VOICE BANDWIDTH PRIVATE LINE DATA CIRCUITS

MAINTENANCE

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LIST OF TABLES AND FIGURES

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1. GENERAL

1.01 This section provides the maintenance considerations and testing policy to be used when performing maintenance tasks on voice bandwidth private line data circuits. At this time, there are several types of data sets used in private line data service, ranging in bit speed from low (below 300 bits per second) to high (up to 10,800 bits per second).

1.02 In order to prevent high level signals from causing harm to the telephone plant, a program of signal power measurements should be established. Broadband carrier systems should be surveyed for problems caused by high signal power. In addition, signal power measurements are required every 6 months and are a part of every trouble report involving a CPM.

2. MAINTENANCE CONSIDERATIONS

2.01 This part provides maintenance and test access information on 2-point and multipoint circuits.

A. 2-Point Circuits

2.02 2-point circuits provide data communication between two locations. These circuits may be basic, or have C1, C2, C4, or C5 conditioning. C3 conditioning is restricted to switched services network only. Information on this type of conditioning is given in Section 309-200-301. C5 conditioning can be ordered only on 2-point circuits. Some C5 circuits have more than one station per exchange, but only one can be connected at a time. A given station may communicate only with a particular designated station in the distant exchange. No trouble report will be accepted nor testing done for combinations of stations other than those specified by the service order.

2.03 The minimum conditions under which end-to-end measurements are required are given in Table A. End-to-end measurements are preferred in all cases and should be performed if service conditions permit. Sectional measurements made with the Collins CLA-101A system are considered equivalent to end-to-end measurements in conjunction with the minimum conditions given in Table A. End-to-end measurements are required in all cases where the customer is not satisfied and/or the need for technical escalation is indicated.

TABLE A

CONDITIONS UNDER WHICH END-TO-END CIRCUIT ORDER ATTENUATION DISTORTION AND ENVELOPE DELAY DISTORTION MEASUREMENTS ARE REQUIRED ON 2-POINT CIRCUITS

CONDITIONING	DATA SET TYPE		
	1	2	3
Basic	No	No	No
C1	No	No	Yes
C2	No	Yes	Yes
C4	Yes	Yes	Yes
C5	Yes	Yes	Yes

2.04 For the purpose of estimating end-to-end performance from sectional measurements, a 2-point circuit should be divided into only two sections. One section should normally be from the control STC to its station and the other section should be from the same STC to the distant station. Care should be exercised to ensure that no office equipment or wiring is omitted or measured twice in this sectionalization. End-to-end performance is estimated from sectional measurements as given in Section 314-410-102.

> ***Note:*** If sectional measurements are permitted as given in Table A and are made partly with the Collins CLA-101A and partly with other test equipment, the static measurements should be made using the CLA-101A frequencies where possible.

B. Multipoint Circuits

2.05 The end link/midlink concept allocates end-to-end transmission parameter requirements to individual link requirements. This simplifies the design and maintenance of multipoint and switched networks and reduces the need for end-to-end testing. Networks can be altered or expanded with a minimum of redesign or testing. Sometimes to accommodate planned growth, circuits are engineered with links designated to tighter limits than are immediately required. In these cases they should be maintained on the same basis that they were engineered, and shown on the circuit layout record card (CLRC).

2.06 The end link/midlink allocation rules take advantage of statistics when combining link parameters and thus do not guarantee that the end-to-end connection will always meet limits. End links generally contain voice frequency cable plant, and their high-frequency response characteristics tend to be similar and cumulative. The limits on end links have been tightened over previous limits to reflect this condition. Even with the tighter limits it is possible for all the end links and midlinks to be within limits and the end-to-end limits to be exceeded. Particularly on end links it is important that the full capability of any selected equalizers be used; ie, do not add extra equalizers to optimize the parameters, but ***do select the optimum equalizer(s) and optimize any adjustments on lineup.***

2.07 End-to-end attenuation distortion and delay distortion tests will not be required on multipoint circuits with conditioning requirements equivalent to C2 or less. End-to-end tests are required on C4 conditioned circuits.

