METHODS FOR IDENTIFYING AND CORRECTING INDUCTIVE NOISE TROUBLES ON SUBSCRIBER LINES

CONTENTS PAGE

CONTENTS

1. GENERAL

A. Introduction

1.01 This section provides a guide for clearing inductive noise from subscriber lines by identifying and correcting unbalances in the telephone circuit. The most common source of inductive noise in telephone circuits is longitudinal voltages (N_G) which are converted to noise metallic (N_M) by unbalances in the circuit. Longitudinal voltages are most commonly induced into the cable pair by power line ground return current. Circuit unbalances are most commonly caused by grounded station ringers and defective cable pairs. Part 1B contains a more detailed discussion of the inductive process.

1.02 (Whenever this section is reissued, the reasons for reissue will be given in this paragraph.)

1.03 The procedures described in this section are usually initiated as a result of a customer noise complaint. They may also be used on lines that have been identified as being noisy by a noise survey.

1.04 Inductive noise can be reduced by lowering the influence, but this is usually a difficult process. This section deals with clearing noise from subscriber lines by ***improving the circuit balance.*** If, after the procedures in this section have been performed, the noise persists, the inductive coordination and electrical protection (ICEP) engineer should be contacted for methods of reducing the influence. The ICEP engineer will usually recommend checking the shielding, bonding, and grounding of the cable. These maintenance items, when properly administered, will help reduce the effect of influence.

1.05 In those cases where the service is provided by a concentrator or subscriber line carrier, this section applies only to that portion of the loop extending from the concentrator or carrier terminal to the customer location.

B. Inductive Noise

1.06 There are three independent parameters that must be present to cause inductive noise: influence, coupling, and unbalance. Except for cases where influence and coupling are severe, a well-balanced circuit will provide service with an acceptable level of metallic noise.

Influence

1.07 The source, or influence, consists of the odd harmonics (such as 180, 300, 420, etc) of the fundamental frequency (60 Hz) used on ac power lines. These odd harmonics are almost always what the customer hears and complains about. This is because of the response characteristics of the station set and human ear. Figure 1 shows the response of the telephone set and average human ear to various frequencies in the audible range. This curve is called the C-message weighting curve. The curve represents the average received volume found by customers through experimentation to determine the effect of noise on intelligibility of received speech. As shown in Fig. 1, the level of the harmonics of 60 Hz are of much more interest to the tester than the fundamental frequency. The noise measuring set (NMS) equipped with a C-message weighting network should, therefore, indicate the approximate interfering effect that the noise would create for the average telephone user.

1.08 The pure 60-Hz induced voltage, if sufficiently high in magnitude, may, however, cause problems that are "noise" related. These include bell tapping, sputtering (due to tube or ringer isolator breakdown), or relay malfunctioning. The amount of influence present is determined by making noise-to-ground (N_G) measurements. If the N_G reading is above 95 dBrnc, the inductive coordination group should be consulted, since power company contact may be required. Proper grounding and bonding of cable shields (see 1.04) and the use of drainage coils and filters are some of the means of reducing influence.

Coupling

1.09 The influence described above is coupled into a telephone cable in the same way the primary winding current of a transformer couples voltage into the secondary windings. In this case, the primary is the power line and the secondary is the telephone cable.

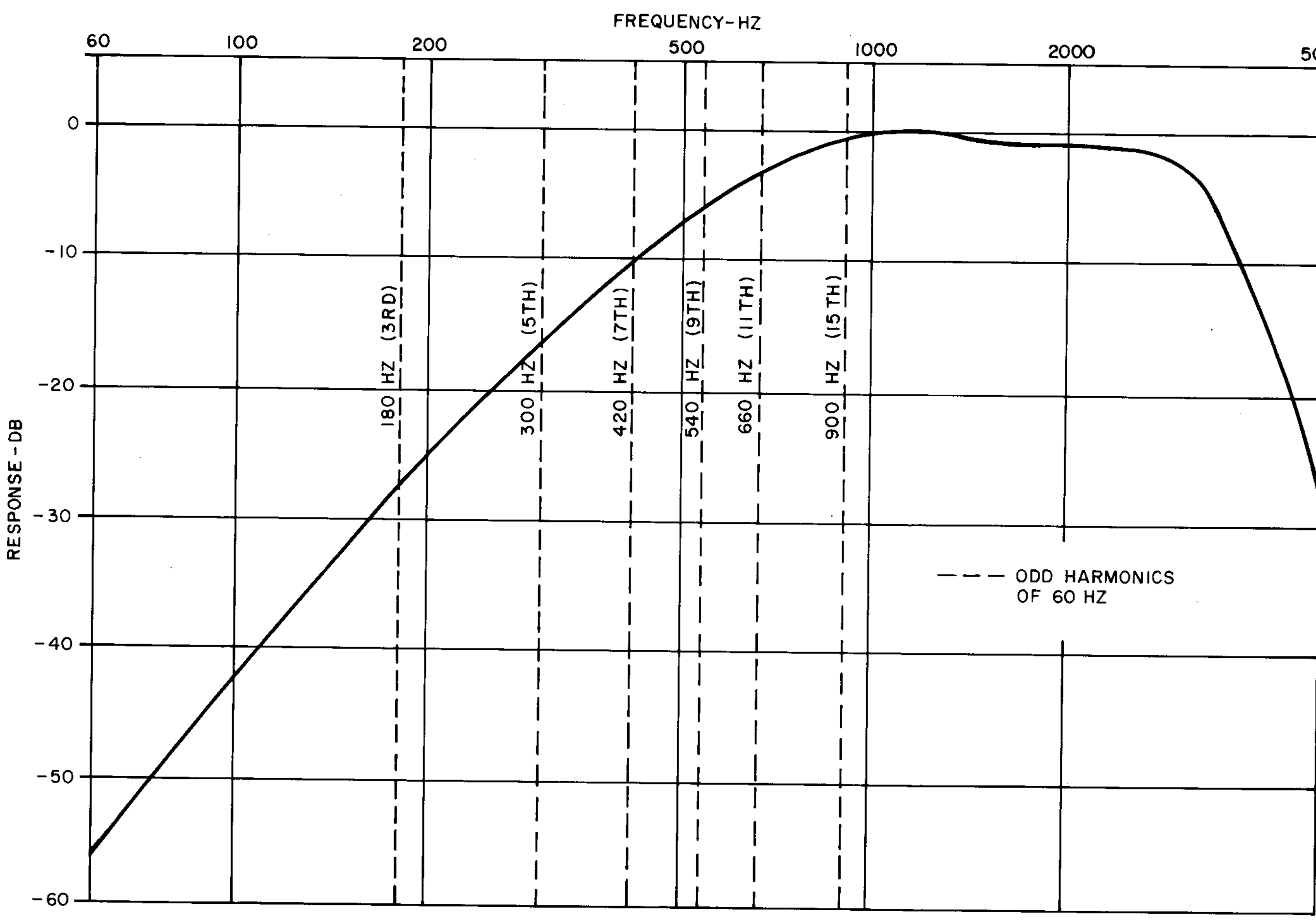


Fig. 1—C-Message Frequency Response

1.10 The coupling between a power line and a telephone cable depends on several factors. The prime factors of coupling are:

(a) Spacing between the power line and telephone cable,

(b) The distance they parallel each other,

(c) The amount of shielding (sheath, strand wire, metal conduit, water pipes, etc), and

(d) Earth return current, frequency of induced voltage, and earth resistivity.

Unbalance

1.11 The effects of influence and coupling produce voltages to ground along the cable pairs. These voltages, also called noise-to-ground, are measured from the tip and ring conductors to ground. The conversion of longitudinal noise voltage to a voltage called noise metallic (N_M), measured from tip to ring, depends on the balance of the cable plant and station sets. Figure 2 illustrates the relationship between N_G and N_M when a balanced and unbalanced circuit are subjected to power influence. ***If the influence remains constant, better balance will result in less metallic noise being present on the circuit.*** Plant with good balance is said to be less susceptible to influence. In order to achieve a high balance, the electrical characteristics of the tip-to-ground and ring-to-ground circuits must be nearly identical.

1.12 There are two general types of unbalances: ***series*** and ***shunt.*** Most series unbalances are resistive: that is, there is more resistance in one conductor than there is in the other. The most common cause of this unbalance is poor splices. Series unbalances are more critical near the central office. Shunt unbalances are *capacitive* unbalances. One conductor may have a greater number of ringers-to-ground than the other conductor; this causes a capacitive unbalance. However, an equal number of ringers-to-ground could still result in an unbalance due to their relative position along a cable pair. Shunt unbalances are more critical near the station.

2. GENERAL PROCEDURES

A. General

2.01 To locate the cause of an inductive noise problem, it is important to follow a logical procedure. This section provides a flowchart (Fig. 3) to assist the user. The flowchart shows what things should be done and when. It is designed to locate the source of the noise problem with the least amount of time and travel. The procedures outlined in this section are general in nature to allow for local variations in administration.

2.02 The basic steps in handling a customer's noise complaint are:

(a) Get important details from the customer.

(b) Have dc tests made on the line by the test center.

(c) Identify the problem as "inside" or "outside" the wire center.

(d) Isolate the section in trouble and determine the cause.

(e) Clear the trouble or initiate corrective action.

(f) Restore the line to service and advise the customer.

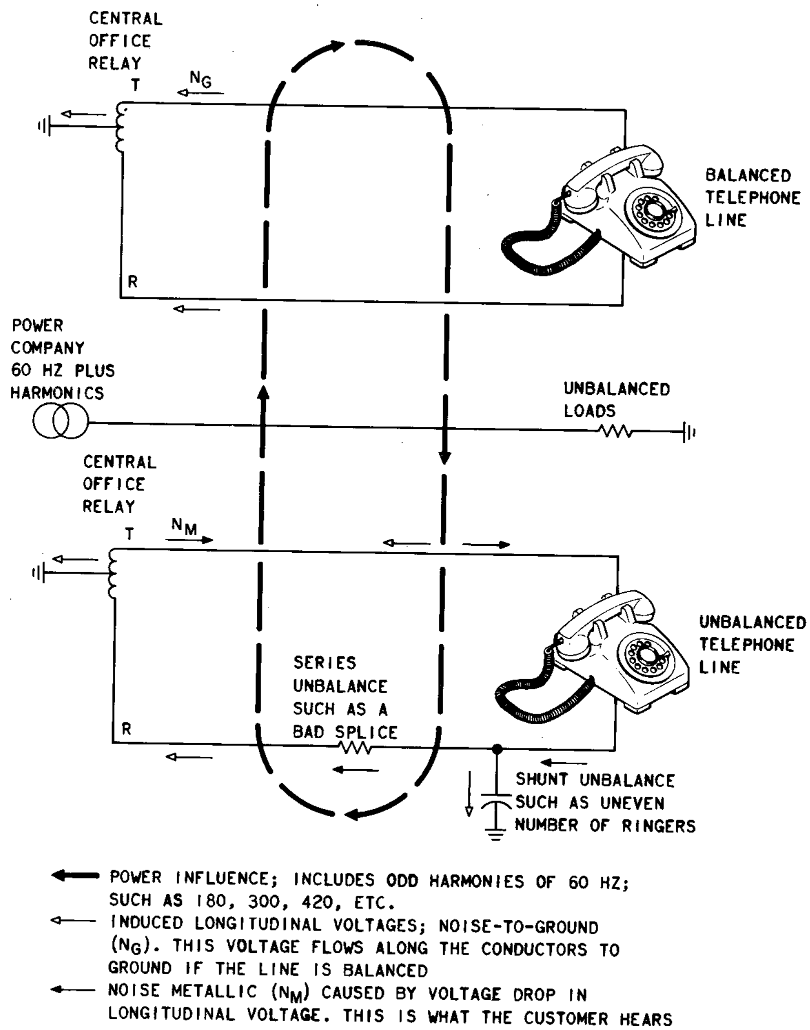


Fig. 2—Induction of Longitudinal Voltage

These steps are discussed in more detail in the following paragraphs.

