SUBSCRIBER LINES

TELETYPEWRITER SWITCHBOARDS NOS. 3 AND 3A

1. GENERAL

1.01 This section outlines the methods of performing tests of subscriber lines (attended or unattended) associated with the teletypewriter switchboards Nos. 3 and 3A which are made at the test boards Nos. 4, 5 or 9. The information in this section is under the following headings:

Contents

1.02 In test (A) the line terminals are considered as shorted at the subscriber station.

1.03 Tests (A), (B), (C), (D) and (F) require two persons; one at the test board and one at the subscriber station and will be made ordinarily in connection with the visit of an installer or repairman to the subscriber station.

2. APPARATUS

Tests (B), (C) and (E)

2.01 Two P2A Cords equipped with No. 347B Plugs.

3. GENERAL INFORMATION FOR ESTABLISHING AND RESTORING TEST CONNECTIONS

Subscriber Line Testing Facilities

3.01 Circuit arrangements are provided between the test board and the teletypewriter switchboard and between the test board and the relay rack bays for use in testing subscriber line circuits. These facilities consist of a testing and two-way trunk which is jack ended at the test board and switchboard and a subscriber line test trunk which is jack ended at the test board and the relay rack bays. The former trunk provides a two-way automatic trunk between the switchboard and test board. These arrangements are used when the attendant at the test board makes tests of a subscriber station through the switchboard cord circuit using the subscriber line relay equipment or direct with the subscriber station without the use of the line relay equipment using the jacks at the relay rack.

3.02 When a call for the test board attendant is received at the teletypewriter switchboard, the operator connects the subscriber line to the test board over the TRK jack of the testing and two-way trunk. The ANS lamp associated with the testing and two-way trunk at the test board should light. To answer the test board attendant connects the test board teletypewriter to the REC & TRK jack associated with the lighted ANS lamp. The ANS lamp is extinguished and the person at the station is in a position to communicate with the test board attendant by means of the teletypewriter.

3.03 If a test of the line is desired, the test board attendant requests the person at the station to operate the power switch to the OFF position in order to be called back and communicates with the switchboard operator requesting the line to be tested be made "out-of-order," and directs the switchboard operator to disconnect from the subscriber line and testing and two-way trunk at the switchboard. The test board attendant should disconnect from the REC & TRK jack of the testing and two-way trunk and then arrange to have the subscriber line connected to the subscriber

line testing trunk at the relay rack bay. The test board teletypewriter is connected to the TTY or LINE jack associated with the subscriber line testing trunk. The test board should call the subscriber station and communicate with the person at the station by means of the teletypewriter.

3.04 When the test board attendant wishes to establish a connection with a subscriber line through the teletypewriter switchboard, the test board attendant communicates with the operator at the switchboard by connecting the test board teletypewriter to the REC & TRK jack of the testing and two-way trunk. The switchboard operator is requested to connect the desired subscriber line to the testing and two-way trunk after first determining that the line is idle or being held for test and to call the subscriber. The test board attendant is in a position to communicate with the station by means of the test board teletypewriter. The test board attendant may signal the switchboard operator to disconnect by removing the plug of the cord from the REC & TRK jack of the testing and two-way trunk. This operation lights the switchboard cord supervisor lamp as a disconnect signal and upon receipt of the signal the switchboard operator should disconnect from the subscriber line and testing and two-way trunk.

3.05 When the test board attendant desires to establish a connection to a subscriber line at the relay rack bay, the test board attendant communicates with the switchboard operator over the testing and two-way trunk and requests the subscriber line circuit to be tested to be made "out-of-order," if the subscriber line is idle. The test board attendant connects the test board teletypewriter to the TTY or LINE jack of the subscriber line testing trunk and operates the BAT or SPLIT key.

3.06 At the relay rack bay the plugs of the P2A cords are inserted first into the A and B jacks of the subscriber line testing trunk and then into the A and B jacks of the subscriber line, respectively. The ANS or LINE lamp at the test board associated with the subscriber line testing trunk should light when the patch is made at the relay rack in the case of regular subscriber line. The test board attendant is now in a position to call the station, if desired. On subscriber lines having subscriber sets arranged for attended only service, insert the plug of the TALK cord of the telegraph test circuit into the VM jack of the subscriber line testing trunk and operate the ringing key associated with this cord. When the plug is inserted into the VM jack, the ANS or LINE lamp is extinguished and again lights when the plug is removed. Remove the plug of the TALK cord from the VM jack. When the station answers the ANS or LINE lamp will be extinguished. If the station does not answer the ANS or LINE lamp will remain lighted. On subscriber lines having subscriber sets arranged for unattended service, the station can be called by operating the BREAK key of the test board teletypewriter followed by operating upper case S key intermittently. When the station answers acknowledgment will be received on the test board teletypewriter.

