"DATAPHONE®" DATA COMMUNICATIONS SERVICE OVERALL DATA TRANSMISSION TEST REQUIREMENTS DATA SYSTEMS ON THE PUBLIC SWITCHED NETWORK

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1. GENERAL

1.01 This section describes the overall transmission considerations and test requirements involved in providing data transmission over the Public Switched Network (PSN) using loops, trunks, and switching equipment as used in voice service. This section applies to both DATAPHONE data communications service and to data services using customer-provided equipment (CPE), unless otherwise specified. There are no specific requirements for inductively or acoustically coupled data stations. Specific test requirements for access lines [subscriber, foreign exchange (FX), wide area telecommunications service (WATS), and PBX extensions] used for data transmission are given in Section 314-205-501. The overall minimum acceptable performance (MAP) criteria for the network facilities are given in Section 314-205-503.

Note: In this section the term TELCO applies to all operating telephone companies, Bell System and independent.

1.02 This section is reissued for the following reasons:

- To update test requirements
- To eliminate Tables J, K, and L
- To change information on international data service.

Since this is a general revision, change arrows ordinarily used to indicate changes have been omitted.

1.03 Data services on switched networks to the 50 states and Canada are supported. International data service is not supported.

1.04 In general, data transmission calls are handled the same as voice telephone calls. The calling party dials the desired number and the called party answers. When the parties are ready to send or receive data, both parties change their mode of operation from voice to data by the operation of pushbuttons or keys either built into or associated with the data set. It is necessary that the data sets on both ends of the connection be of the same type and be compatible in bit rate, frequency, etc. Upon completion of the data transmission, both parties (by previous agreement) either hang up or return to the voice mode. There are exceptions to this procedure, eg, the called station may be unattended. If the called station is unattended, the calling party receives a tone indicating that the distant end data set has answered and is ready to receive (or send) data. At the end of the call, the distant end will disconnect under the control of the far-end business machine equipment. Another exception is in the use of automatic calling units. These units permit a computer or other similar business machine to "dial" the desired number. These systems are usually associated with the unattended service feature described above, and therefore no person is involved at any time during the sequence of operations.

1.05 A number of data test centers have been established in various locations in the Bell System and are used in conjunction with local and toll test centers. The data test centers are arranged for remote testing and monitoring of data sets in DATAPHONE data communications service and in voiceband private line services.

1.06 Voice or data jacks are used to provide means for registered data sets to be connected to the

PSN. When a CPE data set is used with these jacks, neither the error rate performance nor the data set is to be tested by the DTC or by other TELCO personnel. Refer to Section 314-205-300 for various levels of support.

> ***Note:*** As of July 1, 1979, only registered data sets may be connected to the network; however, apparatus legally connected to the network before this date (grandfathered apparatus) may remain connected for life.

1.07 An important characteristic of analog transmission systems is that the adjustment of a component made at any one point will have an effect upon adjustments made at other points. Therefore, it is important in clearing transmission difficulties to correct the basic cause of the trouble rather than to make terminal adjustments to eliminate the symptoms.

1.08 Descriptive information common to the transmission of data on the PSN, private line services, and Switched Service Network (SSN) is covered in the following sections:

- Data General, Analog Transmission Parameters, Description (Section 314-010-100)
- Data General, Data Testing Principles (Section 314-010-101)
- Data General, Data Services Support (Section 314-010-102)
- Data General, Interconnection/Interpositioning (Section 314-010-103)

A basic understanding of the Data General sections is recommended prior to the use of this section.

2. INVESTIGATION OF NETWORK TROUBLES

2.01 Data transmission requires control of more parameters than does voice transmission. The parameters of interest are listed in the order in which they are to be tested for maintenance purposes and are as follows:

- C-Notched noise
- Impulse noise
- Phase jitter
- Gain slope
- Peak-to-average ratio (P/AR)
- Intermodulation distortion
- Gain hits
- Dropouts.

Requirements for the parameters of data transmission are given in Tables A through I.

