

Bell. System Practices
Transmission Testing.
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TRANSMISSION MAINTENANCE PRACTICES

SECTION VI-A
METHODS FOR MAKING
TRANSMISSION TESTS
ON
MANUAL EXCHANGE AREA
CIRCUITS AND EQUIPMENT

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DEPARTMENT OF OPERATION AND ENGINEERING
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General.

This section of Transmission Maintenance Practices outlines in detail the method for making transmission tests on manual circuits and equipment.

The methods as stated embody the features which field experience with the measuring sets has indicated to be desirable on the basis that the measuring set will be used in a routine way for measuring periodically all the equipment in an office which enters into the talking circuits. This means, of course, that the tests are made on the apparatus in its normal condition of operation.

It will be noted that for certain of the circuits it is specified that the tests be made with the impedance keys of the transmission measuring sets in one position, and for other circuits in some other position. The settings specified are those which are considered, all things taken into account, best suited for the respective tests. In this connection, the conditions corresponding to the different settings of the impedance keys are as follows:

High—Heavily loaded cable physical circuits and loaded open-wire physical circuits.

Medium—Medium loaded cable physical circuits, heavily loaded cable phantom circuits and loaded open-wire phantom circuits.

Low—Non-loaded cable and non-loaded open-wire circuits.

Toll Switchboard.

1. Cord and Operators' Telephone Circuits.

A. Universal and Semi-universal Toll Cord Circuits.

Universal toll cord circuits are used to complete connections between common battery and magneto lines, through magneto and common battery to common battery lines, while semi-universal toll cord circuits are used only to complete connections between common battery and magneto, and through magneto lines. For each of the above combinations of the cord circuits there is a different arrangement of the equipment associated with the tip and ring conductors, this equipment being operated by apparatus in the sleeve circuit. Each cord circuit should be tested under all conditions of service.

- (1) Procure two switchboard cords, one end of each should terminate in a plug of the type used at the switchboard under test. The other end should have the sleeve conductor accessible. Connect the sleeve conductor of one cord to terminal S_1 and that of the other to terminal S_2 of the transmission measuring set.

- (2) Connect an operator's telephone set to the position under test.
- (3) Throw the keys associated with the cord circuits in the normal or non-operative position so that the operator's telephone circuit is disconnected from the cords.
- (4) Set the impedance keys of the transmission measuring set to the impedances between which the cord circuits are to be tested; that is, either low-low (L-L) or high-high (H-H).
- (5) Insert the front and back plugs of the first cord circuit to be tested into the corresponding type jacks of the transmission measuring set.
- (6) Establish one of the conditions of the circuit (i. e., common battery to common battery) as outlined below by inserting the plugs of the cords connected to binding posts S_1 and S_2 of the transmission measuring set into the proper switchboard jacks.
- (7) Test the front and back cords of the cord circuit for cutouts by shaking (especially at the plug end).
- (8) Test all keys associated with the cord circuit for cutouts, (a) in the normal position, (b) in the operated position (except ringing keys).
- (9) If no cutouts are found, measure the transmission loss of the cord circuit.
- (10) Measure the transmission loss of the cord circuit for the remaining conditions of the circuit; that is, magneto to magneto and magneto to common battery.
- (11) Repeat the above for the remaining cord circuits of the position.
- (12) From the results of tests of the cord circuits of the position choose a cord circuit which shows no transmission troubles and use it to make the following tests of the operator's telephone circuit:
- (13) Insert the cord circuit of (12) in the corresponding type jacks of the transmission measuring set.
- (14) Throw the key associated with the cord circuit so that the operator's telephone circuit is connected across the cord circuit in the talking position.
- (15) Measure the transmission loss for this condition.

Note.—This value is the loss of the cord circuit and operator's circuit combined.

- (16) Throw the key associated with the above cord circuit so that the operator's telephone circuit is connected across the cord circuit in the monitoring position.
- (17) Measure the transmission loss for this condition.

Note.—This value is the combined loss of the cord circuit and the operator's circuit connected in the monitoring position.

In order that the operator's telephone circuit wiring may be tested, the following procedure which gives a direct relation to the transmitting and receiving efficiency of the operator's telephone circuit wiring, exclusive of the receiver and transmitter, may be followed.

