SUBSCRIBER LINES

TELETYPEWRITER SWITCHBOARD NO. 5

1. GENERAL

1.01 This section describes tests of the subscriber lines associated with the teletypewriter switchboard No. 5. The tests are as follows:

(A) Approximation of Compensating Resistances for Local Loops from Data Furnished on Service Order

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

(C) Overall Line Operation Test

(D) Line Relay Test

(E) Line Current Test

(F) Orientation Test

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

1.03 Tests (B), (C), and (F) require two persons; one at the testboard 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), (E) and (F)

2.01 Test Trunk Circuit SD-70105-01.

Test (D)

2.02 35-Type Test Set

2.03 W3M Cord 6 ft. long equipped with a No. 310 Plug and 3 No. 360 type Tools with a No. 364 Tool in the No. 360A (sleeve) Tool.

2.04 S1B Cord 6 ft. long equipped with No. 291A Plug (cord connected to tip).

3. METHOD

(A) Approximation of Compensating Resistances for Local Loops from Data Furnished on Service Order

3.01 An approximation of the compensating resistances will facilitate the installation and testing of the station teletypewriter. Equipment arrangements consisting of resistances, wave shaping network or set may be required on the loop, depending upon the length and gauge of the subscriber line and the details will be covered by the Service Order.

3.02 Obtain the overall resistance of the subscriber line circuit by adding together the resistance of the following items:

Item	Resistance
1. Loop resistance of subscriber line conductor. (This may include the wave shaping network as covered in item 2(a).)	As measured to a short or calculated from line make-up.
2. Station resistance	
(a) Subscriber wave shaping network, set or outlying office network and resistance.	As specified on Service Order.
(b) Station Line relay.	85 ohms.

3.03 Subtract the total resistance obtained in 3.02 from 3206 ohms. This will be the approximate value of the resistances in the tip of the line.

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

3.04 With the L1 to L8 resistances in the tip of the line to be tested strapped out, operate the 100, 200, 400, 800 and 1600 keys associated with the test trunk circuit. If the approximate value of the resistances has been determined as covered in test (A), operate the pad keys 100 to 1600 to correspond with the approximate value of the resistance required.

3.05 Communicate with the switchboard operator and request that the plug of the test trunk circuit be inserted into the jack of the subscriber line to be tested.

3.06 The GUARD lamp associated with the test trunk at the testboard should light, indicating that the trunk is connected to the subscriber line. Connect the testboard teletypewriter to the TTY jack of the test trunk. The TWX lamp associated with the test trunk should light.

Note: Should a call be originated on the subscriber line which is under test before connection has been established to the TTY jack, the TWX lamp associated with the test trunk circuit will light.

3.07 With the subscriber teletypewriter set connected to the subscriber line, and the station switch in the on position, the TWX lamp should be extinguished.

3.08 Momentarily operate the MA ON TTY key of the telegraph test circuit, where

provided. Note the milliammeter reading.

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

3.09 Determine the sum of the positive and negative telegraph voltages and adjust the 100 to 1600 pad keys as necessary until the line current corresponds within ± .001 ampere to the value for the voltage shown in table A.

TABLE A

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 testboard teletypewriter is not in series with the milliammeter, the reading should be approximately .001 ampere higher than the values shown above.

3.10 If the proper line current cannot be obtained within the adjustment of the pad keys it may be because the resistance of the wave shaping network is not of the proper value.

3.11 In using the pad keys to determine the amount of compensating resistance required, the designations of the operated keys correspond to the value of resistance which should remain in the circuit. Strap the L1 to L8 resistances as required to secure the current values shown in table A. The strapping required to secure the desired value of current shall be exactly in accordance with table B to give proper heat dissipation.

3.12 After the L1 to L8 resistances have been strapped, restore all the pad keys 100 to 1600 and note the milliammeter reading. The current should be as closely as possible to the proper value shown in table A.

3.13 Restore the MA ON TTY key to normal, when used and request the person at the station to send a disconnect signal. The TWX lamp associated with the test trunk circuit should light.

