SHIELD CONTINUITY

CONTENTS

FIGURES

TABLE

1. GENERAL

1.1 This section provides REA borrowers, consulting engineers, contractors and other interested parties technical information for use in the design, construction and maintenance of REA borrowers telecommunications systems. Several techniques for determining the continuity of a cable shield are discussed.

1.2 A historic problem in the telecommunications industry has been to determine that a cable shield is continuous from end-to-end. While this knowledge is often vital to a successful noise investigation the task of obtaining it can be time consuming. There are protection and hazard problems attributable to shielding and grounding deficiencies in addition to the direct relationship to telecommunications system noise.

1.2.1 The effectiveness of cable shields in controlling voice frequency circuit noise is reduced when the shield is open circuited along a cable route. (See REA TE&CM Section 451 for a discussion of shielding theory.) Harmonic frequency power influence levels, on cable pairs in cables that have open circuited shields, can approach levels associated with unshielded conductors. When there are high resistance bonds in a shielding circuit the shielding efficiency is degraded due to reduced shielding current. Adequate grounding is essential to obtain an effective cable shielding system. The magnitude of the shielding current in any segment of a cable shield is a function of the resistance of the shielding circuit for that segment. As discussed in REA TE&CM Section 451.7 a power system multigrounded neutral (MGN) usually provides the lowest resistance path for completing the shielding circuit.

1.2.2 Shielding effects are minimal at the 60 Hertz fundamental frequency. The effectiveness of the shield will increase as the frequency increases. For example; a 6.1 Km. (20 Kf) length of 12 pair 24 gauge cable with an 8 mil Aluminum shield will reduce induced 60 Hz influence by 0.23 dB while at 540 Kz the reduction will be 5.3 dB. Also, the effectiveness of the shield will increase as the size of the cable is increased. Using the same length, gauge and shield material at 60 Hz a 100 pair cable provides a reduction of 0.55 dB while a 2100 pair cable will provide 1.61 dB. At 540 Hz the reductions will be 8.9 and 14.1 dB, respectively. Regardless, the cable shield and associated grounding system are important in controlling high voltage levels induced in telecommunications systems from power system faults and nearby lightning strikes (See REA TE&CM Section 801.) An effective shielding and grounding system helps dissipate the high voltage thus reducing the chance of communication system damage.

1.3 Cable pairs with greater than 80 dBrnc power influence may indicate excessive power system interference. It is equally likely that a shielding problem is indicated. A shielding problem may be related to an open shield circuit, a high resistance bonding connection, inadequate grounding or any combination of these.

1.3.1 A power influence greater than 90 dBrn indicates an excessive power system interference. The principal frequency component is usually 60 Hertz. Correction of shielding and/or grounding problems will not significantly reduce low frequency interference. During a noise investigation, effort should be directed toward reducing the 60 Hz voltage level before proceeding further. After reduction to an acceptable level it can be determined whether there is still a voice frequency noise problem that will require further investigation.

1.3.2 This does not mean that shield deficiencies should not be corrected when there is a 60 Hz voltage problem. It is intended to show that in these situations it is not the first priority for the reduction of circuit noise. Such shield problems should be repaired to eliminate a potential hazard to the public and craftspeople.

1.4 The following procedure is recommended for determining shielding effectiveness and the specific locations where repair is needed. It combines three techniques and has the advantage of not requiring that the shield circuit be opened at any time. The procedure is divided into three phases; Identification, Isolation and Location.

1.4.1 Identification: Determination that there are existing shield problems is essential. This may be accomplished by completing a harmonic analysis of a cable pair power influence at the subscriber end of the cable. The technique is discussed in REA TE&CM 452.1. The general harmonic frequency pattern that denotes an open shield also occurs if there are high resistance bonding connections or inadequate grounding. When the results indicate a shielding problem exists proceed to isolation. The identification phase can be omitted when a spectrum analyzer is not available. Starting the procedure with the isolation phase will be effective if there are shield problems.

1.4.2 Isolation: The objective is, of course, to complete the work in the shortest time with minimum travel. This can be accomplished by eliminating from further consideration lengths of cable along a cable route in which there are no shielding problems. The technique for verification of shield continuity in lengths containing a single size, gauge and shield material is discussed in Paragraph 2. This method effectively reduces the number of splice locations that are visited to determine the exact location(s) of the problems.

1.4.2.1 As previously discussed in Paragraph 1.2.1 effective shielding can be impaired by inadequate grounding of the cable shield. Cable shield grounding should be checked during the isolation phase in the interest of meeting the minimum time and travel objective. This action will eliminate the need for a special trip along the entire cable length for this purpose.

1.4.2.2 The cable should be checked for connections between the power system MGN and the cable shield at the points identified in REA TE&CM 451.7. Where connections are missing they should be established. This provides maximum voice frequency shielding effectiveness.

1.4.3 Location: A visit is made to each splice location along a length of cable after it has been determined that there are shielding problems in the section. The shield and bonding continuity are evaluated during the visit. The splice should also be examined for evidence of conductor insulation cracking or other signs of deterioration. Every splice should be visited even though a problem has been found and corrected since there may be more than one shielding problem in the cable section. There are two techniques which may be used for measuring continuity at each splice location, without disturbing the shield continuity through the splice.

1.4.3.1 A shield splice continuity test set provides a sensitive method for determining the effectiveness of bonding connections across the splice. Although it is designed primarily for checking the bonding connections an experienced tester can usually detect major shield problems between splice locations. The position of the probe(s) on the cable sheath is critical and dirt on the sheath can affect the accuracy of the results. It is important that the tester be familiar with the test set limitations discussed in Paragraph 3.

1.4.3.2 Measurement of the longitudinal ac shield current appears to be the most sensitive method for determining shield continuity. There are fewer limitations associated with this technique which is discussed in Paragraph 4.

1.4.3.3 Some testers may prefer to utilize both test procedures at each splice location visited. The shield splice continuity test set can be used to examine the bonding and longitudinal current measurements completed to analyze the shield continuity between splices.

1.4.3.4 A Wheatstone bridge can be used to determine if there are shield problems between splices. It is also possible to find some intermittent problems in bonding connections with a Wheatstone bridge. The test is not sensitive enough to detect minor problems that may be contributing to overall shield degradation. Use of a Wheatstone bridge has the disadvantage of having to open the cable shield during testing. Thus, there is always a possibility of creating a new continuity problem when restoring the bonding connection after the testing is completed. See Paragraph 5 for a discussion of this test.

2. ISOLATION OF SHIELD CONTINUITY PROBLEMS

2.1 Before undertaking the checking of individual bonds and grounds along a cable route isolation procedures should be applied. These procedures will identify those specific sections of cable where there are shield problems. The sections where no problem is indicated do not have to be considered further. This can produce a significant reduction in the number of splice locations that must be tested.

2.2 Divide the cable route into sections of cable containing the same size, gauge and shield material. If the length of any of these sections exceeds 6 kilometers (20 kilofeet), they should be divided so that no individual section is more than that length. When cable lengths exceeding these are measured it is difficult to identify minor shield problem which may contribute to the over all shield problem. Measurements will be made between two splices that must be located near a power system multi-grounded neutral.

2.2.1 Testing may be started at either end of the cable route. In the interest of completing the work in the least time with minimum travel, starting at the office end of the route is recommended. Measurements can be made from the field end of the first test section to a termination set at the office. Then the termination set is moved to the field end of the second test sections. Now measurements can be completed from the office end of the second section without moving the test equipment. This leap frogging technique provides an efficient means of completing isolation measurements of shield continuity.

2.2.2 The initial action upon arrival at a splice location is to determine that there is a connection between the cable shield and the power system MGN. Where there is no existing connection at the location, one should be established prior to making any measurements.

2.3 Select ten pairs for bunching and grounding during the measurements. Also select another pair to be used as a talk pair and another for a test pair. See Figure 1, Shield Continuity Test, for a schematic of the test procedure.

2.3.1 It is desirable that the pairs selected be nonworking but this is not always possible, especially where small pair count cables are being measured. When working pairs must be used, notify the subscriber on those lines that work is in progress and that a short interruption may occur. All pairs must have dc continuity for the length of the test section. The dc continuity should be verified when nonworking pairs are to be used.

2.3.2 Terminate the test pair with a termination set at one end of the test section. Ground the center tap of the termination set. The test pair may not extend beyond the ends of the test section.

2.3.3 Connect a noise measuring set or spectrum analyzer to the test pair at the other end of the test section. Connect the ground terminal of the set to a screwdriver ground.

2.4 Open the ten selected pairs at each end of the test section and connect all conductors together. Measure the C-message weighted noise to ground on the test pair with the bunched pairs ungrounded. It is not necessary to use C-message weighting when measuring the noise to ground (Ng) of a single harmonic frequency, such as 540 Hertz, with a spectrum analyzer. Ground the bunched pairs at both ends and repeat the measurement of noise to ground on the test pair. Several measurements may be needed if the power influence is varying.

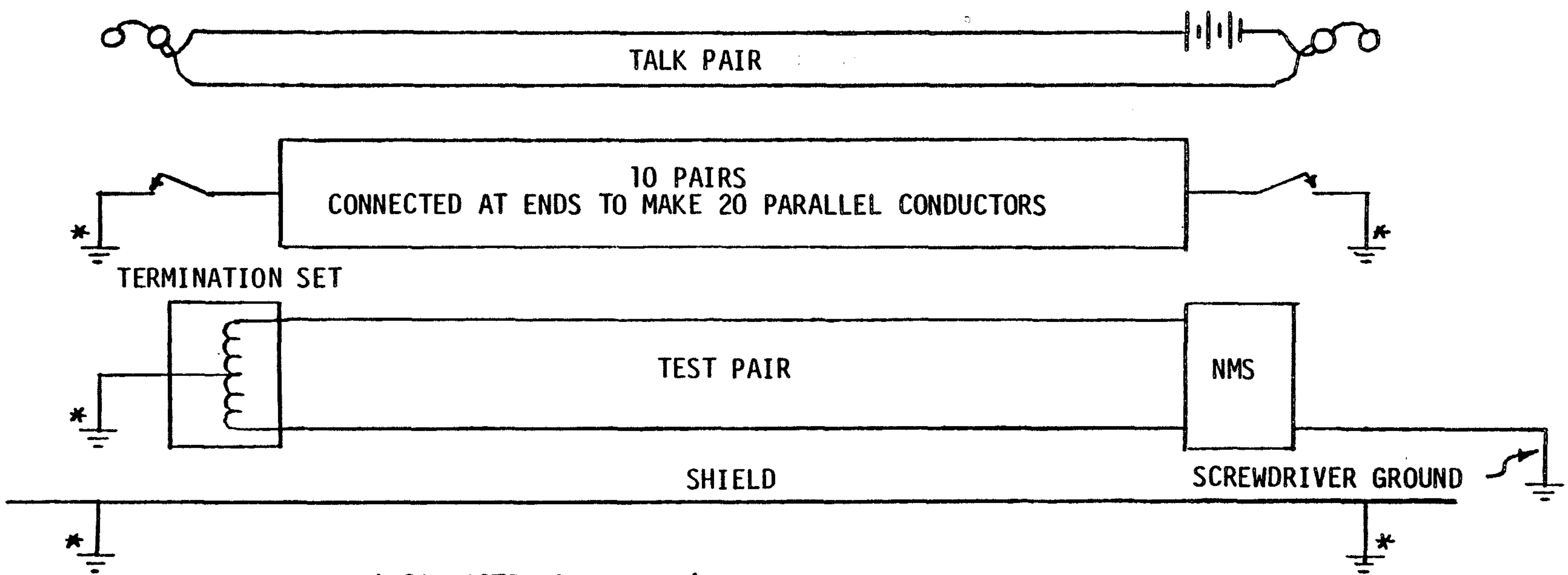
2.4.1 Subtract the recorded results of the second measurement from that of the first. Compare this measured difference to the calculated values in the Tables in Appendices B & C, as appropriate, for the size, gauge and length of cable in the test section. If the measured difference is equal to or less than the calculated value in the column for the shield material used (columns A through E, inclusive) the shield can be considered good. Generally, when the measured difference is more than fifty percent larger than this calculated value a partially open circuited shield is indicated. Measured differences in the range between the calculated value and fifty percent larger indicate the presence of minor bonding problems in the test section. An open circuited shield is indicated by a measured difference very near to or exceeding the value in the "10 Pr" column.

2.4.2 The termination set can be moved to the end of the next test section beyond the test location when the measured differences show the shield of the first test section is good. There is no necessity for correcting shield problems, if indicated, before testing subsequent cable section since the test does not rely on shield continuity back to the office for measurement of shield current. However it is suggested that in the interest of minimum travel time the necessary repairs be completed before proceeding further.

2.5 Reference to the Tables shows the difference between values indicating good and bad shield performance are small for short lengths of small pair size cables. This is also true for all lengths of 26 gauge cable. It is recommend that a spectrum analyzer be used for these tests. Results obtained when a noise measuring set is used will not provide accurate information.

3. SHIELD SPLICE CONTINUITY TESTING

3.1 A shield splice continuity test set can be used to effectively determine the integrity of bonding between cable shields at a splice location. An experienced operator can also detect open shields between splices.



* CONNECTIONS TO MGN (It is important that the 10 pairs and the shield are connected to the <u>same</u> MGN connection to establish the parallel path.

<u>PROCEDURE</u>

1. Measure Ng in dBrnc with 10-Pairs ungrounded
2. Measure Ng in dBrnc with 10-Pairs grounded
3. Calculate measured difference = Meas. 1 minus Meas. 2
4. Determine shield quality from appropriate Table in Appendices B and C

<u>SHIELD CONTINUITY TEST</u>

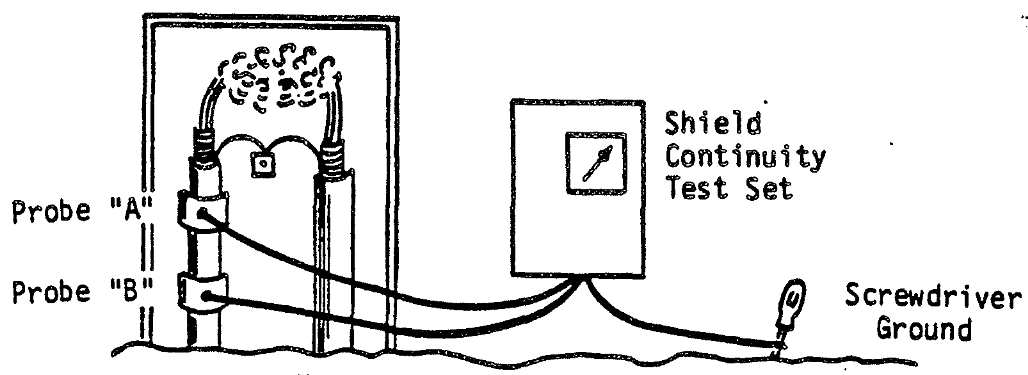
<u>FIGURE 1</u>

3.2 The test set is essentially a sensitive electrostatically coupled voltmeter calibrated in dB's for ease of reading. All cable shields have some 60 Hertz voltage and its harmonics present. The magnitude of the voltage is dependent upon several factors.

3.3 When a bond across a splice between two cable shields is good, the same potential to ground will appear on both sides of the splice. Should the bond be open or defective, a difference voltage will appear on each side of the splice. Measurement of the differential voltages across the splice and the voltage to ground on each side will determine the quality of the bond between the shields of the cable involved.

3.4 The test set manufacturer's recommended method for making splice continuity tests should be followed wherever possible.

3.4.1 A reference measurement should be taken by applying the probes to the same side of the cable sheath (both probes on one side of the splice) as shown in Figure 2, and recording the reading. Theoretically, there should be no reading but slight unbalances will result in a differential reading.

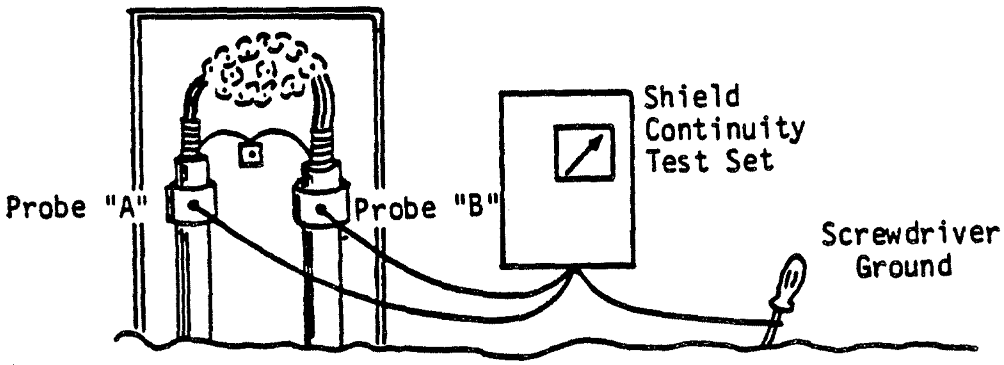


INITIAL DIFFERENTIAL READING

FIGURE 2

3.4.2 At the time the reference differential voltage is measured and the splice is measured, the voltage to ground on each probe should be measured and recorded. If no current is flowing in the shield, these voltages will be equal. If current is flowing in the shield circuit, or if there is a defective bond, there will be a voltage difference.

3.4.3 The probes are then placed across the splice as shown in Figure 3 and another reading is taken and recorded. If the bond between the two shields is good, there should be little difference between the two sets of readings. Should the values differ by more than about 2 dB, trouble in the bond is indicated. An open bond will produce a difference of 15 dB or greater. Smaller differences between 2 and 15 dB usually indicates a high resistance connection in the bonding circuit.



MEASUREMENT OF SPLICE BONDING CONTINUITY

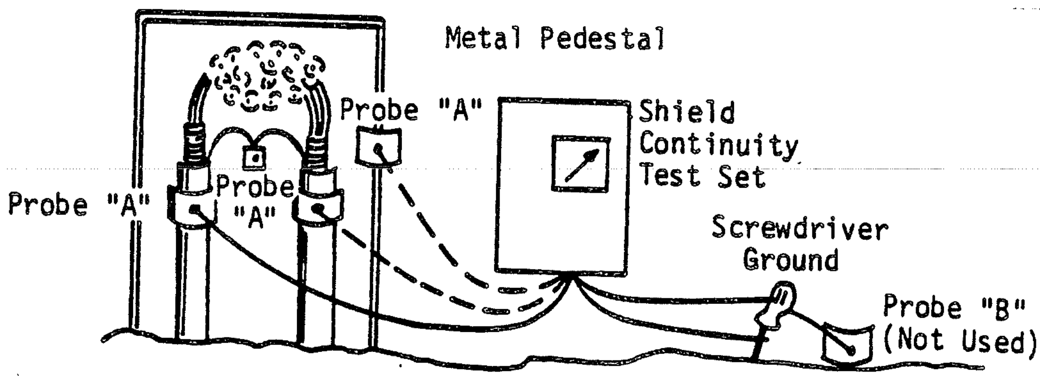
FIGURE 3

3.4.4 Intermittent conditions can usually be detected by moving the cable and wire of the bonding connector. When a problem exists the meter will move erratically as the components are moved.

3.4.5 Sometimes erratic meter readings will be observed without physical movement of the cable and the bonding connector wire. This condition may be caused by intermittent bonding connections or by missing grounds near the point of measurement. When grounds are missing, induced voltages on the shield will fluctuate sufficiently to give erratic readings on the measuring device.

3.5 When measuring splices in pedestals along buried cable routes, often there is not enough cable length in the pedestal for making a reference differential voltage reading. These splices may be effectively checked using a single probe and ground connection. This suggested method of operation eliminates the problems associated with using two probes in small pedestals. There is only one probe to position and the operation has two hands available for this operation.

3.5.1 With the single problem method voltage-to-ground is measured on each cable shield within the pedestal as shown in Figure 4. If the pedestal is metal the voltage-to-ground should be measured on it. Since with proper shielding everything, including the pedestal, should be at the same potential all readings should be the same. Where differences greater than 2 dB are found, there is a defective bond. This method can only be used with a metal pedestal.



SINGLE PROBE METHOD

FIGURE 4

3.5.2 When an indication of a defective bond is found, the probe can be placed on the bonding wires. When a large voltage difference is found between a bonding wire and its associated shield, the problems will be in the connection between the two.

3.6 It is recommended that shield continuity tests be started at the central office, working from there toward the subscriber end. Each shield problem should be corrected when it is found before proceeding with further tests. Measurements made beyond an uncorrected problem may be in error and additional shielding problems might not be detected.

3.7 The magnitude of the voltage-to-ground at each splice location should be recorded. If all bonds and ground connections are good, the magnitude of the voltage to ground should rise slowly as the distance from the central office increases and then decreases slowly as a ground is approached in the field. Where a sudden rise or fall in potential is found between two adjacent pedestals the shield continuity between the pedestals should be measured with a Wheatstone bridge as described in Paragraph 5. Many open shields between pedestals have been found using this method.

3.8 As with all test equipment, the manufacturers instructions for the particular piece of test equipment should be studied before using the equipment.

