TWO-POINT PRIVATE LINE TELEPHONE CIRCUITS

OVER-ALL MEASUREMENTS

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1. GENERAL

1.01 This Section is reissued to add information pertaining to the noise requirements for PBX off-premises extensions and tie lines. Table I is revised showing changes in attenuation requirements. Table III pertaining to the interval of routine tests is also revised. Other miscellaneous changes are indicated by arrows, also.

1.02 Maybe you read the book about "How to Win Friends and Influence People." That's what we aim to do by providing better facilities for our customers. One way we can "Win Friends" is to make these two-point private line services and toll foreign exchange circuits work better than they have in the past. And that's the purpose of this practice. You can begin by making over-all circuit order tests. Routine tests are important too. This will help to insure that the circuit continues to perform properly when the customer uses it. Here's the pitch!

1.03 This section outlines the over-all tests, requirements and intervals for tests to be made between cities from station to station. Over-all tests should be made where practical whenever coordination problems are not insurmountable.

These are in addition to other tests outlined in practices pertaining to:

(1) Toll facilities between Serving Test Centers (STC's).

(2) Local facilities between the STC and station, and,

(3) Tests on carrier and repeater equipment used to make up the over-all private line service.

1.04 Generally speaking, private lines which operate on a 4-wire basis between the STC and the customer's premises are 600 ohm facilities when terminated in a telephone set. Facilities which terminate at a PBX are 900 ohms even though they may be 4-wire.

1.05 Two-wire facilities between the STC and the customers' premises are tested as if they were 900 ohms. You ask, "Why 900 ohms when we know the impedance of these facilities at 1000 cycles can vary from around 400 to 1500 ohms?" The answer is that a good average impedance is 900 ohms. There's another reason too — the 500A and 500B telephone sets are considered to be 900 ohms.

1.06 Arrangements for routine tests should be made with the customer by the control office. In some cases, it may be necessary to make these tests after normal working hours in order to minimize service interruptions. In some cases this may mean that considerable coordinating effort is required.

2. TESTING APPARATUS

2.01 Make sure the test equipment is working O.K. It should be calibrated in accordance with the sections covering the equipment. Ample warmup time should be allowed for the apparatus in order to stabilize its operation.

DON'T FORGET — A POOR TEST IS A WASTE OF TIME.

2.02 The following test apparatus may be used at the customer's premises:

13A TMS	2AB Auxiliary Transmission Test Set
21A TMS	200CD Oscillator or equivalent
2B or 3A Noise Measuring Set	Dial Test Set — Code 1011G

2.03 When using the 13A or 21A TMS's, BE CAREFUL! The presence of dc in the input circuit of these sets may cause permanent damage. For this reason, it is necessary to use the 2AB test set with them. This blocks dc from the sets, provides a holding bridge, if required, to hold the connection while testing and matches 600 ohm testing equipment to the private line facility.

2.04 The output impedance of oscillators is important too. The 200CD provides a balanced 600 ohm output impedance and should be connected to the 2AB set as shown in the figures.

2.05 The 2B or 3A NMS should NOT be used as a TMS to measure frequency response. The 13A or 21A should be used since their characteristics are more desirable for this work.

2.06 The dial test set may be used for talking between stations if other facilities are not available. A jack is provided on the 2AB set for this purpose. The DIAL-SLV key should be in the DIAL position when talking but should be normal when measuring. DON'T FORGET!

3. NET LOSS MEASUREMENTS

3.01 Net loss measurements should be made in both directions on all circuits except those which are nonrepeatered or those which use E-type repeaters. This will require a little more work. But it may show up a case of trouble that might be missed otherwise.

