LINE CONCENTRATOR NO. 1A WITH MF SIGNALING SYSTEM TESTS

1. GENERAL

1.01 This section describes a method of making tests on concentrator systems after cutover. It is one of a group of sections pertaining to the line concentrator No. 1A when modified for use with multifrequency signaling.

1.02 The tests covered are:

MAINTENANCE TESTS

A. Measuring Battery Voltage at Remote Concentrator: This test checks battery voltage.

B. Battery Replacement at Remote Concentrator: This test provides a procedure for replacing the battery.

C. Battery Charging Current at Remote Concentrator: This test checks battery-charging current at the remote concentrator.

D. Ground Return Resistance — Control and Remote Ends: This test checks the value of resistance which exists in the signaling ground return path.

E. Insulation Resistance of Signaling Leads — Control and Remote Ends: This test checks the insulation resistance of the signaling leads at both the control and remote ends.

F. Interference on Signaling Leads — Control and Remote Ends: This test measures ac and dc interference voltages on signaling leads at both the control and remote ends to determine if they are within stated limits.

G. DC-to-MF Conversion in MF Signaling Circuit — Control and Remote Ends: This test checks the conversion of the direct current signals to alternating current multifrequency signals at the control and remote ends.

H. Mark Counting in MF Signaling Circuit — Control End: This test checks for a proper operating sequence in the mark counting circuit at the control end.

I. Check Counting in MF Signaling Circuit — Remote End: This test checks for a proper operating sequence in the check counting circuit at the remote end.

J. Test Circuit — Control and Remote Ends: This test checks for proper operation of the test circuit at both the control and remote ends without originating calls through the concentrator.

K. Timing in MF Signaling Circuits — Control and Remote Ends: This test checks for the required time in the timing circuits of the multifrequency signaling circuits at both the control and remote ends.

L. Line Insulation — Remote End: This test checks the line insulation resistance of the line between the remote concentrator and the customer station.

M. Alarm Circuits: This test checks the alarm features of the concentrator control and remote units.

N. Dial Tone Speed Register: This test checks the connection of the dial tone speed register circuit when used with this system.

O. Trunk Group Usage Recorder: This test checks the connections to a trunk group usage recorder from this system.

P. Service Denial Call: This test checks the service denial features of the concentrator system.

Q. Service Denial Under Permanent Signal Conditions: This test provides a procedure for instituting service denial under permanent signal conditions.

OPERATIONAL TESTS (to be performed when trouble is experienced)

R. Test Lines

(1) Service Request Call: This test checks the ability of the concentrator system to handle a service request test call (Steps 1 through 17).

(2) Terminating Call: This test checks the ability of the concentrator system to handle a terminating test call (Steps 18 through 38).

S. Service Request Call: This test checks the ability of a particular line to place a service request call.

T. Terminating Call: This test checks the ability of the concentrator system to place a terminating call on a particular line.

U. Disconnect Call: This test checks the ability of the concentrator system to process a disconnect call on any particular line.

V. Trunk Tests: This test provides a means for operating all trunks.

W. Trunk Transmission Tests: This test measures transmission levels on all trunks using the loop-around method.

X. Releasing Double Connections: This test provides a means for releasing double connections.

1.03 During the time that maintenance tests are being performed, the concentrator system is out of service. Arrangements should be made to notify the control end when tests are conducted at the remote end and vice versa. When this occurs, close cooperation between personnel will be required to keep out-of-service time to a minimum; therefore, it is preferable to make such tests during periods of light traffic.

1.04 Tests G, M, P, Q, R, S, T, U, and V will require simultaneous testing at both the control and remote ends of the system; therefore, a talking circuit will be required between units to coordinate testing. If possible, the talking circuit should use facilities other than those assigned for concentrator use.

1.05 In the case of interruption of normal service, the sequence charts of SD-95971-01 and SD-96536-01 should be consulted to determine in which of the units and at what point trouble may be occurring.

1.06 If there is an indication of signaling trouble between the remote and control MF signaling circuits and carrier facilities are used, these facilities should be checked first for proper operation.

1.07 The following reference material is required.

CD-95957-01 SD-95957-01	Common Systems — Line Concentrator No. 1A — Remote Circuit — 50-Line Capacity
CD-95971-01 SD-95971-01	Common Systems — Line Concentrator No. 1A — Multifrequency Signaling Circuit — Control End
CD-95972-01 SD-95972-01	Common Systems — Line Concentrator No. 1A — Multifrequency Signaling Circuit — Remote End
CD-96536-01 SD-96536-01	Common Systems — Line Concentrator No. 1A — Control Circuit — 100-Line Capacity
CD-96537-01 SD-96537-01	Common Systems — Line Concentrator No. 1A — Remote Circuit — 100-Line Capacity
CD-96556-01 SD-96556-01	Common Systems — Line Concentrator No. 1A — Modification to Provide Long Lines Service
CD-96557-01 SD-96557-01	Common Systems — Line Concentrator No. 1A — Modification Circuit for Additional Applications in MTWX Service
CD-98137-01 SD-98137-01	Common Systems — E1L Signaling and 4-Wire Terminating Circuit
CD-98138-01 SD-98138-01	Common Systems — E1S Signaling and 4-Wire Terminating Circuit
067-106-201	Line Concentrator No. 1A With MF Signaling, Cutover Procedures, and Addition and Deletion of Individual Lines

067-106-301	Line Concentrator No. 1A With MF Signaling, Trouble Analysis
067-106-501	Line Concentrator No. 1A With MF Signaling, Preinstallation Tests
167-285-301 C70.027	Line Concentrator No. 1A KS-15917 List 3 Battery Supply
A804.468	Trunk Transmission Testing Using the Loop-Around Method

OPERATIONAL TESTS (tests to be used when trouble is experienced)

A. General

1.08 The following tests describe the actions necessary to perform operational tests. However, it will be necessary to analyze the trouble condition to determine which tests to perform and what equipment should be tested so that unnecessary testing effort may be eliminated and the trouble located in minimum time. It is imperative that a thorough knowledge of the circuit functions is known and, especially, the results of improper signaling and the effects of magnetically latched equipment. Familiarity with sequence charts can be of inestimable help.

1.09 The line concentrator and its associated MF signaling circuit use ground return signaling employing marginal relays and will perform satisfactorily if the voltage and range limits stated on the schematic drawings are met. If these conditions are not met during the signaling operation, wrong signals may result and different information may be registered in the remote and control circuits. Temporary cable trouble due to outside plant operations or momentary high ac voltages will also cause wrong signaling. A trouble in either MF signaling circuit may cause an incorrect translation to MF tones which will cause an incorrect concentrator registration. In addition, correct signaling with circuit troubles, such as crossed or open contacts, may cause the signal to be registered incorrectly.

1.10 Operation of the line concentrator circuit causes apparatus (hold magnets and cut-off relays) within the concentrator circuits to be operated or released and to remain in this condition magnetically until changed by a succeeding call. This is done to minimize power requirements at the remote unit when a connection has been established. For example, on any service request call, hold magnets are operated and cut-off relays are released and the equipment will remain in this condition when the customer returns the line to an on-hook condition or until a disconnect call is made. (Previous systems allowed the equipment to return to normal by an on-hook signal; therefore, a disconnect call must identify which equipment requires disconnection and will subsequently cause a reversal of current flow which will change the magnetic state established during the service request call, thereby permitting the hold magnets to release and the cut-off relays to reoperate.)

1.11 As previously stated, a disconnect call identifies which equipment must be returned to a normal condition in the control concentrator circuit; therefore, if wrong signaling or registration caused improper line or trunk equipment in the remote and control concentrator to be used on a service request call, a disconnect call will change the magnetic field of the equipment in both the remote and control concentrators that has been identified in the control concentrator. The result will be that the equipment in the remote concentrator used for the service request call remains unchanged in state. To illustrate this, assume that line 10 initiates a service request call which causes line 10 to be connected to trunk 00 in the remote concentrator, and that improper registration or signaling causes trunk 00 to connect to line 20 at the control concentrator. If line 20 was not in use, the customer would receive dial tone and would complete his call. At this time, line 10 would be cut off (CO- relay released) in the remote circuit and line 20 would be cut off in the control circuit. When an on-hook condition occurs, the concentrator will disconnect this call if the Trunk Load Control is active. However, the control circuit will identify the line as line 20 and, if correct signaling and registration occur, the CO- relays of line 20 in both the remote and control concentrators will operate to remove the cut-off condition. This will result in line 10 remaining in a cut-off condition at the remote concentrator, thereby denying service to the customer on line 10.

1.12 A similar situation will exist when improper identification occurs on a disconnect call. Assume that a service request call cuts through line 10 properly in both the remote and control concentrators. However, when the disconnect call occurs, there is either improper registration or wrong signaling so that the remote unit identifies line 20 as the one to be restored to a normal on-hook condition. Line 10 is again left in a cut-off condition, thereby denying service to the customer.

1.13 Another effect of wrong identification, signaling, or registration is double connections. Some of the troubles caused by double connections are listed in Section 067-106-301 covering Line Concentrator No. 1A With MF Signaling, Trouble Analysis. In order to test the proper equipment and minimize testing effort when locating a trouble causing double connections, a thorough knowledge of how double connections occur and what their effects are is necessary. Table A contains some of the combinations that can occur due to wrong signaling, improper registration, or crosses, and also the effects of various types of calls that may follow the initial call. Cases 1 through 9 assume correct signaling and registration on calls listed in "Type of Call or Action That Follows" column.

1.14 Double connections will cause the concentrator to cycle until released. This occurs because the first trunk in releasing will return the cut-off relay (CO-) in the remote circuit to a normal condition (operated) which causes the −24 voltage through the line relay to be connected through the remaining trunk of the double connection to −48 voltage through the A relay of the E1S signaling circuit. This action will originate another service request call on the line and another double connection will occur; thus, the cycle will continue until released.

1.15 For the above reasons, it will be necessary to observe both the remote and control concentrator circuits when double connections, no dial tone, ringing cannot be tripped, and wrong customer reached reports are received and there appears to be no trouble associated with the line, E1S and E1L signaling units, or carrier facilities. Examination of Table A shows that many combinations of troubles and succeeding calls can cause these trouble reports; therefore, a single test that appears to complete may cause future trouble reports. An example of this is Case 2 where a single test may obtain dial tone and the call would complete satisfactorily. However, a disconnect call following the test call will deny service to the customer. In this example, the trouble would have been found if the crosspoints had been checked in the remote and control circuits on the service request call to determine that the remote and control concentrators had different line appearances connected to the trunk. Another factor to consider in analyzing the trouble reports is the fact that common control circuits are used and blocking and operating relays may affect all lines; therefore, a thorough knowledge of the circuit is necessary to minimize service interruptions.

1.16 Due to common control circuits, many lines have access to a group of trunks; therefore, a line may fail only when connected to a particular trunk. Analyzation of the troubles may indicate that the troubles are occurring on one line or trunk, in certain LA- or LB-groups, or one group of trunks; therefore, it would be beneficial to keep a record of trouble reports to determine if the trouble is located in a particular portion of the circuit.

1.17 In summary, trouble reports will have to be analyzed to determine which tests should be made and what portion of the circuit is in trouble. A single test or many operational tests may not locate the trouble if the condition that causes the trouble is not duplicated. Table A shows many of the possible troubles, but all possibilities are not listed since the troubles depend upon the duration and location of wrong identification, signaling, or registration and also the sequence of succeeding calls. If the trouble appears to be due to signaling, the trouble may exist in the MF signaling circuits or their carrier facilities. A check of the ac voltages on the signaling pairs between the MF signaling circuits and the concentrator units should also be made. When ac voltage exceeds the limits shown in the schematic drawings, consult the information (D) sheets of the SDs for compensatory measures to be taken.

Caution: The ac voltage on the signaling leads must be within limits at all times.

B. Analysis of Trouble Conditions

1.18 Table A lists some of the effects which may result when calls do not complete satisfactorily. Case 2 will be explained in detail to provide an understanding of Table A.

1.19 In Case 2, a service request call is originated from the remote circuit and cross-points are closed to the line originating the call in the remote circuit and to a different line terminal in the control circuit as shown in the "Line Terminal Connected" column. Also, the same trunk is used in both units on the call as shown in the "Trunk Connected" column. This trouble would occur when the customer on line 10 originates a service request call and cross-points are closed for both line terminal 10 in the remote circuit and line terminal 20 in the control circuit. The column designated "Conditions" indicates that the call is made when both line terminals have no previous connection (closed cross-points) and both are working lines (assigned). Since line 20 is a working line and does not have a previous cross-point closed, the customer will obtain dial tone and will complete his call. The "Action That Follows" column indicates the type of call that follows, and the results of such calls are shown in the "Results" column. It is further assumed that the call completes satisfactorily in the "Action That Follows" column.

1.20 A service request call from the line connected at the control unit will cause a double connection at the control end. In the above example, the customer associated with line 20 can originate a service request call since the cut-off relay associated with the line terminal at the remote end is normal. This call will select another trunk and it is assumed that this call will complete satisfactorily. This call would close cross-points in both the remote and control circuit to line 20. When this occurs, lines 10 and 20 will each be connected to one set of cross-points in the remote circuit but line 20 will be closed to two sets of cross-points in the control circuit, thus causing two trunks to be connected to one line terminal in the control circuit.

1.21 When a terminating call to line 10 is made after the original call, the call will complete since the cut-off relay in the control circuit of line 10 remained normal on the original call. This will cause two trunks to be connected to line 10 in the remote unit and one trunk to lines 10 and 20 in the control unit.

1.22 A disconnect call following the original call will identify the line desiring disconnection as line 20; therefore, the cut-off relay for line 10 in the remote unit will remain in the cut-off condition which will deny originating service for line 10.

1.23 The "Results" column shows the results of subsequent calls but may not be the observed results when a customer reports trouble. An example of this follows.