4. SHIELD CURRENT MEASUREMENTS

4.1 Measurement of the current on a telephone cable shield can effectively determine the condition of the shielding circuit. Problems in the shield between splice locations, shield bonding connectors, connections to grounds at the ends of drops and taps, etc., can be detected with this technique.

4.1.1 A clamp-on ammeter is utilized to measure the current magnitude flowing in the shield circuit. A clamp-on current adapter designed for use with a shield splice continuity test set can be used for this purpose. The clamp-on adapter may also be used with a noise measuring set. Due to its portability a shield continuity test set is most convenient.

4.1.1.1 The following discussion of specific test equipment produced by a single manufacturer for completing shield current measurements does not constitute an endorsement of these products. It further does not indicate the measurements cannot be performed using other manufacturers' test equipment which are capable of making the described tests. At the time of this writing they were the only ones known to be available for making the measurements.

4.1.1.2 The tests described can be completed with the Wilcom Products, Inc., T174 Shield Splice Continuity Test Set and T172 Current Adapter. There are two models of the T124 in use. The early model requires a 45-volt battery while the later model uses five 9-volt batteries. Table 1A has been prepared for converting the dB readings obtained with T124 test sets equipped with a 45-volt battery (serial number 1 through 2222) to current values. When the T124 test set is equipped with 9-volt batteries (serial number 2223 or higher) use Table 1B for this conversion.

4.1.1.3 The T172 Current Adapter may also be used with a noise measuring set for the measurement of shield current. When making these measurements set the noise measuring set for 600 ohm TERM and 3 kHz Flat. Table 1A has been prepared for converting the dBrn readings from the noise measuring set to current values.

4.1.1.4 The same manufacturer is also producing a T304 Current Meter and T305 Current Probe which provide direct measurement of shield current from 10 milliamperes to 100 amperes. This is an ideal tool for locating cable shield problems by measurement of shield current.

4.1.1.5 A T305 Current Adapter can also be used with a noise measuring set (NMS) for measuring shield current. When used for performing these measurements set the noise measuring set for 600 ohm BRDG and 3 kHz Flat. Table 1B has been prepared for converting the dBrn readings from the noise measuring set to current values.

4.1.1.5.1 For individuals who find it more convenient to use a calculator the nominal output of T305 is 24.5 mV/ampere. With a NMS set as described in Paragraph 4.1.1.5 the reading on the dBrn scale is in dB above one milliampere.

4.1.1.5.2 This reading can be converted to milliamperes or amperes without any need for a special conversion table. The equation is:

$$I_{mA} = \log^{-1}\left(\frac{\text{dBrn (reading)}}{20}\right)$$

4.1.2 Testing should always be started at the central office main frame, moving progressively to each splice location until the far end of the cable is reached. When a problem is found it should be corrected before moving to the next location. Failure to do this can result in problems located further from the office being overlooked. This will add unnecessary time to locate and correct all shielding problems along the cable route.

4.1.3 When a major shield problem is located a declining shield current will be found in several splice locations as the problem site is approached. It is recommended that these splice locations be remeasured after repair of the major fault to insure that a less severe problem has not been bypassed. Such problems can be masked by the effects of major defects along the cable shield.

4.2 The shield circuit along a cable has many potential paths to ground as shown in Figure 5. When making shield current tests along the main cable route all shield connections at a splice location, except the main route shield connections toward the office and the field, are assumed to be ground connections.

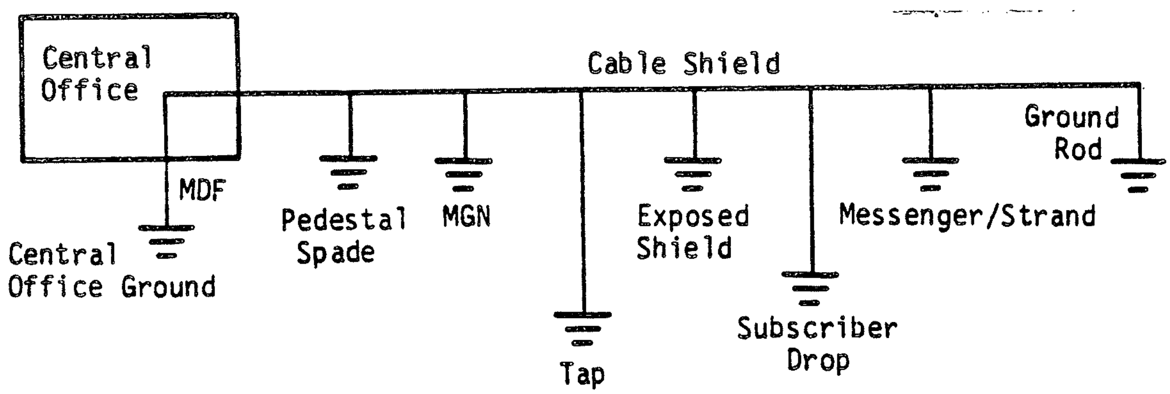


FIGURE 5

SHIELD GROUND CONNECTIONS

Table 1A

Conversion From Decibel Reading to Current in Milliamperes

T124 Shield Continuity Test Set and T172 Current Adapter
(For T124 using a 45-volt battery)

0		-10		-20		-30		-40		-50	
dB	Amp	dB	Amp	dB	Amp	dB	mA	dB	mA	dB	mA
-0.5	29.85	-10.5	9.44	-20.5	2.99	-30.5	944	-40.5	299	-50.5	94
-1.0	28.18	-11.0	8.91	-21.0	2.82	-31.0	891	-41.0	282	-51.0	89
-1.5	26.61	-11.5	8.41	-21.5	2.66	-31.5	841	-41.5	266	-51.5	84
-2.0	25.12	-12.0	7.94	-22.0	2.51	-32.0	794	-42.0	251	-52.0	79
-2.5	23.71	-12.5	7.50	-22.5	2.37	-32.5	750	-42.5	237	-52.5	75
-3.0	22.39	-13.0	7.08	-23.0	2.24	-33.0	708	-43.0	224	-53.0	71
-3.5	21.14	-13.5	6.68	-23.5	2.11	-33.5	668	-43.5	211	-53.5	67
-4.0	19.95	-14.0	6.31	-24.0	2.00	-34.0	631	-44.0	200	-54.0	63
-4.5	18.84	-14.5	5.96	-24.5	1.88	-34.5	596	-44.5	188	-54.5	60
-5.0	17.78	-15.0	5.62	-25.0	1.78	-35.0	562	-45.0	178	-55.0	56
-5.5	16.79	-15.5	5.31	-25.5	1.68	-35.5	531	-45.5	168	-55.5	53
-6.0	15.85	-16.0	5.01	-26.0	1.59	-36.0	501	-46.0	159	-56.0	50
-6.5	14.96	-16.5	4.73	-26.5	1.50	-36.5	473	-46.5	150	-56.5	47
-7.0	14.13	-17.0	4.47	-27.0	1.41	-37.0	447	-47.0	141	-57.0	45
-7.5	13.34	-17.5	4.22	-27.5	1.33	-37.5	422	-47.5	133	-57.5	42
-8.0	12.59	-18.0	3.98	-28.0	1.26	-38.0	398	-48.0	126	-58.0	40
-8.5	11.89	-18.5	3.76	-28.5	1.19	-38.5	376	-48.5	119	-58.5	38
-9.0	11.22	-19.0	3.55	-29.0	1.12	-39.0	355	-49.0	112	-59.0	36
-9.5	10.59	-19.5	3.35	-29.5	1.06	-39.5	335	-49.5	106	-59.5	34
-10.0	10.0	-20.0	3.16	-30.0	1.00	-40.0	316	-50.0	100	-60.0	32

Table 1B

Conversion From Decibel Reading to Current in Milliamperes

T124 Shield Continuity Test Set and T172 Current Adapter
(For T124 using five 9-volt batteries)

0		-10		-20		-30		-40		-50	
dB	Amp	dB	Amp	dB	mA	dB	mA	dB	mA	dB	mA
-0.5	18.07	-10.5	5.71	-20.5	1806	-30.5	571	-40.5	181	-50.5	57
-1.0	17.06	-11.0	5.39	-21.0	1705	-31.0	539	-41.0	171	-51.0	54
-1.5	16.10	-11.5	5.09	-21.5	1610	-31.5	509	-41.5	161	-51.5	51
-2.0	15.20	-12.0	4.81	-22.0	1520	-32.0	481	-42.0	153	-52.0	48
-2.5	14.35	-12.5	5.38	-22.5	1435	-32.5	454	-42.5	143	-52.5	45
-3.0	13.55	-13.0	4.28	-23.0	1355	-33.0	428	-43.0	136	-53.0	43
-3.5	12.79	-13.5	4.04	-23.5	1279	-33.5	404	-43.5	128	-53.5	40
-4.0	12.08	-14.0	3.82	-24.0	1207	-34.0	382	-44.0	121	-54.0	38
-4.5	11.40	-14.5	3.61	-24.5	1140	-34.5	361	-44.5	114	-54.5	36
-5.0	10.76	-15.0	3.40	-25.0	1076	-35.0	340	-45.0	108	-55.0	34
-5.5	10.16	-15.5	3.21	-25.5	1016	-35.5	321	-45.5	102	-55.5	32
-6.0	9.59	-16.0	3.03	-26.0	960	-36.0	303	-46.0	96	-56.0	30
-6.5	9.06	-16.5	2.86	-26.5	905	-36.5	286	-46.5	91	-56.5	29
-7.0	8.64	-17.0	2.70	-27.0	855	-37.0	271	-47.0	85	-57.0	27
-7.5	8.07	-17.5	2.55	-27.5	807	-37.5	255	-47.5	81	-57.5	26
-8.0	7.62	-18.0	2.41	-28.0	762	-38.0	241	-48.0	76	-58.0	24
-8.5	7.19	-18.5	2.27	-28.5	720	-38.5	228	-48.5	72	-58.5	23
-9.0	6.79	-19.0	2.15	-29.0	679	-39.0	215	-49.0	68	-59.0	21
-9.5	6.41	-19.5	2.03	-29.5	641	-39.5	203	-49.5	64	-59.5	20
-10.0	6.06	-20.0	1.91	-30.0	605	-40.0	191	-50.0	61	-60.0	19

Table 2A

Conversion From Decibel Reading to Current in Milliamperes

Noise Measuring Set and T172 Current Adapter

10		30		40		50		60		70		80	
dBrn	mA	dBrn	mA	dBrn	mA	dBrn	mA	dBrn	Amp	dBrn	Amp	dBrn	Amp
11	3	30.5	24	40.5	75	50.5	237	60.5	.75	70.5	2.37	80.5	7.4
12	3	31.0	25	41.0	79	51.0	251	61.0	.79	71.0	2.51	81.0	7.9
13	3	31.5	27	41.5	84	51.5	266	61.5	.84	71.5	2.66	81.5	8.4
14	4	32.0	28	42.0	89	52.0	282	62.0	.89	72.0	2.82	82.0	8.9
15	4	32.5	30	42.5	94	52.5	298	62.5	.94	72.5	2.98	82.5	9.4
16	5	33.0	32	43.0	100	53.0	316	63.0	1.00	73.0	3.16	83.0	10.0
17	5	33.5	34	43.5	106	53.5	335	63.5	1.06	73.5	3.35	83.5	10.6
18	6	34.0	35	44.0	112	54.0	354	64.0	1.12	74.0	3.54	84.0	11.2
19	6	34.5	38	44.5	119	54.5	375	64.5	1.19	74.5	3.75	84.5	11.9
20	7	35.0	40	45.0	126	55.0	398	65.0	1.26	75.0	3.98	85.0	12.6
21	8	35.5	42	45.5	133	55.5	421	65.5	1.33	75.5	4.21	85.5	13.3
22	9	36.0	45	46.0	141	56.0	446	66.0	1.41	76.0	4.46	86.0	14.1
23	10	36.5	47	46.5	149	56.5	473	66.5	1.49	76.5	4.73	86.5	14.9
24	11	37.0	50	47.0	158	57.0	501	67.0	1.58	77.0	5.01	87.0	15.8
25	13	37.5	53	47.5	168	57.5	530	67.5	1.68	77.5	5.30	87.5	16.8
26	14	38.0	56	48.0	178	58.0	562	68.0	1.78	78.0	5.62	88.0	17.8
27	16	38.5	60	48.5	188	58.5	595	68.5	1.88	78.5	5.95	88.5	18.8
28	18	39.0	63	49.0	199	59.0	630	69.0	1.99	79.0	6.30	89.0	19.9
29	20	39.5	67	49.5	211	59.5	668	69.5	2.11	79.5	6.68	89.5	21.1
30	22	40.0	71	50.0	224	60.0	707	70.0	2.24	80.0	7.07	90.0	22.4

NOTE: Set NMS for 600 ohm TERM and 3 kHz Flat

Table 2B

Conversion From Decibel Reading to Current in Milliamperes

Noise Measuring Set and T305 Current Probe

0		20		30		40		50		60		70		80	
dBrn	mA	dBrn	mA	dBrn	mA	dBrn	mA	dBrn	mA	dBrn	Amp	dBrn	Amp	dBrn	Amp
1	1	20.5	11	30.5	33	40.5	106	50.5	335	60.5	1.06	70.5	3.35	80.5	10.6
2	1	21.0	11	31.0	35	41.0	112	51.0	355	61.0	1.12	71.0	3.55	81.0	11.2
3	1	21.5	12	31.5	38	41.5	119	51.5	376	61.5	1.19	71.5	3.76	81.5	11.9
4	2	22.0	13	32.0	40	42.0	126	52.0	398	62.0	1.26	72.0	3.98	82.0	12.6
5	2	22.5	13	32.5	42	42.5	133	52.5	422	62.5	1.33	72.5	4.22	82.5	13.3
6	2	23.0	14	33.0	45	43.0	141	53.0	447	63.0	1.41	73.0	4.47	83.0	14.1
7	2	23.5	15	33.5	47	43.5	150	53.5	473	63.5	1.50	73.5	4.73	83.5	15.0
8	3	24.0	16	34.0	50	44.0	158	54.0	501	64.0	1.58	74.0	5.01	84.0	15.8
9	3	24.5	17	34.5	53	44.5	168	54.5	531	64.5	1.68	74.5	5.31	84.5	16.8
10	3	25.0	18	35.0	56	45.0	178	55.0	562	65.0	1.78	75.0	5.62	85.0	17.8
11	4	25.5	19	35.5	60	45.5	188	55.5	596	65.5	1.88	75.5	5.96	85.5	18.8
12	4	26.0	20	36.0	63	46.0	200	56.0	631	66.0	2.00	76.0	6.31	86.0	20.0
13	5	26.5	21	36.5	67	46.5	211	56.5	668	66.5	2.11	76.5	6.68	86.5	21.1
14	5	27.0	22	37.0	71	47.0	224	57.0	708	67.0	2.24	77.0	7.08	87.0	22.4
15	6	27.5	24	37.5	75	47.5	237	57.5	750	67.5	2.37	77.5	7.50	87.5	23.7
16	6	28.0	25	38.0	79	48.0	251	58.0	794	68.0	2.51	78.0	7.94	88.0	25.1
17	7	28.5	27	38.5	84	48.5	266	58.5	841	68.5	2.66	78.5	8.41	88.5	26.6
18	8	29.0	28	39.0	89	49.0	282	59.0	891	69.0	2.82	79.0	8.91	89.0	28.2
19	9	29.5	30	39.5	94	49.5	299	59.5	944	69.5	2.99	79.5	9.44	89.5	29.9
20	10	30.0	32	40.0	100	50.0	316	60.0	1000	70.0	3.16	80.0	10.00	90.0	31.6

NOTE: Set NMS for 600 ohm BRDG and 3 kHz. Flat.

4.2.1 As stated, taps from the main cable route are treated as ground connections when testing along the main cable route. After completion of work along the main route each tap is studied individually. During testing along a tap route it is considered in the same manner as the main cable route discussed in Paragraph 4.2.

4.2.2 After all testing has been completed and problems corrected it is sometimes desirable to remeasure the shield currents at all splice locations a second time recording the results. This will provide a reference for comparison should future problems occur.

4.3 Shield current measurements are made by placing the clamp-on device around the wire or strap of the bonding harness, reading and recording the current. The readings when in dBrn, should be converted to current in amperes before recording. Measuring the current in the bonding wire or strap eliminates the longitudinal current flowing on the conductor bundle forming the cable core. Thus the reading provides only the magnitude of the current flowing in the shielding circuit.

4.3.1 Measure the current in each bonding wire or strap in each pedestal or splice with the clamp-on device as shown in Figure 6A and record the results. Start at the office end of the cable route. In a pedestal there is no wire leading to the spade and sometimes the wire connection to a ground rod is not readily accessible. The current flowing to ground through these connections can be measured by clamping the device around all the bonding wires or straps leading to the common point as shown in Figure 6B.

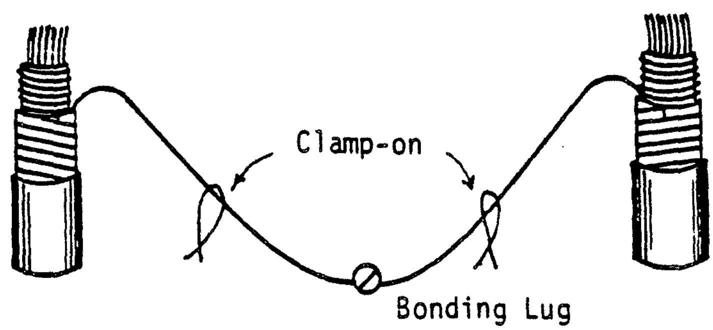


FIGURE 6A

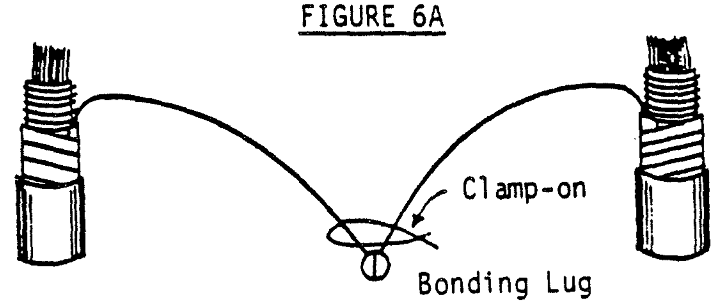


FIGURE 6B

MEASUREMENT OF SHIELD CURRENT

4.3.1.1 The total incoming current should be equal to the total outgoing current at any given point. Where there are only two or three directions (ground and/or office and field direction) to consider this determination is quite simple. The recorded current in either the office of field direction will equal the current in the other direction plus that in the ground connection as shown in Figure 7. A 10 percent tolerance should be allowed since the power influence is a variable factor and changes can occur during the measurements. Also in pedestals where long taps join the main cable varying phase angles may produce differences between incoming and outgoing curents.

Ped., Pole or Terminal No.	Office Side	Field Side	Ground Type	Current	Remarks
CO	-	890	CO		
B1	950	950			
B2	1000	800	B2R TAP	100	
			Drop	120	
B3	840	1200	MGN	350	
			PED	#	
			Drop	100	
			Drop	C	

NOTE: # Indicates no meter movement
C Indicates meter movement but no readable current

FIGURE 7
SAMPLE CURRENT MEASUREMENTS

4.3.1.2 There is an apparent exception to the rule that total input current equals the total output current. This can occur when a connection to the multigrounded neutral exists at the points of measurement. Due to the phase angle relationships between the current flowing in the power neutral and the cable shields large apparent differences may be found between ins and outs.

4.3.1.2.1 Theoretically, if there is one ampere measured current toward the office and toward the field and both have the same phase angle no current will be measured toward the power neutral. When the phase angles are completely opposite, for example 0^o toward the office and 180^o toward the field, two amperes will be measured toward the power neutral. If the phase angle toward the office is 60^o and toward the field is 120^o (a 60^o phase angle difference) one ampere will be measured toward the neutral conductor. Thus, depending on the phase angle relationship in two directions, any current value between zero and the sum of two currents will be measured in the third.

4.3.1.2.2 When measuring shield current at a point where there is a connection to the multigrounded neutral first measure the current in each of the wires. Then measure the pair combinations (office-MGN, field-MGN, and office-field) as shown in Figure 6B. If the results of each of the combination measurements is essentially the same as the recorded current in the third wire the measurements can be accepted as correct. The bonding connections should be checked in the manner shown in Paragraph 4.3.3.

4.3.1.3 Where there are more than three connections to consider, such as, office, field, tap, drop, and ground rod or pedestal spade it is sometimes difficult to identify the ins and outs by inspections. The direction of current flow can be determined by measurement. In the example shown in Figure 8 six measurements have been made and recorded. Inspection reveals there are several combinations that are essentially equal and the problem is to determine which applies.

