

BELL SYSTEM PRACTICES
Outside Plant Construction
and Maintenance

SECTION G50.225.2
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AT&T Co Standard

CABLE TESTING—GENERAL

KS-14103 TEST SET

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1. GENERAL

1.01 This section replaces Issue 4. It describes the use of the KS-14103 Test Set in locating high resistance faults resulting from moisture or water entering paper insulated exchange cables, including those containing loaded pairs.

1.02 The section has been revised to call attention to the use of the KS-14103 List 4 Filter.

1.03 The KS-14103 List 4 Filter shall always be in the circuit in breaking down a fault in order to prevent transmission errors in SAGE and similar type data circuits operating on carrier pairs in the same cable in which the breakdown set is being used.

1.04 KS-14103 List 5 Test Sets now being supplied are equipped with a KS-14103 List 4 Filter. Superseded sets can be converted into equivalent List 5 sets by removing the cover to the battery compartment, replacing it with a List 4 Filter and installing a new circuit label in the cover.

1.05 The KS-14103 Test Set can be used to advantage in cases where the entire cable is out of service or where a Wheatstone bridge location can not be made.

1.06 The breakdown set is not suitable for breaking down high resistance faults in plastic insulated cables as the insulation in these cables is designed to withstand relatively high voltage.

1.07 The set is not very effective in cables having aluminum conductors as the high voltage tends to melt the wires at the fault rather than weld them as occurs in cables having copper conductors.

1.08 The description and maintenance of the set are covered in Section G86.060.2.

2. CONNECTING SET TO CONDUCTORS

2.01 The general location of the fault should be determined by analysis of the pair count affected or by Wheatstone bridge measurements. The resistance between wires including the resistance of the fault can be measured using the meter in the test set.

2.02 The breakdown set should be applied at a termination as near to the fault as practicable as determined by analysis or measurement. Before connecting the set, the central office and subscriber equipment should be isolated and also one of the following requirements shall be met:

(a) A breakdown test has been made at the frame or

(b) An observer is stationed at the form who, in the case of an "A" type frame or cable terminated on 444-type jacks, has established a talking circuit with the workman applying the voltage, or in the case of a "B" type frame, is ready to remove the B Warning Marker should a spark or smoke be observed coming from the form.

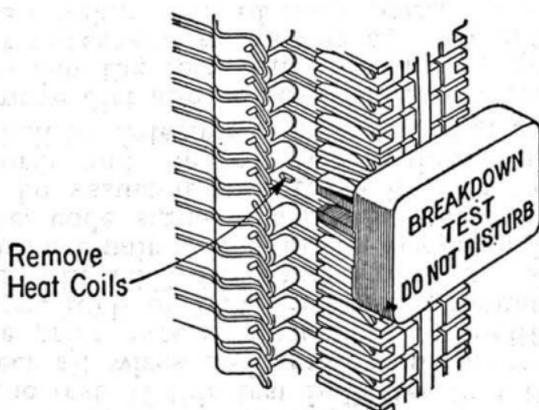
2.03 The pair or pairs having the lowest fault resistance (as a short) should be used for the test, if possible. If the fault can not be broken down using individual pairs, the sides of the two pairs having the lowest insulation resistance between them may be used.

3. PRECAUTIONS

3.01 The subscriber or subscribers on the pair or pairs involved in a breakdown test shall, if practicable, be notified before service is interrupted.

3.02 The workman making the test shall call the test deskman to determine whether any other men are working in the cable (at locations other than terminals) in the section in which the breakdown voltage will be applied. These men should be advised to suspend work in the cable and wrap the splice at their locations in the standard manner. **The breakdown voltage shall not be applied to any cable in which there are temporary openings unless the openings are tightly wrapped.** At underground locations the workmen shall be advised to stay out of the manhole while the test is under way.