(a) As previously shown, line 10 could be double connected at the remote end when a terminating call follows the original call. When the customers return their switchhooks to the normal condition (on hook), a disconnect call will be made if the Trunk Load Control is active. If the trunk that has line 10 connected in the remote unit and line 20 in the control unit disconnects first, the trunk will disconnect. Since line identification is made in the control unit, line 20 will be identified and the cut-off relay will be returned to normal in both units. Since it was assumed that line 20 was idle in the remote unit, the cut-off relay for line 20 will be normal; and when the disconnect call is made, the condition of the cut-off relay will remain the same. The second trunk with line 10 connected in both units will now disconnect.

(b) However, if the trunk that has line 10 connected in both units disconnects first, the cut-off relay for line 10 in the remote unit will be returned to normal. This will originate a service request call caused by the connection of the −48 volt battery of the central office through the remaining cross-points of the cut-off relay and the line relay (line 10) to −24 volt battery. This cycle would continue as long as the trunk with line 10 connected at both ends is disconnected first; thus, in one case, the double connection could be observed while the other case would show no double connection.

1.24 An analysis of each case and the results of double connections in Table A can be made to determine the results of a mismatch of

information between the remote and control units and the conditions that will be left in the line concentrator when a double connection occurs.

1.25 *Lettered Steps:* A letter a, b, c, etc, added to a step number in Part 4 of this section, indicates an action which may or may not be required depending on local conditions. The condition under which a lettered step or a series of lettered steps should be made is given in the ACTION column, and all steps governed by the same condition are designated by the same letter within a test. Where a condition does not apply, all steps designated by that letter should be omitted.

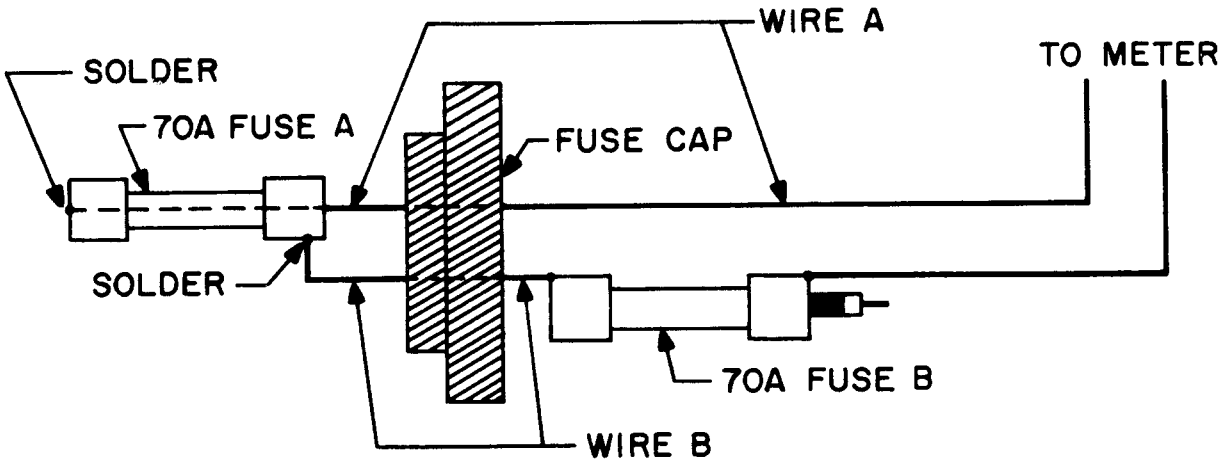

Fig. 1 – Construction of Dummy Fuse for Charge Current Measurements

Steps in Construction

1. Unsolder fuse element of 70A fuse A. Remove element, spring, cap, plastic tip, etc.
2. Replace fuse element with wire connections as shown.
3. Thread wire through fuse cap.
4. Solder 70A fuse B into circuit with wire B.
5. Tape bare parts of fuse B.

TABLE A — TYPICAL TROUBLE CASES

CASE	TYPE OF CALL	CONDITIONS	LINE TERMINAL CONNECTED ON CALL		TRUNK CONNECTED		RESULTS	ACTION THAT FOLLOWS	RESULTS
			REMOTE	CONTROL	REMOTE	CONTROL			
1	SR	Remote and control line terminals used on call not connected on previous call and line terminal of control circuit not assigned. (See Fig. 5.)	Line terminal originating call	Different	Same		Call will cycle as long as an off-hook signal is present due to no trunk closure to central office.		
2	SR	Remote and control line terminals used on call not connected to previous call. (See Fig. 5.)	Line terminal originating call	Different	Same		Call will complete.	SR call from line terminal connected in control circuit. (See Fig. 6.)	Two trunks connected in the control unit to line terminal used in control unit.
								Terminating call to line terminal originating SR call. (See Fig. 7.)	Two trunks connected in the remote unit to line terminal originating service request call.
								Disconnect call.	Line terminal originating call will be left in a cut-off condition.

TABLE A (cont)

CASE	TYPE OF CALL	CONDITIONS	LINE TERMINAL CONNECTED ON CALL		TRUNK CONNECTED		RESULTS	ACTION THAT FOLLOWS	RESULTS
			REMOTE	CONTROL	REMOTE	CONTROL			
3	SR	Remote line terminal used on call not connected to previous call; however, control line terminal connected on previous call. (See Fig. 8.)	Line terminal originating call	Different	Same		Double connection of two trunks to line terminal of control circuit.	First disconnect call on trunk connected to line terminal originating call.	Line terminal originating call will be left in a cut-off condition and a service request call will be originated by the other line terminal, causing two trunks in both the remote and control circuit to be connected.
								First disconnect call on trunk used on previous call.	Both trunks will disconnect, but line terminal originating call will be left in cut-off condition.
								Terminating call to terminal originating call. (See Fig. 9.)	Two trunks on each line terminal. Three trunks involved with one trunk shared.

TABLE A (cont)

CASE	TYPE OF CALL	CONDITIONS	LINE TERMINAL CONNECTED ON CALL		TRUNK CONNECTED		RESULTS	ACTION THAT FOLLOWS	RESULTS
			REMOTE	CONTROL	REMOTE	CONTROL			
4	SR	Trunks used on call did not have previous connection. (See Fig. 10.)	Same as line terminal originating call	Line terminal originating call	Different	Trunk selected by control unit	No dial tone. Both trunks will remain held operated. The trunk connected in the remote unit will not be identified by the control unit for disconnection. The trunk connected in the control unit will remain busy due to central office −48 volt battery through the TS-relay to −24 volt battery through remote unit off normal contact.	Terminating call using trunk connected in remote unit. Service request call using trunk connected in remote unit.	Will be connected to wrong line terminal. No dial tone.
5	SR	Connection on trunk used in remote unit.	Same as line terminal originating call	Line terminal originating call	Different	Trunk selected by control unit	No dial tone. Trunk selected by control unit will remain busy. (See Case 4.) Line terminal will be cut off but no line closure in remote unit.		

TABLE A (cont)

CASE	TYPE OF CALL	CONDITIONS	LINE TERMINAL CONNECTED ON CALL		TRUNK CONNECTED		RESULTS	ACTION THAT FOLLOWS	RESULTS
			REMOTE	CONTROL	REMOTE	CONTROL			
6	Term.	Remote and control line terminals not used on previous call. (See Fig. 5.)	Different	Line terminal originating call	Same		Wrong customer will be reached.	SR call from line terminal originating call. (See Fig. 6.)	Double connection in control unit.
								Terminating call to line terminal of remote unit. (See Fig. 7.)	Double connection in remote unit.
								Disconnect call.	Line terminal in remote unit left in cut off.
7	Term.	Connection on remote unit line terminal used on call. (See Fig. 11.)	Different	Line terminal originating call	Same		Wrong customer reached and double connection in remote circuit.	First disconnect call on trunk connected to line terminal originating call.	Both trunks will disconnect if Trunk Load Control is active.
								First disconnect call on trunk used on previous call.	When line terminal in remote unit is returned to normal, a service request call will be made due to central office battery through the other trunk. This cycle will continue.
								SR call from line terminal originating the call. (See Fig. 12.)	Two trunks on each line terminal with three trunks involved and one trunk shared by each line terminal.

TABLE A (cont)

CASE	TYPE OF CALL	CONDITIONS	LINE TERMINAL CONNECTED ON CALL		TRUNK CONNECTED		RESULTS	ACTION THAT FOLLOWS	RESULTS
			REMOTE	CONTROL	REMOTE	CONTROL			
8	Term.	Trunks used on call did not have previous connections. (See Fig. 10.)	Same as line originating call	Line terminal originating call	Different	Trunk selected by control circuit	Customer will not be reached and ringing may not be tripped. The trunk connected in the remote unit will not be identified by the control unit for disconnections. The trunk connected in the control unit will remain busy due to central office −48 volt battery through the TS-relay to −24 volt battery through remote unit off-normal contact.	Same as Case 4.	
9	Term.	Connection on trunk used in remote unit.	Same as line originating call	Line terminal originating call	Different	Trunk selected by control circuit	Customer will not be reached and ringing may not be tripped. Trunk selected by control unit will remain busy. (See Case 8.) Line terminal will be cut off, but no line closure in remote circuit.		

TABLE A (cont)

CASE	TYPE OF CALL	CONDITIONS	LINE TERMINAL CONNECTED ON CALL		TRUNK CONNECTED		RESULTS	ACTION THAT FOLLOWS	RESULTS
			REMOTE	CONTROL	REMOTE	CONTROL			
10	SR or Term.	No connection on line terminals used on call in remote and control units.	Other than line originating call		Trunk selected by control circuit		All trunks would be connected to wrong line and concentrator would connect trunks as they disconnect.		
11	SR		Different	Line terminal originating call	Same		All trunks would be set up since line requesting service would not be cut off and trunks would be set up as disconnect calls are made.		
12	Term.		Line terminal originating call	Different	Same		All trunks would be set up since line requesting service would not be cut off. Also trunks would be set up as disconnect calls are made.		

TABLE A (cont)

CASE	TYPE OF CALL	CONDITIONS	LINE TERMINAL CONNECTED ON CALL		TRUNK CONNECTED		RESULTS	ACTION THAT FOLLOWS	RESULTS
			REMOTE	CONTROL	REMOTE	CONTROL			
13	Disconnect	No connection on line terminal of remote unit used on call.	Different	Line terminal requiring disconnection	Same		Line terminal requiring disconection is left in cut-off condition in remote circuit.		
14	Disconnect	Connection on line terminal of remote unit used on call.	Different	Line terminal requiring disconnection	Same		Line terminal requiring disconnection is left in cut-off condition in remote circuit. Line terminal in remote circuit used on call will be returned to a cut-through condition, thus causing a service request call and a double connection of this line in both the remote and control units. (See Fig. 12.)		

CONCENTRATOR UNIT

MF SIGNALING UNIT LOCATION

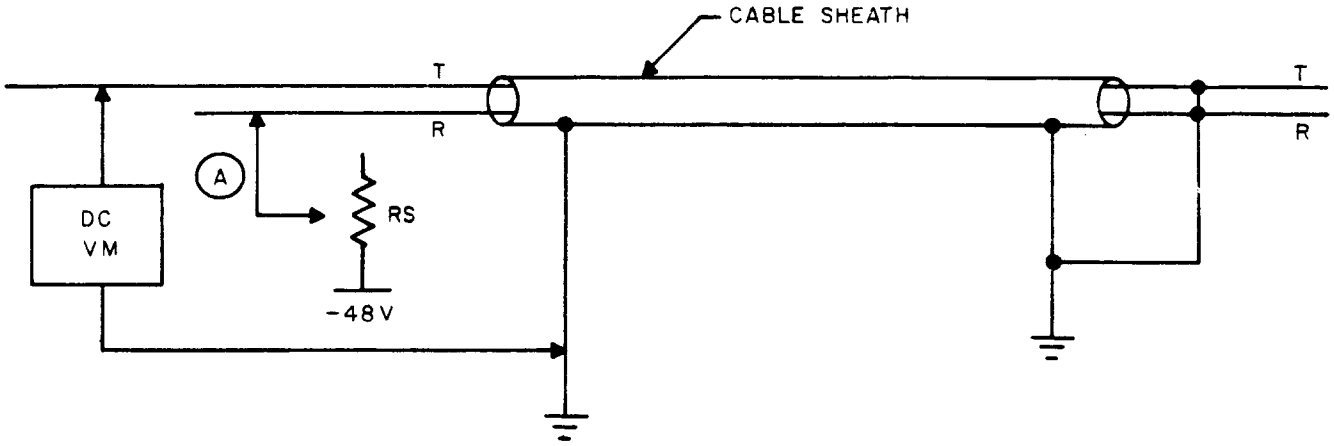

Fig. 2 – Measurement of Ground Return Resistance

Procedure

1. Establish a cable pair between the concentrator unit location and MF signaling unit location for test purposes. (See note 1.)
2. At the MF signaling unit location, ground the tip and ring leads of the test pair to cable sheath ground.
3. At the concentrator unit, measure dc voltage E_1 from tip lead to building ground. Determine polarity of voltage relative to ground: plus (+) for positive, minus (−) for negative.
4. At the concentrator unit, connect 48 volts to ring lead in series with sufficient resistance (RS1) to maintain current (I) between 40 ma and 140 ma. [Wattage rating of (RS) should be equal to I^2 (RS) watts.] Measure current (I).
5. At the concentrator unit, measure dc voltage E_2 from tip lead to building ground with about 140 ma ring lead current flowing (determine polarity as in Step 3).
6. Resistance of ground return (approximate) $= \frac{\pm E_2 + E_1}{I}$ ohms.

Note

1. This test is to be made at the remote end if the remote concentrator and remote MF signaling circuit are not in the same office. This test is to be made at the control end if the control concentrator and control MF signaling circuit are not in the same office.