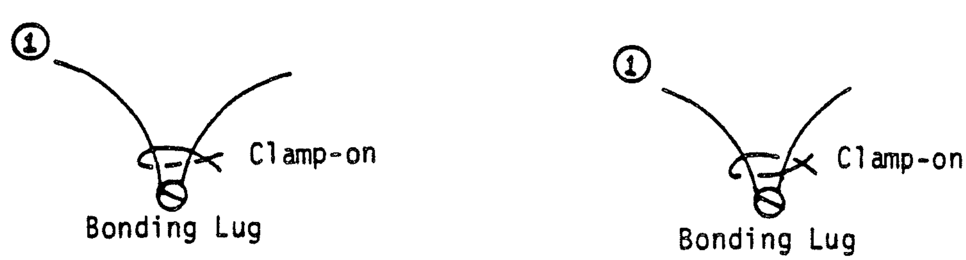
4.3.1.3.1 First, assume that the current in the bonding wire or strap having the highest recorded value is flowing toward the bonding lug. In the example in Figure 8, the office direction has been selected. Next number the various directions as shown in the example with the selected wire designated 1. An arrow pointing down indicates current is flowing toward the common connection point. Place the clamp-on device around wires 1 and 2. If the resulting current is lower than that recorded for number 1, the current in the two wires is flowing in opposite directions. When it is higher the current flow is in the same direction. In the example, the current is lower so an arrow pointing up is placed by the 2 indicating the current is flowing away from the common connection point.

Ped., Pole or Terminal No.	Office Side	Field Side	Ground Type	Current	Remarks
C6-1	①↓950	②↑750	Ped.	③↓ 300	
			Drop	④↑ 120	
			Drop	⑤↑ 150	
			Tap	⑥↑ 260	
				220	↓① - ②↑
				850	↓① + ④↑
				800	↓① + ⑤↑
				680	↓① + ⑥↑
				1210	② + ④ + ⑤ + ⑥

FIGURE 8
MULTIPLE SHIELD EXAMPLE

4.3.1.3.2 Measure progressively through all combinations with the number 1 as shown in the example (1 & 4, 1 & 5 and 1 & 5). In the example it is not possible to measure the 1 and 3 combination directly since 3 is the pedestal spade. By inspection the current should be flowing toward the lug in the same direction as 1 to obtain equality. As a check of the results place the clamp-on device around the group of wires shown as having current flowing in the same direction which does ot include the pedestal spade and verify that the current read is within 10 percent of the sum of the individual readings.

4.3.1.4 Should there still be a question after performing the measurements described in Paragraph 4.3.1.3.1 as to the direction of the current in one of the bonding wires or straps it can be established by a direct measurement. Repeat the measurement of the wire in question and wire 1 but reverse the direction of the wire in question through the clamp-on device as shown in Figure 9. If the first recorded result of the measurement from Paragraph 4.3.1.3.1 is higher the current in the two wires is flowing in the same direction. If the results of this second measurement is higher, the current is flowing in opposite directions or away from the common connecting point.



(As measured in P. 4.3.1.3.1)

(Second Measurement)

FIGURE 9

DETERMINING CURRENT DIRECTION

4.3.2 Valuable information can sometimes be obtained by using a nearby ground connection to the multi-grounded neutral as a reference ground. This is accomplished by extending a wire from the ground wire on a power pole to a telephone pedestal and connecting it to the telephone cable shield.

4.3.2.1 This technique should be employed when there is a question that the magnitude of the shield current is too low. Such condition may be indicated when a sudden drop in shield current occurs over a length of three or four splice locations. Connecting the shield to a known low resistance ground such as the multigrounded neutral will provide an indication of the direction to a shield problem

4.3.2.2 An example of this technique is taken from the recorded results made during a noise investigation showing a shield current toward the office of 40mA and toward the field 5mA. After the connection was made to a nearby pole with a multigrounded neutral ground wire the measured shield current toward the office was 450mA and toward the field 9mA with a current of 500mA in the MGN connection. An open in the shield circuit was found in the next pedestal toward the field. After this was repaired the shield current in the original pedestal, after removal of the MGN connection, was 500mA in both the office and field connection.

4.3.3 The last operation at each location is the measurement of the bonding connection to the shield for each cable in the pedestal of splice point. For this measurement a single insulated wire about three feet long is needed with a test probe at each end. The test probes should have steel tips honed to a sharp needle point. It is advisable when performing these tests that a small oil stone be available for maintaining the tips sharp.

4.3.3.1 Place the clamp-on device around the cable below the bonding connection. Place one test probe point on the bonding wire or strap adjacent to but not touching the bond lug. With the other probe, while watching the test set meter, pierce the sheath between the bonding harnes connection and the clamp-on device until contact is made with the shield as shown in Figure 10. If the dB reading changes by 0.5 dB or more, there is a problem and the bonding harness should be replaced. The bonding wire or strap should be moved during this measurement to detect any intermittent condition.

4.3.3.2 When there is no change in the meter reading move the probe from the bonding wire or strap to the bonding lug as shown in Figure 10. A change in the meter reading of 0.5 dB or more indicates a problem in the connection at the bonding lug and it should be remade. The bonding wire or strap should be moved at the point of connection with the bonding lug during this measurement to detect any intermittent condition.

4.3.3.3 This same procedure is followed for each cable entering the splice point. If a multigrounded neutral connection exists one probe should be placed on the wire outside the pedestal or splice point and the other on the bonding lug after placing the clamp-on device around the wire to the MGN beyond the probe location. A change of 0.5 dB or more indicates a problem in the connection to the bonding lug and it should be remade.

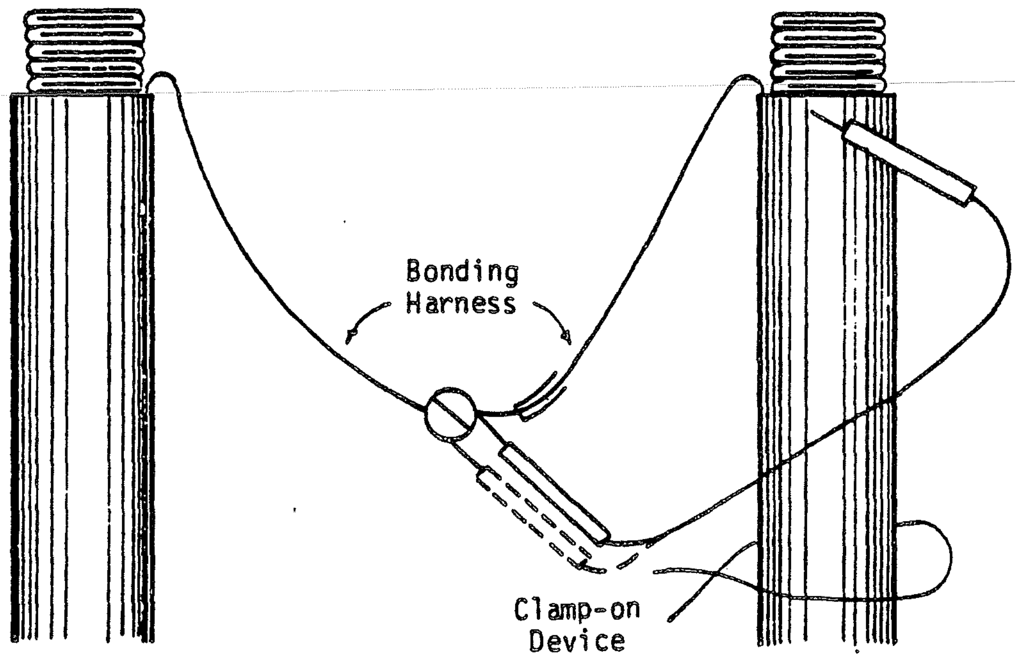


FIGURE 10

MEASUREMENT OF BONDING HARNESS CONNECTION

4.4 A suggested format for recording the results of shield current measurements is shown in Figure 11.

5. SHIELD RESISTANCE USING A WHEATSTONE BRIDGE

5.1 This test is effective for determining condition of the shield between splices. It can also give some indication of the effectiveness of the connection between the bonding harness and the shield, although it is not as sensitive as a shield continuity test set.

5.2 Using a Wheatstone bridge, measure the loop resistance (R1) of an idle pair between two pedestals or splices (Figure 12). Record this resistance. This can be done with the pair shorted at the far end and connected to the cable shield.

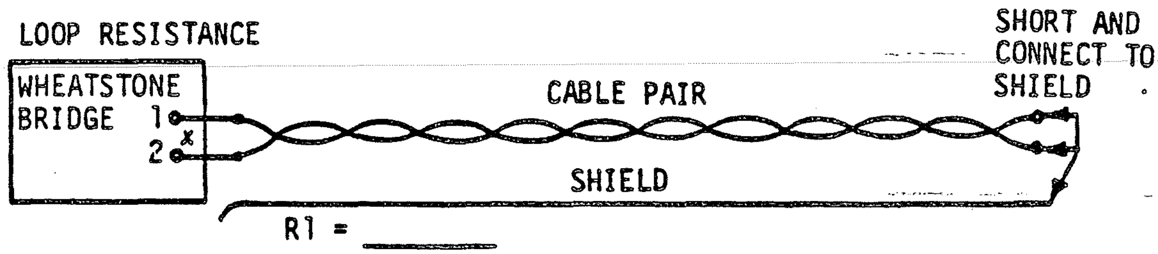
FIGURE 11

SHIELD CURRENT MEASUREMENT

SHEET____of____

EXCHANGE ________________LINE NO.________DATE________________

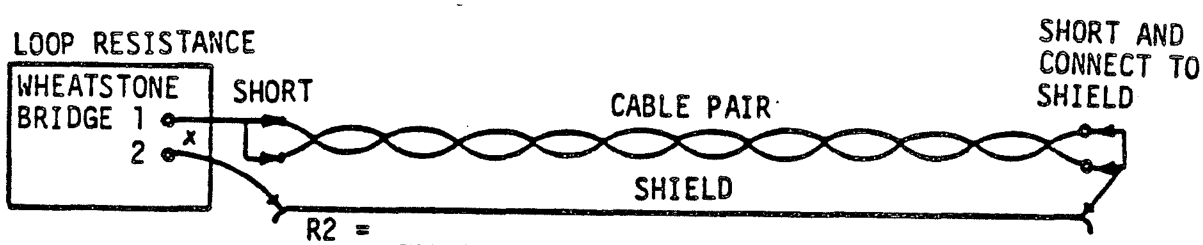
PED., POLE OR TERMINAL	OFFICE SIDE	FIELD SIDE	GROUND TYPE	CURRENT	COMMENTS



SHIELD CONTINUITY WITH WHEATSTONE BRIDGE - LOOP RESISTANCE

FIGURE 12

5.3 Short tip and ring of the pair at measuring end and connect to one terminal of the Wheatstone bridge. Connect shield to other terminal of the bridge. Measure loop resistance (R2) and record the value (Figure 13).



SHIELD CONTINUITY WITH WHEATSTONE BRIDGE - SHIELD RESISTANCE

FIGURE 13

The shield resistance (R_s) is: $R_s = R2 - \frac{R1}{4}$

5.4 If the measured shield resistance exceeds the calculated shield resistance by 25 percent, it is likely that a shield problem exists. An open circuited shield is easy to identify since the difference between measured and calculated values will be very great. Calculated shield resistances for various shield materials are shown in Tables B-34 thru B-45 in Appendix B for English units of measure and in Tables C-34 thru C-45 in Appendix C for the metric equivalents of the English units.

Total Shield Resistance = Shield Resistance per Unit Length x Total Length

APPENDIX A

SHIELD ISOLATION THEORY

1. GENERAL

1.1 Checking the integrity of shield continuity and bonding connections along a cable route requires many hours when every splice location is visited. The working time can be significantly reduced by isolating the shield problem(s) into the specific section(s) of cable where located. This can be accomplished by measuring lengths of cable along the route containing only a single cable size, gauge and shield material. Visits to individual splice locations are required along only those sections of cable where the isolation measurements indicate there is a problem.

1.1.1 The technique presented in this practice is an adaptation of one that has been used to check the end to end shield integrity of a cable route. The original method required the availability of sufficient cable pairs that when connected in parallel would equal the end to end resistance of the cable shield. Two measurements of power influence were completed on another cable pair; one with the parallel pairs open circuited to ground and the second with the parallel pairs grounded via the power system multigrounded neutral at both ends. A reduction of power influence between the first and second measurement of less than 3 dBrnc was assumed to indicate the shield was continuous. Any reduction in power influence exceeding 6 dBrnc was interpreted as indicating an open circuited shield. Reductions in power influence between 3 and 6 dBrnc were believed to be an indication of bonding problems. The technique was only moderately successful in identifying the presence of open shield circuits.

1.1.2 Investigation has shown that the size and length of each cable section which is part of the total cable route has a direct bearing on the measured level of power influence at the end of the cable. There are conditions where a reduction in power influence in excess of 3 dBrnc can be measured with a continuous cable shield circuit. Conversely bonding problems may be present when the measured power influence levels are reduced by less than 3 dBrnc. There is no reliable means available for predicting the end to end reduction in power influence level indicative of good or poor shielding along a cable route. This is due to the limitless combination of cable sizes and lengths found in the field.

1.2 A reduction in the power influence will occur when a group of cable pairs is grounded at each end of a length of cable. The magnitude of this reduction is controlled by whether there is good or poor shield continuity. The reductions can be accurately calculated for cable lengths having a single size, gauge and shield material. There will be a relatively small reduction of power influence when a continuous cable shield in connected in parallel with a group of cable pairs. A significantly larger reduction will occur when the cable shield is open circuited and a group of cable pairs connected in parallel are grounded at each end of the section.

1.2.1 The reduction in dBrnc that will occur with a continuous or open circuited shield can be calculated for any power system harmonic frequency. Tables have been included in Appendices B & C of this practice showing the calculated values at 540 Hertz for various cable sizes, gauges, lengths and shielding materials. Appendix B is in English units of measure and Appendix C is in the metric equivalents of the units in Appendix B.

1.2.2 Selection of 540 Hertz as the frequency for preparing the tables permits the measurements to be made with a noise measuring set using C-message weighting. This is the predominant harmonic frequency component of most C-message weighted power influence and will usually control the level of noise measurements. The test will have maximum sensitivity when a spectrum analyzer is used to measure the power influence at only the harmonic frequency of interest. Sensitivity to shielding irregularities increases with frequency. Calculations have been made of the reductions in power influence with a continuous and open circuited shield circuit for a cable 3 kilometers (10 kilofeet) long. The cable is assumed to be 100 pair 24 gauge filled with an 8 mil coated aluminum shield. It is further assumed that earth resistivity is 1000 meter-ohms and the total resistance of all grounds is 5 ohms. The results of these calculations at various frequencies are:

Reduction in dBrnc

Frequency in Hz.	180	300	540	780	900
10 Pairs Only	1.0	2.2	4.6	6.7	7.6
10 Pairs and Shield	0.7	1.1	1.5	1.7	1.7

When another harmonic frequency is identified as predominant it will be necessary to calculate factors for that frequency. The equations for completing these calculations are shown in Appendix B for English units and in Appendix C for metric units of measure.

1.2.3 The Tables in Appendices B and C are for use with ten cable pairs connected in parallel through the test section. Ten pairs is considered enough to provide good sensitivity for the test. The sensitivity to open circuited shield circuits improves in direct relation to the number of bunched pairs used. Calculations at 540 Hertz using the same cable as in Paragraph 1.2.2 for different numbers of cable pairs produced the following results:

Reduction in dBrnc

No. of Pairs	5	10	15	20
Pairs Only	2.2	4.6	6.2	7.2
Pairs and Shield	0.9	1.5	2.0	2.5

When necessary other numbers of bunched pairs may be used for completing the test. New factors will have to be calculated using the equations in Appendices B or C as appropriate. Adequate pairs should be used to assure that open circuited shield circuits will be detected.

1.2.4 A total resistance to ground of 5 ohms was used to calculate the factors shown in the Tables of Appendices B and C. This value appears to be a reasonable representation of the resistance of a typical power system multigrounded neutral conductor and associated grounds. The sensitivity of the test to open circuited shields improves as the ground resistance is decreased. Calculations using the same cable as defined in Paragraph 1.2.2 for several different ground resistances are shown below:

Reduction in dBrnc

Total Ground Resistance in Ohms	2	5	10	15	20	25
10 Pairs Only	5.6	4.6	3.4	2.5	2.0	1.6
10 Pairs and Shield	2.3	1.5	0.9	0.5	0.4	0.2

1.2.5 The Tables in Appendices B & C are based on 1000 meter-ohms earth resistivity. Calculations for the 100 pair cable described in Paragraph 1.2.2 for 100, 1000 and 10,000 meter-ohms earth resistivity are shown below:

Reduction in dBrnc

Earth Resistivity (Meter-Ohms)	100	1000	10000
10 Pairs Only	4.0	4.6	5.1
10 Pairs and Shield	1.5	1.5	1.6

The possibility of the earth resistivity along an entire cable route averaging 100 or 10,000 meter-ohms is very small. Field experience shows that Tables based on the 1000 meter-ohm value are effective in almost all locations. Should it be found that earth resistivity is extremely high or low new factors can be calculated using the equations shown in Appendices B & C, as appropriate.

1.2.6 The reductions are essentially the same for various types of cable insulation, air-core, filled and foam insulated as shown below:

Reduction in dBrnc

Cable Type	Air-Core	Filled	Foam Insulated
10 Pairs Only	4.6	4.6	4.6
10 Pairs and Shield	1.8	1.5	1.8

The Tables in the Appendices, which were calculated for filled cable, can be used for all types of insulation.

1.2.7 The calculation of the field factors for identifying open-circuited shields can be completed quickly with a programmable calculator. Program A, in Appendix E, located at the end of this section contains the TI/58-TI/59 program that was used to calculate the enclosed Tables. It may be used to calculate new factors at different frequencies, etc.

APPENDIX B

EQUATIONS AND TABLES-ENGLISH UNITS OF MEASURE

1. GENERAL

1.1 Tables B-1 to B-33 inclusive, of this Appendix contain the deviation factors in decibels for determining shield quality. The factors are given for lengths of cable from 1 to 20 kilofeet at a frequency of 540 Hertz. They cover 19, 22, 24 and 26 gauge filled cable with an earth resistivity of 1000 meter-ohms and total ground resistance of 5 ohms and for shield materials used in the REA program. See Appendix A for a discussion of shield isolation theory.

1.2 The equations used to develop these tables have also been include. They can be used to calculate new factors where it is determined that a frequency other than 540 Hertz is dominant in the power influence. The shield resistance per kilofeet for various shield materials and cable sizes is given in Tables B-34 to B-45, inclusive. They are provided for air core, filled and filled cable with expanded insulation for use with the equations.

2. CALCULATION OF SHIELD FACTOR

2.1 The shield deviation factors in decibels shown in Tables B-1 to B-33, inclusive are based on the fundamental equation for calculation of shield factor.

$$n = \frac{R_{SH} + \frac{R_T}{\ell}}{R_{SH} + Z_{23} + \frac{R_T}{\ell}}$$

Where: n = Shield Factor

R_{SH} = Shield resistance in ohms per unit length of the non-ferromagnetic shield.

R_T = Sum of the ground resistance at each end in ohms.

ℓ = Length of cable.

Z_{23} = Mutual impedance between the shield and cable pairs per unit length.

2.2 The value of Z_{23} is determined by Carson's equation. In simplified form:

$$Z_{23} = R_{23} + jX_{23} = 0.3 \times 10^{-3}f + j\,0.882 \times 10^{-3}f \times \log_{10}\left(\frac{2280}{d\sqrt{\frac{f}{\rho}}}\right)$$

Where: R_{23} = Resistance component of Z_{23} per unit length

X_{23} = Reactance component of Z_{23} per unit length

f = Frequency in Hertz.

d = Radius of shield conductor in feet (Tables B-34 to B-45, inclusive)

ρ = Earth resistivity in Meter-Ohms

2.2 There are two limits that provide the basis for determining shield circuit quality. The first, indicative of a good shield circuit, is the reduction of cable pair power influence in dB that will occur when a continuous shield is connected in parallel with a group of cable pairs. Second, indicative of an open-circuited shield circuit, is the dB reduction in power influence that will take place when an open shield is connected in parallel with a group of cable pairs.

2.4 Derivation of the first factor entails calculating the reduction in cable pair power influence in dB that would be observed when an unshielded cable is provided with a shield. This equation is:

$$n_1 = 20 \log_{10}\left(\frac{R_{SH} + \frac{R_T}{\ell}}{R_{SH} + \frac{R_T}{\ell} + R_{23} + jX_{23}}\right)$$

Where: n_1 = Cable Shield Factor in dB.

R_{SH} = Shield resistance of cable in ohms/kilofoot (Tables B-34 to B-45)

R_T = Sum of the ground resistance at each end (5 ohms for MGN connection).

ℓ = Cable length in kilofeet.

R_{23} = From equation in Paragraph 2.2, Appendix B

X_{23} = From equation in Paragraph 2.2, Appendix B

2.4.1 Next the reduction of power influence in dB is calculated that would occur when the same unshielded cable is provided the same shield connected in parallel with a group of the cable pairs. This equation is:

$$n_2 = 20 \log_{10}\left(\frac{\dfrac{1}{\dfrac{1}{R_{SH}} + \dfrac{1}{R_{Pr}}} + R_T}{\dfrac{1}{\dfrac{1}{R_{SH}} + \dfrac{1}{R_{Pr}}} + \dfrac{R_T}{\ell} + R_{23} + jX_{23}}\right)$$

Where: n_2 = Cable Shield Factor in dB (Shield paralleled by N Cable Pairs)

R_{Pr} = Parallel resistance of N cable pairs in ohms/kilofoot.

