OHMMETER NO. 18B OPERATING INSTRUCTIONS

1 **GENERAL** This Instruction describes the operating procedures for testing and fault locating with the ohmmeter No. 18B. The description and facilities of the instrument are detailed in A2 D3114.

The Ohmmeter 18B can be used for a wide variety of cable fault tests. Insulation tests can be made at either 95 V or 500 V, with direct readings in Megohms. Conductor resistance tests may be made, including loop resistance, single wire resistance, and location of earth or contact faults. Disconnexion tests are made using the RHEOSTAT BALANCE scale on the meter.

2 **CHECK METER ZERO** Place the instrument on a level surface and check that the meter reads zero on the RHEOSTAT BALANCE scale (∞ on the MΩ scales). If the pointer needs adjustment, do this by carefully turning the screw on the outside of the meter.

3 **CHECK BATTERY** Set the TEST FUNCTION switch to CHECK BATTERY, press the ON button, and make sure that the pointer reaches the white OK part of the short B scale. If the pointer only reaches the red part of the scale, the battery must be changed.

4 **INSULATION RESISTANCE** Set the TEST FUNCTION switch to the INSULATION 500 V position normally, but 95 V position should be used if there are gas discharge tubes fitted at the far end.

4.1 **Wire-to-Wire Insulation Test** (see Fig 1) Connect the A and B wires to the LINE and RETURN terminals. Switch on, and read the INSULATION RESISTANCE after the line has had time to charge, ie the meter pointer is steady.

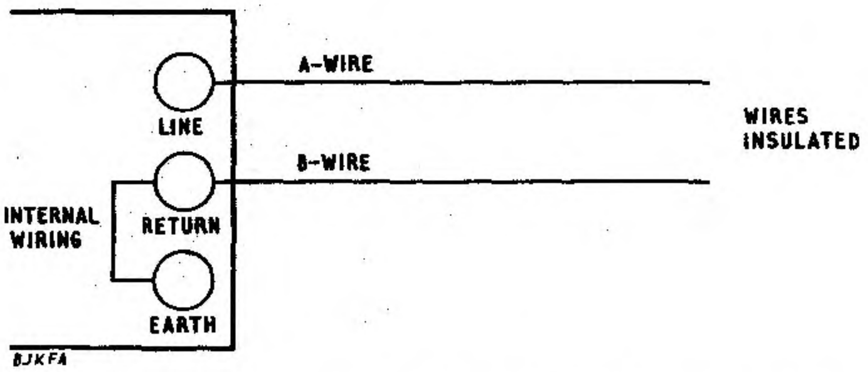

FIG 1 - INSULATION RESISTANCE BETWEEN A AND B WIRES

4.2 **Wire-to-Earth Insulation Test** (see Fig 2) Connect the A and B wires to the LINE and RETURN terminals, and the Earth terminal to earth. Test as described in para 4.1 to measure the insulation resistance of the A wire with the B wire earthed. To measure the insulation resistance to earth of the B wire, reverse the connexions to the terminals. For a single wire to earth measurement, connect the wire to the line terminal.

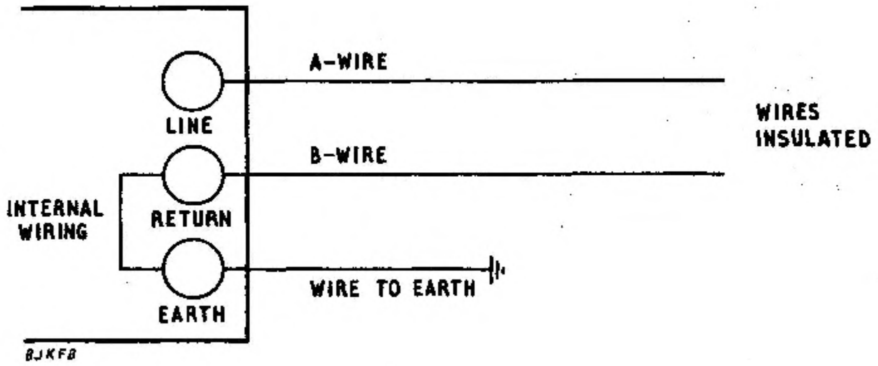

FIG 2 - INSULATION RESISTANCE OF A WIRE; B WIRE EARTHED

4.3 **Insulation Resistance Per Kilometre** To determine the insulation resistance of one Kilometre of wire, multiply the meter reading by the length in Kilometres of the wire under test.

4.4 **Bunched Wires** When measuring the insulation resistance of bunched wires, multiply the meter reading by the number of bunched wires connected to the LINE terminal, to give the insulation resistance for one wire.

