

## MESSAGE CIRCUIT NOISE MEASUREMENTS ON MESSAGE TRUNKS—REQUIREMENTS

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### 1. GENERAL

1.01 This section provides requirements for message circuit type noise, C-message weighted, all types of trunks used in direct distance dialing (DDD), extended area, and local dialing networks. The types of trunks covered by this section are the same as those listed in Section 660-402-300.

1.02 This section is reissued for the following reasons:

- (a) To include requirements for multifacility trunks
- (b) To show separately the requirements for trunks using voice-frequency facilities

(c) To provide a method for estimating noise at the distant end of E-repeatered trunks

- (1) E-repeater at the far-end terminal
- (2) E-repeaters at intermediate locations

(d) To provide a new set of noise limits tables which make it easier to determine the noise requirements for any trunk.

1.03 Tables A through E provide the noise limits for message trunks as follows:

• **Table A:** Voice-Frequency Metallic Facilities

• **Tables B and C:** Analog Carrier-terrestrial facilities and circuits longer than 1500 miles with one direction of transmission utilizing satellite facilities (1/2 hop). Table B applies to noncompandored facilities, and Table C applies to compandored ones.

• **Table D:** Satellite facilities and circuits shorter than 1501 miles with one direction of transmission utilizing terrestrial facilities (1/2 hop).

• **Table E:** Digital Carrier

1.04 The tables show circuit order and maintenance limits and immediate action limits: Any trunk in any mileage category shown in the tables should meet the circuit order and maintenance limits, provided it has been designed, installed, and maintained correctly. The immediate action limit, when exceeded, indicates that the trunk affected is very likely to cause adverse service

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reaction and should be removed from service immediately.

**1.05** The distant end of a trunk should always be terminated in office impedance during noise measurements. A 100-type test line or an equivalent balance test line dialed over the trunk to be tested may be used, or a termination of proper impedance (connected manually) will satisfy the requirement. This arrangement will allow for a far-to-near end noise reading. Centralized Automatic Reporting on Trunks (CAROT) or Trunk and Facilities Maintenance System (TFMS) testing to a 105-type test line will provide noise readings in both directions of transmission, and are preferred arrangements. Testing to a 104-type test line will allow for a far-to-near end noise reading, and will provide a near-to-far end noise indication (not a reading).

**1.06** All message circuit trunks, except as discussed below, must be in the "off-hook" condition at both terminals when being measured for noise. This is necessary because "off-hook" removes single frequency signaling tone, disables the single frequency signaling unit filter and places the trunk in the condition under which it is normally used. Trunks serving information operators, intercepting service, and a number of others normally return "on-hook" supervision when in the talking condition, in order to avoid charging the customer for calls to these services. "On-hook" supervision requires that 2600-Hz tone remain on the circuit as far as the signaling receiver where a band elimination or "slot" filter with 30-dB to 40-dB insertion loss at 2600-Hz reduces its amplitude to below objectionable levels. Enough 2600-Hz tone may remain, however, to affect noise measurements. Objectives for measuring the noise on these trunks while in the talking condition are not yet available.

**1.07** Noise measuring equipment must be calibrated before making measurements. The appropriate sections for the particular type of noise measuring equipment include calibrating instructions.

**1.08** For most purposes, noise on message circuit trunks may be measured at any convenient time of day. This results from the widespread application of single frequency signaling equipment, which tends to load the network with the power associated with inband signaling tones. These are present on all idle message trunks equipped with inband single frequency signaling, and contribute

approximately the same amount of power as the corresponding message signal when the trunk is in use.

**1.09** The requirements given in Tables A through E are designed for busy period calculations. In certain cases the noise may not be relatively constant throughout the day as described above, but may increase during the busy period. Trunks arranged for loop, simplex, or composite signaling may exhibit this effect.

