

APPENDIX A  
NOISE INVESTIGATION GUIDE

1. GENERAL

1.1 This revision presents a step-by-step flow chart for noise investigations for use of craftspeople in the field. It is organized so that each page provides a single link in the total investigation which directs the user to the next link in the investigation.

1.2 It is essential that the results of all measurements be recorded for reference as the investigation progresses.

1.3 Figures and Tables are referred to as appropriate in the flow charts.

2. HOW TO USE THE GUIDE

2.1 The first measurements should be completed at the subscriber location. To reduce travel time the measurements shown below are best completed during this first visit of the investigation to the subscriber location.

2.1.1 If loop checking equipment is being used complete measurements covered by Charts 1, 2, 3, 4 & 7.

2.1.2 If a noise measuring set is used complete measurements covered by Charts 1, 2, 3, 4, 7 & 14.

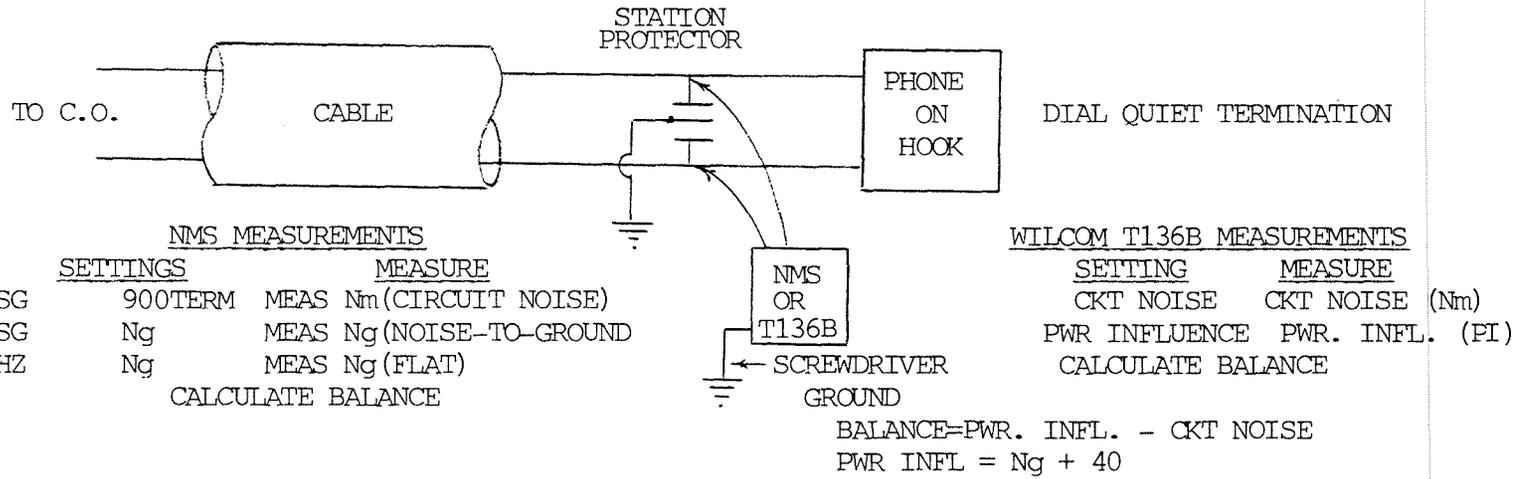
2.1.3 When a noise measuring set and spectrum analyzer is available complete measurements covered by Charts 1, 2, 3, 4, 7, 9, 14 & 17.

2.2 Start analyzing the recorded results at Chart 1. Then proceed to the Chart indicated below the appropriate level for the next step.

2.3 An \* on the Chart indicates a measurement which may be completed with loop checking equipment.

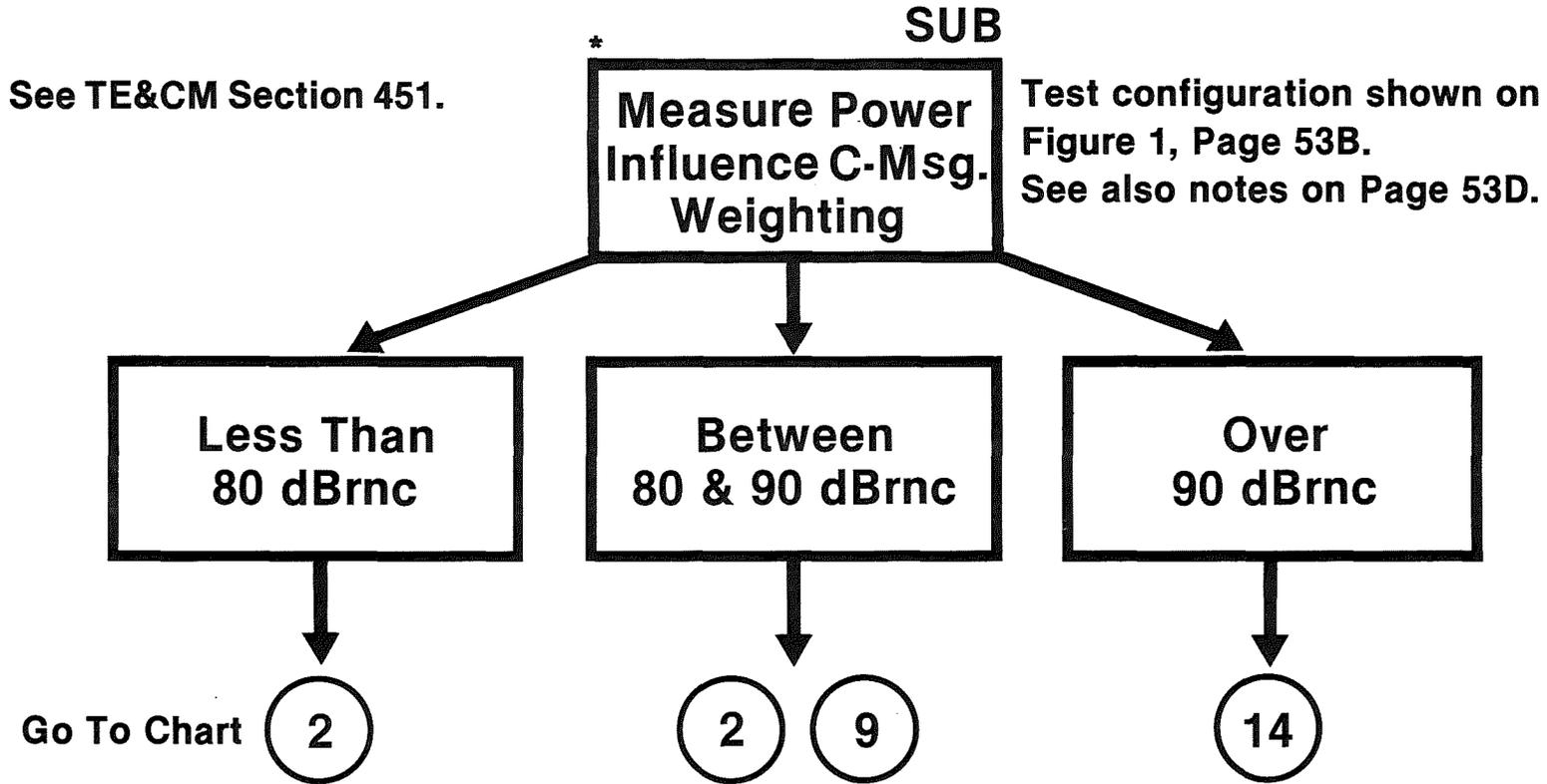
3. TEST EQUIPMENT

3.1 The use of specific types of specialized test equipment manufactured by Wilcom Products, Inc. are described in the Noise Investigation Guide. These items are generally used throughout the Telecommunications industry and in some cases are, to the best of our knowledge, the only ones specifically designed for these applications. This is not an endorsement of these products by REA. Any test equipment capable of performing the measurements described may be used in lieu of those identified herein.



NOISE MEASUREMENT SUBSCRIBER LOCATION  
FIGURE 1

-53C-



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\*Measurements may be completed with Loop Checking equipment.

SAVE A TRIP

While at the subscriber location don't forget housekeeping of protector.

Check:

Station protectors: Kill insects and destroy eggs. Remove webs and nests.

Note evidence of corrosion and clean.

Gas Tubes: Inspect. Replace damaged or \*defective tubes.

Carbon Blocks: Inspect. Clean or replace dirty blocks. Replace damaged or defective carbon blocks.

Station Fuses: Inspect for corrosion. Clean fuse holder contacts. Replace both fuses with units known to be good.

\*Identification of defective requires use of a gas tube checker.

-53B-

See REA TE&CM Section 451.

SUB

\*  
Measure  
Balance  
PI - CN = BAL

Test configuration shown on  
Figure 1, Page 53B.

Greater Than  
60 dB

Between  
50 & 60 dB

Less Than  
50 dB

Go To Chart **3**

**4** **5**

**5**

\*Measurements may be completed with Loop Checking equipment.

TABLE I  
INVERSE POWER SUMMATION

FIND DIFFERENCE, IN DBRNC, BETWEEN MEASUREMENT 1 & 3 (Nm) OF FIGURE 2 IN COLUMN A. ALGEBRAICALLY ADD THE VALUE FOUND IN COLUMN B FOR THIS DIFFERENCE TO RECORDED RESULTS OF MEASUREMENT 3 TO FIND NOISE DUE TO CONNECTOR BALANCE.

A	B	A	B	A	B	A	B	A	B
0.5	-9.1	3.5	0.9	6.5	5.4	9.5	9.0	12.5	12.2
1.0	-5.9	4.0	1.8	7.0	6.0	10.0	9.5	13.0	12.8
1.5	-3.8	4.5	2.6	7.5	6.6	10.5	10.1	13.5	13.3
2.0	-2.3	5.0	3.3	8.0	7.3	11.0	10.6	14.0	13.8
2.5	-1.1	5.5	4.1	8.5	7.8	11.5	11.2	14.5	14.3
3.0	0	6.0	4.7	9.0	8.4	12.0	11.7	15.0	14.9

NOTE: IF DIFFERENCE IS GREATER THAN 15DBRNC THE POSSIBILITY OF EQUIPMENT SATURATION SHOULD BE INVESTIGATED.

