

AT&T Standard Plant Training Cours

Trainee Workbook

Unit 3

KS-14103 L-5 Breakdown Test Set

Issue 1 February 1, 1974

PTC No. 157 - Cable Repair

Module 1

Fault Locating



BREAKDOWN TEST SETS

When a request for a breakdown test is received, the RSB/MC must notify the appropriate control center for Public Services, Construction, Installation, and the Distribution Services Provisioning and Administrative Center (DSPAC), and the CLB in the event of involvement of trunk/toll cables before and after a breakdown test is made. The RSB/MC/CLB will maintain a Breakdown Control Log (Exhibit 3) indicating telephone numbers of the above control groups, date, time of test, central office, cable and complement, actual pair, technician, location, and control groups notified of the breakdown test. The log shall be reproduced locally.

NOTE: When T-Carrier pairs are involved in the same sheath of the breakdown test, the Facility Maintenance Administration Center (FMAC) should be notified, (312)930-9300.

DANGER: Sections 634-305-501 and 634-305-502 cover procedures necessary of proper and safe operation of Breakdown Test Sets. Apply breakdown tests only for locating faults in cables having paper or pulp insulated copper conductors. All personnel who use or manage the use of breakdown sets are responsible for strict adherence to the following rules:

- DO NOT ATTEMPT TO BREAK DOWN FAULTS IN CABLES HAVING PLASTIC INSULATION, i.e., PIC CABLE. Use the 710A or similar type test set to measure and localize faults.
- DO NOT MAKE BREAKDOWN TESTS IN CABLES HAVING ALUMINUM CONDUCTORS. High voltage tends to melt wires at the fault, causing an open rather than a traceable short.
- DO NOT APPLY BREAKDOWN VOLTAGE BETWEEN A CABLE CONDUCTOR AND GROUND. This procedure can place high voltage on adjacent working pairs which have low insulation resistance at the fault.
- DO NOT CONNECT TWO OR MORE BREAKDOWNS TOGETHER IN ANY MANNER TO OBTAIN HIGHER VOLTAGE OR MORE CURRENT. Violation of this rule could result in serious injury to personnel, equipment damage, and possible damage to customer equipment.
- DO NOT MAKE BREAKDOWN TESTS IN CABLES WHERE THERE ARE TEMPORARY OPENINGS UNLESS THE OPENINGS HAVE BEEN TIGHTLY WRAPPED.

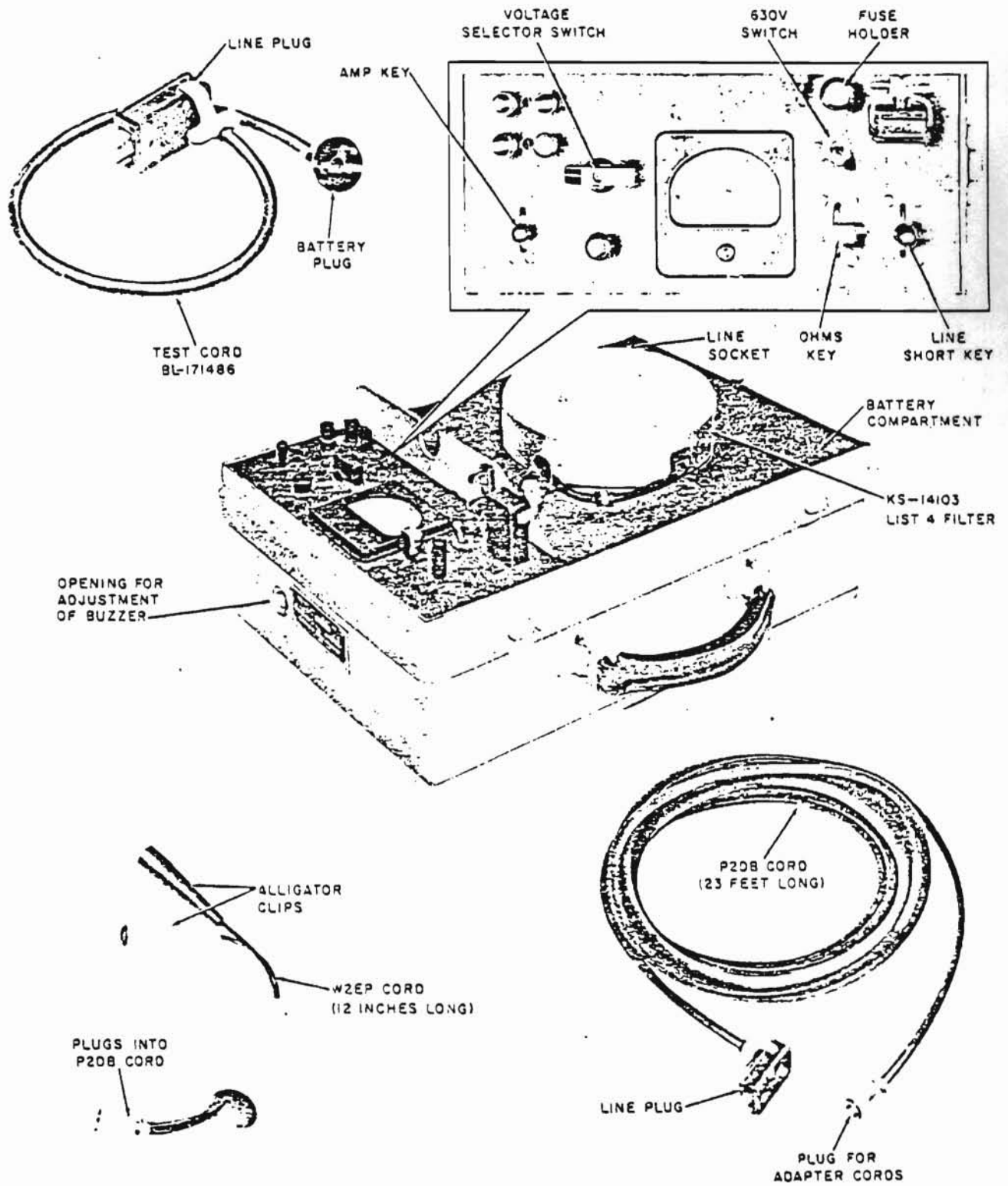
DANGER: The following precautions are necessary before making breakdown tests:

- CALL THE APPROPRIATE RSB/MC TO SECURE CLEARANCE FOR A BREAKDOWN TEST. Persons working in the cables must suspend work. Open splices must be tightly wrapped in an approved manner. In underground locations, personnel must stay out of manhole while the test is underway.

NOTE: "Tightly wrapped" means using a splice closure, CR tape, or a KS-21822 temporary splice cover used in cable vaults. All splices must be enclosed while unattended, overnight, or when using a breakdown test set, whether it is a vault splice or an outside splice location. All splice locations must be "tightly wrapped" so they are sufficiently airtight to smother an internal fire accidentally ignited when using a breakdown test set.

- DISCONNECT ALL SUBSCRIBER AND CENTRAL OFFICE EQUIPMENT FROM THE PAIRS INVOLVED.

- HAVE OBSERVER STATIONED AT MDF TO FACILITATE IMMEDIATE SUSPENSION OF BREAKDOWN TEST IF ARCING OR SMOKE OCCURS. This is required on breakdown tests from field locations involving pairs not isolated from the central office.



KS-14103, L5 TEST SET

Answer the following questions - then check your answers by restarting the tape.

1 - Why is the KS14103 test set equipped with a filter?

SUPPRESS CURRENT FROM DATA

2 - The KS14103 uses 630 volts to weld conductors.

3 - The meter is provided for -

a. Reading the Breakdown VOLTAGE through the fault.

b. Reading the RESISTANCE of the fault before and after the fault is welded.

c. Testing the BATTERIES of the test set.