Where a number of operator's telephone circuits are to be tested, the work can be simplified by means of accessory apparatus shown on Drawing No. 38-Y-1449. The following method is based on the use of this apparatus.

- (18) Insert the plug of the cord circuit which was used in the above test and to which the operator's telephone circuit is bridged when the talking key is operated, in the corresponding type "Line 1" or "Sending" jack of the transmission measuring set. When the talking key is operated, the operator's telephone circuit will be bridged on either the front or back cord. If bridged on the front cord, use the plug of this cord for the above test, and if bridged on the back cord, use the plug of this cord.
- (19) Throw the key associated with this cord circuit so that the operator's telephone circuit is connected to the cord circuit in the talking position.
- (20) Set the impedance keys of the transmission measuring set in the position low-low (L-L).
- (21) Insert the plug of the lead from the key as shown on Drawing No. 38-Y-1449 in the corresponding type "Line 2" or "Receiving" jack of the transmission measuring set.
- (22) Insert the operator's plug which is connected to the key, as shown in the above drawing, in the position jack in place of the operator's telephone set.
- (23) Throw the key, as shown on Drawing No. 38-Y-1449, to the receiving position and measure.

- (24) Throw the key, as shown on Drawing No. 38-Y-1449, to the transmitting position and measure.
- (25) Remove plug of the lead from the key, as shown on Drawing No. 38-Y-1449, from the jack of the transmission measuring set.
- (26) Connect "Line 1" or "Sending" terminal "T" to "Line 2" or "Receiving" terminal "T" and "Line 1" or "Sending" terminal "R" to "Line 2" or "Receiving" terminal "R."

Note.—When the 3-A type transmission measuring set is used, these connections are made through the jack contacts of the set when the plug referred to in item (25) is removed.

- (27) Throw the key associated with the cord circuit to the normal or non-operative position so that the operator's telephone circuit is disconnected.
- (28) Measure the transmission loss for this condition.

Note.—The value obtained in item (28) represents the transmission loss of the bridged cord circuit only. The differences between the values obtained in items (23) and (24) and that obtained in item (28) are values which bear a direct relation to the receiving and transmitting efficiencies of the operator's telephone circuit, exclusive of the transmitter and receiver.

The different types of connection, as referred to above, which can be made with a universal cord circuit, are as follows:

(a) **Common Battery to Common Battery.** This condition is obtained by inserting plugs connected to S_1 and S_2 into jacks wired in a manner similar to those connected to common battery lines.

(b) **Magneto to Magneto.** This condition is obtained by inserting plugs connected to S_1 and S_2 into jacks wired in a manner similar to those connected to magneto lines.

(c) **Magneto to Common Battery.** This condition is obtained by inserting plug connected to S_1 into a jack as described in (b) and inserting plug connected to S_2 into a jack as described in (a).

(d) **Common Battery to Magneto.** This condition is obtained by inserting plug connected to S_1 into a jack as described in (a) and inserting plug connected to S_2 into a jack as described in (b).

B. Toll Cord Circuits Arranged for Through or Terminating, or Both Types of Connections.

This type of toll cord may be arranged for terminating connections only, through connections only, or arranged for both through and terminating connections. Wherever a cord circuit is arranged for more than one type of connection, it should be tested for all connections.

Arrange for the proper sleeve connections and proceed with the test as outlined under "Universal and Semi-universal Toll Cord Circuits."

The methods of obtaining the different types of connection of these toll cord circuits are as follows:

(a) **Circuits Arranged for Terminating Calls Only.** Insert the plug connected with S_1 into a jack wired in a manner similar to those associated with toll lines. Connect to the corresponding "Line 1" or "Sending" jack of the transmission measuring set that plug of the cord under test which is normally used with toll lines. Insert the plug connected with S_2 into a jack wired in a manner similar to those associated with the circuits to which the toll lines are connected. Connect to the corresponding "Line 2" or "Receiving" jack of the set that plug of the cord under test which is normally used with these circuits.

(b) **Circuits Arranged for Through Calls Only.** Insert plugs connecting with S_1 and S_2 into jacks wired in a manner similar to those associated with toll lines. Connect to the corresponding type "Line 1" or "Sending" and "Line 2" or "Receiving" jacks of the transmission measuring set both front and back plugs of the cord under test.