EXAMPLE 1

MEASUREMENT 1 (Nm) 15 DBRNC  
 MEASUREMENT 1 (NL) 30 DBRNC  
 MEASUREMENT 3 14.5 DBRNC

MEAS. 1 (Nm) 15.0	BAT 0.5	-9.1
MEAS. 3 - 14.5	MEAS. 3	+14.5
DIFF. 0.5	CONNECTOR NOISE	5.4

MEAS. 1 (NL) 30.0	PWR. INFL. 70.0	
+ 40.0	CONNECTOR NOISE	- 5.4
PWR. INF.L. 70.0	CONNECTOR BALANCE	64.5 DB.

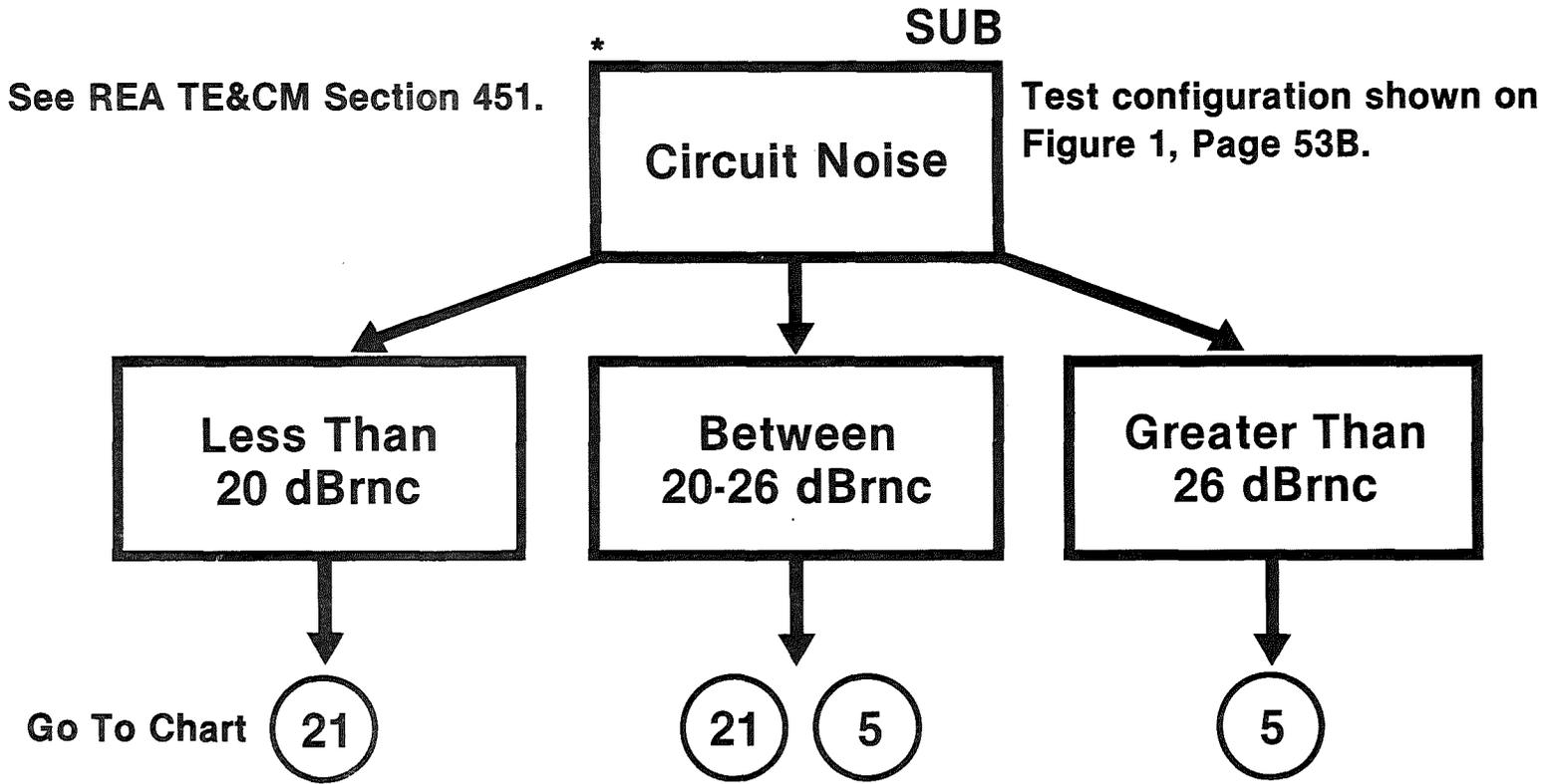
EXAMPLE 2

MEASUREMENT 1 (Nm) 20 DBRNC  
 MEASUREMENT 1 (NL) 37 DBRNC  
 MEASUREMENT 3 7 DBRNC

MEAS. 1 (Nm) 20.0	BAT 13	12.8
MEAS. 3 - 7.0	MEAS. 3	+ 7.0
DIFF. 13.0	CONNECTOR NOISE	19.8

MEAS. 1 (NL) 37.0	PWR. INF. 77.0	
+40.0	CONNECTOR NOISE	-19.8
PWR. INF.L. 77.0	CONNECTOR BALANCE	57.2 DB

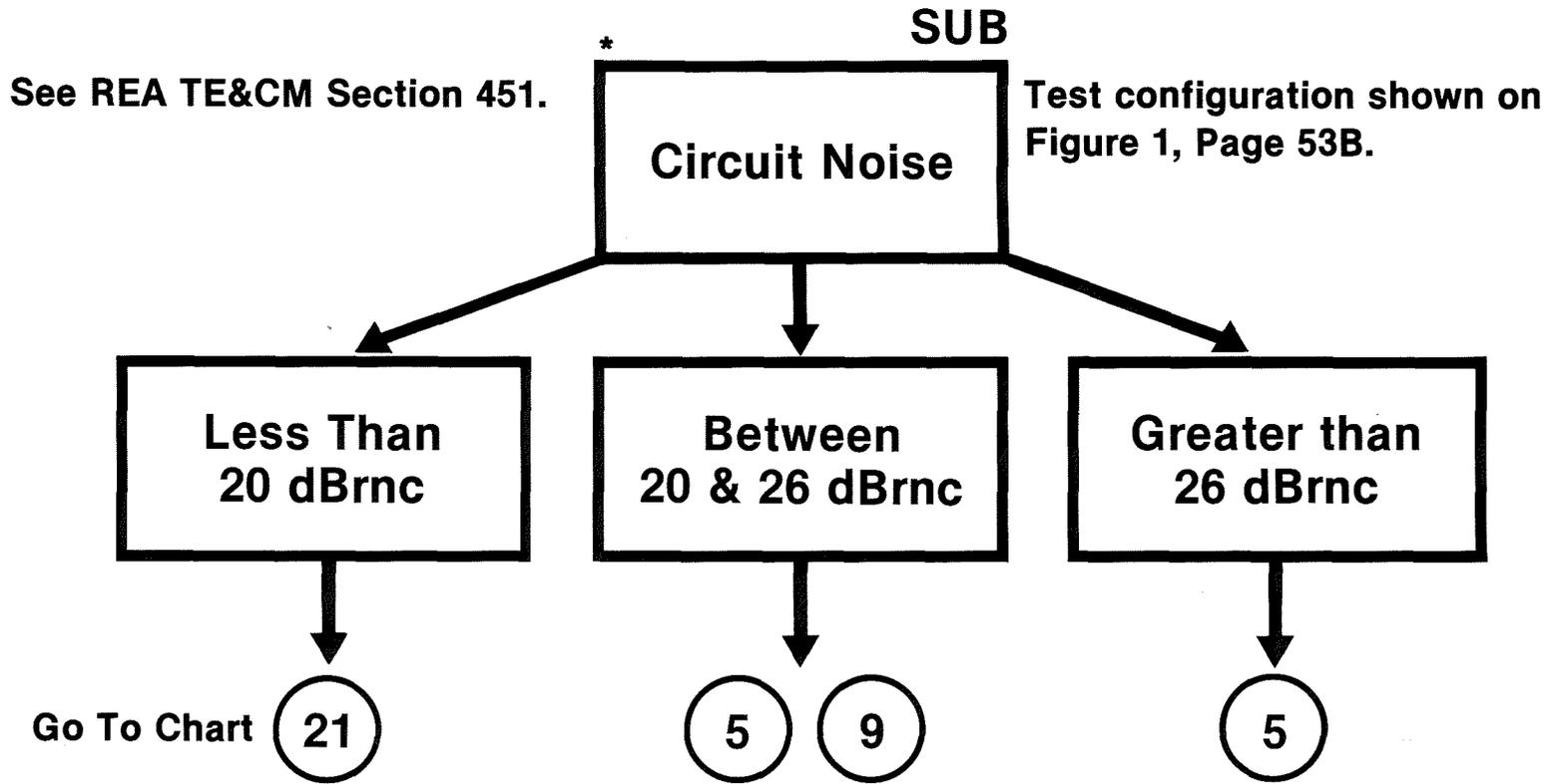
-53G-



\*Measurements may be completed with Loop Checking equipment.

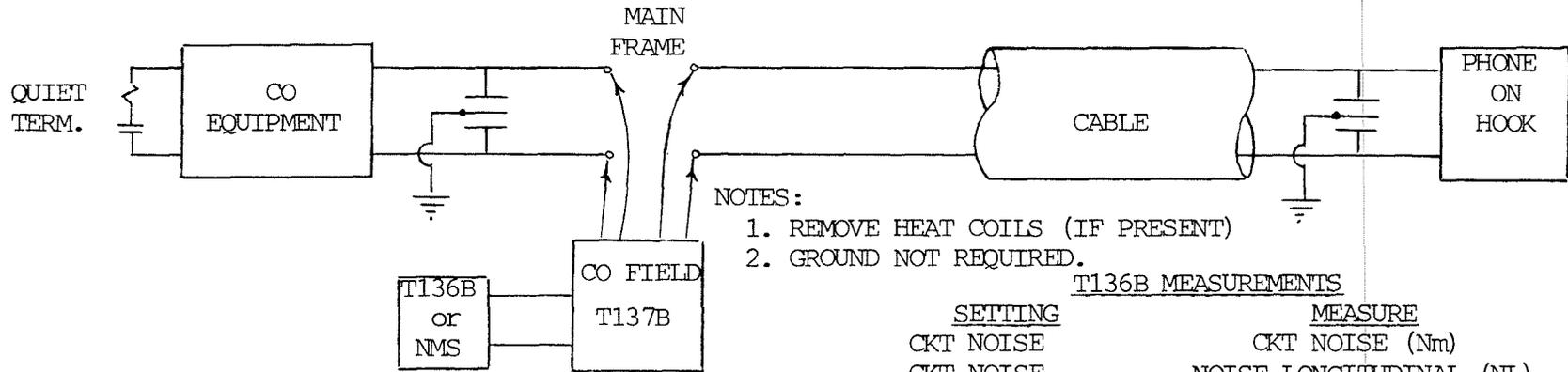
While at the central office don't forget to check ground connections.