4 - A diagram showing the battery connections is found where?

UNDER FILTER

Answer the following questions - then check your answers by restarting the tape.

- 1 - The AMPS key controls the meter.
- 2 - For the meter to be used to read amps this key must be in the AMPS position.
- 3 - The ADJUST 0 key is used to compensate for changes in BATT VOLTAGE.
- 4 - The LINE SHORT key is used to reverse the test set connections.
- 5 - With the amps key in the R x 1000 position the meter reading must be (multiplied, ~~divided~~) by 1000. (Cross out the incorrect answer)

1. The OHMS key has 3 positions.

Write in the correct position opposite its function.

BREAKDOWN applies 630V to faulted conductors
BZZZ applies tone to the faulted conductors
OHMS meter will measure resistance

2. For the tone to operate, the resistance of the faulted conductors must be 750 ohms or less.

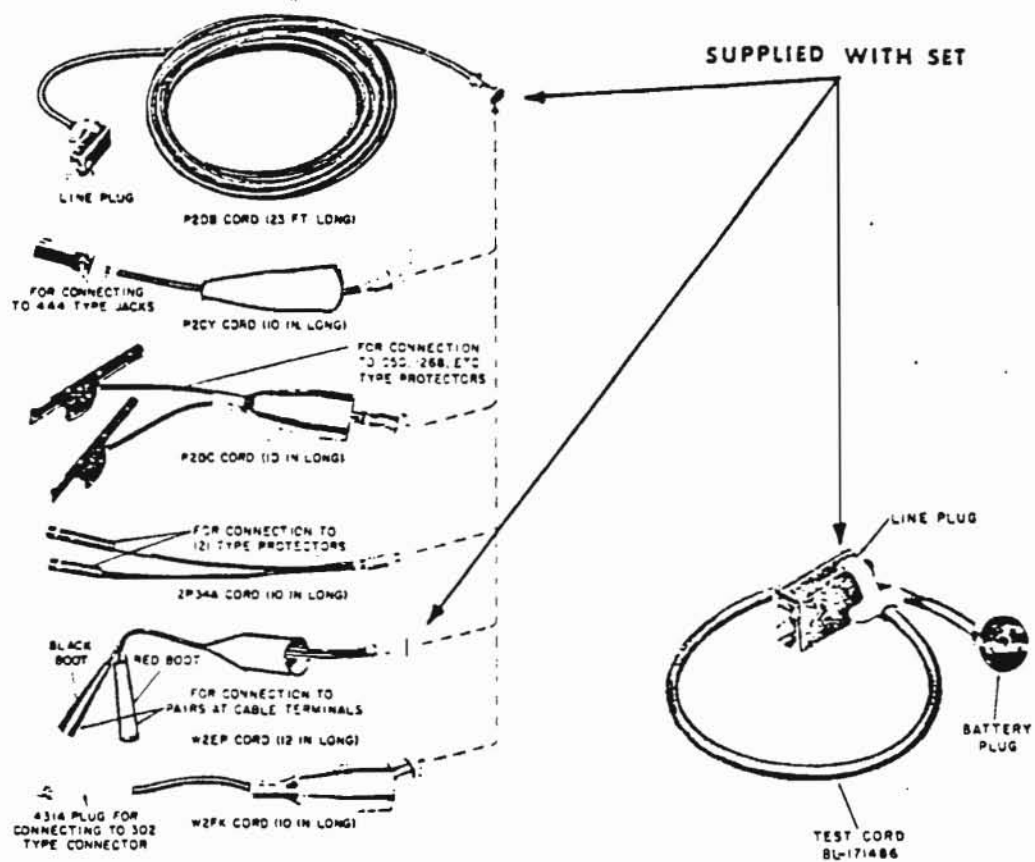
3. Check the correct answer:

When breakdown voltage is applied, the key is held operated

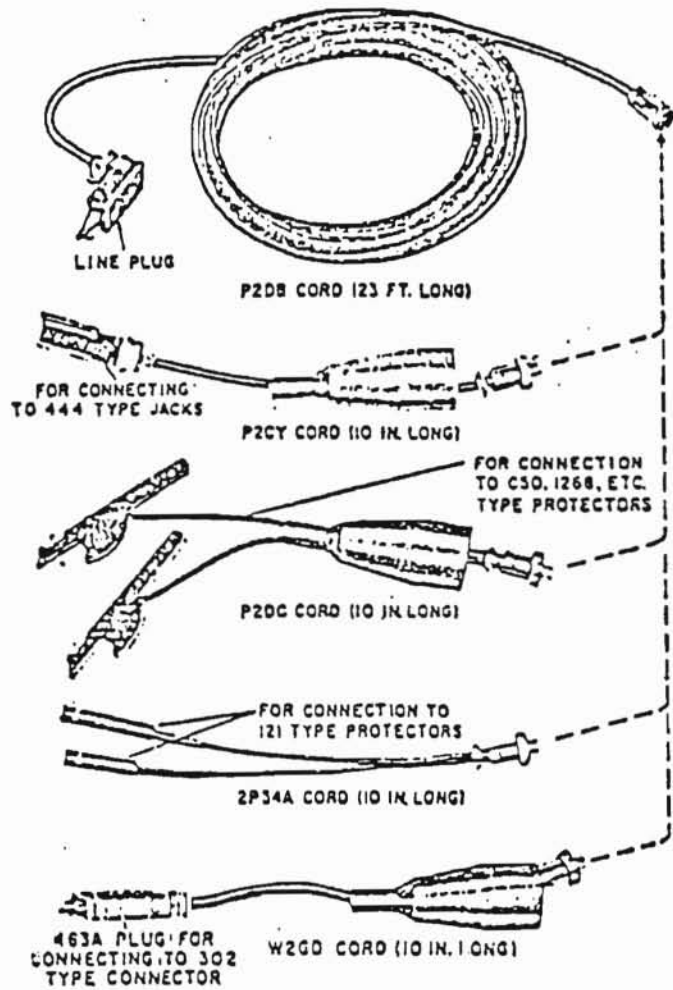
- a. for 10 seconds
b. until conductor burns in half
c. for only an instant
4. The 630 volt ON/OFF switch should only be in the ON position when breakdown voltage is actually being applied to the faulted conductors. True
or False (circle the correct answer)
5. Before the 630 volt switch is turned to the ON position, the OHMS key must be in the OHMS position.

6. The position of the LINE^{SHORT KEY} or the 630V^{ON-OFF} should not be changed while the OHMS key is operated to the breakdown position.

1. The voltage selector switch controls the voltage to the BUZZER.
2. When the voltage is increased, the volume of the tone output is INCREASED.
3. By operating the tone on too high of a voltage, two problems can occur.
They are: 1. TONE WILL SKILL OVER
2. BUZZER CAN BE DAMAGED
4. An INTERMITTENT tone is the easiest to distinguish in a noisy cable.



Cords Used With KS-14103 Test Set



Cords Used With KS-14103 L5 Test Set

The 45 volt batteries should be tested about twice a month - or whenever you think their condition is doubtful.

To do the battery test:

- 1 - Plug the P2DB and W2EP cords together.
- 2 - Plug the P2DB cord into the LINE jack.
- 3 - Short circuit the W2EP cord by connecting the clips together.
- 4 - Operate the 630V switch to the ON position.
- 5 - Operate the LINE SHORT key to either the up or down position.
- 6 - Operate the OHMS key to the BRKDWN position momentarily and observe the ampere scale of the meter.

If the meter reading is less than 2 amperes, the batteries should be replaced.

If they have been in use only a short time and there is reason to suspect that only a few of the batteries are down, they should be tested individually.

Follow the steps listed above - if you have any trouble ask the administrator for assistance.