Example:

$E_1 = -0.4^V$ (Step 3)
$E_2 = +3.2^V$ (Step 5)
I = 0.140A (Step 4)

Ground return resistance $= \frac{+3.2 - 0.4}{0.140} = 20$ ohms (Step 6)

(a) CONTROL CONCENTRATOR UNIT
(b) REMOTE MF SIGNALING UNIT

(a) CONTROL MF SIGNALING UNIT
(b) REMOTE CONCENTRATOR UNIT

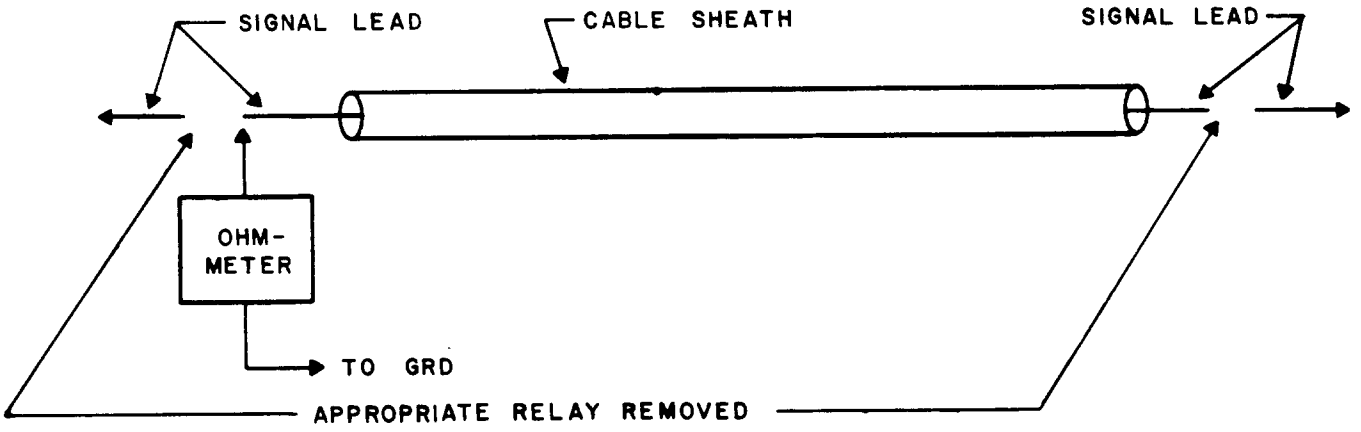

Fig. 3 – Measurement of Signal Lead Insulation Resistance

(a) Measurements at control concentrator unit.

Procedure

1. Remove S1 relays in both units.
2. Measure leakage of TS0 lead at CAD 6 terminal 70.
3. Remove S3 relays in both units.
4. Measure leakage of RS0 lead at CAD 6 terminal 60.
5. Remove M relay in control MF signaling circuit.
6. Measure leakage of TS1 lead at CAD 6 terminal 71.
7. Remove RS1 lead from terminal at control MF signaling circuit.
8. Measure leakage at CAD 6 terminal 61.
9. Correct any leakage found less than 30,000 ohms.
10. Replace all leads and relays.

(b) Measurements at remote MF signaling unit.

Procedure

1. Remove S1 relays in both units.
2. Measure leakage of TS0 lead at CAD 1 terminal 52.
3. Remove S3 relays in both units.
4. Measure leakage of RS0 lead at CAD 1 terminal 42.
5. Remove M relay in remote concentrator unit.
6. Measure leakage of TS1 lead at CAD 1 terminal 32.
7. Remove RS1 lead from screw terminal in remote concentrator unit.
8. Measure leakage of RS1 lead at CAD 1 terminal 22.
9. Correct any leakage less than 30,000 ohms.
10. Replace all leads and relays.

(a) CONTROL CONCENTRATOR UNIT
(b) REMOTE MF SIGNALING UNIT

(a) CONTROL MF SIGNALING UNIT
(b) REMOTE CONCENTRATOR UNIT

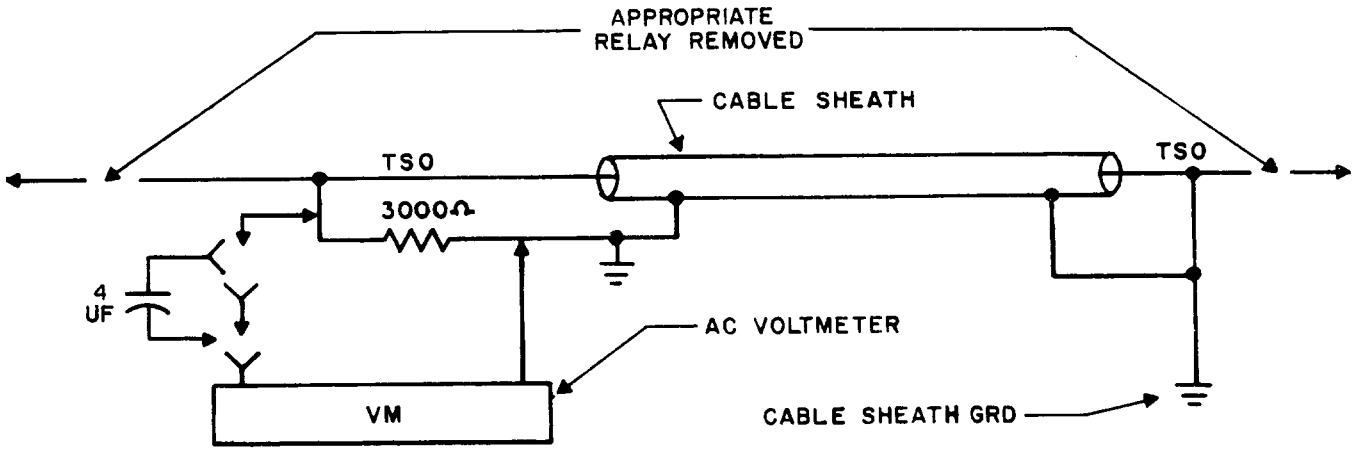

Fig. 4 – Measurement of AC Interference on Signal Leads

(a) CONTROL END

Procedure

1. Remove S1 relays in concentrator and S2 relay in MF signaling unit.
2. At the MF signaling unit location, ground the TS0 lead to cable sheath ground.
3. At the concentrator, terminate TS0 lead to ground with 3,000 ohms as shown.
4. Measure AC voltage across 3,000 ohms.

(b) REMOTE END

Procedure

1. Remove S1 relays in both units.
2. At the remote concentrator, ground the TS0 lead to cable sheath ground.
3. At the MF signaling unit, terminate TS0 lead to ground with 3,000 ohms as shown.
4. Measure AC voltage across 3,000 ohms.

Note

AC voltmeter should isolate ac from dc. If meter does not isolate dc, a 4-μf capacitor should be placed in series with the voltmeter leads as shown by the dotted lines in the above figure.

Example:

Signaling current = 0.100 ampere (for all cases)
Ground return resistance (obtained in Test D) = 20 ohms
DC Voltage = (+0.100) x 20 = 2 volts
Total interference (AC + DC) = 2 volts + 1.414 (ac voltage)

Note

AC voltage component must be 5 volts rms or less.

TROUBLE CONDITIONS (Fig. 5 through 12)

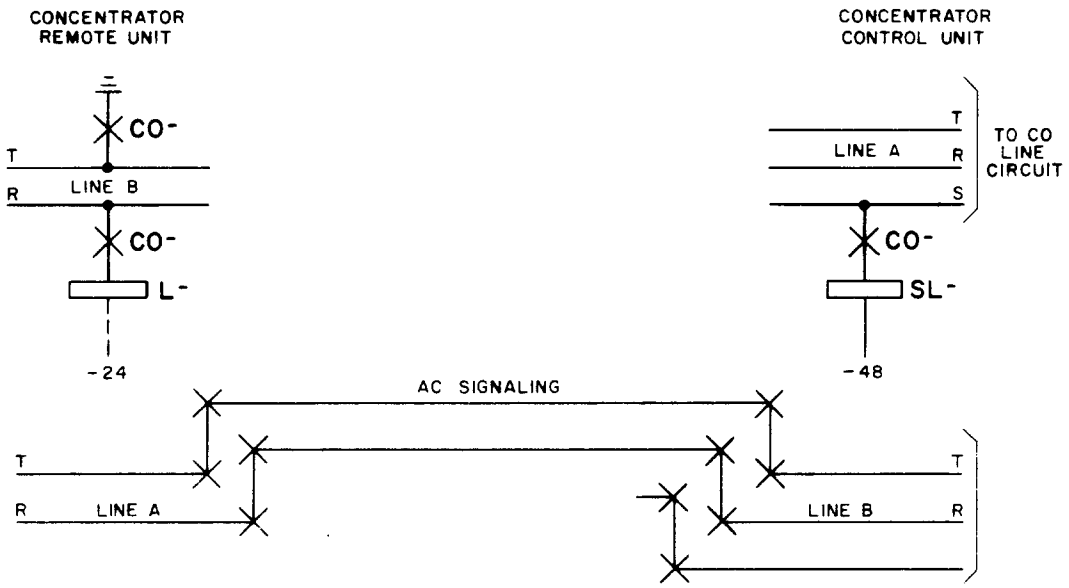

Fig. 5

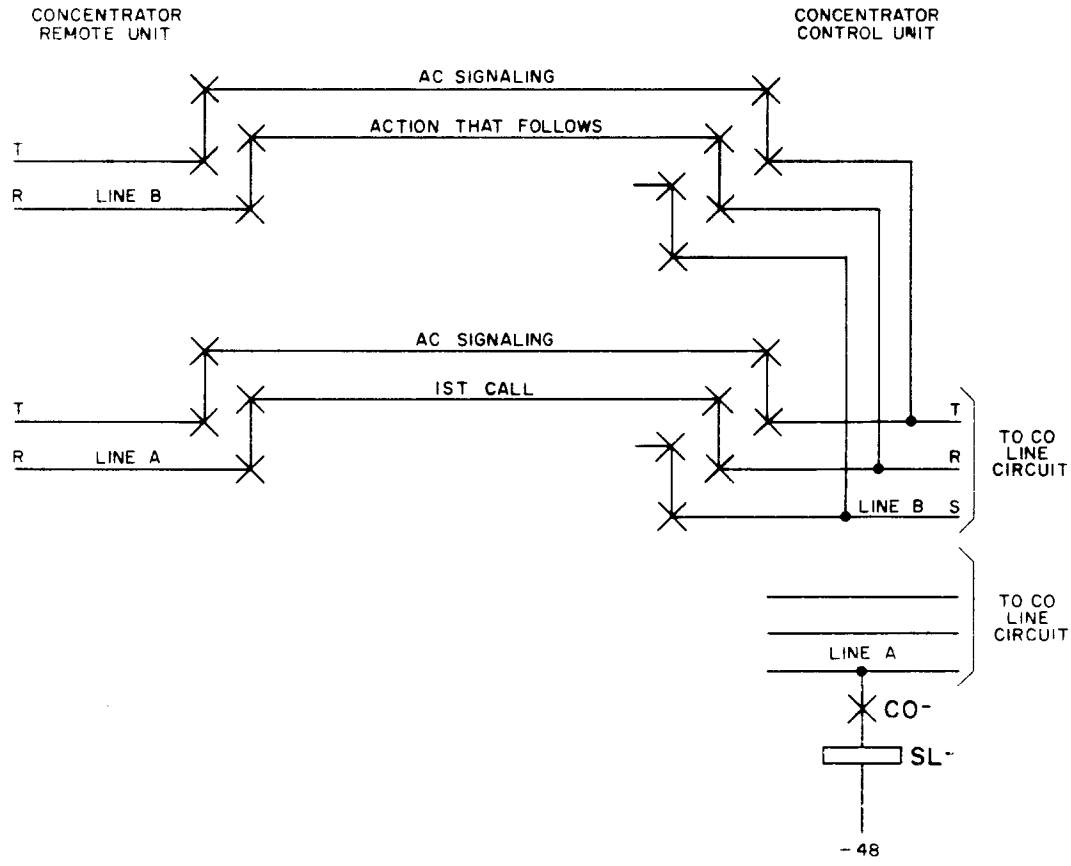

Fig. 6

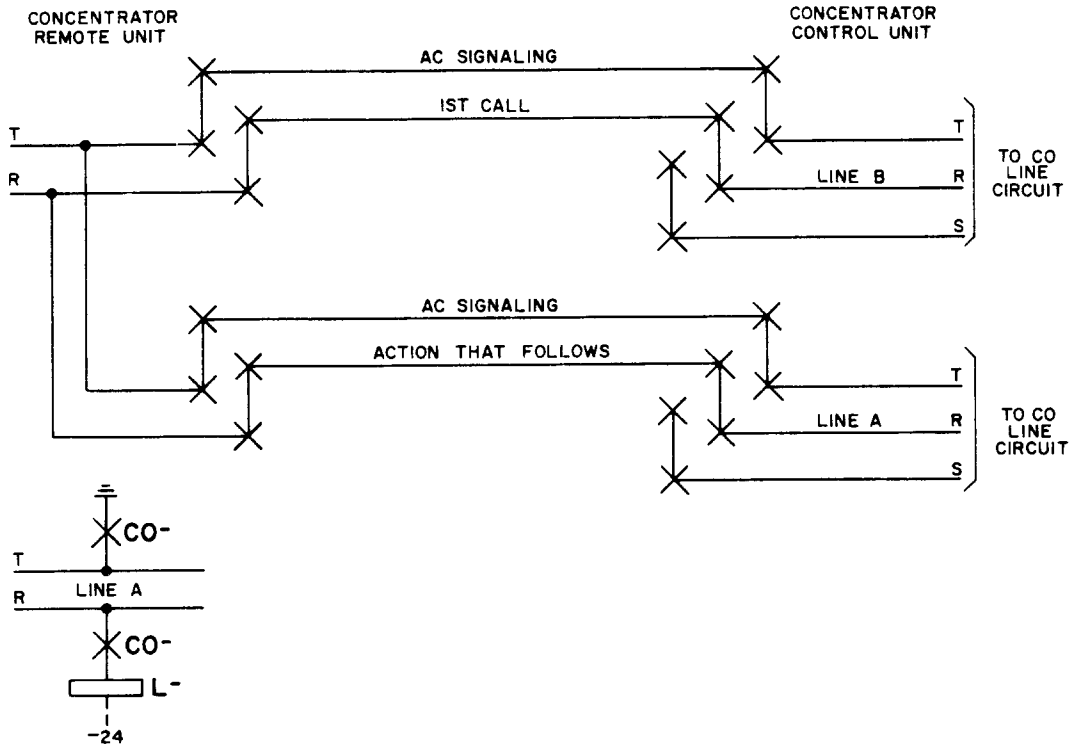
CONCENTRATOR
REMOTE UNIT
CONCENTRATOR
CONTROL UNIT
AC SIGNALING
1ST CALL
T
R
T
LINE B
R
S
TO CO
LINE
CIRCUIT
AC SIGNALING
ACTION THAT FOLLOWS
T
LINE A
R
S
TO CO
LINE
CIRCUIT
CO-
T
R
LINE A
CO-
L-
-24