2. Line and Trunk Circuits.

A. General.

In testing such circuits as interoffice trunks, it is necessary to provide the proper sleeve connections at the testing end in order to operate the sleeve relay which completes the trunk circuit. In cases such as line circuits, recording and tandem trunks, sleeve connections are not necessary except where the tester desires some means of knowing if the circuits have been looped properly at the distant end by observing the supervisory signals, or in the case of testing circuits such as line circuits that are multiplied through the switchboard, sleeve connections will be necessary in order to operate the

signals on the multiples, showing the operators that particular trunks are busy. The method of obtaining such sleeve connections is as follows:

Procure two switchboard cords; one end of each should terminate in a plug of the type used with the switchboard under test. The other end should have the sleeve conductor accessible. Connect the sleeve conductor of one cord to terminal S_1 and that of the other to terminal S_2 of the transmission measuring set. Insert the plugs of these cords into the proper type jacks at the switchboard.

When making loop measurements, it will be necessary to first determine the transmission loss of one circuit to be used as the standard circuit. The trunks to be tested should be looped with this standard circuit. In order to determine the transmission loss of the standard circuit, it will be necessary to make triangulation measurements, using three circuits, as follows:

Assume the three circuits to be A, B and C, respectively; measure the transmission loss caused by circuits A and B looped together at the distant end, then A and C, and B and C. From these three measurements, compute the loss of one circuit and use this circuit as the standard circuit.

In looping the circuits to be tested at the distant end, a double-ended cord equipped with plugs corresponding to the trunk jacks at that end may be used, the conductors in this cord being connected tip to tip and ring to ring. If the trunks being tested are of a type which require the operation of a sleeve circuit at the distant end to put the circuits in an operative condition, the sleeves of the plugs at the two ends of the looping cord should be equipped in the same manner as the sleeves of the cord circuits normally used with the trunks at that end. It will, of course, be permissible to loop the two trunks together with one of the regular cord circuits, provided this cord circuit is known to be in good condition and its loss is allowed for.

In cases of trunks equipped for machine ringing, it will be necessary to stop this ringing before the transmission tests can be made. This can be done by operating the keys provided on the transmission measuring set for tripping the ringing relays when the trunks to be tested are connected to the set.

B. Line Circuits.

Line circuits should be tested at the toll switchboard and looped at the toll testboard. Tests should be made from a position at the toll switchboard to

include all of the multiple and so looped at the testboard in order not to include any apparatus or equipment. In order to loop the line circuits and cut off the apparatus, a patching cord should be inserted in the drop jacks of the circuits at the toll testboard.

- (1) Provide the necessary cords or cord circuits for picking up the line circuits for test, also the proper sleeve connections in order to put a busy signal on the circuit under test.
- (2) Make triangulation measurements on three line circuits to determine the standard line circuit.
- (3) Make transmission tests on the remaining line circuits to be tested, looping each with the standard line circuit.

Note.—This value is the combined loss of the standard line circuit and the one under test.

C. Trunk Circuits.

(a) Toll Switching Trunks.

Toll Switching trunk circuits should be tested at the "B" board and looped at the toll board. The testing of these trunks is similar to the testing of interoffice trunks as described under "Trunk Circuits for 'B' Board."

(b) Recording Trunks.

The procedure for testing recording trunks is very similar to that described under "Line Circuits," as they terminate in jacks at both the local "A" board and the recording toll board. No additional sleeve connections need be supplied except as an aid to the tester in determining whether or not the circuits have been properly looped by observing the supervisory signals.

(c) Tandem Trunks.

Tandem trunks usually terminate in a jack at the toll switchboard and a cord and plug at the local "B" board and are similar to toll switching trunks, and should be tested as outlined for "Inter-office Trunks," except that the tandem trunks should be looped at the toll board.

(d) Miscellaneous Trunks.

Miscellaneous trunks, such as interposition trunks, terminate in jacks at both ends and should be tested as outlined for similar circuits described above.