REMEMBER TO RETURN THE 630 VOLT KEY TO THE OFF POSITION WHEN THE TEST IS COMPLETED!

Answer the following questions - then check your answers by restarting the tape.

1. The 45 volt batteries should be tested about 2 TIMES a month or whenever you think their condition is doubtful.
2. If the meter reads less than 2 amps the batteries should be replaced.
3. The 45 volt batteries provide the BREAKDOWN voltage.
4. If the 45 volt batteries have been in use only a short time and there is a reason to suspect that only a few of the batteries are weak they should be tested INDIVIDUALLY.

To test individual 45 volt batteries . . .

1. Open the battery compartment.
2. Plug in the BL 171486 test cord into the jack on the test panel.
3. Remove the battery cable plug from the battery to be tested and insert the test cord.
4. Be certain that the 630V key is in the OFF position.
5. Operate the line short key to the \bar{F} position.
6. Move the OHMS key momentarily to the BRKDOWN position and observe meter.
7. If the meter shows current flow of less than 2 amperes, the battery should be replaced.



THE 630 VOLT KEY MUST BE IN THE OFF POSITION FOR THIS TEST!

To test the two 4 1/2 volt batteries - 1st method.

1. Plug in the line cord and clip the ends together.
2. Turn the voltage selector switch to 4.5 volts.
3. Operate the OHMS key to the BUZ position.
4. Operate the line short key in either direction.
5. The buzzer should produce a steady audible tone.

Restore the line short key for a moment -

6. Turn the voltage selector switch to 9.0 volts.
7. Reoperate the line short key.
8. The buzzer should produce a steady audible tone.

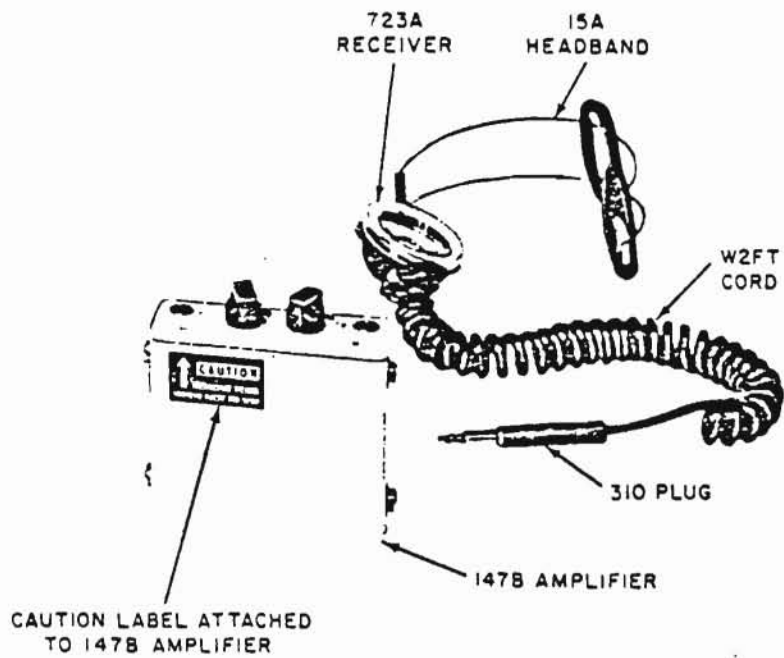
If a steady audible tone is not received in Steps 5 and 8 it indicates that the voltage of one or both of the 4 1/2 volt batteries is low and should be replaced.

After any battery replacement the steps above should be repeated.

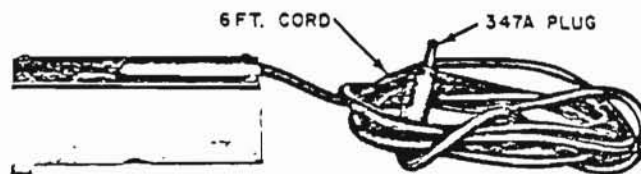
To test the 4 1/2 volt batteries - 2nd method.

Ask the administrator for a KS8455 test set or an equivalent - voltmeter - you will only need it for a short time.

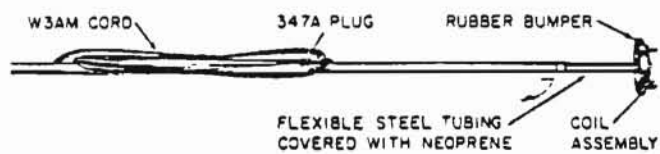
1. Connect the voltmeter across the terminals marked BRDG and BAT.
2. Short the clips of the line cord.
3. Set the voltage selector switch to 9.0 volts.
4. Operate the OHMS key to the BUZ position.
5. The reading on the voltmeter should be 6.5 volts or above. If below 6.5 volts the batteries should be replaced.



147B AMPLIFIER AND HEADSET



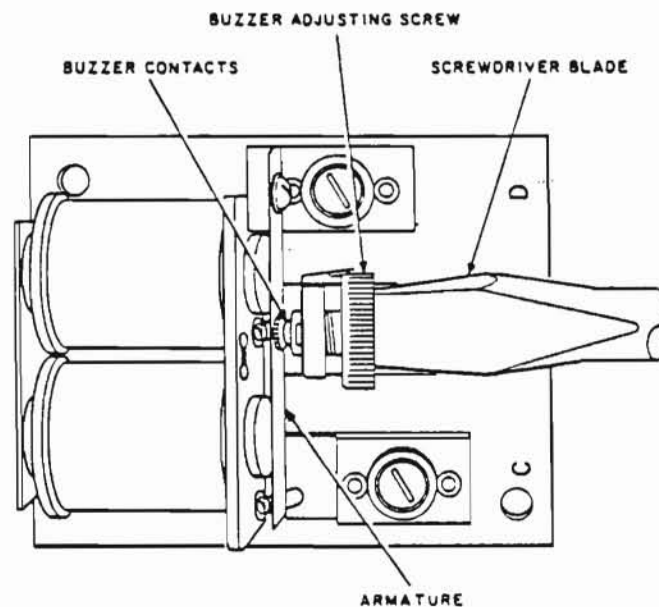
101B Test Set



105D Test Set

The buzzer adjustment steps -

- 1 - Insert line cord in test set and short the test clips.
- 2 - The KS14103 control settings are -
- 3 - Connect the hand coil and receiver to 147B amplifier.
- 4 - Position the 101B hand coil anywhere along the line cord.
 - a - Set voltage selector on 4.5 volts.
 - b - Operate the OHMS key to BUZ.
 - c - Operate the LINE SHORT key to either position.
 - d - Operate the TONE key to CONTINUOUS.
- 5 - Open the buzzer hole and insert a screw driver in slot of buzzer adjusting screw as in figure below.



KS-14485 L1 Buzzer

- 6 - Turn adjusting screw counter clockwise until tone in the receiver stops.
- 7 - Turn screw clockwise until tone is heard again.
- 8 - Keep turning screw until maximum tone is heard.

9 - If tone begins to fall off again turn in opposite direction until maximum tone is heard.

Note: Do not force the adjusting screw. It is made of brass and the threads can be stripped easily.

Answer the following questions, then check your answers by restarting the tape.

1 - The three basic uses of the Breakdown Set are:

1 - Break down high RES FALT

2 - TRACE TONE

3 - RES MEASURE

2 - There are two limitation of the Breakdown Set.