Fig. 7

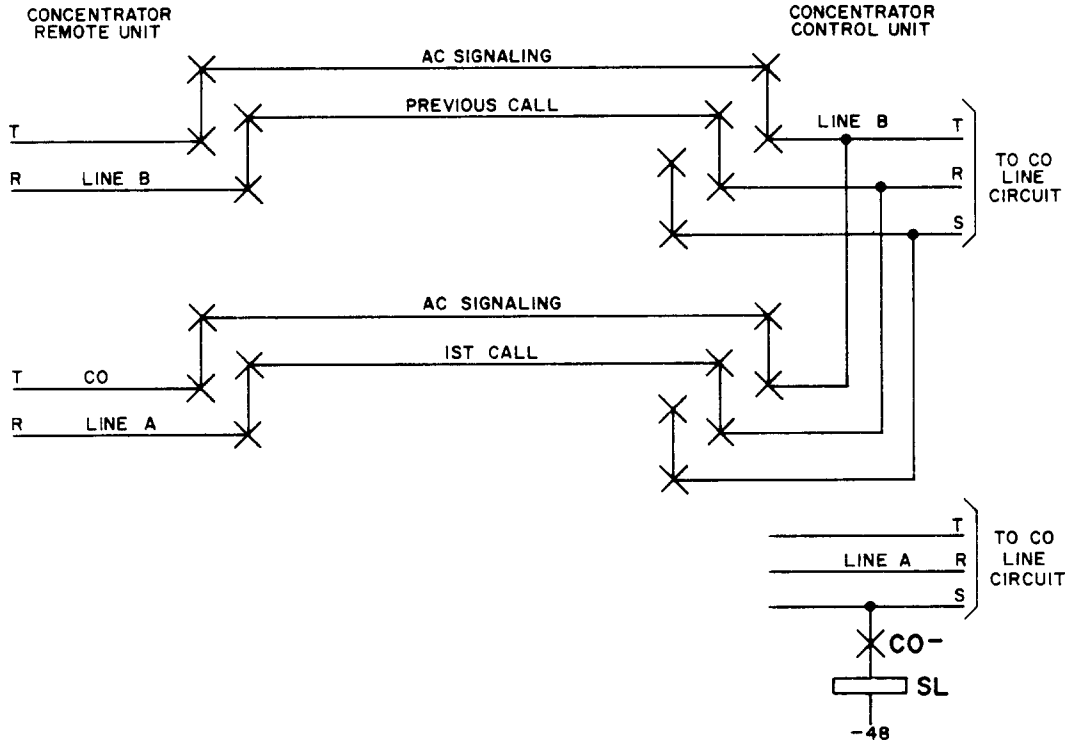
CONCENTRATOR
REMOTE UNIT
CONCENTRATOR
CONTROL UNIT
AC SIGNALING
PREVIOUS CALL
T
R
LINE B
LINE B
T
R
S
TO CO
LINE
CIRCUIT
AC SIGNALING
1ST CALL
T
CO
R
LINE A
T
LINE A
R
S
TO CO
LINE
CIRCUIT
CO-
SL
-48

Fig. 8

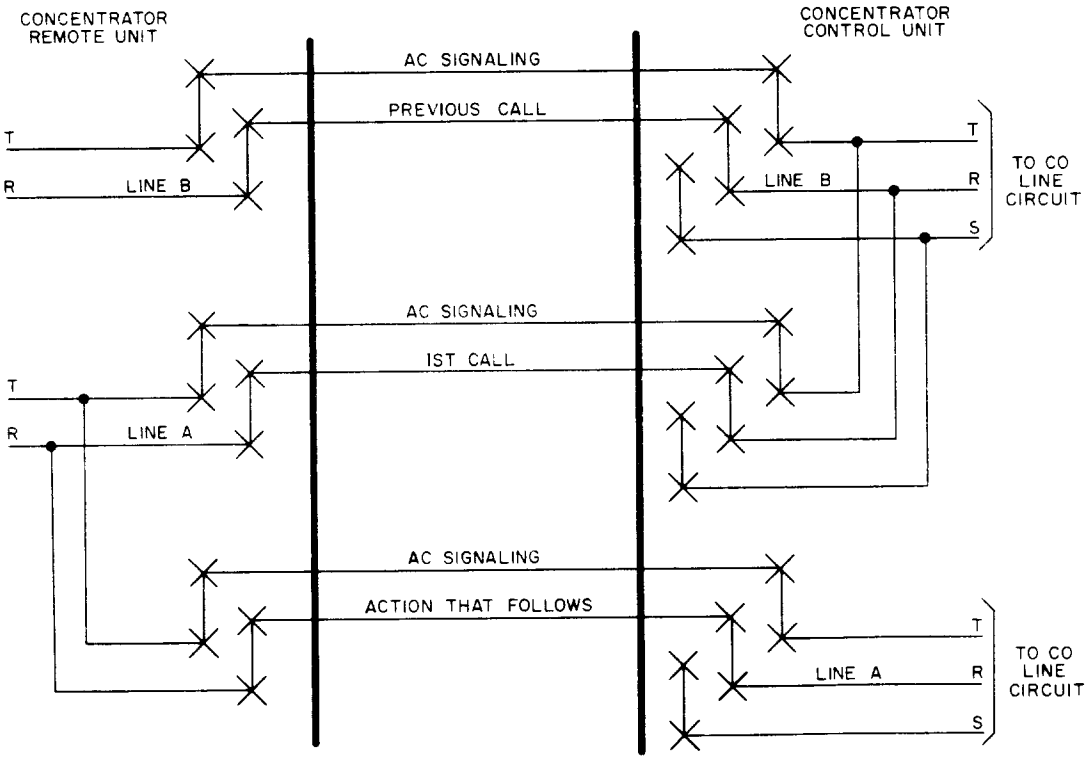
CONCENTRATOR
REMOTE UNIT
CONCENTRATOR
CONTROL UNIT
AC SIGNALING
PREVIOUS CALL
T
R
LINE B
T
LINE B
R
S
TO CO
LINE
CIRCUIT
AC SIGNALING
IST CALL
T
R
LINE A
AC SIGNALING
ACTION THAT FOLLOWS
T
LINE A
R
S
TO CO
LINE
CIRCUIT

Fig. 9

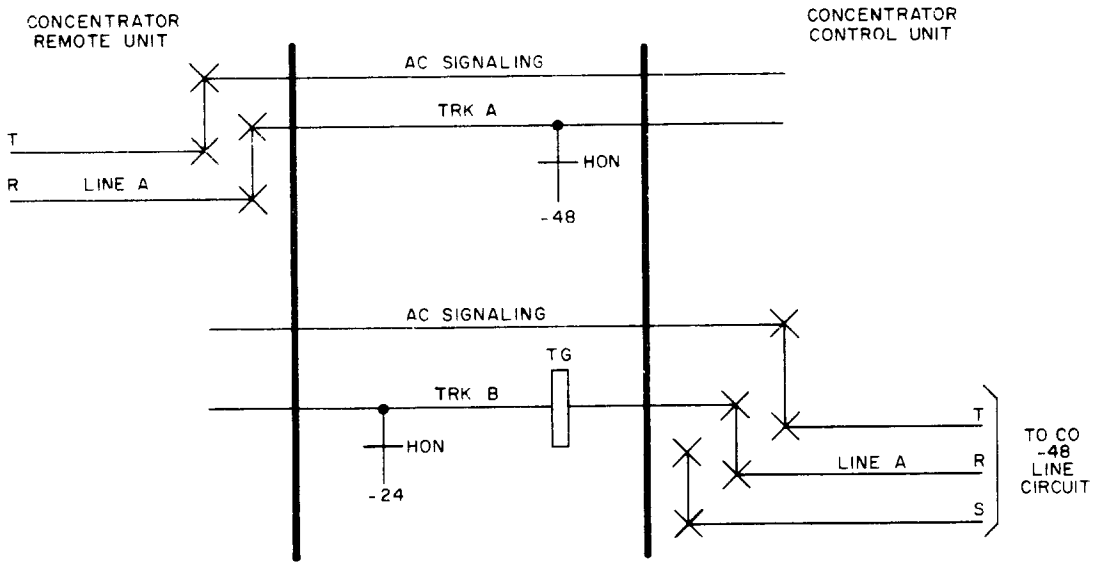
CONCENTRATOR
REMOTE UNIT
CONCENTRATOR
CONTROL UNIT
AC SIGNALING
TRK A
T
R
LINE A
HON
-48
AC SIGNALING
TG
TRK B
HON
-24
T
LINE A
R
S
TO CO
-48
LINE
CIRCUIT

Fig. 10

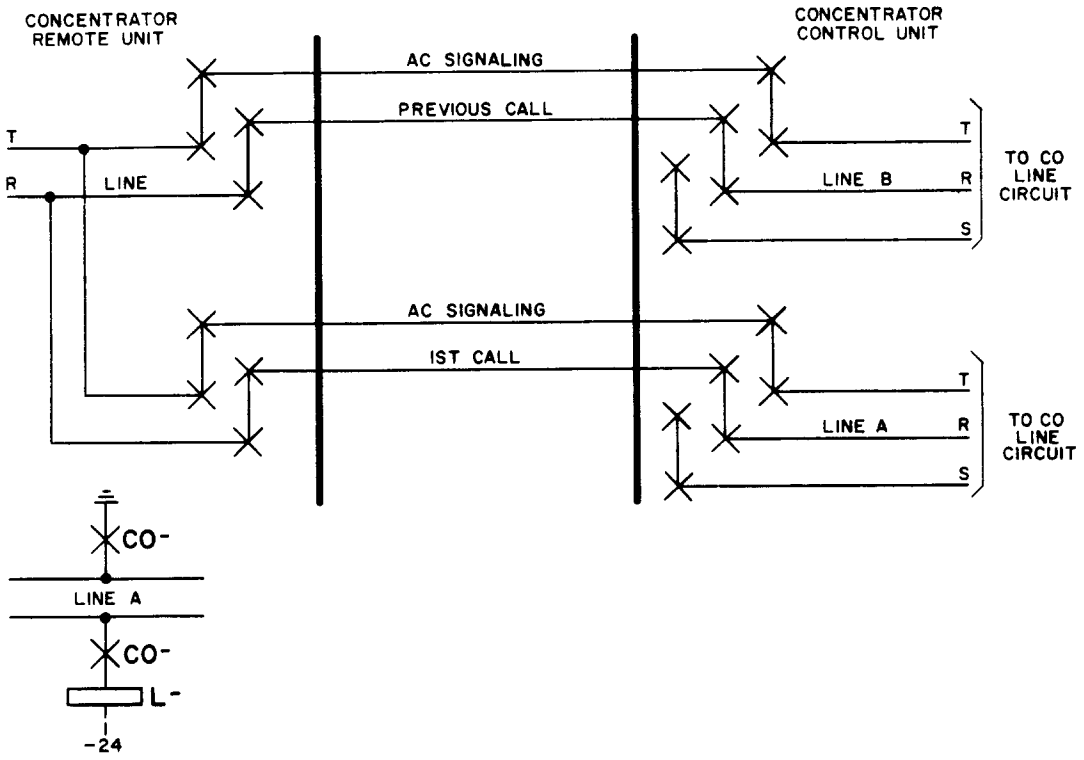
CONCENTRATOR
REMOTE UNIT
CONCENTRATOR
CONTROL UNIT
AC SIGNALING
PREVIOUS CALL
T
R
LINE
T
LINE B
R
S
TO CO
LINE
CIRCUIT
AC SIGNALING
IST CALL
T
LINE A
R
S
TO CO
LINE
CIRCUIT
CO-
LINE A
CO-
L-
-24