3. Toll Service Observing Board.

- (1) Listen in with and inspect the receivers used on this board,

- (2) Measure the bridged transmission loss of all service observing operators' telephone circuits, and test the wiring of the circuit exclusive of the receiver and transmitter as described under "Universal and Semi-universal Toll Cord Circuits." The only difference in this case is that the cord circuits are single-ended instead of double-ended. In testing the bridged transmission loss, it will be necessary to connect the two tip binding posts and the two ring binding posts of the transmission measuring set together, as the cord circuit is single-ended as mentioned above.

Toll Testboard.

1. Composite Sets.

Composite sets may be picked up for test by inserting the proper type plugs into the composite line and drop jacks. The tip and ring of the plugs should be connected to the tip and ring terminals of the transmission measuring set, and measurements made between the low impedance settings of the transmission measuring set.

2. Composite Ringers.

Composite ringers can be picked up by inserting plugs of the proper type into the drop jacks of the ringer jackbox. The procedure for test is the same as that outlined for "Composite Sets."

3. Simplex Coils.

In order to test simplex coils alone, it will be necessary to short-out the composite ringer at the ringer jackbox if ringers are used. The simplex coils may be picked up at the toll testboard by inserting the proper type plugs into the simplex line and drop jacks.

4. Phantom Coils.

If ringers are used in connection with the phantom coils to be tested, it will be necessary to short them out as outlined for "Simplex Coils." Phantom coils can be picked up at the toll testboard by inserting the proper type plugs into the phantom line and drop jacks.

5. Monitoring Arrangements.

Monitoring arrangements should be checked up with the transmission measuring set to make certain that the proper types are being used and that these are wired correctly. The method of testing these monitoring arrangements is very similar to the testing of "Monitoring Arrangements" under "Toll Switchboard."

Local Switchboard.

"A" Board

1. Cord and Operators' Telephone Circuits.

A. Local "A" Cord Circuits.

- (1) Connect an operator's telephone set to the position under test.
- (2) Throw the keys associated with the cord circuits in the normal or non-operative position so that the operator's telephone circuit is disconnected from the cords.
- (3) Set the impedance keys of the transmission measuring set in position low-low (L-L).
- (4) Insert the front and back plugs of the first cord circuit to be tested into the corresponding type jacks of the transmission measuring set.
- (5) Test the front and back cords for cutouts by shaking. (Especially at the plug end.)
- (6) Test all keys associated with each cord for cutouts, (a) in the normal position, (b) in the operated position (except ringing keys).
- (7) Measure the transmission loss of the cord circuit.
- (8) Repeat the above for the remaining cord circuits of the position.
- (9) From the results of tests of the cord circuits of the position, choose a cord circuit which shows no transmission troubles and use it to make the following test of the operator's telephone circuit:
- (10) Insert cord circuit of item (9) in the corresponding type jacks of the transmission measuring set.
- (11) Throw the key associated with the cord circuit so that the operator's telephone circuit is connected across the cord circuit in the talking position.
- (12) Measure the transmission loss for this condition.

Note.—This value is the combined loss of the cord circuit and operator's circuit.

In order that the operator's telephone circuit wiring may be tested, the procedure as outlined under "Toll Switchboard—Universal and Semi-universal Toll Cord Circuits" should be followed.

B. Rural Subscribers' Cord Circuits.

Rural subscribers' cord circuits are arranged to complete common battery to common battery,

magneto to magneto, or common battery to magneto connections. For each of these combinations there is a different arrangement of the equipment associated with the tip and ring conductors of the cord circuit, this equipment being operated by apparatus in the sleeve circuit. Each cord circuit should be tested under all conditions of service. The procedure of test is very similar to that outlined under "Toll Switchboard—Universal and Semi-universal Toll Cord Circuits."

2. Information Trunks.

Information trunks terminate in jacks at both ends and should be tested as outlined for similar circuits under "Toll Switchboard."

"B" Board

1. Operators' Telephone Circuits.

With this class of telephone circuit, it is not possible to obtain a connection with the line terminals of the circuit by means of a switchboard cord at the position under test. In order that the operator's circuit wiring may be tested, the following procedure, which gives a direct relation to the transmitting and receiving efficiency of the operator's telephone circuit wiring, exclusive of the transmitter and receiver, may be followed. A method as outlined is based on the employment of the accessory apparatus as described before and shown on Drawing No. 38-Y-1449.