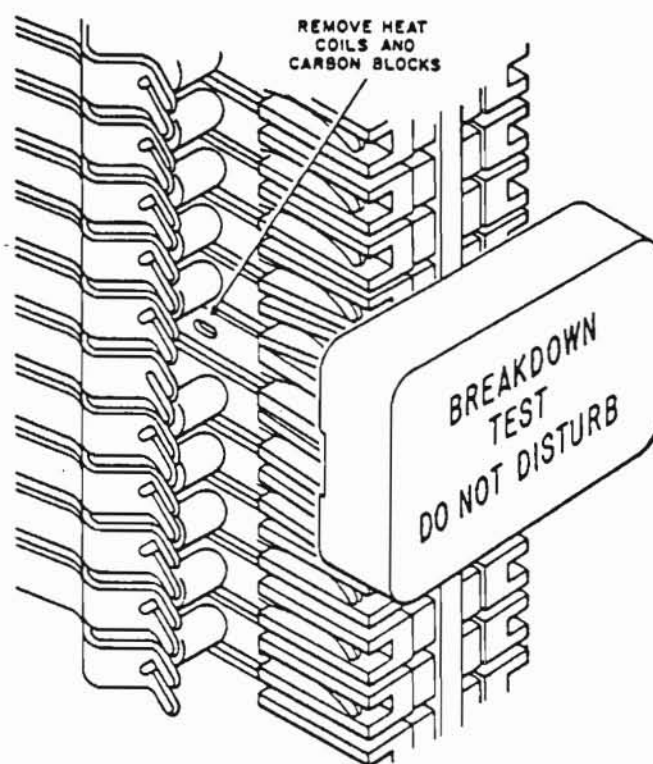
1 - ALUMINUM

- Why - CAUSES OPEN

2 - PLASTIC INSAL

- Why - WONT BREAKDOWN

On frames with this type protector. (B type frame)

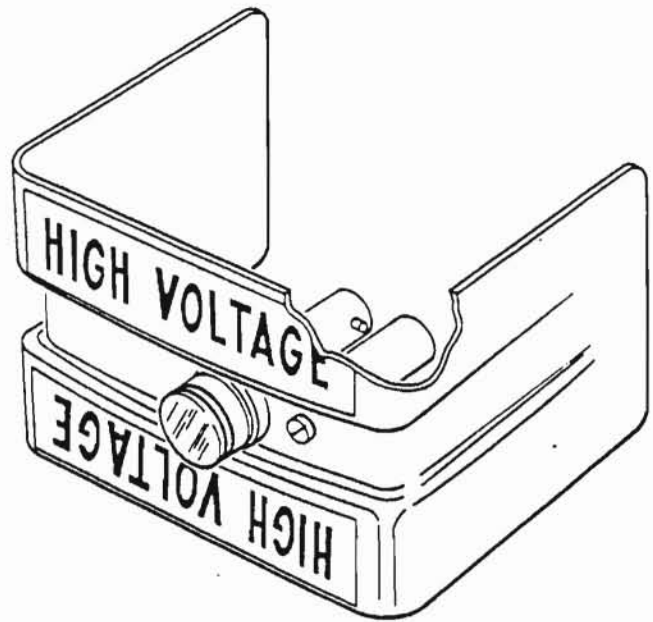


B Warning Marker

Note: If this type warning marker is pulled out both sides of the pair are grounded.

On frames using the 300 type connector this is the warning marker used.

First, both twist caps containing the heat coils and protector blocks are removed.

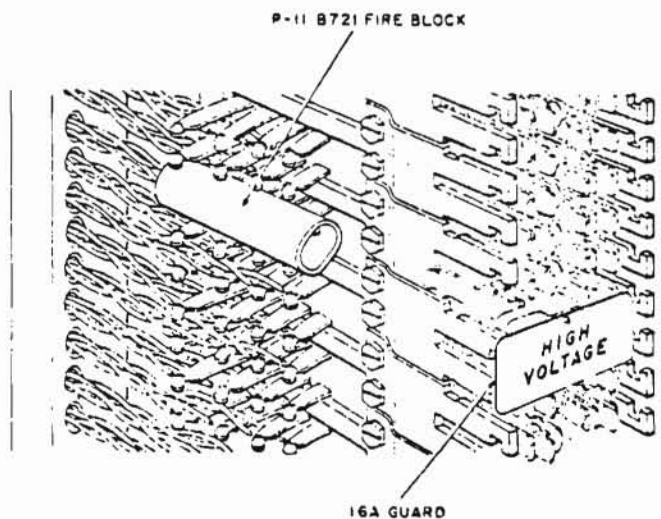


C Warning Marker

This is required on frames having the 444 type jack.

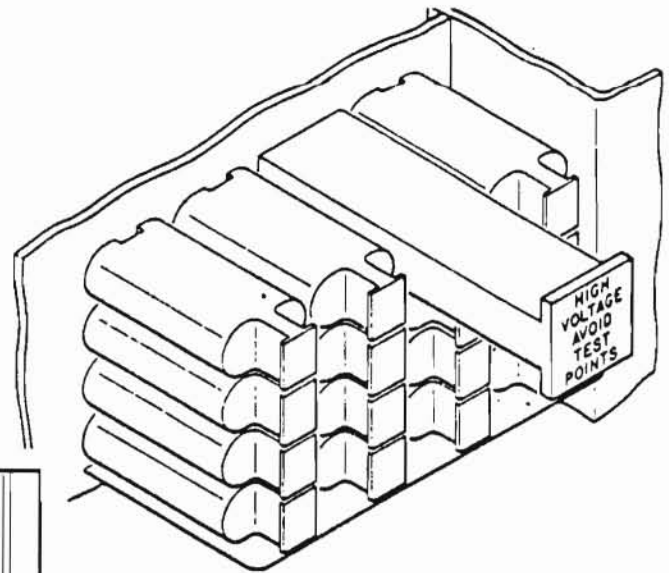
The 16A guard opens the contacts of the pair as it is inserted.

Note also the placing of the fire block - It has a slot to permit sliding over the lugs and skimmers.

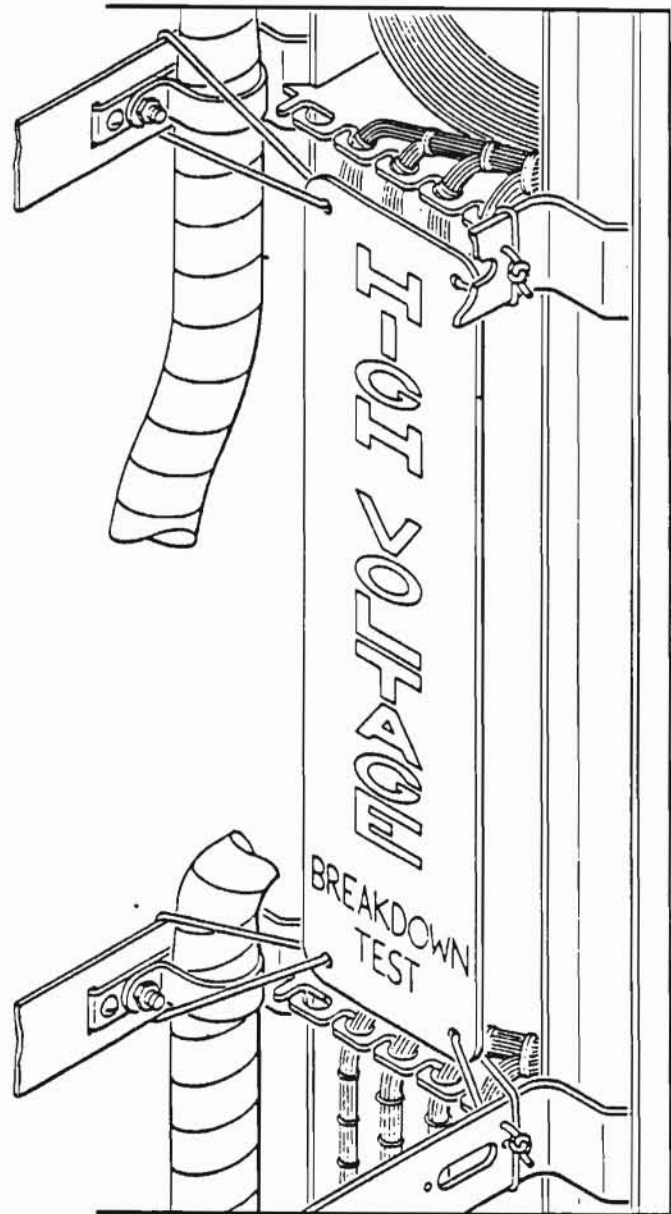


Protecting B-Type Frames and 444-Type Jacks

On frames using the 302 type connector the protector unit is removed and the D warning device inserted in its place.