2.08 Where a customer is dissatisfied with performance on a multipoint channel and the data set is customer-provided, end-to-end measurements are required between at least one pair of points where service is not satisfactory to the customer before technical escalation on circuits of any grade of conditioning. If the complaint concerns service between one pair of points, the measurements should be between those points. If the complaint concerns service between more than one pair of points but some are worse than others, the worst pair should be chosen for measurement tests. If they are equally bad, choose any convenient pair.

C. Central Office Relay Switched Circuits

2.09 The end link/midlink concept is also used with central office relay switched circuits. The circuit may be unconditioned or have C1 or C2 conditioning between all pairs of stations. End-to-end (customer-to-customer) attenuation distortion and envelope delay distortion measurements are not normally required.

2.10 Although the transmission parameters are normally measured on an end link/midlink basis, the overall transmission requirements must be met between any pairs of customer stations. These measurements must be made between the two worst-case stations through the switched connection in the event of a trouble report before technical escalation.

D. Customer Premises Switched Circuits

2.11 A customer premises switched arrangement is permissible; however, no overall conditioning can be guaranteed.

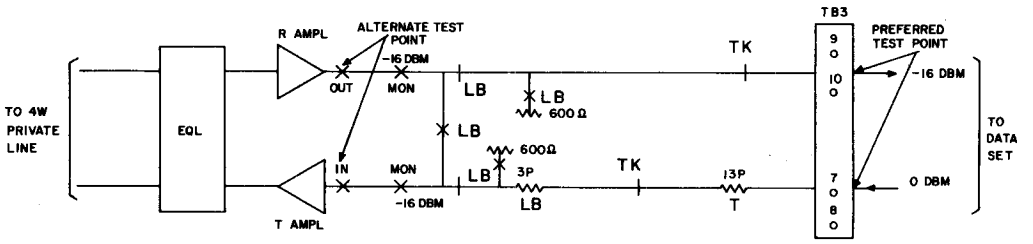
2.12 The overall connection may be arranged to approximate the bandwidth parameter response of a basic channel or a C2 conditioned channel. Only the individual channel should be measured, never the overall connection.

2.13 The end-to-end facility parameter must be met on each individual channel. However, it is often not possible nor is it required to assure that end-to-end facility parameter requirements will be met on the overall connection, since it may include more local and short-haul facilities in tandem than normal.

E. Test Points

2.14 Although there may be a number of points where transmission tests can be made, it is best to limit the choice of test access points to a few locations in order to be certain of measuring at a known impedance and TLP. Figure 1 illustrates a typical 4-wire data set circuit design at a customer location using DAS 828A or equivalent. In this case the test access points would be at the point where the data set is connected to the circuit. This point has been chosen because it is a fixed 600-ohm point and terminated measurements can be made (with the data set disconnected from the circuit) which include all the pads and amplifiers at the station.

2.15 If DAS 828A is used at the station, an alternate test point may be considered. This would be the AMP IN jack looking toward the central office and the AMP OUT jack looking from the central office. Measurements at these points are made on a terminated basis at a 600-ohm impedance.



NOTE:
1. DATA LEVELS ASSUMING -13 DBMO DESIGN ARE SHOWN.

Fig. 1—Standard Circuit Design for Data Only, 4-Wire Data Set

Note: The station loss between this point and the connection to the data set must be tested before this test access point is used. This point should ***not*** be used when tests are being performed in the case of repeated trouble reports, to check that the end-to-end transmission parameters are within limits. Only the point where the data set is connected is used.

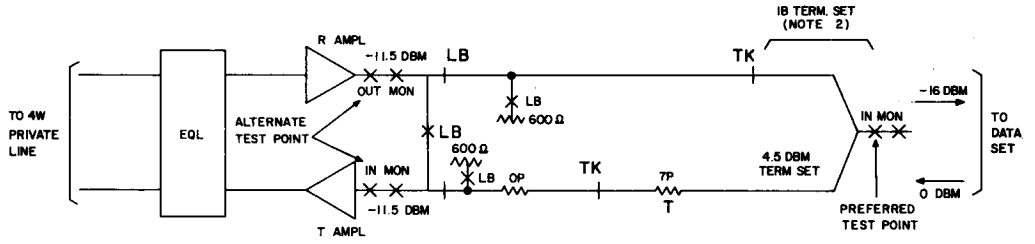
2.16 When making transmission measurements at the station, DAS 828A is considered to be part of the channel facilities and tests are to be made through it.