1. Are they solid? Tighten if loose.
2. Is positive battery terminal connected directly to ground and isolated electrically from all other ground points?
  - SXS Office - connected to MDF ground bar.
  - Digital Office - connected to ground window points
3. Is there a direct connection between the main ground bar and the ground bar in the main ac power panel.
4. Refer to REA TE&CM Section 810 for further details.



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\*Measurements may be completed with Loop Checking equipment.



- NOTES:  
 1. REMOVE HEAT COILS (IF PRESENT)  
 2. GROUND NOT REQUIRED.

T136B MEASUREMENTS

SETTING	MEASURE
CKT NOISE	CKT NOISE (Nm)
CKT NOISE	NOISE LONGITUDINAL (NL)
	CALCULATE BALANCE

NMS MEASUREMENTS

SETTING	MEASURE
C-MSG 900 TERM MEAS	Nm(CKT NOISE)
C-MSG 900 TERM MEAS	NOISE LONGITUDINAL (NL)
	CALCULATE BALANCE

WILCOM T137B SWITCH POSITIONS

	MEAS. NO. 1	MEAS. NO. 2	MEAS. NO. 3
TERM:	OFF	OFF	OFF
LONG.	OFF FOR	OFF FOR	OFF FOR
CURRENT:	CKT. NOISE	CKT. NOISE	CCT NOISE
	ON FOR NOISE LONG.	ON FOR NOISE LONG.	
DIAL. MEAS:	MEAS.	MEAS.	MEAS.
FUNCTION:	POSITION 1.	POSITION 2	POSITION 4

$$\text{TRUE EQUIPMENT BALANCE} = (\text{NOISE LONG.} + 40) - 10 \log_{10} \left( \log_{10}^{-1} \left( \frac{\text{CKT NOISE (MEAS.1)}}{10} \right) - \log_{10}^{-1} \left( \frac{\text{CKT NOISE (MEAS.3)}}{10} \right) \right)$$

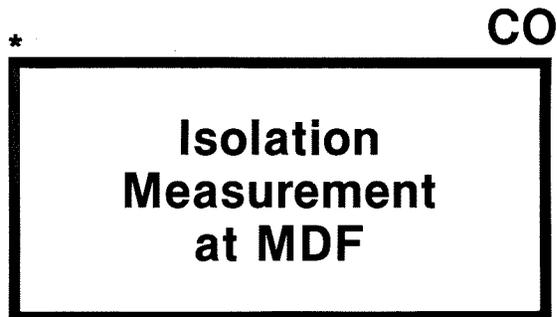
NOTE: THE INVERSE POWER SUMMATION CAN BE SOLVED WITH TABLE I. (PAGE 53F)

ISOLATION MEASUREMENT AT MDF

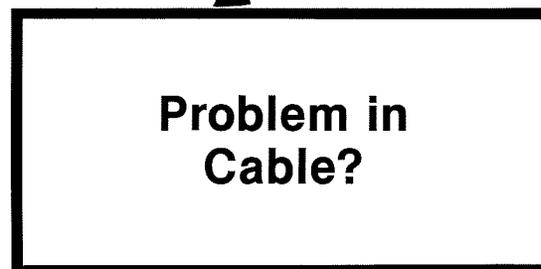
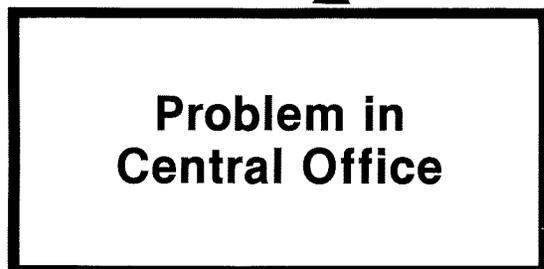
FIGURE 2

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See REA TE&CM Section 451.1.



Test configuration shown on Figure 2, Page 53 J. See also the notes on Page 53H.



Go To Chart

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\*Measurements may be completed with Loop Checking equipment.

TABLE II

For identification of an Open Shield (Based on 540 Hz)

Length-Kf.	24 GAUGE SHIELDS: 5mil CU, 8mil Al & 7mil 194															
	12 Pr.		18 Pr.		25 Pr.		50 Pr.		75 Pr.		100 Pr.		150 Pr.		200 Pr.	
	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.
1	0.8	0.2	0.8	0.1	0.8	0.1	0.8	0.1	0.8	0.1	0.7	0.1	0.7	-	0.7	-
2	1.8	0.6	1.8	0.5	1.8	0.5	1.7	0.4	1.7	0.3	1.6	0.2	1.6	0.2	1.6	0.1
3	2.6	1.1	2.5	1.0	2.5	0.9	2.5	0.7	2.4	0.5	2.4	0.4	2.3	0.3	2.3	0.3
4	3.2	1.5	3.1	1.3	3.1	1.2	3.0	0.9	3.0	0.8	2.9	0.6	2.9	0.5	2.8	0.4
5	3.6	1.9	3.6	1.7	3.6	1.5	3.5	1.2	3.4	1.0	3.4	0.8	3.3	0.6	3.2	0.5
6	4.0	2.2	4.0	2.0	3.9	1.8	3.8	1.4	3.8	1.2	3.7	1.0	3.6	0.8	3.6	0.6
7	4.3	2.4	4.2	2.2	4.2	2.0	4.1	1.6	4.0	1.3	4.0	1.1	3.9	0.9	3.8	0.7
8	4.5	2.6	4.5	2.4	4.4	2.2	4.3	1.8	4.3	1.5	4.2	1.3	4.1	1.0	4.1	0.8
9	4.7	2.8	4.7	2.6	4.6	2.4	4.5	1.9	4.5	1.6	4.4	1.4	4.3	1.1	4.2	0.9
10	4.9	3.0	4.8	2.7	4.8	2.5	4.7	2.0	4.60	1.7	4.6	1.5	4.5	1.2	4.4	1.0

1. If measured difference is nearly equal to (less than 50% greater) or less than the calculated difference, the shield can be considered acceptable.
2. If measured difference is more than 50% greater than the calculated difference the shield is probably partially open.
3. If measured difference is nearly equal to or greater than the value in the "10 Pr." column, the shield can be considered completely open.

NOTE: Use for Air Core, Filled, and Foam Insulated Filled Cables.

**Chart 6**

CO

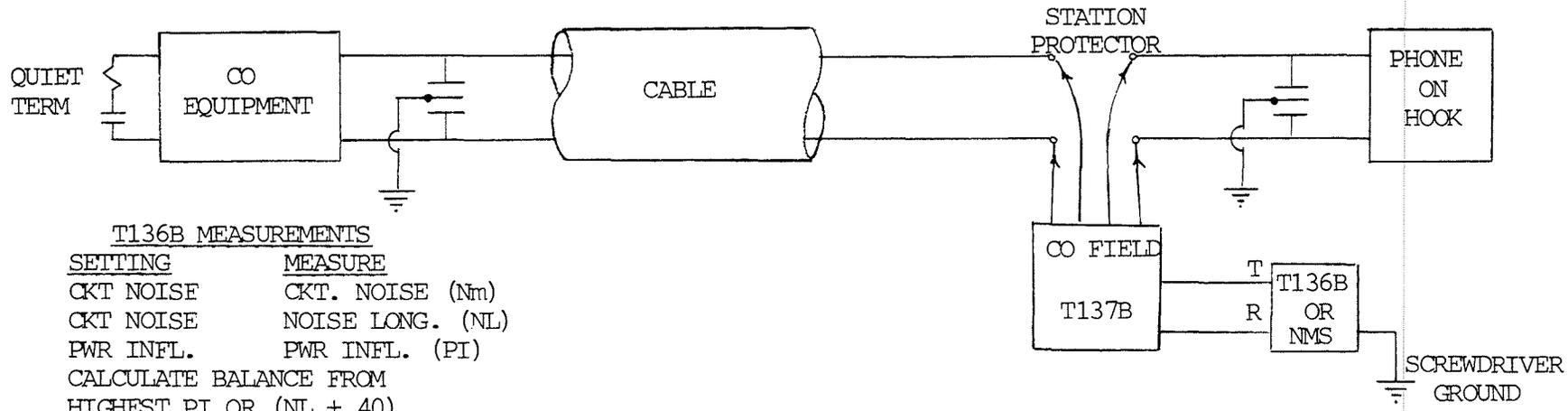


**Locate & Repair  
Problem**

**21**

**See REA TE&CM Section  
451, Appendix C.**

**Go To Chart**



T136B MEASUREMENTS

SETTING	MEASURE
CKT NOISE	CKT. NOISE (Nm)
CKT NOISE	NOISE LONG. (NL)
PWR INFL.	PWR INFL. (PI)
CALCULATE BALANCE FROM HIGHEST PI OR (NL + 40)	

NMS MEASUREMENTS

SETTINGS	MEASURE
MSG 900 TERM MEAS.	Nm (CKT NOISE)
MSG 900 TERM MEAS.	NOISE LONG. (NL)
MSG Ng MEAS.	Ng (NOISE-TO-GROUND)
CALCULATE BALANCE FROM HIGHEST PI: (NL + 40) OR (Ng + 40)	

T137B SETTINGS

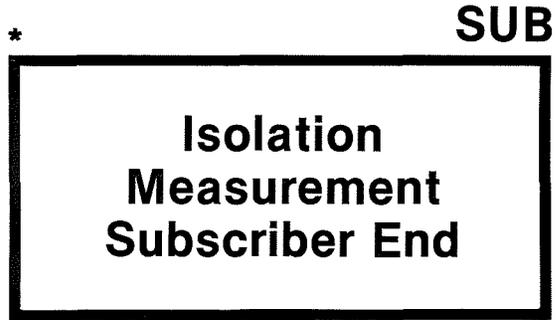
	MEAS. NO. 1	MEAS. NO. 2	*MEAS. NO. 3
TERM:	OFF	OFF	OFF
LONG CURRENT:	OFF FOR CKT NOISE	OFF FOR CKT NOISE	OFF FOR CKT NOISE
DIAL-MEAS:	ON FOR NOISE LONG.	ON FOR NOISE LONG.	ON FOR NOISE LONG.
FUNCTION:	MEAS. POSITION 1	MEAS. POSITION 2	MEAS. POSITION 6

\*NOTE: MEASURE ONLY WHEN HIGH CKT NOISE IS FOUND ON MEAS. NO. 2.