TABLE B

RES. TO COMPENSATE LOOP, OHMS	RES. TO BE STRAPPED TO COMPENSATE SUBS. LOOP ("X" indicates resistances to be strapped out)										
	L1	L2	L3		L4	L5	L6	L7		L8
	50Ω	200Ω	200Ω	100Ω	600Ω	800Ω	600Ω	100Ω	200Ω	200Ω
100	Strap as Required for 50 ohm Adjustment	X	X		X	X	X	X	X	X
200			X	X	X	X	X	X	X	X
300			X		X	X	X	X	X	X
400			X	X	X	X	X	X	X	
500			X		X	X	X	X	X	
600			X		X	X	X		X	
700			X		X	X	X	X		
800				X	X	X	X	X		
900				X	X	X	X			
1000					X	X	X			
1100			X	X		X	X		X	
1200			X			X	X		X	
1300			X			X	X	X		
1400				X		X	X	X		
1500						X	X	X		
1600						X	X			
1700			X	X		X			X	
1800			X			X			X	
1900				X		X			X	
2000				X		X		X		
2100						X		X		
2200						X				
2300							X	X		
2400							X			
2500			X	X					X	
2600			X						X	
2700				X					X	
2800				X				X		
2900								X		
3000										

3.14 Communicate with the switchboard operator and request that the plug of the test trunk circuit be removed from the jack of the subscriber line under test.

3.15 The GUARD and TWX lamps associated with the test trunk circuit at the testboard should be extinguished. Disconnect the testboard teletypewriter from the TTY jack associated with the test trunk circuit, unless proceeding with other tests.

(C) Overall Line Operation Test

3.16 Communicate with the switchboard operator and request that the plug of the test trunk circuit be inserted into the jack of the subscriber line to be tested.

3.17 The GUARD lamp associated with the test trunk circuit at the testboard should light, indicating that the trunk is connected to the subscriber line. Connect the testboard teletypewriter to the TTY jack of the test trunk. The TWX lamp associated with the test trunk circuit should light.

Note: Should a call be originated on the subscriber line which is under test before connection has been established to the TTY jack, the TWX lamp associated with the test trunk circuit will light.

3.18 Station Ringing Test: Operate the STA ± key associated with the test trunk circuit.

3.19 Station Answer Test: After ringing the station and the station answers the TWX lamp associated with the test trunk circuit should be extinguished.

3.20 Communication Test: With the testboard teletypewriter connected to the TTY jack of the test trunk circuit communicate with the station. 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) 3.41 to 3.50.

3.21 Station Recall Test: Request the person at the station to send a recall signal. The TWX lamp associated with the test trunk circuit should light while the recall signal is sent from the station.

3.22 Station Disconnect Test: Request the person at the station to send a disconnect signal and then originate a call after a wait of a few seconds. The TWX lamp associated with the test trunk circuit should light when the person at the station has disconnected and should be extinguished when the new call is originated.

3.23 Disconnection: Advise the person at the station to disconnect. Then communicate with the switchboard operator and request that the plug of the test trunk circuit be removed from the jack of the subscriber line under test.

3.24 The GUARD and TWX lamps associated with the test trunk circuit at the testboard should be extinguished. Disconnect the testboard teletypewriter from the TTY jack associated with the test trunk circuit.

(D) Line Relay Test

3.25 Before using the 35 type test set, be sure that all resistance is cut in to avoid damaging the needle of the milliammeter. This is accomplished by moving all resistance slides to the extreme right.

3.26 Arrange the keys and switches of the test set as follows:

Keys	Position	Switches	Position
1	Open	G	Operated
2	Open	L	Open
3	Open	Res.	0
4	Open		
BATT & GRD CO	Operated		
REV	Operated		

3.27 Connect the No. 364 tool of the W3M cord to the GRD binding post of the test set and insert the No. 310 plug into the TOLL jack of the cord test circuit.

3.28 Connect the S1B cord equipped with the No. 291A plug to the T binding post of the test set and partially insert the No. 291A plug into the jack of the subscriber line circuit to be tested so that the tip of the plug makes contact with the tip spring of the jack, making sure that the tip of the plug does not operate the tip spring of the jack.

3.29 Depress key 3, and move the No. 3 resistance slides to the left until the specified "operate" value is observed on the milliammeter. Then release the key.

3.30 Depress key 4 and move the No. 4 resistance slides to the left until the specified "non-operate" value is observed on the milliammeter. Then release the key.