The testing of this type of operator's telephone circuit is easily accomplished on switchboards equipped with emergency call circuit jacks and an emergency key at each position which is provided for call circuit failure.

- (1) At the "B" position under test, operate the emergency key. This removes the operator's telephone circuit of the position from the call circuit and connects it to the multiplied emergency call circuit jacks.
- (2) Procure a cord, one end of which terminates in a plug of the type corresponding to the emergency call circuit jacks.
- (3) Connect the tip and ring conductors of this cord to the "Line 1" or "Sending" terminals of the transmission measuring set.
- (4) Insert the plug of this cord in an emergency call circuit jack.
- (5) Set the impedance keys of the transmission measuring set in the position low-low (L-L).
- (6) Insert the plug of the lead from the key, as shown on Drawing No. 38-Y-1449, in the corresponding type "Line 2" or "Receiving" jack of the transmission measuring set.

- (7) Throw the key, as shown on Drawing No. 38-Y-1449, to the receiving position and measure.
- (8) Throw the key, as shown on Drawing No. 38-Y-1449, to the transmitting position and measure.

Note.—The values obtained in items (7) and (8) bear a direct relation to the receiving and transmitting efficiencies of the operator's telephone circuit, exclusive of the transmitter and receiver.

2. Trunks.

Interoffice Trunks.

Interoffice trunks should be looped at the "A" board by means of a double-ended cord or one of the regular cord circuits, provided this cord circuit is known to be in good condition and its loss allowed for.

- (1) Set the impedance keys of the transmission measuring set in the position which gives the impedance nearest that of the trunks under test.
- (2) Arrange for the proper sleeve connections of the transmission measuring set as outlined under "General Method of Testing Line Circuits and Trunks."
- (3) When two trunks are looped for test and connected to the transmission measuring set, it will be necessary to trip the machine ringing relays if the trunks are so equipped.
- (4) Determine the transmission loss of the standard trunk as outlined under "General Method of Testing Line Circuits and Trunks."
- (5) With this standard trunk, loop the remaining trunks to be tested and measure.

Note.—This value is the combined loss of the standard trunk and the one under test.

3. Information, Managers', Chief Operators', Wire Chiefs' and Miscellaneous Desks.

A. Operators' Telephone Circuits.

Make transmission measurements of all monitoring arrangements as described under "Toll Service Observing Board."

4. Local Service Observing Board.

- (1) Listen in with and inspect the receivers used on this board.
- (2) Measure the bridged transmission loss of all service observing operators' telephone cir-

cuits, and test the wiring of the circuit, exclusive of the receiver and transmitter, as described under "Universal and Semi-universal Toll Cord Circuits." The only difference in this case is that the cord circuits are single-ended instead of double-ended. In testing the bridged transmission loss, it will be necessary to connect the two tip binding posts and the two ring binding posts of the transmission measuring set together, as the cord circuit is single-ended as mentioned above.

Private Branch Exchanges.

1. Cord and Operators' Telephone Circuits.

The cord circuits in all types of private branch exchange switchboards are arranged to complete local and central office connections which are referred to as extension to extension and trunk to extension connections, respectively. In most P. B. X. cord circuits there is a different arrangement of the equipment associated with the tip and ring conductors, which is operated by apparatus in the sleeve circuit. Wherever there is more than one arrangement of the equipment in a cord circuit, tests should be made for each arrangement.

- (1) Procure two switchboard cords; one end of each should terminate in a plug of the type used with the switchboard under test. The other end should have the sleeve conductor accessible. Connect the sleeve conductor of one cord to terminal S_1 and that of the other to terminal S_2 of the transmission measuring set.
- (2) Connect an operator's telephone set to the position under test.
- (3) Throw the keys associated with the cord circuits in the normal or non-operative position so that the operator's telephone circuit is disconnected from the cords.
- (4) Set the impedance keys of the transmission measuring set to the impedance between which the cord circuits are to be tested; that is, either low-low (L-L) or high-high (H-H).
- (5) Insert the front and back plugs of the first cord circuit to be tested into the corresponding type of jacks of the transmission measuring set.
- (6) Establish one of the conditions of the circuit (i. e., extension to extension), as outlined below, by inserting the plugs of the cord connected to S_1 or S_2 into the proper switchboard jacks.

