white test clips exceeds the limit of the circuitry within the instrument. The flashing light indicates a valid null cannot be obtained. Usually the solution is to set the MULTIPLY BY switch to a longer range. If the instrument or far-end-strap becomes disconnected, the light will also flash.

3.23 If the OVER-RANGE light continues to flash, even when the red and white test clips are connected together, then the internal protection fuse may be open. Refer to FUSE in Part 5, Maintenance.

NULL

3.24 Set the measurement switch to the NULL position and adjust NULL 1 control for a null indication on the meter. With PRESS FOR NULL 2 button held down, adjust NULL 2 control to move meter needle away from null, then reset needle back on null for final adjustment. If meter needle cannot be set away from null before final adjustment, the fault may have dried out and should be rechecked using the FAULTMETER. The NULL 2 control should not be moved after its final setting as it would affect the DISTANCE TO FAULT and STRAP TO FAULT measurements. If the NULL 2 control is disturbed, it may be set again without repeating previous measurements.

FAULT MEASUREMENT

3.25 Set the measurement switch to DISTANCE TO FAULT and rotate the digital dial for a null on the meter. The reading on the digital dial multiplied by the MULTIPLY BY switch is the distance from the test set to the fault in feet and should be recorded.

3.26 Set the measurement switch to STRAP TO FAULT and adjust the digital dial in the same manner as before. This reading is the distance from the far-end-strap back to the fault and should also be recorded.

> *Note:* The instrument may be down-ranged for improved readability and greater accuracy if the first digit on the digital dial is 0.

LOOP LENGTH MEASUREMENT

3.27 With the measurement switch set to LOOP LENGTH, the total length of conductors between the white and red test clips is measured. The electrical length of load coils can be measured for the actual conductor gauge and temperature. (See 4.10)

SERIES FAULT TEST

3.28 A test for a series resistance fault (partial open) in the fault conductor can be performed when using the separate good pair hook-up and the good pair is the same length and gauge as the faulted conductor.

3.29 To test for a series fault, measure the DISTANCE TO STRAP and record this distance. Then disconnect the yellow test clip and measure the DISTANCE TO STRAP again. If the first distance measurement was longer than the second distance measurement by more than 5 percent, then the fault conductor has a series fault and should not be used for test. If the first measurement was shorter, the unbalance was due to the good conductor and will not affect the measurements.

4. SPECIAL APPLICATIONS

B SERVICE AND D UNDERGROUND WIRE

4.01 B service wire contains iron and has electrical characteristics similar to 24-gauge copper. When testing B service wire, set GAUGE switch to 24 and the TEMPERATURE control to a temperature 26°F lower than the actual conductor temperature. For D underground wire, set GAUGE SWITCH to 19 and temperature control 15°F lower than actual conductor temperature.

BRIDGE TAPS

4.02 When a bridge tap is located between the test set and the strap, it is necessary to determine whether the fault is in the main section or in the bridge tap section. ***A FAULT THAT IS LOCATED ANYWHERE IN THE BRIDGE TAP SECTION WILL MEASURE TO THE POINT WHERE THE BRIDGE TAP IS SPLICED INTO THE MAIN SECTION.***

4.03 To determine whether the fault is in the splice or the bridge tap section, disconnect the strap from the main section and connect a strap at an access point in the bridge tap section. The fault is now measured in the main section to the splice and then in the bridge tap section to the strap. If the fault still measures to the splice, then the fault is in the splice.

GOOD PAIR IN SEPARATE CABLE

4.04 ***THE GOOD PAIR DOES NOT HAVE TO BE IN THE SAME CABLE AS THE FAULTED PAIR, AND DOES NOT HAVE TO BE OF THE SAME GAUGE OR THE SAME LENGTH AS THE FAULTED PAIR.***

4.05 When testing short cable sections or buried drop, it is often faster to use a separate good pair such as B service wire of JKT wire. B service wire is very convenient because its foot markers can be used to measure the actual distance on the surface. When a reel of several hundred feet of wire has both ends available for connection, this wire need not be cut. Just roll off required amount of wire to complete the test, then roll back for reuse. Since only one pair is required for test, the other pair may be used as a talk pair. ***THE SINGLE PAIR HOOK-UP CANNOT BE USED WHEN THE GOOD CONDUCTOR IS A DIFFERENT LENGTH OR GAUGE.*** The LOOP LENGTH measurement will include the length and gauge of one of the good pair and should not be used when a separate drop is connected.