NOTE:- The line is automatically discharged when the ohmmeter is switched off.

5 CONDUCTOR RESISTANCE

5.1 **Loop Resistance** (see Fig 3) Connect the looped A and B wires to the LINE and RETURN terminals. Set the TEST FUNCTION switch to the LOOP position, the RHEOSTAT VALUE switch to the LOOP ÷10 ratio position. Switch on, and adjust the rheostat until the pointer is on the RHEOSTAT BALANCE scale zero mark. The rheostat setting divided by 10 is equal to the conductor loop resistance to the nearest 0.1 ohm. Change to ratio X1 if necessary, to obtain a setting on all four dials of the rheostat when the loop resistance exceeds 999.9Ω.

When long tests leads are used, subtract their loop resistance from the total value to give the actual loop resistance of the pair.

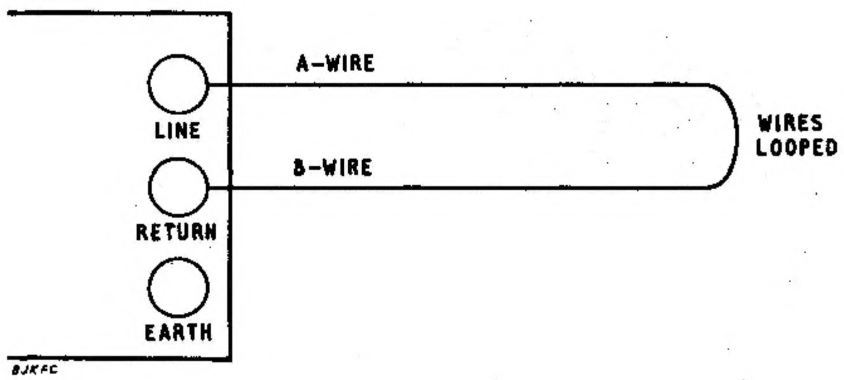

FIG 3 - LOOP RESISTANCE OF A AND B WIRES

5.2 Single wire resistance (see Fig 4) Bunch the wire to be measured and two good conductors at the far end. An earth may be used in place of one of the two good conductors provided that the wire to be measured is not faulty, ie low insulation or in contact with earth. Connect the wire to be measured to the LINE terminal, and the other two conductors to the RETURN and EARTH terminals respectively.

NOTE:- The conductor connected to the RETURN terminal should be of equal or higher resistance than the wire being measured. If this is not so, a Resistor Spool No. 9 100 OHMS may be connected in series with the RETURN wire.

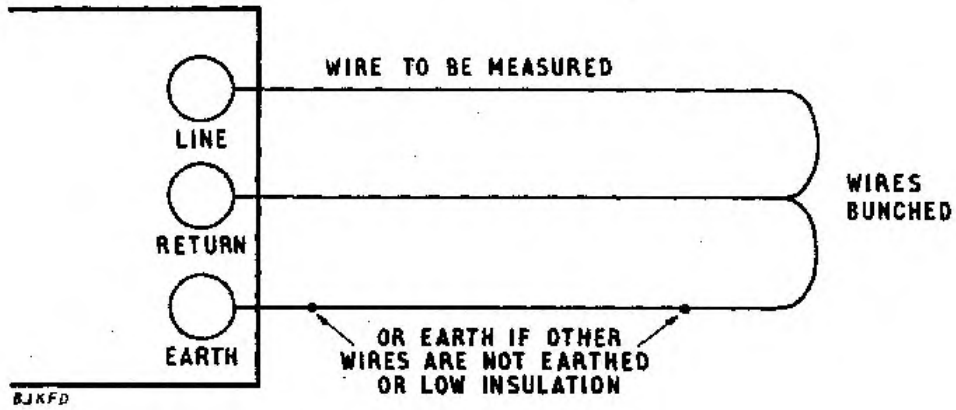

FIG 4 - SINGLE WIRE RESISTANCE (3-WIRE OR 2-WIRE AND EARTH)

Set the TEST FUNCTION switch to the EARTH AND CONTACT position, the RHEOSTAT VALUE switch to CALIBRATE. Switch on, and rotate the CALIBRATE (10 TURNS) knob for bridge balance. Set the RHEOSTAT VALUE switch to MEASURE EARTH AND CONTACT X1, and adjust the rheostat to rebalance the bridge. For a more accurate measurement switch the MEASURE EARTH AND CONTACT ÷10. At rebalance the rheostat setting is equal to the single wire resistance of the wire connected to the LINE terminal to the nearest 0.1 ohm. Check balance by repeating both tests.