3.02 The attached figures cover the most common arrangements for making 1000 cycle net loss measurements on two-point systems. Figs. 1, 2 and 3 pertain to 2-wire circuits only, which may include E-type repeaters. Figs. 4, 5 and 6 pertain to facilities which operate on a 4-wire basis either in part or their entirety. These may include carrier or V-type repeaters. It is not intended that this practice will include all possible arrangements at the customer's premises. In some cases, it may be necessary to test from a terminal block or similar access point. In these situations the methods for testing are the same although there may be some deviation in the procedures. The figures also are applicable when testing from the customer's premises to the STC.

3.03 Chart I lists the steps and procedures to be followed for the various test figure arrangements. All tests should be performed where an asterisk (*) is shown for the figure.

4. FREQUENCY RESPONSE MEASUREMENTS

4.01 The net loss measurement gives only part of the story when it comes to determining how well you can talk over a connection. For instance, a facility may look good at 1000 cycles but very poor at other frequencies. This means the customer still complains because he can't hear.

4.02 Now that you know what the problem is, here's the solution. Measure the loss from station to station at any three frequencies within the voice ranges shown in Table I. This is in addition to the 1000 cycle measurement which you already made and is in addition to the three frequency test called for on the circuit order card for each component of the over-all facility.

This will give you a pretty good idea of how well the over-all facility will talk up when the customer uses it. Measure these losses in both directions except in the cases noted in Paragraph 3.01.

4.03 Use the same test setup and test procedures for the frequency run as used for the net loss measurement. Correct for cord circuit loss at these frequencies and the 2AB set loss (0.5 db) as discussed in Chart I. The requirements are shown below.

5. NOISE MEASUREMENTS

5.01 Steady noise measurements should be made at each station in accordance with the practices covering the use of the 2B or 3A Noise Measuring Set. In general, the measurements should be made using the LINE jacks and F1A LINE weighting with the 2B NMS, and 600-ohm input and C-MESSAGE weighting with the 3A NMS. When monitoring during this test, listen for intelligible crosstalk. Its presence is an indication of trouble which should be cleared.

5.02 When measuring steady noise at a PBX, the cord circuit may be used. The trunk cord circuit should be connected to the line jacks or terminals of the 2B or 3A noise set.

5.03 The telephone set at the station should be disconnected after the telephone line is connected to the MEAS jacks of the 2AB test set. The noise set should be connected to the TMS jack of the 2AB set with the DIAL-SLV key normal, 2DB PAD key OUT and TEST switch in 900 ohm REC. The through loss of the 2AB set can be neglected (0.5 db) since it will have little effect on the actual noise reading.

6. STATION TESTS AND INSPECTIONS

6.01 The over-all performance of the circuit should also be checked by making talking and signaling tests. All wiring and equipment associated with the station should also be inspected.

7. REQUIREMENTS

7.01 Before making the over-all net loss measurements from station to station, each section of the facility should meet its requirements. These requirements are covered in the practices for the equipment, toll facilities, loops, etc.

7.02 The measured over-all net loss of the facility (station to station) should be within +3 to −1 db of the design loss specified on the circuit order card or sketch. If these limits cannot be met in either direction, the control office should be consulted for further instructions. This doesn't mean to "pass the buck" but rather, they are supposed to assist in locating the troubles and clearing them.

7.03 The loss of the facility (station to station) at frequencies other than 1000 cycles should be within the limits shown in Table I below. The positive number means the facility measures longer at that frequency than it does at 1000 cycles. The negative number means the facility measures shorter than it does at 1000 cycles.

TABLE I

FREQUENCY (CYCLES)	LIMITS (db)
500 to 800	+5 and −3
2000 to 2300	+4 and −2
2500 to 2700	+8 and −4

7.04 On facilities used only for voice transmission with no alternate use for data, the steady noise level should meet the requirements shown in Table II below. The values shown are the actual noise meter readings for the over-all circuit losses shown.