B. Customer Information

2.03 The customer should be called and his comments regarding the noise recorded. If noise is heard at this time, it should be verified with the customer that the type of noise being heard is that about which he has complained. If noise is not heard at this time, the customer should be asked if the noise occurs at specific times. Inductive noise will vary during the day as the power company load varies. If the noise is other than hum or buzz, the problem is probably not one that is caused by power line induced voltages. Table A contains a list of other types of noise and their probable causes. Table B contains a list of possible locations of noise sources.

C. Test Center Procedures

2.04 DC tests can detect physical troubles which, since they may be the dominant cause of the unbalance, must be cleared before any further steps are taken. The test center should make the following dc tests when looking for a circuit unbalance:

(a) Short

(b) Ground

(c) Cross

(d) Leakage

(e) Capacitive unbalance.

D. Identifying the Problem

2.05 With the information gathered above, the test center can determine whether the problem is in the wire center or in the cable and/or station. Before a visit to the station is undertaken, the following pertinent data should be obtained and entered on Form E-6407 (blank form is shown in Fig. 4A and 4B):

(a) Measured rate line data

(b) Party-line station locations

(c) Number of party-line extension ringers

(d) Location and type of any of the following electrical devices used in the circuit:

(1) Ringer isolators

(2) Tip-party identification kits

(3) Range-extenders

(4) Dial-long-line equipment

(5) Repeaters

(e) Cable number

(f) Binding post number and/or pair color

(g) Terminal locations.

All of the above information should be posted to a sketch of the circuit as drawn on Form E-6407.

E. Isolating the Trouble and Determining the Cause

2.06 If it is determined that the trouble is outside the wire center and the pertinent information described above has been obtained, noise measurements and balance computations must be made. The method

Fig. 3—Procedures in the Investigation of Unbalances to Reduce Inductive Noise on Subscriber Lines

TABLE A

POSSIBLE CAUSES OF NOISE

DESCRIPTION OF NOISE	POSSIBLE CAUSE OF NOISE
Static (steady)	Carrier system, open-wire lines, dc telegraph
Static (rhythmic)	DC telegraph
Hum	Loop (open-wire and cable facilities)
Sputter and buzzing	Loop (60-Hz voltage firing tube ringers)
Single pops (clicks)	Switching equipment (worse with heavy traffic)
Frying, crashing	SXS wiper contact noise (noise starts during use)
Dial pulses	
2 or 3 consecutive digits	SXS wipers
4 or 5 consecutive digits	Local trunks
7 or more consecutive digits	Loop or central office bridge
Crosstalk (babble)	Usually a carrier system
Banjo noise (twang)	Microphonic noise from crossbar switches
"Tinny" pulses	Microphonic noise from SXS wipers
Hollow sound	Unbalanced 4-wire to 2-wire termination, high repeater gain
Tones (beeps)	Toll circuits (multi-frequency signaling tones)
Radio interference	Detection in station or carrier equipment, crosstalk in the loop from a radio lease line circuit

TABLE B

POSSIBLE LOCATION OF NOISE SOURCES

TROUBLE REPORT	POSSIBLE LOCATION OF NOISE SOURCES
Noise is heard by both ends:	
On every call	Loop
On local calls only	Loop, central office or local trunk
On toll calls only	Toll network or loop at distant end
On calls to the same station	Loop at distant end
On call through operator	Toll recording or connecting trunk
Noise is heard by one end only:	4-wire part of connection

of isolating the trouble will vary slightly when multiparty lines are involved, but generally the procedure is as follows:

(a) N_G and N_M measurements are made at the station and the overall circuit balance is computed.

(b) Portions of the circuit are isolated and the measurements redone until the unbalanced portion has been identified by the process of elimination.

(c) The three basic portions should be eliminated in the following sequence:

(1) The stations,

Form E-6407
331-850-502
Iss. 1, April 1975

WORKSHEET AND TEST REPORT
FOR CLEARING INDUCTIVE NOISE TROUBLES ON SUBSCRIBER LINES

CUSTOMER NAME ________________ TEL. NO. ________ CL. SVC. ________ PTY(1) ______ TEST EQUIP. ______

ADDRESS ________________ CUST. DESCRIPTION OF NOISE ________________

CABLE	PAIR	BINDING POST/COLOR	TERMINAL
1.			
2.			
3.			

SKETCH OF FACILITY: – SHOW ALL TERMINALS, PARTIES, ELECTRONICS, ETC., SEE PARAGRAPH 2.05.

1. INITIAL CIRCUIT LEVEL @ 1kHz: ________ dBrn

2. INITIAL OVERALL CIRCUIT BALANCE:

   Ng ______ (METER) + ______ (FACTOR)(2) = ______ dBrnc
   SUBTRACT Nm = ______ dBrnc
   BALANCE = ______ dB

   (WITH 3kHz FLAT WEIGHTING: Ng ______ dBrn3KHz

3. NATURE OF NOISE:

   HUM ______ STATIC ______ XTALK ______ OTHER ______

4. OVERALL CIRCUIT BALANCE WITH STATION ISOLATED:

   Ng ______ (METER) + ______ (FACTOR)(2) = ______ dBrnc
   SUBTRACT Nm = ______ dBrnc
   BALANCE = ______ dB

5. OVERALL CIRCUIT BALANCE AFTER CLEARING STATION TROUBLES OR ADDING ISOLATORS:

   Ng ______ (METER) + ______ (FACTOR)(2) = ______ dBrnc
   SUBTRACT Nm = ______ dBrnc
   BALANCE = ______ dB

6. OVERALL CIRCUIT BALANCE WITH C.O. ISOLATED:

   Ng ______ (METER) + ______ (FACTOR)(2) = ______ dBrnc
   SUBTRACT Nm = ______ dBrnc
   BALANCE = ______ dB

7. OVERALL CIRCUIT BALANCE AFTER CLEARING C.O. AND ALL STATION TROUBLES:

   Ng ______ (METER) + ______ (FACTOR)(2) = ______ dBrnc
   SUBTRACT Nm = ______ dBrnc
   BALANCE = ______ dB

(1) USE SEPARATE SHEET FOR EACH PARTY. FILL IN HEADING AND LINES 2, 4 AND 5

(2) FACTOR = 40dB FOR WESTERN ELECTRIC 3 TYPE NOISE MEASURING SET.

Fig. 4A—Form E-6407, Front—Form for Recording Measurements Made During the Investigation of Inductive Noise

CABLE/WIRE FACILITY TESTS

TEST	TEST POINTS* 1	2	3	4	5	6
8. Nm REFERANCE dBrnc Fig. 5D and 6A						
9. Nm TO STA. END dBrnc Fig. 5D, 6B and 6D						
10. Nm TO C.O. END dBrnc Fig. 5D, 6C and 6D						
11. Ng (METER) dBrnc Fig. 5D and 6A						
CORRECTION FACTOR						
Ng dBrnc						
Ng dBrn3kHz						
* SHOW NUMBERED TEST POINTS ON SKETCH.						

12. FINAL OVERALL CIRCUIT BALANCE:

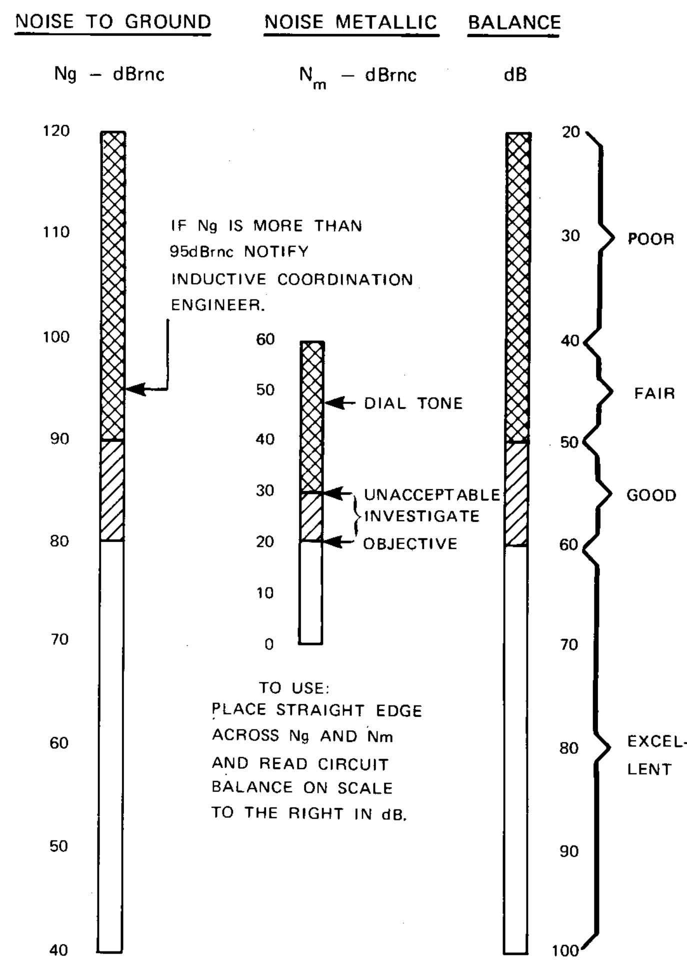
Ng______ (METER) + ________ (FACTOR)(2) = ________ dBrnc

SUBTRACT Nm = ________ dBrnc

BALANCE = ________ dB

13. FINAL CIRCUIT LEVEL @ 1kHz: ____________ dBrn

NOMOGRAPH TO DETERMINE BALANCE



14. SUMMARY OF CORRECTIVE ACTIONS: ________________________

____

____

Fig. 4B—Form E-6407, Back—Form for Recording Measurements Made During the Investigation of Inductive Noise

(2) The wire center, and then

(3) The cable/wire facility.