D Warning Marker Installed on 302-Type Connector



E Warning Sign Installed on Back Side of 302-Type Connector



This is also required.



The E Warning Sign has cords for tying in place on the rear of the 302 type connector.



All of these warning devices are used in the Central Office and are not removed until the breakdown tests are completed.

Answer the following questions, then check your answers by restarting the tape.

- 1 - Breakdown voltage shall never be applied between a faulted conductor and GRND.
- 2 - Breakdown voltage shall not be applied to pairs equipped with special devices like lattice build-out networks.

True or False

- 3 - The filter is only required while applying tone to a faulted conductor.

True or False

- 4 - Before a breakdown test is made the pair or pairs involved shall be isolated from the CO and the SUBSCRIBER.
- 5 - The breakdown voltage shall not be applied to any cable in which there are temporary openings unless the openings are RAPEO and BONDED.
- 6 - The set should be operated in a car or truck. If this is impractical, what other methods can be used to insulate the set?

RUBBER BLANKET

- 7 - Workmen visiting terminals on the date marked on the tag shall not disturb caps or tags placed as a warning of a breakdown test.

True or False

- 8 - At underground locations workmen shall be advised to STAY OUT
OF MANHOLES

(Complete the sentence)

In accordance with local routine, get the location of each point where the pair appears.

Visit all distribution and cross-connecting terminal appearances of the pair and proceed as follows:

- 1 - Make a listening test of the pair.
- 2 - If this test indicates the pair is dead, disconnect all wires or cross-connections.
- 3 - If test indicates pair working - talking, dial tone, etc.

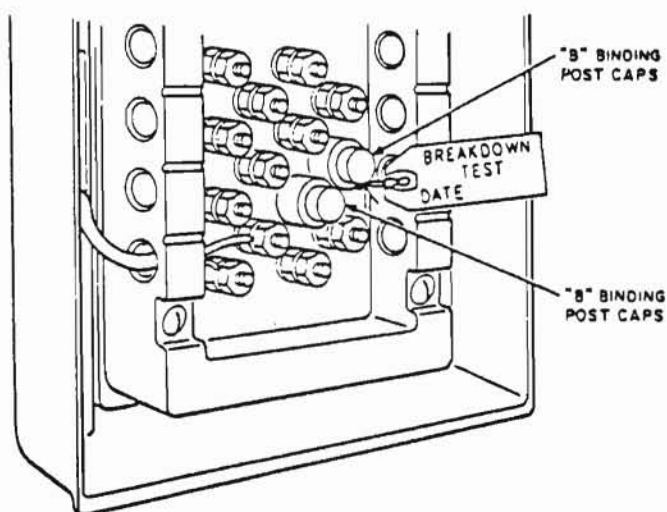
Assume that there is a discrepancy between cable records and the pair termination.

Identify pair with tone if necessary.

- 4 - Remove dirt and corrosion from terminals where faulted pair appears.
- 5 - Dress all wires to give 1/4 inch clearance for binding posts of faulted pair.
- 6 - At any terminal, so equipped, remove carbon protection.
- 7 - At each appearance, cover the tip and ring terminals with RED BINDING POST CAPS or insulators.

Then tie a linen tag, on one of the caps, on which is written BREAKDOWN TEST and the date.

Place tag so string does not touch any binding post in the terminal.



F-Type Terminal Correctly Protected

Making breakdown - first connect the test set to the pair involved in the test - then:

1. Operate the OHMS key to the OHMS position.
2. Operate the 630V key to the ON position.
3. Operate the LINE SHORT key to the forward position +.
4. Momentarily operate OHMS key to BRKDWN position - REMEMBER - hold this key operated for only 1/2 second.

If necessary

5. Operate the LINE SHORT key to the back position I.
6. Again momentarily operate the OHMS key to BRKDWN position (about 1/2 second).
7. Repeat 3-4 and 5-6 above until a reading on the meter is obtained.

When the fault breaks down the meter will show a reading of 1 amp or more.

Answer the following questions - then check your answers by restarting the tape.

1. When a pair breaks down, you will get a reading of 1 amp(s) or more on the meter.

2. You have repeatedly applied breakdown to a pair with the LINE SHORT key in both the forward and back positions and the pair does not breakdown - what should you do? TRY ANOTHER PAIR

3. In applying the breakdown to the sides of two pairs, the meter gives an indication of breakdown but the buzzer does not operate - should you apply breakdown until the buzzer does run? NO

4. What should you do next? TEST FOR BATT & GND

Move your test set into a comfortable working position and set the keys and switches to read resistance.

<u>Key or Switch</u>	<u>Position</u>
OHMS KEY	OHMS
630V SWITCH	OFF
LINE SHORT KEY	\pm or \mp
AMPS KEY	R x 1 or R x 1000

Now "zero" the meter -

Plug the P2DB (the long cord) and the W2EP (the short cord with alligator clips) together.

Insert the plug of the P2DB into the line jack of the test set.
Short the test clips of the W2EP cord.

Operate the AMPS key to R x 1

Turn the ADJUST 0 knob until the meter pointer is on zero.

Now you are ready to try some resistance readings for this first measurement operate the AMPS key to the R x 1000 position.

In the practice terminal in your carrel, connect your test clips to BP24 of terminal B.

Answer the following questions, then use your breakdown set to identify the faults on the pairs listed.

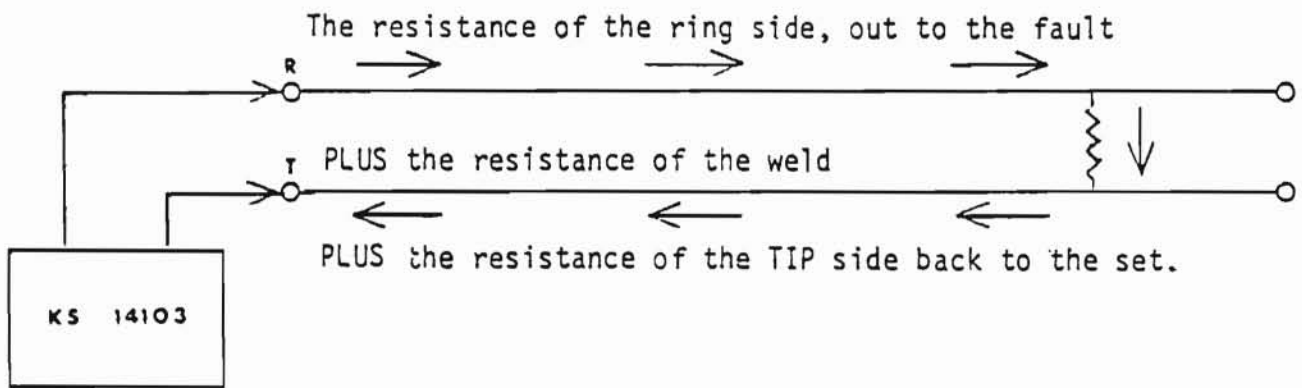
1. To read resistance on your breakdown set the AMPS KEY should be in the R x 1 or the R x 1000 position.
2. To read resistance on your breakdown set the LINE SHORT KEY can be in either the F or the BACK position.
3. To read resistance on your breakdown set, the 630V key must be in the OFF position.
4. To read resistance on your breakdown set the OHMS KEY should be in the OHMS position.
5. Before reading resistance you should first ZERO the meter.
6. The ADJUST 0 knob is used to do number 5 above.
7. When the AMPS KEY is in the R x 1 position the scale of the meter is from 0 to 2,000 ohms.
8. When the AMPS KEY is in the R x 1000 position the scale of the meter is from 0 to 2 MILLION ohms.