2.4.2 The reduction of power influence in dB that will occur when a continuous cable shield is connected parallel with a group of cable pairs can now be calculated. This is accomplished by subtracting n_2 from n_1. The values of this factor difference for 10 cable pairs at 540 Hertz are shown in the shield material columns A-E of Tables B-1 to B-33, inclusive.

2.5 The second factor is derived by calculating the reduction in power influence that would occur when the same unshielded cable is provided a shield consisting of a group of cable pairs connected in parallel. The same number of cable pairs should be used for this calculation as were used in the equation in Paragraph 2.4.1. The equation for this calculation is:

$$n_3 = 20 \log_{10}\left(\frac{P_{Pr} + \dfrac{R_T}{\ell}}{R_{Pr} + \dfrac{R_T}{\ell} + R_{23} + jX_{23}}\right)$$

Where: n_3 = Shield Factor in dB (N Cable Pairs connected in parallel).

The factors for a cable shield of ten pairs at 540 Hertz are shown in the "10 Pr." column of Tables B-1 to B-33, inclusive.

The factors for a cable shield of ten pairs at 540 Hertz are shown in the "10 Pr." column of Tables B-1 to B-33, inclusive.

TABLE B-1

26 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	12 Pairs						18 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.7	0.2	0.1	0.2	0.2	0.2	0.7	0.1	0.1	0.2	0.2	0.1	1
2	1.4	0.5	0.3	0.7	0.6	0.5	1.4	0.5	0.2	0.6	0.6	0.5	2
3	1.9	0.9	0.5	1.2	1.1	0.9	1.8	0.8	0.4	1.0	1.0	0.8	3
4	2.2	1.2	0.7	1.5	1.4	1.3	2.2	1.1	0.6	1.4	1.3	1.1	4
5	2.5	1.5	0.9	1.9	1.7	1.5	2.5	1.4	0.7	1.7	1.6	1.4	5
6	2.7	1.7	1.0	2.1	2.0	1.8	2.7	1.6	0.9	2.0	1.8	1.6	6
7	2.9	1.9	1.1	2.3	2.2	2.0	2.8	1.8	1.0	2.2	2.0	1.8	7
8	3.0	2.1	1.3	2.5	2.4	2.1	2.9	1.9	1.1	2.3	2.2	2.0	8
9	3.1	2.2	1.3	2.7	2.5	2.3	3.1	2.0	1.2	2.5	2.3	2.1	9
10	3.2	2.3	1.4	2.8	2.6	2.4	3.1	2.2	1.3	2.6	2.4	2.2	10
11	3.3	2.4	1.5	2.9	2.7	2.5	3.2	2.3	1.3	2.7	2.6	2.3	11
12	3.3	2.5	1.6	3.0	2.8	2.6	3.3	2.3	1.4	2.8	2.6	2.4	12
13	3.4	2.6	1.6	3.1	2.9	2.7	3.3	2.4	1.5	2.9	2.7	2.5	13
14	3.4	2.7	1.7	3.2	3.0	2.7	3.4	2.5	1.5	3.0	2.8	2.5	14
15	3.5	2.8	1.7	3.2	3.1	2.8	3.4	2.5	1.6	3.1	2.9	2.6	15
16	3.5	2.8	1.8	3.3	3.1	2.9	3.5	2.6	1.6	3.1	2.9	2.7	16
17	3.5	2.9	1.8	3.4	3.2	2.9	3.5	2.7	1.6	3.2	3.0	2.7	17
18	3.6	2.9	1.9	3.4	3.2	3.0	3.5	2.7	1.7	3.2	3.0	2.8	18
19	3.6	3.0	1.9	3.5	3.3	3.0	3.6	2.7	1.7	3.3	3.1	2.8	19
20	3.6	3.0	1.9	3.5	3.3	3.1	3.6	2.8	1.7	3.3	3.1	2.8	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-2

26 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	25 Pairs						50 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.7	0.1	0.1	0.2	0.1	0.1	0.7	0.1	-	0.1	0.1	0.1	1
2	1.3	0.4	0.2	0.6	0.5	0.4	1.3	0.3	0.1	0.4	0.4	0.3	2
3	1.8	0.7	0.4	1.0	0.9	0.8	1.8	0.6	0.3	0.8	0.7	0.6	3
4	2.2	1.0	0.5	1.3	1.2	1.1	2.1	0.8	0.4	1.1	1.0	0.8	4
5	2.4	1.3	0.7	1.6	1.5	1.3	2.4	1.0	0.5	1.3	1.2	1.0	5
6	2.6	1.5	0.8	1.9	1.7	1.5	2.6	1.2	0.6	1.5	1.4	1.2	6
7	2.8	1.6	0.9	2.1	1.9	1.7	2.7	1.3	0.7	1.7	1.6	1.4	7
8	2.9	1.8	1.0	2.2	2.1	1.8	2.8	1.4	0.8	1.9	1.7	1.5	8
9	3.0	1.9	1.1	2.4	2.2	2.0	3.0	1.6	0.8	2.0	1.8	1.6	9
10	3.1	2.0	1.2	2.5	2.3	2.1	3.0	1.6	0.9	2.1	1.9	1.7	10
11	3.2	2.1	1.2	2.6	2.4	2.2	3.1	1.7	0.9	2.2	2.0	1.8	11
12	3.3	2.2	1.3	2.7	2.5	2.2	3.2	1.8	1.0	2.3	2.1	1.9	12
13	3.3	2.3	1.3	2.8	2.6	2.3	3.2	1.9	1.0	2.4	2.2	1.9	13
14	3.4	2.3	1.4	2.8	2.7	2.4	3.3	1.9	1.1	2.4	2.3	2.0	14
15	3.4	2.4	1.4	2.9	2.7	2.5	3.3	2.0	1.1	2.5	2.3	2.0	15
16	3.4	2.5	1.5	3.0	2.8	2.5	3.4	2.0	1.1	2.6	2.4	2.1	16
17	3.5	2.5	1.5	3.0	2.8	2.6	3.4	2.1	1.2	2.6	2.4	2.1	17
18	3.5	2.5	1.5	3.1	2.9	2.6	3.4	2.1	1.2	2.7	2.5	2.2	18
19	3.5	2.6	1.6	3.1	2.9	2.6	3.5	2.2	1.2	2.7	2.5	2.2	19
20	3.6	2.6	1.6	3.2	3.0	2.7	3.5	2.2	1.3	2.7	2.5	2.3	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-3

26 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	75 Pairs						100 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.6	0.1	-	0.1	0.1	0.1	0.6	0.1	-	0.1	0.1	0.1	1
2	1.3	0.3	0.1	0.4	0.3	0.3	1.3	0.2	0.1	0.3	0.3	0.2	2
3	1.8	0.5	0.2	0.7	0.6	0.5	1.7	0.4	0.2	0.6	0.5	0.4	3
4	2.1	0.7	0.3	0.9	0.8	0.7	2.1	0.6	0.3	0.8	0.7	0.6	4
5	2.3	0.9	0.4	1.2	1.1	0.9	2.3	0.8	0.3	1.0	0.9	0.8	5
6	2.5	1.0	0.5	1.4	1.2	1.0	2.5	0.9	0.4	1.2	1.1	0.9	6
7	2.7	1.1	0.6	1.5	1.4	1.2	2.6	1.0	0.5	1.4	1.2	1.0	7
8	2.8	1.3	0.6	1.7	1.5	1.3	2.8	1.1	0.5	1.5	1.4	1.1	8
9	2.9	1.4	0.7	1.8	1.6	1.4	2.9	1.2	0.6	1.6	1.5	1.2	9
10	3.0	1.4	0.7	1.9	1.7	1.5	3.0	1.3	0.6	1.7	1.5	1.3	10
11	3.1	1.5	0.8	2.0	1.8	1.6	3.0	1.4	0.7	1.8	1.6	1.4	11
12	3.1	1.6	0.8	2.1	1.9	1.6	3.1	1.4	0.7	1.9	1.7	1.5	12
13	3.2	1.7	0.9	2.2	2.0	1.7	3.1	1.5	0.7	2.0	1.8	1.5	13
14	3.2	1.7	0.9	2.2	2.0	1.8	3.2	1.5	0.8	2.0	1.8	1.6	14
15	3.3	1.8	0.9	2.3	2.1	1.8	3.2	1.6	0.8	2.1	1.9	1.6	15
16	3.3	1.8	1.0	2.3	2.1	1.9	3.3	1.6	0.8	2.1	1.9	1.7	16
17	3.3	1.8	1.0	2.4	2.2	1.9	3.3	1.7	0.9	2.2	2.0	1.7	17
18	3.4	1.9	1.0	2.4	2.2	1.9	3.3	1.7	0.9	2.2	2.0	1.7	18
19	3.4	1.9	1.1	2.5	2.3	2.0	3.4	1.7	0.9	2.3	2.9	1.8	19
20	3.4	2.0	1.1	2.5	2.3	2.0	3.4	1.8	0.9	2.3	2.1	1.8	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs. Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-4

26 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	150 Pairs						200 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.6	-	-	0.1	0.1	-	0.6	-	-	0.1	-	-	1
2	1.2	0.2	0.1	0.3	0.2	0.2	1.2	0.1	0.1	0.2	0.2	0.1	2
3	1.7	0.3	0.1	0.5	0.4	0.3	1.7	0.3	0.1	0.4	0.3	0.3	3
4	2.0	0.5	0.2	0.7	0.6	0.5	2.0	0.4	0.2	0.6	0.5	0.4	4
5	2.3	0.6	0.3	0.9	0.8	0.6	2.2	0.5	0.2	0.7	0.6	0.5	5
6	2.4	0.7	0.3	1.0	0.9	0.7	2.4	0.6	0.3	0.9	0.8	0.6	6
7	2.6	0.8	0.4	1.2	1.0	0.9	2.6	0.7	0.3	1.0	0.9	0.7	7
8	2.7	0.9	0.4	1.3	1.1	0.9	2.7	0.8	0.3	1.1	1.0	0.8	8
9	2.8	1.0	0.5	1.4	1.2	1.0	2.8	0.8	0.4	1.2	1.0	0.9	9
10	2.9	1.1	0.5	1.5	1.3	1.1	2.9	0.9	0.4	1.3	1.1	0.9	10
11	3.0	1.1	0.5	1.5	1.4	1.2	2.9	0.9	0.4	1.3	1.2	1.0	11
12	3.0	1.2	0.6	1.6	1.4	1.2	3.0	1.0	0.5	1.4	1.2	1.0	12
13	3.1	1.2	0.6	1.7	1.5	1.3	3.0	1.0	0.5	1.5	1.3	1.1	13
14	3.1	1.3	0.6	1.7	1.6	1.3	3.1	1.1	0.5	1.5	1.3	1.1	14
15	3.2	1.3	0.6	1.8	1.6	1.4	3.1	1.1	0.5	1.6	1.4	1.2	15
16	3.2	1.4	0.7	1.8	1.6	1.4	3.2	1.2	0.6	1.6	1.4	1.2	16
17	3.2	1.4	0.7	1.9	1.7	1.4	3.2	1.2	0.6	1.6	1.5	1.2	17
18	3.3	1.4	0.7	1.9	1.7	1.5	3.2	1.2	0.6	1.7	1.5	1.3	18
19	3.3	1.5	0.7	2.0	1.8	1.5	3.2	1.3	0.6	1.7	1.5	1.3	19
20	3.3	1.5	0.8	2.0	1.8	1.5	3.3	1.3	0.6	1.7	1.6	1.3	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-5

26 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	300 Pairs						400 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.6	-	-	-	-	-	0.6	-	-	-	-	-	1
2	1.2	0.1	-	0.2	0.1	0.1	1.2	0.1	-	0.1	0.1	0.1	2
3	1.6	0.2	0.1	0.3	0.3	0.2	1.6	0.2	0.1	0.3	0.2	0.2	3
4	1.9	0.3	0.1	0.5	0.4	0.3	1.9	0.2	0.1	0.4	0.3	0.3	4
5	2.2	0.4	0.2	0.6	0.5	0.4	2.1	0.3	0.1	0.5	0.4	0.3	5
6	2.4	0.5	0.2	0.7	0.6	0.5	2.3	0.4	0.2	0.6	0.5	0.4	6
7	2.5	0.5	0.2	0.8	0.7	0.6	2.5	0.5	0.2	0.7	0.6	0.5	7
8	2.6	0.6	0.3	0.9	0.8	0.6	2.6	0.5	0.2	0.7	0.7	0.5	8
9	2.7	0.7	0.3	1.0	0.9	0.7	2.7	0.6	0.2	0.8	0.7	0.6	9
10	2.8	0.7	0.3	1.1	0.9	0.8	2.7	0.6	0.3	0.9	0.8	0.6	10
11	2.9	0.8	0.3	1.1	1.0	0.8	2.8	0.6	0.3	0.9	0.8	0.7	11
12	2.9	0.8	0.4	1.2	1.0	0.8	2.9	0.7	0.3	1.0	0.9	0.7	12
13	3.0	0.9	0.4	1.2	1.1	0.9	2.9	0.7	0.3	1.0	0.9	0.7	13
14	3.0	0.9	0.4	1.3	1.1	0.9	3.0	0.7	0.3	1.1	0.9	0.8	14
15	3.1	0.9	0.4	1.3	1.2	1.0	3.0	0.8	0.3	1.1	1.0	0.8	15
16	3.1	1.0	0.4	1.4	1.2	1.0	3.0	0.8	0.4	1.1	1.0	0.8	16
17	3.1	1.0	0.5	1.4	1.2	1.0	3.1	0.8	0.4	1.2	1.0	0.9	17
18	3.1	1.0	0.5	1.4	1.3	1.0	3.1	0.9	0.4	1.2	1.1	0.9	18
19	3.2	1.0	0.5	1.5	1.3	1.1	3.1	0.9	0.4	1.2	1.1	0.9	19
20	3.2	1.1	0.5	1.5	1.3	1.1	3.1	0.9	0.4	1.3	1.1	0.9	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs. Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B- 6

26 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	600 Pairs						900 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.6	-	-	-	-	-	0.6	-	-	-	-	-	1
2	1.1	0.1	-	0.1	0.1	0.1	1.1	-	-	0.1	0.1	-	2
3	1.6	0.1	-	0.2	0.2	0.1	1.5	0.1	-	0.1	0.1	0.1	3
4	1.9	0.2	0.1	0.3	0.2	0.2	1.8	0.1	-	0.2	0.2	0.1	4
5	2.1	0.2	0.1	0.4	0.3	0.3	2.0	0.2	0.1	0.3	0.2	0.2	5
6	2.3	0.3	0.1	0.5	0.4	0.3	2.2	0.2	0.1	0.3	0.3	0.2	6
7	2.4	0.3	0.1	0.5	0.5	0.4	2.3	0.3	0.1	0.4	0.3	0.3	7
8	2.5	0.4	0.2	0.6	0.5	0.4	2.5	0.3	0.1	0.5	0.4	0.3	8
9	2.6	0.4	0.2	0.7	0.6	0.4	2.5	0.3	0.1	0.5	0.4	0.3	9
10	2.7	0.5	0.2	0.7	0.6	0.5	2.6	0.3	0.1	0.5	0.5	0.4	10
11	2.7	0.5	0.2	0.8	0.7	0.5	2.7	0.4	0.1	0.6	0.5	0.4	11
12	2.8	0.5	0.2	0.8	0.7	0.6	2.7	0.4	0.2	0.6	0.5	0.4	12
13	2.9	0.6	0.2	0.8	0.7	0.6	2.8	0.4	0.2	0.7	0.6	0.4	13
14	2.9	0.6	0.2	0.9	0.8	0.6	2.8	0.4	0.2	0.7	0.6	0.5	14
15	2.9	0.6	0.3	0.9	0.8	0.6	2.9	0.5	0.2	0.7	0.6	0.5	15
16	3.0	0.6	0.3	0.9	0.8	0.7	2.9	0.5	0.2	0.7	0.6	0.5	16
17	3.0	0.7	0.3	1.0	0.8	0.7	2.9	0.5	0.2	0.8	0.7	0.5	17
18	3.0	0.7	0.3	1.0	0.9	0.7	3.0	0.5	0.2	0.8	0.7	0.5	18
19	3.1	0.7	0.3	1.0	0.9	0.7	3.0	0.5	0.2	0.8	0.7	0.6	19
20	3.1	0.7	0.3	1.0	0.9	0.7	3.0	0.6	0.2	0.8	0.7	0.6	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-7

26 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft.	1200 Pairs						1500 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.6	-	-	-	-	-	0.6	-	-	-	-	-	1
2	1.1	-	-	0.1	0.1	-	1.1	-	-	0.1	-	-	2
3	1.5	0.1	-	0.1	0.1	0.1	1.5	0.1	-	0.1	0.1	0.1	3
4	1.8	0.1	-	0.2	0.2	0.1	1.8	0.1	-	0.2	0.1	0.1	4
5	2.0	0.2	0.1	0.3	0.2	0.2	2.0	0.1	-	0.2	0.2	0.1	5
6	2.2	0.2	0.1	0.3	0.3	0.2	2.1	0.2	0.1	0.3	0.2	0.2	6
7	2.3	0.2	0.1	0.4	0.3	0.2	2.3	0.2	0.1	0.3	0.2	0.2	7
8	2.4	0.3	0.1	0.4	0.3	0.3	2.4	0.2	0.1	0.3	0.3	0.2	8
9	2.5	0.3	0.1	0.4	0.4	0.3	2.5	0.2	0.1	0.4	0.3	0.2	9
10	2.6	0.3	0.1	0.5	0.4	0.3	2.6	0.3	0.1	0.4	0.3	0.3	10
11	2.7	0.3	0.1	0.5	0.4	0.3	2.6	0.3	0.1	0.4	0.4	0.3	11
12	2.7	0.4	0.1	0.6	0.5	0.4	2.7	0.3	0.1	0.5	0.4	0.3	12
13	2.8	0.4	0.1	0.6	0.5	0.4	2.7	0.3	0.1	0.5	0.4	0.3	13
14	2.8	0.4	0.2	0.6	0.5	0.4	2.8	0.3	0.1	0.5	0.4	0.3	14
15	2.8	0.4	0.2	0.6	0.5	0.4	2.8	0.3	0.1	0.5	0.5	0.4	15
16	2.9	0.4	0.2	0.7	0.6	0.4	2.8	0.4	0.1	0.6	0.5	0.4	16
17	2.9	0.4	0.2	0.7	0.6	0.5	2.9	0.4	0.1	0.6	0.5	0.4	17
18	2.9	0.5	0.2	0.7	0.6	0.5	2.9	0.4	0.2	0.6	0.5	0.4	18
19	3.0	0.5	0.2	0.7	0.6	0.5	2.9	0.4	0.2	0.6	0.5	0.4	19
20	3.0	0.5	0.2	0.7	0.6	0.5	2.9	0.4	0.2	0.6	0.5	0.4	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-8

26 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	1800 Pairs						2100 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.5	-	-	-	-	-	0.5	-	-	-	-	-	1
2	1.1	-	-	-	-	-	1.1	-	-	-	-	-	2
3	1.5	0.1	-	0.1	0.1	0.1	1.4	-	-	0.1	0.1	-	3
4	1.8	0.1	-	0.1	0.1	0.1	1.7	0.1	-	0.1	0.1	0.1	4
5	2.0	0.1	-	0.2	0.2	0.1	1.9	0.1	-	0.2	0.1	0.1	5
6	2.1	0.1	-	0.2	0.2	0.1	2.1	0.1	-	0.2	0.2	0.1	6
7	2.3	0.2	0.1	0.3	0.2	0.2	2.2	0.1	-	0.2	0.2	0.1	7
8	2.4	0.2	0.1	0.3	0.3	0.2	2.3	0.2	0.1	0.3	0.2	0.2	8
9	2.5	0.2	0.1	0.3	0.3	0.2	2.4	0.2	0.1	0.3	0.2	0.2	9
10	2.5	0.2	0.1	0.4	0.3	0.2	2.5	0.2	0.1	0.3	0.3	0.2	10
11	2.6	0.2	0.1	0.4	0.3	0.3	2.6	0.2	0.1	0.3	0.3	0.2	11
12	2.6	0.3	0.1	0.4	0.4	0.3	2.6	0.2	0.1	0.4	0.3	0.2	12
13	2.7	0.3	0.1	0.4	0.4	0.3	2.7	0.2	0.1	0.4	0.3	0.3	13
14	2.7	0.3	0.1	0.5	0.4	0.3	2.7	0.3	0.1	0.4	0.3	0.3	14
15	2.8	0.3	0.1	0.5	0.4	0.3	2.7	0.3	0.1	0.4	0.4	0.3	15
16	2.8	0.3	0.1	0.5	0.4	0.3	2.8	0.3	0.1	0.4	0.4	0.3	16
17	2.8	0.3	0.1	0.5	0.4	0.4	2.8	0.3	0.1	0.5	0.4	0.3	17
18	2.9	0.4	0.1	0.5	0.5	0.4	2.8	0.3	0.1	0.5	0.4	0.3	18
19	2.9	0.4	0.1	0.6	0.5	0.4	2.9	0.3	0.1	0.5	0.4	0.3	19
20	2.9	0.4	0.2	0.6	0.5	0.4	2.9	0.3	0.1	0.5	0.4	0.3	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs. Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B- 9