(d) After the unbalance has been identified, the cause of the unbalance must be found and cleared. A final overall circuit measurement should be made to verify that the noise has been cleared.

Note: After clearing a trouble, it is important to return to the station to remeasure the noise since other unbalances may exist. In fact, the noise may be worse if the trouble that was cleared partially counter-balanced another unbalance someplace else in the circuit.

2.07 The steps on the flowchart are organized so that the most common sources of unbalance are corrected first. For this reason, many noisy lines will be cleared before all of the steps are applied. It is important to realize, however, that the ***overall*** circuit, and not just a particular section of the circuit, must meet the objectives. The overall circuit is the circuit between the reporting station or the most distant station and the central office quiet termination with all normal bridged tap, station equipment, and miscellaneous equipment connected to it.

F. Clearing the Trouble or Initiating Corrective Action

2.08 In most instances, the trouble will be found at the station (ringer unbalance, protector, wiring, etc) or at a terminal in the cable facility (dead drops, unbalanced bridge tap, etc). These troubles can be readily eliminated by the repair person, or the cable pair may be changed. However, if no spare cable pairs are available and an unbalance exists in a location (such as in midspan of a cable) or it has been found that the central office is unbalanced, the repair person must refer the trouble through supervision to either the cable maintenance forces or the central office maintenance personnel.

G. Restoring the Line to Service

2.09 At any point in the test procedure, the trouble may be located and cleared and the line will be ready for the customer to use before all steps have been performed. In some instances, clearing of the trouble may require more time than usual, and the repair person may have to tell the customer that, even though the line is still noisy, it can be used, and give the customer an approximate time or date when normal service can be expected. In all instances, ***keep the customer informed.***

2.10 If the trouble has been found and cleared at a location other than the reporting station, return to the reporting station and make the ***final*** noise measurement and balance computation before restoring the line to service.

H. Noise Measurements

2.11 Noise measurements in this section are made to either the central office quiet termination (reached by dialing the appropriate telephone number) or to a balanced termination placed at the main distributing frame (MDF). The noise measuring set should have both C-MESSAGE weighting and 3KC FLAT weighting networks available. With the exception of the initial 3KC FLAT weighted measurement (to be used by the ICEP engineer if necessary), ***all measurements should be made with C-MESSAGE weighting.*** The procedures described in Section 331-850-501 for making noise measurements at stations should be followed with the results recorded on Form E-6407. The test numbers shown on the flowchart refer to the tests shown on Form E-6407 (see Fig. 4).

2.12 When making noise metallic measurements on loops that have a balance of 60 dB or more in an area where the influence is 90 dB or more, care must be taken to ensure that the line is always connected to the noise measuring set in the same manner on subsequent measurements—ie, tip conductor to tip connector and ring conductor to ring connector. This is important because, in this range of loop balance, the test set may be less balanced than the loop and an inadvertment reversal of conductors will increase or decrease the overall loop balance. This can lead to the misconception that the loop balance has been improved or degraded by some other trouble-clearing action. Another way of avoiding this problem is to remove the ground lead from the test set when making N_M tests. This will disrupt the longitudinal path and any test set unbalance will no longer be a factor in the measurement. If this action is taken, it is important to remember to reconnect the ground for N_G measurements.

2.13 In cases of reported trouble, the initial test for noise should be made at the protector of the station originating the complaint. In survey cases, the initial test should be made at the station most distant from the wire center.

I. Computation of Balance

2.14 For the purpose of this section, balance is said to be a measure of how well the telephone plant is able to prevent the induced longitudinal voltage from being converted to circuit noise (N_M). In equation form, this can be expressed as

$$\text{Balance (in dB)} = N_G - N_M.$$

When a Western Electric 3-type NMS is used, circuit noise is synonymous with noise metallic. However, noise-to-ground measurements made with the 3-type NMS read 40-dB lower than actual level. For this reason, when a 3-type NMS is used, the equation becomes

$$\text{Balance (in dB)} = N_G \text{ (meter reading)} + 40 - N_M \text{ (meter reading)}$$

where N_G and N_M are in dBrnc. When using other than a 3-type NMS, verify whether a correction factor is needed, and, if one is required, use that value to correct N_G readings.

J. Requirements

2.15 The following requirements should be met:

(a) ***Noise Metallic*** (N_M): 20 dBrnc or less.

(b) ***Noise-to-Ground*** (N_G): 95 dBrnc or less. If it exceeds this value, the ICEP engineer should be notified.

(c) ***Balance:*** 60 dB (or greater, if necessary to achieve the noise metallic objective).

(d) ***1000-Hz Level:*** The initial level measurement made to the 1000-Hz 900-ohm test line should not be less than 70 dBrn. The final level should be between 80 and 90 dBrn.

3. TEST APPARATUS

3.01 The following test apparatus is required to perform the procedures described in this section:

APPARATUS	REMARKS
3C noise measuring set equipped with C-MESSAGE and 3KC FLAT weighting networks	See Section 103-611-101.
1011-type handset or station set	For dialing and/or holding.

APPARATUS	REMARKS
120-H repeating coil	For isolation of station or facility.
120-H repeating coil equipped with a 900-ohm resistor and a 100-ohm resistor	For isolation of central office at MDF.

3.02 Substitution of test apparatus is permissible if the substitute item is electrically equal to or better than the apparatus listed above.

4. FIELD PROCEDURES

4.01 If the line is still noisy after the test center has made tests and known physical faults have been cleared, Form E-6407 should be initiated and a repair person dispatched to the station of the customer making the complaint.

4.02 The following paragraphs give a detailed explanation of what the flowchart (Fig. 3) shows graphically. The procedures are performed by the repair person at the station or along the facility at selected test points. The flowchart is designed to include all activities in a logical sequence. The initial and final steps are the same for all classes of service. The intermediate steps vary for 2-party and multiparty service. Some steps are repeated to eliminate potentially confusing cross references to other steps.

STEP	PROCEDURE	REMARKS
A. Initial Procedures—All Lines		
1	Calibrate the NMS.	See Section 103-611-101.
2	Set the FUNCTION switch to NM 600/900. (If a 3A NMS is used, set the FUNCTION switch to NM 600 for nonloaded cable or NM 900 for loaded cable.)	Weighting network can be either C-MESSAGE or 3KC FLAT for this first test.
3	At the station protector, use the handset to dial the number for the central office 1000-Hz test line.	This is a ***initial test point***, and it should be at the premise of the party making the noise complaint or the party farthest from the wire center.
4	Set the DBRN switch of the NMS to 85 to protect the meter, and connect the NMS to the line.	Test No. 1 on Form E-6407. Initial 1000-Hz level measurement. See Fig. 5A and 6A. (Throughout these procedures, reference is made to these two figures. Figure 5 shows the location of the NMS and coil in the overall circuit. Figure 6 shows the wiring of the coil.)
5	Read and record the 1000-Hz level. Release the 1000-Hz test line.	***Requirement:*** The level must be greater than 70 dBrn for these procedures to work. Although this measurement is not normally related to noise, it can help to identify noise-causing irregularities such as bridged taps and defective load coils. The ***objective*** for level is that it not be less than 82 dBrn

STEP	PROCEDURE	REMARKS
		(8 dB). Loops which exceed the objective can still be treated for noise. Level in the range of 70 to 75 dBrn is usually as disturbing as noise; and when it is less than 70 dBrn, the level problem must be cleared first.
6a	If, in Step 5, the requirement is met, go on to Step 7.	
6b	If, in Step 5, the requirement is not met, refer the condition to the test center. Either have them rectify the problem, or change the cable pair. Continue with these procedures when the 1000-Hz level is at least 70 dBrn.	If the level is less than 70 dBrn, the loss is too much to test properly for noise. Some of the following items contribute to excessive loss: (a) Loading irregularities (b) Excessive bridged tap (c) Bridged tap between loading points (d) Incorrect repeater gains (e) Missing bridge lifters (f) Physical faults.
7	Dial the number for the central office quiet termination.	Test No. 2 on Form E-6407. See Fig. 5A and 6A. Initial noise measurements and computation of balance.
8	Make N_M and N_G readings with C-MESSAGE weighting. Change the weighting network to 3KC FLAT and read N_G. Return to C-MESSAGE weighting. Compute the overall circuit balance as shown on the form. Use either the equation or the nomogram (back of Form E-6407).	***Requirements:*** (a) N_M — 20 dBrnc or less. (b) N_G — Between 60 and 95 dBrnc. (c) Balance — At least 60 dB. (d) N_G 3KC FLAT — No requirement. If the ICEP engineer is consulted, this reading will be an indication to the engineer of the nature of the influence.
9	Monitor the line and determine the character of the noise.	Test No. 3 on Form E-6407. See Table A for types of noise. This is an initial test and is not repeated on subsequent tests.
10a	If, in Step 8, all of the requirements are met and no noise is heard in Step 9, release the central office quiet termination and go to Step 58a.	

STEP	PROCEDURE	REMARKS
10b	If, in Step 8, the N_M and balance meet the requirement but the N_G is greater than 95 dBrnc, release the central office quiet termination and go to Step 58a. However, report the N_G reading to the ICEP engineer.	Even though the N_M is acceptable, the ICEP engineer will want to know about cases where the power influence is high.
10c	If, in Step 8, all of the requirements are met but noise is heard in Step 9, determine whether or not the noise is power line hum. If it is power line hum, repeat the tests in Step 8. If the requirements are still met, release the central office quiet termination and go to Step 58a. If the noise heard is other than power line hum, refer the trouble to the test center and stop these procedures.	See Table A for other types of noise.
10d	If, in Step 8, the N_G reading is less than 60 dBrnc and the other requirements are met, stop testing. Notify the test center that tests will be continued when the influence increases. Advise the customer that the line is temporarily okay but that work is to be continued. Check the N_G reading later in the day to see if the influence has increased. When the N_G is above 60 dBrnc, resume the procedures with Step 7.	If the N_G is less than 60 dBrnc, the influence is too low for reliable measurements. The influence will vary throughout the day with respect to power company load.
10e	If, in Step 8, either the N_M or balance requirement is not met, check the station balance first. Go on to Step 11.	

B. Initial Test Point: Station Balance Test—All Lines

STEP	PROCEDURE	REMARKS
11	Isolate the station using the 120-H coil. Make N_M and N_G measurements and compute the balance.	Test No. 4 on Form E-6407. See Fig. 5B and 6C.
12a	If the balance in Step 11 (Test No. 4) is not at least 3-dB better than the balance in Step 8 (Test No. 2), the station is ***not unbalanced.*** Go to Step 34 when working on individual lines. Go to Step 22 when working on 2-party lines. Go to Step 34 when working on 4-party (or more) lines.	This station is not unbalanced. The unbalance could be in another station (on multiparty lines), the central office, or in the facility.
12b	If the balance in Step 11 (Test No. 4) is 3-dB or more better than the balance in Step 8 (Test No. 2), the station is ***unbalanced.*** Go to Step 13 when working on individual lines. Go to Step 17 when working on 2-party lines.	This station is unbalanced.