2.02 On a connection over the PSN, the effects of such items as overall loss, attenuation frequency distortion, envelope delay distortion, etc, are cumulative as the length of the circuit and the number of links involved increase. All types of switched facilities are subject to some interruptions, which may be due to equipment failures, facility failures, or human errors. The object of maintenance testing for data services is to determine the location of troubles which can cause actual failures in data transmission over the message network. The malfunction may be of very short duration—measured in microseconds, fading,or dropouts which can extend seconds or minutes, or actual facility failures which will interrupt service for a considerable length of time. It is important to note that service should be restored as quickly as possible. For example, a data service operating at 1200 bits per second is capable of transmitting or receiving over four million bits of information in 1 hour. The message network is so arranged that a complete failure of a cable, a carrier channel, or central office terminal equipment will usually be detected by means of automatic alarm systems.

2.03 Analysis of station records may give an indication as to the source of repeated data troubles. When it is possible, the circuit or connection should be "held" at the serving office and the call traced and tested through its various links in order to detect the malfunction. Since it is not always possible to continue to "hold" the suspected circuit for immediate testing, a record should be made of the links involved and arrangements made to test the circuit at the first appropriate opportunity.

2.04 When tests are made between the serving office and the data set location, maximum use should be made of test signal sources, such as milliwatt sources, quiet terminations, and 107-type test lines, when available.

INTERNATIONAL SERVICE

2.05 If a data transmission trouble report involving an international location is received, perform standard tests on the local access line. In addition, any TELCO provided equipment (eg, data set, terminal, etc) should be checked to ensure that it is operating properly.

> ***Note:*** Tests of the network or far-end equipment should not be made.

2.06 If the results of the above test indicate no trouble, the bureau should call the customer and close the trouble report. If the customer is not satisfied, the International Data Coordinating Center (IDCC) should be informed. The IDCC is located at the Long Lines organization in Morris Plains, New Jersey. It may be contacted by calling 201-631-4515 or 4516. This center will contact and communicate with the customer. After the IDCC has been informed, the PSC should consider the report closed.

3. REFERENCES

3.01 Bell System Practices mentioned in this section which cover various equipment are listed as follows.

SECTION	TITLE
010-521-100	Data Technical (DATEC) Support
103-110-110	J94027F and G Par Meter Generator and Receiver, Description, Operation, and Maintenance
314-205-300	Data Systems—DATAPHONE® Service on Direct Distance Dialing Network, Overall Transmission Maintenance Procedures
314-205-501	Data Systems—DATAPHONE® Service and Other Data Services on the Direct Distance Dialing Network—Test Requirements for Subscribers, Foreign Exchange, and WATS Lines
314-205-503	Data Systems—DATAPHONE® Service and Other Data Services on the Direct Distance Dialing Network—Minimum Acceptable Performance Criteria and Test Procedures

TABLE A

ATTENUATION FREQUENCY DISTORTION (SLOPE) LIMITS

FACILITY	LOSS IN DB RELATIVE TO 1004 HZ					
	MAINTENANCE LIMITS		IMMEDIATE ACTION LIMITS		TYPICAL	
	400 HZ	2800 HZ	400 HZ	2800 HZ	400 HZ	2800 HZ
OA, OB OC, OD	−1.0, +2.5	−1.5, +2.5	−2.0, +4.0	−2.0, +4.0	±0.8	±1.0
ON	−1.0, +2.0	−1.0, +2.5	−2.0, +4.0	−2.0, +4.0	±0.8	±1.1
N1	−1.0, +2.0	−1.0, +2.5	−2.0, +4.0	−2.0, +4.0	±0.8	±2.3
N2	−1.0, +1.6	−1.0, +2.0	−2.0, +3.0	−2.0, +3.0	±0.7	±1.2
N3	−1.0, +1.5	−1.0, +1.5	−2.0, +3.0	−2.0, +3.0	±0.8	±0.6
NR	−1.0, +1.6	−1.0, +1.0	−2.0, +3.0	−2.0, +3.0	±0.8	±0.9
R, LR, L	−1.0, +1.5	−1.0, +1.0	−2.0, +3.0	−2.0, +3.0	±1.0	±0.6
T1 (Toll)	−1.0, +1.0	−1.0, +1.0	−2.0, +3.0	−2.0, +3.0	±0.5	±0.5
T1 (Nontoll)	−1.0, +2.1	−1.0, +2.0	−2.0, +3.0	−2.0, +3.0	±2.3	±2.2
Metallic (Non-repeatered)	−1.0, +2.0	−1.0, +3.0	−2.0, +3.5	−3.0, +4.0	±0.5	±0.5
Metallic (Repeatered)	−1.0, +3.0	−1.0, +4.5	−2.0, +4.5	−2.0, +5.5	±0.5	±2.0

