

VOICE AND VOICEBAND DATA CHANNELS TRANSMISSION TEST REQUIREMENTS AND LIMITS

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1. GENERAL

A. Purpose

1.01 The purpose of this section is to provide the network personnel with the transmission requirements and limits for testing voice and voiceband data channels. The specified requirements and limits are based on the engineering recommendations and the design of the network. This section provides only transmission requirements and limits for the network side of the network interface (NI) located at the customer premises (CP) or in switching equipment at the Bell Operating Company (BOC) central office (CO). Test requirements and limits for channel segments are not addressed in this section. This section covers testing parameters for isolating probable causes of channel impairments.

1.02 This section is reissued to:

- (a) Change the title of the section
- (b) Add test set requirements to paragraph 2.01
- (c) Include additional channel categories to Table A
- (d) Make changes and include additions to Table B
- (e) Include additional transmission grades and superscript (7) to Tables C, D, and E
- (f) Include additional information to Table F
- (g) Delete transmission grade VJ and include additional note in Table G
- (h) Replace Table H
- (i) Include additions and changes to the notes in Tables I, J, K, L, M, and N
- (j) Change transmission grades in Table Q
- (k) Include additional note to Table V
- (l) Make correction to Table Y
- (m) Include additional note to Table AB.

Since this reissue is not a general revision, revision arrows have been used to denote significant changes. Equipment Test List is not affected.

B. Transmission Test Requirements

1.03 Transmission test requirements and limits are determined by the performance requirements of the voiceband channels. In order to identify the various categories of transmission performance requirements, similar types of private voice-grade channels have been assigned a two letter transmission grade. These channels are described in Table A. A cross-reference between these transmission grades and the common language circuit identification (CLCI) service codes and modifiers is given in Table B. Test requirements are given in Tables C through F. The test limits are given in Tables G through AE.

1.04 When the voice-grade facility is to be used for data transmission, the requirements and limits for tests may be different from those for voice only services. The tables in this section indicate those differences. For alternate voice/data use, the requirements and limits for data will apply.

2. TRANSMISSION TEST DESCRIPTIONS

A. General

2.01 The categories of transmission testing are described in the following paragraphs. ♦Test sets used for measurement of the parameter limits contained in this section must be capable of simulating the electrical characteristics as described in Sections 313-110-101 and 313-120-101.♦

2.02 Preservice testing is performed during the period prior to establishing a newly installed, rearranged, or repaired channel. Preservice testing is required to determine if the engineering design objectives are met. Also, these tests will identify any major repairs or adjustments required on the transmission facilities (ie, defective cable pairs, equipment mismatches, etc).

2.03 The engineering design of the channel will specify various parameters which must be met depending on the intended use of the channel. These parameters will include such things as the type of facility makeup and the special transmission equipment needed (ie, amplifiers, equalizers, attenuation devices, etc).

2.04 The required preservice tests are found in Tables C, D, and E. In these tables references are made to the tables containing the limits for each test.

2.05 Benchmark tests are recommended during the preservice testing activity. They are used as an aid in localizing subsequent channel problems. Table AD identifies the benchmark measurements to be made.

B. Trouble Testing

2.06 After a channel has been established, any condition that is identified as an impairment to the normal transmission can be classified as a trouble. A trouble may be reported by the customer or it may be detected by the telephone company network personnel.

2.07 Trouble testing will include tests required to verify a trouble report, to isolate the trouble, and to verify that the trouble has been cleared.

2.08 The tester will determine from his initial investigation and preliminary trouble tests what additional tests must be made and what action is required to administer the test procedures. The test considerations covered in Section 313-110-100 will assist the tester in determining what action must be taken as well as which tests to make.

2.09 Tables C, D, and E indicate which tests are required for the particular trouble indication and the order in which these tests should be made (from top to bottom). There is also a reference to the appropriate measurement limits table to verify the limits for each measurement.

2.10 Benchmark measurements should be taken during trouble testing activity. These measurements are to be compared to those benchmark measurements obtained during preservice testing. Any time the benchmark measurements are beyond the limits shown in Table AE when compared to recorded measurements, corrective action should be taken on that portion of the channel.

C. Routine Testing

2.11 In order to maintain the proper channel performance, routine testing is recommended. Some types of channels such as switched service net-

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work (SSN) intermachine trunks are routinely tested by automated systems such as centralized automatic reporting on trunks (CAROT). Routine testing is used to determine the performance of the channel.

2.12 Routine testing may be performed as agreed between the Bell Operating Company and the customer.

2.13 Tables C and D contain some suggested routine tests for voice and voiceband data channels. Routine testing shall be performed without service interruption except where schedule releases are obtained.

2.14 Benchmark measurements are recommended during routine testing. See paragraph 2.10 for benchmark measurement descriptions.

3. TRANSMISSION TEST LIMITS

3.01 The following paragraphs describe the limits for the transmissions test described in Part 2.

A. Preservice Limits

3.02 This is the limit of a parameter that will be allowed when the channel is installed, rearranged, or repaired. This is an internal limit and is not guaranteed to a customer. The preservice limit is the same as the maintenance limit for all parameters except 1004-Hz loss. This parameter is a variation from the design objective limit and is tighter than the maintenance limit. The preservice limits for this transmission parameter (loss) are in Table G.

3.03 Benchmark measurements do not have preservice limits.

B. Maintenance Limit

3.04 This is the limit of a parameter that must be met when a channel is installed, rearranged, repaired, or routinely tested.

3.05 Channels should be maintained within the maintenance limits throughout their entire life. When the maintenance limit has been exceeded, it is an indication that a channel component is performing poorly and corrective action should be considered even though the immediate action limit (IAL) may not have been exceeded.

3.06 Channel maintenance limits are close enough to the design objective to maintain transmission quality with parameters that will not extend beyond the guaranteed (immediate action) limit. Tables G, H, I, J, L, N, O, P, Q, R, S, T, V, Z, AA, and AB provide the maintenance limits for the transmission test parameters.

3.07 Benchmark measurement maintenance limits are given in Table AE. The benchmark limits are based on the original benchmark tests made when the channel had met all preservice limits.

C. Immediate Action Limit

3.08 The immediate action limit is a level of performance guaranteed to the customer. It is also the value of a parameter at which the channel is considered to be out-of-limits and immediate corrective action is required. This applies whether the trouble is detected by the network personnel or reported by the customer and verified by the network personnel.

3.09 When a channel is repaired after having a test parameter out of limits, the parameter must be brought back to its preservice limit. The immediate action limits for the various test parameters are given in Tables G, H, I, K, M, N, O, Q, R, S, T, W, X, Y, Z, AA, and AB.

3.10 Benchmark measurements do not have immediate action limits. However, they do have maintenance limits and tests as specified in paragraphs 2.10 and 3.07.

D. Loss Limits

3.11 Loss as used in this section is based on the expected measured loss (EML). Because of the imperfections of test equipment and variations in test frequencies, the channel design allows for a specified variation between the EML and the actual measured loss (AML). The allowable amount of variation is given in Table G.

E. Impedance Balance

3.12 The impedance balance limits are given in Table H. These limits are expressed as echo return loss (ERL) and singing return loss (SRL).