STEP	PROCEDURE	REMARKS
	Go to Step 30 when working on 4-party (or more) lines.	

C. Individual Lines—Clearing Station Unbalance

STEP	PROCEDURE	REMARKS
13	Check the protector and clear unbalances in the drop or inside wiring. Bridge the ringer if it is grounded.	In the past, some local practices specified that individual line ringers should be wired to ground. When encountered, these ringers should be bridged or a ringer isolator should be installed. Check with repair service supervision for local policy.
14	If an unbalance has been cleared, remove the 120-H coil. Make N_M and N_G measurements. Compute the overall circuit balance.	Test No. 5 on Form E-6407. See Fig. 5A and 6A.
15a	If, in Step 14, the requirements specified in Step 8 are met, go to Step 56.	
15b	If, in Step 14, the requirements specified in Step 8 are not met, there is a possibility that something has been overlooked. Check the station again for unbalances and repeat Steps 13, 14, and either 15a or 16, whichever is appropriate.	
16	If, in Step 15b, the requirements specified in Step 8 are not met and the station has been rechecked for unbalances as specified in Step 13, the unbalance could be in the central office or the facility. Proceed to test the central office next. Go to Step 34.	

D. Two-Party Lines—Clearing Station Unbalances

STEP	PROCEDURE	REMARKS
17	Check the protector, clear unbalances in the wiring, and, if necessary, install a ringer isolator.	See Sections 500-112-100 and 500-112-400 for information about ringer isolators.
18a	If, in Step 17, a ringer isolator was installed, remove the 120-H coil and proceed to the station at the other party. Go to Step 21.	
18b	If, in Step 17, a ringer isolator was not installed and an unbalance has been cleared, remove the 120-H coil. Make N_M and N_G measurements and compute the overall circuit balance.	Test No. 5 on Form E-6407. See Fig. 5A and 6A.
19a	If, in Step 18b, the requirements specified in Step 8 are met, go to Step 56.	

STEP	PROCEDURE	REMARKS
19b	If, in Step 18b, the requirements specified in Step 8 are not met, there is a possibility that something has been overlooked. Check the station again for unbalances and repeat Steps 17, 18a, and either 19a or 20, whichever is appropriate.	
20	If, in Step 19b, the requirements specified in Step 8 are not met and the station has been rechecked for unbalances as specified in Step 17, the unbalance could be in the station of the other party, the central office, or the facility. Proceed to the station of the other party. Go to Step 22.	
21	If a ringer isolator was installed at the station of the first party in Step 17, install a ringer isolator at this station. Return to the initial test point to check the overall circuit balance. Go to Step 28.	See Sections 500-112-100 and 500-112-400 for information about ringer isolators.
22	At the station protector of the other party station, dial the number for the central office quiet termination. Make N_M and N_G measurements and compute the overall circuit balance. Clearly label the heading of a second Form E-6407 showing the party and telephone number.	Test No. 2 on a second copy of Form E-6407. See Fig. 5A and 6A.
23	Isolate the station using the 120-H coil. Make N_M and N_G measurements and compute the circuit balance.	Test No. 4 on second Form E-6407. See Fig. 5B and 6C.
24a	If the balance in Step 23 (Test No. 4) is not at least 3-dB better than the balance in Step 22 (Test No. 2), the station is ***not unbalanced.*** The unbalance could be in the central office or in the cable or wire facility. Check the central office for unbalances. Go to Step 34.	
24b	If the balance in Step 23 (Test No. 4) is 3 or more dB better than the balance in Step 22 (Test No. 2), the station is ***unbalanced.*** Check the protector, clear unbalances in the station wiring, and, if required, install a ringer isolator at this station.	See Sections 500-112-100 and 500-112-400 for information about ringer isolators.
25a	If a ringer isolator was installed in Step 24b, return to the initial test point. Go to Step 27.	

STEP	PROCEDURE	REMARKS
25b	If a ringer isolator was not installed in Step 24b, remove the 120-H coil. Make N_M and N_G measurements and compute the overall circuit balance.	Test No. 5 on second Form E-6407. See Fig. 5A and 6A.
26a	If, in Step 25b, the requirements specified in Step 8 are met, go to Step 56.	
26b	If, in Step 25b, the requirements specified in Step 8 are not met, the unbalance could be in the central office, the facility, or both. Go to Step 34.	
27	At the initial test point, if a ringer isolator was installed in Step 24b, install a ringer isolator at this station.	
28	Dial the central office quiet termination. Make N_M and N_G measurements and compute the overall circuit balance.	Test No. 5 on first Form E-6407. See Fig. 5A and 6A.
29a	If, in Step 28, the requirements specified in Step 8 are met, go to Step 56.	
29b	If, in Step 28, the requirements specified in Step 8 are not met, the unbalance could be in the central office, the facility, or both. Go to Step 34.	

E. Four-Party (or More) Lines—Clearing Initial Test Point Unbalance

STEP	PROCEDURE	REMARKS
30	Check the protector, clear unbalances in wiring, and, if necessary, install a ringer isolator.	See Sections 500-112-100 and 500-112-400 for information about ringer isolators.
31	If, in Step 30, an unbalance was found and cleared, remove the 120-H coil. Make N_M and N_G measurements and compute the overall circuit balance.	Test No. 5 on Form E-6407. See Fig. 5A and 6A.
32a	If, in Step 31, the requirements specified in Step 8 are met, go to Step 58a.	
32b	If, in Step 31, the requirements specified in Step 8 are not met, check the station again for unbalances. Repeat Steps 30, 31, and either 32a, 32c, or 33, whichever is appropriate.	
32c	If, in Step 31, the requirements specified in Step 8 are not met and the station has been rechecked for unbalances as specified in Step 30, the unbalance could be in another party	

STEP	PROCEDURE	REMARKS
	station, the central office, the facility, or all three. Proceed to test the central office next. Go to Step 34.	
33	If, in Step 30, a ringer isolator was installed, it is likely that an unbalanced condition will appear at the other party stations. Therefore, a visit to each party will be required. Check the central offices for unbalances first. Go to Step 34.	

F. Central Office Balance Check

STEP	PROCEDURE	REMARKS
34	Request that the wire center place a 120-H coil on the cable pair at the MDF to isolate the central office. Make N_M and N_G measurements and compute the circuit balance.	Test No. 6 on Form E-6407. See Figs. 5C and 6D.
35a	If the balance in Step 34 (Test No. 6) is not at least 3-dB better than the balance in Step 8 (Test No. 2), the central office is ***not unbalanced.*** When working with individual or 2-party lines, go to Step 46. When working with 4-party (or more) lines, go to Step 38.	
35b	If the balance in Step 34 (Test No. 6) is 3 or more dB better than the balance in Step 8 (Test No. 2), the central office is ***unbalanced.*** Refer the trouble to the test center for clearance. Go on to Step 36.	
36a	If the central office is unbalanced and the unbalance can be cleared within 30 minutes, have the 120-H coil at the MDF removed. When the trouble is cleared, make N_M and N_G measurements and compute the overall circuit balance. Go to Step 37.	Test No. 7 on Form E-6407. See Fig. 5A and 6A.
36b	If the central office is unbalanced and the unbalance cannot be cleared within 30 minutes and the balance in Step 34 (Test No. 6) is 60 dB or better, advise the test center that the noise level will be acceptable when the central office unbalance is cleared. Advise the customer that repairs are being made in the central office and that, although the line is still noisy, it may be used. Give an approximate time or date by which the trouble is expected to be cleared. Have the 120-H coil at the MDF removed. Go to Step 56.	No further isolation procedures by the repair person are necessary since it appears that the noise will be eliminated as soon as the central office problem is cleared.

STEP	PROCEDURE	REMARKS
36c	If the central office is unbalanced and the unbalance cannot be cleared within 30 minutes and the balance in Step 34 is less than 60 dB, when working with individual or 2-party lines, go to Step 46. When working with 4-party (or more) lines, go to Step 38. If working with individual or 2-party lines, leave the 120-H coil on the cable pair at the MDF. If working with 4-party (or more) lines, have the 120-H coil removed.	Although the central office is unbalanced, the improvement when the unbalance is cleared will not be sufficient to justify stopping now the search for other unbalances.
37a	If, in Step 36a, the requirements specified in Step 8 are met, go to Step 56.	
37b	If, in Step 36a, the requirements specified in Step 8 are not met, the facility may be unbalanced if individual or 2-party lines are involved, or another station may be unbalanced if 4-party (or more) service is involved. When working with individual or 2-party lines, go to Step 46. When working with 4-party (or more) lines, go to Step 38.	

G. Four-Party (or More) Lines—Clearing Other Station Unbalances

STEP	PROCEDURE	REMARKS
38	Proceed to the next station. At the protector of this station, dial the number for the central office quiet termination. Make N_M and N_G measurements and compute the overall circuit balance.	Test No. 2 on Form E-6407. This sheet is identified by the party at which the procedures are being performed. See Fig. 5A and 6A. A new sheet of the form should be used for each party.
39	Isolate the station using the 120-H coil. Make N_M and N_G measurements and compute the circuit balance.	Test No. 4 on Form E-6407. This sheet is identified by the party at which the procedures are being performed. See Fig. 5B and 6C.
40a	If the balance in Step 39 (Test No. 4) is not at least 3-dB better than the balance in Step 38 (Test No. 2), this station is ***not unbalanced.*** Proceed to each station and repeat Steps 38, 39, and either 40a, 40b, or 41a, whichever is appropriate.	
40b	If the balance in Step 39 (Test No. 4) is 3 or more dB better than the balance in Step 38 (Test No. 2), the station is ***unbalanced.*** Check the protector, clear unbalances in the wiring, and if required, install a ringer isolator.	See Sections 500-112-100 and 500-112-400 for information about ringer isolators.
41a	If a ringer isolator is installed at any one party station on the line, equip the stations of all the parties on the line with ringer	

STEP	PROCEDURE	REMARKS
	isolators. Return to the initial test point. Go to Step 44.	
41b	If a ringer isolator was not installed in Step 40b, remove the 120-H coil and make N_M and N_G measurements. Compute the overall circuit balance.	Test No. 5 on Form E-6407. This sheet of the form is identified by the party at which the procedures are being performed. See Fig. 5A and 6A.
42a	If, in Step 41b, the requirements specified in Step 8 are met, go to Step 56.	
42b	If, in Step 41b, the requirements specified in Step 8 are not met, proceed to each station and check the balance until the requirements are met or all stations are found to be clear of unbalances.	
43	If all of the stations are found to be clear of unbalances and the requirements specified in Step 8 are still not met, proceed to check the facility for unbalances. Go to Step 46.	At this point, all stations should be clear of unbalances. Central office unbalances, if any, may or may not have been cleared.
44	At the initial test point, make N_M and N_G measurements. Compute the overall circuit balance.	See Fig. 5A and 6A.
45a	If, in Step 44, the requirements specified in Step 8 are met, go to Step 56.	
45b	If, in Step 44, the requirements specified in Step 8 are not met, the facility is unbalanced. Go to Step 46.	