2.17 The test equipment should not be connected directly to the local cable pairs when transmission components (such as pads, repeat coils, and amplifiers) are used at the customer location, as this will result in the incorrect measurement of attenuation distortion, delay distortion, and other parameters. If the data set is connected directly to the cable pair, the test equipment should be connected at the same point with the data set temporarily disconnected. The test equipment should be set to make measurements in a 600-ohm terminated mode unless the circuit layout record card (CLRC) specifies a different impedance at this point. Although the cable pair will seldom have a 600-ohm impedance, the transmission measuring equipment will be indicating the insertion loss characteristics of the circuit with which the data set (which should also be 600 ohms) is designed to work.

2.18 Figure 2 illustrates a typical long haul circuit which is 4-wire station-to-station but converts to 2-wire for connection of a 2-wire modem. The test access point is at the point where the data set is connected to the circuit. In the case of DAS 828A, this would correspond to the 2-WIRE IN jack. Measurements are made on a 600-ohms terminated basis unless the CLRC specifies some other impedance.

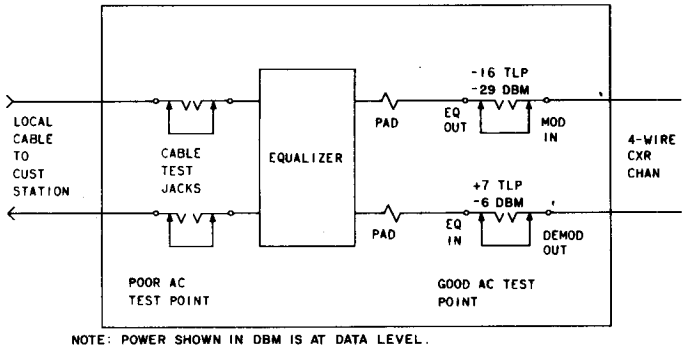
2.19 Figure 3 illustrates a 4-wire circuit at a typical serving test center. Measurements should be made at a point where the impedance is known to be 600 ohms rather than looking directly at the cable pair. An excellent measuring point is the VF jacks or equivalent private line testboard jacks associated with a 4-wire carrier channel.

2.20 Figure 4 illustrates a 4-wire multipoint circuit at a central office bridge location. Measurements should be made at the closest test access point to the bridge in order to measure the effect of all equipment used to make up the end link or midlink. When testing a link off a bridge, it is necessary to first terminate that appearance in 600 ohms (both transmitting and receiving) in order to avoid unbalancing the bridge and to permit use by the customer of other portions of the circuit without interference from test tones or other trouble conditions.



NOTES:
1. DATA LEVELS ASSUMING -13 DBM 0 DESIGN ARE SHOWN.
2. SI SCREW AND COMP NET SCREW MUST BE DOWN IN ALL CASES.

Fig. 2—Standard Circuit Design for Data Only, 2-Wire Data Set



NOTE: POWER SHOWN IN DBM IS AT DATA LEVEL.

Fig. 3—Test Access Points on 4-Wire Circuit at Typical STC Office

3. TESTING POLICY

A. Required Channel Transmission Tests

3.01 Table B shows the three basic types of data sets used for voiceband data service. The general classifications are used to determine the degree of initial testing required. Table C is used to determine the specific parameter that should be measured for the circuit order, routine, or initial trouble tests.

3.02 Table C is arranged to reduce the number of tests required to verify that the channel meets critical requirements for the ordered service. This minimizes the testing of some parameters to which the data set is not particularly sensitive, or which are likely to be within limits as specified in this section.