F. Noise Limits

- 3.13** Tables I through M give the limits for steady state noise.
- 3.14** Voice-frequency cable noise is specified in dBrnC. It is not necessary to convert it to dBrnC0. However, it should be corrected by the value of any gain or loss between the point of measurement and the cable.
- 3.15** The noise limit for a basic channel should be maintained at or below the appropriate maintenance limits.
- 3.16** The noise limits are shown in the following tables:
- | TABLE | CONTENT |
|-------|--|
| I | C-message noise limits without a holding tone |
| J | C-notched noise maintenance limits using a -13 dBm0 holding tone |
| K | C-notched noise immediate action limits using a -13 dBm0 holding tone |
| L | C-notched noise maintenance limits using a -16 dBm0 holding tone |
| M | C-notched noise immediate action limits using a -16 dBm0 holding tone. |
- 3.17** Table N gives the impulse noise limits for voice and voiceband data channels for the various types of facilities.
- 3.18** The threshold level values allow the test equipment to be set for simultaneous measurement of the immediate action limit and the maintenance limit.
- 3.19** The measurement values shown in Table N for local loop are specified assuming a zero test level point (TLP) at the central office. The threshold limit at the network interface should be corrected by the amount of the loop loss.

G. Phase Jitter Limits

- 3.20** The limits for phase jitter measurements are shown in Table O. Both the maintenance limits and the immediate action limits are shown. The C-notch noise measurements should always be made before the phase jitter measurements to assure that noise is not the chief contributor to the phase jitter readings.
- 3.21** The three types of measurements shown are BELL, low frequency (LF), and BELL+LF. Any two of the three measurements are considered a valid test depending on the available test equipment. However, BELL+LF is the recommended test.

3.22 If an end or midlink of a multipoint channel exceeds the limit, the overall channel phase jitter must be verified to assure that it meets the transmission limits.

H. Peak-to-Average Ratio (P/AR) Limits

3.23 Table P gives the P/AR limits for single and multifacility circuits. The limits shown are maintenance limits.

I. The 3-Tone Slope Limits

3.24 Table Q gives the limits for the 3-tone slope measurements of 2-point channels. Table R gives the limits for 3-tone slope measurements of multipoint channels.

3.25 The values shown on these tables are \pm dB variations relative to 1004-Hz loss.

J. Attenuation Distortion

3.26 The attenuation distortion limits are shown in the following tables:

TABLE	CONTENT
S	Attenuation distortion for 2-point channels
T	Attenuation distortion for multipoint channels
U	Frequencies to be used for attenuation distortion measurements.

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3.27 The maintenance limits shown in Table S were selected to allow some margin before the immediate action value is reached. Channels should be established and maintained within these limits. Some channels in Table S and all channels in Table T have only the immediate action limits specified. In these cases, the channel must be established and maintained within the limits.

3.28 The C-conditioning and T-conditioning limits are also shown in these tables. When the channel has conditioning requirements, the conditioning limit will supersede the transmission grade limit.

K. Intermodulation Distortion Limits

3.29 Table V provides the maintenance limits for intermodulation distortion using the 4-tone method of measurement. Table W gives the immediate action limits for the same measurement method.

3.30 These tables give the ratio of distortion products to a fundamental power. All measurements should be equal to or greater than the limits shown.

3.31 The D-conditioning limits are also shown in these tables. When the channel has conditioning requirements, the conditioning limit supersedes the transmission grade limit.

L. Gain Hit, Phase Hit, and Dropout Limits

3.32 Table X provides the limits for gain hits, phase hits, and dropouts. These tests require a 1004-Hz tone to be applied at the far end of the channel or channel segment.

3.33 When testing for dropouts, if one dropout occurs, continue testing for another 15 minutes. If more than one dropout occurs in the total 30-minute testing time, then the reason for the trouble should be pursued.

Note: The 15- and 30-minute intervals of testing do not need to be consecutive.

M. Single-Frequency Interference

3.34 Table Y provides the single-frequency interference limits for the various circuit lengths in miles. The values are expressed in dBm0.

N. Frequency Shift Limits

3.35 Table Z gives the allowable plus or minus frequency shift limit for voice and voiceband data channels. Both the maintenance and the immediate action limits are shown.

O. Envelope Delay Distortion Limits

3.36 The envelope delay distortion limits are shown in the following tables:

TABLE	CONTENT
AA	Envelope delay distortion limits for 2-point channels
AB	Envelope delay distortion limits for multipoint channels
AC	Measurement frequencies for envelope delay distortion measurements.

TABLE A

TRANSMISSION GRADES (NOTE)

GRADE	CHANNEL CATEGORY
DA	Data or Voice/Data Channel Two-point voiceband data Multipoint voiceband data Off-premises station line AIOD Link EPSCS Link
DB	Voice and Data Public Switched Network (PSN) Access Foreign exchange line PBX Centrex ACD foreign exchange trunk
DC	Voice and Data SSN Access EPSCS, CCSA, AUTOVON/SCAN access line, or direct home station line
DD	Voice and Data SSN Intermachine EPSCS, CCSA, AUTOVON intermachine trunk Tie trunk Long distance trunk ACD overflow trunk
DE	Voice and Data Tie Trunk Tie trunks
DG	WATS Service
DJ	Public Switched Network Line (Local loop) Data jack
DL	Protective Relay Channel With C-6 conditioning
TA	Telephoto
VA	Voice Nonswitched Line Two-point voice channel Multipoint voice channel Remote metering Dial dictation line Wired music line Paging line Radio land line Voice-only channel for the FAA

See note at end of table.

TABLE A4 (Contd)

TRANSMISSION GRADES (NOTE)

GRADE	CHANNEL CATEGORY
VB	Voice Switched Line Centrex line Off-premises extension line Secretarial line Long distance line
VC	Voice Switched Trunk PBX, Centrex, and ACD foreign exchange trunk EPSCS, CCSA, AUTOVON/SCAN access line EPSCS, CCSA, AUTOVON/SCAN directly home station line EPSCS, CCSA, AUTOVON/SCAN intermachine trunk
VF	Voice FAA Private Channel Two-point channel for the FAA per spec S-1142A

Note: The following are definitions of acronyms:

- ACD — Automatic call distributor
- AIOD — Automatic identified outward dialing
- CCSA — Common control switching arrangements
- EPSCS — Enhanced private switched communication service
- FAA — Federal aviation administration
- SCAN — Switched Circuit Automatic Notebook
- SSN — Switched service network
- WATS — Wide area telecommunications service.

TABLE B4

**COMMON LANGUAGE CIRCUIT IDENTIFICATION
CONVERSION SERVICE TYPE/TRANSMISSION GRADE**

COMMON LANGUAGE CIRCUIT IDENTIFICATION			(NOTE 2)			SERVICE TYPE (NOTE 3)	TRANS- MISSION GRADE
CHARACTER 3-4 SERVICE CODE	CHARACTER 5 MODIFIER (NOTE 1)		CP TO CP	CP TO CO	CO TO CO		
	A,B,D,E	N,I					
	DATA	VOICE					
WI,WO,WS,WX,WY,WZ	X	X		X	X	WATS lines and trunks	DG
FT		X		X	X	Foreign exchange trunk	VC
FT	X			X	X	Foreign exchange trunk	DB
FX		X		X		Foreign exchange line	VB
FX	X			X		Foreign exchange line	DB
CA, CE		X		X	X	SSN station and access lines	VC
CA, CE	X			X	X	SSN station and access lines	DC
CN		X			X	SSN network trunk	VC
CN	X				X	SSN network trunk	DD
CT		X	X	X		SSN tie trunk	VC
CT	X		X	X		SSN tie trunk	DE
FD	X		X			2-point or multipoint data	DA
PA, PM		X	X			Protective alarm or monitoring	YA
PA, PM	X		X			Protective alarm or monitoring	DA
PR	X		X			Protective relaying	DL
VM		X	X			Remote metering	VA
VM	X		X			Remote metering	DA
OI		X	X	X		Off-premises intercommunications line	VA
PL		X	X			2-point or multipoint voice	VA
DL		X	X	X		Dictation line	VA
LL		X		X		Long distance terminal line	VB
LT		X		X		Long distance terminal trunk	VC
SL		X		X		Secretarial line	VB
OP		X		X		Off-premises extension	VB
TR			X	X		ACD trunk	VC
TU		X	X	X		ACD line	VB
EF		X	X	X		Entrance facility	VA
EF	X		X	X		Entrance facility	DA
MT		X	X			Wired music	VA
PG		X	X	X		Paging	VA
RT		X	X			Radio land line	VA
TF	X		X			Telephoto/facsimile	TA
NA	X			X		CSACC line (EPSCS)	DA
NC	X			X		CNCC line (EPSCS)	DA
NS	X				X	Intermachine link (EPSCS)	DA
ON		X			X	SSN off-network access line	VC
IT,TA,TL		X	X	X	X	Tie trunks	VC
IT,TA,TL	X		X	X	X	Tie trunks	DE

See notes at end of table.