3.07 The subscriber testing trunk between the test board and the subscriber line relay rack bay is so arranged that when a connection is made at the relay rack bay to the subscriber line under test, the circuit from the station to the relay equipment is not broken until a plug is inserted into the VM jack or the BAT or SPLIT key of the subscriber testing trunk is operated at the test board. Therefore, whenever a subscriber line is normally connected to the testing trunk at the relay rack bay, the switchboard operator may complete calls to and from the subscriber in the normal manner. In making connections at the relay rack bay using this trunk the plugs of the P2A cords should be inserted first into the trunk and then the subscriber line.

3.08 Upon completion of tests using the subscriber line testing trunk, the plugs of the P2A cords should be removed first from the subscriber line under test before removing the plugs from the subscriber line testing trunk at the relay rack bay. The plug of the cord may be removed from the TTY or LINE jack of the subscriber testing trunk at the test board and the switchboard operator advised to remove the out-of-order condition.

Making Line Under Test "Out-of-Order" at the Switchboard

3.09 If it is desired to make a subscriber line "out-of-order" at the switchboard, the test board attendant should communicate with the operator at the switchboard. Request the switchboard operator to make the line "out-of-order" in accordance with approved operating instructions.

Reestablishing Connections for Subscriber Use on Receipt of Incoming Calls

3.10 If a call is received for a subscriber when a test connection has been established to that subscriber in accordance with 3.03 or 3.06, the switchboard operator will advise the test board attendant. If the subscriber line can be released, the test board attendant should communicate with the switchboard operator and request the "out-of-order" condition be removed from the subscriber line. The patch cords at the subscriber line relay rack bay should also be removed.

3.11 If a call is received for a subscriber when a test connection has been established to that subscriber in accordance with 3.04, the switchboard operator

will advise the test board attendant. Assuming the subscriber line can be released, the test board attendant should communicate with the switchboard operator and request the subscriber line be cleared by removing the plug from the subscriber line multiple.

3.12 If an attended only service subscriber places a call when a test connection has been established in accordance with 3.03 or 3.06, providing there are no plugs in the TTY, LINE or VM jacks, the subscriber calling signal will be received at the test board. The test board attendant should advise the subscriber the line is under test and if it is feasible, also advise that the line will be restored and the operator will call back. The test board attendant should then remove the cords at the subscriber line relay rack bay, communicate with the switchboard operator and request the out-of-order condition be removed from the subscriber line. At the same time the switchboard operator should be instructed to communicate with the subscriber.

3.13 If the subscriber line is in use for routine work at the station when a call comes in to the switchboard the line is reestablished by calling the test board attendant via telephone. The test board attendant then requests the switchboard operator to remove the out-of-order condition on the subscriber line. The test board attendant should then remove first the plugs of the P2A cords from the A and B jacks of the subscriber line and then from the A and B jacks of subscriber testing trunk. The test board attendant should then usually make an over-all test with the station and restore the subscriber line to normal in accordance with 3.08. However, if the subscriber line is considered to be in condition to care for a call, the call may be completed before making the over-all test.

4. METHOD OF PERFORMING TESTS

(A) Preliminary Adjustment of Compensating Resistances for Local Loops from Data Furnished in Service Order

4.01 A preliminary adjustment of the compensating resistances will facilitate the installation and testing of the station teletypewriter. This adjustment is made as described in the following paragraphs.

4.02 On certain subscriber lines, a resistance will be specified at the station and in some cases a network will be required at the switchboard terminal. In the case of exceptionally long loops, an additional network may be specified for the installation at an outlying office or at the station. These arrangements are dependent upon the length and gauge of the subscriber line and the details will be covered by the Service Order when required.

4.03 Obtain the over-all resistance of the subscriber line circuit by adding together the resistance of the following items:

Item	Resistance
1. Loop resistance of subscriber line conductor.	As measured to a short or calculated from line make-up.
2. Station resistance.	
(a) Subscriber wave shaping network or outlying office network.	As specified in Service Order.
(b) Line relay.	85 ohms.
3. Fixed resistance R or impedance modifying central office network.	As specified in Service Order.
4. Line circuit relay.	
(a) B1127	106 ohms
(b) B583	35 ohms
(c) R2015 (shunted)	74 ohms
5. Battery tap resistance	120 ohms
6. Cord Circuit repeater circuit	550 ohms

4.04 Subtract the total resistance obtained in 4.03 from 4166 ohms. This will be the approximate value of the T resistance.

(B) Final Adjustment of Compensating Resistances by Line Current Measurement with Subscriber Set Connected

4.05 The switchboard end of the subscriber line circuit to be tested should be made "out-of-order" at the switchboard as covered in 3.09 and connections should be established with the associated subscriber line A and B jacks and the A and B jacks of the subscriber testing trunk at the relay rack.