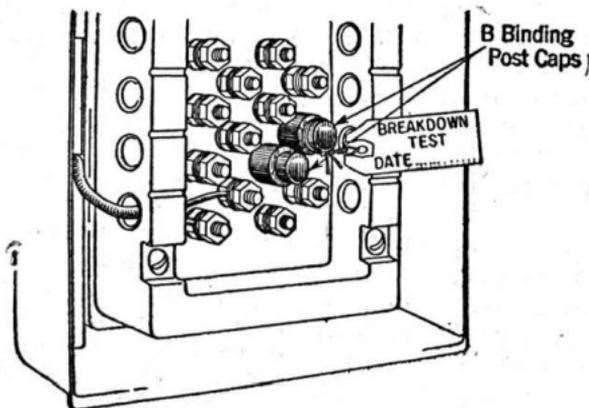
3.03 **Before a breakdown test is made** the pairs involved shall be isolated from the subscriber and central office equipment. The method of isolating subscriber equipment by lifting the drops is covered in Paragraph 3.05. Cable forms in a subscriber building shall be handled in the same manner as cable forms in central offices. The central office equipment should be isolated (a) by removing the heat coils of the pair or pairs terminated on protector mountings at "B" or similar type frames, (b) by opening the contacts using a 319C Plug on pairs terminated on 444-type jacks, (c) by lifting the jumpers of pairs terminated on terminating strips at "A" or similar type frames, or (d) by lifting the cross connections in a cross-connecting terminal. (An "A" type frame is one in which the heat coils and carbon blocks are located away from the cable form, usually on the opposite side of the frame. This is the reason for lifting the jumper.) At "B" type frames the protector blocks and heat coils of the test pair or pairs should be removed and a B Warning Marker installed, as illustrated below; at "A" frames the terminations should be protected by placing red Binding Post Caps over the lugs and tying a linen tag bearing the notation "Breakdown Test" to one of the lugs, and at 444-type jacks by tying a linen tag bearing the notation "Breakdown Test" to the plug support to warn central office personnel that a breakdown test is in progress. **Warning markers shall not be removed nor shall the pair or pairs be restored to normal until the tests are completed.**



3.04 Obtain the location of the terminals at which the pair or pairs to be tested appear.

3.05 Visit all terminal appearances of the pair or pairs and proceed as outlined below.

- (1) Make a listening test, using a capacitor in series with a talking set, across each pair on which a breakdown is to be made at each terminal in which the pair terminates. If no conversation is heard, remove the capacitor and repeat the test. If this test indicates that the pair is dead, disconnect all wires and remove all protectors associated with the pairs except those equipped with 107B or 107C Protectors. 107B or 107C Protectors should be temporarily replaced with 107D (dummy) Protectors. If the test indicates that the pair is working as evidenced by conversation, dial tone, code signals, operator answering the line, etc., it shall be assumed that there is a discrepancy between the records and the pair terminations. In that event the count shall be determined by identifying the pairs by tone.
- (2) Remove dirt and corrosion products from all terminals in which the test pair or pairs appear and rearrange wires, if necessary, to provide at least 1/4-inch clearance with the binding posts of these pairs.
- (3) Depending on the nature of the termination, at each appearance cover the tip and ring terminals of the pair or pairs and also any fuse mountings with red B Binding Post Caps or Binding Post Insulators. Then tie a linen tag on which is written "Breakdown Test" together with the date on one of the caps or insulators at each appearance, except at the location where the breakdown voltage is applied. It is important that the tag and string be so placed that they are not in contact with any binding posts in the terminals as a high resistance fault might result due to dampness at some later date. A pair so prepared and marked is illustrated below.



3.06 If a cable form is involved in the test, the breakdown voltage shall be applied as follows:

(a) **"B" Type Frames Equipped with Protector Mountings:**

Apply the breakdown voltage to the pair or pairs at the protector springs. If no breakdown is observed, the voltage may then be applied at distribution terminals. Also, if a workman is stationed at the form to observe for evidence of breakdown in the form, the voltage may be applied at distribution terminals without making a test at the form.

(b) **"B" Type Frames Equipped with 444-Type Jacks:**

Apply the voltage at the jack and if there is no evidence of breakdown in the form, the voltage may then be applied at distribution terminals.

(c) **"A" Type Frames:** Lift the jumper or jumpers and apply the voltage at the terminating strip. If no breakdown is observed in the form, the voltage may then be applied at distribution terminals.

3.07 Before the test voltage is applied to pair or pairs in a cable containing a textile form, **examine the skimmers of the form to ensure that the wires are not in contact with a terminal lug.**

3.08 A workman stationed at a protector mounting shall immediately remove the B Warning Marker in the event that a spark or smoke is observed. This will short-circuit and ground the pair, thereby indicating to the splicer that the fault has broken down and that further application of high voltage is unnecessary. The marker shall not be replaced until the splicer has been advised of the trouble. The workman at "A" type frames or 444-type jacks shall advise the tester to discontinue applying the voltage. Locate and clear the trouble in the form.