TABLE B4 (Contd)

**COMMON LANGUAGE CIRCUIT IDENTIFICATION
CONVERSION SERVICE TYPE/TRANSMISSION GRADE**

COMMON LANGUAGE CIRCUIT IDENTIFICATION			(NOTE 2)			SERVICE TYPE (NOTE 3)	TRANS- MISSION GRADE
CHARACTER 3-4 SERVICE CODE	CHARACTER 5 MODIFIER (NOTE 1)		CP TO CP	CP TO CO	CO TO CO		
	A,B,D,E	N,I					
	DATA	VOICE					
SA		X	X	X		Satellite tie trunk	VC
SA	X		X	X		Satellite tie trunk	DE
AD		X		X		Attendant line	VC
AD	X			X		Attendant line	DB
AI	X			X		AIOD line	DA
DI,DO		X		X	X	Direct in/out dial trunks	VC
DI,DO	X			X	X	Direct in/out dial trunks	DB
OC,OS		X	X			Centrex/PBX off-premises station	VB
OS	X		X			Off-premises PBX line	DB
RA		X	X			Remote attendant line	VC
RA	X		X			Remote attendant line	DB
TK		X		X		Local PBX trunk	VC
TK	X			X		Local PBX trunk	DB
ND	X			X		Network data line (data jack)	DJ
SS	X		X			Dataphone select-a-station	DA
CL		X		X		Centrex line	VB

Note 1: X indicates application of character 5 modifier

Note 2: X indicates application of specific type of circuit

Note 3: The following are definitions of service type acronyms:

- ACD — Automatic call distributor
- AIOD — Automatic identified outward dialing
- CNCC — Customer network control center
- CSACC — Customer service administration control center
- EPSCS — Enhanced private switched communication service
- SSN — Switched service network
- WATS — Wide area telecommunications service.

TABLE C

CP-CO CHANNEL TEST REQUIREMENTS
(NOTES 1 AND 2)

MEASUREMENT PARAMETER	PRESERVICE				TROUBLE				ROUTINE (NOTE 3)		
	LIMIT TABLE	TRANSMISSION GRADE			LIMIT TABLE	TRANSMISSION GRADE			LIMIT TABLE	TRANSMISSION GRADE	
		VA VB, VC	DA DB, DC DE, DB	DJ		VA, DB, VC	DA DB, DC DE, DG	DJ		VC	DC, DD
Continuity	—	R	R	R	—	AR	AR	AR	—		
Loss	G	R	R	R	G	AR	AR	AR	G	R	R
Noise											
C-Message	I	R			I	AR			I	R	
C-Notched	J,L		R ⁷		K,M		AR ⁷		J,L		R ^{1,7}
Impulse	N		NR		N		AR	AR	—		
Phase Jitter	O		NR		O		AR		—		
3-Tone Slope	Q,R	R ²	R ³		Q,R	AR	AR	AR	Q,R	R	R
P/AR	P		R ⁴		P		AR	AR	—		
Attenuation Distortion	S,T		NR		S,T		AR		—		
C-Conditioning	S,T		R		S,T		AR		—		
Intermodulation Distortion	V		NR		W		AR		—		
Gain Hits, Phase Hits, Dropouts	X		NR		X		AR		—		
Impedance Balance	H	NR	NR		H	AR	AR		—		
Single Frequency Interference	Y		NR		Y		AR		—		
Frequency Shift	Z		NR		Z		AR		—		

See notes at end of table.

TABLE C4 (Contd)

**CP-CO CHANNEL TEST REQUIREMENTS
(NOTES 1 AND 2)**

MEASUREMENT PARAMETER	PRESERVICE				TROUBLE				ROUTINE (NOTE 3)		
	LIMIT TABLE	TRANSMISSION GRADE			LIMIT TABLE	TRANSMISSION GRADE			LIMIT TABLE	TRANSMISSION GRADE	
		VA VB, VC	DA DB, DC DE, DG	DJ		VA, DB, VC	DA DB, DC DE, DG	DJ		VC	DC, DD
Envelope Delay Distortion	AA,AB		NR		AA,AB		AR		—		
C-Conditioning	AA,AB		R		AA,AB		AR	AR	—		
T-Conditioning	—				—				—		

Note 1: The following are definitions of symbols:

- R — Required preservice or routine test.
- NR — Preservice tests are not required, but the parameter is supported either as a regulation guarantee or as a reasonable performance criteria for the intended use of the channel.
- AR — Trouble tests should be performed as required to resolve the trouble report.

Note 2: The numbers shown above and to the right of the symbols refer to channel test codes. These codes are defined in Table F.

Note 3: Routine tests on CP-CO channels apply to only SSN access lines.

TABLE D

CO-CO CHANNEL TEST REQUIREMENTS
(NOTES 1 AND 2)

MEASUREMENT PARAMETER	PRESERVICE			TROUBLE			ROUTINE		
	LIMIT TABLE	TRANSMISSION GRADE		LIMIT TABLE	TRANSMISSION GRADE		LIMIT TABLE	TRANSMISSION GRADE	
		VC	DB, DC DD,DE		VC	DB, DC DD,DE		VC	DC,DD
Continuity	—	R	R	—	AR	AR	—		
Loss	G	R	R	G	AR	AR	G	R	R
Noise	—			—			—		
C-Message	I	R		I	AR		I	R	
C-Notched	J,L		R ⁷	K,M		AR ⁷	J,L		R ⁷
Impulse	N		NR	N		AR	—		
Phase Jitter	O		NR	O		AR	—		
3-Tone Slope	Q,R	R	R ⁸	Q,R	AR	AR	Q,R	R	R
P/AR	P		R ⁴	P		AR	—		
Attenuation Distortion	S,T		NR	S,T		AR	—		
C-Conditioning	S,T		R	S,T		AR	—		
Intermodulation Distortion	V		NR	W		AR	—		
Gain Hits, Phase Hits, Dropouts	X		NR	X		AR	—		
Impedance Balance	H	R	R	H	AR	AR	—		
Single Frequency Interference	Y		NR	Y		AR	—		
Frequency Shift	Z		NR	Z		AR	—		

See notes at end of table.

▶TABLE D▶ (Contd)

CO-CO
CHANNEL TEST REQUIREMENTS
(NOTES 1 AND 2)

MEASUREMENT PARAMETER	PRESERVICE			TROUBLE			ROUTINE		
	LIMIT TABLE	TRANSMISSION GRADE		LIMIT TABLE	TRANSMISSION GRADE		LIMIT TABLE	TRANSMISSION GRADE	
		VC	DB, DC DD,DE		VC	DB, DC DD,DE		VC	DC,DD
Envelope Delay Distortion	AA,AB		NR	AA,AB		AR	—		
C-Conditioning	AA,AB		R	AA,AB		AR	—		

Note 1: The following are definitions of symbols:

- R — Required preservice and routine tests.
- NR — Preservice tests are not required, but the parameter is supported either as a regulation guarantee or as a reasonable performance criteria for the intended use of the channel.
- AR — Trouble tests should be performed as required to resolve the trouble report.