ELECTRICAL MAPPING

4.06 Since a fault anywhere in a bridge tap section will measure to the point where the bridge tap is spliced into the main cable, this allows a convenient way to electrically map the cable at the time of installation.

4.07 Using the standard single pair hook-up, measure the DISTANCE TO STRAP and record for future use. Without changing the strap, ground the fault conductor anywhere along a bridge tap and measure the DISTANCE TO FAULT in the usual manner. This is the distance from the test set to the splice where the bridge tap starts.

LOAD COILS

4.08 When a load coil is located in the cable section under test, measure the DISTANCE TO FAULT per 3.25. If the DISTANCE TO FAULT is less than the distance to the load coil, then this is the correct distance. If the DISTANCE TO FAULT is longer than the distance to the load coil, then the STRAP TO FAULT measurement is correct.

4.09 The DISTANCE TO STRAP will measure longer than the true length by an amount equal to the electrical length of the load coil. The electrical length of load coils can be from 10 feet to over 1000 feet depending upon which coil is used, the conductor gauge, and temperature.

4.10 To measure the equivalent electrical length of an individual load coil, connect it to the

red and white clips, set the measurement switch to LOOP LENGTH, set the conductor GAUGE and TEMPERATURE controls, and rotate the digital dial for a null. The electrical length may be read directly in feet from the digital dial and MULTIPLY BY switch. This measurement gives the equivalent length of the coil in terms of the gauge and temperature selected.

4.11 If a fault is located between two identical sets of load coils, then the electrical length of the load coil may be subtracted from either the DISTANCE TO FAULT or STRAP TO FAULT distances to obtain a correct measurement.

4.12 With two load coils in a section of cable, the DISTANCE TO STRAP will measure longer than the true length by an amount equal to the electrical length of both load coils.

4.13 The electrical length of a common load coil is shown in Table A.

TABLE A

ELECTRICAL LENGTH OF A LOAD COIL

CODE	EQUIVALENT ELECTRICAL LENGTH OF COIL AND STUB (FEET AT 70°F)			
	19 GA	22 GA	24 GA	26 GA
632	561	279	174	108

EQUIVALENT LENGTH CALCULATIONS

4.14 For some measurement problems it is necessary to change an actual conductor length to an equivalent length of another gauge. Equivalent length calculations are not necessary because the 710A can compute the equivalent length and display the answer directly in feet on the digital dial.

4.15 Connect the 710A to a cable section, or the test fault on the test cable plug. Set the measurement switch to DISTANCE TO FAULT, and set the digital dial and MULTIPLY BY switch to the actual conductor length. Set the GAUGE switch to the gauge of the conductor and adjust the NULL 2 control for a null. Now set the gauge switch to the equivalent gauge and adjust the digital dial for a null. The equivalent length of the conductor is read directly from the digital dial.

EXTENSION LENGTH CALCULATIONS

4.16 Normally all measurements are made from the test clips on the test cable. When the 9002 extension cable is used, no calculations are necessary since all measurements are still made from the test clips.

4.17 If a length of conductor is connected between the test clips and the cable to be tested, then an allowance must be made for the length and gauge of this short section.

> ***Example:*** A 40-foot length of 26-gauge conductor is used to connect the test clips to a 22-gauge cable and the DISTANCE TO FAULT measures 500 feet of 22-gauge conductor.

Connect a strap at the location where the 26-gauge conductor connects to the 22-gauge cable and measure the DISTANCE TO STRAP with the GAUGE switch set to 22 gauge. The electrical length of this short section measures 101.5 feet and must be subtracted from the DISTANCE TO STRAP and DISTANCE TO FAULT measurements to obtain the true length. In this case, subtract 101.5 feet from the 500 foot measurement to obtain a distance of 398.5 feet from the fault to the point where the 26-gauge conductor connects to the cable.

TEMPERATURE CONSIDERATIONS

4.18 Bridge type instruments measure the resistance of the conductors to determine their length.

The resistance of copper changes when its temperature is changed, so temperature must be taken into account if an accurate length measurement is to be made. The resistance of copper changes by approximately 0.218 percent for each degree F change in temperature. A few degrees may be insignificant, but a 25°F error in temperature will cause the length measurement to be in error by more than 5 percent. This phenomenon applies to all resistance bridge type instruments.