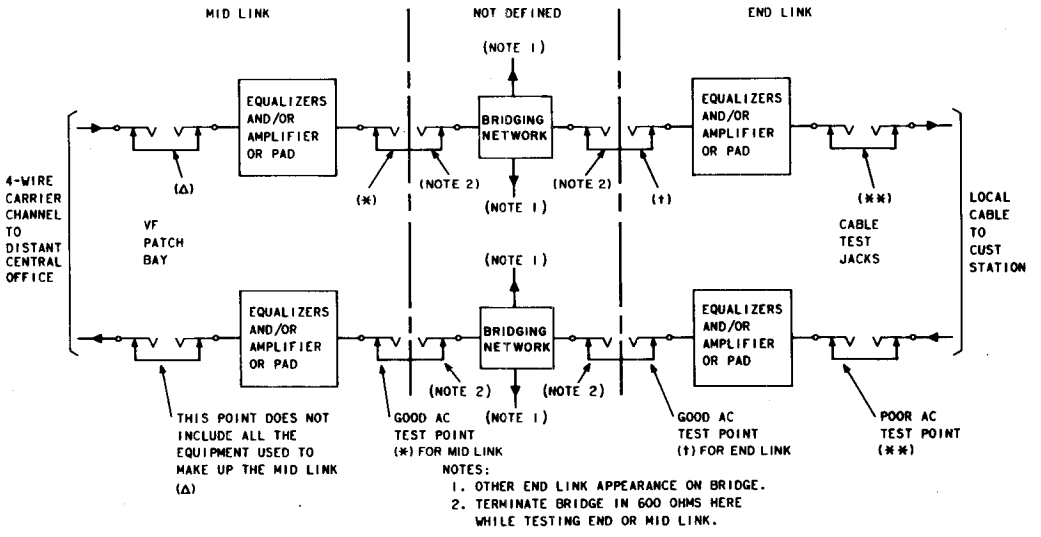


Fig. 4—Test Access Points on 4-Wire Multipoint Circuit at Bridge Location

TABLE B

TYPE LISTING OF DATA SETS BY BIT RATE SPEED

TYPE 1	TYPE 2	TYPE 3
Generally low speed (below 300 bps) Bell System analog or digital serial and parallel sets: 100 Series 401-type 403 407 601 603	Generally medium speed analog or digital serial and parallel sets: 201-type 202-type 205 207 402 602 All CP modems operating at 2400 bps or below	203-, 208-, 209- type All CP modems operating above 2400 bps

TABLE C

REQUIRED TRANSMISSION TESTS FOR MAINTENANCE PROCEDURES

TRANSMISSION TEST	CIRCUIT ORDER TEST			ROUTINE TEST			INITIAL TROUBLE REPORT TEST		
	DATA SET TYPE			DATA SET TYPE			DATA SET TYPE		
	1	2	3	1	2	3	1	2	3
NET LOSS	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
MESSAGE CIRCUIT NOISE	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
C-NOTCHED NOISE	No	No	Yes	No	No	No	(5)	(5)	Yes
IMPULSE NOISE	No	Yes	Yes	No	No	No	Yes	Yes	Yes
TOTAL POWER OUTPUT (8)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FREQUENCY RESPONSE	(1)	(1)	Yes	No	No	No	(5)	Yes	Yes
ENVELOPE DELAY	(1)	(1)	Yes	No	No	No	(5)	Yes	Yes
SINGING MARGIN/RETURN LOSS	(7)	(7)	(7)	No	No	No	(5)	(5)	(5)
FREQUENCY SHIFT	No	No	No	No	No	No	(5)	(5)	(5)
PHASE JITTER (2)	No	No	Yes	No	No	No	(5)	(5)	Yes
NONLINEAR DISTORTION (3)	No	No	Yes	No	No	No	Yes	Yes	Yes
DC LOOP RESISTANCE	Yes	Yes	Yes	No	No	No	(4)	(4)	(4)
SINGLE TONE INTERFERENCE (6)	Yes	Yes	Yes	No	No	No	(5)	(5)	(5)

( ) Numbers in parentheses refer to the following notes.

(1) If conditioning (C1, C2, C4, or C5) or a multipoint circuit has been ordered, a frequency response and envelope delay distortion measurement must be made. If a basic (not C-conditioned) 2-point (not multipoint) channel is ordered, the following policy applies:

Type 1 Data Sets — Frequency response and envelope delay distortion measurements are not required.