Identify the fault and measure its resistance on the following binding posts, then restart the tape to check your answers. Use Terminal B.

<u>Binding Post</u>	<u>Trouble Condition</u>
6 -	2000 OHM
10 -	15000 OHM
25 -	600 OHM

SHORT

The actual distance to the fault usually will be less than the calculated distance, because the measured resistance includes the resistance of the fault. This resistance depends on the quality of the weld made with the breakdown voltage.



This chart is part of the circuit label inside the lid of your Breakdown set. Look at the lid of your set and compare the chart with the one below.

Wire Resistance Table 68° F		
Gauge	Approx. ft. per Ohm	Approx. Ohms per 1000 ft.
19	125	8
22	62	16
24	40	26
26	25	42

The test set reads 120 ohms for entire loop resistance.

Cable gauge is 22 and this has a resistance of 62 feet per ohm.

So . . . $120 \text{ ohms} \div 2 = 60 \text{ ohms to fault.}$

$60 \text{ ohms} \times 62 \text{ feet per ohm} = 3,720 \text{ feet to fault.}$

Calculate the approximate distance to the fault in the following example:

1. Loop resistance - 60 ohms

Gauge - 26

Approximate distance to fault 750'

2. Loop resistance - 90 ohms

Gauge - 22

Approximate distance to fault 2790'

3. Loop resistance - 100 ohms

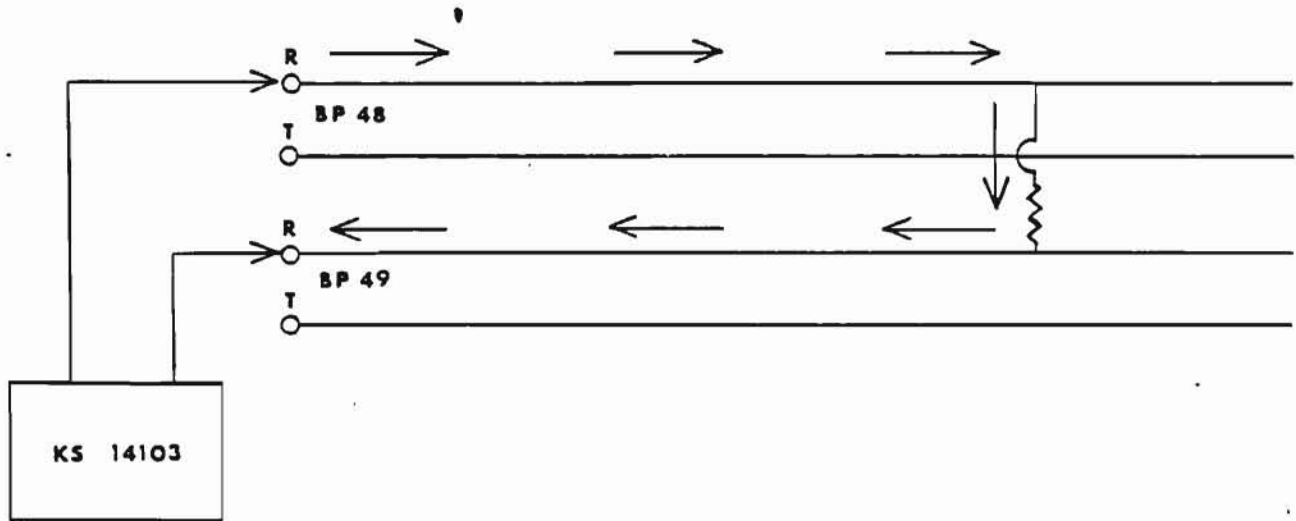
Gauge - 24

Approximate distance to fault 2000'

4. Loop resistance - 26 ohms

Gauge - 19

Approximate distance to fault 1625'

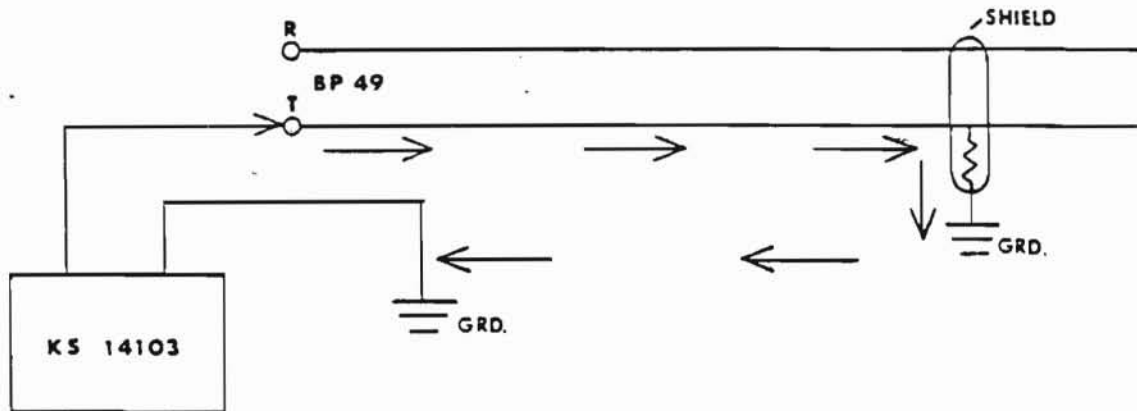


Crossed Conductors

1. Verify Fault
2. Apply Tone
3. Listen with amplifier and coil at mark on the cable



When the exploring coil is passed over the fault the tone volume will decrease. The tone volume will be greatest before the fault location is reached and then will disappear or noticeably decrease after the fault is passed.