Note 2: The numbers shown above and to the right of the symbols refer to channel test codes. These codes are defined in Table F.

TABLE E

**CP-CP CHANNEL TEST REQUIREMENTS
(NOTES 1 AND 2)**

MEASUREMENT PARAMETER	PRESERVICE						TROUBLE					
	LIMIT TABLE	TRANSMISSION GRADE					LIMIT TABLE	TRANSMISSION GRADE				
		VA,VB VC,VF 2-POINT	DE DA,DL 2 POINT (NOTE 3)	VA MULTI- POINT	DA MULTI- POINT	TA		VA,VB VC, VF 2-POINT	DE DA,DL 2 POINT (NOTE 3)	VA MULTI- POINT	DA MULTI- POINT	TA
Continuity	—	R	R	R	R	R	—	AR	AR	AR	AR	AR
Loss	G	R	R	R	R	R	G	AR	AR	AR	AR	AR
Noise	—					—						
C-Message ⁵	I	R		R		R	I	AR		AR		AR
C-Notched ⁵	J,L		R ⁷		R ⁷		K,M		AR ⁷		AR ⁷	
D-Conditioning	J,L		R				—		AR			
Impulse	N		NR		NR	R	N		AR		AR	AR
Phase Jitter	O		NR		NR	NR	O		AR		AR	AR
3-Tone Slope ⁵	Q,R	R ²	R ³	R			Q,R	AR	AR	AR	AR	
P/AR	P		NR ⁴		NR		P		AR		AR	
Attenuation Distortion	S,T		NR		R	R	S,T		AR		AR	AR
C-Conditioning	S,T		R		R		S,T		AR		AR	
T-Conditioning	S,T					R	S,T					AR
Intermodulation Distortion	V		NR		NR	NR	W		AR		AR	AR
D-Conditioning	V		R		R ⁶		W		AR		AR	
Gain Hits, Phase Hits Dropouts	X		NR		NR	NR	X		AR		AR	AR
Impedance Balance	H	NR	NR	NR	NR		H	AR	AR	AR	AR	
Single Frequency Interference	Y		NR		NR	NR	Y		AR		AR	AR
Frequency Shift	Z		NR		NR	NR	Z		AR		AR	AR

See notes at end of table.

♦TABLE E♦ (Contd)

**CP-CP CHANNEL TEST REQUIREMENTS
(NOTES 1 AND 2)**

MEASUREMENT PARAMETER	PRESERVICE						TROUBLE					
	LIMIT TABLE	TRANSMISSION GRADE					LIMIT TABLE	TRANSMISSION GRADE				
		VA,VB VC,VF 2-POINT	DE DA,DL 2 POINT (NOTE 3)	VA MULTI- POINT	DA MULTI- POINT	TA		VA,VB VC, VF 2-POINT	DE DA,DL 2 POINT (NOTE 3)	VA MULTI- POINT	DA MULTI- POINT	TA
Envelope Delay Distortion	AA,AB		NR		R	R	AA,AB		AR		AR	AR
C-Conditioning	AA,AB		R		R		AA,AB		AR		AR	
T-Conditioning	AA,AB					R	AA,AB					AR

Note 1: The following are definitions of symbols:

- R — Required preservice tests.
- NR — Preservice tests are not required, but the parameter is supported either as a regulation guarantee or as a reasonable performance criteria for the intended use of the channel.
- AR — Trouble tests should be prepared as required to resolve the trouble report.

Note 2: The numbers shown above and to the right of the symbols refer to channel test codes. These codes are defined in Table F.

Note 3: Transmission grade DL has C6 conditioning requirements.

◆TABLE F◆

CHANNEL TEST CODES

CODE	DEFINITION
1	C-message noise tests can be substituted for C-notched noise tests if CAROT or the responder cannot make the C-notched noise test.
2	3-tone slope parameter is required for VC grade only.
3	3-tone slope parameter not required on C-conditioned circuits.
4	The P/AR tests are required only on SSN trunks but are highly recommended on other trunks during preservice to establish a benchmark for comparison in the event of a future trouble report. If P/AR limits are not met, then attenuation distortion, envelope delay distortion, and impedance balance should be tested to determine why. The P/AR tests are not required on C-conditioned channels.
5	Noise and 3-tone slope measurements are not required on CP-CP intrabuilding interpremises channels.
6	The intermodulation distortion parameter for DA multipoint is applicable to D5 conditioning only.
7	Channels composed entirely of VF cable should be measured without a tone according to the limits and qualifications of Table I (C-message noise).

♦TABLE G♦

ALLOWABLE VARIATION FROM EML FOR AML (NOTES 1 AND 2)

TESTING ACTIVITY	TRANSMISSION GRADES VA,VB,VC,DA,DB,DC,DD,DE,DG,DJ,TA,DL						TRANSMISSION GRADE VF		
	CO-CO CIRCUIT OR MIDLINK SEGMENT OF A MULTIPOINT CIRCUIT			CP-CO, CP-CP OR END LINK OF MULTIPOINT CIRCUIT			CP-CP		
	ML (NOTE 3)	PRESERVICE	IAL (NOTE 4)	ML (NOTE 3)	PRESERVICE	IAL (NOTE 4)	ML (NOTE 3)	PRESERVICE	IAL (NOTE 4)
Preservice	—	-0.5, +0.5	—	—	-1, +1	—	—	-1, +1	—
Trouble	-1, +1	—	-3, +3	-2, +2	—	-4, +4	-2, +2	—	-2, +3
Routine	-1, +1	—	-3, +3	-2, +2	—	-4, +4	—	—	—

Note 1: The AML is determined by measurement.

Note 2: The + means higher loss value and the - means lower loss value.

Note 3: The ML is the allowable overall variation beyond which sectionalizing is required to determine where readjustment is needed.

Note 4: The IAL is the variation beyond which performance may be jeopardized and immediate corrective action is required.

♦TABLE H♦

IMPEDANCE BALANCE

FACILITY (NOTE)	INTERFACE BEING MEASURED	LIMITS			
		IAL		ML	
		ERL	SRL	ERL	SRL
Effective 2-Wire	2-wire	6	3	8	5
	2-wire with impedance comp.	13	8	18	11
	4-wire	13	8	18	11
Effective 4-Wire	2-wire	18	12	22	15
	4-wire	18	12	22	15

Note: An effective 2-wire facility may be all 2 wire or may contain some 4-wire portions (such as a carrier with 2-wire extensions); an effective 4-wire facility must be all 4 wire. Both may have 2-wire and/or 4-wire interface.

♦TABLE 14

C-MESSAGE NOISE LIMITS WITHOUT HOLDING TONE

FACILITY LENGTH (MILES)	MAXIMUM NOISE (DBRNC0) (NOTE 1)				
	IMMEDIATE ACTION LIMITS (NOTE 3)	MAINTENANCE LIMITS (NOTE 2)			
		VF CABLE (NOTE 4)	L-TYPE CARRIER	N1, 0N N2, N3, N4	D1, D2 D3, D4 SLC CARRIER
0-50	40	25 dBrnC	31	26	28
51-100	40		33	28	28
101-200	40		35	30	28
201-400	42		37		28
401-1000	44		40		
1001-1500	46		42		
1501-2500	48		43		
2501-4000	50		45		
4001-8000	52		48		
8001-16000	55		51		
Satellite*	46		43		
Local Loop VF Cable	36 dBrnC	20 dBrnC			
Local Loop Other	36 dBrnC				28

Note 1: To combine two noise limits (power basis), take the difference between the two limits and combine as follows:

- Difference is 0 dB — add 3 dB to the greater limit.
- Difference is 1 to 3 dB — add 2 dB to the greater limit.
- Difference is 4 to 8 dB — add 1 dB to the greater limit.
- Difference is 9 dB or greater — use greater limit.