Fig. 11

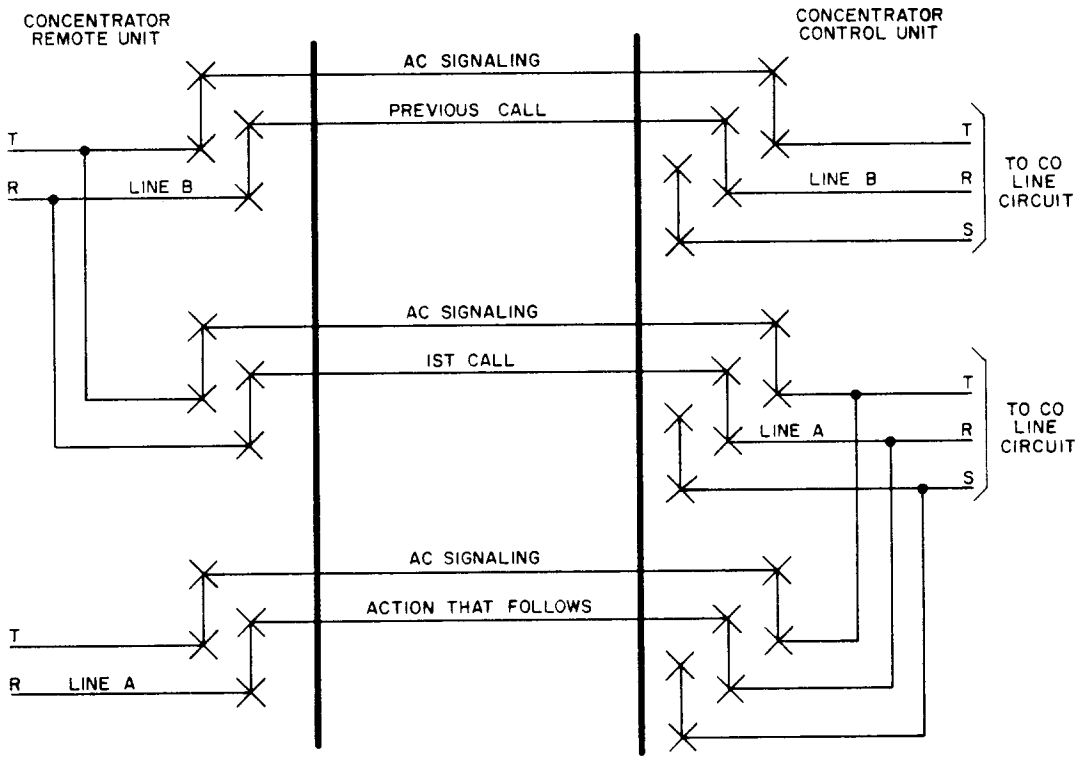
CONCENTRATOR
REMOTE UNIT
CONCENTRATOR
CONTROL UNIT
AC SIGNALING
PREVIOUS CALL
T
R
LINE B
T
LINE B
R
S
TO CO
LINE
CIRCUIT
AC SIGNALING
IST CALL
T
LINE A
R
S
TO CO
LINE
CIRCUIT
AC SIGNALING
ACTION THAT FOLLOWS
T
R
LINE A

Fig. 12

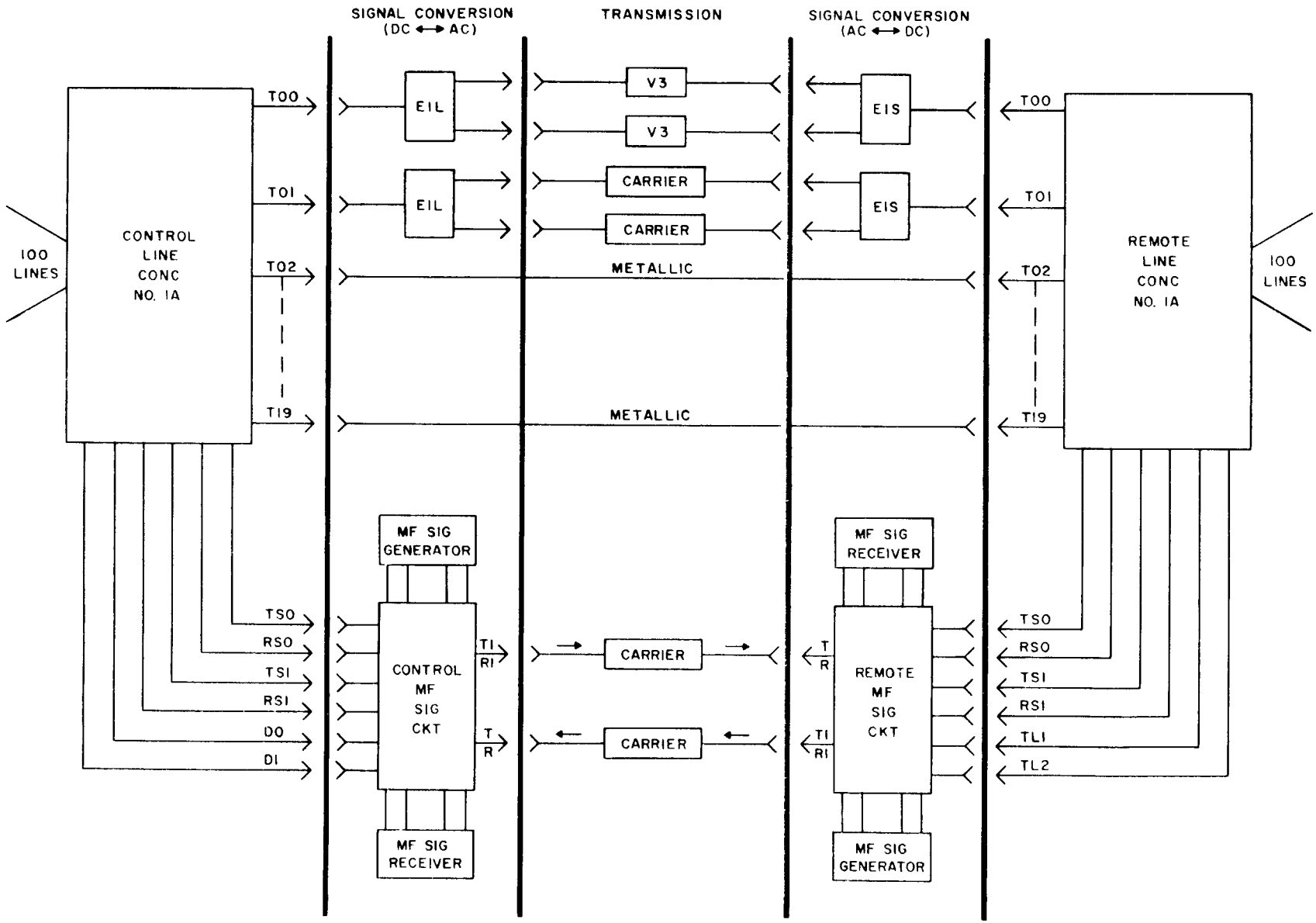

Fig. 13 – Illustrating Various Possible System Configurations

SHEET OF

LOOP-AROUND TRANSMISSION TESTS

ORIGINATING (NEAR) OFFICE: DATE:

TERMINATING (FAR) OFFICE: TIME:

TYPE OF TRUNK: TESTER:

TRUNK NUMBER	EXPECTED MEASURED LOSS DB	FAR-TO-NEAR DIRECTION		MEASURED LOOP-AROUND LOSS DB	MEASURED FAR-TO-NEAR LOSS OF REFERENCE TRUNK DB	NEAR-TO-FAR DIRECTION	
		ACTUAL MEASURED LOSS DB	DEVIATION (3) - (2) = (4) DB			ACTUAL MEASURED LOSS (5) - (6) = (7) DB	DEVIATION (7) - (2) = (8) DB
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

* USED AS REFERENCE TRUNK FOR NEAR-TO-FAR MEASUREMENTS.

** USED AS REFERENCE TRUNK FOR NEAR-TO-FAR MEASUREMENT OF ORIGINAL REFERENCE TRUNK.

Fig. 14

2. APPARATUS

2.01 The apparatus required for each test is shown in Table B. The details of each item are covered in the paragraph indicated by the number in parentheses.

TABLE B

APPARATUS	MAINTENANCE TESTS											OPERATIONAL TESTS											
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
KS-14510 Volt-Ohm-Milliammeter or Equivalent 20,000 Ohm-per-Volt Meter	1	1	1	1	1	1						1							1	1	1			1
21A Transmission Measuring Set																						1	1	
2AB Auxiliary Transmission Test Set																						1	2	
Hand Test Set Equipped With 309 Plug													1					1	1	1	1	1		1
Timing Test Set, J24753A (SD-25707-01)											1													
Cord (2.02)											1													
Cord (2.03)							1			1														
Cord (2.04)																						1	2	
Cord (2.05)																						2	2	
Cord (2.06)											1													
322 Plug																		2	2	2		2	2	
Blocking and Insulating Tools	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Test Leads (2.07)	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Dummy Fuse With Meter Connections (see Fig. 1)			1																					
Chart (see Fig. 5) (2.08)																							1	
1015A Spare Parts and Tool Kit	√	√	√	√	√	√	√		√	√	√	√	√			√	√	√	√	√	√	√	√	√

√ As required.

2.02 Testing cord, W3M cord, 6 feet long, equipped with one 310 plug at one end and one each of 360A, 360B, and 360C tools at the other end (3W4A cord assembly).

2.03 Two patching cords, P3E cord, 2 feet long, each equipped with two 310 plugs (3P7D cord assembly).

2.04 Two patching cords, P3N cord, 6 feet long, each equipped with one 310 plug and one 241A plug (3P17B cord assembly).

2.05 Two patching cords, P3D cord, 6 feet long, each equipped with two 309 plugs (3P3A cord assembly).

2.06 Patching cord, P3K cord, 6 feet long, equipped with two 310 plugs (3P15A cord assembly).

2.07 Blocking and insulating tools as required. Use tools and apply as covered in Section 069-020-801.

2.08 Chart for recording transmission measurements may be reproduced locally. See Fig. 14 and BSP section covering Trunk Transmission Testing Using Loop-Around Method.

3. PREPARATION

3.01 ***Precautions:*** The line concentrator No. 1A contains neutral and magnetic latching dry-reed relays, mercury relays, diodes, and magnetic latching crossbar switches in both the remote and control units. Detailed precautions are listed below.

(a) ***General:*** Do not make any adjustments to relays or crossbar switches without consulting the appropriate requirement and adjusting procedure section for the particular relay or switch.

(b) ***Dry-Reed Relay:*** The cut-off (CO-) relays in the concentrator control unit and the L- and cut-off CO- relays in the concentrator remote unit are of the 302 dry-reed type. Before testing on contacts of these relays or the circuits containing the contacts, refer to Section 040-275-301 covering Dry-Reed-Type Relays — Precautions to Be Observed When Testing. Contacts of reed relays may be damaged if test connections are made which cause these contacts to make or break at 1/2 ampere or more of current.

(c) ***Mercury Relays:*** The relays in series with the signaling leads in both the remote and control units of the concentrator and the MF signaling circuits are of the 303 mercury contact type. Before testing these relays or the circuits containing them, refer to Section 040-263-501 covering Relays 275, 276, 291, 292, 301, and 303 Types Using Test Sets SD-95439-01 (J94725A). These signaling relays may be permanently damaged if more than 60 ma of current is caused to flow through their windings.

(d) ***Magnetic Latching Crossbar Switches and Reed Relays:*** The hold magnets and cut-off relays in both concentrator units are magnetic latching. These switches or relays should not be operated or released electrically or manually during testing except by normal circuit operation or in strict accordance with approved procedures. Indiscriminate operation or release of these switches and relays will cause malfunctions in the system.

(e) ***Diodes:*** Before testing diodes or circuits containing the diodes, refer to Section 032-173-301 covering Procedures To Be Followed When Working on Circuits Containing Diodes, Varistors, or Transistors.

3.02 The battery in the concentrator remote unit does not have sufficient capacity to allow blocking a major portion of the apparatus used in making a call or blocking the TM1 timing circuits without proper safeguards. The recommended procedure is:

(a) Make repeated tests observing relay operation.

(b) Determine condition of W, Z, MC, and CC relays when operation stops.

(c) Determine condition of RK2 and CCK relays when operation stops.

(d) Localize trouble to the area limited by W, Z, MC, CC, RK2, and CCK relay operation on sequence charts (SCs).

(e) Pinpoint possible troubles on FS drawings.

(f) Check on equipment for troubles pinpointed above.

Note: Section 067-106-301 covering Line Concentrator No. 1A With MF Signaling, Trouble Analysis and Section 067-106-501 covering Line Concentrator No. 1A With MF Signaling, Preinstallation Tests, Tests and Inspections at Time of Installation, and Out-of-Service Tests may be used to assist in locating trouble experienced during application of this section.

STEP	ACTION	VERIFICATION

Test V

Note: The transmission level measurement portion of this test need be performed only if the trunk overflow tone is machine recognizable as in WADS applications. If this is not the case, proceed directly to Steps 9, 10, 11, 14, and 18 of Part 4, Test V.

21A Transmission Measuring Set

1a	If trunk overflow tone is machine recognizable — Connect power cord to 115-volt ac power supply and, if there is an associated test clip, connect it to building ground.	
2a	Operate 115-volt 60-cycle switch to ON position, allowing 10 minutes for warmup before use.	

2AB Auxiliary Transmission Test Set

3a	Set DIAL-SLV key to NORMAL.	
4a	Set 2DB PAD key to OUT.	
5a	Turn TEST switch to 900-ohm REC.	

Patching

6a	Patch DET IN 600-ohm jack of 21A TMS to TMS jack of 2AB AUX TTS with a 3P17B cord.	
7a	Patch one end of 3P3A cord to MEAS 309 jack of 2AB AUX TTS.	

Test W

Note: When these tests are made, information shall be recorded on a form similar to Fig. 14.

21A Transmission Measuring Set

1	Connect power cord to 115-volt ac power supply and, if there is an associated test clip, connect it to building ground.	
2	Operate 115-volt 60-cycle switch to ON position, allowing 10 minutes for warmup.	

STEP	ACTION	VERIFICATION
3	Turn FREQ MULT switch to X100 and FREQ scale setting to 10.0 for 1000-cycle output.	
4	Adjust both OSC OUTPUT controls to 0 in white or −dbm range.	
	First 2AB Auxiliary Transmission Test Set (sending)	
5	Set DIAL-SLV key to NORMAL.	
6	Set 2DB PAD key to OUT.	
7	Turn TEST switch to 900-ohm SEND.	
	Second 2AB Auxiliary Transmission Test Set (receiving)	
8	Repeat Steps 5, 6.	
9	Turn TEST switch to 900-ohm REC.	
	Patching	
10	With 3P17B cord, connect OSC OUT 600-ohm jacks of 21A TMS to OSC jack of first (sending) 2AB AUX TTS.	
11	Place one end of 3P3A cord into MEAS 309 jack of first 2AB AUX TTS and designate this cord as "send cord."	
12	With second 3P17B cord, connect DET IN 600-ohm jacks of the 21A TMS to the TMS jack of second (receiving) 2AB AUX TTS.	
13	Place one end of second 3P3A cord into MEAS 309 jack of second 2AB AUX TTS and designate this cord as "receive cord."	