3.09 The 630V switch should be in the OFF position except when the high voltage is applied; it should not be manipulated unless the breakdown key is in the OFF position.

3.10 The tone in the KS-14103 Test Set can be used in running down the fault following the general rules and precautions for the use of the 20C Test Set.

3.11 On completion of the breakdown test the workman shall notify the test deskman or cable fault locating bureau, who will, in accordance with local routine, notify the men working in the cable that the tests have been completed.

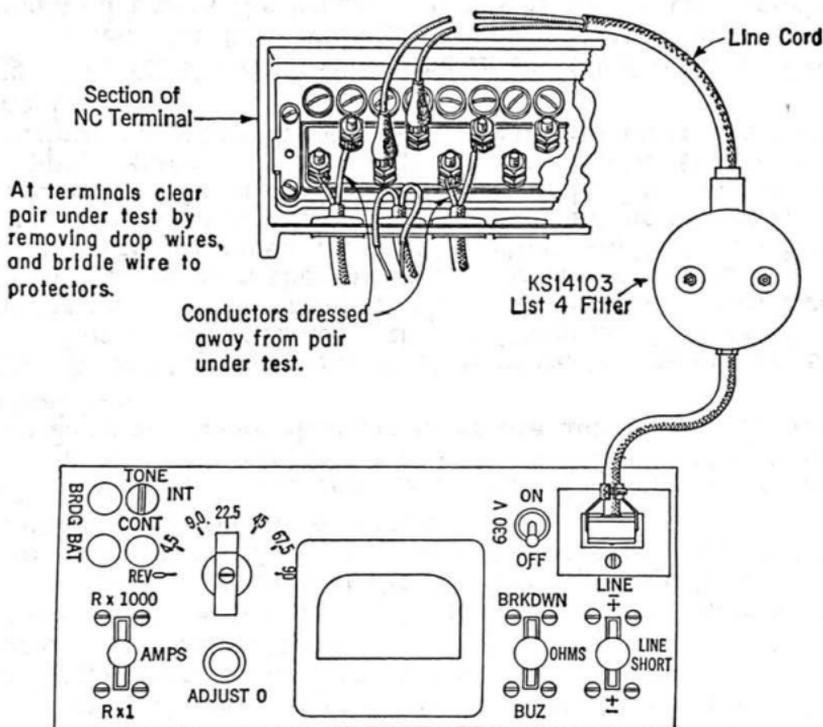
4. TESTING PROCEDURE

4.01 The use of the set is outlined below. For convenience the keys are referred to by the designation in the normal position.

4.02 The set should preferably be operated in a car or truck. If this is impracticable, place the set on a rubber blanket or B Splice Covering on the ground.

4.03 **Insert the plug of the line cord into the output jack of the filter** in the test set, short the test clips on the line cord and zero the ohmmeter.

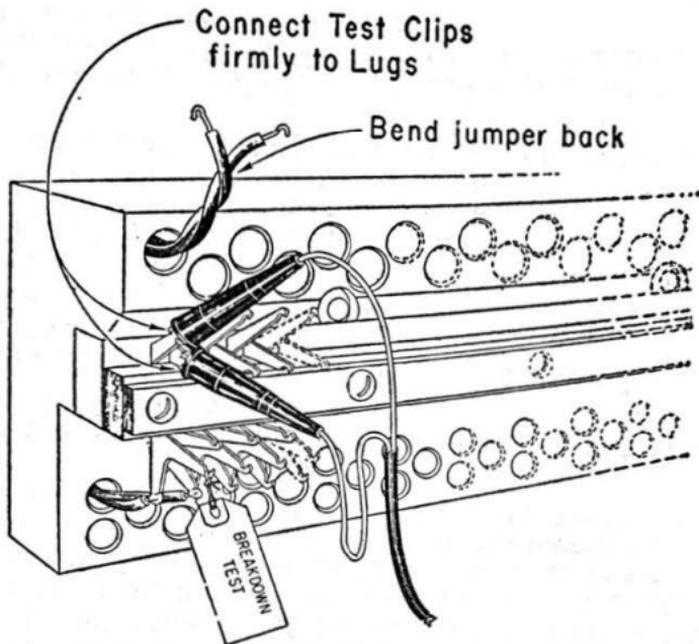
4.04 **Distribution Terminals:** Connect the test clips of the KS-14103 Test Set Line Cord to the pair or sides of the pairs under test, and measure the resistance of the fault. The method of connecting the line cord to a pair in an NC terminal is shown below.