The resulting number is the limit for the combined facilities. For three facility types, combine two facilities as above and combine the result with the remaining facility in the same manner.

Note 2: Calculate the maintenance limit for channels with multiple facilities as follows: Combine the limits for individual carrier and satellite facilities on a power basis as in Note 1. Convert this dBrnC0 limit to dBrnC by adding the TLP of the channel at the point of measurement. For channels with VF cable facilities (trunk or local loop), compare the cable section limit with the above limit and use the larger limit.

Note 3: The immediate action limit for multiple facility channels is calculated as above except that the limit does not depend on the type of carrier or trunk cable facility and the only limits to be combined are those for satellite and loop (if part of facility make up).

Note 4: The VF cable noise is specified in dBrnC; it should not be converted to dBrnC0. Multiple cable facilities connected in tandem count as one facility.

♦TABLE J♦

**C-NOTCHED NOISE LIMITS
WITH -13 DBM0 HOLDING TONE
FOR MAINTENANCE LIMITS**

C-NOTCHED WEIGHTING (NOTES 1, 2, 3, AND 4)									
FACILITY LENGTH (MILES)	VF CABLE (NOTE 5)	L-TYPE CARRIER	VF AMP N2 N3 N4	ON N1	COMPANDORED				
					N2 N3 N4	D1A D1B	D1D	D2	D3 D4 SLC
0-50	25 dBrnC	31,46	48,29	48,29	42,35	47,30	40,37	39,38	45,32
51-100		33,44	49,28	49,28	43,34	47,30	40,37	39,38	45,32
101-200		35,42	51,26	52,25	46,31	47,30	40,37	39,38	45,32
201-400		37,40							45,32
401-1000		40,37							
1001-1500		42,35							
1501-2500		43,34							
2501-4000		45,32							
4001-8000		48,29							
8001-16000		51,26							
Satellite*		42,35							
Local Loop	20 dBrnC								45,32

Note 1: The first value is in dBrnC0 (noise measurements should not exceed this value). The second value is the signal-to-noise ratio (S/N) (measurements should not be below this value). The 90 dBrnC minus 13 dBm0 signal power equals 77 dBm0. This value minus the noise limit equals the S/N ratio in dB.

Note 2: To combine two noise limits (power basis), take the difference between the two limits and combine as follows:

- Difference is 0 dB — add 3 dB to the greater limit.
- Difference is 1 to 3 dB — add 2 dB to the greater limit.
- Difference is 4 to 8 dB — add 1 dB to the greater limit.
- Difference is 9 dB or greater — use greater limit.

The resulting number is the limit for the combined facilities. For three facility types, combine two facilities as above and combine the result with the remaining facility in the same manner.

Note 3: Calculate the maintenance limit for channels with multiple facilities as follows:

Combine the limits for individual carrier and satellite facilities on a power basis as in Note 2. Convert this dBrnC0 limit to dBrnC by adding the TLP of the channel at the point of measurement. For channels with VF cable facilities (trunk or local loop), compare the cable section limit with the above limit and use the larger limit.

Note 4: The D-conditioned channels use this table for preservice and maintenance limits except for the VF AMP, N2, N3, N4, and ON, N1 non-compandored columns. For these, use Table K limits.

Note 5: Channels that are derived entirely from VF cable should be measured without a tone per the limits and qualifications of Table I.

* Combine satellite limit and land facility mileage limit using sum of powers (Section 314-010-101).

TABLE K

**C-NOTCHED NOISE LIMITS WITH -13 DBM0 HOLDING TONE
FOR IMMEDIATE ACTION LIMITS**

C-NOTCHED WEIGHTING (NOTES 1 AND 2)							
TRANSMISSION GRADE							D-TYPE CONDITIONING
DA,DL	DB	DC,DJ	DD	DE	DG	TA	
53,24	50,27	49,28	46,31	52,25	48,29	53,24	49,28

Note 1: The first value is in dBrnC0 (noise measurements should not exceed this value). The second value is the signal-to-noise ratio (S/N) (measurements should not be below this value). The 90 dBrnC minus 13 dBm0 signal power equals 77 dBm0. This value minus the noise limit equals the S/N ratio in dB.

Note 2: The S/N values are provided in this table as a convenience for use when direct reading S/N ratio equipment is available.

TABLE L

**C-NOTCHED NOISE LIMITS WITH -16 DBM0 HOLDING TONE
FOR MAINTENANCE LIMITS**

FACILITY LENGTH (MILES)	C-NOTCHED WEIGHTING (NOTES 1, 2, 3, AND 4)								
	VF CABLE (NOTE 5)	L-TYPE CARRIER	VF AMP N2 N3 N4	ON N1	COMPANDORED				
					N2 N3 N4	D1A D1B	D1D	D2	D3, D4 SLC CARRIER
0-50	25 dBrnC	31,43	42,32	46,28	40,34	44,30	37,37	36,38	42,32
51-100		33,41	49,25	47,27	41,33	44,30	37,37	36,38	42,32
101-200		35,39	51,23	50,24	44,30	44,30	37,37	36,38	42,32
201-400		37,37							42,32
401-1000		40,34							
1001-1500		42,32							
1501-2500		43,31							
2501-4000		45,29							
4001-8000		48,26							
8001-16000		51,23							
Satellite*		42,32							
Local Loop	20 dBrnC								42,32

Note 1: The first value is in dBrnC0 (noise measurements should not exceed this value). The second value is the signal-to-noise ratio (S/N) (measurements should not be below this value). The 90 dBrnC minus 16 dBm0 signal power equals 74 dBm0. This value minus the noise limit equals the S/N ratio in dB.

Note 2: To combine two noise limits (power basis), take the difference between the two limits and combine as follows:

Difference is 0 dB — add 3 dB to the greater limit.

Difference is 1 to 3 dB — add 2 dB to the greater limit.

Difference is 4 to 8 dB — add 1 dB to the greater limit.

Difference is 9 dB or greater — use greater limit.

The resulting number is the limit for the combined facilities. For three facility types, combine two facilities as above and combine the result with the remaining facility in the same manner.

Note 3: Calculate the maintenance limit for channels with multiple facilities as follows:

Combine the limits for individual carrier and satellite facilities on a power basis as in Note 2. Convert this dBrnC0 limit to dBrnC by adding the TLP of the channel at the point of measurement. For channels with VF cable facilities (trunk or local loop), compare the cable section limit with the above limit and use the larger limit.

Note 4: The D-conditioned channels use this table for preservice and maintenance limits except for the VF AMP, N2, N3, N4, and ON, N1 non-compandored columns. For these, use Table M limits.

Note 5: Channels that are derived entirely from VF cable should be measured without a tone per the limits and qualifications of Table I.

* Combine satellite limit and land facility mileage limit using sum of powers (Section 314-010-101).

◆TABLE M◆

**C-NOTCHED NOISE LIMITS WITH -16 DBM0 HOLDING TONE
FOR IMMEDIATE ACTION LIMITS**

C-NOTCHED WEIGHTING (NOTES 1 AND 2)						
TRANSMISSION GRADE						D-TYPE CONDITIONING
DA,DL,TA	DB	DC,DJ	DD	DE	DG	
50,24	47,27	46,28	43,31	49,25	45,29	46,28

Note 1: The first value is in dBrnC0 (noise measurements should not exceed this value). The second value is the signal-to-noise ratio (measurements should not be below this value). The 90 dBrnC minus 16-dBm0 signal power equals 74 dBm0. This value minus the noise limit equals the S/N ratio in dB

Note 2: The S/N values are provided in this table as a convenience for use when direct reading S/N ratio equipment is available.