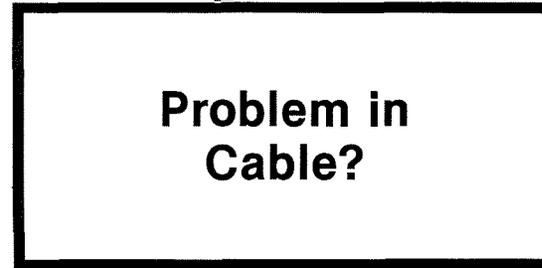
ISOLATION MEASUREMENT AT SUBSCRIBER END  
FIGURE 3

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See REA TE&CM Section 451.1.



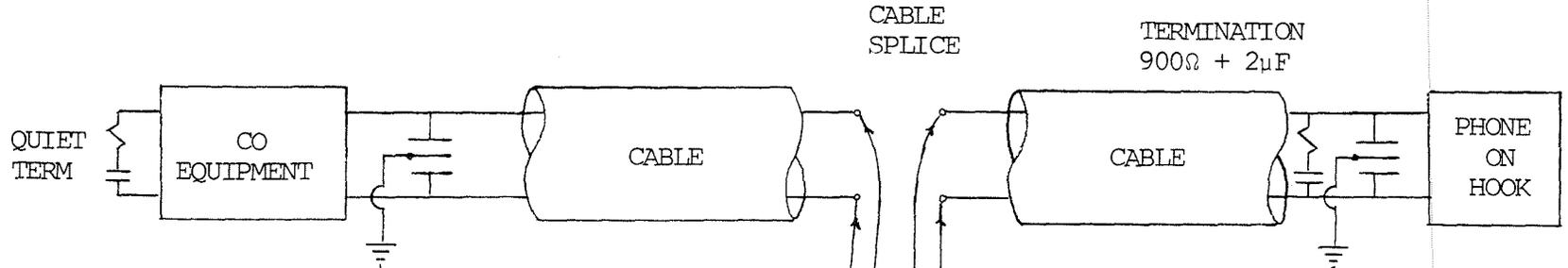
Test configuration shown on Figure 3, Page 53N.



Go To Chart

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\*Measurements may be completed with Loop Checking equipment.



NMS MEASUREMENTS

	<u>SETTINGS</u>	<u>MEASURE</u>
CMSG	900 TERM MEAS.	Nm (CKT NOISE)
CMSG	900 TERM MEAS.	NOISE LONG. (NL)
CMSG	Ng MEAS.	Ng (NOISE-TO-GROUND)

CALCULATE BALANCE FROM HIGHEST PI:  
(NL + 40) OR (Ng + 40).

T136B MEASUREMENTS

	<u>SETTINGS</u>	<u>MEASURE</u>
	CKT NOISE	CKT NOISE (Nm)
	CKT NOISE	NOISE LONG. (NL)
	PWR. INFL.	PWR. INFL. (PI)

CALCULATE BALANCE FROM HIGHEST PI OR (NL + 40)

T137B SETTINGS

	<u>MEAS. NO. 1</u>	<u>MEAS. NO. 2.</u>
TERM:	OFF	OFF
LONG. CURRENT:	OFF FOR	OFF FOR
	CKT NOISE	CKT NOISE
	ON FOR	ON FOR
	NOISE LONG.	NOISE LONG.
DIAL-MEAS:	MEAS.	MEAS.
FUNCTION:	POSITION 1	POSITION 2

ISOLATION MEASUREMENT ALONG CABLE  
FIGURE 4

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See REA TE&CM Section 451.1.

**Isolation  
Measurements  
Along Cable Until  
Problem is Found.**

Test configuration shown on Figure 4, Page 53 P.

-530-

See REA TE&CM Section 451.8.

**Repair**

Go To Chart

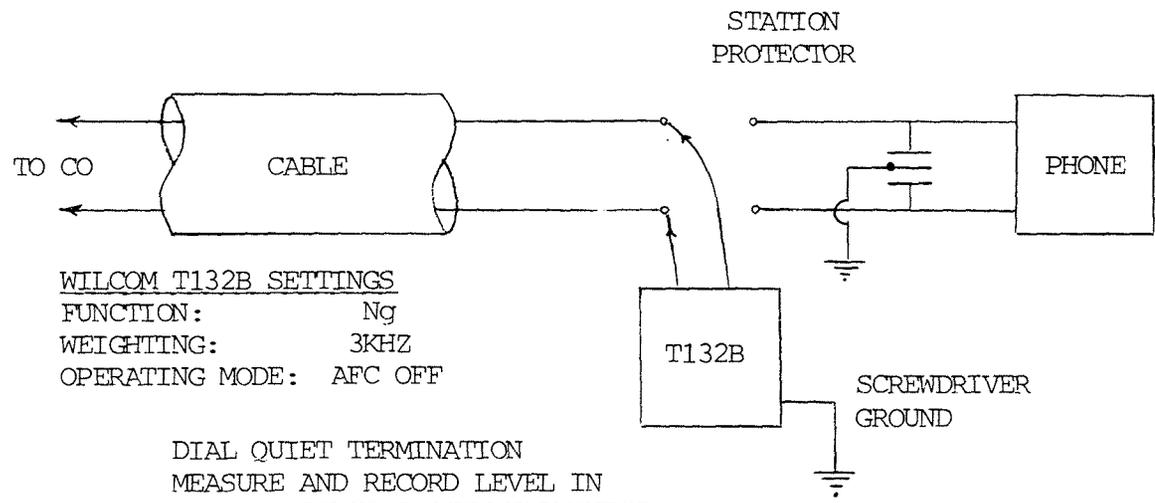
21

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\*Measurements may be completed with Loop Checking equipment.

**Chart  
\*8**

REA TE&CM 451



WILCOM T132B SETTINGS  
FUNCTION: Ng  
WEIGHTING: 3KHZ  
OPERATING MODE: AFC OFF

DIAL QUIET TERMINATION  
MEASURE AND RECORD LEVEL IN  
DBRN OF POWER SYSTEM HARMONICS  
1 THROUGH 47 (60 TO 2820 HZ).

HARMONIC ANALYSIS OF POWER INFLUENCE  
FIGURE 5

**SUB**

See REA TE&CM Section 452.1.

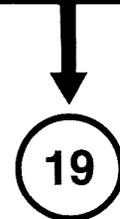
**NOTE:** If Spectrum Analyzer is not available go to Chart 10.

**Measure Power Influence Harmonics and Analyze**

Test configuration shown on Figure 5, Page 53R.

**Shield Problem**

**Shield Good**



**Go To Chart**

**10**

**19**

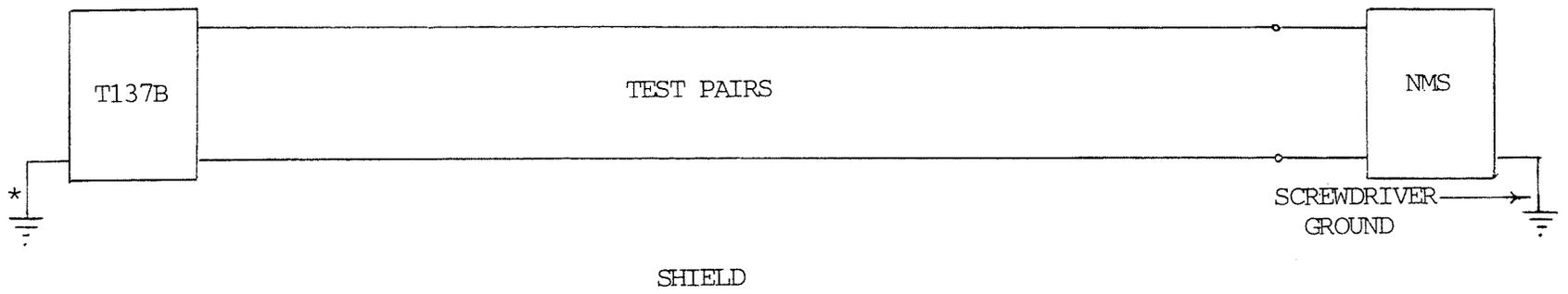
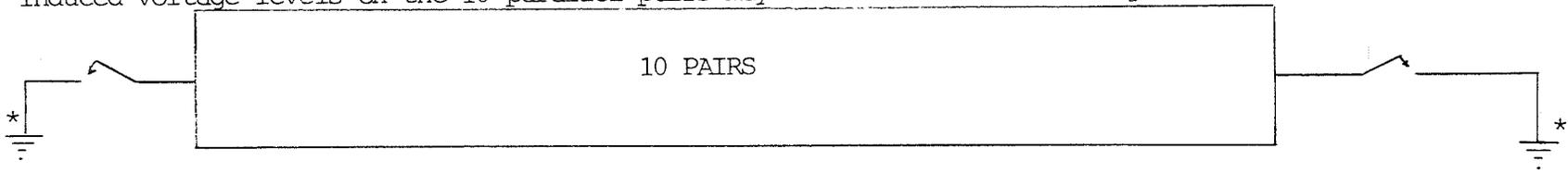
-535-

**Chart 9**

REA TE&CM 451

USE CAUTION

Induced voltage levels on the 10 parallel pairs may be in the hazardous range.



1. MEASURE Ng WITH 10-PAIRS UNGROUNDED.
2. MEASURE Ng WITH 10-PAIRS GROUNDED.
3. CALCULATE MEASURED DIFFERENCE - MEAS. 1 MINUS MEAS. 2.
4. DETERMINE SHIELD QUALITY FROM APPROPRIATE TABLE:

T137B SETTINGS

TERM: ON  
 LONG. CURRENT: OFF  
 DIAL-MEAS: MEAS.  
 FUNCTION: POSITION 5  
 CONNECT TEST PAIR TO  
 FIELD TERMINALS.