6 EARTH FAULTS (see Fig 5) To locate an earth fault on a single wire, loop the faulty wire to a good wire at the far end preferably in the same cable. Ensure that the insulation resistance of the good wire is at least ten times greater than that of the faulty wire.

If all wires are low insulation, bunch ten wires together for the faulty wire, and use a single wire as the good wire.

Connect the faulty wire to the LINE terminal, the good wire to the RETURN terminal, and an earth wire to the EARTH terminal. Test as for single wire resistance (see Para 5.2). At rebalance the rheostat setting is equal to the resistance to the fault to the nearest 0.1 ohm. If 10 bunched wires are used as a faulty wire, the resistance to the fault is 10 times the measured value.

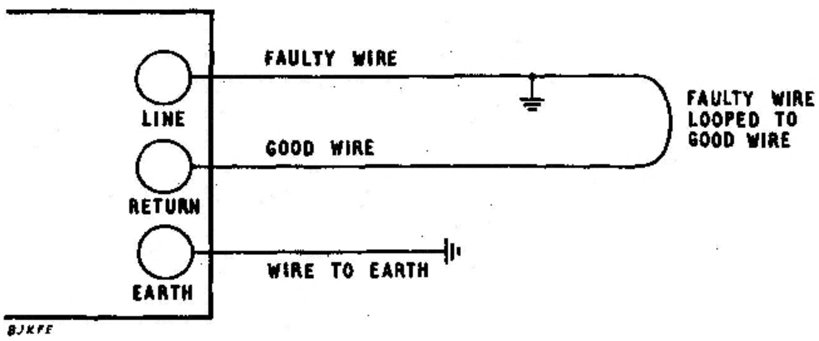

FIG 5 - EARTH FAULT

7 CONTACT FAULTS Loop one faulty wire to a good wire at the far end. Connect and test as for earth faults (see para 6) but with the other faulty wire connected to the EARTH terminal (see Fig 6).

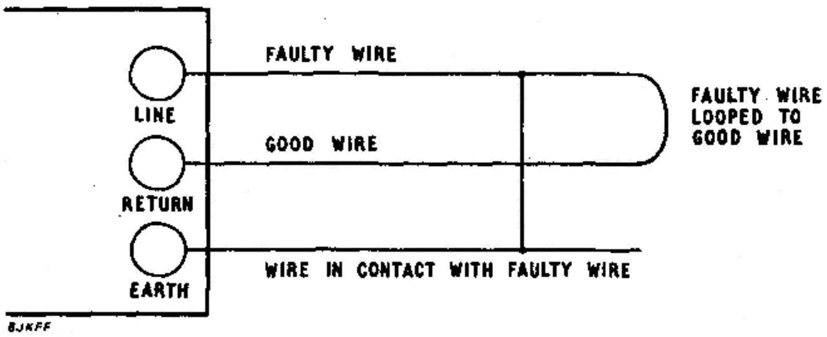

FIG 6 - CONTACT FAULT

8 SHORT CIRCUIT PAIR FAULT Connect the faulty pair to the LINE and RETURN terminals, and an earth to the EARTH terminal. At the far end connect the LINE wire to earth and leave the RETURN wire disconnected (see Fig 7). Test as for EARTH OR CONTACT fault.

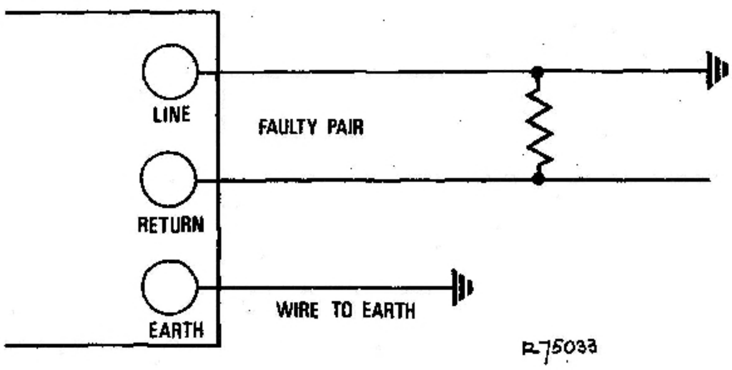

FIG 7 - SHORT CIRCUIT FAULT

9 **DISTANCE TO EARTH OR CONTACT FAULT** The distance to the fault can be estimated using information obtained from the line plant records, and the average resistance values given in TABLES 1 and 2.