TABLE B

C-NOTCH NOISE LIMITS IN DBRNC0 (NOTE)

FACILITY		HOLDING TONE LEVEL IN DBM0	CIRCUIT LENGTH (MILES)						
			0 TO 100	101 TO 200	201 TO 400	401 TO 1000	1001 TO 1500	1501 TO 2500	2501 TO 4000
Noncompandored		any	32, 38	34, 38	35, 42	38, 42	39, 42	41, 46	43, 48
Mixed Comp	N1, ON	-10	51, 54	51, 54	51, 54	51, 54	51, 54	51, 54	52, 54
		-13	48, 51	48, 51	48, 51	48, 51	48, 51	48, 51	49, 52
		-16	45, 48	45, 48	45, 48	45, 48	45, 48	45, 48	47, 49
Noncomp or comp only	N2, 3, 4	-10	44, 47	44, 47	45, 47	45, 47	45, 48	46, 48	47, 48
		-13	41, 44	42, 44	42, 45	43, 45	43, 45	44, 46	45, 46
		-16	38, 41	39, 42	40, 42	41, 43	41, 43	43, 44	44, 45
	T1/D1A, B	-10	51, 53	51, 53	51, 53	51, 53	51, 53	51, 53	52, 53
		-13	48, 50	48, 50	48, 50	48, 50	48, 50	48, 50	49, 51
		-16	45, 47	45, 47	45, 47	45, 47	45, 47	45, 47	47, 48
	T1/other	-10	44, 45	45, 46	45, 46	46, 48	46, 48	48, 49	48, 49
		-13	41, 42	42, 43	42, 43	43, 45	43, 45	45, 46	45, 46
		-16	38, 39	39, 40	39, 40	40, 42	40, 42	42, 43	42, 43

Note: First number given in each entry is the maintenance limit, and the second number is the immediate action limit.

TABLE C

SIGNAL-TO-C-NOTCH NOISE RATIO IN DB (NOTE)

FACILITY		HOLDING TONE LEVEL IN DBM0	CIRCUIT LENGTH (MILES)						
			0 TO 100	101 TO 200	201 TO 400	401 TO 1000	1001 TO 1500	1501 TO 2500	2501 TO 4000
Noncompandored		−10	48, 42	46, 42	45, 38	42, 38	41, 38	39, 34	37, 32
		−13	45, 39	43, 39	42, 35	39, 35	38, 35	36, 31	34, 29
		−16	42, 36	40, 36	39, 32	36, 32	35, 32	33, 28	31, 26
Mixed Comp	N1, ON	−10	31, 28	31, 28	31, 28	31, 38	31, 28	31, 28	30, 27
		−13	29, 26	29, 26	29, 26	29, 26	9, 26	9, 26	8, 25
		−16	27, 24	27, 24	27, 24	27, 24	7, 24	27, 24	6, 23
Noncomp or comp only	N2, 3, 4	−10	38, 35	37, 35	37, 34	36, 34	36, 34	36, 33	34, 33
		−13	36, 33	35, 33	35, 32	34, 32	34, 32	33, 31	32, 31
		−16	34, 31	33, 31	33, 30	32, 30	32, 30	31, 29	30, 29
	T1/D1A, B	any	29, 27	29, 27	29, 27	29, 27	29, 27	29, 27	8, 26
	T1/other	any	36, 35	35, 34	35, 34	34, 32	34, 32	32, 31	32, 31

Note: First number given in each entry is the maintenance limit, and the second number is the immediate action limit.

TABLE D

IMPULSE NOISE OBJECTIVES (NOTE)

FACILITY	HOLDING TONE LEVEL DBM0	THRESHOLD IN DBRNC0			
		CIRCUIT LENGTH (MILES)			
		0 TO 125	126 TO 1000	1001 TO 2000	2001 AND OVER
Metallic	–10 –13 –16	54			
Noncompandored	–10 –13 –16	58	59	61	64
N or Mixed N and Noncompandored	–10 –13 –16	67 66 65	67 66 65	67 67 67	68 68 68
T or mixed T and Noncompandored	–10 –13 –16	69 67 64	69 67 64	69 67 65	70 68 66
N3 (With VF amp)	–10 –13 –16	73	73	73	73

Note: Maintenance Limit: 15 counts in 15 minutes.