NMS MEASUREMENTS

SETTINGS MEASURE

C-MSG Ng MEAS. Ng

	5 mil CU	8 mil AL	7 mil 194	10 mil CU	6 mil CCS	6 mil 194
24 GA.	TABLE II, PAGE 53L	TABLE V, PAGE 54I	TABLE VIII, PAGE 540			
22 GA.	TABLE III, PAGE 54C	TABLE VI, PAGE 54K	TABLE IX, PAGE 54Q			
19 GA.	TABLE IV, PAGE 54E	TABLE VII, PAGE 54M	TABLE X, PAGE 54S			

\* GROUNDS TO MGN.

SHIELD CONTINUITY TEST

FIGURE 6

SHIELD MATERIALS

- CU Copper
- AL Aluminum
- CCS Copper Clad Steel
- 194 Alloy 194

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See REA TE&CM Section 451.2.

**Test Continuity  
of Sections With  
One Size & Gauge**

Test configuration shown  
on Figure 6, Page 53T.

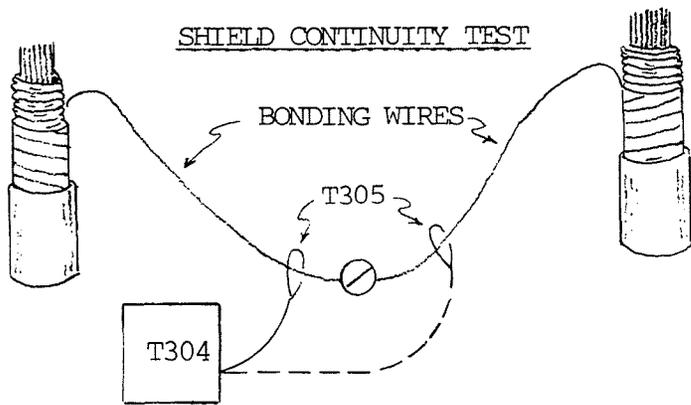
**Shield Problem**

**Shield Good**

**11**

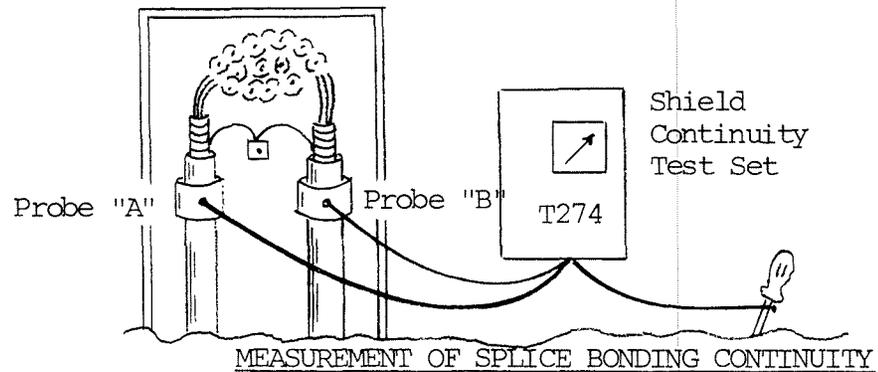
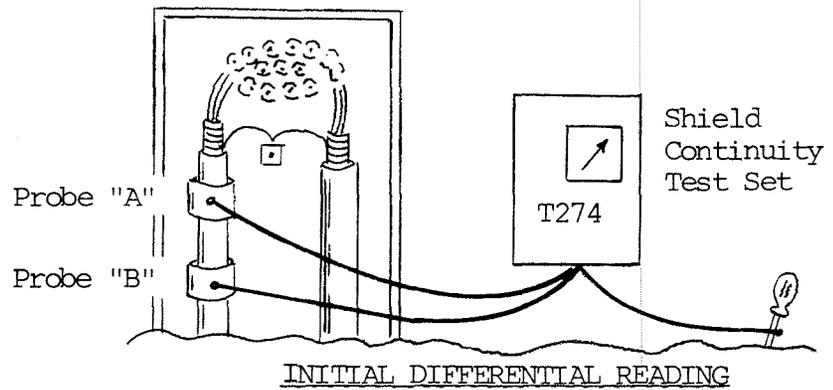
**13**

**Go To Chart**



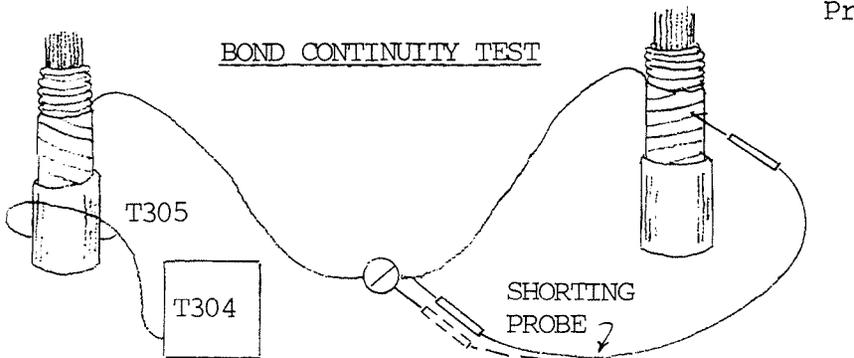
1. READ & RECORD CURRENT IN EACH BONDING WIRE AT EACH SPLICE.
2. CURRENT WILL REDUCE TO NEAR ZERO IN VICINITY OF OPEN SHIELD.
3. SEE REA TE&CM 451.2 FOR COMPLETE DETAILS.

FIGURE 7A



1. IF MEASUREMENT IS MORE THAN 2 DB GREATER THAN DIFFERENTIAL READING, BOND IS DEFECTIVE.
2. SEE REA TE&CM 451.2 FOR COMPLETE DETAILS.

SHIELD SPLICE CONTINUITY TEST  
FIGURE 7C



1. READ CURRENT WITHOUT SHORTING PROBE
2. READ CURRENT WITH BOND WIRE BYPASSED BY PROBE
3. IF 2 IS 1.06 TIMES OR MORE GREATER THAN 1 BOND IS DEFECTIVE

FIGURE 7B

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See REA TE&CM Section 451.2.

**Measure  
Shield Current  
Test for  
Bonding Problem**

Test configuration shown on Figure 7, Page 53V.

**Shield Problem**

**Shield Good**

**12**

**13**

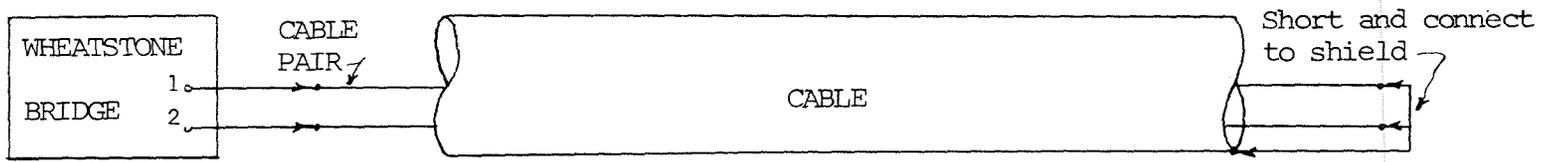
**Go To Chart**

-53W-

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**Chart 11**

REA TE&CM 451



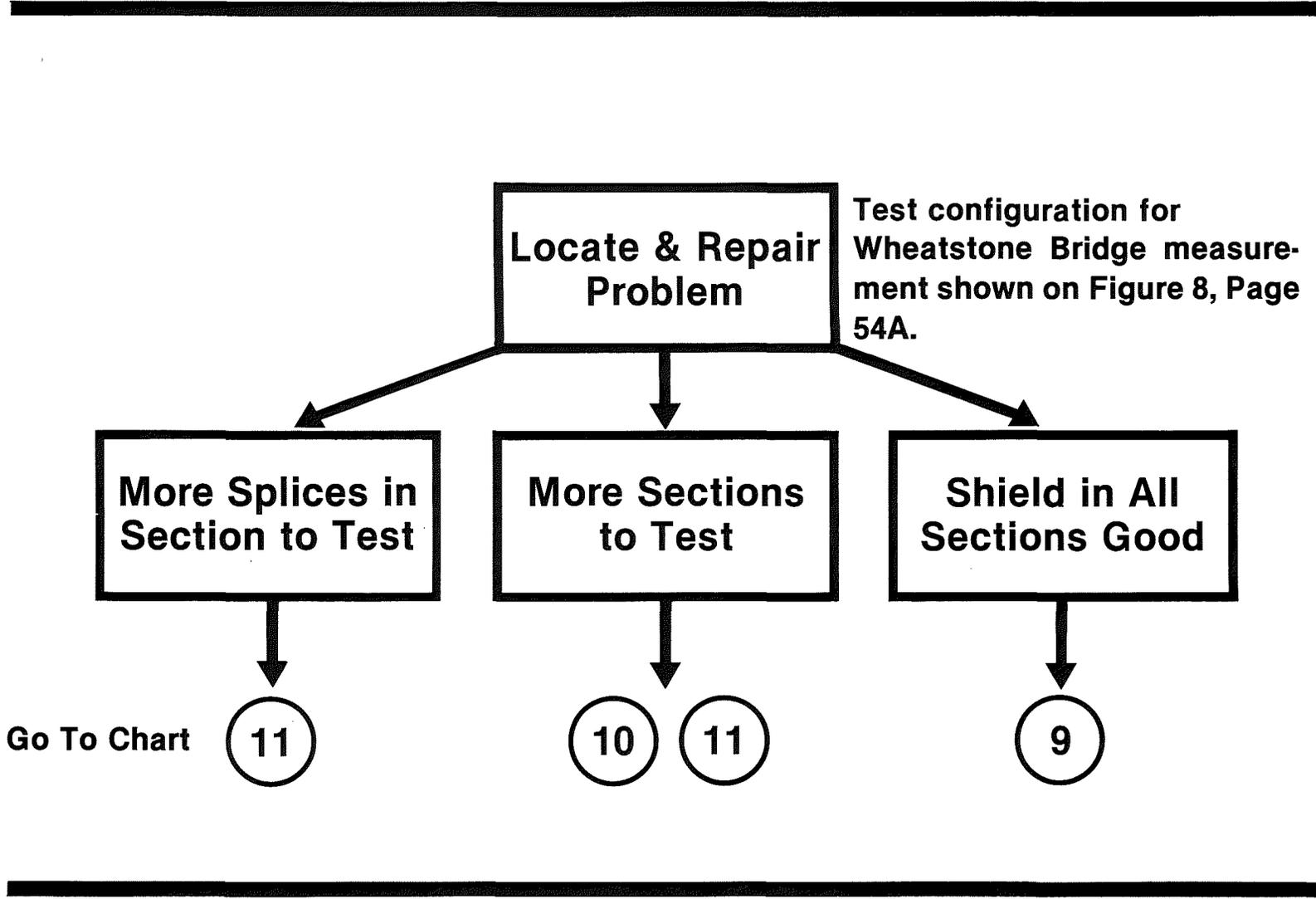
1. Measure loop resistance  $R_1$ .