TABLE 1 (COPPER)

1		2	3	4
Wire Gauge		Ohms/Km	Ohms/100 metres	Metres/Ohm
lb/mile	mm			
2½	0.32	211	21.1	4.7
4	0.4	131	13.1	7.6
6½	0.5	82	8.2	12.2
10	0.63	52.4	5.2	19.2
20	0.9	26.2	2.6	38.1

TABLE 2 (ALUMINIUM)

5	6	7	8
Wire Gauge mm	Ohms/Km	Ohms/100 metres	Metres/Ohm
0.5	140.5	14.1	7.1
0.6	97.5	9.7	10.3
0.7	72.0	7.2	13.9
0.8	55.0	5.5	18.1

The information in TABLES 1 and 2 may also be obtained from the Slide Rules Fault locating Nos. 1A and 3A respectively. The description and operating instructions for these are contained in E3 F1057.

9.1 Using single wire resistance.

9.1.1 If the faulty wire is of uniform type and gauge up to the fault, then using the appropriate table or slide rule.

Distance to fault (metres) =

Resistance to fault x metres/ohm. (metres)

9.1.2 If the length to the far end is known, and the faulty wire is of uniform gauge throughout then:- Distance to fault (metres) =

$$\left[\frac{\text{Resistance to fault}}{\text{Single wire resistance}} \times \text{Distance to far end}\right] \text{metres.}$$

9.1.3 If the faulty wire is not of uniform gauge, then the resistance of individual lengths can be calculated using the appropriate table or slide rule.

9.2 Using loop resistance If the conductor gauge is the same throughout the length of the good and faulty wires, then:- Distance to fault (metres) =

$$\frac{\text{Resistance to fault}}{\text{Loop resistance}} \times \left[\begin{array}{l}\text{length of good wire +} \\ \text{length of faulty wire}\end{array}\right] \text{(metres).}$$

10 DISCONNEXION FAULTS To locate a disconnexion fault on a pair, or on one wire of a pair:-

10.1 If a good spare exists in the cable, loop it to the faulty pair at the far end (A-A wire and B-B wire) (see Fig 8). At the near end, connect the faulty A-wire to the LINE terminal, and the good A-wire to the RETURN terminal. Bunch the two B-wires and connect them to the EARTH terminal. Set the TEST FUNCTION switch to the DISCONNEXION position, and the RHEOSTAT VALUE switch to CALIBRATE. Switch on, and rotate the CALIBRATE (10 turns) knob to bring the pointer to zero on the RHEOSTAT BALANCE scale. Now set the RHEOSTAT VALUE switch to the MEASURE (DISCONNEXION) position, and adjust rheostat to bring the pointer again to zero.

The rheostat setting is a percentage of the distance to the far end, so at minimum tone:- Distance to fault (metres) =

$$\frac{\text{RHEOSTAT setting}}{1{,}000} \times \text{(distance to far end) (metres)}$$

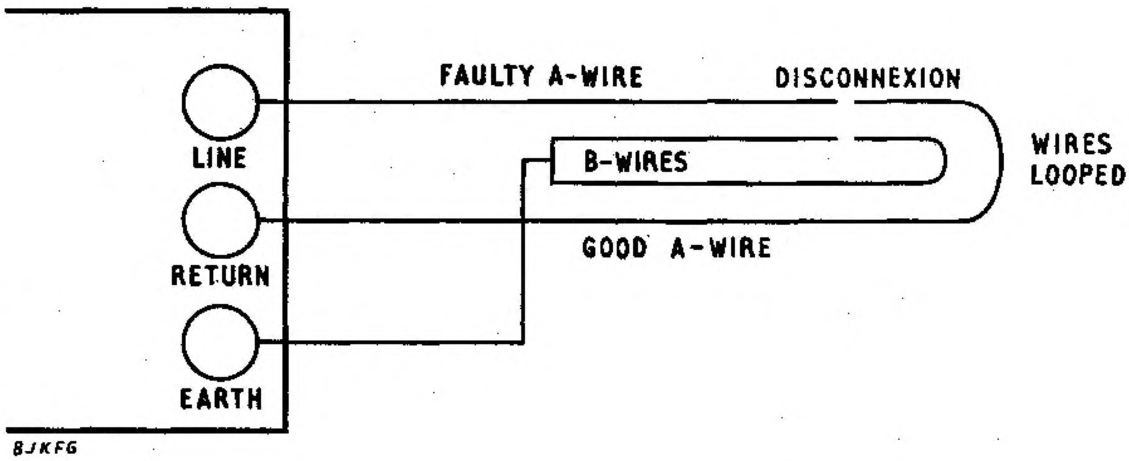

FIG 8 - DISCONNEXION ON ONE OR BOTH WIRES OF A PAIR (SPARE PAIR AVAILABLE)