Type 2 Data Sets — Measure the loss deviation of the channel at 3000 Hz as compared to 1000 Hz. The measurement should be within the limits of Table C in Section 314-410-500. If not, equalize and make frequency response and envelope delay measurements over the entire frequency band using the measurement frequencies given in Table C of Section 314-410-500. The limits are specified in Tables D and E of Section 314-410-500.

Type 3 Data Sets — A frequency response and envelope delay distortion measurement must be made using the measurement frequencies given in Table C of Section 314-410-500. The limits are specified in Tables D and E of Section 314-410-500.

(2) This measurement required if LMX carrier facilities make up part of the circuit.

(3) This measurement required only if D1A or B channel banks (used on T1 carrier, for example) or N or ON carrier make up part of the circuit.

(4) The dc loop resistance measurement is required if loss measurements are out of limits between the customer station and the STC.

(5) This test required after repeated trouble reports have been received and the source of the problem cannot be determined.

(6) A listening test for single tone interference will normally be sufficient.

(7) Required to 2-wire data station if the circuit is 4-wire at any point.

(8) Refer to Part 3G for total power output test policy and intervals.

B. Testing Circuits Terminating in Telco-Provided Modems

3.03 When the modem (data set) is provided by Telco and the conditions specified in Table D are met, the following testing policy applies:

(1) Measure and meet the requirements for 1000-Hz loss, attenuation distortion, and envelope delay distortion.

(2) Make error performance test specified in the 59X Division for each modem with the modem output power reduced 3 dB below normal (−16 dBm0 or 3 dB below data level).

(3a) If normal error performance requirements are met, no further installation tests are necessary.

(3b) If normal error performace requirements are not met, perform additional circuit order installation tests as specified in Table C and meet all reqirements.

(4) After all transmission requirements in (3b) are met, repeat the error performance tests with the modem output power at data level (−13 dBm0). If the error performance requirements specified in the 59X Division for each modem are met, no further tests are required.

Note: The modem power output may be reduced by 3 dB by double terminating. To do this, connect a 600-ohm termination or the input of a 600-ohm test set to the EQ OUT jack (looking from the data set) of DAS 828A. Error performance tests at a reduced output power help to determine the margin of the modem against noise and impulse noise.

3.04 When the modem is provided by Telco but the conditons specified in Table D are not met, the following testing policy applies:

(1) Measure and meet the requirements for each of the transmission tests specified in Table C.

(2) The modems should be tested and maintained to their requirements given in the appropriate section (590—596 Divisions).

3.05 Although the modem error performance may be satisfactory, it is possible that other interface requirements may not be met by the modem. For example, the modem receive clock may be momentarily out of synchronization in starting up a polling-type system. If error tests are satisfactory but the customer is still experiencing trouble, the problem should be referred immediately via established procedure to a DATEC representative. Procedures for obtaining data technical support are covered in 3.24.

3.06 If the customer has ordered a 2-point conditioned channel, it is a tariff requirement to meet the conditioning requirements (attenuation distortion and envelope delay distortion), regardless of the satisfactory error performance of the Bell System modem. In addition, if alternate voice service is ordered, the message circuit noise limits must also be met before the channel is placed in service, regardless of the error performance of the modem. All other transmission parameter requirements are provided to serve as a guide for troubleshooting in the event that error performance tests are not made. On multipoint circuits it may be difficult to make error performance tests between all modems; therefore, transmission parameter requirements should be met on all end links and midlinks.

C. Testing Circuits Terminating in Customer-Provided Modems

3.07 If a customer-provided modem (CPM) terminates the channel, normal Bell System testing is restricted to channel-only tests. ***Do not test any customer-provided equipment (CPE)****. This includes cases where Bell System equipment is on both sides of CP equipment; the Bell System equipment must be tested separately rather than through the CPE. The channel limits specified in this section must be met.

*Joint tests of CPE are permitted only if Bell System data technical support personnel request such tests.