2. Measure loop resistance  $R_2$ .  
3. Calculate shield resistance.

$$\text{Shield Resistance} = R_2 - \frac{R_1}{4}$$

WHEATSTONE BRIDGE MEASUREMENT OF SHIELD CONTINUITY  
FIGURE 8



Go To Chart

TABLE III

For identification of an Open Shield (Based on 540 Hz)

Length-Kf.	22 GAUGE SHIELDS: 5mil CU, 8mil Al & 7mil 194															
	12 Pr.		18 Pr.		25 Pr.		50 Pr.		75 Pr.		100 Pr.		150 Pr.		200 Pr.	
	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.
1	0.9	0.2	0.9	0.1	0.9	0.1	0.9	0.1	0.8	0.1	0.8	0.1	0.8	-	0.8	-
2	2.2	0.7	2.1	0.6	2.1	0.5	2.0	0.4	2.0	0.3	2.0	0.2	1.9	0.2	1.9	0.1
3	3.3	1.2	3.2	1.1	3.2	1.0	3.1	0.7	3.0	0.5	3.0	0.5	2.9	0.3	2.9	0.3
4	4.1	1.8	4.1	1.5	4.0	1.4	3.9	1.0	3.8	0.8	3.8	0.7	3.7	0.5	3.6	0.4
5	4.8	2.2	4.7	1.9	4.7	1.7	4.6	1.3	4.5	1.0	4.4	0.9	4.3	0.7	4.3	0.6
6	5.4	2.6	5.3	2.3	5.2	2.1	5.1	1.6	5.0	1.2	5.0	1.1	4.9	0.8	4.8	0.7
7	5.8	2.9	5.7	2.6	5.7	2.3	5.6	1.8	5.4	1.4	5.4	1.3	5.3	1.0	5.2	0.8
8	6.2	3.2	6.1	2.8	6.1	2.6	5.9	2.0	5.8	1.6	5.8	1.4	5.6	1.1	5.6	0.9
9	6.5	3.4	6.4	3.1	6.4	2.8	6.2	2.2	6.1	1.7	6.1	1.6	5.9	1.2	5.9	1.0
10	6.8	3.7	6.7	3.3	6.6	3.0	6.5	2.3	6.4	1.9	6.3	1.7	6.2	1.3	6.1	1.1

1. If measured difference is nearly equal to (less than 50% greater) or less than the calculated difference, the shield can be considered acceptable.
2. If measured difference is more than 50% greater than the calculated difference the shield is probably partially open.
3. If measured difference is nearly equal to or greater than the value in the "10 Pr." column, the shield can be considered completely open.

NOTE: Use for Air Core, Filled, and Foam Insulated Filled Cables.

# Chart 13

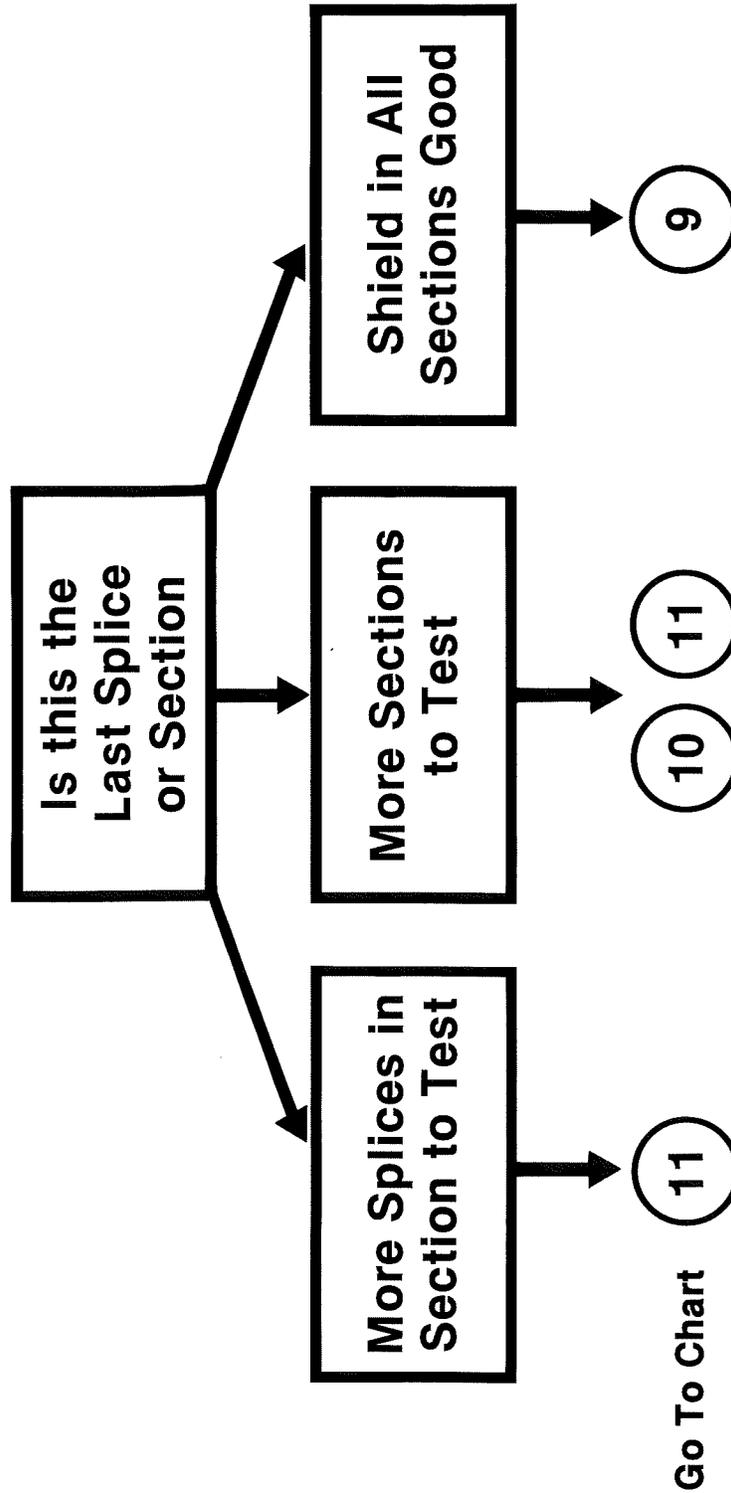


TABLE IV

For identification of an Open Shield (Based on 540 Hz)

Length-Kf.	19 GAUGE SHIELDS: 5mil CU, 8mil Al & 7mil 194															
	12 Pr.		18 Pr.		25 Pr.		50 Pr.		75 Pr.		100 Pr.		150 Pr.		200 Pr.	
	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.
1	1.0	0.2	1.0	0.1	1.0	0.1	0.9	0.1	0.9	0.1	0.9	-	0.9	-	0.9	-
2	2.5	0.7	2.5	0.6	2.5	0.5	2.4	0.3	2.3	0.3	2.3	0.2	2.2	0.2	2.2	0.1
3	4.0	1.3	3.9	1.1	3.9	1.0	3.7	0.6	3.7	0.5	3.6	0.5	3.5	0.3	3.5	0.3
4	5.2	1.9	5.1	1.7	5.1	1.4	4.9	1.0	4.8	0.8	4.8	0.7	4.7	0.5	4.6	0.4
5	6.2	2.5	6.1	2.1	6.1	1.9	5.9	1.3	5.8	1.1	5.7	0.9	5.6	0.7	5.6	0.6
6	7.0	2.9	6.9	2.5	6.9	2.2	6.7	1.5	6.6	1.3	6.5	1.1	6.4	0.8	6.3	0.7
7	7.7	3.4	7.6	2.9	7.6	2.6	7.3	1.8	7.3	1.5	7.2	1.3	7.1	1.0	7.0	0.9
8	8.3	3.7	8.2	3.2	8.1	2.9	7.9	2.0	7.8	1.7	7.8	1.5	7.6	1.1	7.6	1.0
9	8.8	4.0	8.7	3.5	8.7	3.1	8.4	2.2	8.3	1.9	8.3	1.6	8.1	1.2	8.1	1.0
10	9.3	4.3	9.2	3.8	9.1	3.4	8.9	2.4	8.8	2.0	8.7	1.8	8.5	1.4	8.5	1.2

1. If measured difference is nearly equal to (less than 50% greater) or less than the calculated difference, the shield can be considered acceptable.
2. If measured difference is more than 50% greater than the calculated difference the shield is probably partially open.
3. If measured difference is nearly equal to or greater than the value in the "10 Pr." column, the shield can be considered completely open.

NOTE: Use for Air Core, Filled, and Foam Insulated Filled Cables.

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See REA TE&CM Section 451.

**SUB**

**Measure Power  
Influence 3Khz  
Flat Weighting**

Test configuration shown on  
Figure 1, Page 53B.