TABLE N
IMPULSE NOISE LIMITS
(NOTES 1, 2, AND 3)

FACILITY TYPE	1004-HZ HOLDING TONE LEVEL (DBM0)	THRESHOLD LEVEL DBRNCO (NOTE 4)					IMMEDIATE ACTION LIMIT
		MAINTENANCE LIMIT					
		CIRCUIT LENGTH (MILES)					
		ANY	0 TO 125	126 TO 1000	1001 TO 2000	OVER 2000	
Noncompandored L-Type Carrier	None	—	57	59	61	63	71
Compandored O, ON, N, T-Carrier	-13	67	—	—	—	—	71
	-16	65	—	—	—	—	69
Mixed Compandored and Noncompandored	-13	—	67	67	69	69	71
	-16	—	65	65	67	67	69
ON, N-Carrier (with VF Amplifier)	None	71	—	—	—	—	71
VF Cable Interoffice	None	53	—	—	—	—	71
VF Cable Local Loop*	None	59	—	—	—	—	71

Note 1: Limits apply to all transmission grades and conditioning.

Note 2: All measurements are ≤ 15 counts in 15 minutes.

Note 3: If the majority of impulse hits are counted during one time frame (ie, 12 hits during second minute of test) but the count limit is not exceeded during the full test, continue the test for another 15 minutes. If a similar hit grouping reappears, then the reason for trouble should be pursued.

Note 4: Threshold level values have been selected to allow test equipment to be set for simultaneous measurement of the immediate action limit and the maintenance limit.

* The local loop measurement values are specified assuming a 0 TLP at the central office. The threshold limit at the customer premises network interface (NI) should be reduced by the amount of loop loss.

TABLE O
PHASE JITTER LIMITS

MEASUREMENT TYPE (NOTES 2 AND 3)	PEAK-TO-PEAK DEGREES (NOTE 1)				
	TRANSMISSION GRADES			MULTIPOINT MIDLINKS & END LINKS (NOTE 4)	
	DA,TA	DB,DC,DD,DE	DG		
BELL 20-300 HZ	8/10	6/8	2/8	3/8	
LF 4-20 HZ	8/10	6/8	3/8	3/8	
BELL+LF 4-300 HZ	13/15	11/12	3/12	5/12	

Note 1: The first number is the maintenance limit. The second number is the immediate action limit. Measurements should be less or equal to these limits.

Note 2: Any two of the three measurements are considered a valid test. Dependent upon available test equipment, however, the BELL+LF is the currently recommended test.

Note 3: The BELL+LF immediate action limits of 12 and 15 degrees peak-to-peak are the only values guaranteed.

Note 4: If a multipoint end or midlink exceeds the limit, then the overall phase jitter must be verified to assure that it meets transmission grade DA limits.

TABLE P

**P/AR LIMITS FOR SINGLE AND MULTIFACILITY CHANNELS
MAINTENANCE LIMITS (NOTE)**

TYPE FACILITY	UPPER LIMIT	LOWER LIMIT
O,ON,N3	94	86
N1	98	86
L	99	87
N2	101	93
T1	102	93
T1+T1	97	88
N3+N3	93	83
N2+N2	96	88
N1+N1	93	85
T1+N3	95	87
T1+N2	96	88
N1+N3	97	87
ON+T1	96	87
ON+L	93	83
ON+N3	93	83
ON+N2	96	88
ON+N1	96	88
ON+ON	91	83
T1+N1	96	87
N2+N3	97	87
N1+N2	95	87
L+L	92	82
L+T1	95	86

See note at end of table.

TABLE P (Contd)

**P/AR LIMITS FOR SINGLE AND MULTIFACILITY CHANNELS
MAINTENANCE LIMITS (NOTE)**

TYPE FACILITY	UPPER LIMIT	LOWER LIMIT
L+N3	91	83
L+N2	96	86
L+N1	96	86
L+L+L	83	74
NL 0-18 kft nonrepeated cable		97
H88 0-18 kft nonrepeated cable		94
NL 0-18 kft repeated cable		90
H88 0-36 kft repeated cable		90
H88 >36 kft repeated cable		80

Note: These limits do not apply to C-conditioned channels.

TABLE Q

3-TONE SLOPE LIMITS FOR 2-POINT CHANNELS

±DB VARIATION RELATIVE TO 1004-HZ LOSS (NOTE 1)				
GRADE (NOTE 2)	IAL	ML	404 HZ	2804 HZ
VA	X		-2 to +11.5	-2 to +11.5
VA		X	-1.5 to +10.5	-1.5 to +10.5
VB	X		-2 to +9	-2 to +9
VB		X	-1.5 to +8	-1.5 to +8
VC	X		-2 to +6	-2 to +6
VC		X	-1.5 to +5	-1.5 to +5
VF	X		-2 to +6	-2 to +8
VF		X	-1 to +3	-1 to +5
DA	X		-2 to +10	-2 to +10
DB	X		-1 to +6	-1 to +6
DC	X		-1 to +5	-1 to +5
DD	X		-1 to +4	-1 to +4
DE	X		-2 to +4.5	-2 to +4.5
DG	X		-1 to +4.5	-1 to +4.5
DJ	X		-1 to +3	-1 to +3

Note 1: X indicates application of IAL and ML for each grade.

Note 2: When the channel has conditioning requirements, the attenuation distortion requirements apply (Table S).

TABLE R

3-TONE SLOPE LIMITS FOR MULTIPOINT CHANNELS

MAINTENANCE AND IMMEDIATE ACTION LIMITS						
±DB VARIATION RELATIVE TO 1004-HZ LOSS (NOTE)						
GRADE	MID-LINKS	END LINK	MID-LINK	404 HZ	2804 HZ	
VA	0	X		-1.5 to +4	-1.5 to +4	
	1	X		-1 to +4	-1 to +4	
			X		-1 to +3.5	-1 to +3.5
	2	X		-1 to -4	-1 to +4	
			X		-1 to +3.5	-1 to +3.5
	3	X		-1 to +3.5	-1 to +3.5	
			X		-0.8 to +3.5	-0.8 to +3.5
	4	X		-0.8 to +3.5	-0.8 to +3.5	
			X		-0.8 to +3	-0.8 to +3
	DA	0	X		-1.5 to +5	-1.5 to +5
		1	X		-1 to +5	-1 to +5
				X		-1 to +5
2		X		-1 to +5	-1 to +5	
			X		-1 to +4.5	-1 to +4.5
3		X		-1 to +4.5	-1 to +4.5	
			X		-0.8 to +4	-0.8 to +4
4		X		-1 to +4	-1 to +4	
			X		-0.8 to +4	-0.8 to +4

Note: X indicates required tests.