4.19 The TEMPERATURE control on the 710A should be set to the temperature of the faulted conductor in the section being tested (see 3.15 and 3.16). If part of the cable is underground and part of the cable is aerial, then an estimate of each should be made and a temperature selected that represents an average condition for the section being tested. If the fault is found to be in the first portion of cable, then the TEMPERATURE control should be set to the temperature of that portion of cable for the fault distance measurements, and the distance to fault will be the correct reading.

4.20 When the conductor temperature is below 0°F, set the TEMPERATURE control to 0°F for all distance measurements. The last DISTANCE TO FAULT and STRAP TO FAULT readings can be easily corrected for the exact temperature.

> ***Example:*** Correct a distance measurement for a conductor temperature of −40°F. First, record the distance reading with the TEMPERATURE control set to 0°F. Then set the TEMPERATURE control to +40°F and renull the meter using the digital control. Subtract this new distance reading from the 0°F reading. Now add this difference to the 0°F reading to obtain the −40°F distance.

TWO CONDUCTOR GAUGES

4.21 When two conductor gauges are used in a cable section, set the GAUGE switch to the gauge of the conductor at the test set end and measure the DISTANCE TO FAULT in the normal manner. If the distance to fault is less than the distance where the gauge changes, then the DISTANCE TO FAULT measurement is correct.

4.22 If the distance to fault is longer than the length of the first gauge, then set the GAUGE switch to the gauge of conductor at the far-end strap and measure the STRAP-TO-FAULT distance. This is the correct distance from the strap to the fault without calculation.

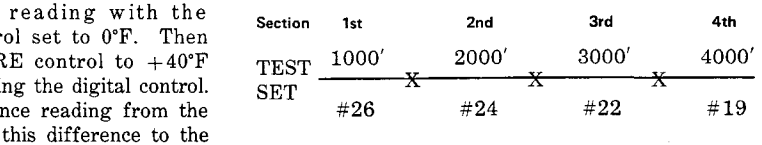
> ***Note:*** If the cable has the same gauge at each end and has a section with a different gauge in the middle, refer to MULTIGAUGE MEASUREMENTS.

MULTIGAUGE MEASUREMENTS

4.23 When several conductor gauges are involved and the fault is located in the gauge of conductor that is connected to the test set or the far-end-strap, then this may be measured directly. Refer to the preceding paragraph TWO CONDUCTOR GAUGES.

4.24 If the distance to the fault is longer than the length of the first gauge section, then set the GAUGE switch to the gauge of the second section and measure the DISTANCE TO FAULT again. Now subtract the equivalent length of the first gauge section and add the actual length of the first gauge section to obtain the true distance from the test set to the fault.

> ***Example:*** In the diagram shown below, the DISTANCE TO FAULT measures 2200 feet of 24-gauge conductor.



4.25 To obtain the equivalent length of the first section, set to DISTANCE TO FAULT, to 26 gauge, to 100 on the digital dial, to 10 on the MULTIPLY BY switch and adjust NULL 2 control for a null. Now set the GAUGE switch to 24 gauge and adjust the digital dial for a null. This is the 24 gauge equivalent length of 1000 feet of 26 gauge conductor. (ANSWER: 1606 feet.)

(a) To obtain the actual distance to fault, subtract the 1606 feet from the measured distance of 2200 feet and add the 1000 feet of actual length. (ANSWER: 1594 feet from test set to fault.)

(b) If the fault is in the third section, then use the same process except use the STRAP TO FAULT measurement instead of the DISTANCE TO FAULT.

LOCATING EARTH RETURN FAULTS

4.26 Isolate the shield at both ends of the cable and connect as shown in the solid lines of the hook-up diagram (Fig. 7).

Note: The yellow clip may be left disconnected if only one pair is available.

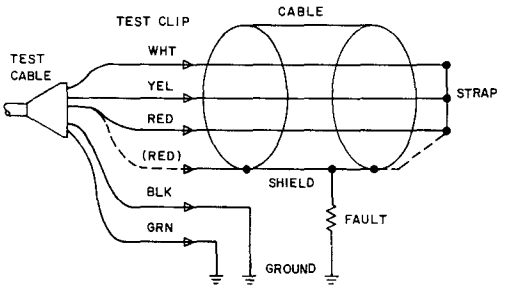


Fig. 7—Locating Earth Return Faults

4.27 Measure the DISTANCE TO STRAP and compare with the actual length as a check on the conductor gauge and cable routing. Connect the red clip and strap as shown in dashed lines and adjust the NULL 1 and NULL 2 controls in the normal manner. Now connect the instrument the same as in the first hook-up and measure the DISTANCE TO FAULT and STRAP TO FAULT in the normal manner.