**1.10** Noise measurements on voice-frequency trunks during the busy period may be preferred for critical evaluation of noise as the customer is likely to hear it. When external disturbances are suspected as the principal noise contributors, measurements during periods when the suspected external disturbances are most active will be the most meaningful.

**1.11** Trunks between No. 4 Crossbar Switching Machines, associated manual switchboards, class 5 and other offices may often be designed as "high-loss" trunks. That is, they include excess loss equal to the amount of the "A" pad in the trunks to which they may connect. However, this "A" pad is switched out when the trunk of which it is a part connects to a high-loss trunk. This type of design has no effect on the noise requirement at the end of the high-loss trunk remote from the 4-type crossbar office. At the 4-type crossbar end, however, the noise on the high-loss trunk when impressed on the connected trunk, would be increased by "A" dB by removal of the "A" pad. This increase would apply all the way to the distant customer location. With few exceptions, high-loss trunks are provided on voice-frequency facilities and noise requirements for such facilities are more stringent than for carrier facilities by more than the value of the "A" pad. Hence, the noise experienced by the distant customer would be no worse than if the high-loss trunk were replaced by a carrier trunk of normal low-loss design. For this reason, and in the interest of avoiding complex requirements, it has been decided to apply the same noise requirements for both ends of high-loss trunks, the same as other types of trunks.

**1.12** Noise measurements should be made at both ends of all trunks. In the case of 2-wire trunks (either with E-type repeaters and without a hybrid or with no-gain devices), however, the noise at the distant end may be estimated by the

appropriate method described in Part 5. The method of estimating provides a value that will seldom be exceeded, although the actual noise (if measured) might be found to be considerably less. Multifrequency transmitter equipped trunks must have noise measurements made at both ends.

**1.13** It is desirable to measure the loss of a trunk before making noise measurements. The value of the actual measured loss (AML) should be recorded, along with the noise measurement. Before the reasons for excessive noise are investigated, the cause of any excessive deviation from the trunk expected measured loss (EML) should be determined and corrected. In some cases, the cause of the excessive difference between the EML and AML may also be the reason for the apparent excessive measured noise.

## **2. TRUNK NOISE MEASUREMENTS**

**2.01** Transmission loss and noise measurements are both made on the trunk at the same level point. Trunks which contain a 2-dB test pad (TP2) or a 3-dB test pad (TP3) in the EML must include the test pad in the noise measurement, or compensate for the test pad when it is not included in the measurement by subtracting 2 dB or 3 dB, respectively, from the measurement.

**2.02** Yearly measurements are required for all types of trunks. Trunks tested with CAROT or TFMS to a 105-type test line have 2-way noise measurements made every time loss measurements are made.

**2.03** In the case of CAROT or TFMS testing to a combined (milliwatt and quiet termination) 100-type test line, both loss and noise readings will be provided for one direction of transmission. If the trunk being tested is a 2-wire trunk with no hybrids, the readings are estimated for the other direction of transmission.

## **3. TEST METHODS**

**3.01** The sections dealing with particular test boards, test frames, and other test locations, together with the sections describing the noise measuring equipment, give detailed methods for making noise measurements. The measurements at the outgoing end of a trunk are made via the test jack multiple of the trunk (or equivalent) or via an access trunk to the switching machine. At

the incoming end, they are made through the 101-type or equivalent, test line. For the purpose of noise measurements, a 2-way trunk is considered to be an outgoing trunk at the control office and an incoming trunk at the noncontrol office. Section 660-450-301 includes a list of sections which describe methods for making noise measurements at the various testing locations.

**3.02** The 100-, and 104-type test lines provide a quiet termination for making one-way manual noise measurements. Automated trunk maintenance systems such as CAROT and TFMS, when testing to a 105-type test line, provide 2-way noise and loss measurements.