H. Facility Test Procedures—All Lines

STEP	PROCEDURE	REMARKS
46	When all stations and the central office have been cleared of unbalances, select an appropriate test point near the center of the cable or wire facility.	It is possible to proceed with checking the facility for unbalances even though an unbalance still exists in the central office. See "Remarks" column, Step 36c.
47	Connect the NMS and the 120-H coil to the line. If the 120-H coil at the MDF has been removed, have it reconnected to the cable pair. Make reference N_M measurement (Test No. 8). Make N_G measurements with both C-MESSAGE and 3KC FLAT weighting (Test No. 11).	Tests No. 8 and 11 on initial Form E-6407. See Fig. 5D and 6A.
48	Connect the 120-H coil and NMS as shown in Fig. 5D, 6B, and 6D. Make N_M measurement using C-MESSAGE weighting.	Test No. 9 on Form E-6407. This test isolates the station end of the facility.

STEP	PROCEDURE	REMARKS
49	Connect the 120-H coil and NMS as shown in Fig. 5D, 6C, and 6D. Make N_M measurement using C-MESSAGE weighting.	Test No. 10 on Form E-6407. This test isolates the central office end of the facility.
50a	If N_M in Step 48 (Test No. 9) is within 3 dB of the N_M in Step 47 (Test No. 8, the reference N_M), the unbalance is in the facility section toward the station. Go to Step 51.	
50b	If N_M in Step 49 (Test No. 10) is within 3 dB of the N_M in Step 47 (Test No. 8), the unbalance is in the facility section toward the central office. Go to Step 51.	
50c	If N_M in both Steps 48 (Test No. 9) and 49 (Test No. 10) are within 3 dB of the N_M in Step 47 (Test No. 8), an unbalance is in each direction. Attempt to clear unbalances toward the customer's end first.	
51	If additional test points are available, select a test point near the center of the section with the unbalance and repeat Steps 47, 48, and 49. Continue until the unbalance is sectionalized to the smallest portion of the cable facility.	
52	When no additional test points are available, clear the unbalance or change the cable pair.	
53a	Cable facility unbalances ususally appear at terminals or pedestals. If the unbalance is in midsection, refer it to the cable maintenance forces.	Some causes of unbalance found at terminals or pedestals are split pairs, a bridged tap, a drop wire with one side open, a cross with a dead conductor, etc.
53b	If the unbalance has been cleared or if the cable pair has been changed, return to the original test point (Test No. 1) and make N_M and N_G measurements with the central office isolated. Compute the circuit balance.	Test No. 6 on Form E-6407. See Fig. 5D and 6A. If the balance is better now than the first time Test No. 6 was performed, it indicates that some cable unbalances have been cleared.
54a	If the balance in Step 53b is less than 60 dB, return to Step 46 and sectionalize the facility again.	It is possible that a second unbalance exists on the facility that was not apparent until the first unbalance was cleared.
54b	If the balance in Step 53b is 60 dB or more, have the 120-H coil at the MDF in the wire center removed. Return to the initial test point. Dial the number for the quiet termination in the central office. Make N_M and N_G measurements and compute the overall circuit balance. Go to Step 55.	Test No. 12 on Form E-6407. See Fig. 5A and 6A. Final overall balance check.

STEP	PROCEDURE	REMARKS
54c	If the balance in Step 53b is less than 60 dB but all other requirements are met, the problem should be referred to the ICEP engineer for his information. Go to Step 56.	
55a	If the N_M in Step 54b is less than 20 dBrnc, the N_G is less than 96 dBrnc, and the balance is better than 60 dB, go to Step 56.	
55b	If the N_M in Step 54b is greater than 20 dBrnc, the balance is less than 60 dB, and the central office unbalance has been cleared, something has been overlooked. Start the procedures again at Step 7.	
55c	If the N_M in Step 54b is greater than 20 dBrnc, the balance is less than 60 dB, and the central office unbalance has ***not*** been cleared, go to Step 56.	
55d	If the N_M in Step 54b is greater than 30 dBrnc but the balance is 60 dB or better, refer the problem to the ICEP engineer for power company coordination and/or his advice on how to improve the shielding. This should also be done if the N_G is greater than 95 dBrnc (regardless of whether the N_M and balance meet the requirements). If N_G is less than 60 dBrnc, accurate measurements cannot be made. Stop testing. Notify the test center that tests will continue when the influence increases. Advise the customer that the line is temporarily okay but that work is to be continued. Check the N_G measurement throughout the day to see if the influence has increased. When the N_G is above 60 dBrnc, start the procedures again at Step 7.	When the noise-to-ground is greater than 95 dBrnc, the ICEP engineer will want to know.
55e	If the N_M in Step 54b is more than 20 dBrnc but less than 30 dBrnc and the balance is better than 60 dB, there is little else that the repair person can do if all corrective action has been taken. It is best that the line be restored to service if this marginal condition exists.	
56	Release the central office quiet termination. Dial the number for the 1000-Hz test line. Make a 1000-Hz level measurement.	Test No. 13 on Form E-6407. See Fig. 5A and 6A.

STEP	PROCEDURE	REMARKS
57	If the 1000-Hz level is not between 80 and 90 dBrn, refer the trouble to the test center for follow-up.	
58a	If all unbalances have been cleared, return the line to service and advise the customer that the trouble no longer exists.	
58b	If an unbalance still exists in the central office, advise the customer that the line can be used. Give a date and time by which the trouble should be cleared.	

5. EXAMPLES OF INDUCTIVE NOISE INVESTIGATION

5.01 The following examples are provided to illustrate the procedure for identifying inductive noise problems on subscriber lines.

5.02 ***Example 1—Individual Party Line:*** The customer complained of noise and it was identified as power line hum. The repair person found the station and central office to be clear of unbalances. The unbalance was found in the facility. A dead drop left on the cable pair at another terminal caused the trouble. See Fig. 7A, 7B.

5.03 ***Example 2—Two-Party Line:*** The customer at Party 1 complained of a roaring noise. Investigation of his station proved the trouble to be elsewhere. At the second party, an unbalanced ringer was found to be causing the trouble. A ringer isolator was installed at both parties. See Fig. 8A, 8B, 8C, 8D.

5.04 ***Example 3—Four-Party Line:*** Party 2 complained about a buzzing sound on the line. Investigation at his station showed it to be balanced. Since this was a 4-party line, a check of the central office was made before visiting the other stations. The trouble was an unbalanced line relay which was replaced immediately, thus preventing additional searching of the other stations and facility for unbalances. See Fig. 9A, 9B.

6. REFERENCES

6.01 The following references are presented to help the user:

SECTION	TITLE
103-611-101	J94003C Noise Measuring Set (3C)
331-850-501	Noise Measurements on 2-Wire Subscriber Loops—Methods and Requirements at Stations
460-100-400	Customer Products—Protection and Grounds
460-200-201	Inside Wire and Cable—Selection
462-800-500	Drop and Block Wiring—Testing and Fault Locating
500-112-100	Reference—Inductive Noise

SECTION	TITLE
500-112-400	Service—Inductive Noise
500-114-100	Ringing Limitations
500-150-100	Radio Signal Suppression for Telephone Sets
501-120-100	Reference—Buzzers and Bells
501-250-300	Ringers—General Maintenance and Ringing Tests
501-375-100	Ringer Isolators (D-180036 Kit of Parts)—Identification
629-795-500	Buried Wire Testing
638-215-300	Station Protection—Maintenance
876-300-100	Electrical Protection—Station and PBX
876-402-100	Protection Practices—Protection Consideration—Multiple Line Wire, Single Pair Rural Wire, and Buried Wire