**Less Than  
105 dBrn**

**Between  
105 & 126 dBrn**

**Greater Than  
126 dBrn**

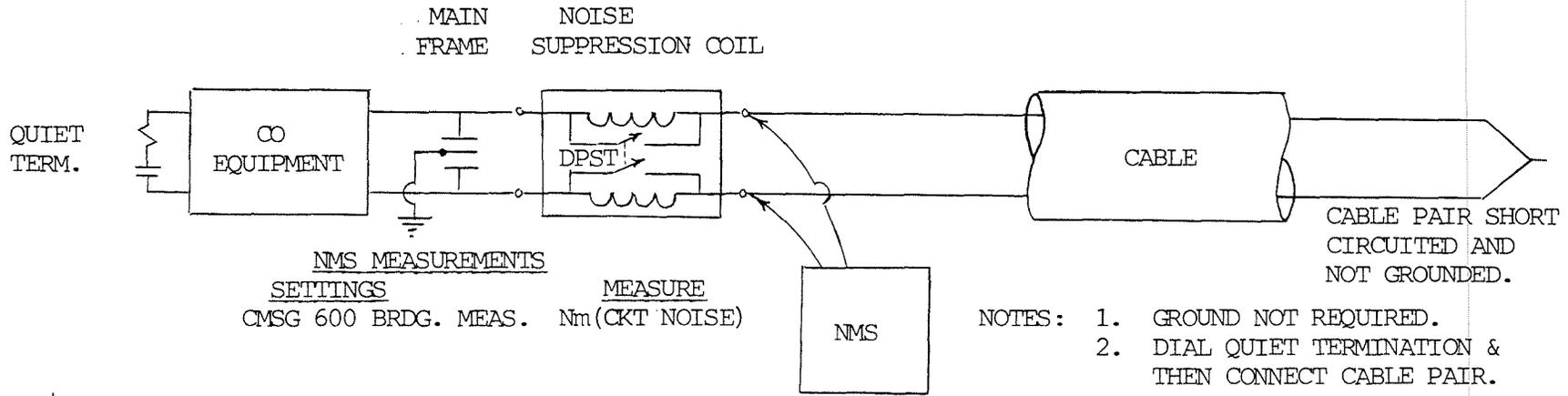
Go To Chart

**9**

**15**

**17**

-54F-



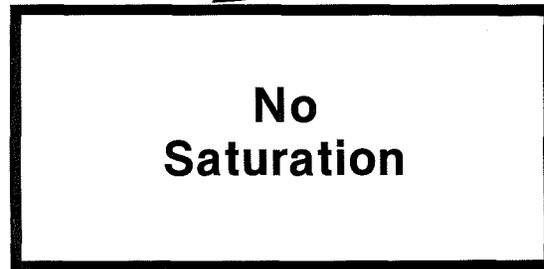
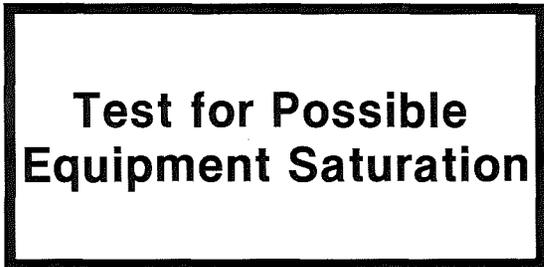
1. MEASURE CKT NOISE WITH COIL REMOVED FROM CKT. (SWITCH CLOSED)
2. MEASURE CKT NOISE WITH COIL IN CKT. (SWITCH OPEN)
3. LARGE REDUCTION OF CKT NOISE (GREATER THAN 15 DBRNC) INDICATES PROBABLE SATURATION.

SATURATION TEST  
FIGURE 9

CO

See REA TE&CM Section 451.8.

Test configuration shown on Figure 9, Page 54G.



Go To Chart

-54H-

TABLE V

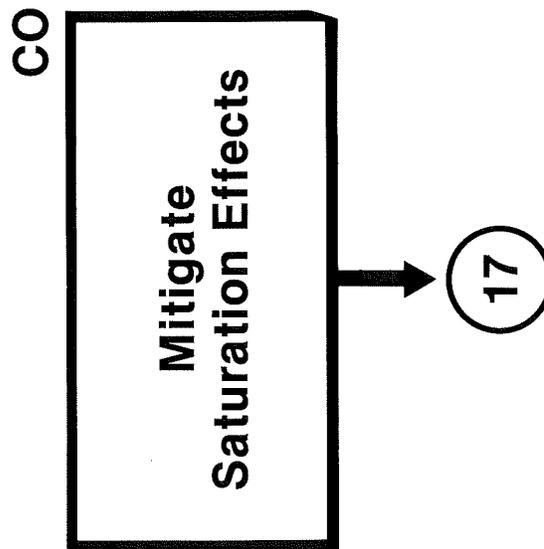
For identification of an Open Shield (Based on 540 Hz)

Length-Kf.	24 GAUGE SHIELDS: 10mil CU															
	12 Pr.		18 Pr.		25 Pr.		50 Pr.		75 Pr.		100 Pr.		150 Pr.		200 Pr.	
	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.
1	0.8	0.1	0.8	0.1	0.8	0.1	0.8	-	0.7	-	0.7	-	0.7	-	0.7	-
2	1.8	0.3	1.8	0.3	1.8	0.2	1.7	0.2	1.7	0.1	1.6	0.1	1.6	0.1	1.6	0.1
3	2.6	0.6	2.5	0.5	2.5	0.4	2.5	0.3	2.4	0.2	2.4	0.2	2.3	0.1	2.3	0.1
4	3.2	0.8	3.1	0.7	3.1	0.6	3.0	0.4	3.0	0.3	2.9	0.3	2.9	0.2	2.8	0.2
5	3.6	1.0	3.6	0.9	3.6	0.8	3.5	0.6	3.4	0.4	3.4	0.4	3.3	0.3	3.2	0.2
6	4.0	1.2	4.0	1.1	3.9	1.0	3.8	0.7	3.8	0.5	3.7	0.5	3.6	0.3	3.6	0.3
7	4.3	1.4	4.2	1.2	4.2	1.1	4.1	0.8	4.0	0.6	4.0	0.5	3.9	0.4	3.8	0.3
8	4.5	1.5	4.5	1.4	4.4	1.2	4.3	0.9	4.3	0.7	4.2	0.6	4.1	0.4	4.1	0.4
9	4.7	1.7	4.7	1.5	4.6	1.3	4.5	1.0	4.5	0.8	4.4	0.7	4.3	0.5	4.2	0.4
10	4.9	1.8	4.8	1.6	4.8	1.4	4.7	1.1	4.6	0.8	4.6	0.7	4.5	0.5	4.4	0.4

1. If measured difference is nearly equal to (less than 50% greater) or less than the calculated difference, the shield can be considered acceptable.
2. If measured difference is more than 50% greater than the calculated difference the shield is probably partially open.
3. If measured difference is nearly equal to or greater than the value in the "10 Pr." column, the shield can be considered completely open.

NOTE: Use for Air Core, Filled, and Foam Insulated Filled Cables.

# Chart 16



See REA TE&CM Sections  
451.4 and 451.5.

Go To Chart

TABLE VI

For identification of an Open Shield (Based on 540 Hz)

Length-Kf.	22 GAUGE SHIELDS: 10mil CU															
	12 Pr.		18 Pr.		25 Pr.		50 Pr.		75 Pr.		100 Pr.		150 Pr.		200 Pr.	
	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.
1	0.9	0.1	0.9	0.1	0.9	0.1	0.9	-	0.8	-	0.8	-	0.8	-	0.8	-
2	2.2	0.4	2.1	0.3	2.1	0.2	2.0	0.2	2.0	0.1	2.0	0.1	1.9	0.1	1.9	0.1
3	3.3	0.7	3.2	0.6	3.2	0.5	3.1	0.3	3.0	0.2	3.0	0.2	2.9	0.1	2.9	0.1
4	4.1	1.0	4.1	0.8	4.0	0.7	3.9	0.5	3.8	0.4	3.8	0.3	3.7	0.2	3.6	0.2
5	4.8	1.2	4.7	1.0	4.7	0.9	4.6	0.6	4.5	0.5	4.4	0.4	4.3	0.3	4.3	0.2
6	5.4	1.5	5.3	1.2	5.2	1.1	5.1	0.8	5.0	0.6	5.0	0.5	4.9	0.4	4.8	0.3
7	5.8	1.7	5.7	1.4	5.7	1.2	5.6	0.9	5.4	0.7	5.4	0.6	5.3	0.4	5.2	0.3
8	6.2	1.8	6.1	1.6	6.1	1.4	5.9	1.0	5.8	0.7	5.8	0.7	5.6	0.5	5.6	0.4
9	6.5	2.0	6.4	1.7	6.4	1.5	6.2	1.1	6.1	0.8	6.1	0.7	5.9	0.5	5.9	0.4
10	6.8	2.2	6.7	1.9	6.6	1.6	6.5	1.2	6.4	0.9	6.3	0.8	6.2	0.6	6.1	0.5

1. If measured difference is nearly equal to (less than 50% greater) or less than the calculated difference, the shield can be considered acceptable.
2. If measured difference is more than 50% greater than the calculated difference the shield is probably partially open.
3. If measured difference is nearly equal to or greater than the value in the "10 Pr." column, the shield can be considered completely open.

NOTE: Use for Air Core, Filled, and Foam Insulated Filled Cables.

**SUB**

See REA TE&CM Section 452.2.

**Measure Power Influence Harmonics and Analyze**

Test configuration shown on Figure 5, Page 53R.

See REA TE&CM Sections 452 and 452.2.

**Complete Additional Tests, as Required, to Verify Problem(s)**

Go To Chart

18

-541-

TABLE VII

For identification of an Open Shield (Based on 540 Hz)

Length-Kf.	19 GAUGE SHIELDS: 10mil CU															
	12 Pr.		18 Pr.		25 Pr.		50 Pr.		75 Pr.		100 Pr.		150 Pr.		200 Pr.	
	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.
1	1.0	0.1	1.0	0.1	1.0	0.1	0.9	-	0.9	-	0.9	-	0.9	-	0.9	-
2	2.5	0.4	2.5	0.3	2.5	0.2	2.4	0.1	2.3	0.1	2.3	0.1	2.2	0.1	2.2	0.1
3	4.0	0.7	3.9	0.6	3.9	0.5	3.7	0.3	3.7	0.2	3.6	0.2	3.5	0.1	3.5	0.1
4	5.2	1.1	5.1	0.9	5.1	0.7	4.9	0.4	4.8	0.4	4.8	0.3	4.7	0.2	4.6	0.2
5	6.2	1.4	6.1	1.1	6.1	1.0	5.9	0.6	5.8	0.5	5.7	0.4	5.6	0.3	5.6	0.2
6	7.0	1.6	6.9	1.4	6.9	1.2	6.7	0.7	6.6	0.6	6.5	0.5	6.4	0.4	6.3	0.3
7	7.7	1.9	7.6	1.6	7.6	1.4	7.3	0.8	7.3	0.7	7.2	0.6	7.1	0.4	7.0	0.4
8	8.3	2.1	8.2	1.8	8.1	1.5	7.9	1.0	7.8	0.8	7.8	0.7	7.6	0.5	7.6	0.4
9	8.8	2.3	8.7	2.0	8.7	1.7	8.4	1.1	8.3	0.9	8.3	0.7	8.1	0.5	8.1	0.5
10	9.3	2.5	9.2	2.1	9.1	1.8	8.9	1.2	8.8	1.0	8.7	0.8	8.5	0.6	8.5	0.5

1. If measured difference is nearly equal to (less than 50% greater) or less than the calculated difference, the shield can be considered acceptable.
2. If measured difference is more than 50% greater than the calculated difference the shield is probably partially open.
3. If measured difference is nearly equal to or greater than the value in the "10 Pr." column, the shield can be considered completely open.