26 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	2400 Pairs						2700 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.5	-	-	-	-	-	0.5	-	-	-	-	-	1
2	1.1	-	-	-	-	-	1.1	-	-	-	-	-	2
3	1.4	-	-	0.1	0.1	-	1.4	-	-	0.1	0.1	-	3
4	1.7	0.1	-	0.1	0.1	0.1	1.7	0.1	-	0.1	0.1	0.1	4
5	1.9	0.1	-	0.1	0.1	0.1	1.9	0.1	-	0.1	0.1	0.1	5
6	2.1	0.1	-	0.2	0.1	0.1	2.1	0.1	-	0.2	0.1	0.1	6
7	2.2	0.1	-	0.2	0.2	0.1	2.2	0.1	-	0.2	0.2	0.1	7
8	2.3	0.1	0.1	0.2	0.2	0.2	2.3	0.1	-	0.2	0.2	0.1	8
9	2.4	0.2	0.1	0.3	0.2	0.2	2.4	0.2	0.1	0.3	0.2	0.2	9
10	2.5	0.2	0.1	0.3	0.2	0.2	2.5	0.2	0.1	0.3	0.2	0.2	10
11	2.5	0.2	0.1	0.3	0.3	0.2	2.5	0.2	0.1	0.3	0.2	0.2	11
12	2.6	0.2	0.1	0.3	0.3	0.2	2.6	0.2	0.1	0.3	0.3	0.2	12
13	2.6	0.2	0.1	0.4	0.3	0.2	2.6	0.2	0.1	0.3	0.3	0.2	13
14	2.7	0.2	0.1	0.4	0.3	0.2	2.7	0.2	0.1	0.4	0.3	0.2	14
15	2.7	0.2	0.1	0.4	0.3	0.3	2.7	0.2	0.1	0.4	0.3	0.2	15
16	2.8	0.3	0.1	0.4	0.3	0.3	2.7	0.2	0.1	0.4	0.3	0.3	16
17	2.8	0.3	0.1	0.4	0.4	0.3	2.8	0.3	0.1	0.4	0.3	0.3	17
18	2.8	0.3	0.1	0.4	0.4	0.3	2.8	0.3	0.1	0.4	0.4	0.3	18
19	2.8	0.3	0.1	0.5	0.4	0.3	2.8	0.3	0.1	0.4	0.4	0.3	19
20	2.9	0.3	0.1	0.5	0.4	0.3	2.8	0.3	0.1	0.4	0.4	0.3	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-10

26 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	3000 Pairs						3300 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.5	-	-	-	-	-	0.5	-	-	-	-	-	1
2	1.0	-	-	-	-	-	1.0	-	-	-	-	-	2
3	1.4	-	-	0.1	-	-	1.4	-	-	0.1	-	-	3
4	1.7	0.1	-	0.1	0.1	0.1	1.7	-	-	0.1	0.1	0.1	4
5	1.9	0.1	-	0.1	0.1	0.1	1.9	0.1	-	0.1	0.1	0.1	5
6	2.1	0.1	-	0.2	0.1	0.1	2.0	0.1	-	0.1	0.1	0.1	6
7	2.2	0.1	-	0.2	0.2	0.1	2.2	0.1	-	0.2	0.1	0.1	7
8	2.3	0.1	-	0.2	0.2	0.1	2.3	0.1	-	0.2	0.2	0.1	8
9	2.4	0.1	-	0.2	0.2	0.1	2.4	0.1	-	0.2	0.2	0.1	9
10	2.5	0.2	0.1	0.3	0.2	0.2	2.4	0.1	-	0.2	0.2	0.1	10
11	2.5	0.2	0.1	0.3	0.2	0.2	2.5	0.2	0.1	0.2	0.2	0.2	11
12	2.6	0.2	0.1	0.3	0.2	0.2	2.6	0.2	0.1	0.3	0.2	0.2	12
13	2.6	0.2	0.1	0.3	0.3	0.2	2.6	0.2	0.1	0.3	0.2	0.2	13
14	2.7	0.2	0.1	0.3	0.3	0.2	2.6	0.2	0.1	0.3	0.3	0.2	14
15	2.7	0.2	0.1	0.3	0.3	0.2	2.7	0.2	0.1	0.3	0.3	0.2	15
16	2.7	0.2	0.1	0.4	0.3	0.2	2.7	0.2	0.1	0.3	0.3	0.2	16
17	2.8	0.2	0.1	0.4	0.3	0.2	2.7	0.2	0.1	0.3	0.3	0.2	17
18	2.8	0.2	0.1	0.4	0.3	0.3	2.8	0.2	0.1	0.3	0.3	0.2	18
19	2.8	0.3	0.1	0.4	0.3	0.3	2.8	0.2	0.1	0.4	0.3	0.2	19
20	2.8	0.3	0.1	0.4	0.4	0.3	2.8	0.2	0.1	0.4	0.3	0.3	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B- 11

26 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	3600 Pairs						Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.5	-	-	-	-	-							1
2	1.0	-	-	-	-	-							2
3	1.4	-	-	0.1	-	-							3
4	1.7	-	-	0.1	0.1	-							4
5	1.9	0.1	-	0.1	0.1	0.1							5
6	2.0	0.1	-	0.1	0.1	0.1							6
7	2.2	0.1	-	0.2	0.1	0.1							7
8	2.3	0.1	-	0.2	0.2	0.1							8
9	2.4	0.1	-	0.2	0.2	0.1							9
10	2.4	0.1	-	0.2	0.2	0.1							10
11	2.5	0.1	0.1	0.2	0.2	0.2							11
12	2.5	0.2	0.1	0.3	0.2	0.2							12
13	2.6	0.2	0.1	0.3	0.2	0.2							13
14	2.6	0.2	0.1	0.3	0.2	0.2							14
15	2.7	0.2	0.1	0.3	0.3	0.2							15
16	2.7	0.2	0.1	0.3	0.3	0.2							16
17	2.7	0.2	0.1	0.3	0.3	0.2							17
18	2.8	0.2	0.1	0.3	0.3	0.2							18
19	2.8	0.2	0.1	0.4	0.3	0.2							19
20	2.8	0.2	0.1	0.4	0.3	0.2							20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B- 12

24 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	12 Pairs						18 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.8	0.2	0.1	0.2	0.2	0.2	0.8	0.1	0.1	0.2	0.1	0.1	1
2	1.8	0.6	0.3	0.8	0.7	0.6	1.8	0.5	0.3	0.7	0.6	0.6	2
3	2.6	1.1	0.6	1.4	1.3	1.1	2.5	1.0	0.5	1.3	1.1	1.0	3
4	3.2	1.5	0.8	1.9	1.8	1.5	3.1	1.3	0.7	1.7	1.6	1.4	4
5	3.6	1.9	1.0	2.3	2.2	1.9	3.6	1.7	0.9	2.1	2.0	1.7	5
6	4.0	2.2	1.2	2.7	2.5	2.2	4.0	2.0	1.1	2.5	2.3	2.0	6
7	4.3	2.4	1.4	3.0	2.8	2.5	4.2	2.2	1.2	2.8	2.5	2.2	7
8	4.5	2.6	1.5	3.2	3.0	2.7	4.5	2.4	1.4	3.0	2.8	2.5	8
9	4.7	2.8	1.7	3.4	3.2	2.9	4.7	2.6	1.5	3.2	3.0	2.6	9
10	4.9	3.0	1.8	3.6	3.4	3.1	4.8	2.7	1.6	3.4	3.1	2.8	10
11	5.0	3.1	1.9	3.8	3.6	3.2	5.0	2.9	1.7	3.5	3.3	2.9	11
12	5.2	3.3	2.0	3.9	3.7	3.3	5.1	3.0	1.7	3.7	3.4	3.1	12
13	5.3	3.4	2.1	4.1	3.8	3.5	5.2	3.1	1.8	3.8	3.5	3.2	13
14	5.4	3.5	2.1	4.2	3.9	3.6	5.3	3.2	1.9	3.9	3.6	3.3	14
15	5.5	3.6	2.2	4.3	4.0	3.6	5.4	3.3	2.0	4.0	3.7	3.4	15
16	5.5	3.7	2.3	4.4	4.1	3.7	5.5	3.4	2.0	4.1	3.8	3.4	16
17	5.6	3.7	2.3	4.5	4.2	3.8	5.6	3.4	2.1	4.2	3.9	3.5	17
18	5.7	3.8	2.4	4.5	4.3	3.9	5.6	3.5	2.1	4.2	4.0	3.6	18
19	5.7	3.9	2.4	4.6	4.3	3.9	5.7	3.6	2.2	4.3	4.0	3.6	19
20	5.8	3.9	2.5	4.7	4.4	4.0	5.7	3.6	2.2	4.4	4.1	3.7	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B- 13

24 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	25 Pairs						50 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.8	0.1	0.1	0.2	0.2	0.1	0.8	0.1	-	0.1	0.1	0.1	1
2	1.8	0.5	0.2	0.7	0.6	0.5	1.7	0.4	0.2	0.5	0.4	0.4	2
3	2.5	0.9	0.4	1.2	1.1	0.9	2.5	0.7	0.3	0.9	0.8	0.7	3
4	3.1	1.2	0.6	1.6	1.5	1.3	3.0	0.9	0.4	1.3	1.2	1.0	4
5	3.6	1.5	0.8	2.0	1.8	1.6	3.5	1.2	0.6	1.6	1.4	1.2	5
6	3.9	1.8	1.0	2.3	2.1	1.8	3.8	1.4	0.7	1.9	1.7	1.4	6
7	4.2	2.0	1.1	2.6	2.4	2.1	4.1	1.6	0.8	2.1	1.9	1.6	7
8	4.4	2.2	1.2	2.8	2.6	2.3	4.3	1.8	0.9	2.3	2.1	1.8	8
9	4.6	2.4	1.3	3.0	2.8	2.4	4.5	1.9	1.0	2.5	2.3	2.0	9
10	4.8	2.5	1.4	3.2	2.9	2.6	4.7	2.0	1.1	2.6	2.4	2.1	10
11	5.0	2.7	1.5	3.3	3.1	2.7	4.8	2.1	1.1	2.8	2.5	2.2	11
12	5.1	2.8	1.6	3.5	3.2	2.8	5.0	2.2	1.2	2.9	2.6	2.3	12
13	5.2	2.9	1.7	3.6	3.3	3.0	5.1	2.3	1.2	3.0	2.8	2.4	13
14	5.3	3.0	1.7	3.7	3.4	3.0	5.2	2.4	1.3	3.1	2.8	2.5	14
15	5.4	3.1	1.8	3.8	3.5	3.1	5.2	2.5	1.3	3.2	2.9	2.6	15
16	5.4	3.1	1.8	3.9	3.6	3.2	5.3	2.6	1.4	3.3	3.0	2.6	16
17	5.5	3.2	1.9	3.9	3.7	3.3	5.4	2.6	1.4	3.3	3.1	2.7	17
18	5.6	3.3	1.9	4.0	3.7	3.3	5.3	2.7	1.5	3.4	3.1	2.7	18
19	5.6	3.3	2.0	4.1	3.8	3.4	5.5	2.7	1.5	3.5	3.2	2.8	19
20	5.7	3.4	2.0	4.1	3.9	3.5	5.6	2.8	1.5	3.5	3.2	2.9	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-14

24 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	75 Pairs						100 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.8	0.1	-	0.1	0.1	0.1	0.7	0.1	-	0.1	0.1	0.1	1
2	1.7	0.3	0.1	0.4	0.4	0.3	1.6	0.2	0.1	0.3	0.3	0.2	2
3	2.4	0.5	0.2	0.8	0.7	0.5	2.4	0.4	0.2	0.7	0.6	0.5	3
4	3.0	0.8	0.3	1.1	1.0	0.8	2.9	0.6	0.3	0.9	0.8	0.7	4
5	3.4	1.0	0.4	1.4	1.2	1.0	3.4	0.8	0.4	1.2	1.0	0.9	5
6	3.8	1.2	0.5	1.6	1.4	1.2	3.7	1.0	0.5	1.4	1.2	1.0	6
7	4.0	1.3	0.6	1.8	1.6	1.4	4.0	1.1	0.5	1.6	1.4	1.2	7
8	4.3	1.5	0.7	2.0	1.8	1.5	4.2	1.3	0.6	1.8	1.6	1.3	8
9	4.5	1.6	0.8	2.1	1.9	1.6	4.4	1.4	0.7	1.9	1.7	1.4	9
10	4.6	1.7	0.8	2.3	2.1	1.8	4.6	1.5	0.7	2.0	1.8	1.5	10
11	4.8	1.8	0.9	2.4	2.2	1.9	4.7	1.6	0.8	2.1	1.9	1.6	11
12	4.9	1.9	1.0	2.5	2.3	1.9	4.8	1.6	0.8	2.2	2.0	1.7	12
13	5.0	2.0	1.0	2.6	2.4	2.0	4.9	1.7	0.8	2.3	2.1	1.8	13
14	5.1	2.0	1.0	2.7	2.4	2.1	5.0	1.8	0.9	2.4	2.2	1.8	14
15	5.2	2.1	1.1	2.8	2.5	2.2	5.1	1.9	0.9	2.5	2.2	1.9	15
16	5.2	2.2	1.1	2.9	2.6	2.2	5.2	1.9	1.0	2.6	2.3	2.0	16
17	5.3	2.2	1.2	2.9	2.7	2.3	5.2	2.0	1.0	2.6	2.4	2.0	17
18	5.4	2.3	1.2	3.0	2.7	2.3	5.3	2.0	1.0	2.7	2.4	2.1	18
19	5.4	2.3	1.2	3.0	2.8	2.4	5.4	2.1	1.1	2.7	2.5	2.1	19
20	5.5	2.4	1.3	3.1	2.8	2.4	5.4	2.1	1.1	2.8	2.5	2.2	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-15

24 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft.	150 Pairs						200 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.7	-	-	0.1	0.1	-	0.7	-	-	0.1	-	-	1
2	1.6	0.2	0.1	0.3	0.2	0.2	1.6	0.1	0.1	0.2	0.2	0.1	2
3	2.3	0.3	0.1	0.5	0.4	0.4	2.3	0.3	0.1	0.4	0.4	0.3	3
4	2.9	0.5	0.2	0.7	0.6	0.5	2.8	0.4	0.2	0.6	0.5	0.4	4
5	3.3	0.6	0.3	1.0	0.8	0.7	3.2	0.5	0.2	0.8	0.7	0.5	5
6	3.6	0.8	0.3	1.1	1.0	0.8	3.6	0.6	0.3	0.9	0.8	0.7	6
7	3.9	0.9	0.4	1.3	1.1	0.9	3.8	0.7	0.3	1.1	0.9	0.8	7
8	4.1	1.0	0.4	1.4	1.3	1.0	4.1	0.8	0.4	1.2	1.1	0.9	8
9	4.3	1.1	0.5	1.6	1.4	1.1	4.2	0.9	0.4	1.3	1.1	0.9	9
10	4.5	1.2	0.5	1.7	1.5	1.2	4.4	1.0	0.4	1.4	1.2	1.0	10
11	4.6	1.3	0.6	1.8	1.6	1.3	4.5	1.0	0.5	1.5	1.3	1.1	11
12	4.7	1.3	0.6	1.9	1.6	1.4	4.7	1.1	0.5	1.6	1.4	1.1	12
13	4.8	1.4	0.7	1.9	1.7	1.4	4.8	1.2	0.5	1.7	1.5	1.2	13
14	4.9	1.5	0.7	2.0	1.8	1.5	4.9	1.2	0.6	1.7	1.5	1.3	14
15	5.0	1.5	0.7	2.1	1.9	1.6	4.9	1.3	0.6	1.8	1.6	1.3	15
16	5.1	1.6	0.7	2.1	1.9	1.6	5.0	1.3	0.6	1.8	1.6	1.4	16
17	5.1	1.6	0.8	2.2	2.0	1.7	5.1	1.3	0.6	1.9	1.7	1.4	17
18	5.2	1.6	0.8	2.3	2.0	1.7	5.1	1.4	0.6	1.9	1.7	1.4	18
19	5.3	1.7	0.8	2.3	2.1	1.7	5.2	1.4	0.7	2.0	1.8	1.5	19
20	5.3	1.7	0.9	2.4	2.1	1.8	5.2	1.5	0.7	2.0	1.8	1.5	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-16

24 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	300 Pairs						400 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.7	-	-	-	-	-	0.7	-	-	-	-	-	1
2	1.6	0.1	-	0.2	0.1	0.1	1.5	0.1	-	0.1	0.1	0.1	2
3	2.2	0.2	0.1	0.3	0.3	0.2	2.2	0.2	0.1	0.3	0.2	0.2	3
4	2.8	0.3	0.1	0.5	0.4	0.3	2.7	0.3	0.1	0.4	0.4	0.3	4
5	3.2	0.4	0.2	0.7	0.6	0.5	3.1	0.4	0.1	0.6	0.5	0.4	5
6	3.5	0.5	0.2	0.8	0.7	0.6	3.4	0.4	0.2	0.7	0.6	0.5	6
7	3.8	0.6	0.3	0.9	0.8	0.6	3.7	0.5	0.2	0.8	0.7	0.5	7
8	4.0	0.7	0.3	1.0	0.9	0.7	3.9	0.6	0.2	0.9	0.8	0.6	8
9	4.2	0.8	0.3	1.1	1.0	0.8	4.1	0.6	0.3	1.0	0.8	0.7	9
10	4.3	0.8	0.3	1.2	1.1	0.9	4.3	0.7	0.3	1.1	0.9	0.7	10
11	4.5	0.9	0.4	1.3	1.1	0.9	4.4	0.8	0.3	1.1	1.0	0.8	11
12	4.6	0.9	0.4	1.4	1.2	1.0	4.5	0.8	0.3	1.2	1.0	0.8	12
13	4.7	1.0	0.4	1.4	1.3	1.0	4.6	0.8	0.4	1.2	1.1	0.9	13
14	4.8	1.0	0.5	1.5	1.3	1.1	4.7	0.9	0.4	1.3	1.1	0.9	14
15	4.9	1.1	0.5	1.5	1.4	1.1	4.8	0.9	0.4	1.4	1.2	1.0	15
16	4.9	1.1	0.5	1.6	1.4	1.2	4.9	1.0	0.4	1.4	1.2	1.0	16
17	5.0	1.1	0.5	1.6	1.4	1.2	4.9	1.0	0.4	1.4	1.3	1.0	17
18	5.1	1.2	0.5	1.7	1.5	1.2	5.0	1.0	0.5	1.5	1.3	1.1	18
19	5.1	1.2	0.6	1.7	1.5	1.3	5.0	1.1	0.5	1.5	1.3	1.1	19
20	5.2	1.2	0.6	1.8	1.6	1.3	5.1	1.1	0.5	1.6	1.4	1.1	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-17

24 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	500 Pairs						600 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.7	-	-	-	-	-	0.7	-	-	-	-	-	1
2	1.5	0.1	-	0.1	0.1	0.1	1.5	0.1	-	0.1	0.1	0.1	2
3	2.2	0.2	0.1	0.2	0.2	0.2	2.2	0.1	-	0.2	0.2	0.1	3
4	2.7	0.2	0.1	0.4	0.3	0.2	2.7	0.2	0.1	0.3	0.3	0.2	4
5	3.1	0.3	0.1	0.5	0.4	0.3	3.1	0.3	0.1	0.4	0.4	0.3	5
6	3.4	0.4	0.1	0.6	0.5	0.4	3.4	0.3	0.1	0.5	0.4	0.3	6
7	3.7	0.4	0.2	0.7	0.6	0.5	3.7	0.4	0.1	0.6	0.5	0.4	7
8	3.9	0.5	0.2	0.8	0.7	0.5	3.9	0.4	0.2	0.7	0.6	0.5	8
9	4.1	0.6	0.2	0.9	0.7	0.6	4.0	0.5	0.2	0.8	0.6	0.5	9
10	4.2	0.6	0.2	0.9	0.8	0.6	4.2	0.5	0.2	0.8	0.7	0.6	10
11	4.4	0.7	0.3	1.0	0.8	0.7	4.3	0.6	0.2	0.9	0.7	0.6	11
12	4.5	0.7	0.3	1.0	0.9	0.7	4.4	0.6	0.2	0.9	0.8	0.6	12
13	4.6	0.7	0.3	1.1	0.9	0.8	4.5	0.6	0.3	1.0	0.8	0.7	13
14	4.7	0.8	0.3	1.2	1.0	0.8	4.6	0.7	0.3	1.0	0.9	0.7	14
15	4.8	0.8	0.3	1.2	1.0	0.8	4.7	0.7	0.3	1.1	0.9	0.7	15
16	4.8	0.8	0.4	1.2	1.1	0.9	4.8	0.7	0.3	1.1	1.0	0.8	16
17	4.9	0.9	0.4	1.3	1.1	0.9	4.8	0.8	0.3	1.1	1.0	0.8	17
18	5.0	0.9	0.4	1.3	1.1	0.9	4.9	0.8	0.3	1.2	1.0	0.8	18
19	5.0	0.9	0.4	1.4	1.2	1.0	5.0	0.8	0.3	1.2	1.0	0.8	19
20	5.1	0.9	0.4	1.4	1.2	1.0	5.0	0.8	0.4	1.2	1.1	0.9	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-18

24GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	900 Pairs						1200 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.7	-	-	-	-	-	0.7	-	-	-	-	-	1
2	1.5	-	-	0.1	0.1	-	1.4	-	-	0.1	-	-	2
3	2.1	0.1	-	0.2	0.1	0.1	2.1	0.1	-	0.1	0.1	0.1	3
4	2.6	0.1	0.1	0.2	0.2	0.2	2.6	0.1	-	0.2	0.2	0.1	4
5	3.0	0.2	0.1	0.3	0.3	0.2	2.9	0.2	0.1	0.3	0.2	0.2	5
6	3.3	0.2	0.1	0.4	0.3	0.2	3.3	0.2	0.1	0.3	0.3	0.2	6
7	3.6	0.3	0.1	0.5	0.4	0.3	3.5	0.2	0.1	0.4	0.3	0.2	7
8	3.8	0.3	0.1	0.5	0.4	0.3	3.7	0.3	0.1	0.4	0.3	0.3	8
9	4.0	0.4	0.1	0.6	0.5	0.4	3.9	0.3	0.1	0.5	0.4	0.3	9
10	4.1	0.4	0.1	0.6	0.5	0.4	4.0	0.3	0.1	0.5	0.4	0.3	10
11	4.2	0.4	0.2	0.7	0.6	0.4	4.2	0.3	0.1	0.5	0.5	0.4	11
12	4.3	0.5	0.2	0.7	0.6	0.5	4.3	0.4	0.1	0.6	0.5	0.4	12
13	4.4	0.5	0.2	0.7	0.6	0.5	4.4	0.4	0.1	0.6	0.5	0.4	13
14	4.5	0.5	0.2	0.8	0.7	0.5	4.5	0.4	0.2	0.7	0.6	0.4	14
15	4.6	0.5	0.2	0.8	0.7	0.6	4.5	0.4	0.2	0.7	0.6	0.5	15
16	4.7	0.6	0.2	0.9	0.7	0.6	4.6	0.5	0.2	0.7	0.6	0.5	16
17	4.7	0.6	0.2	0.9	0.8	0.6	4.7	0.5	0.2	0.7	0.6	0.5	17
18	4.8	0.6	0.2	0.9	0.8	0.6	4.7	0.5	0.2	0.8	0.6	0.5	18
19	4.8	0.6	0.3	0.9	0.8	0.6	4.8	0.5	0.2	0.8	0.7	0.5	19
20	4.9	0.6	0.3	1.0	0.8	0.7	4.8	0.5	0.2	0.8	0.7	0.5	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-19

24 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	1500 Pairs						1800 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.6	-	-	-	-	-	0.6	-	-	-	-	-	1
2	1.4	-	-	0.1	-	-	1.4	-	-	-	-	-	2
3	2.0	0.1	-	0.1	0.1	0.1	2.0	0.1	-	0.1	0.1	0.1	3
4	2.5	0.1	-	0.2	0.1	0.1	2.5	0.1	-	0.1	0.1	0.1	4
5	2.9	0.1	-	0.2	0.2	0.1	2.9	0.1	-	0.2	0.2	0.1	5
6	3.2	0.2	0.1	0.3	0.2	0.2	3.2	0.1	-	0.2	0.2	0.1	6
7	3.5	0.2	0.1	0.3	0.3	0.2	3.4	0.2	0.1	0.3	0.2	0.2	7
8	3.7	0.2	0.1	0.4	0.3	0.2	3.6	0.2	0.1	0.3	0.3	0.2	8
9	3.9	0.2	0.1	0.4	0.3	0.3	3.8	0.2	0.1	0.4	0.3	0.2	9
10	4.0	0.3	0.1	0.4	0.4	0.3	4.0	0.2	0.1	0.4	0.3	0.2	10
11	4.1	0.3	0.1	0.5	0.4	0.3	4.1	0.3	0.1	0.4	0.4	0.3	11
12	4.2	0.3	0.1	0.5	0.4	0.3	4.2	0.3	0.1	0.5	0.4	0.3	12
13	4.3	0.3	0.1	0.5	0.5	0.4	4.3	0.3	0.1	0.5	0.4	0.3	13
14	4.4	0.4	0.1	0.6	0.5	0.4	4.4	0.3	0.1	0.5	0.4	0.3	14
15	4.5	0.4	0.1	0.6	0.5	0.4	4.5	0.3	0.1	0.5	0.4	0.3	15
16	4.6	0.4	0.2	0.6	0.5	0.4	4.5	0.3	0.1	0.6	0.5	0.4	16
17	4.6	0.4	0.2	0.7	0.5	0.4	4.6	0.4	0.1	0.6	0.5	0.4	17
18	4.7	0.4	0.2	0.7	0.6	0.4	4.6	0.4	0.2	0.6	0.5	0.4	18
19	4.7	0.4	0.2	0.7	0.6	0.5	4.7	0.4	0.2	0.6	0.5	0.4	19
20	4.8	0.5	0.2	0.7	0.6	0.5	4.7	0.4	0.2	0.6	0.5	0.4	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-20

24 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	2100 Pairs						Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.6	-	-	-	-	-							1
2	1.4	-	-	-	-	-							2
3	2.0	-	-	0.1	0.1	0.1							3
4	2.5	0.1	-	0.1	0.1	0.1							4
5	2.9	0.1	-	0.2	0.1	0.1							5
6	3.2	0.1	-	0.2	0.2	0.1							6
7	3.4	0.2	0.1	0.3	0.2	0.2							7
8	3.6	0.2	0.1	0.3	0.2	0.2							8
9	3.8	0.2	0.1	0.3	0.3	0.2							9
10	3.9	0.2	0.1	0.4	0.3	0.2							10
11	4.1	0.2	0.1	0.4	0.3	0.2							11
12	4.2	0.3	0.1	0.4	0.3	0.3							12
13	4.3	0.3	0.1	0.4	0.4	0.3							13
14	4.4	0.3	0.1	0.5	0.4	0.3							14
15	4.4	0.3	0.1	0.5	0.4	0.3							15
16	4.5	0.3	0.1	0.5	0.4	0.3							16
17	4.6	0.3	0.1	0.5	0.5	0.4							17
18	4.6	0.3	0.1	0.6	0.5	0.4							18
19	4.7	0.4	0.1	0.6	0.5	0.4							19
20	4.7	0.4	0.1	0.6	0.5	0.4							20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-21

22 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft.	12 Pairs						18 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.9	0.2	0.1	0.2	0.2	0.2	0.9	0.1	0.1	0.2	0.2	0.2	1
2	2.2	0.7	0.4	0.9	0.8	0.7	2.1	0.6	0.3	0.8	0.7	0.6	2
3	3.3	1.2	0.7	1.6	1.5	1.3	3.2	1.1	0.6	1.4	1.3	1.1	3
4	4.1	1.8	1.0	2.2	2.1	1.8	4.1	1.5	0.8	2.0	1.8	1.6	4
5	4.8	2.2	1.2	2.8	2.6	2.3	4.7	1.9	1.0	2.5	2.3	2.0	5
6	5.4	2.6	1.5	3.2	3.0	2.6	5.3	2.3	1.2	2.9	2.7	2.3	6
7	5.8	2.9	1.7	3.6	3.3	3.0	5.7	2.6	1.4	3.3	3.0	2.6	7
8	6.2	3.2	1.8	3.9	3.7	3.3	6.1	2.8	1.6	3.6	3.3	2.9	8
9	6.5	3.4	2.0	4.2	3.9	3.5	6.4	3.1	1.7	3.9	3.6	3.1	9
10	6.8	3.7	2.2	4.5	4.2	3.7	6.7	3.3	1.9	4.1	3.8	3.3	10
11	7.0	3.8	2.3	4.7	4.4	3.9	6.9	3.4	2.9	4.3	4.0	3.5	11
12	7.2	4.0	2.4	4.9	4.6	4.1	7.1	3.6	2.1	4.5	4.2	3.7	12
13	7.4	4.2	2.5	5.1	4.7	4.3	7.3	3.7	2.2	4.6	4.3	3.8	13
14	7.6	4.3	2.6	5.2	4.9	4.4	7.5	3.9	2.3	4.8	4.5	4.0	14
15	7.7	4.4	2.7	5.4	5.0	4.5	7.6	4.0	2.4	4.9	4.6	4.1	15
16	7.8	4.5	2.8	5.5	5.1	4.6	7.8	4.1	2.4	5.1	4.7	4.2	16
17	8.0	4.7	2.9	5.6	5.3	4.7	7.9	4.2	2.5	5.2	4.8	4.3	17
18	8.1	4.8	2.9	5.7	5.4	4.8	8.0	4.3	2.6	5.3	4.9	4.4	18
19	8.2	4.8	3.0	5.8	5.4	4.9	8.1	4.4	2.6	5.4	5.0	4.5	19
20	8.2	4.9	3.1	5.9	5.5	5.0	8.2	4.5	2.7	5.5	5.1	4.6	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-22

22 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	25 Pairs						50 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.9	0.1	0.1	0.2	0.2	0.1	0.9	0.1	-	0.1	0.1	0.1	1
2	2.1	0.5	0.2	0.7	0.6	0.5	2.0	0.4	0.2	0.5	0.5	0.4	2
3	3.2	1.0	0.5	1.3	1.2	1.0	3.1	0.7	0.3	1.0	0.9	0.7	3
4	4.0	1.4	0.7	1.8	1.7	1.4	3.9	1.0	0.5	1.4	1.3	1.1	4
5	4.7	1.7	0.9	2.2	2.1	1.8	4.6	1.3	0.6	1.8	1.6	1.4	5
6	5.2	2.1	1.1	2.6	2.4	2.1	5.1	1.6	0.8	2.1	1.9	1.6	6
7	5.7	2.3	1.2	2.9	2.8	2.4	5.6	1.8	0.9	2.4	2.2	1.8	7
8	6.1	2.6	1.4	3.2	3.0	2.6	5.9	2.0	1.0	2.7	2.4	2.0	8
9	6.4	2.8	1.5	3.5	3.3	2.9	6.2	2.2	1.1	2.9	2.6	2.2	9
10	6.6	3.0	1.6	3.7	3.5	3.1	6.5	2.3	1.2	3.1	2.8	2.4	10
11	6.9	3.1	1.7	3.9	3.7	3.2	6.7	2.5	1.3	3.2	2.9	2.5	11
12	7.1	3.3	1.8	4.1	3.8	3.4	6.9	2.6	1.3	3.4	3.1	2.7	12
13	7.3	3.4	1.9	4.2	4.0	3.5	7.1	2.7	1.4	3.5	3.2	2.8	13
14	7.4	3.6	2.0	4.4	4.1	3.6	7.3	2.8	1.5	3.7	3.3	2.9	14
15	7.6	3.7	2.1	4.5	4.2	3.8	7.4	2.9	1.5	3.8	3.4	3.9	15
16	7.7	3.8	2.2	4.6	4.4	3.9	7.5	3.0	1.6	3.9	3.5	3.1	16
17	7.8	3.9	2.2	4.7	4.5	4.0	7.7	3.1	1.7	4.0	3.6	3.2	17
18	7.9	4.0	2.3	4.8	4.6	4.1	7.8	3.2	1.7	4.1	3.7	3.2	18
19	8.0	4.0	2.4	4.9	4.6	4.1	7.9	3.2	1.8	4.2	3.8	3.3	19
20	8.1	4.1	2.4	5.0	4.7	4.0	7.9	3.3	1.8	4.2	3.9	3.4	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-23

22 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft.	75 Pairs						100 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.8	0.1	-	0.1	0.1	0.1	0.8	0.1	-	0.1	0.1	0.1	1
2	2.0	0.3	0.1	0.4	0.4	0.3	2.0	0.2	0.1	0.4	0.3	0.3	2
3	3.0	0.5	0.2	0.8	0.7	0.6	3.0	0.5	0.2	0.7	0.6	0.5	3
4	3.8	0.8	0.4	1.1	1.0	0.8	3.8	0.7	0.3	1.0	0.9	0.7	4
5	4.5	1.0	0.5	1.4	1.3	1.1	4.4	0.9	0.4	1.3	1.2	0.9	5
6	5.0	1.2	0.6	1.7	1.5	1.3	5.0	1.1	0.5	1.6	1.4	1.1	6
7	5.4	1.4	0.7	2.0	1.7	1.5	5.4	1.3	0.6	1.8	1.6	1.3	7
8	5.8	1.6	0.7	2.2	1.9	1.6	5.8	1.4	0.7	2.0	1.8	1.5	8
9	6.1	1.7	0.8	2.4	2.1	1.8	6.1	1.6	0.7	2.2	1.9	1.6	9
10	6.4	1.9	0.9	2.5	2.3	1.9	6.3	1.7	0.8	2.3	2.1	1.7	10
11	6.6	2.0	1.0	2.7	2.4	2.0	6.6	1.8	0.9	2.5	2.2	1.9	11
12	6.8	2.1	1.0	2.8	2.5	2.1	6.8	1.9	0.9	2.6	2.3	2.0	12
13	7.0	2.2	1.1	3.0	2.6	2.3	6.9	2.0	1.0	2.7	2.4	2.1	13
14	7.1	2.3	1.1	3.1	2.8	2.3	7.1	2.1	1.0	2.8	2.5	2.1	14
15	7.3	2.4	1.2	3.2	2.9	2.4	7.2	2.2	1.1	2.9	2.6	2.2	15
16	7.4	2.4	1.2	3.3	2.9	2.5	7.4	2.2	1.1	3.0	2.7	2.3	16
17	7.5	2.5	1.3	3.4	3.0	2.6	7.5	2.3	1.1	3.1	2.8	2.4	17
18	7.6	2.6	1.3	3.4	3.1	2.7	7.6	2.4	1.2	3.2	2.9	2.4	18
19	7.7	2.6	1.4	3.5	3.2	2.7	7.7	2.4	1.2	3.3	2.9	2.5	19
20	7.8	2.7	1.4	3.6	3.2	2.8	7.8	2.5	1.3	3.3	3.0	2.6	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-24

22 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	150 Pairs						200 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.8	-	-	0.1	0.1	-	0.8	-	-	0.1	-	-	1
2	1.9	0.2	0.1	0.3	0.2	0.2	1.9	0.1	0.1	0.2	0.2	0.2	2
3	2.9	0.3	0.1	0.5	0.5	0.4	2.9	0.3	0.1	0.4	0.4	0.3	3
4	3.7	0.5	0.2	0.8	0.7	0.5	3.6	0.4	0.2	0.7	0.6	0.5	4
5	4.3	0.7	0.3	1.0	0.9	0.7	4.3	0.6	0.2	0.9	0.7	0.6	5
6	4.9	0.8	0.4	1.2	1.1	0.9	4.8	0.7	0.3	1.0	0.9	0.7	6
7	5.3	1.0	0.4	1.4	1.2	1.0	5.2	0.8	0.3	1.2	1.0	0.8	7
8	5.6	1.1	0.5	1.6	1.4	1.1	5.6	0.9	0.4	1.4	1.2	1.0	8
9	5.9	1.2	0.5	1.7	1.5	1.2	5.9	1.0	0.4	1.5	1.3	1.1	9
10	6.2	1.3	0.6	1.9	1.6	1.3	6.1	1.1	0.5	1.6	1.4	1.1	10
11	6.4	1.4	0.6	2.0	1.7	1.4	6.4	1.2	0.5	1.7	1.5	1.2	11
12	6.6	1.5	0.7	2.1	1.8	1.5	6.6	1.3	0.6	1.8	1.6	1.3	12
13	6.8	1.5	0.7	2.2	1.9	1.6	6.7	1.3	0.6	1.9	1.7	1.4	13
14	7.0	1.6	0.7	2.3	2.0	1.7	6.9	1.4	0.6	2.0	1.7	1.4	14
15	7.1	1.7	0.8	2.4	2.1	1.7	7.0	1.4	0.7	2.1	1.8	1.5	15
16	7.2	1.7	0.8	2.4	2.2	1.8	7.2	1.5	0.7	2.1	1.9	1.6	16
17	7.3	1.8	0.8	2.5	2.2	1.9	7.3	1.6	0.7	2.2	1.9	1.6	17
18	7.4	1.9	0.9	2.6	2.3	1.9	7.4	1.6	0.7	2.3	2.0	1.7	18
19	7.5	1.9	0.9	2.6	2.4	2.0	7.5	1.7	0.8	2.3	2.1	1.7	19
20	7.6	2.0	0.9	2.7	2.4	2.0	7.5	1.7	0.8	2.4	2.1	1.8	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-25

22 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	300 Pairs						400 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.8	-	-	-	-	-	0.8	-	-	-	-	-	1
2	1.9	0.1	-	0.2	0.1	0.1	1.8	0.1	-	0.1	0.1	0.1	2
3	2.8	0.2	0.1	0.4	0.3	0.2	2.8	0.2	0.1	0.3	0.2	0.2	3
4	3.6	0.3	0.1	0.5	0.5	0.4	3.5	0.3	0.1	0.4	0.4	0.3	4
5	4.2	0.5	0.2	0.7	0.6	0.5	4.1	0.4	0.1	0.6	0.5	0.4	5
6	4.7	0.6	0.2	0.8	0.7	0.6	4.6	0.4	0.2	0.7	0.6	0.5	6
7	5.1	0.6	0.3	1.0	0.8	0.7	5.1	0.5	0.2	0.8	0.7	0.6	7
8	5.5	0.7	0.3	1.1	1.0	0.8	5.4	0.6	0.2	0.9	0.8	0.6	8
9	5.8	0.8	0.3	1.2	1.1	0.8	5.7	0.7	0.3	1.0	0.9	0.7	9
10	6.0	0.9	0.4	1.3	1.1	0.9	6.0	0.7	0.3	1.1	1.0	0.8	10
11	6.3	1.0	0.4	1.4	1.2	1.0	6.2	0.8	0.3	1.2	1.0	0.8	11
12	6.5	1.0	0.4	1.5	1.3	1.1	6.4	0.8	0.3	1.3	1.1	0.9	12
13	6.6	1.1	0.5	1.6	1.4	1.1	6.6	0.9	0.4	1.3	1.2	0.9	13
14	6.8	1.1	0.5	1.7	1.4	1.2	6.7	0.9	0.4	1.4	1.2	1.0	14
15	6.9	1.2	0.5	1.7	1.5	1.2	6.8	1.0	0.4	1.5	1.3	1.0	15
16	7.1	1.2	0.5	1.8	1.6	1.3	7.0	1.0	0.4	1.5	1.3	1.1	16
17	7.2	1.3	0.6	1.9	1.6	1.3	7.1	1.1	0.5	1.6	1.4	1.1	17
18	7.3	1.3	0.6	1.9	1.7	1.4	7.2	1.1	0.5	1.6	1.4	1.2	18
19	7.4	1.4	0.6	2.0	1.7	1.4	7.3	1.1	0.5	1.7	1.5	1.2	19
20	7.4	1.4	0.6	2.0	1.8	1.5	7.4	1.2	0.5	1.7	1.5	1.2	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

22 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft.	600 Pairs						900 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.7	-	-	-	-	-	0.7	-	-	-	-	-	1
2	1.8	0.1	-	0.1	0.1	0.1	1.7	-	-	0.1	0.1	-	2
3	2.7	0.1	-	0.2	0.2	0.1	2.6	0.1	-	0.2	0.1	0.1	3
4	3.4	0.2	0.1	0.3	0.3	0.2	3.4	0.2	0.1	0.3	0.2	0.2	4
5	4.1	0.3	0.1	0.4	0.4	0.3	4.0	0.2	0.1	0.3	0.3	0.2	5
6	4.6	0.3	0.1	0.5	0.4	0.3	4.5	0.3	0.1	0.4	0.3	0.3	6
7	5.0	0.4	0.1	0.6	0.5	0.4	4.9	0.3	0.1	0.5	0.4	0.3	7
8	5.3	0.4	0.2	0.7	0.6	0.5	5.2	0.3	0.1	0.6	0.5	0.4	8
9	5.6	0.5	0.2	0.8	0.7	0.5	5.5	0.4	0.1	0.6	0.5	0.4	9
10	5.9	0.6	0.2	0.9	0.7	0.6	5.8	0.4	0.2	0.7	0.6	0.4	10
11	6.1	0.6	0.2	0.9	0.8	0.6	6.0	0.5	0.2	0.7	0.6	0.5	11
12	6.3	0.6	0.3	1.0	0.8	0.7	6.2	0.5	0.2	0.8	0.7	0.5	12
13	6.4	0.7	0.3	1.0	0.9	0.7	6.3	0.5	0.2	0.8	0.7	0.6	13
14	6.6	0.7	0.3	1.1	0.9	0.7	6.5	0.6	0.2	0.9	0.7	0.6	14
15	6.7	0.8	0.3	1.1	1.0	0.8	6.6	0.6	0.2	0.9	0.8	0.6	15
16	6.8	0.8	0.3	1.2	1.0	0.8	6.7	0.6	0.2	1.0	0.8	0.7	16
17	7.0	0.8	0.3	1.2	1.0	0.9	6.8	0.7	0.3	1.0	0.9	0.7	17
18	7.1	0.9	0.4	1.3	1.1	0.9	6.9	0.7	0.3	1.0	0.9	0.7	18
19	7.1	0.9	0.4	1.3	1.1	0.9	7.0	0.7	0.3	1.1	0.9	0.7	19
20	7.2	0.9	0.4	1.4	1.2	0.9	7.1	0.7	0.3	1.1	0.9	0.8	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-27