- (7) Test the front and back cords of the cord circuit for cutouts by shaking, especially at the plug end.
- (8) Test all keys associated with each cord for cutouts, (a) in the normal position, (b) in the operated position (except ringing keys).
- (9) If no cutouts are found, measure the transmission loss of the cord circuit.
- (10) Measure the transmission loss of the cord circuit for the remaining condition of the circuit; that is, trunk to extension, if there is a different arrangement of the equipment in the circuit for this condition.
- (11) Repeat the above for the remaining cord circuits of the position.
- (12) From the results of tests of the cord circuits of the position, choose a cord circuit which shows no transmission troubles and use it to make the following tests of the operator's telephone circuit:
- (13) Insert the cord circuit of (12) in the corresponding type jacks of the transmission measuring set.
- (14) Throw the key associated with the cord circuit so that the operator's telephone circuit is connected across the cord circuit in the talking position.
- (15) Measure the transmission equivalent for this condition.
Note.—This value is the loss of the cord circuit and operator's circuit combined.
- (16) On switchboards equipped with a transmitter cutout, a separate test should be made to determine the loss caused by the operator's telephone circuit when the cutout is operated.
- (17) On switchboards equipped with a key, which cuts either of two receivers into the operator's circuit or connects them both to it at the same time, the loss caused by the operator's telephone circuit should be measured for each combination of receivers.
Note.—These values are the losses of the cord circuit and operator's circuit combined for the particular conditions of operator's circuit.

In order that the operator's telephone circuit wiring may be tested, the following procedure, which gives a direct relation to the transmitting and receiving efficiency of the operator's telephone circuit

wiring, exclusive of the receiver and transmitter, may be followed.

Where a number of operators' telephone circuits are to be tested, the work can be simplified by means of accessory apparatus shown on Drawing No. 38-Y-1449, and the following method is based on the use of this apparatus:

- (18) Insert the plug of the cord circuit which was used in the above test and to which the operator's telephone circuit is bridged when the talking key is operated in the corresponding type "Line 1" or "Sending" jack of the transmission measuring set. When the talking key is operated, the operator's telephone circuit will be bridged on either the front or back cord. If bridged on the front cord, use the plug of this cord for the above test, and if bridged on the back cord, use the plug of this cord.
- (19) Throw the key associated with this cord circuit so that the operator's telephone circuit is connected to the cord circuit in the talking position.
- (20) Set the impedance keys of the transmission measuring set in the position low-low (L-L).
- (21) Insert the plug of the lead from the key as shown on Drawing No. 38-Y-1449 in the corresponding type "Line 2" or "Receiving" jack of the transmission measuring set.
- (22) Insert the operator's plug which is connected to the key, as shown in the above drawing, in the position jack in place of the operator's telephone set.
- (23) Throw the key, as shown on Drawing No. 38-Y-1449, to the receiving position and measure.
- (24) Throw the key, as shown on Drawing No. 38-Y-1449, to the transmitting position and measure.
- (25) Remove plug of the lead from the key as shown on Drawing No. 38-Y-1449 from the jack of the transmission measuring set.
- (26) Connect "Line 1" or "Sending" terminal "T" to "Line 2" or "Receiving" terminal "T" and "Line 1" or "Sending" terminal "R" to "Line 2" or "Receiving" terminal "R."

Note.—When the 3-A type transmission measuring set is used, these connections are

made through the jack contacts of the set when the plug referred to in item (25) is removed.

- (27) Throw the key associated with the cord circuit to the normal or non-operative position so that the operator's telephone circuit is disconnected.
- (28) Measure the transmission loss for this condition.

Note.—The value obtained in item (28) represents the transmission loss of the bridged cord circuit only. The differences between the values obtained in items (23) and (24) and that obtained in item (28) are values which bear a direct relation to the receiving and transmitting efficiencies of the operator's telephone circuit, exclusive of the transmitter and receiver.