TABLE 5
ATTENUATION DISTORTION FOR 2-POINT CHANNELS

±DB DISTORTION RELATIVE TO 1004-HZ LOSS (NOTE 1)										
VOICE GRADE	FREQUENCY RANGE (HZ) (NOTE 2)	IMMEDIATE ACTION LIMIT	MAINTENANCE LIMIT (NOTE 3)	DATA GRADE	FREQUENCY RANGE (HZ) (NOTE 2)	IMMEDIATE ACTION LIMIT	MAINTENANCE LIMIT (NOTE 3)	CONDITIONING TYPE	FREQUENCY RANGE (HZ) (NOTE 2)	IMMEDIATE ACTION LIMIT
VA	400-2800	-2 to +11.5	-1.5 to +10.5	DA	500-2500	-2 to +8		C1	1000-2400	-1 to +3
	300-3000	-3 to +12	-3 to +12		400-2800	-2 to +10			300-2700	-2 to +6
VB	400-2800	-2 to +9	-1.5 to +8		300-3000	-3 to +12			2700-3000	-3 to +12
	300-3000	-3 to +12	-3 to +12	DB	400-2800	-1 to +6		C2	500-2800	-1 to +3
VC	400-2800	-2 to +6	-1.5 to +5		300-3000	-3 to +12			300-3000	-2 to +6
	300-3000	-3 to +12	-3 to +12	DC	400-2800	-1 to +5		C3	500-2800	-0.5 to +1.5
VF	300-500	-2 to +9	-1 to +6		300-3000	-3 to +12			CP-CO	300-3000
	500-2500	-2 to +6	-1 to +3	DD	400-2800	-1 to +4		C3	500-2800	-0.5 to +1
	2500-2800	-2 to +8	-1 to +5		300-3000	-3 to +12			CO-CO	300-3000
	2800-3000	-2 to +11	-1 to +8	DE	400-2800	-2 to +4.5		C4	500-3000	-2 to +3
			300-3000		-3 to +12	300-3200			-2 to +6	
				DG	400-2800	-1 to +4.5		C5	500-2800	-0.5 to +1.5
				DJ	500-2800	-1 to +3			300-3000	-1 to +3
				TA*	1200-2600	-3 to +3		C6	500-2800	-1 to +3
					300-3000	-3 to +12			300-3000	-2 to +6
								C7	400-2800	-1 to +4.5
									300-3000	-3 to +12

See notes at end of table.

TABLE S (Contd)

ATTENUATION DISTORTION FOR 2-POINT CHANNELS

±DB DISTORTION RELATIVE TO 1004-HZ LOSS (NOTE 1)										
VOICE GRADE	FREQUENCY RANGE (HZ) (NOTE 2)	IMMEDIATE ACTION LIMIT	MAINTENANCE LIMIT (NOTE 3)	DATA GRADE	FREQUENCY RANGE (HZ) (NOTE 2)	IMMEDIATE ACTION LIMIT	MAINTENANCE LIMIT (NOTE 3)	CONDITIONING TYPE	FREQUENCY RANGE (HZ) (NOTE 2)	IMMEDIATE ACTION LIMIT
								C8	400-2800	-1 to +3
									300-3000	-3 to +12
								T1	500-3000	-1 to +3
									300-3000	-2 to +6

Note 1: When the channel has conditioning requirements, the conditioning limit will supersede the transmission grade limit.

Note 2: Refer to Table U for frequencies to be measured.

Note 3: The limits in these columns have been selected to allow some margin before the immediate action value is reached. Circuits should be established and maintained within this range. Other transmission grades have only the immediate action limit specified within which circuits must be established and maintained.

*Telephoto transmission grade TA is measured relative to the circuit loss at 2200 Hz.

TABLE T
ATTENUATION DISTORTION FOR MULTIPOINT CHANNELS

±DB DISTORTION RELATIVE TO 1004-HZ LOSS (NOTE 1)										
GRADE OR CONDITIONING TYPE	FREQUENCY RANGE (HZ) (NOTE 2)	0 MIDLINKS	1 MIDLINKS		2 MIDLINKS		3 MIDLINKS		4 MIDLINKS	
		END LINK	END LINK	MIDLINK	END LINK	MIDLINK	END LINK	MIDLINK	END LINK	MIDLINK
VA	400-2800	-1.5 to +4	-1 to +4	-1 to +3.5	-1 to +4	-1 to +3.5	-1 to +3.5	-0.8 to +3.5	-0.8 to +3.5	-0.8 to +3
	300-3000	-1.5 to +6	-1.5 to +6	-1.5 to +6	-1.5 to +6	-1.5 to +5	-1.5 to +5	-1 to +4.5	-1.5 to +4.5	-1 to +4.5
DA	500-2500	-1.5 to +4	-1 to +4	-1 to +3.5	-1 to +4	-1 to +3.5	-1 to +3.5	-0.8 to +3.5	-0.8 to +3.5	-0.8 to +3
	400-2800	-1.5 to +5	-1 to +5	-1 to +5	-1 to +5	-1 to +4.5	-1 to +4.5	-0.8 to +4	-1 to +4	-0.8 to +4
	300-3000	-1.5 to +6	-1.5 to +6	-1.5 to +6	-1.5 to +6	-1.5 to +5	-1.5 to +5	-1 to +4.5	-1.5 to +4.5	-1 to +4.5
TA*	1200-2600	-2 to +2	-1.5 to +1.5	-1.5 to +1.5	-1.5 to +1.5	-1.5 to +1.5	-1.5 to +1.5	-1 to +1	-1.5 to +1.5	-1 to +1
	300-3000	-2 to +6	-1.5 to +6	-1.5 to +6	-1.5 to +6	-1.5 to +5	-1.5 to +5	-1 to +4.5	-1.5 to +4.5	-1 to +4.5
C1	1000-2400	-0.7 to +1.5	-0.6 to +1.5	-0.5 to +1.5	-0.5 to +1.5	-0.5 to +1.5	-0.5 to +1.5	-0.5 to +1	-0.5 to +1.5	-0.5 to +1
	300-2700	-1.5 to +3	-1 to +3	-1 to +3	-1 to +3	-1 to +2.5	-1 to +3	-0.8 to +2	-0.8 to +3	-0.8 to +2
	2700-3000	-1.5 to +6	-1.5 to +6	-1.5 to +6	-1.5 to +6	-1.5 to +5	-1.5 to +5	-1.5 to +4.5	-1.5 to +4.5	1 to +4.5
C2	500-2800	-0.7 to +1.5	-0.6 to +1.5	-0.5 to +1.5	-0.5 to +1.5	-0.5 to +1.5	-0.5 to +1.5	-0.5 to +1	-0.5 to +1.5	-0.5 to +1
	300-3000	-1.5 to +3	-1 to +3	-1 to +3	-1 to +3	-1 to +2.5	-1 to +3	-0.8 to +2	-0.8 to +3	-0.8 to +2
C4	500-3000	-1 to +1.5								
	300-3200	-1 to +3								
T1	500-3000	-0.7 to +2	-0.6 to +1.7	-0.5 to +1.5						
	300-3200	-1.5 to +4	-1 to +3.5	-1 to +3.5						

Note 1: When the channel has conditioning requirements, the conditioning limit will supersede the transmission grade limit. These are maintenance and immediate action limits.

Note 2: Refer to Table U for frequencies to be measured.

* Telephoto transmission grade TA is measured relative to the channel loss at 2200 Hz.

TABLE U

**MEASUREMENT FREQUENCIES FOR ATTENUATION DISTORTION
(NOTE 1)**

GRADE OR CONDITIONING	FREQUENCIES TO BE MEASURED (HZ)																
	304	404	504	604	804	1004	1204	1404	1604	1804	2004	2204	2404	2604 (NOTE 2)	2804	3004	3204
VA,VB,VC, DB,DC,DE, C7,C8	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	
VF,DA,C3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
TA*,C1	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	
DJ			X	X	X	X	X	X	X	X	X	X	X	X	X		
DG		X		X	X	X	X	X	X	X	X	X	X	X	X		
C2,C5,C6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
T1,C4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Note 1: X indicates frequencies to be used.

Note 2: When testing channels with 2600-Hz single-frequency signaling, measurements are made at 2504 and 2704 Hz and interpolated to determine the 2604-Hz measurement.

*Telephoto transmission grade TA is measured relative to the channel loss at 2200 Hz.

TABLE V

**INTERMODULATION DISTORTION MAINTENANCE LIMITS
(NOTES 1, 2, 3, 4, AND 5)**

RATIO OF DISTORTION PRODUCTS TO FUNDAMENTAL (DB)							
INTERMODULATION PRODUCTS	FACILITY TYPE						
	ON	N1	N2	N3	D1A D1B	D1D D2,D3,D4	L
Second Order	29	27	33	39	28	48	48
Third Order	33	30	43	37	38	51	49

Note 1: Limits are for all transmission grades.