NOTE: Use for Air Core, Filled, and Foam Insulated Filled Cables.

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See REA TE&CM Section 451.

Contact Power Company for Coordination



Mitigate



21

Go To Chart

-54N-

TABLE VIII

For identification of an Open Shield (Based on 540 Hz)

Length-Kf.	24 GAUGE SHIELDS: 6mil CCS & 6mil 194															
	12 Pr.		18 Pr.		25 Pr.		50 Pr.		75 Pr.		100 Pr.		150 Pr.		200 Pr.	
	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.
1	0.8	0.2	0.8	0.2	0.8	0.2	0.8	0.1	0.8	0.1	0.7	0.1	0.7	0.1	0.7	0.1
2	1.8	0.8	1.8	0.7	1.8	0.7	1.7	0.5	1.7	0.4	1.6	0.3	1.6	0.3	1.6	0.2
3	2.6	1.4	2.5	1.3	2.5	1.2	2.5	0.9	2.4	0.8	2.4	0.7	2.3	0.5	2.3	0.4
4	3.2	1.9	3.1	1.7	3.1	1.6	3.0	1.3	3.0	1.1	2.9	0.9	2.9	0.7	2.8	0.6
5	3.6	2.3	3.6	2.1	3.6	2.0	3.5	1.6	3.4	1.4	3.4	1.2	3.3	1.0	3.2	0.8
6	4.0	2.7	4.0	2.5	3.9	2.3	3.8	1.9	3.8	1.6	3.7	1.4	3.6	1.1	3.6	0.9
7	4.3	3.0	4.2	2.8	4.2	2.6	4.1	2.1	4.0	1.8	4.0	1.6	3.9	1.3	3.8	1.1
8	4.5	3.2	4.5	3.0	4.4	2.8	4.3	2.3	4.3	2.0	4.2	1.8	4.1	1.4	4.1	1.2
9	4.7	3.4	4.7	3.2	4.6	3.0	4.5	2.5	4.5	2.1	4.4	1.9	4.3	1.6	4.2	1.3
10	4.9	3.6	4.8	3.4	4.8	3.2	4.7	2.60	4.6	2.3	4.6	2.0	4.5	1.7	4.4	1.4

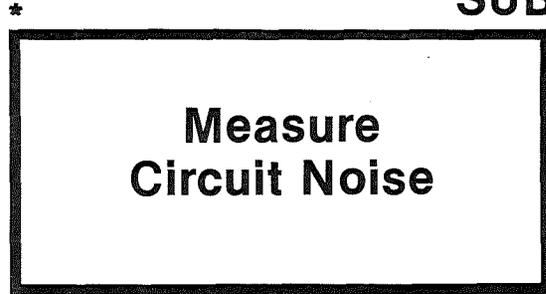
1. If measured difference is nearly equal to (less than 50% greater) or less than the calculated difference, the shield can be considered acceptable.
2. If measured difference is more than 50% greater than the calculated difference the shield is probably partially open.
3. If measured difference is nearly equal to or greater than the value in the "10 Pr." column, the shield can be considered completely open.

NOTE: Use for Air Core, Filled, and Foam Insulated Filled Cables.

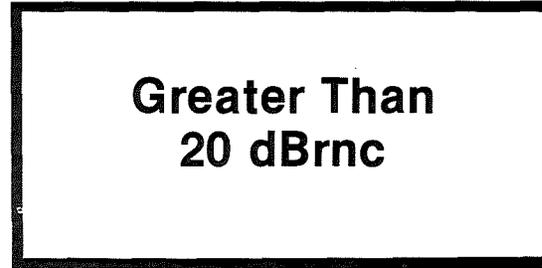
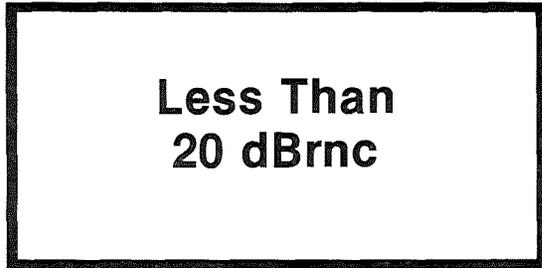
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See REA TE&CM Section 451.

**SUB**



Test configuration shown on Figure 1, Page 53B.



Go To Chart

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\*Measurements may be completed with Loop Checking equipment.

TABLE IX

For identification of an Open Shield (Based on 540 Hz)

Length-Kf.	22 GAUGE SHIELDS: 6mil CCS & 6mil 194															
	12 Pr.		18 Pr.		25 Pr.		50 Pr.		75 Pr.		100 Pr.		150 Pr.		200 Pr.	
	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.
1	0.9	0.2	0.9	0.2	0.9	0.2	0.9	0.1	0.8	0.1	0.8	0.1	0.8	0.1	0.8	0.1
2	2.2	0.9	2.1	0.8	2.1	0.7	2.0	0.5	2.0	0.4	2.0	0.4	1.9	0.3	1.9	0.2
3	3.3	1.6	3.2	1.4	3.2	1.3	3.1	1.0	3.0	0.8	3.0	0.7	2.9	0.5	2.9	0.4
4	4.1	2.2	4.1	2.0	4.0	1.8	3.9	1.4	3.8	1.1	3.8	1.0	3.7	0.8	3.6	0.7
5	4.8	2.8	4.7	2.5	4.7	2.2	4.6	1.8	4.5	1.4	4.4	1.3	4.3	1.0	4.3	0.9
6	5.4	3.2	5.3	2.9	5.2	2.6	5.1	2.1	5.0	1.7	5.0	1.6	4.9	1.2	4.8	1.0
7	5.8	3.6	5.7	3.3	5.7	2.9	5.6	2.4	5.4	2.0	5.4	1.8	5.3	1.4	5.2	1.2
8	6.2	3.9	6.1	3.6	6.1	3.2	5.9	2.7	5.8	2.2	5.8	2.0	5.6	1.6	5.6	1.4
9	6.5	4.2	6.4	3.9	6.4	3.5	6.2	2.9	6.1	2.4	6.1	2.2	5.9	1.7	5.9	1.5
10	6.8	4.5	6.7	4.1	6.6	3.7	6.5	3.1	6.4	2.5	6.3	2.3	6.2	1.9	6.1	1.6

1. If measured difference is nearly equal to (less than 50% greater) or less than the calculated difference, the shield can be considered acceptable.
2. If measured difference is more than 50% greater than the calculated difference the shield is probably partially open.
3. If measured difference is nearly equal to or greater than the value in the "10 Pr." column, the shield can be considered completely open.

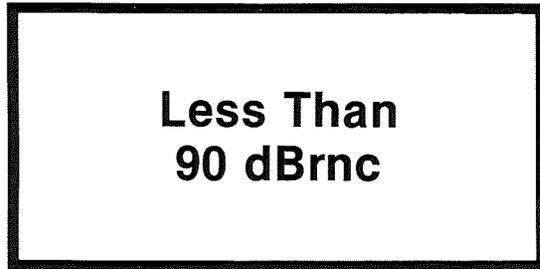
NOTE: Use for Air Core, Filled, and Foam Insulated Filled Cables.

See REA TE&CM Section 451.

**SUB**



Test configuration shown on Figure 1, Page 53B.



Go To Chart



\*Measurements may be completed with Loop Checking equipment.

TABLE X

For identification of an Open Shield (Based on 540 Hz)

Length-Kf.	19 GAUGE SHIELDS: 6mil CCS & 6mil 194															
	12 Pr.		18 Pr.		25 Pr.		50 Pr.		75 Pr.		100 Pr.		150 Pr.		200 Pr.	
	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.	10 Pr.	Diff.
1	1.0	0.2	1.0	0.2	1.0	0.2	0.9	0.1	0.9	0.1	0.9	0.1	0.9	0.1	0.9	-
2	2.5	0.9	2.5	0.8	2.5	0.7	2.4	0.5	2.3	0.4	2.3	0.3	2.2	0.3	2.2	0.2
3	4.0	1.8	3.9	1.5	3.9	1.3	3.7	0.9	3.7	0.8	3.6	0.7	3.5	0.5	3.5	0.5
4	5.2	2.5	5.1	2.2	5.1	1.9	4.9	1.4	4.8	1.2	4.8	1.0	4.7	0.8	4.6	0.7
5	6.2	3.2	6.1	2.8	6.1	2.5	5.9	1.8	5.8	1.5	5.7	1.3	5.6	1.0	5.6	0.9
6	7.0	3.7	6.9	3.3	6.9	3.0	6.7	2.1	6.6	1.8	6.5	1.6	6.4	1.2	6.3	1.1
7	7.7	4.2	7.6	3.7	7.6	3.4	7.3	2.5	7.3	2.1	7.2	1.9	7.1	1.5	7.0	1.3
8	8.3	4.7	8.2	4.1	8.1	3.8	7.9	2.7	7.8	2.4	7.8	2.1	7.6	1.6	7.6	1.5
9	8.8	5.00	8.7	4.5	8.7	4.1	8.4	3.0	8.3	2.6	8.3	2.3	8.1	1.8	8.1	1.6
10	9.3	5.4	9.2	4.8	9.1	4.4	8.9	3.2	8.8	2.8	8.7	2.5	8.5	2.0	8.5	1.8

1. If measured difference is nearly equal to (less than 50% greater) or less than the calculated difference, the shield can be considered acceptable.
2. If measured difference is more than 50% greater than the calculated difference the shield is probably partially open.
3. If measured difference is nearly equal to or greater than the value in the "10 Pr." column, the shield can be considered completely open.

NOTE: Use for Air Core, Filled, and Foam Insulated Filled Cables.

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See REA TE&CM Section 451.

\*

**SUB**

**Measure Power  
Influence & Circuit  
Noise to Confirm  
Mitigation**

Test configuration shown on Figure 1, Page 53B.

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\*Measurements may be completed with Loop Checking equipment.