4. METHOD

STEP	ACTION	VERIFICATION
MAINTENANCE TESTS		
	A. Measuring Battery Volage at Remote Concentrator	
	Note: Test under load if possible.	
1a	If concentrator battery is used — Remove CHG fuse.	
2b	If concentrator battery is not used — Tests A, B, and C need not be made.	
3	Place volt-ohm-milliammeter across battery terminals and measure voltage.	23 volts minimum.
4	Replace CHG fuse.	

STEP	ACTION	VERIFICATION

B. Battery Replacement at Remote Concentrator

Note: See Section 167-285-301 covering Line Concentrator No. 1A — Battery Supply.

1	Tie replacement battery to equipment in a position to allow removal of existing battery and rapid transfer of leads.	
2	At concentrator control unit — Block operated RL2 relay.	
3	At concentrator remote unit — Transfer battery lead from existing battery to replacement.	
4	At concentrator control unit — Remove blocking tool from RL2 relay.	
5	At concentrator remote unit — Remove existing battery, install replacement.	
6	Perform Test A.	

C. Battery Charging Current at Remote Concentrator

Note 1: The battery will not obtain a charge while the charge (CHG) fuse is out of the fuse holder.

Note 2: Use CC potentiometer to adjust charging current per SD-96557-01.

Note 3: The current measuring capacity of the KS-14510 VOM is 120 ma. If a higher range meter is not available, the following procedure may be used: (1) connect a 1-ohm (106A, 107A, 145A, or 146A) resistor across the leads of the KS-14510 VOM; (2) set meter scale to 0.3 volt dc; (3) adjust strapping for 0.14 volt dc strapped.

1a	If concentrator battery is used — Measure charging current by inserting dummy fuse (see Fig. 1) into CHG fuse position to measure current.	Charging current near 140 ma in 100-line unit or 80 ma in 50-line unit but not to exceed 140 ma in either case.

D. Ground Return Resistance — Control and Remote Ends

Note: This test is to be made at both the remote and control ends of the system. If the concentrator unit and its associated MF signaling circuit are located in the same office, this test need not be made.

1	Measure ground return resistance following procedure specified in Fig. 2.	Ground return resistance not more than 23 ohms.

E. Insulation Resistance of Signaling Leads — Control and Remote Ends

Note: If concentrator and MF signaling circuit appear on same distribution frame and their terminal strips are directly cross connected, this test need not be made.

Caution: This test will make the concentrator inoperative; therefore, close cooperation between personnel is necessary to keep out-of-service time to a minimum when this test is performed.

1	Measure insulation resistance of signaling leads following procedure specified in Fig. 3.	Minimum insulation resistance of 30,000 ohms to ground or other conductor pair.

STEP	ACTION	VERIFICATION

F. Interference on Signaling Leads — Control and Remote Ends

Note: The ac interference should be below limits at all times; therefore, sufficient tests should be made to ensure that the limits are met during all intervals of the day if troubles occurring appear to be due to ac interference (signaling troubles during certain intervals of the day). If random troubles are occurring which might be due to ac interference, a recording voltmeter can be used to determine whether ac interference is exceeding the limits during random intervals. Seasonal variations in ac power loads may change ac interference on signaling leads. It may be desirable to place ac filters on systems not so equipped.

1	Measure total interference (ac + dc) on signaling leads, following procedure specified in Fig. 4.	AC interference shall not exceed limits of Table C.

TABLE C — SIGNALING LEAD INTERFERENCE LIMITS

For Systems Without 60-Cycle Filters on Signal Leads in Control and Remote Units		For Systems Equipped With 60-Cycle Filters on Signal Leads in Control and Remote Units	
WHEN DC INTERFERENCE IS	AC INTERFERENCE MAY NOT EXCEED	WHEN DC INTERFERENCE IS	AC INTERFERENCE MAY NOT EXCEED
10 Volts	0 Volts RMS	10 Volts	0 Volts RMS
9.5	0.4	9.5	1.4
9.0	0.7	9.0	2.9
8.5	1.1	8.5	4.3
8.0	1.4	8.0	5.7
7.5	1.8	7.5	7.1
7.0	2.1	7.0	8.6
6.5	2.5	6.5	10.0
6.0	2.8	6.0	11.4
5.5	3.2	5.5	12.8
5.0	3.6	5.0	14.3
4.5	3.9	4.5	15.7
4.0	4.3	4.0	17.2
3.5	4.6	3.5	18.6
3.0 or less	5.0	3.0 or less	20.0

Note 1: The ac voltage component must be 5 volts rms or less on systems not equipped with 60-cycle filters on ***each*** end. Systems equipped with these ac filters (SD-96536-01, Fig. 11, control unit; SD-95957-01, Option V, 50-line remote unit; SD-96537-01, Fig. 8, 100-line remote unit) at each end will tolerate up to 20 volts rms ac interference. If these limits are exceeded, it will be necessary to supply signal battery and ground to the MF signaling circuit from its associated concentrator unit.

STEP	ACTION	VERIFICATION
	G. DC-to-MF Conversion in MF Signaling Circuit — Control and Remote Ends	
Control End		
1	At concentrator control unit — Block operated RL2, TM1, SB2 relays.	
2	Block nonoperated M, W1 relays.	
3	At MF signaling control circuit — Remove ABC relay from socket.	
4	Connect J5 jack to J7 jack using 3P7D cord.	At MF signaling control circuit — R2, R4 relays release.
5	Insulate 1M, 2M contacts of MC1 relay.	
6	Block nonoperated MC2 relay.	
7	Block operated MC1, MC3 relays.	T6 relay operates.
8	Operate RLSA relay momentarily.	All relays release.
9	Block operated R0, R1 relays.	T1 relay operates.
10	Remove blocking tools from R0, R1 relays.	R0, R1 relays remain operated.
11	Operate RLSA relay momentarily.	All relays release.
12	Block operated R0, R2 relays.	T2 relay operates.
13	Remove blocking tools from R0, R2 relays.	R0, R2 relays remain operated.
14	Operate RLSA relay momentarily.	All relays release.
15	Block operated R1, R2 relays.	T3 relay operates.
16	Remove blocking tools from R1, R2 relays.	R1, R2 relays remain operated.
17	Operate RLSA relay momentarily.	All relays release.
18	Block operated R0, R4 relays.	T4 relay operates.
19	Remove blocking tools from R0, R4 relays.	R0, R4 relays remain operated.
20	Operate RLSA relay momentarily.	All relays release.
21	Block operated R4, R7 relays.	T5 relay operates.
22	Remove blocking tools from R4, R7 relays.	R4, R7 relays remain operated.
23	Operate RLSA relay momentarily.	All relays release.
24	Block operated R2, R4 relays.	T6 relay operates.
25	Remove blocking tools from R2, R4 relays.	R2, R4 relays remain operated.
26	Operate RLSA relay momentarily.	All relays release.
27	Block operated R0, R7 relays.	T7 relay operates.
28	Remove blocking tools from R0, R7 relays.	R0, R7 relays remain operated.
29	Operate RLSA relay momentarily.	All relays release.
30	Block operated R1, R7 relays.	T8 relay operates.
31	Remove blocking tools from R1, R7 relays.	R1, R7 relays remain operated.

STEP	ACTION	VERIFICATION
32	Operate RLSA relay momentarily.	All relays release.
33	At control concentrator — Remove blocking tool from M relay.	
34	Block operated M relay.	R2, R7 relays operate.
35	Remove blocking tool from M, W1 relays.	All relays release.
36	At control MF signaling circuit — Block nonoperated S2A, S4A relays.	
37	At control concentrator — Operate RR1 relay momentarily.	R0, R10 relays operate momentarily.
38	At control MF signaling circuit — Operate RLSA relay momentarily.	All relays release.
39	Remove blocking tools from S2A, S4A relays.	
40	Operate momentarily, release by hand RL1 relay.	R1, R10 relays operate momentarily.
41	Block operated RLSA relay.	
42	Remove blocking tools from MC1, MC2, MC3 relays.	
43	Remove insulators from MC1 relay.	
44	Remove 3P7D cord from J5, J7 jacks.	
45	At concentrator control unit — Remove blocking tool from SB2 relay.	
46	At MF signaling control circuit — Remove blocking tool from RLSA relay.	R2, R4, S2A, S4A relays operate. At concentrator control unit — S2A, S4A relays operate. No other wire-spring relays should operate.
47	Replace ABC relay in socket.	
48	At concentrator control unit — Remove blocking tools from TM1, RL2 relays.	TM1 relay remains operated if S option provided.
Remote End		
49	At concentrator control unit — Block operated RL2, TM1 relays.	
50	At MF signaling control circuit — Remove ABC relay from socket.	
51	At MF signaling remote circuit — Block operated RL relay.	At MF signaling remote circuit — All other relays release.
52	At remote concentrator — Block operated RRA relay.	
53	At remote MF signaling circuit — Insulate 6B, 8B contacts of CC3 relay.	

STEP	ACTION	VERIFICATION
54	Block nonoperated CC3 relay.	
55	Connect J5 jack to J7 jack using 3P7D cord.	
56	Block operated R0, R1 relays.	
57	Remove blocking tool from RL relay.	T1 relay operates.
58	Remove blocking tool from R0, R1 relays.	R0, R1 relays remain operated.
59	Block operated RL relay.	All relays release.
60	Block operated R0, R2 relays.	
61	Remove blocking tool from RL relay.	T2 relay operates.
62	Remove blocking tool from R0, R2 relays.	R0, R2 relays remain operated.
63	Block operated RL relay.	All relays release.
64	Block operated R1, R2 relays.	
65	Remove blocking tool from RL relay.	T3 relay operates.
66	Remove blocking tool from R1, R2 relays.	R1, R2 relays remain operated.
67	Block operated RL relay.	All relays release.
68	Block operated R0, R4 relays.	
69	Remove blocking tool from RL relay.	T4 relay operates.
70	Remove blocking tool from R0, R4 relays.	R0, R4 relays remain operated.
71	Block operated RL relay.	All relays release.
72	Block operated R4, R7 relays.	
73	Remove blocking tool from RL relay.	T5 relay operates.
74	Remove blocking tool from R4, R7 relays.	R4, R7 relays remain operated.
75	Block operated RL relay.	All relays release.
76	Block operated R2, R4 relays.	
77	Remove blocking tool from RL relay.	T6 relay operates.
78	Remove blocking tool from R2, R4 relays.	R2, R4 relays remain operated.
79	Block operated RL relay.	All relays release.
80	Block operated R0, R7 relays.	
81	Remove blocking tool from RL relay.	T7 relay operates.
82	Remove blocking tool from R0, R7 relays.	R0, R7 relays remain operated.
83	Block operated RL relay.	All relays release.
84	Block operated R1, R7 relays.	
85	Remove blocking tool from RL relay.	T8 relay operates.
86	Remove blocking tool from R1, R7 relays.	R1, R7 relays remain operated.
87	Block operated RL relay.	All relays release.

STEP	ACTION	VERIFICATION
88	At remote concentrator — Block operated CK relay.	At remote MF signaling circuit — R1, R10 relays operate.
89	Remove blocking tool from CK relay.	All relays release.
90	At remote MF signaling circuit — Remove 3P7D cord from J5, J7 jacks.	
91	At concentrator remote unit — Remove blocking tool from RRA relay, release relay manually.	
92	At MF signaling remote circuit — Remove insulators from 6B, 8B contacts of CC3 relay.	
93	Remove blocking tool from CC3 relay.	
94	Remove blocking tool from RL relay.	S2A, S4A, T6, GBA relays operate. At MF signaling control circuit — R2, R4 relays operate.
95	At MF signaling control circuit — Replace ABC relay in socket.	
96	At concentrator control unit — Remove blocking tools from TM1, RL2 relays.	

H. Mark Counting in MF Signaling Circuit — Control End

1	At control concentrator — Block operated RL2, TM1 relays.	
2	Block nonoperated W1 relay.	
3	At control MF signaling circuit — Remove ABC, S2, S4 relays.	At control MF signaling circuit — S2A, S4A relays release.
4	Block nonoperated T9, T10 relays.	
5	At control concentrator — Operate M relay momentarily.	MC1, MC2 relays operate.
6	At control MF signaling circuit — Operate RLSA relay momentarily.	All relays release.
7	At control concentrator — Operate M relay four times momentarily.	MC1, MC3 relays operate. MC2 relay releases.
8	At control MF signaling circuit — Operate RLSA relay momentarily.	All relays release.
9	At control concentrator — Operate RR1 relay momentarily.	MC1, MC3 relays operate.
10	At control MF signaling circuit — Operate RLSA relay momentarily.	All relays release.
11	Remove blocking tools from T9, T10 relays.	
12	Replace ABC, S2, S4 relays.	S2A, S4A relays operate.

STEP	ACTION	VERIFICATION
13	At control concentrator — Remove blocking tools from TM1, W1, RL2 relays.	

I. Check Counting in MF Signaling Circuit — Remote End

1	At control concentrator — Block operated RL2, TM1 relays.	
2	At control MF signaling circuit — Remove ABC relay.	
3	At remote MF signaling circuit — Block nonoperated T11 relay.	
4	Remove S2, S4 relays.	At remote MF signaling circuit — T6 relay releases. S2A, S4A relays release.
5	At remote concentrator — Operate HMK relay momentarily.	CC1, CC2 relays operate.
6	At remote MF signaling circuit — Operate RL relay momentarily.	All relays release.
7	At remote concentrator — Operate HMK relay four times momentarily.	CC3 relay operates.
8	At remote MF signaling circuit — Operate RL relay momentarily.	All relays release.
9	Operate RR relay momentarily.	CC3 relay operates.
10	Operate RL relay momentarily.	All relays release.
11	Replace S2, S4 relays.	S2A, S4A relays operate.
12	Remove blocking tool from T11 relay.	
13	At control MF signaling circuit — Replace ABC relay.	
14	At control concentrator — Remove blocking tools from TM1, RL2 relays.	