10.2 If a good spare pair exists in the cable which cannot be looped to the faulty pair at the far end, connect and test as described in para 10.1 but with the far end open-circuited (see Fig 9). This test will not be so accurate as that described in para 10.1 but at zero balance:-

Fig 9 follows

Distance to fault (Metres) =

$$\frac{\text{RHEOSTAT setting}}{(2000 - \text{RHEOSTAT setting})} \times \text{(distance to far end of good pair)} \quad \text{(metres)}$$

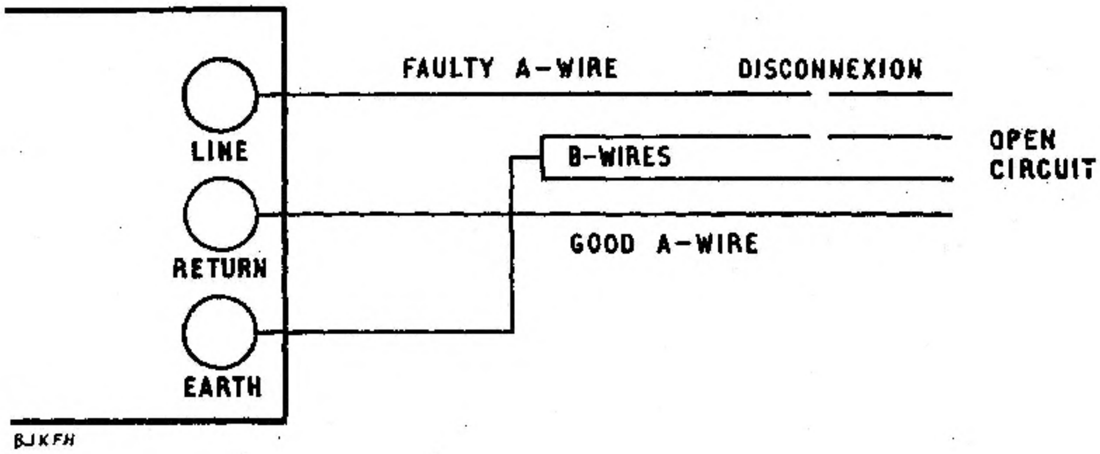

FIG 9 - DISCONNEXION ON ONE OR BOTH WIRES OF A PAIR (FAR-END OPEN-CIRCUITED)

10.3 If no spare pair exists, single wire disconnexions can be found by looping the faulty wire to a good wire at the far end (see Fig 10). At the near end, connect the faulty wire to the LINE terminal, the good wire to the RETURN terminal, and an earth wire connexion to the EARTH terminal. Test as described in para 10.1 using the same calculation for distance to fault. This test is not so accurate as that described in para 10.1 so repeat the test at the far end and determine the mid-point between the two measurements.

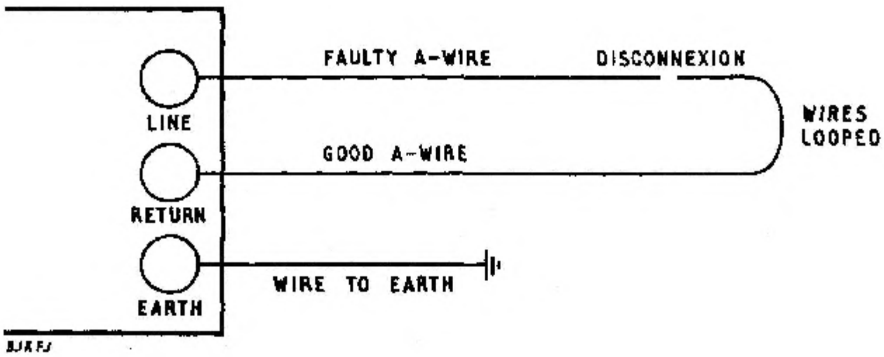

FIG 10 - DISCONNEXION ON ONE WIRE ONLY (NO SPARE PAIR AVAILABLE)

11 MAINTENANCE

11.1 To replace the battery (Battery, Dry No. 29) give the locking screws on the battery compartment a quarter of a turn each and remove the cover-plate. Lift the battery out and transfer the terminals to a new battery. Place the battery in the battery compartment and replace the cover plate.

11.2 Take care to conserve the battery when testing and switch on for as short a time as possible; just sufficient to take a reliable measurement.

11.3 Remove the battery before storing the ohmmeter for any period which may be longer than a week.

11.4 When replacing faulty apparatus use the following Vocabulary of Engineering Stores (VES) items.

11.4.1 Ohmmeter - Ohmmeter No. 18B

11.4.2 Battery - Battery, Dry, No. 29

Sv 5.1.1 END