3.08 After circuit order tests given in Table C have been made, any trouble condition is corrected, and the CPM has begun operation on the channel, the customer may complain of a high error rate which he believes is due to the channel. The initial trouble measurements specified in Table C should then be made on an end-to-end basis even though the Bell System does not guarantee any error rate when a CPM is used. All transmission tests must be performed if recurring trouble reports

TABLE D

CIRCUIT TYPES WHERE TELCO MODEMS ARE USED AND ERROR RATES ARE MAINTAINED

TYPE OF CIRCUIT	ERROR RATE MAINTAINED
Private Line	
Recommended channel*	Yes
Lower grade than recommended	No
Access to Switched Telecommunications Network from PBX or Centrex	
From on-premises station	Yes
From off-premises station	No†
Connection to Switched Telecommunications Network from Private Line	
Network (via PBX, Centrex, etc)	No†

*Where more than two circuits are to be switched together, the combined circuits must meet the recommended grade of channel. Interconnecting a series of point-to-point channels, each having the recommended grade of conditioning, will not necessarily result in an overall circuit meeting the recommended grade of channel conditioning. Where switching arrangements are desired, the channel conditioning must be ordered and billed as switched under F.C.C. Tariff No. 260 or similar intrastate tariff. Refer to Section 314-410-101 for data set channel conditioning requirements.

†Low speed (below 300 bps) and limited distance high speed may be successful, but no performance is specified.

are received. However, repeated reports of high error rates with a CPM after the chanel has been verified to be within limits should not result in the channel being measured repeatedly. Such cases may require data technical (DATEC) assistance referred to in 3.24.

3.09 If a channel-only service with a CPM has operated satisfactorily for an extended period of time (several weeks) and the customer complains of high error rates which he attributes to the telco channel, the initial trouble measurements should be made as given in 3.12 through 3.21.

3.10 Channel measurements are made in the cases mentioned in 3.08 and 3.09, since the customer will usually know only that he has a high error rate and in these instances this may well be due to a channel problem. The customer should have tested his own equipment first. The customer should not be required to specify which transmission parameter is out of limits for such initial trouble reports. However, on a complex trouble investigation where Bell System channels have been measured and are meeting limits and the customer calls in the technical support people representing the manufacturer or maintenance organization responsible for the data set, more definitive trouble reports may be expected.

3.11 If the channel is within all specified limits when measured following a customer complaint and repair personnel have been dispatched to the customer location, the supervisor should be notified, since a service charge may be applied.

D. Loop-Back Tests

3.12 The loop-back tests given in Table E should be performed for purposes of trouble

sectionalization on 4-wire facilities from the STC with the circuit looped back at the customer station. Before operating the loop-back arrangement at the customer station, the transmit leg from the customer station should be terminated at a point looking toward the other customer stations. At the VF patch bay, a 600-ohm termination placed in the MOD IN jack will be suitable. This is important to prevent the possibility that tests made toward the local customer station might affect service to other stations on multipoint circuits. In the case of some tone-operated loop-back arrangements, it will prevent the loop-back control tone towards the local station from causing loop-back relays at the other customer stations to operate.

3.13 The application of direct current to the 4-wire simplex path for purposes of operating the loop-back relay at the customer station may cause troubles such as opens or noise to come clear. This is generally caused by a poor solder connection. In the event of repeated trouble reports of this nature, do not apply direct current to the circuit, but isolate the trouble by applying a tone to the circuit and monitoring the circuit at appropriate test points (such as the frame). If a trouble of this nature cannot be isolated, it may be necessary to apply sealing current to the circuit.

E. Interexchange and Midlink Tests

3.14 The initial trouble report tests given in Table C should be performed on the interexchange facilities (in the case of a 2-point private line) or on a suspected midlink or links in the case of a multipoint circuit.

F. End-to-End Trouble Tests

3.15 The end-to-end trouble tests are required if the customer is not satisfied with the service and the following steps have been taken:

(1) Loop-back tests have been made at each end of the circuit and all limits met.

(2) Interexchange or midlink tests have been made and all limits met.

(3) The customer has been requested to verify the proper operation of his equipment and has reported back that no trouble has been found but problems are still being encountered overall.

3.16 To make the tests, repair personnel should be dispatched to the appropriate customer locations for purposes of end-to-end trouble tests. In the case of certain multipoint circuits, where the trouble is limited to transmission to a single remote station, it may only be necessary to make tests of the end link from the bridge to the customer location, and coverage may not be required at any other stations.