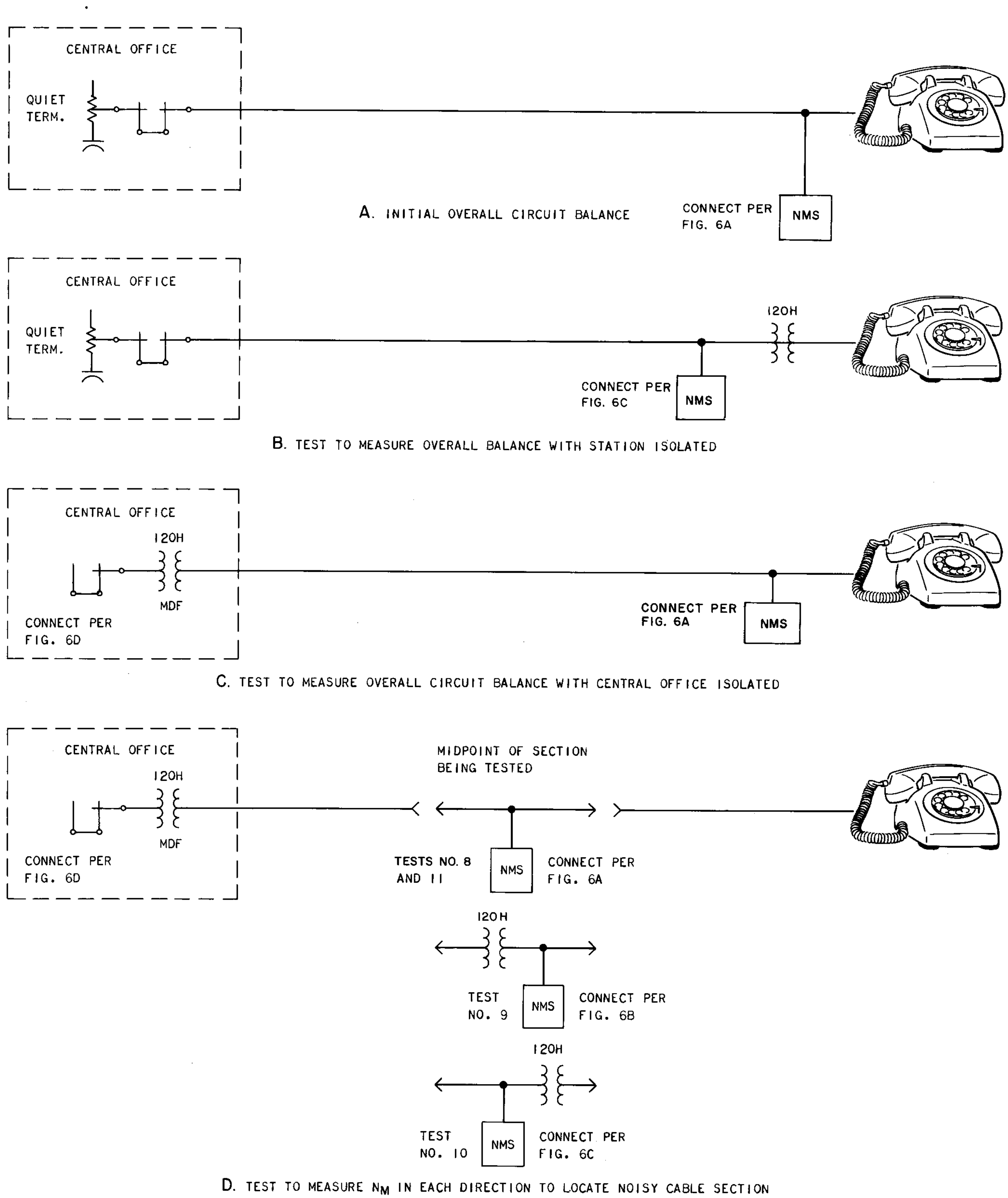
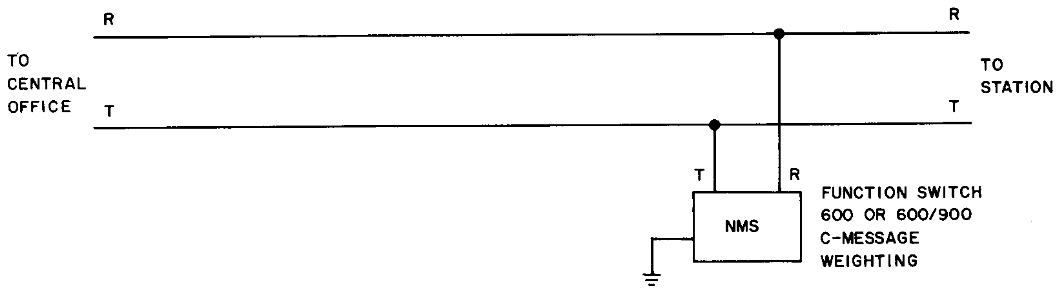
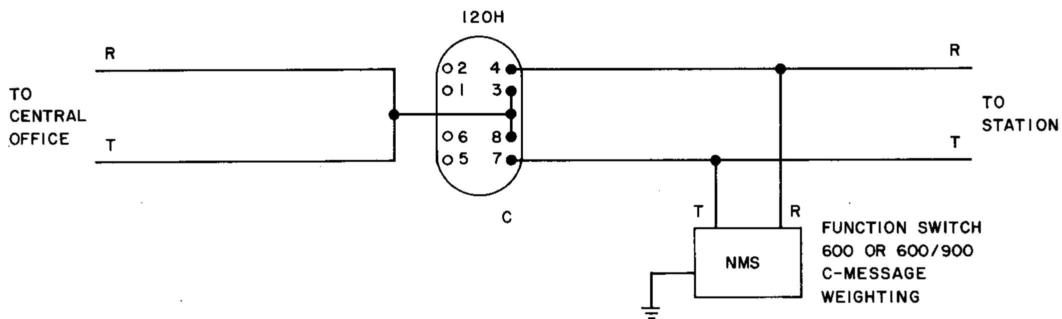


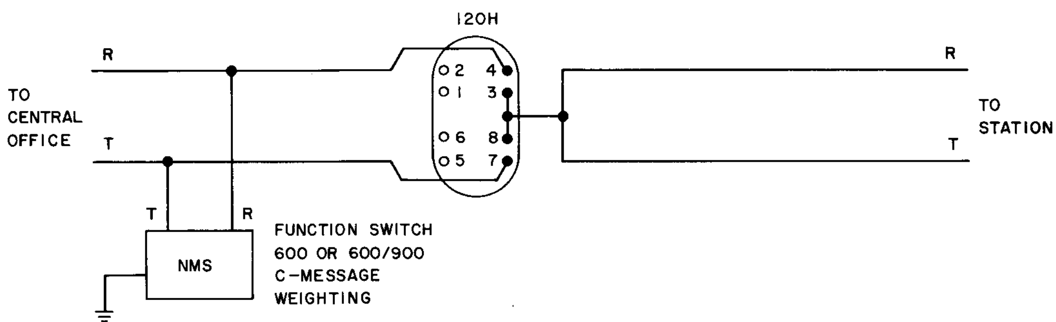
Fig. 5—Test Point Locations for Initial Balance Test



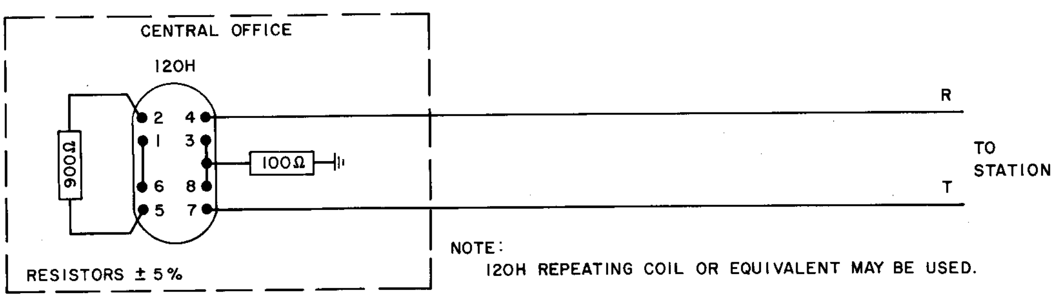
A. CONNECTION TO MEASURE OVERALL CIRCUIT NOISE AND REFERENCE NOISE



B. CONNECTION TO MEASURE N_M TO STATION END OF CIRCUIT



C. CONNECTION TO MEASURE N_M TO CENTRAL OFFICE OR TO ISOLATE CIRCUIT



D. CONNECTION TO ISOLATE CENTRAL OFFICE AND SECTIONALIZE CABLE

Fig. 6—Transmission Facility Testing

Form E-6407
331-850-502
Iss. 1, April 1975

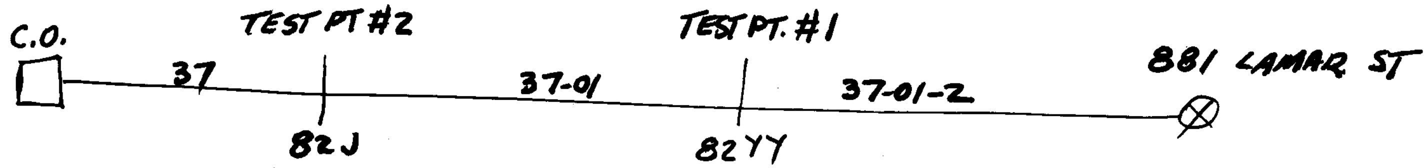
WORKSHEET AND TEST REPORT FOR CLEARING INDUCTIVE NOISE TROUBLES ON SUBSCRIBER LINES

CUSTOMER NAME R. JONES TEL. NO. 727-6610 CL. SVC. 1FR PTY(1) ______ TEST EQUIP. 3C

ADDRESS 881 LAMAR ST CUST. DESCRIPTION OF NOISE HUM

	CABLE	PAIR	BINDING POST/COLOR	TERMINAL
1.	37	218		82 J
2.	37-01	29		82 YY
3.	37-01-2	1		PEDESTAL

SKETCH OF FACILITY: – SHOW ALL TERMINALS, PARTIES, ELECTRONICS, ETC., SEE PARAGRAPH 2.05.



1. INITIAL CIRCUIT LEVEL @ 1kHz: 78 dBrn

2. INITIAL OVERALL CIRCUIT BALANCE:
   Ng 45 (METER) + 40 (FACTOR)(2) = 85 dBrnc
   SUBTRACT Nm = 32 dBrnc
   BALANCE = 53 dB
   (WITH 3kHz FLAT WEIGHTING: Ng 49 dBrn3KHz

3. NATURE OF NOISE:
   HUM ✓ STATIC ______ XTALK ______ OTHER ______

4. OVERALL CIRCUIT BALANCE WITH STATION ISOLATED:
   Ng 45 (METER) + 40 (FACTOR)(2) = 85 dBrnc
   SUBTRACT Nm = 31 dBrnc
   BALANCE = 54 dB

5. OVERALL CIRCUIT BALANCE AFTER CLEARING STATION TROUBLES OR ADDING ISOLATORS:
   Ng ______ (METER) + ______ (FACTOR)(2) = ______ dBrnc
   SUBTRACT Nm = ______ dBrnc
   BALANCE = ______ dB

6. OVERALL CIRCUIT BALANCE WITH C.O. ISOLATED:
   Ng 43 (METER) + 40 (FACTOR)(2) = 86 dBrnc
   SUBTRACT Nm = 31 dBrnc
   BALANCE = 52 dB

7. OVERALL CIRCUIT BALANCE AFTER CLEARING C.O. AND ALL STATION TROUBLES:
   Ng ______ (METER) + ______ (FACTOR)(2) = ______ dBrnc
   SUBTRACT Nm = ______ dBrnc
   BALANCE = ______ dB

(1) USE SEPARATE SHEET FOR EACH PARTY. FILL IN HEADING AND LINES 2, 4 AND 5

(2) FACTOR = 40dB FOR WESTERN ELECTRIC 3 TYPE NOISE MEASURING SET.

Fig. 7A—Example No. 1—Individual Line With Unbalanced Facility

CABLE/WIRE FACILITY TESTS

TEST	TEST POINTS* 1	2	3	4	5	6
8. Nm REFERANCE dBrnc Fig. 5D and 6A	32	33				
9. Nm TO STA. END dBrnc Fig. 5D, 6B and 6D	17	30				
10. Nm TO C.O. END dBrnc Fig. 5D, 6C and 6D	31	20				
11. Ng (METER) dBrnc Fig. 5D and 6A	41	43				
CORRECTION FACTOR	40	40				
Ng dBrnc	81	83				
Ng dBrn3kHz	46	46				
* SHOW NUMBERED TEST POINTS ON SKETCH.						