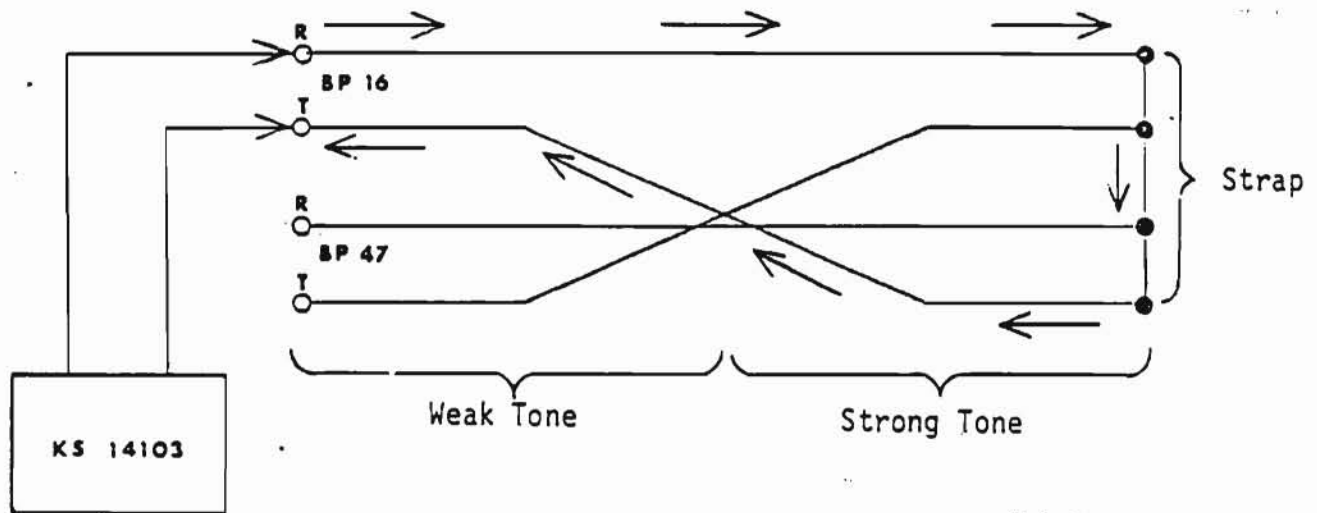


Ground

1. Verify Fault
2. Apply Tone
3. Listen for tone change at listening area.



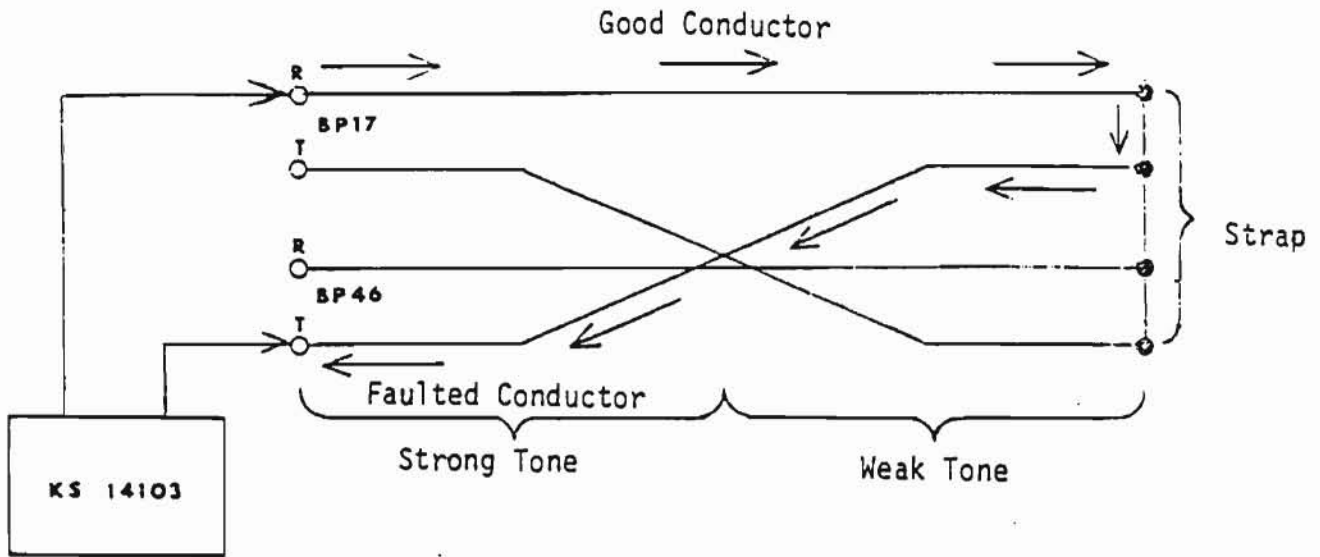
1. NEVER APPLY BREAKDOWN VOLTAGE BETWEEN A CONDUCTOR AND GROUND.
2. When adjusting the tone output, use the lowest volume to eliminate any spill over or carry by of the tone past the fault.



Split

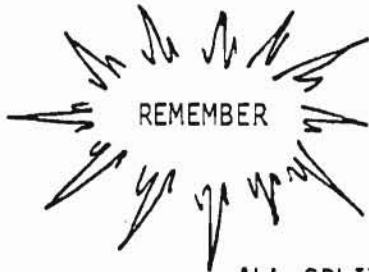
1. Place strap on all conductors.
2. Apply Tone.
3. Listen for tone at listening area.

Note: The tone change at the location of a split will not be as great as it is with a short or a cross . . . but there will be a definite tone difference at the fault.