J. Test Circuit — Control and Remote Ends

Control End

1	At control concentrator — Block operated RL2, TM1 relays.	
2	At control MF signaling circuit — Remove ABC relay.	
3	Connect J5 jack to J7 jack using 3D7D cord.	At control MF signaling circuit — S2A, S4A relays release.

STEP	ACTION	VERIFICATION
4	Operate TEST key to L49 position.	TEST lamp lights. No test call is originated.
5	Return TEST key to neutral position.	TEST lamp extinguishes.
6	Block nonoperated AC relay. *Note:* Steps 7, 8, 9, 10 may be repeated as many times as necessary for verification of momentary relay operations.	
7	Operate TEST key to L49 position.	R2, R10 relays operate momentarily. TR1 relay operates.
8	Restore TEST key to neutral position.	R2, R10 relays operate momentarily. TR1 relay releases.
9	Operate TEST key to L99 position.	R4, R10 relays operate momentarily. TR2 relay operates.
10	Restore TEST key to neutral position.	R2, R10 relays operate momentarily. TR2 relay releases.
11	Remove blocking tool from AC relay.	
12	Remove 3P7D cord from J5, J7 jacks.	S2A, S4A relays operate.
13	Replace ABC relay in socket.	
14	At control concentrator — Remove blocking tool from TM1, RL2 relays.	

Remote End

15	At remote MF signaling circuit — Insulate 4M contact of CL49 relay.	
16	Insulate 4M contact of CL99 relay.	
17	Block operated R2, R10 relays.	TT1, DL relays operate. CL49 relay operates momentarily.
18	Remove blocking tools from R2, R10 relays.	TT1, DL relays release.
19	Block operated R4, R10 relays.	TT2, CL99 relays operate.
20	Remove blocking tools from R4, R10 relays.	TT2 relay releases.
21	Operate DL relay momentarily.	CL99 relay releases.
22	Remove insulation from CL49, CL99 relays.	

K. Timing in MF Signaling Circuits — Control and Remote Ends

1	Perform all timing tests per SD-95971-01, SD-95972-01, timing requirements tables.	Requirements of table are met.

STEP	ACTION	VERIFICATION
	L. Line Insulation — Remote End	
	Caution: Be sure no potential appears across tip and ring terminals before connecting ohmmeter.	
	Note: This test may be omitted if customer facilities between remote concentrator and customer are the same as those used before concentrator installation and are trouble free.	
1	At remote concentrator unit cross connecting terminal — Measure assigned customer line insulation with ohmmeter by connecting ohmmeter across tip and ring terminals.	Minimum insulation resistance 15,000 ohms.
	M. Alarm Circuits	
1	At control concentrator unit — Block nonoperated CCK relay.	
2	At remote concentrator unit — Initiate call.	At control concentrator unit — CAL alarm relay operates. AL lamp lights. At central office — Alarms operate.
3	At control concentrator unit — Remove blocking tool from CCK relay.	
4	Operate AR (alarm release) key.	At control concentrator unit — CAL relay releases. AL lamp extinguished. At central office — Alarms retired.
5	Block nonoperated RK2 relay.	
6	At remote concentrator unit — Initiate call.	At control concentrator unit — RAL alarm relay operates. AL lamp lights. At central office — Alarms operate.
7	At control concentrator unit — Remove blocking tool from RK2 relay.	
8	Operate AR key.	At control concentrator unit — RAL relay releases. AL lamp extinguished. At central office — Alarms retired.
9	Block nonoperated CCK, RK2 relays.	
10	At remote concentrator unit — Initiate call.	At control concentrator unit — SAL alarm relay operates. AL lamp lights. At central office — Alarms operate.

STEP	ACTION	VERIFICATION
11	At control concentrator unit — Remove blocking tool from CCK, RK2 relays.	
12	Operate AR key.	At control concentrator unit — SAL relay releases. AL lamp extinguished. At central office — Alarms retired.
13	Block operated CCK, RK2 relays.	
14	At remote concentrator unit — Initiate call.	At control concentrator unit — SAL relay operates. AL lamp lights. At central office — Alarms operate.
15	At control concentrator unit — Remove blocking tools from CCK, RK2 relays.	
16	Operate AR key.	At control concentrator unit — SAL relay releases. AL lamp extinguished. At central office — Alarms retired.
17	Block nonoperated S2A relay.	
18	At remote concentrator unit — Initiate call. ***Note:*** When S option is provided, a call should not be initiated since it is unnecessary.	At control concentrator unit — SAL relay operates. AL lamp lights. At central office — Alarms operate.
19	At control concentrator unit — Remove blocking tool from S2A relay.	
20	Operate AR key.	At control concentrator unit — SAL relay releases. AL lamp extinguished. At central office — Alarms retired.
21	Repeat Steps 17 through 20 for S4A relay observing S option caution.	Same as Steps 17 through 20.
22	At control concentrator unit — Insert and remove operated fuse in each fuse location. ***Note:*** After each removal of operated fuse, AR key must be operated to retire alarms and extinguish FA lamp.	At control concentrator unit — FA alarm relay operates for each insertion of fuse. FA lamp lights. At central office — Alarms operate.

STEP	ACTION	VERIFICATION
23	At remote concentrator unit — Insert operated fuse into CHG fuse holder.	At remote concentrator unit — CF relay operates. FA lamp lights. At remote central office — Alarms operate.
24	Remove operated fuse from CHG position and replace with original fuse.	At remote concentrator unit — CF relay releases. FA lamp extinguishes. At remote central office — Alarms retire.
25	Insert and remove operated fuse in each fuse location, one at a time, except at CHG, M fuse positions. ***Note:*** After removing operated fuse, replace the original fuse. This will cause the FAL relay to release, FA lamp to extinguish, and alarms to retire. If alarms do not retire, follow local procedures to achieve this.	FAL relay operates for each insertion of fuse. FA lamp lights. At remote central office — Alarms operate.

N. Dial Tone Speed Register

Note: The dial tone speed register circuit must be started when this test is performed. Also, since one terminal on an arc of the dial tone speed register is assigned to each group of trunks of the control circuit, and the dial tone register circuit will test many terminals not associated with the concentrator and other arcs during one cycle of testing, it will be necessary to cause the dial tone speed register circuit to make a cycle for each step shown below.

1	Insulate 8B of TGB0 relay in control unit.	One registration on the dial tone delay and dial tone attempt register associated with Group 0 when dial tone speed register circuit is testing the associated arc and terminal.
2	Remove insulation from TGB0 relay. (TGB0 relay should not be operated.)	One registration on the dial tone attempt register associated with Group 0 when dial tone speed register circuit is testing the associated arc and terminal.
3	Insulate 8B of TGB1 relay in control circuit.	Verification will be same as Step 1 except the registers, arc, and terminal will be associated with Group 1.
4	Remove insulation from TGB1 relay. (TGB1 relay should not be operated.)	Verification will be same as Step 2; however, the registers, arc, and terminal will be associated with Group 1.

O. Trunk Group Usage Recorder

Note: For procedures to follow when performing Test O, refer to BSP Section entitled Concentrator Trunk Usage Recorder (SD-96549-01) Miscellaneous Tests.

STEP	ACTION	VERIFICATION
	P. Service Denial Call	
1	At concentrator control unit — Cross connect terminal A69 of concentrator terminal block to terminal 3 of CO- relay associated with line to be denied service.	
2a	In crossbar offices — When a line is to be denied — Insulate contact on D1S- relay associated with line (SD-96536-01, Sheet B2, Table A). In step-by-step offices — Proceed to Step 3.	
3	Block released SRP0, SRP1, DP0, and DP1 relays.	
4	Operate, hold operated T0 or T1 key depending on group line is in. ***Caution: Do not operate the T0 or T1 key while a call is in progress.***	Observe SL relay of the line to be denied service to ensure that it operates and releases and COK lamp lights. If SL relay does not release, observe which A and B relays are operated and determine from the chart on Sheet B2 of SD-96536-01 which line attempted to place a terminating call and was denied service. In most cases when the T0 or T1 key is released, the terminating call will complete since ringing is not tripped and, when the call is disconnected, the service denied condition will be removed. However, if a terminating call is not completed (observation of cross-points will determine if a call is completed), it will be necessary to remove the wrong service denied condition.
5	Release T0 or T1 key, immediately block nonoperated SL- relay of line involved.	
6	Remove blocking tool from SRP0, SRP1, DP0, and DP1 relays.	
7	Open sleeve lead between concentrator control unit and central office equipment.	
8	Remove insulation on D1S- relay and cross connection between terminal A69 and CO- relay. Remove blocking tool from SL- relay.	
9	When service is to be restored, close sleeve lead between concentrator control unit and central office and then make a terminating call to customer.	

STEP	ACTION	VERIFICATION
	Q. Service Denial Under Permanent Signal Conditions	
1	At concentrator control unit — Cross connect terminal A69 of concentrator terminal block to terminal 3 of CO- relay associated with line to be denied service.	
2a	In crossbar offices — When a line is to be denied — Insulate contact on D1S- relay associated with line (SD-96536-01, Sheet B2, Table A. In step-by-step offices — Proceed to Step 3.	
3	Block released SRP0, SRP1, DP0, and DP1 relays.	
4	Release TB- relay for trunk connected to line to be denied service, remove blocking tool from appropriate DP relay.	
5	If trunk did not release in Step 4, operate appropriate DP0 or DP1 relay.	
6	Block nonoperated DP- relay used in Step 5.	
7	Operate, hold operated T0 or T1 key depending on group line is in. ***Caution: Do not operate T0 or T1 key while a call is in progress.***	Observe that SL- relay of line to be denied service operates and releases and COK lamp lights.
8	Release T0 or T1 key, immediately block nonoperated SL- relay of line involved.	
9	Remove blocking tool from SRP0, SRP1, DP0, and DP1 relays.	
10	Open sleeve lead between concentrator control unit and central office equipment.	
11	Remove insulation on D1S- relay and cross-connection between terminal A69 and CO- relay.	
12	Remove blocking tool from SL- relay.	
13	When service is to be restored — Close sleeve lead between concentrator control unit and central office, then make a terminating call to customer.	

STEP	ACTION	VERIFICATION

OPERATIONAL TESTS

R. Test Lines

Note: These tests indicate that the concentrator system is capable of completing a call on one line in each group and can be used to test that connections can be made on each trunk. Other lines can be failing and, unless the concentrator remote unit is observed, these tests would not indicate false operations of the remote concentrator or MF signaling circuits. Furthermore, one test call may not be sufficient to find the trouble since the failure of contact closure of one set of cross-points would only give trouble reports when the associated trunk was used on a call. Also, the failure of one trunk would only be found when this trunk was selected. In the latter case, originating or terminating denied service reports should be received from all customers in the group.

Service Request Call

1	At concentrator control unit — Operate G key to G0 position for 100-line remote concentrator or for 50-line remote concentrator used as Group 0.	
2	Insert hand test set equipped with 309-type plug into line jack 49.	
3	Operate TL0 key to ON position.	Observe that a service request call is made. Verify presence of test tone in hand test set.
4	Return TL0 key to OFF position.	Observe that disconnect call is made and associated hold magnet and cross-points release.
5	Block operated A, C hold magnets used on previous call or calls.	
6	Repeat Steps 3 through 5 until calls are made on all trunks of Group 0.	Same as Steps 3 through 5.

Caution: Since trunks should be available for service calls, remove blocking tools if all trunks in group being tested become busy.

Note: It may be necessary to operate DP0 relay to cause unused trunks to release because of trunk load control feature.

7	Remove all blocking tools from hold magnets.	
8	Remove hand test set from line jack 49.	
9	Operate G key to G0 position for 100-line remote concentrator and to G1 position for 50-line remote concentrator used as Group 1.	
10	Insert hand test set equipped with 309-type plug in line jack 99.	
11	Operate TL1 key to ON position for 100-line remote concentrator, operate TL0 key to ON position for 50-line remote concentrator used as Group 1.	Observe that service request call is made. Verify presence of test tone in hand test set.

STEP	ACTION	VERIFICATION
12	Return TL- key to OFF position.	Observe that a disconnect call is made and associated hold magnet and cross-points release.
	Note: It may be necessary to operate the DP1 relay to cause trunk release.	
13	Block operated A, C hold magnets used on previous call or calls.	
14	Repeat Steps 11 through 13 until calls are made on all trunks of Group 1.	Same as Steps 11 through 13.
	Caution: Since trunks should be available for service calls, remove blocking tools if all trunks in group being tested become busy.	
15	Remove all blocking tools from hold magnets.	
16	Remove hand test set from line jack 99.	
17	Return G key to neutral position.	
Terminating Call		
18	At control concentrator — Operate G key to G0 position for 100-line remote concentrator or for 50-line remote concentrator used as Group 0.	
19	Insert hand test set equipped with 309-type plug in line jack 49.	
20	Insert 322-type plug in sleeve jack for line 49.	Observe that a terminating call is made.
21	Operate TL0 key to ON position.	Verify presence of test tone in hand test set.
22	Return TL0 key to OFF position.	
23	Remove plug from sleeve jack 49.	Observe that a disconnect call is made and that the associated hold magnet and cross-points release.
	Note: It may be necessary to operate the DP0 relay to cause trunk release.	
24	Block operated A, C hold magnets used on previous call or calls.	
25	Repeat Steps 3 through 7 until calls are made on all trunks of Group 0.	Same as Steps 3 through 7.
	Caution: Since trunks should be available for service, remove blocking tools if all trunks in group being tested become busy.	
	Note: It may be necessary to operate DP0 relay to cause unused trunks to release because of trunk load control feature.	
26	Remove all blocking tools from hold magnets.	
27	Remove hand test set from line jack 49.	