12. FINAL OVERALL CIRCUIT BALANCE:

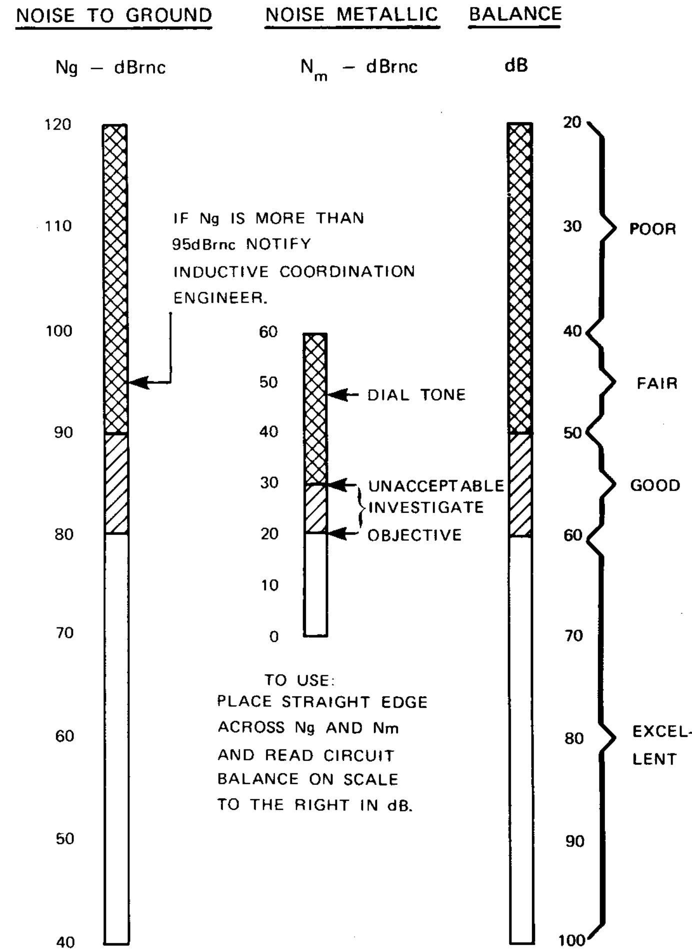
Ng 43 (METER) + 40 (FACTOR)(2) = 83 dBrnc

SUBTRACT Nm = 10 dBrnc

BALANCE = 73 dB

13. FINAL CIRCUIT LEVEL @ 1kHz: 81 dBrn

NOMOGRAPH TO DETERMINE BALANCE



14. SUMMARY OF CORRECTIVE ACTIONS: FOUND OLD DROP WIRE AT 82J TERMINAL

Fig. 7B—Example No. 1—Individual Line With Unbalanced Facility

Form E-6407
331-850-502
Iss. 1, April 1975

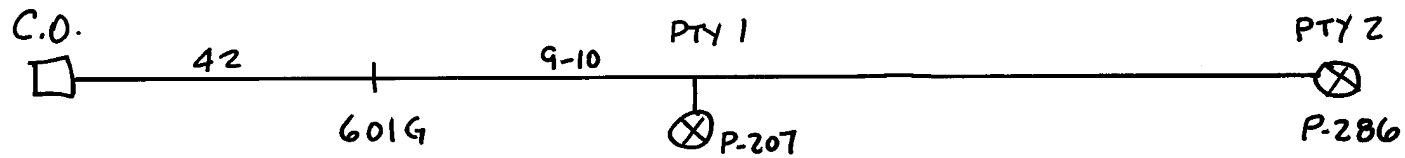
WORKSHEET AND TEST REPORT
FOR CLEARING INDUCTIVE NOISE TROUBLES ON SUBSCRIBER LINES

CUSTOMER NAME L. BROWN   TEL. NO. 765-4321   CL. SVC. 2FR   PTY(1) 1   TEST EQUIP. 3C

ADDRESS 13 G ST.   CUST. DESCRIPTION OF NOISE ROARING NOISE

	CABLE	PAIR	BINDING POST/COLOR	TERMINAL
1.	42	81		601 G
2.	OW	9-10		P-207
3.				

SKETCH OF FACILITY: – SHOW ALL TERMINALS, PARTIES, ELECTRONICS, ETC., SEE PARAGRAPH 2.05.



1. INITIAL CIRCUIT LEVEL @ 1kHz: 88 dBrn

2. INITIAL OVERALL CIRCUIT BALANCE:
   Ng 42 (METER) + 40 (FACTOR)(2) = 82 dBrnc
   SUBTRACT Nm = 31 dBrnc
   BALANCE = 51 dB
   (WITH 3kHz FLAT WEIGHTING: Ng 47 dBrn3KHz

3. NATURE OF NOISE:
   HUM ✓ STATIC ____ XTALK ____ OTHER ____

4. OVERALL CIRCUIT BALANCE WITH STATION ISOLATED:
   Ng 42 (METER) + 40 (FACTOR)(2) = 82 dBrnc
   SUBTRACT Nm = 30 dBrnc
   BALANCE = 52 dB

5. OVERALL CIRCUIT BALANCE AFTER CLEARING STATION TROUBLES OR ADDING ISOLATORS:
   Ng 42 (METER) + 40 (FACTOR)(2) = 82 dBrnc
   SUBTRACT Nm = 18 dBrnc
   BALANCE = 64 dB

6. OVERALL CIRCUIT BALANCE WITH C.O. ISOLATED:
   Ng ____ (METER) + ____ (FACTOR)(2) = ____ dBrnc
   SUBTRACT Nm = ____ dBrnc
   BALANCE = ____ dB

7. OVERALL CIRCUIT BALANCE AFTER CLEARING C.O. AND ALL STATION TROUBLES:
   Ng 41 (METER) + 40 (FACTOR)(2) = 81 dBrnc
   SUBTRACT Nm = 7 dBrnc
   BALANCE = 74 dB

(1) USE SEPARATE SHEET FOR EACH PARTY. FILL IN HEADING AND LINES 2, 4 AND 5   (2) FACTOR = 40dB FOR WESTERN ELECTRIC 3 TYPE NOISE MEASURING SET.

Fig. 8A—Example No. 2—Two-Party Line With Trouble in Second Party

CABLE/WIRE FACILITY TESTS

TEST	TEST POINTS* 1	2	3	4	5	6
8. Nm REFERANCE dBrnc Fig. 5D and 6A						
9. Nm TO STA. END dBrnc Fig. 5D, 6B and 6D						
10. Nm TO C.O. END dBrnc Fig. 5D, 6C and 6D						
11. Ng (METER) dBrnc Fig. 5D and 6A						
CORRECTION FACTOR						
Ng dBrnc						
Ng dBrn3kHz						
* SHOW NUMBERED TEST POINTS ON SKETCH.						

12. FINAL OVERALL CIRCUIT BALANCE:

Ng 41 (METER) + 40 (FACTOR)(2) = 81 dBrnc

SUBTRACT Nm = 18 dBrnc

BALANCE = 63 dB

13. FINAL CIRCUIT LEVEL @ 1kHz: 84 dBrn

14. SUMMARY OF CORRECTIVE ACTIONS: INSTALLED RINGER ISOLATORS

NOMOGRAPH TO DETERMINE BALANCE

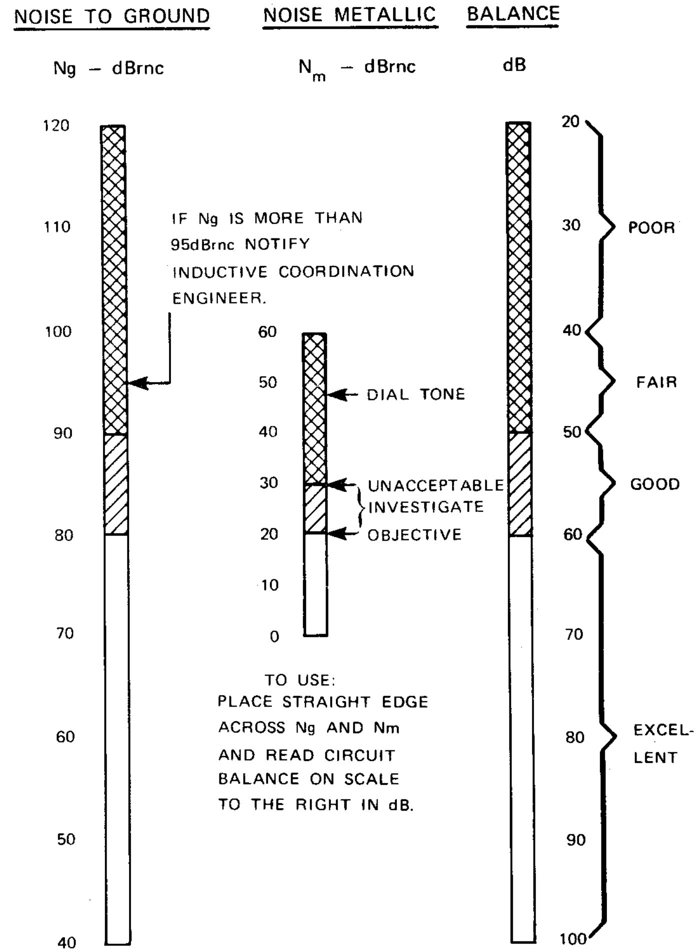


Fig. 8B—Example No. 2—Two-Party Line With Trouble in Second Party

Form E-6407
331-850-502
Iss. 1, April 1975

WORKSHEET AND TEST REPORT
FOR CLEARING INDUCTIVE NOISE TROUBLES ON SUBSCRIBER LINES

CUSTOMER NAME F. SHIPMAN TEL. NO. 765-1234 CL. SVC. 2FR PTY[1] 2 TEST EQUIP. 3C

ADDRESS 301 DART ST CUST. DESCRIPTION OF NOISE ______

	CABLE	PAIR	BINDING POST/COLOR	TERMINAL
1.				P-286
2.				
3.				

SKETCH OF FACILITY: – SHOW ALL TERMINALS, PARTIES, ELECTRONICS, ETC., SEE PARAGRAPH 2.05.

1. INITIAL CIRCUIT LEVEL @ 1kHz: ______ dBrn

2. INITIAL OVERALL CIRCUIT BALANCE:
   Ng 44 (METER) + 40 (FACTOR)[2] = 84 dBrnc
   SUBTRACT Nm = 32 dBrnc
   BALANCE = 52 dB
   (WITH 3kHz FLAT WEIGHTING: Ng 49 dBrn3KHz

3. NATURE OF NOISE:
   HUM ____ STATIC ____ XTALK ____ OTHER ____

4. OVERALL CIRCUIT BALANCE WITH STATION ISOLATED:
   Ng 44 (METER) + 40 (FACTOR)[2] = 84 dBrnc
   SUBTRACT Nm = 22 dBrnc
   BALANCE = 62 dB

5. OVERALL CIRCUIT BALANCE AFTER CLEARING STATION TROUBLES OR ADDING ISOLATORS:
   Ng 44 (METER) + 40 (FACTOR)[2] = 84 dBrnc
   SUBTRACT Nm = 20 dBrnc
   BALANCE = 64 dB

6. OVERALL CIRCUIT BALANCE WITH C.O. ISOLATED:
   Ng ____ (METER) + ____ (FACTOR)[2] = ____ dBrnc
   SUBTRACT Nm = ____ dBrnc
   BALANCE = ____ dB

7. OVERALL CIRCUIT BALANCE AFTER CLEARING C.O. AND ALL STATION TROUBLES:
   Ng ____ (METER) + ____ (FACTOR)[2] = ____ dBrnc
   SUBTRACT Nm = ____ dBrnc
   BALANCE = ____ dB

(1) USE SEPARATE SHEET FOR EACH PARTY. FILL IN HEADING AND LINES 2, 4 AND 5 (2) FACTOR = 40dB FOR WESTERN ELECTRIC 3 TYPE NOISE MEASURING SET.