Immediate Action Limit: 20 counts in 15 minutes.

TABLE E

P/AR REQUIREMENTS

SINGLE AND MULTIPLE FACILITY TRUNKS			
FACILITY (NOTE 1)	MAINTENANCE LIMITS (NOTE 2)		
	MAXIMUM	MINIMUM	TYPICAL
O, ON, N3	94	86	90
N1	98	86	92
L or Radio	99	87	93
N2	101	93	97
T1	102	93	97
2T1	97	88	92
2N3	93	83	8
2N2	96	88	92
2N1	93	85	89
T1+ N3	95	87	91
T1 + N2	96	88	92
N1 + N3	97	87	92
ON + T1	96	87	91
ON + A	93	83	8
ON + N3	93	83	8
ON + N2	96	88	92
ON + N1	96	88	92
2 ON	91	83	7
T1 + N1	96	87	91
N2 + N3	97	87	92
N1 + N2	95	87	91
2 "A" Type	92	82	7
A + T1	95	86	90
A + N3	91	83	7
A + N2	96	86	91
A + N1	96	86	91
3A	83	74	78
NONREPEATERED CABLE			
Nonloaded (0 to 18 kft)		97	
H88 (0 to 18 kft)		94	
REPEATERED CABLE			
Nonloaded (0 to 18 kft)		90	
H88 (0 to 36 kft)		90	
H88 (>36 kft)		80	

Note 1: For No. 4 ESS with analog trunking, single facility, use values for T1 + facility under consideration. For No. 4 ESS with T1 carrier interfacing via a diagroup terminal, use T1 values.

Note 2: Immediate Action Limits reduce maintenance limits by 1 for single facility, 2 for 2-facility and 3 for 3-facility trunks.

TABLE F

INTERMODULATION DISTORTION LIMITS

FACILITIES	RATIO OF DISTORTION PRODUCT TO FUNDAMENTAL IN DB (4-TONE METHOD) (NOTE)							
	N1	N2	N3	ON	T/D1A D1B	T/D1D, D2, D3	L, RADIO WITH F SIGNALING	L, RADIO WITH E SIGNALING
Second Order Minimum Typical	28, 26 36	34, 32 42	40, 38 46	30, 28 41	32, 30 40	50, 47 55	51, 50 57	44, 41 45
Third Order Minimum Typical	31, 30 36	44, 42 51	38, 36 45	34, 33 38	39, 38 47	54, 53 58	51, 50 55	
TRUNKS								
Second Order Minimum Typical	28, 26 36	34, 32 42	40, 38 46	30, 28 41	32, 30 40	50, 47 55	44, 41 45	47, 41 46
Third Order Minimum Typical	30, 29 36	42, 40 49	37, 35 44	33, 32 37	39, 38 47	54, 53 58	47, 46 46	

Note: First number given in each entry is maintenance limit, and the second number is the immediate action limit.

TABLE G

PHASE JITTER LIMITS

END-TO-END LIMITS	
FREQUENCY BAND	LIMIT
4 to 20 Hz 20 to 300 Hz	<10 <10

TABLE H

FACILITY AND TRUNK LIMITS (20 TO 300 HZ)

N ON D1 (T1 CARRIER CHANNELS)	
NO OF CHANNELS	LIMIT
ALL	<1.0°
LMX CARRIER	
MILEAGE BAND	LIMIT
0 to 250 251 to 500 501 to 1000 1001 to 2000 2001 to 4000	<4.0° <5.0° <6.0° <7.0° <8.0°

TABLE I

GAIN AND PHASE HIT AND DROPOUT OBJECTIVES

	SHORT-HAUL FACILITIES (N, ON, OR T)	COAXIAL CABLE, RADIO, OR SHORT-HAUL RADIO (TJ)
Gain Hits (≥3 dB)	0 in 15 minutes	No more than 2 in 15 minutes*
Phase Hits (≥20)	0 in 15 minutes	No more than 2 in 15 minutes
Dropouts	No more than 1 in 30 minutes	No more than 1 in 30 minutes

* No more than 1 in 15 minutes for counters with 4 dB threshold.