**3.03** When a noise measurement does not meet circuit order and maintenance limits or immediate action limits, the character of the noise in descriptive terms should be determined and recorded on the appropriate test record form, along with the noise measurement. Examples are: tone, power hum, teletypewriter or data pulses, frying, hissing, crosstalk, static, etc. Where a monitoring arrangement is provided at the testboard, test frame, or switchboard, monitor the test connection during the measurement as directed by the section relating to the particular test location being used. If no monitoring arrangement is available or if the noise heard on the standard monitoring arrangement is not loud enough to be characterized, a 3-type noise measuring set or equivalent bridged across the circuit being measured and used with its associated monitoring receiver will provide adequate gain for monitoring.

## **4. REQUIREMENTS**

**4.01** Tables A through E give the busy period noise limits for trunks. The values are given in dBnc. The trunk or circuit layout record or WORD document should include the length of the trunk in miles, thus indicating the category to which it belongs and the applicable noise limit. The noise limit values in the table should be applied without any corrections to the noise measurements. The tables provide noise limits for the following:

- **Voice-frequency trunks**

- (a) Cable facilities
- (b) Open-wire facilities

- (c) Repeated
- (d) Nonrepeated

• **Noncompandored Analog Carrier**

- (a) Trunks made up entirely of noncompandored analog carrier facilities
- (b) Trunks longer than 1500 miles with one direction of transmission utilizing satellite facilities, and terrestrial facilities for the other (1/2 hop)

• **Compandored Analog Carrier**

- (a) Trunks made up entirely of compandored analog carrier
- (b) Trunks longer than 1500 miles with one direction of transmission utilizing satellite facilities, and terrestrial facilities for the other (1/2 hop)

• **Satellite**

- (a) Trunks using satellite facilities for both directions of transmission
- (b) Trunks shorter than 1501 miles utilizing satellite facilities in one direction of transmission, and terrestrial facilities for the other (1/2 hop)

• **Digital Carrier**

- (a) Trunks made up entirely of digital carrier facilities.

For trunks made up of more than one type of facilities (multifacility trunks) select the requirement for the facility with the higher dBrc value. Mileage applies as appropriate.

**4.02** The tables give two noise limits under each category. The lower is called the "circuit order and maintenance limit," and the higher the "immediate action limit." The first is based on measured values of noise on a large number of actual trunks, smoothed and adjusted to take into account the time, effects of environment, such as maintenance activity and component aging, and to provide an indication of the noise level at which plans for corrective action should begin. The

"immediate action limits" indicate the noise levels that have been found to seriously affect service. These noise limits should guide maintenance activity as follows:

- (a) The "circuit order and maintenance limit" must be met by all trunks when placed in service and when being restored to service following correction of a high noise condition. On subsequent routine measurements, the noise should remain at or below the circuit order and maintenance limit. If it does not, procedures should be initiated to reduce such noise at the earliest practicable opportunity. These circuit order and maintenance limits, therefore, serve to guide programmed maintenance activity by indicating where corrective action may be necessary. The objective of providing good telephone service is to keep the trunk noise at the lowest practicable value. Therefore, any corrective action should be performed with the intent of reducing noise as far as practicable and not under the established limit. The "circuit order and maintenance limit" also serves as the noise reference value for trunks measured with Automatic Transmission Measuring Systems (ATMS), TFMS, and CAROT.
- (b) The "immediate action limit," when exceeded, indicates that the trunk is very likely to cause adverse service reaction. Such trunks must be removed from service immediately and not returned until the noise is reduced to below the circuit order and maintenance limit.

**4.03** Noise on trunks (found by automatic measurements to exceed the immediate action limit) should be immediately verified. After troubles have been found and cleared, the trunk noise must be remeasured and, if below limits, the trunk is returned to service.

**5. ESTIMATING THE NOISE AT THE FAR END OF 2-WIRE VOICE-FREQUENCY TRUNKS**

**5.01** When routine maintenance noise tests are made at the near end of 2-wire voice-frequency trunks, the noise at the far end may be estimated. This does not apply to 4-wire trunks or 2-wire trunks equipped with 4-wire repeaters. These must be measured at both ends.