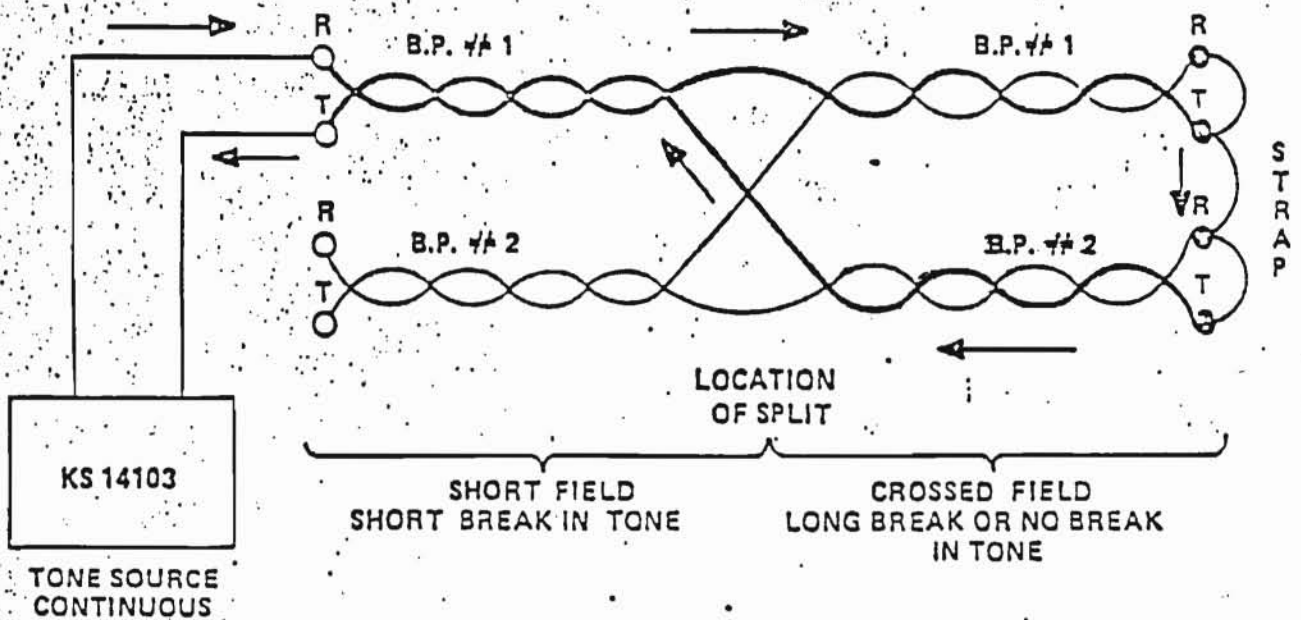


Split

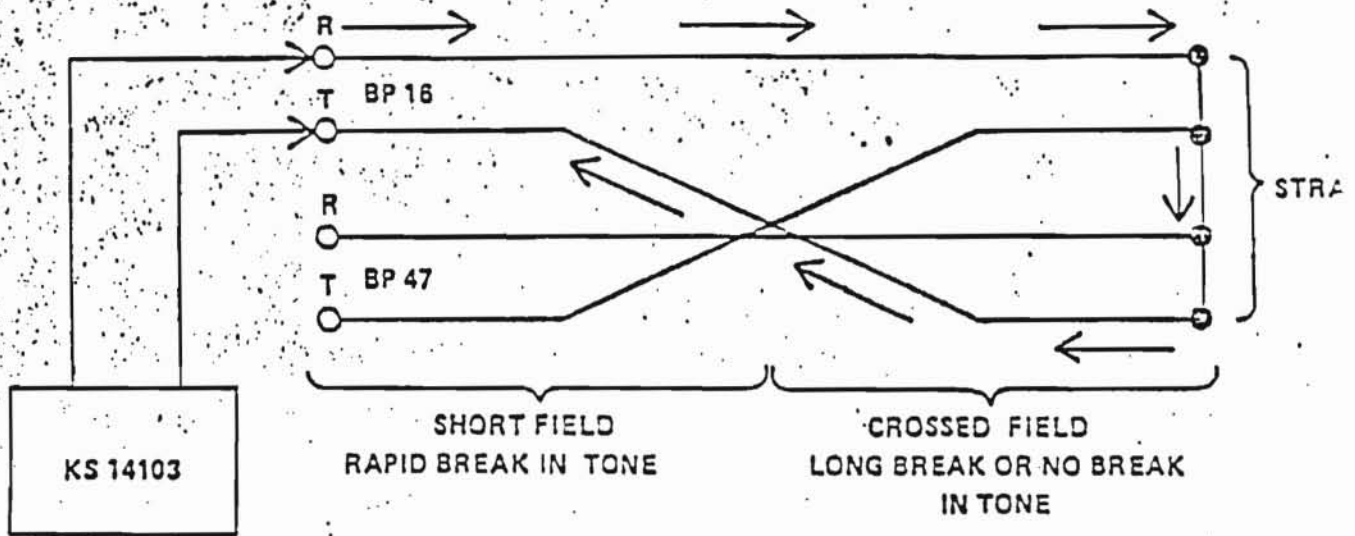
1. Place strap on all conductors
2. Apply tone to good conductor of one pair, and faulted conductor of other pair.
3. Listen for tone at listening area.
4. THIS TIME, LOUD TONE BEFORE FAULT, REDUCED VOLUME BEYOND FAULT.



ALL SPLIT PAIR FAULTS ARE MAN MADE AND THEY WILL BE LOCATED AT SOME POINT WHERE A WORK OPERATION HAS BEEN PERFORMED.



NOTE: FROM THE KS 14103 TO THE FAULT THE TONE IS TRAVELING ON A PAIR OF WIRES. AS ONE WIRE OF THE PAIR CROSSES THE OTHER WIRE OF THE PAIR IT CREATES A BREAK IN THE CONTINUOUS TONE (SHORT FIELD). AFTER THE FAULT IS PASSED THE TONE IS TRAVELING ON TWO WIRES FROM DIFFERENT PAIRS. THE WRAP OF THE CABLE CORE WILL DETERMINE THE LENGTH OF THE BREAK. (CROSSED FIELD).

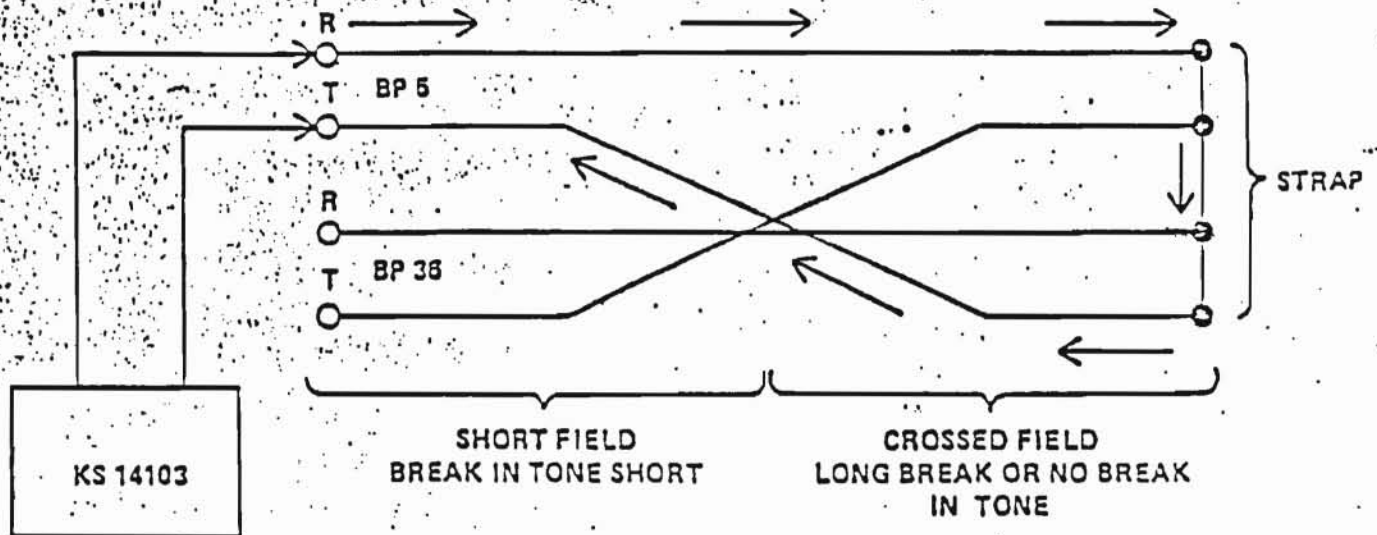


SPLIT

1. PLACE STRAP ON ALL CONDUCTORS
2. APPLY CONTINUOUS TONE
3. LISTEN FOR CHANGE IN TONE AT LISTENING AREA.



HOLD THE 105 D EXPLORING COIL VERTICAL TO CABLE AND MOVE IT RAPIDLY ON THE CABLE.



SPLIT

1. PLACE STRAP ON ALL CONDUCTORS
2. APPLY CONTINUOUS TONE
3. LISTEN FOR TONE AT LISTENING AREA
4. LOCATE FAULT AND REPORT THE LOCATION TO YOUR ADMINISTRATOR ON EXHIBIT "A" FORM.

NOTE: MOVE THE 105D EXPLORING COIL RAPIDLY ON THE CABLE ON BOTH SIDES OF SPLICES. DO NOT USE THE EXPLORING COIL ON A SLEEVE OR CLOSURE.

Unit Test

1. The KS14103 test set can be used to breakdown a fault in cables having
_____ a. Paper insulation
_____ b. Pulp insulation
_____ c. Plastic insulation

(Check any correct statement)
2. The KS14103 can only be used to breakdown a fault in cables with _____ conductors.
3. When testing the 4 1/2 volt, the buzzer must produce a _____ audible tone or the batteries should be replaced.
4. Breakdown voltage must never be applied between a faulted pair and _____.
5. The _____ must always be connected in the test set circuit when applying breakdown voltage.
6. Before applying breakdown voltage, the pair under test must be isolated at the _____ and the _____.
7. All appearances of the pair, that is to be broken down, should be _____ and _____.
8. Before making resistance measurements the meter must be _____.
9. For the tone to operate, the resistance of the faulted pair must be _____ ohms or less.
10. Breakdown voltage shall only be applied _____ (how long).
11. An intermittent tone is easier to distinguish in a _____ cable.
12. When testing the 45 volt batteries, if the meter reads less than _____ amps the battery should be replaced.
13. When a pair breaks down you will get a meter reading of _____ amps or more.

Unit Test

Your final test also consists of locating a group of faults. These will be of the type you have been studying in this unit.

The binding post number is listed below. Use the KS 8455 and verify each type fault, apply tone and locate each fault. PLEASE DO NOT APPLY BREAKDOWN VOLTAGE.

When you have finished, remove the unit test from your workbook and give it to the administrator for checking. When he returns your test paper, you will recheck anything you missed.

Binding Post	Type Fault	Location
1 6	Short - LAST TERM Tip and Ring Ground	
9	Short Circuit	<u>SPLICE B-4</u>
14 & 15	T-14 & R-15 Crossed	<u>SPLICE B4</u>
21	Ring Ground	<u>3RD SPLICE</u>
23	Short Circuit	<u>4TH SPLICE</u>
10 & 30	Tips Split	<u>3RD SPLICE</u>

-50-

Be sure you remove any straps you have placed.

After you have rechecked anything you missed, rewind the tape, then return the test set, the cassette tape and all apparatus to the administrator.

(Leave the player and earphones for use in your next unit.)