4.06 Connect the test board teletypewriter to the TTY or LINE jack of the subscriber testing trunk at the test board and operate the BAT or SPLIT key.

4.07 With the subscriber teletypewriter set connected to the subscriber line, request the repairman or installer at the station to start the teletypewriter.

4.08 Momentarily operate the MA ON TTY key of the telegraph test circuit. Note the milliammeter reading. If there is typing on the line the milliammeter needle will vibrate or fluctuate and a correct reading cannot be obtained. In this case, it will be necessary to wait until the line becomes idle in order to obtain the line current reading.

Note: If the telegraph test circuit is modified for test board answering the milliammeter will be in series with the test board teletypewriter when the MA ON TTY key is operated, but if the test board position is not so arranged or a meter cord is used, the test board teletypewriter should be disconnected from the TTY or LINE jack and the meter cord connected to the TTY or LINE jack. In this case, the operation of the MA ON TTY key should be disregarded.

4.09 Determine the sum of the positive and negative telegraph voltages.

4.10 If the current obtained in 4.08 does not correspond to the voltage as shown in the following table, change the strapping of the T resistances in the subscriber line circuit to obtain as closely as possible the proper value of current. See 4.11.

Total Voltage	Current (Amps.)
270	.065
266	.064
262	.063
258	.062
254	.061
250	.060

Note: If the winding of the line relay of the test board teletypewriter is in series with the milliammeter, the reading should be approximately .001 ampere lower than the values shown above.

4.11 In offices where the subscriber testing trunk is provided with resistance keys, the value of the T resistance can be determined directly by adjusting the resistance keys until the proper line current is obtained. In using the keys to determine the amount of compensating resistance required, the designations of the unoperated keys correspond to the designation and value of the resistances which must be short-circuited, and the designations of the operated keys correspond to the designation and value of resistances which remain in the circuit.

Caution: Because of the heating condition of the test trunk resistances, the (T1) resistance of 500 ohms should not be permitted to remain in the circuit for any appreciable length of time unless the total required compensating resistance is 1000 ohms or more. Neither the (T2) resistance of 300 ohms nor both windings of the (T3) resistance with a total of 300 ohms should be permitted to remain in the circuit for any appreciable length of time unless the total required compensating resistance is 600 ohms or more.

4.12 If the proper line current can not be obtained within the adjustment of the T resistance, request the repairman or installer at the station to reduce the wave shaping network resistance, if it is 1600 ohms to 1200 ohms and proceed as covered in 4.09 to 4.11.

4.13 Restore the MA ON TTY key to normal when used and disconnect from the TTY or LINE jack. Restore the test board relay rack connections to normal.

(C) Line Operation Test Without Relay Equipment

4.14 Communicate with the switchboard operator and have the subscriber line to be tested made "out-of-order."

4.15 Establish connections with the associated A and B jacks of the subscriber line under test and the subscriber testing trunk at the relay rack.

4.16 Connect the test board teletypewriter to the TTY or LINE jack and operate the BAT or SPLIT key of the subscriber testing trunk. The ANS or LINE lamp should light on an attended subscriber line only.

Ringing Test

4.17 On subscriber lines having subscriber sets arranged for attended only service, insert the TALK cord plug of the telegraph test circuit into the VM jack of the subscriber testing trunk and operate the associated ringing key. After ringing the subscriber, withdraw the plug of the TALK cord from the VM jack.

4.18 On subscriber lines having subscriber sets arranged for unattended service, operate the BREAK key of the test board teletypewriter for a short period followed by intermittent sending of upper case S signals.

Subscriber Answer Test

4.19 After ringing the subscriber, the ANS or LINE lamp should be extinguished indicating that the subscriber station arranged for attended only service has answered. On subscriber line arranged for unattended service acknowledgment will be received on the test board teletypewriter.

Communication Test

4.20 With the plug of the cord inserted into the TTY or LINE jack of the subscriber testing trunk communicate with the station by means of the test board teletypewriter.

Attended Station Recall Test

4.21 Request the person at the station to send a recall signal. The ANS or

LINE lamp associated with the subscriber testing trunk should flash when the recall signal is sent from the station.

Attended Station Disconnect Test

4.22 Request the person at the station to send a disconnect signal and after about 5 seconds originate a call. The ANS or LINE lamp should light when the person at the station has disconnected and should be extinguished when the station call is originated.

Disconnection

4.23 Restore all cords and keys to normal unless other tests are to be made.

(D) Over-all Operation Test

4.24 Establish connections with the switchboard end of the subscriber line to be tested through the testing and two-way trunk and request the switchboard operator to call the station.