TABLE II

NET LOSS (db) STATION-STATION	NOISE REQUIREMENT dba (2B NMS)	NOISE REQUIREMENT dbrn (3A NMS)
6	33	39
9	30	36
12	27	33
15	24	30
20	19	25

7.05 For off-premises stations located in the same city as the serving PBX, the noise should not exceed 26 dbrn (20 dba). If the off-premises station is located in a city other than the one where the PBX is located, the noise should not exceed 32 dbrn (26 dba). These are the actual noise meter readings at the station regardless of level.

7.06 The noise on a PBX tie line between PBX's in the same city should not exceed 32 dbrn (26 dba). If the tie line connects two PBX's not located in the same city, the noise should not exceed 35 dbrn (29 dba). These noise measurements are referred to the 0 level point.

8. INTERVALS

8.01 The over-all tests from the station or STC as outlined in Table III should be performed on all circuit orders and service orders. They are in addition to the routine tests performed on the individual sections used to make up the over-all facility. The over-all routine tests should be scheduled, if possible, to coincide with the routine tests between STC's.

TABLE III

TEST	STATION TO STATION(1)	STC TO: STC	STC TO: STA(2)
Net Loss	3M	M	3M
Noise	A	A	A
Frequency Response	A	A	A
Station Inspection	A	—	A

A – Annual 3M – Three Months M – Monthly

(1) These tests should be made where practical, otherwise STC to STC and STC to STA tests should be made. Where it is not practical to make transmission tests station to station, an over-all talking and signaling test must be made.

(2) The use of dialable test lines at the customer's PBX will facilitate the making of these tests.

8.02 When a man is at the customer's premises in connection with trouble, the above tests should be made where practical.

CHART NO. 1

	STEP PROCEDURE	FIGURE NO. 1	2	3	4	5	6	REMARKS
1	Signal Distant Station.	*	*	*	*	*	*	
2	Connect test equipment to AC power	*	*	*	*	*	*	Allow sufficient time to warm up.
3	Connect MEAS jack or Binding Post of 2AB Set to PBX jack.	*	*	—	*	*	—	If PBX cord circuit is used, subtract its loss from reading in Step 12.
4	Disconnect tel set after connecting MEAS jack or Binding Post of 2AB set to line wires.	—	*	*	—	*	—	
5	Connect TMS to TMS jack or Binding Post of 2AB set.	*	*	*	*	*	—	Calibrate TMS before use to insure that it works O.K.
6	Connect oscillator to OSC jack or Binding Post of 2AB set.	*	*	*	*	*	—	
7	Set DIAL-SLV key of 2AB set to normal (upright position).	*	*	*	*	*	—	Dial test set can be used for talking by operating DIAL-SLV key to DIAL. When measuring, restore key to normal.
8	Set 2DB PAD key to OUT.	*	*	*	*	*	—	
9	Set TEST switch of 2AB set to REC. 600 ohms.	*	*	*	*	*	—	For alternate method, see Fig. 8 of Section entitled, "2AB Auxiliary Transmission Test Set."
10	Adjust OSC output for 0 dbm at desired frequency on TMS	*	*	*	*	*	—	This corrects for loss of 2AB set at sending end.
11	At sending end, adj TEST switch of 2AB set to SEND 900 ohms.	*	*	*	*	*	—	Send for 10 seconds.
12	At receiving end adj TEST switch to REC 900 ohms.	*	*	*	*	*	—	Read loss on TMS. Subtract 0.5 db from meter reading for Figs. 1 thru 5. Subtract loss of PBX cord cct, if used, for Figs. 1, 2, 4 and 5.

CHART NO. 1 (Contd)

STEP	PROCEDURE	FIGURE NO. 1	2	3	4	5	6	REMARKS
13	Reverse procedure in Steps 11 and 12.	*	*	*	*	*	—	This measures loss in opposite direction. Subtract 0.5 db for loss of 2AB set at receiving end.
14	Connect oscillator to TMS.	—	—	—	—	—	*	Adjust oscillator to 0 dbm.
15	Send alternately in each direction.	—	—	—	—	—	*	Record reading on TMS. Apply corrections, if any.
16	Compare corrected reading with circuit layout record.	*	*	*	*	*	*	If out of limits in either direction, call control office for further instructions.
17	If facility is within limits restore to normal.	*	*	*	*	*	*	

* = Step applies.