22 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	1200Pairs						Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.7	-	-	-	-	-							1
2	1.7	-	-	0.1	0.1	-							2
3	2.6	0.1	-	0.1	0.1	0.1							3
4	3.3	0.1	-	0.2	0.2	0.1							4
5	3.9	0.2	0.1	0.3	0.2	0.2							5
6	4.4	0.2	0.1	0.3	0.3	0.2							6
7	4.8	0.2	0.1	0.4	0.3	0.3							7
8	5.1	0.3	0.1	0.5	0.4	0.3							8
9	5.4	0.3	0.1	0.5	0.4	0.3							9
10	5.7	0.3	0.1	0.6	0.5	0.4							10
11	5.9	0.4	0.1	0.6	0.5	0.4							11
12	6.1	0.4	0.1	0.6	0.5	0.4							12
13	6.3	0.4	0.2	0.7	0.6	0.5							13
14	6.4	0.5	0.2	0.7	0.6	0.5							14
15	6.5	0.4	0.2	0.8	0.6	0.5							15
16	6.7	0.5	0.2	0.8	0.7	0.5							16
17	6.8	0.5	0.2	0.8	0.7	0.6							17
18	6.9	0.5	0.2	0.9	0.7	0.6							18
19	6.9	0.6	0.2	0.9	0.8	0.6							19
20	7.0	0.6	0.2	0.9	0.8	0.6							20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-28

19 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	12 Pairs						18 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	1.0	0.2	0.1	0.2	0.2	0.2	1.0	0.1	0.1	0.2	0.2	0.1	1
2	2.5	0.7	0.4	0.9	0.9	0.7	2.5	0.6	0.3	0.8	0.7	0.6	2
3	4.0	1.3	0.7	1.8	1.6	1.4	3.0	1.1	0.6	1.5	1.4	1.2	3
4	5.2	1.9	1.1	2.5	2.3	2.0	5.1	1.7	0.9	2.2	2.0	1.7	4
5	6.2	2.5	1.4	3.2	2.9	2.5	6.1	2.1	1.1	2.8	2.5	2.2	5
6	7.0	2.9	1.6	3.7	3.4	3.0	6.9	2.5	1.4	3.3	3.0	2.6	6
7	7.7	3.4	1.9	4.2	3.9	3.4	7.6	2.9	1.6	3.7	3.4	3.0	7
8	8.3	3.7	2.1	4.7	4.3	3.8	8.2	3.2	1.8	4.1	3.8	3.3	8
9	8.8	4.0	2.3	5.0	4.7	4.1	8.7	3.5	2.0	4.5	4.1	3.6	9
10	9.3	4.3	2.5	5.4	5.0	4.4	9.2	3.8	2.1	4.8	4.4	3.9	10
11	9.7	4.6	2.7	5.7	5.3	4.7	9.6	4.0	2.3	5.1	4.7	4.1	11
12	10.0	4.8	2.9	6.0	5.6	4.9	9.9	4.3	2.4	5.4	4.9	4.4	12
13	10.3	5.0	3.0	6.2	5.8	5.2	10.2	4.4	2.6	5.6	5.2	4.6	13
14	10.6	5.2	3.2	6.4	6.0	5.4	10.5	4.6	2.7	5.8	5.4	4.7	14
15	10.8	5.4	3.3	6.6	6.2	5.5	10.7	4.8	2.8	6.0	5.5	4.9	15
16	11.1	5.6	3.4	6.8	6.4	5.7	11.0	5.0	2.9	6.2	5.7	5.1	16
17	11.3	5.8	3.5	6.9	6.5	5.9	11.2	5.1	3.0	6.3	5.9	5.2	17
18	11.5	5.9	3.6	7.2	6.7	6.0	11.3	5.2	3.1	6.5	6.0	5.4	18
19	11.6	6.0	3.7	7.3	6.8	6.2	11.5	5.4	3.2	6.6	6.2	5.5	19
20	11.8	6.2	3.8	7.5	7.0	6.3	11.7	5.5	3.3	6.8	6.3	5.6	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-29

19 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	25 Pairs						50 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	1.0	0.1	0.1	0.2	0.2	0.1	0.9	0.1	-	0.1	0.1	0.1	1
2	2.5	0.5	0.2	0.7	0.6	0.5	2.4	0.3	0.1	0.5	0.4	0.3	2
3	3.9	1.0	0.5	1.3	1.2	1.0	3.7	0.6	0.3	0.9	0.8	0.7	3
4	5.1	1.4	0.7	1.9	1.8	1.5	4.9	1.0	0.4	1.4	1.2	1.0	4
5	6.1	1.9	1.0	2.5	2.2	1.9	5.9	1.3	0.6	1.8	1.6	1.3	5
6	6.9	2.2	1.2	3.0	2.7	2.3	6.7	1.5	0.7	2.1	1.9	1.6	6
7	7.6	2.6	1.4	3.4	3.1	2.6	7.3	1.8	0.8	2.5	2.2	1.8	7
8	8.1	2.9	1.5	3.8	3.4	3.0	7.9	2.0	1.0	2.7	2.4	2.1	8
9	8.7	3.1	1.7	4.1	3.7	3.2	8.4	2.2	1.1	3.0	2.7	2.3	9
10	9.1	3.4	1.8	4.4	4.0	3.5	8.9	2.4	1.2	3.2	2.9	2.5	10
11	9.5	3.6	2.0	4.6	4.2	3.7	9.2	2.5	1.3	3.5	3.1	2.6	11
12	9.8	3.8	2.1	4.9	4.5	3.9	9.6	2.7	1.4	3.7	3.3	2.8	12
13	10.1	4.0	2.2	5.1	4.7	4.1	9.9	2.9	1.4	3.8	3.4	2.9	13
14	10.4	4.2	2.-	5.3	4.9	4.3	10.2	3.0	1.5	4.0	3.6	3.1	14
15	10.6	4.3	2.4	5.5	5.0	4.4	10.4	3.1	1.6	4.2	3.7	3.2	15
16	10.9	4.5	2.5	5.7	5.2	4.6	10.6	3.2	1.7	4.3	3.9	3.3	16
17	11.1	4.6	2.6	5.8	5.3	4.7	10.8	3.3	1.7	4.4	4.0	3.4	17
18	11.3	4.7	2.7	6.0	5.5	4.8	11.0	3.4	1.8	4.6	4.1	3.5	18
19	11.4	4.8	2.8	6.1	5.6	5.0	11.2	3.5	1.9	4.7	4.2	3.6	19
20	11.6	5.0	2.9	6.2	5.7	5.1	11.3	3.6	1.9	4.8	4.3	3.7	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-30

19 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	75 Pairs						100 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.9	0.1	-	0.1	0.1	0.1	0.9	-	-	0.1	0.1	0.1	1
2	2.3	0.3	0.1	0.4	0.3	0.3	2.3	0.2	0.1	0.3	0.3	0.2	2
3	3.7	0.5	0.2	0.8	0.7	0.6	3.6	0.5	0.2	0.7	0.6	0.5	3
4	4.8	0.8	0.4	1.2	1.0	0.8	4.8	0.7	0.3	1.0	0.9	0.7	4
5	5.8	1.1	0.5	1.5	1.3	1.1	5.7	0.9	0.4	1.3	1.1	0.9	5
6	6.6	1.3	0.6	1.8	1.6	1.3	6.5	1.1	0.5	1.6	1.4	1.1	6
7	7.3	1.5	0.7	2.1	1.9	1.6	7.2	1.3	0.6	1.9	1.6	1.3	7
8	7.8	1.7	0.8	2.4	2.1	1.8	7.8	1.5	0.7	2.1	1.8	1.5	8
9	8.3	1.9	0.9	2.6	2.3	1.9	8.3	1.6	0.7	2.3	2.0	1.7	9
10	8.8	2.0	1.0	2.8	2.5	2.1	8.7	1.8	0.8	2.5	2.2	1.8	10
11	9.2	2.2	1.0	3.0	2.7	2.3	9.1	1.9	0.9	2.7	2.4	2.0	11
12	9.5	2.3	1.1	3.2	2.9	2.4	9.4	2.0	0.9	2.8	2.5	2.1	12
13	9.8	2.5	1.2	3.4	3.0	2.5	9.7	2.1	1.0	3.0	2.6	2.2	13
14	10.1	2.6	1.3	3.5	3.1	2.7	10.0	2.2	1.1	3.1	2.8	2.3	14
15	10.3	2.7	1.3	3.7	3.3	2.8	10.2	2.3	1.1	3.3	2.9	2.4	15
16	10.5	2.8	1.4	3.8	3.4	2.9	10.4	2.4	1.2	3.4	3.0	2.5	16
17	10.7	2.9	1.4	3.9	3.5	3.0	10.6	2.5	1.2	3.5	3.1	2.6	17
18	10.9	3.0	1.5	4.0	3.6	3.1	10.8	2.6	1.3	3.6	3.2	2.7	18
19	11.1	3.1	1.6	4.1	3.7	3.2	11.0	2.7	1.3	3.7	3.3	2.8	19
20	11.2	3.2	1.6	4.2	3.8	3.3	11.2	2.8	1.4	3.8	3.4	2.9	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-31

19 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	150 Pairs						200 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.9	-	-	0.1	-	-	0.9	-	-	-	-	-	1
2	2.2	0.2	0.1	0.3	0.2	0.2	2.2	0.1	0.1	0.2	0.2	0.1	2
3	3.5	0.3	0.1	0.5	0.4	0.3	3.5	0.3	0.1	0.5	0.4	0.3	3
4	4.7	0.5	0.2	0.8	0.7	0.5	4.6	0.4	0.2	0.7	0.6	0.4	4
5	5.6	0.7	0.3	1.0	0.9	0.7	5.6	0.6	0.2	0.9	0.8	0.6	5
6	6.4	0.8	0.4	1.2	1.1	0.9	6.3	0.7	0.3	1.1	1.0	0.7	6
7	7.1	1.0	0.4	1.5	1.3	1.0	7.0	0.9	0.4	1.3	1.1	0.9	7
8	7.6	1.1	0.5	1.6	1.4	1.2	7.6	1.0	0.4	1.5	1.3	1.0	8
9	8.1	1.2	0.5	1.8	1.6	1.3	8.1	1.1	0.5	1.6	1.4	1.1	9
10	8.5	1.4	0.6	2.0	1.7	1.4	8.5	1.2	0.5	1.8	1.5	1.2	10
11	8.9	1.5	0.7	2.1	1.9	1.5	8.9	1.3	0.6	1.9	1.7	1.3	11
12	9.3	1.6	0.7	2.3	2.0	1.6	9.2	1.4	0.6	2.0	1.8	1.4	12
13	9.6	1.7	0.8	2.4	2.1	1.7	9.5	1.5	0.7	2.2	1.9	1.5	13
14	9.8	1.8	0.8	2.5	2.2	1.8	9.8	1.6	0.7	2.3	2.0	1.6	14
15	10.1	1.8	0.8	2.6	2.3	1.9	10.0	1.6	0.7	2.4	2.1	1.6	15
16	10.3	1.9	0.9	2.7	2.4	2.0	10.2	1.7	0.8	2.5	2.2	1.7	16
17	10.5	2.0	0.9	2.8	2.5	2.1	10.4	1.8	0.8	2.6	2.3	1.8	17
18	10.7	2.1	1.0	2.9	2.6	2.1	10.6	1.9	0.8	2.7	2.3	1.9	18
19	10.8	2.1	1.0	3.0	2.7	2.2	10.8	1.9	0.9	2.7	2.4	1.9	19
20	11.0	2.2	1.0	3.1	2.7	2.3	10.9	2.0	0.9	2.8	2.5	2.0	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-32

19 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	300 Pairs						400 Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.8	-	-	-	-	-	0.8	-	-	-	-	-	1
2	2.2	0.1	-	0.2	0.1	0.1	2.1	0.1	-	0.1	0.1	0.1	2
3	3.4	0.2	0.1	0.3	0.3	0.2	3.4	0.2	0.1	0.3	0.2	0.2	3
4	4.5	0.3	0.1	0.5	0.4	0.4	4.5	0.3	0.1	0.4	0.4	0.3	4
5	5.4	0.5	0.2	0.7	0.6	0.5	5.4	0.4	0.1	0.6	0.5	0.4	5
6	6.2	0.6	0.2	0.9	0.7	0.6	6.1	0.5	0.2	0.7	0.6	0.5	6
7	6.9	0.7	0.3	1.0	0.9	0.7	6.8	0.5	0.2	0.8	0.7	0.6	7
8	7.4	0.8	0.3	1.2	1.0	0.8	7.4	0.6	0.2	1.0	0.8	0.7	8
9	7.9	0.8	0.3	1.3	1.1	0.9	7.8	0.7	0.3	1.1	0.9	0.7	9
10	8.4	0.9	0.4	1.4	1.2	1.0	8.3	0.8	0.3	1.2	1.0	0.8	10
11	8.7	1.0	0.4	1.5	1.3	1.1	8.6	0.8	0.3	1.3	1.1	0.9	11
12	9.1	1.1	0.5	1.6	1.4	1.1	9.0	0.9	0.4	1.4	1.2	0.9	12
13	9.4	1.2	0.5	1.7	1.5	1.2	9.3	1.0	0.4	1.5	1.3	1.0	13
14	9.6	1.2	0.5	1.8	1.6	1.3	9.5	1.0	0.4	1.5	1.3	1.1	14
15	9.9	1.3	0.5	1.9	1.6	1.3	9.8	1.1	0.4	1.6	1.4	1.1	15
16	10.1	1.3	0.6	2.0	1.7	1.4	10.0	1.1	0.5	1.7	1.5	1.2	16
17	10.3	1.4	0.6	2.1	1.8	1.5	10.2	1.2	0.5	1.8	1.5	1.2	17
18	10.5	1.5	0.6	2.1	1.9	1.5	10.4	1.2	0.5	1.8	1.6	1.3	18
19	10.6	1.5	0.7	2.2	1.9	1.6	10.5	1.3	0.5	1.9	1.6	1.3	19
20	10.8	1.6	0.7	2.3	2.0	1.6	10.7	1.3	0.6	1.9	1.7	1.4	20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

TABLE B-33

19 GAUGE 540 Hertz Earth Resistivity-1000 Meter-Ohms Resistance, Total Grounds-5Ohms

Length in Kft	600 Pairs						Pairs						Length in Kft.
	10 Pr.	A	B	C	D	E	10 Pr.	A	B	C	D	E	
1	0.8	-	-	-	-	-							1
2	2.1	0.1	-	0.1	0.1	0.1							2
3	3.3	0.1	-	0.2	0.2	0.1							3
4	4.4	0.2	0.1	0.3	0.3	0.2							4
5	5.3	0.3	0.1	0.4	0.4	0.3							5
6	6.0	0.3	0.1	0.5	0.5	0.4							6
7	6.7	0.4	0.2	0.6	0.5	0.4							7
8	7.2	0.5	0.2	0.7	0.6	0.5							8
9	7.7	0.5	0.2	0.8	0.7	0.5							9
10	8.1	0.6	0.2	0.9	0.8	0.6							10
11	8.5	0.6	0.2	1.0	0.8	0.7							11
12	8.8	0.7	0.3	1.1	0.9	0.7							12
13	9.1	0.7	0.3	1.1	1.0	0.8							13
14	9.4	0.8	0.3	1.2	1.0	0.8							14
15	9.6	0.8	0.3	1.3	1.1	0.8							15
16	9.8	0.9	0.3	1.3	1.1	0.9							16
17	10.0	0.9	0.4	1.4	1.2	0.9							17
18	10.2	0.9	0.4	1.4	1.2	1.0							18
19	10.4	1.0	0.4	1.5	1.3	1.0							19
20	10.5	1.0	0.4	1.5	1.3	1.0							20

Deviation in dBrnc with open circuited shield paralleled by 10 pairs.
Column 10 Pr.

Deviation in dBrnc with continuous shield circuit paralleled by 10 pairs.
Column A-5mil Copper Shield
Column B-10mil Copper Shield
Column C-6mil Copper Clad Steel
Column D-6mil Alloy 194
Column E-8mil Coated Aluminum, 8mil Coated Aluminum/Coated Steel, 7mil Alloy 194

Table B-34

Shield Resistance - Filled Cable

Size & Gauge	O.D. (Inches)	Resistance - Ohms/Kilofoot				
		A	B	C	D	E
12/26	0.40	1.600	0.875	2.200	1.950	1.650
18/26	0.45	1.422	0.788	1.956	1.733	1.467
25/26	0.49	1.306	0.714	1.796	1.592	1.347
50/26	0.62	1.032	0.565	1.419	1.258	1.065
75/26	0.71	0.901	0.493	1.239	1.099	0.930
100/26	0.80	0.800	0.438	1.100	0.975	0.825
150/26	0.95	0.674	0.368	0.926	0.821	0.695
200/26	1.1	0.592	0.318	0.800	0.709	0.600
300/26	1.3	0.492	0.269	0.677	0.600	0.508
400/26	1.5	0.427	0.233	0.578	0.520	0.440
600/26	1.8	0.356	0.194	0.489	0.433	0.367
900/26	2.2	0.291	0.159	0.400	0.355	0.300
1200/26	2.4	0.267	0.146	0.367	0.325	0.275
1500/26	2.7	0.237	0.130	0.326	0.389	0.244
1800/26	2.9	0.221	0.121	0.303	0.269	0.228
2100/26	3.2	0.200	0.109	0.275	0.244	0.206
2400/26	3.4	0.188	0.103	0.259	0.229	0.194
2700/26	3.5	0.183	0.100	0.251	0.223	0.189
3000/26	3.7	0.173	0.095	0.238	0.211	0.178
3300/26	3.9	0.164	0.090	0.226	0.200	0.169
3600/26	4.0	0.160	0.088	0.220	0.195	0.165

Column A - 5 mil Copper Shield
Column B -10 mil Copper Shield
Column C - 6 mil Copper Clad Steel
Column D - 6 mil Alloy 194
Column E - 8 mil Coated Aluminum
8 mil Coated Aluminum/Coated Steel
7 mil Alloy 194

Table B-35

Shield Resistance - Filled Cable

Size & Gauge	O.D. (Inches)	Resistance - Ohms/Kilofoot				
		A	B	C	D	E
6/24	0.38	1.684	0.921	2.316	2.053	1.737
12/24	0.46	1.391	0.761	1.913	1.696	1.435
18/24	0.52	1.231	0.673	1.692	1.500	1.269
25/24	0.57	1.123	0.614	1.544	1.368	1.158
50/24	0.73	0.877	0.479	1.205	1.069	0.904
75/24	0.87	0.736	0.402	1.011	0.897	0.759
100/24	0.99	0.646	0.354	0.889	0.788	0.677
150/24	1.2	0.533	0.292	0.733	0.650	0.550
200/24	1.4	0.457	0.250	0.629	0.557	0.471
300/24	1.6	0.400	0.219	0.550	0.488	0.413
400/24	1.9	0.355	0.194	0.489	0.433	0.367
500/24	2.0	0.320	0.175	0.440	0.390	0.330
600/24	2.2	0.291	0.159	0.400	0.355	0.300
900/24	2.7	0.237	0.130	0.326	0.289	0.244
1200/24	3.1	0.206	0.113	0.284	0.252	0.213
1500/24	3.4	0.188	0.103	0.250	0.229	0.194
1800/24	3.7	0.173	0.095	0.238	0.211	0.178
2100/24	3.9	0.164	0.090	0.226	0.200	0.169

Column A - 5 mil Copper Shield
Column B - 10 mil Copper Shield
Column C - 6 mil Copper Clad Steel
Column D - 6 mil Alloy 194
Column E - 8 mil Coated Aluminum
8 mil Coated Aluminum/Coated Steel
7 mil Alloy 194

Table B- 36

Shield Resistance - Filled Cable

Size & Gauge	O.D. (Inches)	Resistance - Ohms/Kilofoot				
		A	B	C	D	E
6/22	0.43	1.488	0.814	2.074	1.814	1.535
12/22	0.53	1.208	0.660	1.660	1.472	1.245
18/22	0.61	1.049	0.574	1.443	1.279	1.082
25/22	0.68	0.941	0.515	1.249	1.147	0.971
50/22	0.89	0.719	0.393	0.989	0.876	0.742
75/22	1.1	0.582	0.318	0.800	0.709	0.600
100/22	1.2	0.533	0.292	0.733	0.650	0.550
150/22	1.5	0.427	0.233	0.587	0.520	0.440
200/22	1.7	0.376	0.206	0.518	0.459	0.388
300/22	2.0	0.320	0.176	0.440	0.390	0.330
400/22	2.3	0.278	0.152	0.383	0.339	0.287
600/22	2.8	0.229	0.125	0.314	0.279	0.236
900/22	3.3	0.194	0.106	0.267	0.236	0.200
1200/22	3.8	0.168	0.092	0.232	0.205	0.174