**5.02** In using the estimating technique, it is desirable to measure all identical trunks in

a group at the same time. The far-end noise estimate is made for all measured trunks. If it appears necessary to measure any of the trunks at the far end, then all should be measured. If the estimated values for all trunks are satisfactory, then the estimates are entered on the test record as the far-end noise values.

**5.03** The estimating technique (2-wire trunk) is as follows:

- (a) Add the AML to the near-end noise measurement
- (b) The estimated noise is satisfactory if it does not exceed the circuit order and maintenance limit.

**Note:** The near-end noise measurement and the AML are not added algebraically. Example - near-end noise measurement (+20 dBrnc) + (-4 dB AML) = 24 dBrnc far-end estimate of noise.

**5.04** The actual noise at the far end of a 2-wire trunk with no gain device depends, to varying degrees, on: (a) where the noise is introduced into the disturbed circuit, (b) where the noise is converted from longitudinal to metallic voltage or current, and (c) the combination of longitudinal and metallic losses. Since these combine in an unpredictable way, the safest procedure is to assume

that point of coupling and conversion are the same and are at, or very near, the far end. In this "worst" case, the far-end noise is simply the near-end noise increased by the AML of the circuit.

**5.05** The case of the 2-wire trunk with one or more E-type repeaters is somewhat more complicated, as the effect of the repeater on longitudinal voltages and currents is unknown. A "worst case" might be assumed for a trunk with a single E-type repeater at the far end with the noise introduced and converted from longitudinal to metallic at, or very near, the line side of the repeater (perhaps in the cable vault). In this case, the near-end noise would be reduced by the loss from the line side of the repeater at the far end. This loss would be greater than the AML by the gain of the repeater. Thus, the noise at the far end would be the near-end measured noise plus the AML plus the gain of the repeater. This situation does not cover the trunks with more than one repeater, or trunks with repeaters at locations other than the far end. To provide for these situations, simultaneous noise measurements were studied on both ends of a large number of 2-wire trunks with one or two repeaters at various points, taken from several operating companies in widely separated parts of the country. This study shows that noise at the far end will very rarely exceed a level corresponding to the near-end measured noise combined with the AML and 7 dB.

#### ESTIMATED NOISE AT FAR END

(a) 2-WIRE FACILITIES  
NONREPEATERED

dBrnc = NEAR-END + AML NOISE

(b) 2-WIRE FACILITIES  
E-REPEATER FAR END

dBrnc = NEAR-END + AML + GAIN OF E  
REPT NOISE

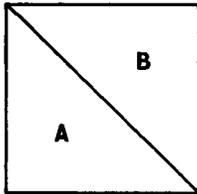
(c) 2-WIRE FACILITIES  
MULTI-E REPEATERS OR  
MID-POINT REPEATER

dBrnc = NEAR-END + AML + 7 dB NOISE

#### 6. TABLES

**6.01** Tables A through E show the noise limits for message trunks. All the limits are

shown in dBrnc. The requirements are shown as follows:



**A = CIRCUIT ORDER AND MAINTENANCE LIMIT**  
**B = IMMEDIATE ACTION LIMIT**

**6.02** Tables B through E show the message noise requirements by both the mileage of the trunk and the expected measured loss. Test pads are already included in the expected measured loss; therefore, the limits do not have to be adjusted to take them into account.

**6.03** The only adjustment which may be required to the limits in Tables B through E is when noise measurements are made without a test pad on a trunk at an office which utilizes a test pad when measuring loss on the same trunk. In this case the value of the test pad should be subtracted from the measurements before making comparisons with the requirements shown in the tables.