3.17 It is not necessary to make all end-to-end transmission tests at the customer station if the tests are primarily intended to verify the proper operation of carrier facilities (such as phase jitter tests). Instead, these tests may be made at the ends of only the carrier portion of the circuit if suitable test equipment is not available at the customer station.

3.18 When the modems (data sets) are provided by Telco and the conditions specified in Table D are met, error performance tests should be made between the appropriate modems. If error runs are unsatisfactory, the initial trouble report transmission tests should be performed in order to sectionalize the trouble. Trouble tests should be continued only until satisfactory error runs are obtained.

3.19 As soon as satisfactory error runs are obtained, the customer should be asked to determine whether his equipment is performing satisfactorily. If not, the customer should be asked to perform extensive trouble tests on the CPE. If no problems can be found in the CPE, follow the procedures in 3.05 of this section.

3.20 When the modems are provided by Telco but the conditions in Table D are not met, it may still be useful to make error performance tests between the appropriate modems. If the error runs are satisfactory, transmission tests will not be required. Instead, the procedures given in 3.19 may be followed.

3.21 If the error performance tests are unsatisfactory, the modems should be tested and maintained to their requirements given in the appropriate section (590-596 Divisions). In addition, the initial trouble report tests specified in Table C should be made at this time. There is no requirement to obtain satisfactory error performance when the conditions in Table D are not met and the Telco-provided modems and channel meet specifications.

TABLE E

SUGGESTED LOOP-BACK TROUBLE TESTS
(STC-TO-STA)

MAINTENANCE TEST	DATA SET TYPE		
	1	2	3
NET LOSS	Yes	Yes	Yes
MESSAGE CIRCUIT NOISE	Yes	Yes	Yes
IMPULSE NOISE	No	No	Yes
NONLINEAR DISTORTION	No	No	Yes (1)
C-NOTCHED NOISE	No	No	Yes (1) (2)
TOTAL POWER OUTPUT	Yes (2)	Yes (2)	Yes (2)

( ) Numbers in parentheses refer to the following notes.

(1) This measurement required only if N, ON, or T carrier. Compandored channels make up part of the local channel.

(2) Remove the loop-back condition and connect the data set transmitter to the line.

3.22 When the modem is provided by the customer, the intial trouble report tests specified in Table C should be made and any troubles found cleared.

3.23 If the initial trouble report tests specified in Table C are made and the limits met but the customer's problem is not cleared, or if recurring trouble reports are received, it will be necessary to verify that all transmission parameters are met. The customer should be advised that considerable circuit turndown time may be required to make a complete set of measurements.

3.24 There will be some circumstances under which special technical support will be needed in order to solve a service problem. Technical support should be sought under the following conditions:

(a) The service meets all Bell System specifications but does not meet the customer's performance expectations. Telephone company personnel should not attempt to provide better than Bell System specifications without higher management approval.

(b) The service does not meet Bell System specifications and the problem source cannot be identified.

(c) Excessive trouble reports have been received and have been closed out as "Test OK," "Came Clear," "Found OK," or "No Trouble Found." This type of conditon should be referred immediately upon receipt of the third trouble report within a 2-month period.

(d) The customer reports a transmission parameter as being out of limits but no mention is made in this section of that parameter. As an example, a report of "percent phase distortion" should be referred for technical support.

3.25 Refer to Section 010-521-100 for guidelines regarding data technical support.

G. Routine Tests

3.26 Routine tests, other than total power output, are not necessary except where required by local practices. Total power output should be checked as a part of inital installation tests and all trouble report tests. It should be tested on a routine basis about 6 months after circuit order tests have been completed to verify that changes have not been made in the modem output level. No further total power output routine tests are necessary if the power is not excessive on the first routine test or on subsequent trouble tests. If the total output power is excessive, action should be taken to bring it within limits, and further total output power routine tests should be made at 6-month intervals until the limits are met for two consecutive tests. Repeated failures to keep the total output power from exceeding Telco specifications may require one of the following:

(a) The addition of limiting amplifiers to the channel in order to prevent possible deterioration of service to other customers.

(b) The suspension of the customer's service on a specified date (10 days) after written notice of the tariff violation is delivered to the customer in those cases where the customer refuses to reduce the total power output, disconnect the device, or allow installation of a signal limiting device.