4.05 Main and Similar Type Frames:

- At protector mountings** carefully place a test clip between each spring and carbon block. Avoid bending the springs.
- At 444-type jacks** open the contacts using a 319C Plug and then attach the test clips to the terminal lugs on the cable (left hand) side of the vertical. Make sure that each test clip is covered with its rubber insulating cap.

- (c) **At terminating strips** connect the test clips to the lugs of the strip as shown below.



4.06 Set the voltage adjustment switch (0 to 90 volts) at 22-1/2 volts. As soon as the buzzer operates after breakdown, reduce the voltage to the lowest value that will maintain the buzzer operation. This will minimize interference on adjacent circuits and will reduce the likelihood of the tone (tracing current) carrying beyond the fault. It will also minimize damage to the buzzer contacts.

4.07 Operate the 630V switch to the ON position, first making sure that the breakdown key is in the OFF position.

4.08 With the LINE SHORT key locked in the forward \pm position, apply voltage to the line by operating the OHMS key momentarily to the BRKDWN position. Then release the OHMS key and move the LINE SHORT key to the back \pm position. Again operate the OHMS key to the BRKDWN position. The OHMS key should be held each time for about 1/2 second. Longer application of the breakdown potential usually tends to clear the fault and will reduce the effectiveness of the batteries.

4.09 Continue to operate the two keys in this manner throughout the test. **Do not change the position of the LINE SHORT key or the 630V switch while the OHMS key is in the BRKDOWN position**, as the heavy current flow may damage the contacts.

4.10 When the fault breaks down, current will flow through the fault, and the meter will show a steady reading of 1 ampere or more. When this occurs, immediately throw the OHMS key to the BUZ position and reduce the buzzer voltage to the lowest value. That will operate the buzzer. Leave the LINE SHORT key in either the forward or back position.

4.11 If the buzzer operates, throw the 630V switch to the OFF position.

4.12 If the buzzer does not operate, apply the breakdown voltage again to the line to break down the fault. If the buzzer fails to operate after the fault breaks down again as indicated on the meter, set the voltage adjustment switch to 90 volts and repeat the test.

4.13 If the fault does not break down after about 25 applications of the high voltage, adjust the "0" position of the ohmmeter with the AMPS key in the $R \times 1000$ position and then check the resistance of the fault to determine whether it has increased or decreased. If the fault resistance has decreased, resume operations on the same pair. If it has increased, transfer operations to another pair after the necessary precautions have been taken.

4.14 If the operations on the second pair are not successful, try a third pair.

4.15 Sometimes the fault can be broken down by applying the voltage from another terminal.

4.16 If the fault can not be broken down by applying 630-volt potential between the wires of a pair, apply the breakdown potential between the sides of two pairs having the lowest insulation resistance, after the necessary precautions on the two pairs have been taken. If operations on these wires are not successful, try the other wires of these pairs or wires of other pairs.

4.17 As soon as the trouble breaks down, as indicated by the operation of the buzzer, check the resistance of the wires by measuring with the ohmmeter.

4.18 The approximate distance to the fault can then be calculated by multiplying the resistance (in ohms) by the feet-per-ohm value of the loop.

<u>Gauge of Cable</u>	<u>Approximate Loop Feet per Ohm</u>
19 cu. or 17 al.	60
22 cu. or 20 al.	30
24 cu. or 22 al.	20
26 cu.	12

4.19 With the buzzer operating, the exact location of the fault can be determined by running it down using an exploring coil. First listen to the tone in the cable in both directions from the set. If the tone is heard in both directions reduce the buzzer voltage until the tone is heard in only one direction. If the set is left unattended, place the cord in the slots provided for that purpose, put the cover on and suspend the set from a pole step by the folding handle provided on the set.

4.20 After the fault has been located, turn the keys to their normal position and disconnect the test set.

5. RESTORING CIRCUITS TO NORMAL

5.01 Any circuits working on the pair or pairs should be restored to service. The B Binding Post Caps and the tags should be removed at the working appearances.

5.02 At terminations where the pair or pairs are not working, the B Binding Post Caps and the linen tags may be left on. A workman visiting the terminal at a later date should remove any caps and tags used to mark pairs on which breakdown tests were made. **Workmen visiting the terminals on the date marked on the tag should not disturb the caps or tags.**