Note 2: Uses the 4-tone test method.

Note 3: All measurements should be greater or equal to the limits shown.

Note 4: All measurements are facility dependent.

Note 5: To meet preservice tests, facility selection/restriction guidelines must have been applied in the initial design.

TABLE W

**INTERMODULATION DISTORTION IMMEDIATE ACTION LIMITS
(NOTES 1 AND 2)**

RATIO OF DISTORTION PRODUCTS TO FUNDAMENTAL (DB)							
INTERMODULATION PRODUCTS	TRANSMISSION GRADES						
	DA,TA	DB,DE	DC	DD	DG	D1,D2,D5 OVERALL	D5 END OR MIDLINK
Second Order	27	28	31	48	33	35	43
Third Order	32	35	38	50	39	40	51

Note 1: Use the 4-tone test method.

Note 2: All measurements should be greater or equal to the limits shown.

TABLE X

**GAIN HIT, PHASE HIT, DROPOUT LIMITS
(NOTES 1 AND 2)**

PARAMETER (NOTE 3)	HITS IN 15 MINUTES	
	FACILITY TYPE	
	N, ON, T, CABLE	LMX
Gain Hits ≥ 3 dB	0	≤ 2
Phase Hits $\geq 20^\circ$	0	≤ 2
Dropouts ≥ 12 dB	0	0

Note 1: These tests require a -13 dBm0, 1004-Hz tone applied at the far end.

Note 2: If one dropout occurs, continue test for another 15 minutes (not necessarily consecutively). If more than one dropout occurs in the total 30 minutes, then the reason for the trouble should be pursued.

Note 3: These are immediate action limits.

◆TABLE Y◆

**SINGLE FREQUENCY INTERFERENCE
(NOTE)**

CHANNEL LENGTH (MILES)	IAL (DBM0)
0-50	-62
51-100	-59
101-400	-56
401-1000	-52
1001-1500	-50
1501-2500	-48
2501-4000	-46
4001-8000	-43
Satellite	-47

Note: The power of interfering tones should be less than or equal to these limits.

TABLE Z
FREQUENCY SHIFT LIMITS

ALLOWABLE FREQUENCY SHIFT \pm HZ				
LIMIT TYPE	TRANSMISSION GRADES			MULTIPOINT MIDLINKS AND END LINKS
	DA,DE,TA	DL	DB,DC,DD	
Maintenance Limits	2	4	1	1
Immediate Action Limits	3	5	2	—

TABLE AA

**ENVELOPE DELAY DISTORTION LIMITS FOR 2-POINT CHANNELS
(NOTES 1, 2, AND 3)**

GRADE OR CONDITIONING	FREQUENCY RANGE (HZ)	DISTORTION LIMIT (μ S)
DA	800 to 2600	1750
DB	800 to 2600	1250
DC	800 to 2600	550
DD	800 to 2600	400
DE	800 to 2600	1500
DJ	1000 to 2800	100
DG	900 to 2500	400
TA	1200 to 2600	600
T1	1000 to 2600 800 to 2800	300 500
C1	1000 to 2400 800 to 2600	1000 1750
C2	1000 to 2600 600 to 2600 500 to 2800	500 1500 3000
C3 CP-CO	1000 to 2600 600 to 1000 500 to 2800	110 300 650
C3 CO-CO	1000 to 2600 600 to 1000 500 to 2800	80 260 500
C4	1000 to 2600 800 to 2800 600 to 3000 500 to 3000	300 500 1500 3000
C5	1000 to 2600 600 to 1000 500 to 2800	100 300 600
C6	800 to 2600	2000
C7	1000 to 2600	550
C8	1000 to 2600	125

Note 1: Refer to Table AC for measurement frequencies.

Note 2: When the channel has conditioning requirements, the conditioning limit will supersede the transmission grade limit.

Note 3: These limits are for both maintenance and immediate action limits.

♦TABLE AB♦

**ENVELOPE DELAY DISTORTION LIMITS FOR MULTIPOINT CHANNELS
(NOTES 1, 2, 3 AND 4)**

TRANSMISSION GRADE OR CONDITIONING	FREQUENCY RANGE (HZ)	0 MIDLINKS	1 MIDLINKS		2 MIDLINKS		3 MIDLINKS		4 MIDLINKS	
		END LINK	END LINK	MIDLINK						
DA	800-2600	960	685	550	550	400	400	375	375	275
TA	1200-2600	330	240	180	180	150	150	120	120	105
T1	1000-2600	165	115	100						
	800-2800	275	200	150						
C1	1000-2400	550	400	300	300	250	250	200	200	175
	800-2600	960	685	550	550	400	400	375	375	275
C2	1000-2600	275	200	150	150	125	125	100	100	80
	600-2600	825	600	450	450	375	375	300	300	260
	500-2800	1650	1200	900	900	750	750	600	650	500
C4	1000-2600	165								
	800-2800	275								
	600-3000	825								
	500-3000	1650								

Note 1: Refer to Table AC for measurement frequencies.

Note 2: When the channel has conditioning requirements, the conditioning limit will supersede the transmission grade limit.

Note 3: Distortion limits are in microseconds.

Note 4: These limits are for both maintenance and immediate action limits.

TABLE AC

**MEASUREMENT FREQUENCIES FOR ENVELOPE DELAY DISTORTION
(NOTE 1)**

TRANSMISSION GRADE OR CONDITIONING	FREQUENCIES TO BE MEASURED (HZ)															
	504	604	804	904	1004	1204	1404	1604	1804	2004	2204	2404	2504	2604 (NOTE 2)	2804	3004
DA,DB,DC,DE,C1,C6			X		X	X	X	X	X	X	X	X		X		
DJ					X	X	X	X	X	X	X	X		X	X	
DG				X	X	X	X	X	X	X	X	X	X			
TA						X	X	X	X	X	X	X		X		
T1			X		X	X	X	X	X	X	X	X		X	X	
C2,C3,C5	X	X	X		X	X	X	X	X	X	X	X		X	X	
C4	X	X	X		X	X	X	X	X	X	X	X		X	X	X
C7,C8					X	X	X	X	X	X	X	X		X		

Note 1: X indicates frequencies to be used.

Note 2: When testing channels with 2600-Hz single-frequency signaling, measurements are made at 2504 and 2704 Hz and interpolated to determine the 2604-Hz measurement.

TABLE AD
BENCHMARK MEASUREMENTS
(NOTE 1)

BENCHMARK MEASUREMENT	VOICE		DATA	
	TEST CENTER — CP	TEST CENTER — TEST CENTER	TEST CENTER — CP	TEST CENTER — TEST CENTER
DC Continuity	R	NR	R	NR
1004-Hz Loss	R	R	NR	NR
P/AR	NR	NR	R	R
3-Tone Slope	R*	R	R†	R†

Note 1: The following are definitions of symbols:

R — Recommended.

NR — Not required.

* The 3-tone slope parameter is required for VC grade only.

† The 3-tone slope parameter is not required on C-conditioned circuits.

TABLE AE
BENCHMARK LIMITS

MEASUREMENT PARAMETER	LIMITS TO PRESERVICE MEASUREMENT
Continuity	$\pm 20\%$ for predominantly aerial cable $\pm 5\%$ for predominantly underground cable $\pm 5\%$ for equipment
Loss	Transmission grades – VA, VB, VC, DA, DB, DC, DL, DD, DE, DJ, DG, and TA = $\pm 4\text{dB}$
P/AR	± 4 P/AR units
Slope	Use IAL from Tables Q and R