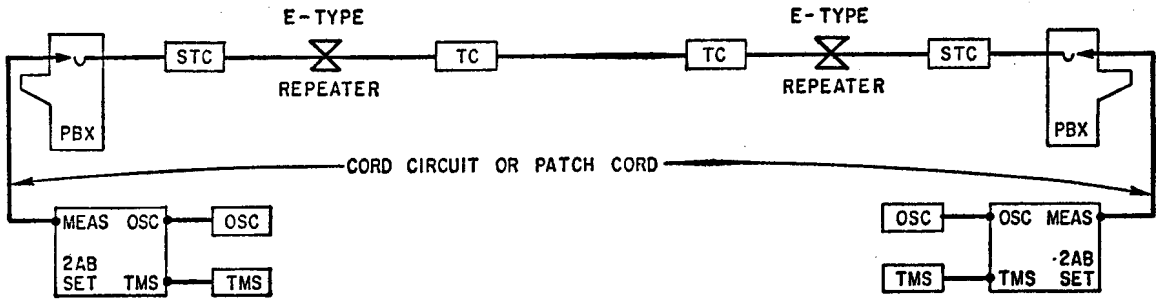

Fig. 1 — PBX to PBX

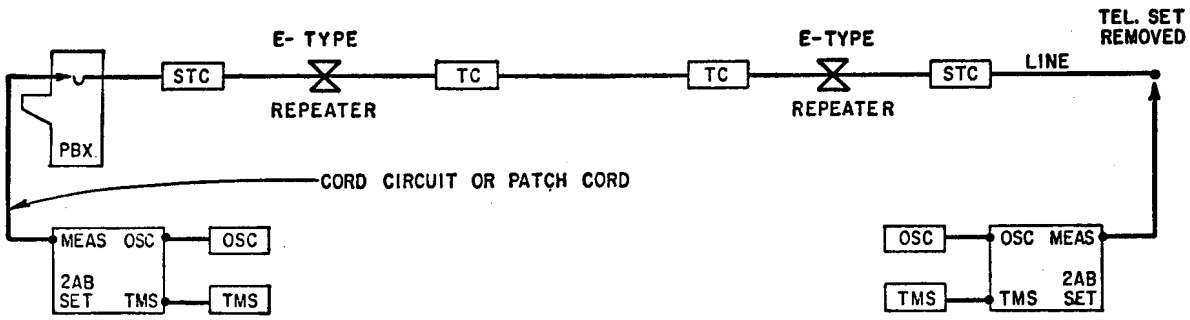

Fig. 2 — PBX to Tel Set

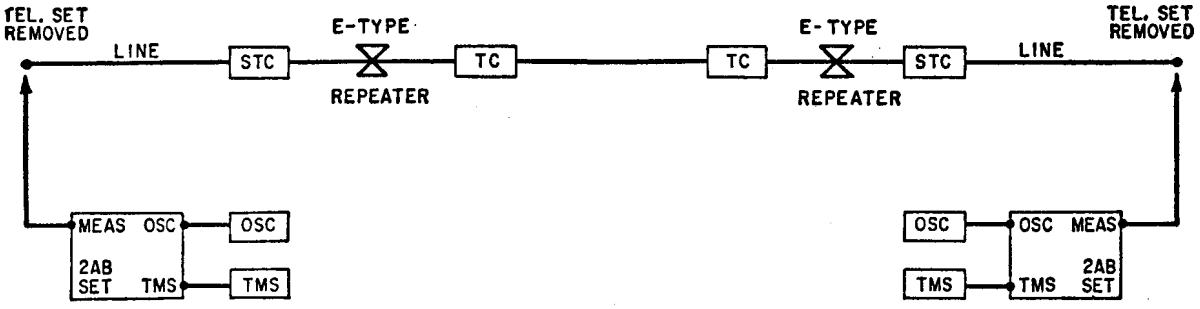

Fig. 3 — Tel Set to Tel Set