Column A - 5 mil Copper Shield
Column B - 10 mil Copper Shield
Column C - 6 mil Copper Clad Steel
Column D - 6 mil Alloy 194
Column E - 8 mil Coated Aluminum
8 mil Coated Aluminum/Coated Steel
7 mil Alloy 194

Table B-37

Shield Resistance - Filled Cable

Size & Gauge	O.D. (Inches)	Resistance - Ohms/Kilofoot				
		A	B	C	D	E
6/19	9.54	1.185	0.648	1.630	1.444	1.222
12/19	0.68	0.941	0.515	1.294	1.147	0.971
18/19	0.80	0.800	0.438	1.100	0.975	0.825
25/19	0.91	0.703	0.385	0.967	0.857	0.725
50/19	1.3	0.492	0.269	0.677	0.600	0.508
75/19	1.5	0.427	0.233	0.587	0.520	0.440
100/19	1.7	0.376	0.206	0.518	0.459	0.388
150/19	2.1	0.305	0.167	0.419	0.371	0.314
200/19	2.3	0.278	0.152	0.383	0.339	0.287
300/19	2.8	0.229	0.125	0.314	0.279	0.236
400/19	3.2	0.200	0.109	0.275	0.244	0.206
600/19	3.9	0.164	0.090	0.226	0.200	0.169

Column A - 5 mil Copper Shield
Column B - 10 mil Copper Shield
Column C - 6 mil Copper Clad Steel
Column D - 6 mil Alloy 194
Column E - 8 mil Coated Aluminum
8 mil Coated Aluminum/Coated Steel
7 mil Alloy 194

Table B-38

Shield Resistance - Air Core Cable

Size & Gauge	O.D. (Inches)	Resistance - Ohms/Kilofoot				
		A	B	C	D	E
12/26	0.38	1.654	0.921	2.316	2.053	1.737
18/26	0.42	1.524	0.833	2.095	1.857	1.571
25/26	0.46	1.391	0.761	1.913	1.696	1.435
50/26	0.56	1.143	0.625	1.571	1.393	1.179
75/26	0.64	1.000	0.547	1.375	1.219	1.031
100/26	0.71	0.901	0.493	1.239	1.099	0.930
150/26	0.83	0.771	0.422	1.060	0.940	0.795
200/26	0.93	0.668	0.376	0.946	0.839	0.710
300/26	1.1	0.582	0.318	0.800	0.709	0.600
400/26	1.3	0.492	0.269	0.677	0.600	0.508
600/26	1.6	0.400	0.219	0.550	0.488	0.413
900/26	1.9	0.337	0.184	0.463	0.411	0.347
1200/26	2.2	0.291	0.159	0.400	0.353	0.300
1500/26	2.4	0.267	0.146	0.367	0.325	0.275
1800/26	2.6	0.246	0.135	0.338	0.300	0.254
2100/26	2.8	0.229	0.125	0.314	0.279	0.236
2400/26	3.0	0.213	0.117	0.293	0.260	0.220
2700/26	3.1	0.206	0.113	0.284	0.252	0.213
3000/26	3.3	0.194	0.106	0.267	0.236	0.200
3300/26	3.4	0.188	0.103	0.259	0.229	0.194
3600/26	3.6	0.178	0.097	0.244	0.217	0.183

Column A - 5 mil Copper Shield
Column B - 10 mil Copper Shield
Column C - 6 mil Copper Clad Steel
Column D - 6 mil Alloy 194
Column E - 8 mil Coated Aluminum
8 mil Coated Aluminum/Coated Steel
7 mil Alloy 194

Table B-39

Shield Resistance - Air Core Cable

Size & Gauge	O.D. (Inches)	Resistance - Ohms/Kilofoot				
		A	B	C	D	E
6/24	9,37	1.730	0.946	2.378	2.108	1.784
12/24	0.43	1.488	0.814	2.047	1.814	1.535
18/24	0.48	1.333	0.729	1.833	1.625	1.375
25/24	0.53	1.208	0.660	1.660	1.472	1.245
50/24	0.66	0.970	0.530	1.333	1.182	1.000
75/24	0.76	0.842	0.461	1.158	1.026	0.868
100/24	0.86	0.744	0.407	1.023	0.907	0.767
150/24	1.0	0.640	0.350	0.880	0.780	0.660
200/24	1.2	0.533	0.292	0.733	0.650	0.550
300/24	1.4	0.457	0.250	0.629	0.557	0.471
400/24	1.6	0.400	0.219	0.550	0.488	0.413
500/24	1.8	0.356	0.194	0.489	0.433	0.367
600/24	1.9	0.337	0.184	0.463	0.411	0.347
900/24	2.3	0.278	0.152	0.383	0.339	0.287
1200/24	2.6	0.246	0.135	0.338	0.300	0.254
1500/24	2.9	0.221	0.121	0.303	0.269	0.228
1800/24	3.1	0.206	0.113	0.284	0.252	0.213
2100/24	3.3	0.194	0.106	0.267	0.236	0.200

Column A - 5 mil Copper Shield
Column B - 10 mil Copper Shield
Column C - 6 mil Copper Clad Steel
Column D - 6 mil Alloy 194
Column E - 8 mil Coated Aluminum
8 mil Coated Aluminum/Coated Steel
7 mil Alloy 194

Table B-40

Shield Resistance - Air Core Cable

Size & Gauge	O.D. (Inches)	Resistance - Ohms/Kilofoot				
		A	B	C	D	E
6/22	0.40	1.600	0.875	2.200	1.950	1.650
12/22	0.48	1.333	0.729	1.833	1.625	1.375
18/22	0.55	1.164	0.636	1.600	1.418	1.200
25/22	0.61	1.049	0.574	1.433	1.279	1.082
50/22	0.77	0.831	0.455	1.143	1.013	0.857
75/22	0.91	0.703	0.385	0.967	0.857	0.725
100/22	1.1	0.582	0.318	0.800	0.709	0.600
150/22	1.3	0.492	0.260	0.677	0.600	0.508
200/22	1.4	0.457	0.250	0.629	0.557	0.471
300/22	1.8	0.356	0.194	0.489	0.433	0.367
400/22	2.0	0.320	0.175	0.440	0.390	0.330
600/22	2.3	0.278	0.152	0.383	0.339	0.287
900/22	2.8	0.229	0.125	0.314	0.279	0.236
1200/22	3.2	0.200	0.109	0.275	0.244	0.206

Column A - 5 mil Copper Shield
Column B - 10 mil Copper Shield
Column C - 6 mil Copper Clad Steel
Column D - 6 mil Alloy 194
Column E - 8 mil Coated Aluminum
8 mil Coated Aluminum/Coated Steel
7 mil Alloy 194

Table B-41

Shield Resistance - Air Core Cable

Size & Gauge	O.D. (Inches)	Resistance - Ohms/Kilofoot				
		A	B	C	D	E
6/19	0.50	1.280	0.700	1.760	1.560	1.320
12/19	0.62	1.032	0.565	1.419	1.258	1.065
18/19	0.71	0.901	0.493	1.239	1.099	0.930
25/19	0.86	0.744	0.407	1.023	0.907	0.767
50/19	1.1	0.582	0.318	0.800	0.709	0.600
75/19	1.3	0.492	0.269	0.677	0.600	0.508
100/19	1.5	0.427	0.233	0.587	0.520	0.440
150/19	1.8	0.356	0.194	0.489	0.433	0.367
200/19	2.1	0.305	0.167	0.419	0.371	0.314
300/19	2.5	0.256	0.140	0.352	0.312	0.264
400/19	2.8	0.229	0.125	0.314	0.279	0.236
600/19	3.4	0.188	0.103	0.259	0.229	0.194

Column A - 5 mil Copper Shield
Column B - 10 mil Copper Shield
Column C - 6 mil Copper Clad Steel
Column D - 6 mil Alloy 194
Column E - 8 mil Coated Aluminum
8 mil Coated Aluminum/Coated Steel
7 mil Alloy 194

Table B-42

Shield Resistance - Filled Cable with Expanded Insulation

Size & Gauge	O.D. (Inches)	Resistance - Ohms/Kilofoot				
		A	B	C	D	E
12/26	0.37	1.730	0.946	2.378	2.108	1.784
18/26	0.41	1.561	0.854	2.146	1.902	1.610
25/26	0.45	1.422	0.778	1.956	1.733	1.467
50/26	0.56	1.143	0.625	1.571	1.393	1.179
75/26	0.64	1.000	0.547	1.375	1.219	1.031
100/26	0.71	0.901	0.493	1.239	1.099	0.930
150/26	0.84	0.762	0.417	1.048	0.929	0.786
200/26	0.94	0.681	0.372	0.936	0.830	0.702
300/26	1.2	0.533	0.292	0.733	0.650	0.550
400/26	1.3	0.492	0.269	0.677	0.600	0.508
600/26	1.5	0.427	0.233	0.587	0.520	0.440
900/26	1.9	0.337	0.184	0.463	0.411	0.347
1200/26	2.1	0.305	0.167	0.419	0.371	0.314
1500/26	2.4	0.267	0.146	0.367	0.325	0.275
1800/26	2.6	0.246	0.135	0.338	0.300	0.254
2100/26	2.8	0.229	0.125	0.314	0.279	0.236
2400/26	2.9	0.221	0.121	0.303	0.269	0.228
2700/26	3.1	0.206	0.113	0.284	0.252	0.213
3000/26	3.3	0.194	0.106	0.267	0.236	0.200
3300/26	3.4	0.188	0.103	0.259	0.229	0.194
3600/26	3.5	0.183	0.100	0.251	0.223	0.189

Column A - 5 mil Copper Shield
Column B - 10 mil Copper Shield
Column C - 6 mil Copper Clad Steel
Column D - 6 mil Alloy 194
Column E - 8 mil Coated Aluminum
8 mil Coated Aluminum/Coated Steel
7 mil Alloy 194

Table B-43

Shield Resistance - Filled Cable with Expanded Insulation

Size & Gauge	O.D. (Inches)	Resistance - Ohms/Kilofoot				
		A	B	C	D	E
6/24	0.35	1.829	1.000	2.514	2.229	1.885
12/24	0.41	1.561	0.854	2.146	1.902	1.610
18/24	0.46	1.391	0.761	1.913	1.696	1.435
25/24	0.51	1.255	0.686	1.725	1.529	1.294
50/24	0.65	0.985	0.538	1.354	1.200	1.015
75/24	0.76	0.842	0.461	1.158	1.026	0.868
100/24	0.85	0.753	0.412	1.035	0.918	0.776
150/24	1.0	0.640	0.350	0.880	0.780	0.660
200/24	1.2	0.533	0.292	0.733	0.650	0.550
300/24	1.4	0.457	0.250	0.629	0.557	0.471
400/24	1.6	0.400	0.219	0.550	0.488	0.413
500/24	1.8	0.356	0.194	0.489	0.433	0.367
600/24	1.9	0.337	0.184	0.463	0.411	0.347
900/24	2.3	0.278	0.152	0.383	0.339	0.287
1200/24	2.6	0.246	0.135	0.338	0.300	0.254
1500/24	2.9	0.221	0.121	0.303	0.269	0.228
1800/24	3.2	0.200	0.109	0.275	0.244	0.206
2100/24	3.4	0.188	0.103	0.259	0.229	0.194

Column A - 5 mil Copper Shield
Column B - 10 mil Copper Shield
Column C - 6 mil Copper Clad Steel
Column D - 6 mil Alloy 194
Column E - 8 mil Coated Aluminum
8 mil Coated Aluminum/Coated Steel
7 mil Alloy 194

Table B-44

Shield Resistance - Filled Cable with Expanded Insulation

Size & Gauge	O.D. (Inches)	Resistance - Ohms/Kilofoot				
		A	B	C	D	E
6/22	0.39	1.641	0.897	2.256	2.000	1.692
12/22	0.48	1.333	0.729	1.833	1.625	1.375
18/22	0.54	1.185	0.648	1.630	1.444	1.222
25/22	0.61	1.049	0.574	1.443	1.279	1.082
50/22	0.79	0.810	0.443	1.114	0.978	0.835
75/22	0.92	0.696	0.380	0.957	0.848	0.717
100/22	1.1	0.582	0.318	0.800	0.709	0.600
150/22	1.3	0.492	0.260	0.677	0.600	0.508
200/22	1.4	0.457	0.250	0.629	0.557	0.471
300/22	1.7	0.376	0.206	0.518	0.459	0.388
400/22	2.0	0.320	0.175	0.440	0.390	0.330
600/22	2.4	0.267	0.146	0.367	0.325	0.275
900/22	2.9	0.221	0.121	0.303	0.269	0.228
1200/22	3.3	0.194	0.106	0.267	0.236	0.200

Column A - 5 mil Copper Shield
Column B - 10 mil Copper Shield
Column C - 6 mil Copper Clad Steel
Column D - 6 mil Alloy 194
Column E - 8 mil Coated Aluminum
8 mil Coated Aluminum/Coated Steel
7 mil Alloy 194

Table B-45

Shield Resistance - Filled Cable with Expanded Insulation

Size & Gauge	O.D. (Inches)	Resistance - Ohms/Kilofoot				
		A	B	C	D	E
6/19	0.48	1.333	0.729	1.833	1.625	1.375
12/19	0.60	1.067	0.583	1.467	1.300	1.100
18/19	0.70	0.914	0.500	1.257	1.114	0.943
25/19	0.80	0.800	0.438	1.100	0.975	0.825
50/19	1.1	0.582	0.318	0.800	0.709	0.600
75.19	1.3	0.492	0.269	0.677	0.600	0.508
100/19	1.5	0.427	0.233	0.587	0.520	0.440
150/19	1.8	0.356	0.194	0.489	0.433	0.367
200/19	2.0	0.320	0.175	0.440	0.390	0.330
300/19	2.4	0.267	0.146	0.367	0.325	0.275
400/19	2.8	0.299	0.125	0.314	0.279	0.236
600/19	3.3	0.194	0.106	0.267	0.236	0.200

Column A - 5 mil Copper Shield
Column B - 10 mil Copper Shield
Column C - 6 mil Copper Clad Steel
Column D - 6 mil Alloy 194
Column E - 8 mil Coated Aluminum
8 mil Coated Aluminum/Coated Steel
7 mil Alloy 194

APPENDIX C

EQUATIONS AND TABLES - S1 UNITS OF MEASURE

Appendix C has been prepared and is available for those with a need for equations and tables using S1 measuring units. Copies may be obtained from:

Telecommunications Engineering and Standards Division
Rural Electrificaton Administration
United States Department of Agriculture
Washington, D.C. 20250

APPENDIX D

PROGRAM A

CALCULATION OF FACTORS FOR IDENTIFYING OPEN-CIRCUITED CABLE SHIELD

(Using a TI/58 or TI/59 Calculator)

Procedure

STEP

1. Key in program A. No repartioning is necessary.
2. Enter data in data registers.

	English Units	SI Units
Register 3 - Shield Resistance in ohms/Kf or ohms/Km	Tables B-34 to B-45	Tables C-34 to C-45
Register 4 - Resistance of 10 parallel Cable pairs (See Step 3)	Lbl B	Lbl C
Register 5 - Total Resistance of Grounds	Ohms	Ohms
Register 6 - Length	Kilofeet	Kilometers
Register 7 - Constant	$882 \times 10_{-6}$	2.894×10^{-3}
Register [illegible] - Constant	$3 \times 10_{-4}$	$987 \times 10_{-6}$
Register 13 - Length increment (For preparing tables)	Kilofeet	Kilometers
Register 15 - Constant	24	200
Register 16 - Constant	2280	695
Register 17 - Cable diameter in inches or centimeters	Tables B-34 to B-35	Tables C-34 to C-45
Register 18 - Frequency	Hertz	Hertz
Register 19 - Earth Resistivity	Meter - Ohm	Meter - Ohms
Register 20 - Cable loop resistance in ohms/kilofoot		See Step 3
Register 21 - Number of parallel pairs		See Step 3

3. Enter the parallel resistance of the number of pairs selected by using the appropriate key for the unit of measure desired. Key B for English units or Key C for SI units.

4. Depress Key A to initiate the calculation of shield factors. The value displayed at the conclusion of this run is the shield factor in decibels for the group of parallel pairs. (For ten pairs, the value in "10 Pr." column of the Tables). Press R/S and the reduction in decibels will be displayed that will occur when a continuous shield is connected in parallel cable pairs.

   If desired, the cable shield factor in decibels may be obtained by recalling Register 12. This is the reduction of noise that will occur when an open-circuited shield is repaired. Also the resistance component (R_{23} of the mutual impedance (Z_{23} may be found by recalling Register 1. The reactance component (X_{23}) may be recalled from Register 2.

5. When preparing tables again press R/S. The length will be increased by one increment (Register 13) and calculations completed for this new length. Repeat this until calculations have been completed for the maximum length desired.

6. When calculations are desired for the same cable size and gauge with a new shield material enter the shield resistance per unit length. Depress Key D. This will store the shield resistance in Register 3, return Register 6 to one unit length and initiate calculation of the new shield factor. Repeat Step 5 as desired.

7. When calculations are desired for the same cable gauge of a different size first enter the resistance of the shield material for the new size. Depress Key E. The shield resistance will be displayed. Enter the cable diameter in inches or centimeters, as appropriate. Press R/S Key. This stores the cable diameter in Register 17, returns Register 6 to one unit length and initiates calculation of the new shield factor. Repeat Step 5 as desired.

8. The cable gauge may be changed by storing the loop resistance per unit length of the desired gauge in Register 20. Store the desired number of pairs in the group in Register 21. Next press Key B for English or Key C SI units of measure to calculate and store the parallel resistance in Register 4. Repeat Step 7 to initiate calculations.

PROGRAM A (Cont'd.)
FACTORS FOR IDENTIFYING OPEN-CIRCUITED CABLE SHIELD

For TI/58 and TI/59 Calculators

LOC	KEY	LOC	KEY	LOC	KEY	LOC	KEY	LOC	KEY	LOC	KEY
000	*Lbl	025	=	050	5	075	=	100	+	125	=
001	A	026	*log	051	÷	076	1/X	101	RCL	126	X⇄t
002	*Fix	027	X	052	RCL	077	STO	102	4	127	RCL
003	1	028	RCL	053	6	078	11	103	SBR	128	2
004	INV	029	7	054	)	079	+	104	1	129	INV
005	EE	030	X	055	STO	080	RCL	105	22	130	*P→R
006	RCL	031	RCL	056	9	081	1	106	RCL	131	X⇄t
007	18	032	18	057	=	082	SBR	107	4	132	1/X
008	÷	033	=	058	SBR	083	1	108	SBR	133	X
009	RCL	034	STO	059	1	084	22	109	1	134	(
010	19	035	2	060	26	085	RCL	110	36	135	INV SBR
011	=	036	RCL	061	RCL	086	11	111	R/S	136	+
012	$\sqrt{x}$	037	18	062	3	087	SBR	112	RCL	137	RCL
013	X	038	X	063	SBR	088	1	113	14	138	9
014	(	039	RCL	064	1	089	36	114	R/S	139	=
015	RCL	040	8	065	36	090	X⇄t	115	RCL	140	*log
016	17	041	=	066	STO	091	RCL	116	13	141	X
017	÷	042	STO	067	12	092	12	117	SUM	142	2
018	RCL	043	1	068	RCL	093	−	118	6	143	0
019	15	044	+	069	3	094	X⇄t	119	GTO	144	=
020	=	045	RCL	070	1/X	095	=	120	0	145	INV SBR
021	1/X	046	3	071	+	096	STO	121	06	146	*Lbl
022	X	047	+	072	RCL	097	14	122	+	147	B
023	RCL	048	(	073	4	098	RCL	123	RCL	148	SBR
024	16	049	RCL	074	1/X	099	1	124	9	149	1

* = 2nd Key

PROGRAM A (Cont'd.)
FACTORS FOR IDENTIFYING OPEN-CIRCUITED CABLE SHIELD

For TI/58 and TI/59 Calculators

LOC	KEY	LOC	KEY	LOC	KEY	LOC	KEY	LOC	KEY	LOC	KEY
150	65	160	24	170	RCL	180	13	190	R/S	200	
151	STO	161	*B	171	21	181	STO	191	STO	201	
152	4	162	STO	172	=	182	6	192	17	202	
153	R/S	163	4	173	1/X	183	GTO	193	RCL	203	
154	*Lbl	164	R/S	174	INV SBR	184	0	194	13	204	
155	C	165	4	175	*Lbl	185	06	195	STO	205	
156	SBR	166	÷	176	D	186	*Lbl	196	6	206	
157	1	167	RCL	177	STO	187	E	197	GTO	207	
158	65	168	20	178	3	188	STO	198	0	208	
159	*Pgm	169	X	179	RCL	189	3	199	06	209	

* = 2nd Key

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