STEP	ACTION	VERIFICATION
28	Operate G key to G0 position for 100-line remote concentrator and to G1 position for 50-line remote concentrator used as Group 1.	
29	Insert hand test set equipped with 309-type plug in line jack 99.	
30	Insert 322-type plug. in sleeve jack for line 99.	Observe that a terminating call is made.
31	Operate TL1 key to ON position for 100-line remote concentrator, operate TL0 key to ON position for 50-line remote concentrator used as Group 1.	Verify presence of 1000-cycle test tone in hand test set.
32	Return TL- key to OFF position.	
33	Remove plug from sleeve jack 99.	Observe that disconnect call is made and that associated hold magnet and cross-points release.
	Note: It may be necessary to operate DP1 relay to cause trunk release.	
34	Block operated A, C hold magnets used on previous call or calls.	
35	Repeat Steps 30 through 34 until calls are made on all trunks of Group 1.	Same as Steps 30 through 34.
	Caution: Since trunks should be available for service calls, remove blocking tools if all trunks in group being tested become busy.	
	Note: It may be necessary to operate DP1 relay to cause unused trunks to release because of trunk load control feature.	
36	Remove all blocking tools from hold magnets.	
37	Remove hand test set from line jack 99.	
38	Return G key to neutral position.	
	S. Service Request Call	
1	Place an off-hook signal on line to be tested using hand test set.	Dial tone should be heard unless all trunks are busy. If no dial tone is heard, wait until a trunk becomes available.
2	Measure voltage drop across 2 and 3, 4 and 5 contacts of associated CO- relays in both control, remote concentrator circuits.	A voltage drop across these contacts indicates that they are open.
	Note: When double connections or denied service reports have been received, it may be necessary to check other CO- relays.	
3	Determine that correct cross-points have closed.	Observe that line used on test call is connected to same trunk in remote and control circuits.
4	Break dial tone (dial a digit).	Call should remain connected with TB- relay operated.

STEP	ACTION	VERIFICATION
5	Replace the off-hook signal with an on-hook signal.	TB- relay should release and call should disconnect within 6 to 8 seconds. ***Note:*** It may be necessary to operate the associated DP- relay due to the trunk load control feature.
6	Check that correct cross-points release.	
7	Measure voltage drop across 2 and 3, 4 and 5 contacts of associated CO- relays in the remote and control concentrator circuits. ***Note 1:*** When double connections or denied service reports have been received, it may be necessary to check other CO- relays. ***Note 2:*** No alarms should be received during test.	No voltage drop across these contacts indicates that they are closed.

T. Terminating Call

1	Ground sleeve lead on control concentrator distributing frame terminal strip. ***Caution: In crossbar offices, it will be necessary to dial the associated directory number since ground on the sleeve lead will operate hold magnets on link frames and could cause double connections on these frames.***	
2	Measure voltage drop across 2 and 3, 4 and 5 contacts of associated CO- relays in both remote and control concentrator circuits. ***Note:*** When double connections or denied service reports have been received, it may be necessary to check other CO- relays.	A voltage drop across these contacts indicates that they are open.
3	Determine that correct cross-points have closed.	Observe that line used on test call is connected to same trunk in remote and control circuits.
4	Remove ground from sleeve lead.	TB- relay should release and call should disconnect within 6 to 8 seconds. ***Note:*** It may be necessary to operate the associated DP- relay due to the trunk load control feature.
5	Check that correct cross-points release.	

STEP	ACTION	VERIFICATION
6	Measure voltage drop across 2 and 3, 4 and 5 contacts of associated CO- relays in remote and control circuits. *Note:* When double connection or denied service reports have been received, it may be necessary to check other CO- relays. ***Caution: This test does not check the leads from central office equipment to the line concentrator. Also, it does not check the ability of the customer to receive and trip ringing. It will be necessary to dial the customer number on another central office line to test these features. Remember that if the customer does not answer, ringing may be occurring on the wrong customer line.***	
	U. Disconnect Call	
1	Place either a service request or terminating call and follow procedures shown in these test calls for disconnect portion of call.	
	V. Trunk Tests	
8a	If trunk overflow tone is machine recognizable — Patch free end of 3P3A cord used in Step 7a into L49 jack at concentrator control unit.	
9	Place a service request or terminating call in Group 0, observe which trunk is used on call.	Same as service request or terminating call.
10	When call releases — Block operated A, C hold magnets of trunk used.	
11	Repeat Steps 9, 10 until all trunks in Group 0 are used. ***Caution: It is preferable that this test be done during light traffic conditions. If necessary to perform this test during heavy traffic, unblock trunks during calls to allow service traffic to complete calls.***	
12a	If trunk overflow tone is machine recognizable — Place 322-type plug in SL49 jack.	At control concentrator — Line 49 sleeve relay operates.
13a	Measure transmission level of overflow tone using 21A TMS.	Level of tone should be −10 dbm ±3 dbm.
14	Remove blocking tools from all A, C hold magnets in Group 0.	

STEP	ACTION	VERIFICATION
15a	If trunk overflow tone is machine recognizable — Remove 322-type plug from SL49 jack.	Line 49 sleeve relay releases.
16a	Remove 3P3A cord from L49 jack.	
17a	Patch free end of 3P3A cord used in Step 16a to L99 jack.	
18	Repeat Steps 9, 10, 11 for Group 1.	
19a	If trunk overflow tone is machine recognizable — Place 322-type plug in SL99 jack.	Line 99 sleeve relay operates.
20a	Measure transmission level of overflow tone using 21A TMS.	Level of tone should be −10 dbm ±3 dbm.
21a	Remove blocking tools from all A, C hold magnets in Group 1.	
22a	Remove 322-type plug from SL99 jack.	
23a	Remove 3P3A cord from L99 jack.	

W. Trunk Transmission Tests

100-Line Remote Concentrator (test lines 49 and 99)

14	Place 322 plug into SL49 jack.	Terminating call placed on line 49.
15	Observe which trunk in Group 0 has both the C4 and C9 select magnets operated. (This is the trunk under test.)	
16	Operate G key to G0 position.	
17	Operate TL0 key to ON position.	1MW tone applied to line 49.
18	Patch the receive cord into L49 jack.	Read far-to-near loss on 21A TMS.
	Note: Record loss in column 3 adjacent to proper trunk number (column 1) as determined in Step 15.	
19	Return TL0 key to OFF position.	1MW tone removed from line 49.
20	Remove the receive cord from L49 jack.	
21	Repeat Step 14 for line 99 by placing 322 plug into SL99 jack.	Terminating call placed on line 99.
22	Repeat Step 15 by observing Group 1 for trunk selected.	
23	Operate TL1 key to ON position.	1MW tone applied to line 99.
24	Patch the receive cord into L99 jack. *Note:* Record loss as in Step 18.	Read far-to-near loss.
25	Operate TL0 key to ON position.	
26	Return TL1 key to OFF position.	Lines 49, 99 connected in loop around. No usable reading on 21A TMS detector.

STEP	ACTION	VERIFICATION
27	Patch the send cord into L49 jack. *Note:* Read loop-around loss and record in column 5 opposite trunk under test in Group 0.	
28	Remove the send, receive cords from L49, L99 jacks.	
29	Patch send cord into L99 jack.	
30	Patch the receive cord into L49 jack. *Note:* Read loop-around loss and record in column 5 opposite trunk under test in Group 1.	
31	Take information in column 2 associated with Group 0 trunk under test, record it in column 6 opposite Group 1 trunk under test. *Note:* Repeat test using column 2 Group 1 information opposite Group 0 trunk under test. Fill in other columns as indicated.	
32	Return TL0 key to OFF position.	Loop around disconnected from lines 49, 99.
33	Remove 322 plugs from SL49, SL99 jacks.	Disconnect calls are placed on lines 49, 99.
34	Remove the send, receive cords from L49, L99 jacks.	
35	After trunk (in each group) which is under test is released, quickly block operated associated A, C hold magnets.	Trunk busied out.
36	Repeat Steps 14 through 35 for remaining trunks, testing two at a time, until all required measurements have been recorded.	Same as Steps 14 through 35.
37	Remove blocking tools from all A, C hold magnets.	

50-Line Remote Concentrator Used as Group 0 (test lines 48 and 49)

38	Place 322 plug into SL48 jack.	Terminating call placed on line 48.
39	Observe which trunk in Group 0 has both the C4, C8 select magnets operated. (This is the first trunk under test.)	
40	Operate G key to G0 position.	
41	Operate TL1 key to ON position.	1MW tone applied to line 48.
42	Patch the receive cord into L48 jack. *Note:* Record loss in column 3 adjacent to proper trunk number (column 1) as determined in Step 39.	Read far-to-near loss on 21A TMS.

STEP	ACTION	VERIFICATION
43	Return TL1 key to OFF position.	1MW tone removed from line 48.
44	Remove receive cord from L48 jack.	
45	Repeat Step 38 for line 49 by placing 322 plug into SL49 jack.	Terminating call placed on line 49.
46	Observe which trunk in Group 0 has both C4, C9 select magnets operated. (This is the second trunk under test.)	
47	Operate TL0 key to ON position.	1MW tone applied to line 49.
48	Patch receive cord into L49 jack. ***Note:*** Record loss as in Step 42.	Read far-to-near loss.
49	Operate TL1 key to ON position.	
50	Return TL0 key to OFF position.	Lines 48, 49 connected in loop around. No usable reading on 21A TMS detector.
51	Patch send cord into L48 jack. ***Note:*** Record loss in column 5 opposite trunk associated with line 48.	Read loop-around loss on 21A TMS.
52	Remove the send, receive cords from L48, L49 jacks.	
53	Patch the send cord into L49 jack.	
54	Patch the receive cord into L48 jack. ***Note:*** Record loss in column 5 opposite the trunk associated with line 49.	Read loop-around loss on 21A TMS.
55	Take information in column 2 associated with L49 trunk under test, record it in column 6 opposite L48 trunk under test. ***Note:*** Repeat using column 2 L48 information opposite L49 trunk under test. Fill in other columns as indicated.	
56	Return TL1 key to OFF position.	Loop around disconnected from lines 48, 49.
57	Remove 322 plugs from SL48, SL49 jacks.	Disconnect calls are placed on lines 48, 49.
58	Remove the send, receive cords from L48, L49 jacks.	
59	After two trunks under test have released, quickly block operated the A, C hold magnets associated with each trunk.	Trunks tested busied out.
60	Repeat Steps 38 through 59 for remaining trunks, testing two at a time, until all required measurements have been recorded.	
61	Remove blocking tools from all A, C hold magnets.	

STEP	ACTION	VERIFICATION
50-Line Remote Concentrator Used as Group 1 (test lines 98 and 99)		
62	Place 322 plug into SL98 jack.	Terminating call is placed on line 98.
63	Observe which trunk in Group 1 has both C4, C8 select magnets operated. (This is the first trunk under test.)	
64	Operate G key to G1 position.	
65	Operate TL1 key to ON position.	1 MW tone applied to line 98.
66	Patch the receive cord into L98 jack. *Note:* Record loss in column 3 adjacent to proper trunk number (column 1) as determined in Step 63.	Read far-to-near loss on 21A TMS.
67	Return TL1 key to OFF position.	1MW tone removed from line 98.
68	Remove receive cord from L98 jack.	
69	Repeat Step 14 for line 99 by placing 322 plug in SL99 jack.	Terminating call placed on line 99.
70	Observe which trunk in Group 1 has both C4, C9 select magnets operated. (This is the second trunk under test.)	
71	Operate TL0 key to ON position.	1MW tone applied to line 99.
72	Patch the receive cord into L99 jack. *Note:* Record loss as in Step 66.	Read far-to-near loss.
73	Operate TL1 key to ON position.	
74	Return TL0 key to OFF position.	Lines 98, 99 connected in loop around. No usable reading on 21A TMS detector.
75	Patch the send cord into L98 jack. *Note:* Record loss in column 5 opposite trunk associated with line 98.	Read loop-around loss on 21A TMS.
76	Remove send, receive cords from L98, L99 jacks.	
77	Patch the send cord into L99 jack.	
78	Patch the receive cord into L98 jack. *Note:* Record loss in column 5 opposite trunk associated with line 99.	Read loop-around loss on 21A TMS.
79	Take information in column 2 associated with L99 trunk under test, record in column 6 opposite L98 trunk under test. *Note:* Repeat using column 2 line 98 information, placing it opposite L99 trunk under test. Fill in other columns as indicated.	
80	Return TL1 key to OFF position.	Loop around is disconnected from lines 98, 99.

STEP	ACTION	VERIFICATION
81	Remove 322 plugs from SL98, SL99 jacks.	Disconnect calls are placed on lines 98, 99.
82	Remove the send, receive cords from L98, L99 jacks.	
83	After two trunks under test have released, quickly block operated the A, C hold magnets.	Trunks tested are busied out.
84	Repeat Steps 62 through 83 for remaining trunks, testing two at a time, until all required measurements have been recorded.	
85	Remove blocking tools from all A, C hold magnets.	

X. Releasing Double Connections

1	Block nonoperated SRP- relay of group containing double connections.	
2	Determine if ground is present on sleeve lead of trunks on double connection.	
3a	If ground is present — Block nonoperated associated TB- relay.	
4b	If no ground is present — Proceed to Step 5.	
5	Block nonoperated TB- relays associated with double connection.	
6	Operate associated DP- relay, observe that double connection releases.	
7	When double connection has released — Release DP- relay.	

Caution: Operation of DP- relays beyond the required time to release the double connected trunks will cause a time-out alarm or cycling.

8	Remove all blocking tools.	