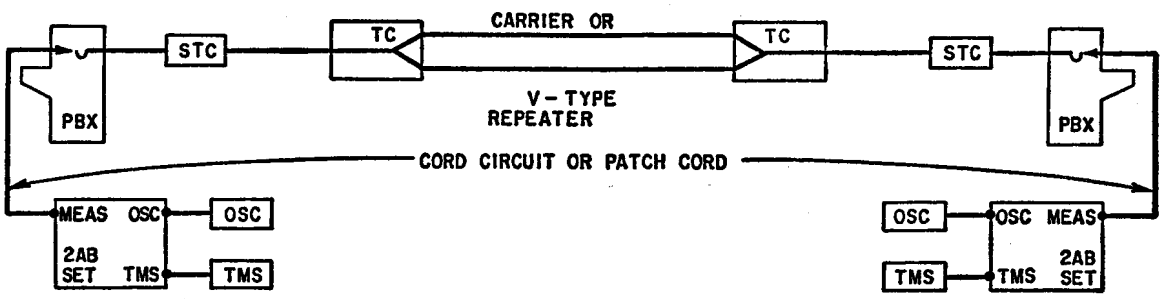

Fig. 4 — PBX to PBX

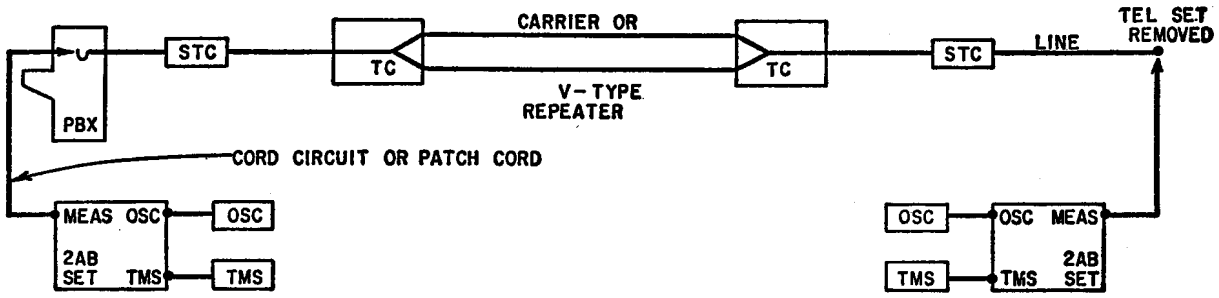

Fig. 5 — PBX to Tel Set

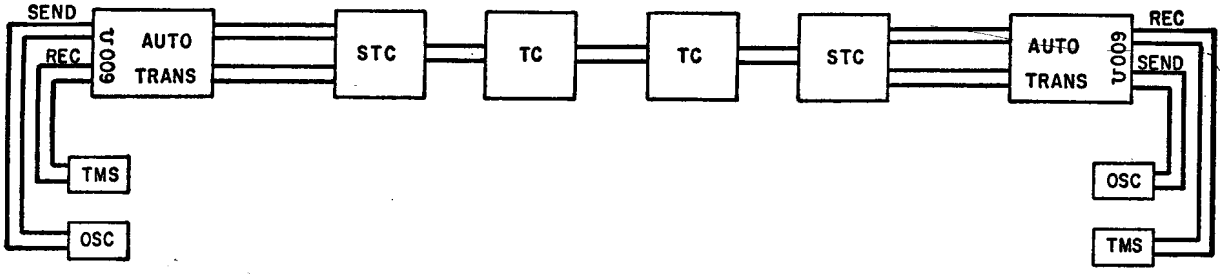

Fig. 6 — Tel Set to Tel Set