5. MAINTENANCE

SELF-TEST

5.01 A complete test of the instrument and test cable may be performed by connecting the test clips to the test fault terminals of the same color on top of the test cable plug (Fig. 8). The operation of the instrument is exactly the same as when connected to a telephone cable. The extension cable may also be connected for check-out.

5.02 The FAULTMETER should indicate a FAULT. Removing the red test clip should cause the meter to return to GOOD.

5.03 The LOOPMETER should indicate GOOD. Removing the white test clip should cause the meter to indicate OPEN. The GOOD zone of the faultmeter and loopmeter actually extend to the null line. Any of the distance measurements given in Table B may be checked.

5.04 The accuracy of the test fault is $\pm 0.1\%$ for the DISTANCE TO STRAP and LOOP LENGTH measurements which is used for all calibration. The accuracy of the test fault for the DISTANCE TO FAULT and STRAP TO FAULT measurements is $\pm 2\%$ and is used as an operational check rather than calibration. The accuracy of the 710A test set is $\pm 1\%$ of reading ± 1 digit for all distance measurements.

ADJUSTMENTS

5.05 Calibration of the Dynatel 710A in the field should not be necessary. A calibrate control and a zero adjustment control are accessible from the battery compartment.

5.06 ***Meter Zero:*** With the instrument OFF, the meter should indicate exactly null. The meter pointer adjustment is located at the left edge of the meter face. (Fig. 2).

5.07 ***Electrical Zero:*** Connect the white, yellow, and red test clips together and set the measurement switch to LOOPMETER. The meter should indicate null. The ZERO adjustmnt, located next to the battery compartment (Fig. 9), may be used to set the instrument to an exact null.

BATTERY REPLACEMENT

5.08 The batteries will provide up to 500 hours of operation or six months to one year of service. All of the batteries will reach the replacement point at about the same time so it is advisable to replace the complete set of batteries at one time (Fig. 9 and Table C.)

FUSE

5.09 A fuse protects the instrument from damage as a result of accidental connection to a power line. The instrument will not be damaged