3.31 Depress key 3 and observe that the line lamp associated with the line under test lights and that it is not dim. Release key 3 and observe that the lamp is extinguished. Depress key 4. Observe that the line lamp associated with the line under test does not light.

3.32 Remove the No. 291A plug from the jack of the subscriber line circuit under test. At completion of the test, disconnect the test set and restore all keys to normal.

(E) Line Current Test

3.33 Communicate with the switchboard operator and request that the plug of the test trunk circuit be inserted into the jack of the subscriber line to be tested.

3.34 The GUARD lamp associated with the test trunk circuit at the testboard should light, indicating that the trunk is connected to the subscriber line. Connect the testboard teletypewriter to the TTY jack of the test trunk circuit. The TWX lamp associated with the test trunk circuit should light.

Note: Should a call be originated on the subscriber line which is under test before connection has been established to the TTY jack, the TWX lamp associated with the test trunk circuit will light.

3.35 Operate the MA ON TTY key of the telegraph test circuit, where provided and the STA ± key associated with the test trunk circuit. When the call is answered the TWX lamp should be extinguished. 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 there is no typing in order to obtain the line current reading.

Note: If the telegraph test circuit is modified for testboard answering the milliammeter will be in series with the testboard teletypewriter when the MA ON TTY key is operated. If the testboard position is not so arranged or a meter cord is used, the testboard teletypewriter should be disconnected from the TTY jack associated with the test trunk circuit and the meter cord connected

to the TTY jack. In the latter case, the operation of the MA ON TTY key should be disregarded.

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

3.37 If the current obtained in 3.35 corresponds within ± .001 ampere to the value for the voltage shown in table A, the line current can be considered satisfactory.

Caution: If the proper value of current is not obtained, the strapping of the L1 to L8 resistances in the tip of the line circuit should not be changed without a check having been made of the line conditions for possible irregularities.

3.38 Restore the MA ON TTY key to normal, when used after recording the meter reading and request the person at the station to send a disconnect signal. The TWX lamp associated with the test trunk circuit should light.

3.39 Disconnection: Communicate with the switchboard operator and request that the plug of the test trunk circuit be removed from the jack of the subscriber line under test.

3.40 The GUARD and TWX lamps associated with the test trunk circuit at the testboard should be extinguished. Disconnect the testboard teletypewriter from the TTY jack associated with the test trunk.

(F) Orientation Test

3.41 Communicate with the switchboard operator and request that the subscriber line to be tested be connected to the two-way teletypewriter trunk circuit by means of a regular cord circuit (known to be in good condition):

3.42 The ANS lamp associated with the trunk circuit at the testboard should light, indicating that the trunk is connected to the subscriber line. Connect the testboard teletypewriter to the TTY TRK jack of the trunk circuit. The ANS lamp associated with the test trunk circuit should be extinguished.

3.43 Advise the repairman or installer at the station that test signals will be sent from the testboard. Request him to measure the orientation range and report the results. Send teletypewriter test signals to the station under test.

3.44 The station teletypewriter range should not be less than 70 points on substantially perfect sent signals or not less than 65 points when keyboard sending is used.

3.45 Request the station to send test sentences and make an orientation measurement. Note the departure from the zero points of the - and + scales. The larger of these two readings is considered to be the distortion caused by the circuit under test.

Note: If end zero scales are not provided the upper and lower limits of the range obtained should be compared with the corresponding limits under "local test." The difference between the two upper limits or the difference between the two lower limits, whichever is larger, is considered to be the distortion caused by the circuit under test.

3.46 No definite requirements can be set up for permissible distortion on these loops as indicated by the orientation measurements since the make-up of subscriber loops includes such a wide range of possibilities. However, the following table will serve as a guide in determining whether or not a trouble condition exists.

Length of Loop	Distortion, i. e. Max. Reduction From Either Upper or Lower Limit
Up to 6 miles	3 points
6 to 25 miles	5 points
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.

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

3.48 With the longer loops, marking bias in the open and closed signals from the subscriber station to the testboard will usually be an indication that the series inductance added is insufficient for the particular make-up of the loop, while spacing 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.

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

3.50 Disconnection: Communicate with the switchboard operator and request that the connection between the trunk circuit and the subscriber line under test be removed. Disconnect the testboard teletypewriter from the trunk circuit.

4. REPORTS

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