The different types of connection, as referred to above, which can be made with a P. B. X. cord circuit, are as follows:

- (a) **Extension to Extension.** This condition is obtained by inserting plugs connected to S_1 and S_2 into jacks wired in a manner similar to those connected to working extensions.
- (b) **Trunk to Extension.** This condition is obtained by removing the plug associated with S_1 from the extension jack and inserting it in a jack wired in a manner similar to those associated with working central office trunks.

2. Trunk Circuits.

A. Central Office Trunks.

Central office trunks are the trunks connecting the P. B. X. with the central office. The procedure for testing these trunks is similar to that outlined for circuits terminating in jacks at both ends, and should be tested accordingly.

When it is desired to measure the loss caused by the apparatus which is bridged across the trunks of the P. B. X., proceed as follows:

- (1) At the lock nut strip in the P. B. X. open the circuit connected to the equipment to be tested.
- (2) Set the impedance keys of the transmission measuring set in position marked high-high (H-H).
- (3) Strap together the "Line 1" or "Sending" tip terminals and the "Line 2" or "Receiving" ring terminals of the transmission measuring set.

- (4) Procure a cord, one end of which terminates in a plug of the type used with the trunk under test. Connect the tip and ring conductors of this cord to either tip or ring binding posts of the transmission measuring set.
- (5) Insert the plug of this cord into the trunk jack which is connected to the equipment to be tested. In this condition the apparatus to be tested is bridged across the line.
- (6) Measure the transmission equivalent of the apparatus.

B. Tie Trunks.

The tie trunks are the trunks connected between two P. B. X.'s. These trunks terminate in jacks at the P. B. X.'s, and should be tested as outlined for similar trunks. If it is required to test the apparatus which is bridged across the trunks at the P. B. X.'s, the method as outlined for "Central Office Trunks" should be followed.

Cordless Private Branch Exchanges

Cordless private branch exchanges are operated entirely by means of keys, and the only place at which access can be had to the private branch exchange circuits is at the connecting lock nut strip associated with the private branch exchange. The procedure to be followed in measuring the losses in cordless private branch exchange circuits is, therefore, different from that for other switchboards and is as follows:

- (1) At the lock nut strip, disconnect the central office trunks and extensions.
- (2) Set the impedance keys of the transmission measuring set in position low-low (L-L).
- (3) At the lock nut strip connect to the "Line 1" or "Sending" terminals of the transmission measuring set a pair of switchboard wires, which normally is associated with a central office trunk, and to the "Line 2" or "Receiving" terminals of the transmission measuring set connect a pair of switchboard wires, which normally is associated with an extension.
- (4) Throw the switchboard keys in a position which will connect the trunk circuit wiring and apparatus under test to the extension circuit equipment under test, and remove the operator's telephone set from the circuit.
- (5) Measure for this condition which simulates an outgoing call from an extension.
- (6) Test all the trunk connections against one extension in the manner described in (4).

- (7) Disconnect the central office trunk from the "Line 1" or "Sending" terminals of the transmission measuring set and connect the transmission measuring set to a second pair of switchboard wires, which normally is associated with an extension.
- (8) Throw a pair of switchboard keys in a position which will connect the wiring and apparatus of the two extension circuits under test.
- (9) Measure for this condition which simulates a connection between extensions.
- (10) Repeat the above for each pair of switchboard keys used to connect extensions.
- (11) For any one of the combinations measured in accordance with items (4) and (8) throw

Attached:

Dwg. No. 38-Y-1449.

the key which connects the operator's telephone circuit across the circuit under test.

- (12) Measure the transmission equivalent for this condition.

Note.—This value is the loss of the particular combination of circuit and the operator's telephone circuit combined.

- (13) Should the switchboard be provided with a key which cuts either of two receivers into the operator's circuit or connects them both to it at the same time, the loss caused by the operator's telephone circuit should be measured for each combination of receivers.
- (14) On switchboards equipped with a transmitter cutout, a separate test for this condition of the operator's telephone circuit should be made with the cutout operated.

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Sketch showing Method of Wiring a #136-A Type Key to Facilitate the Testing of the Receiving and Transmitting Circuits of Operator's Telephone Circuits Exclusive of the Receiver and Transmitter and also Illustrating the Use of the Key when Testing "A" Operator's Telephone Circuits.

38-Y-1449