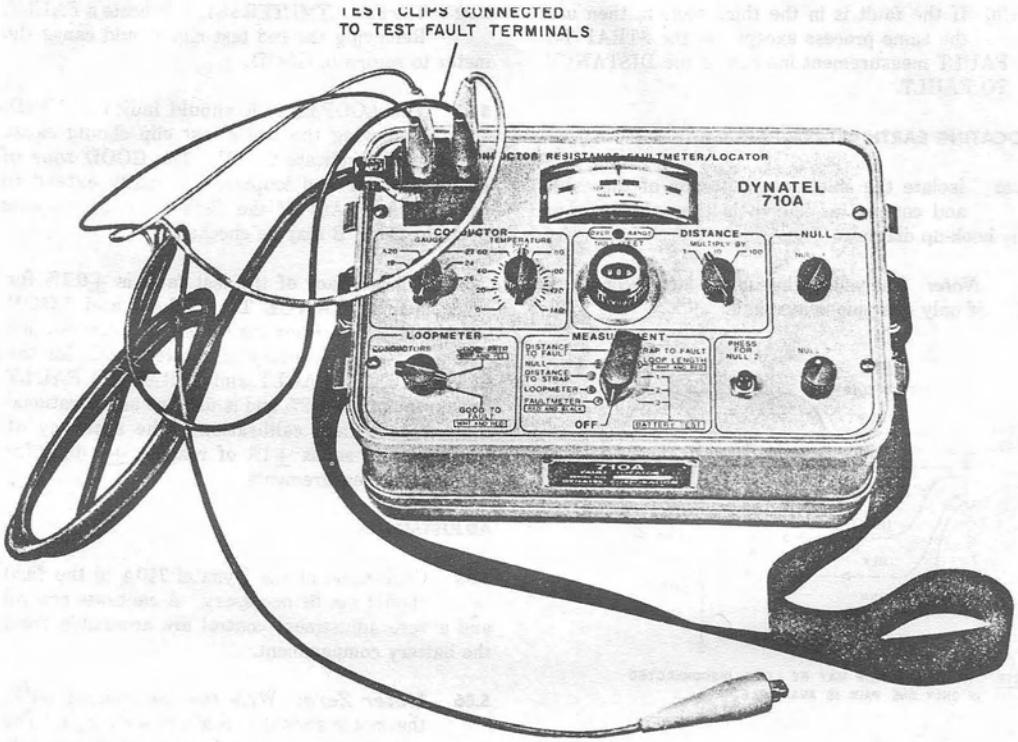


Fig. 8—Self Test

TABLE B

DISTANCE MEASUREMENTS

GAUGE	TEMP.	DISTANCE TO STRAP (FT.)	DISTANCE TO FAULT (FT.)	STRAP TO FAULT (FT.)	LOOP LENGTH (FT.)
26 Ga	70°F	1000 ± 10	100	900	2,000
24 Ga	70°F	1606 ± 16	161	1445	3,212
22 Ga	70°F	2574 ± 26	257	2317	5,148
19 Ga	70°F	5177 ± 52	518	4659	10,350

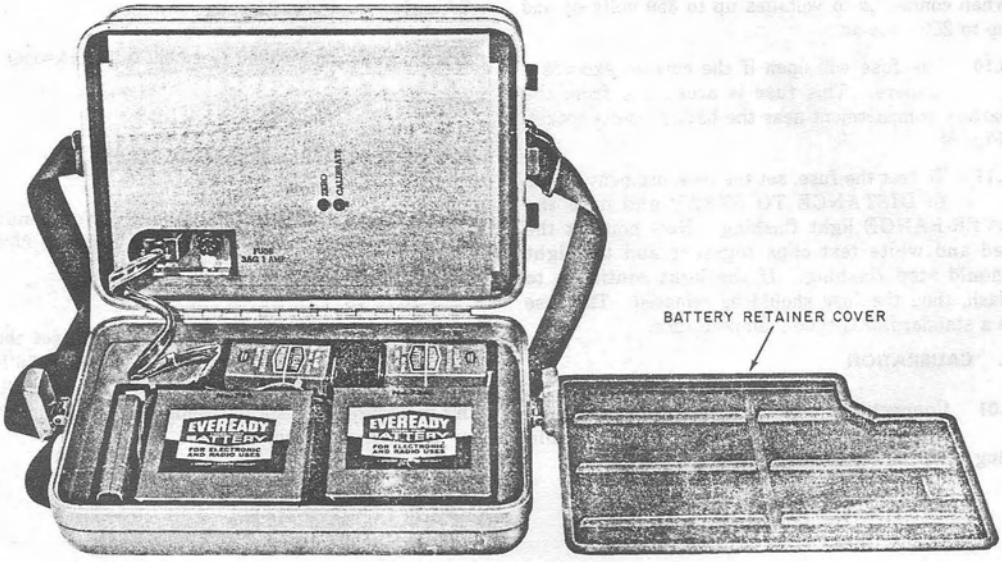


Fig. 9—Battery Compartment

TABLE C

BATTERY CROSS REFERENCE CHART

QUANTITY	VOLTAGE	NEDA	EVEREADY	BURGESS	RAY-O-VAC
2 each	4.5V	3	736	F3	A3
2 each	9 V	1602	246	2N6	1602
1 each	45 V	213	415	U30	213

when connected to voltages up to 350 volts dc and up to 250 volts ac.

5.10 The fuse will open if the current exceeds 1 ampere. This fuse is accessible from the battery compartment near the battery cable socket. (Fig. 9).

5.11 To test the fuse, set the measurement switch to DISTANCE TO STRAP and note the OVER-RANGE light flashing. Now connect the red and white test clips together and the light should stop flashing. If the light continues to flash, then the fuse should be replaced. The fuse is a standard 3AG type 1 ampere fuse.

6. CALIBRATION

6.01 Connect the test clips to the terminals of the same color on top of the test cable plug. Set the controls as follows:

GAUGE: 26 gauge

FEET DIAL: 1000 feet (000 full clockwise)

MULTIPLY BY: 1

MEASUREMENT: DISTANCE TO STRAP

Adjust the TEMPERATURE control for a null indcation on the meter. A reading between 65°F and 75°F is acceptable.

6.02 To adjust the CALIBRATE control, set the TEMPERATURE control to exactly 70°F and adjust the CALIBRATE control for a null. This procedure automatically calibrates the instrument for all distance measurements.