H. Parallel Tests

3.27 Parallel testing is the simultaneous testing of several channels of the same carrier system or group during a customer data run or error performance test. This type of testing assists in locating objectionable facility time-varying parameters such as phase jitter, impulse noise, dropouts, frequency shift, phase hits, and gain hits. The test sets on the adjacent (parallel) channels are observed for fluctuations (or other indications such as counts) that occur at the same time that data errors are noted. A high level of coincidence indicates that the facility being tested is the probable offender.

4. USE OF FORM E-5596

4.01 The tests to be performed are given in Table C. These measurements should be made and the results recorded on Form E-5596. A separate Form E-5596 will be required for recording benchmark loop-back measurements at the STC. Enter the term LOOP-BACK under entry 2 as described in 4.02. Note that the circuit mileage is doubled when loop-back tests are made for purposes of determining message circuit noise and impulse noise requirements.

4.02 The following is an explanation of entries for Form E-5596 (Fig. 5).

1. Enter circuit number.
2. Enter appropriate link or section of circuit if straightaway measurements are recorded. Also, use this space to indicate loop-back test results.
3. Enter date of test.
4. Enter circuit order number.
5. Enter results for gain-frequency and envelope delay distortion measurements made for circuit order or trouble tests.
6. Enter frequency shift measurements as required.
7. Enter phase jitter measurements as required.
8. Enter single tone interference measurements as required. Also enter the approximate frequency of the tone.
9. Enter harmonic distortion measurements as required.
10. Enter C-notched noise test results as required.
11. Enter return loss measurements as required.
12. Enter dc loop resistance test measurements as required.

13. Enter the total power.

14. Enter the 1000-Hz loss measurement.

15. Enter the noise measurement.

16. Enter the impulse noise measurement.

17. Enter the P/AR measurement.

18. Enter routine measurements of total power and any others as required by local practices. The total power measurement is a high-impedance level measurement.

4.03 Form E-5596 is available only in package units of 25 forms. Orders should be placed in multiples of 25 forms and worded as follows:

(Quantity), Form E-5596

4.04 This form will not be stocked automatically at the Western Electric Company Service Center. Each company must authorize its local service center to stock new forms. In case of revised forms, disposition must be given of the old forms before the revised forms can be stocked.

314-410-500 E-5596
CIRCUIT NUMBER (1) DATA TRANSMISSION HISTORY CARD LINK (2) PRINTED IN U.S.A.

TEST DATE	(3)		(3)		(3)		(3)		(3)		(3)	
CKT. ORDER NO. (4)	(5) TR (INITIAL)		(5) REC (INITIAL)		(5) TR		(5) REC		(5) TR		(5) REC	
	DELAY	GAIN FREQ	DELAY	GAIN FREQ	DELAY	GAIN FREQ	DELAY	GAIN FREQ	DELAY	GAIN FREQ	DELAY	GAIN FREQ
300	X		X		X		X		X		X	
500												
600												
800												
1000												
1200												
1400												
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2800												
3000												
3200	X		X		X		X		X		X	
(6) FREQ. SHIFT HZ												
(7) PHASE JITTER DEGREES												
(8) SINGLE-FREQ INT. DBRNCO												
(9) HARMONIC DIST. (2ND/3RD) DB												
(10) C-NOTCHED NOISE DBRNCO												
(11) RETURN LOSS - SP DB												
(12) DC LOOP RESISTANCE OHMS												

A - Form E-5596 (Front)

ROUTINE MEASUREMENTS

CIRCUIT NUMBER (1) LINK (2)

TEST DATE	Total Power DBMO		1000 HZ Loss DEVIATION		Noise DBRNCO		Impulse Noise COUNTS/15 Min.		P/AR	
	TR	REC	TR	REC	TR	REC	TR	REC	TR	REC
INITIAL MSMNTS	(13)	(13)	(14)	(14)	(15)	(15)	(16)	(16)	(17)	(17)
(3)	(18)	(18)	(18)	(18)	(18)	(18)	(18)	(18)	(18)	(18)
(3)										

B - Form E-5596 (Back)

Fig. 5—Form E-5596—Data Transmission History Card