**NOISE LIMITS FOR MESSAGE TRUNKS**  
**LIMITS SHOWN IN dB<sub>rnc</sub>**  
**(SEE NOTE 1)**

**TABLE A**  
**VOICE FREQUENCY METALLIC FACILITIES**

HIGH LOSS (TOLL CONNECTING TRUNK WITH EML GREATER THAN 6 dB)	
ALL OTHER	

**TABLE B**  
**(SEE NOTE 2)**  
**ANALOG CARRIER - TERRESTRIAL**  
**NONCOMPANDORED**

EXPECTED MEASURED LOSS (EML)	MILEAGE							
	0 — 50	51 — 100	101 — 200	201 — 400	401 — 1000	1001 — 1500	1501 — 2500	2501 — 4000
0.0-0.5	31	33	35	37	40	42	43	45
0.6-1.5	30	32	34	36	39	41	42	44
1.6-2.5	29	31	33	35	38	40	41	43
2.6-3.5	28	30	32	34	37	39	40	42
3.6-4.5	27	29	31	33	36	38	39	41
4.6-5.5	26	28	30	32	35	37	38	40
5.6-6.5	25	27	29	31	34	36	37	39
6.6-7.5	24	26	28	30	33	35	36	38
7.6-8.5	23	25	27	29	32	34	35	37
8.6-9.5	22	24	26	28	31	33	34	36

**TABLE C**  
**(SEE NOTE 2)**  
**ANALOG CARRIER – TERRESTRIAL**  
**COMPANDORED**

EXPECTED MEASURED LOSS (EML)	MILEAGE							
	0 – 50	51 – 100	101 – 200	201 – 400	401 – 1000	1001 – 1500	1501 – 2500	2501 – 4000
0.0-0.5	26	28	30	32	35	37	38	40
0.6-1.5	25	27	29	31	34	36	37	39
1.6-2.5	24	26	28	30	33	35	36	38
2.6-3.5	23	25	27	29	32	34	35	37
3.6-4.5	22	24	26	28	31	33	34	36
4.6-5.5	21	23	25	27	30	32	33	35
5.6-6.5	20	22	24	26	29	31	32	34
6.6-7.5	19	21	23	25	28	30	31	33
7.6-8.5	18	20	22	24	27	29	30	32
8.6-9.5	17	19	21	23	26	28	29	31

**TABLE D  
(SEE NOTE 3)  
SATELLITE**

EXPECTED MEASURED LOSS (EML)		
0.0-0.5	42	46
0.6-1.5	41	46
1.6-2.5	40	44
2.6-3.5	39	44
3.6-4.5	38	42
4.6-5.5	37	42
5.6-6.5	36	40
6.6-7.5	35	40
7.6-8.5	34	38
8.6-9.5	33	38

**TABLE E  
DIGITAL CARRIER**

EXPECTED MEASURED LOSS (EML)		
0.0-0.5	28	34
0.6-1.5	27	32
1.6-2.5	26	32
2.6-3.5	25	30
3.6-4.5	24	30
4.6-5.5	23	28
5.6-6.5	22	28
6.6-7.5	21	26
7.6-8.5	20	26
8.6-9.5	19	24

***NOTES***

1. These tables may be utilized for other than message trunks when referenced in the Bell System Practices involved.
2. This table also applies to circuits longer than 1500 miles and one direction of transmission is via a satellite (1/2 hop).
3. This table also applies to circuits shorter than 1501 miles and one direction of transmission is via terrestrial facilities (1/2 hop).

All values are dBrnc and are to be utilized directly.

Noise measurements made without a test pad on a trunk at an office which utilizes a test pad when measuring loss on the same trunk should have the value of the test pad subtracted from the noise measurement before making comparisons with these tables.

When the trunk is routed over multiple facility types, select the requirement with the highest dBrnc value applicable.

For TSPS-RTA/PSS 2 trunks on a combination of noncompandored analog carrier and digital carrier with a total length exceeding 400 miles, the noise limit should be obtained from the 201-400 mileage category.

Those values that are shaded are the noise limits in dBrnc 0.