4.25 When the call is answered, signals should be received on the test board teletypewriter. Operate the test board teletypewriter in acknowledgment of the signals and indicate that this is a test call. At this point such tests should be conducted as are necessary to check the equipment at the station. If orientation tests are to be made with the station, they should be made at this time as covered under test (F), paragraphs 4.38 to 4.46.

4.26 Operate and restore the RCL & REV key of the testing and two-way trunk circuit. This should cause the supervisory lamp of the cord circuit at the switchboard to flash. This signal may be used at any time during the progress of the test to attract the attention of the switchboard operator.

4.27 Disconnect the test board teletypewriter from the testing and two-way trunk. The supervisory lamp associated with the switchboard cord circuit connected to testing and two-way trunk should light as an indication that the test has been completed.

(E) Line Current Test

4.28 Communicate with the switchboard operator and if the line to be tested is not busy have it made "out-of-order."

4.29 Establish connections with the associated A and B jacks of the subscriber line under test and the subscriber testing trunk at the relay rack bay.

4.30 Connect the test board teletypewriter to the TTY or LINE jack of the subscriber testing trunk associated with the line circuit under test and operate the BAT or SPLIT key.

Note: Should a call be originated on an attended line circuit which is under test, the ANS or LINE lamp associated with the subscriber testing trunk at the test board will light.

4.31 Make sure that the line is closed and momentarily operate the MA ON TTY key of the telegraph test circuit. Note the milliammeter reading.

Note: If the telegraph test circuit is modified for test board answering the milliammeter will be in series with the test board teletypewriter when the MA ON TTY key is operated, but if the test board position is not so arranged or a meter cord is used, the test board teletypewriter should be disconnected from the TTY or LINE jack and the meter cord connected to the TTY or LINE jack. In this case, the operation of the MA ON TTY key should be disregarded.

4.32 Determine the sum of the positive and negative telegraph voltages.

4.33 If the current obtained in 4.31 corresponds within ± .001 ampere to the value for the voltage shown in the following table, the line current can be considered satisfactory.

Caution: If the proper value of current is not obtained, the strapping of the T resistances in the line circuit should not be changed without a check having been made of the line conditions for possible irregularities.

Total Voltage	Current (Amps.)
270	.065
266	.064
262	.063
258	.062
254	.061
250	.060

Note: If the winding of the line relay of the test board teletypewriter is in series with the milliammeter, the reading should be approximately .001 ampere lower than the values shown above.

4.34 Restore the MA ON TTY key to normal when used after recording the meter reading and disconnect from the subscriber testing trunk.

4.35 Remove the cords from the A and B jacks of the subscriber line and subscriber testing trunk circuit and restore the BAT or SPLIT key.

(F) Orientation Test

4.36 Establish connections with the switchboard end of the subscriber

line to be tested through the testing and two-way trunks and request the switchboard to call the station.

4.37 When the call is answered, request the repairman or installer at the station to measure the orientation range of the station teletypewriter on local test unless he has already done so. The readings reported should be recorded.

4.38 Advise the repairman or installer at the station that test signals will be sent from the test board. Request him to measure the orientation range and report the results.

4.39 Send teletypewriter test signals to the station under test.

4.40 Request the station to send test sentences, and measure the orientation range of the received signals.

4.41 Orientation ranges obtained in 4.38 and 4.40 should be compared with the orientation test requirements as discussed in 4.42 to 4.46.

4.42 Definite requirements for the orientation tests cannot be given since the make-up of the subscriber loops covers such a wide range of possibilities. The table below will serve as a guide, however, in determining whether or not a trouble condition exists.

Loop Orientation Measurements Compared With Measurements on "Local Test"

	Max. Reduction from Either Limit
1. At test board	
a. Up to 6 miles	3 points
b. 6 to 25 miles	5 points
c. 25 to 34 miles	7 points

Note: These figures assume substantially perfect sent signals, such as those obtained from a transmitter-distributor. When keyboard sending is used, the reduction in range as given above may be increased by as much as 5 points without necessarily indicating a trouble condition.

4.43 It should be noted that marking (positive) bias will normally cause a downward shift of the upper orientation limit as compared with the local test range, and likewise spacing (negative) bias will normally cause an upward shift of the lower limit.

4.44 With the longer loops, marking (positive) bias in the open and closed signals from the subscriber station to the test board will usually be an indication that the series inductance added is insufficient for the particular make-up of the loop, while spacing (negative) bias ordinarily indicates that the series inductance is too great for the particular make-up of the loop. With the signals used in the opposite direction, excessive bias may indicate some irregularity in the telegraph equipment or battery voltages.

4.45 Communicate with the repairman or installer at the station upon completion of the tests and request that a disconnect signal be sent.

4.46 Upon receipt of the disconnect signal restore all cords and keys to normal.

5. REPORTS

5.01 The required record of these tests should be entered on the proper form.