Fig. 8C—Example No. 2—Two-Party Line With Trouble in Second Party

CABLE/WIRE FACILITY TESTS

TEST	TEST POINTS* 1	2	3	4	5	6
8. Nm REFERANCE dBrnc Fig. 5D and 6A						
9. Nm TO STA. END dBrnc Fig. 5D, 6B and 6D						
10. Nm TO C.O. END dBrnc Fig. 5D, 6C and 6D						
11. Ng (METER) dBrnc Fig. 5D and 6A						
CORRECTION FACTOR						
Ng dBrnc						
Ng dBrn3kHz						
* SHOW NUMBERED TEST POINTS ON SKETCH.						

12. FINAL OVERALL CIRCUIT BALANCE:

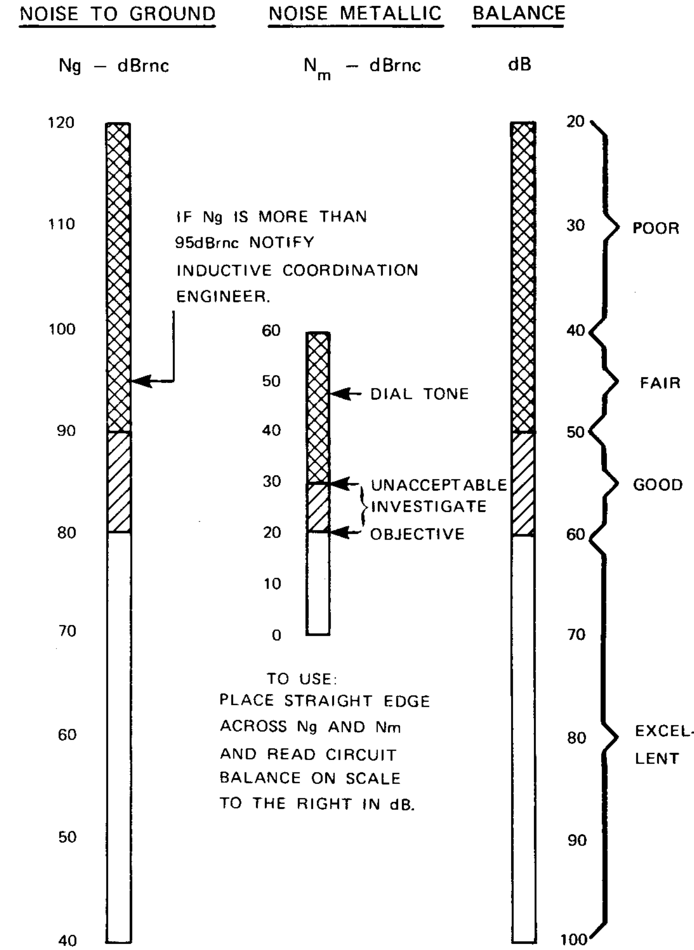
Ng______ (METER) + ________ (FACTOR)$^{(2)}$= __________ dBrnc

SUBTRACT Nm = __________ dBrnc

BALANCE = __________ dB

13. FINAL CIRCUIT LEVEL @ 1kHz: ____________________ dBrn

NOMOGRAPH TO DETERMINE BALANCE



14. SUMMARY OF CORRECTIVE ACTIONS: INSTALLED RINGER ISOLATOR

Fig. 8D—Example No. 2—Two-Party Line With Trouble in Second Party

Form E-6407
331-850-502
Iss. 1, April 1975

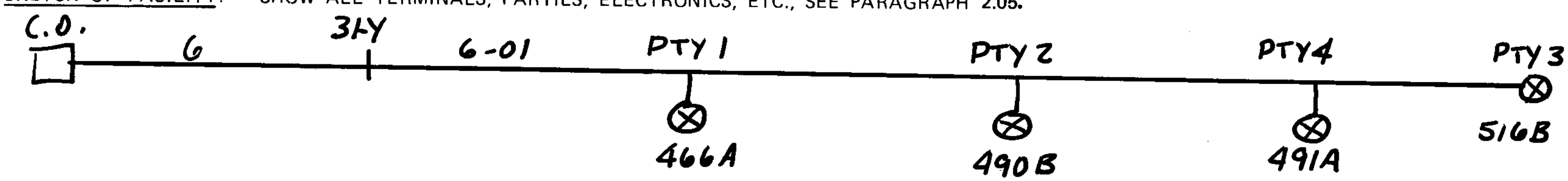
WORKSHEET AND TEST REPORT FOR CLEARING INDUCTIVE NOISE TROUBLES ON SUBSCRIBER LINES

CUSTOMER NAME M. STEELMAN TEL. NO. 345-6789 CL. SVC. 4RF PTY(1) 2 TEST EQUIP. 3C

ADDRESS 123 HIGH ST. CUST. DESCRIPTION OF NOISE BUZZING SOUND

	CABLE	PAIR	BINDING POST/COLOR	TERMINAL
1.	6	1213		31-Y
2.	6-01	9		466A
3.				

SKETCH OF FACILITY: – SHOW ALL TERMINALS, PARTIES, ELECTRONICS, ETC., SEE PARAGRAPH 2.05.



1. INITIAL CIRCUIT LEVEL @ 1kHz: 82 dBrn

2. INITIAL OVERALL CIRCUIT BALANCE:
   Ng 40 (METER) + 40 (FACTOR)(2) = 80 dBrnc
   SUBTRACT Nm = 29 dBrnc
   BALANCE = 51 dB
   (WITH 3kHz FLAT WEIGHTING: Ng 44 dBrn3KHz

3. NATURE OF NOISE:
   HUM ✓ STATIC ____ XTALK ____ OTHER ____

4. OVERALL CIRCUIT BALANCE WITH STATION ISOLATED:
   Ng 40 (METER) + 40 (FACTOR)(2) = 80 dBrnc
   SUBTRACT Nm = 30 dBrnc
   BALANCE = 50 dB

5. OVERALL CIRCUIT BALANCE AFTER CLEARING STATION TROUBLES OR ADDING ISOLATORS:
   Ng ____ (METER) + ____ (FACTOR)(2) = ____ dBrnc
   SUBTRACT Nm = ____ dBrnc
   BALANCE = ____ dB

6. OVERALL CIRCUIT BALANCE WITH C.O. ISOLATED:
   Ng 40 (METER) + 40 (FACTOR)(2) = 80 dBrnc
   SUBTRACT Nm = 15 dBrnc
   BALANCE = 65 dB

7. OVERALL CIRCUIT BALANCE AFTER CLEARING C.O. AND ALL STATION TROUBLES:
   Ng 40 (METER) + 40 (FACTOR)(2) = 80 dBrnc
   SUBTRACT Nm = 10 dBrnc
   BALANCE = 70 dB

(1) USE SEPARATE SHEET FOR EACH PARTY. FILL IN HEADING AND LINES 2, 4 AND 5 (2) FACTOR = 40dB FOR WESTERN ELECTRIC 3 TYPE NOISE MEASURING SET.

Fig. 9A—Example No. 3—Four-Party Line With Central Office Unbalanced

CABLE/WIRE FACILITY TESTS

TEST	TEST POINTS* 1	2	3	4	5	6
8. Nm REFERANCE dBrnc Fig. 5D and 6A						
9. Nm TO STA. END dBrnc Fig. 5D, 6B and 6D						
10. Nm TO C.O. END dBrnc Fig. 5D, 6C and 6D						
11. Ng (METER) dBrnc Fig. 5D and 6A						
CORRECTION FACTOR						
Ng dBrnc						
Ng dBrn3kHz						

* SHOW NUMBERED TEST POINTS ON SKETCH.

12. FINAL OVERALL CIRCUIT BALANCE:

Ng 40 (METER) + 40 (FACTOR)(2) = 80 dBrnc

SUBTRACT Nm = 10 dBrnc

BALANCE = 70 dB

13. FINAL CIRCUIT LEVEL @ 1kHz: 83 dBrn

14. SUMMARY OF CORRECTIVE ACTIONS: BAD LINE RELAY IN C.O. REFERRED TO TEST CENTER. REPLACED.

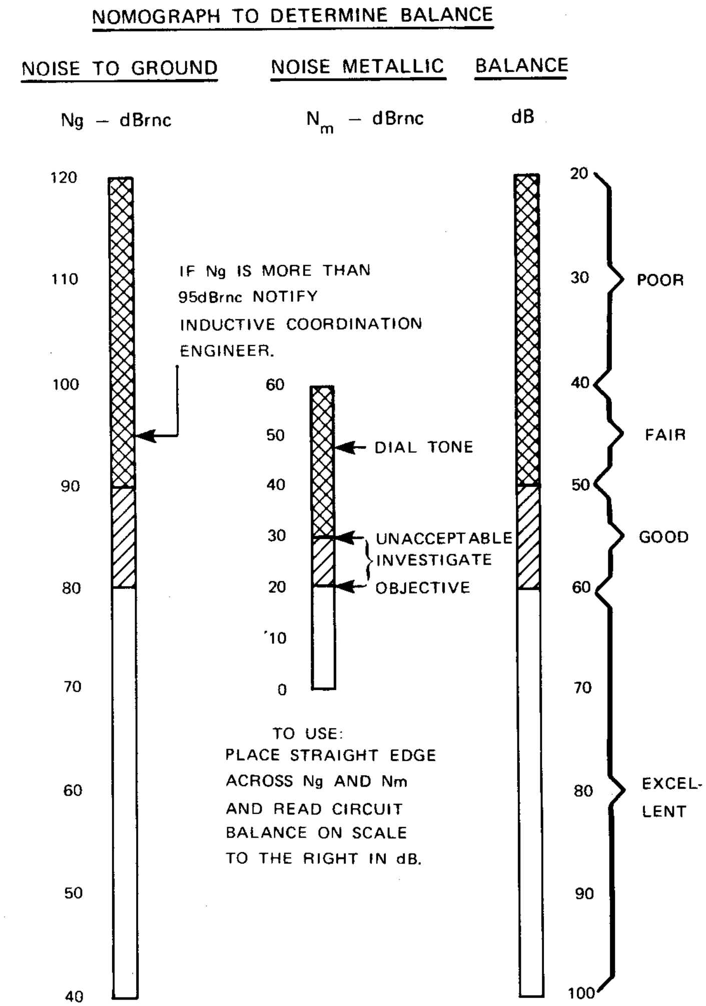


Fig. 9B—Example No. 3—Four-Party Line With Central Office Unbalanced