

CONTROL OF 1 KHZ TRUNK LOSS DEVIATIONS

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1. GENERAL

1.01 This section is concerned with the problems of maintaining trunk losses close to their engineered values. Control of loss variation is one of the major factors in providing good transmission on message trunks.

1.02 This issue is a major revision and combination of Sections 660-430-010, 660-430-012, and 660-430-013. Sections 660-430-010 and 660-430-013 have been cancelled and should be removed from files. Since this is a major revision, the use of arrows to identify changes has been omitted.

1.03 The following sections relate to this section and should be consulted regarding Control of Trunk Loss Deviations.

- (1) 660-430-011, Control of Loss Deviations—Administration of Measurements—Use of Forms E-3834 and E-5152

1.04 Alternate routing now used throughout our switching network requires close supervision of trunk losses. Small deviations from expected measured loss (EML) on individual trunks can accumulate into large values when several trunks are connected together. When trunks do not have enough loss, the connection may howl, echo, or sound hollow or noisy. Howling may cause other trunks in the same cable or on the same carrier system to become noisy. When trunks have too much loss, the connection may be unsatisfactory to the customer because of low volume. These conditions become increasingly serious as the number of links increases.

1.05 With direct distance dialing (DDD), it is impossible to verify the transmission quality of a connection in advance. Even on operator handled station-to-station calls, the operator does not perform this function. This is another reason for maintaining trunk losses close to the EML.

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1.06 It is also impractical, after the fact, to identify and test trunks that were a part of a connection with poor transmission. If the call is customer dialed, the customer cannot hold and report the trouble without using a second telephone. If the call is operator-dialed, and the customer flashes the operator to report the trouble, the operator cannot hold the connection without holding the called party's line busy.

1.07 In summary, the possibility of more links in tandem increases the probability that trunk loss deviations will accumulate in a connection to the point where they cause transmission difficulties. These difficulties will become known only as the result of customer complaints.

2. CONTROL OF LOSS DEVIATIONS AT CIRCUIT ORDER TIME

2.01 The first step in the control of loss deviations is the precise lineup of trunks at circuit order time.

2.02 Before trunks are placed in service, the originating and terminating cross-office losses are set as close to their desired values as the adjustable pads will permit. For example, if the minimum pad step size is 0.25 dB, the cross-office losses should be within half the step size (± 0.13 dB) of their nominal values.

2.03 When carrier facilities are provided, they should be aligned precisely, according to the procedures given in the appropriate Bell System Practices (BSPs).

2.04 The end-to-end trunk loss is usually required to be within ± 0.5 dB of EML at circuit order time, although for nonrepeated voice-frequency trunks and certain complex facilities larger deviations are allowed. Permissible deviations from EML at circuit order time are found in Section 660-450-301, Table L.

3. MONITORING OF LOSS DEVIATIONS ON A CONTINUING BASIS

3.01 The second step in controlling loss deviations is the periodic measurement of loss during the life of each trunk.

3.02 Routine loss measurements are made according to the intervals recommended in Section

660-402-300, Table I. More frequent measurements are recommended when automatic measuring equipment is used.

3.03 The results of routine loss measurements are used in the loss component of the quarterly Trunk Transmission Maintenance Index (TTMI).

3.04 A statistical approach is used to characterize trunk loss deviations. In a 1965 study, the distribution of measured loss deviations in selected offices was sampled and compared with a theoretical normal distribution with the same mean and standard deviation. It was found that the sampled distribution had longer "tails" (a greater fraction of large deviations) than the theoretical normal distribution.

3.05 In order to control the overall spread of the distribution of loss deviations, with proper attention to the relatively long "tails", the loss component of the TTMI is designed to monitor the shape of the distribution at a number of points, and to encourage the measurement of as many trunks as possible. Detailed information on the loss component of the TTMI is found in Sections 301-121-100, 301-121-300, and 301-121-500.

3.06 A uniformly high value (97) for all index subcomponents requires the following:

(a) More than 96.5 percent of the trunks must be measured.

(b) For metallic facility terminal (MFT), E-repeated and nongain trunks, not more than 12 percent of the loss deviations should exceed ± 0.7 dB.

(c) For trunks with non-E repeaters or carriers, not more than 30 percent of the deviations should exceed ± 0.7 dB and not more than 4.5 percent should exceed ± 1.7 dB.

3.07 Clearly, it is not the intent of the TTMI to require that *all* trunks be adjusted to within ± 0.7 dB, as this would carry maintenance beyond the point of diminishing returns.

3.08 Trunks with deviations exceeding ± 3.7 dB must be removed from service until necessary corrective action is completed.

4. USE OF MEASUREMENT DATA TO GUIDE MAINTENANCE ACTIVITY

4.01 Loss measurements by themselves do not control variations, nor do they bring about improvement. It is apparent that a program of correction must be maintained. The program should consist of analysis of results of measurements, determination of the cause of repeat troubles, and the correction of the cause of troubles found.

4.02 Although the only mandatory maintenance activity associated with loss deviations is the immediate turning down of trunks with deviations larger than 3.7 dB, the achievement of a satisfactory TTMI requires corrective action on trunks with deviations less than this amount.

4.03 Each office should determine the criteria for corrective action, considering the number of trunks with excessive deviations, the available manpower, and the current loss index objective. Section 660-402-300, Table II provides suggested deviation limits, depending on trunk facility makeup, beyond which corrective action might be cost-effective. In general, the trunks with the greatest deviations should be worked on first.

4.04 *Corrections should always bring the trunk within circuit order limits*, not just below the 1.7 dB or 0.7 dB points used in calculating the loss index.

4.05 Some individual trunks are very unstable. The problem is to identify these "bad actors" and then to find out why they are "bad actors".

4.06 Another area of improvement lies in correction of trunk groups, carrier channel groups, or cable routes which have like deviations. Analysis of this type of trouble can be facilitated by the use of mechanized arrangements such as Centralized Automatic Reporting On Trunks (CAROT), Trunk and Facility Maintenance Systems (TFMS), or test frames equipped with Automatic Transmission Measuring Systems (ATMS).

4.07 Results should be analyzed to determine where the maintenance effort can be most effectively applied. For example, it is undesirable to correct each trunk loss that deviates only a fraction of a dB unless the entire group or system is biased in one direction. There may be instances where past history indicates the trunk is very

stable, yet deviating a small amount from the EML. In such cases, corrective action may be desirable.

5. IDENTIFYING AND DETERMINING THE CAUSE OF "BAD ACTORS"

5.01 Whenever a trunk is adjusted to correct loss deviations, a trouble ticket (Form E-5840 or equivalent) must be written. The tickets should be analyzed periodically (in accordance with the Controlled Maintenance Plan for Transmission and Signaling Equipment Serving all Trunks and Special Services—Section 010-300-010) and trunks which have required frequent adjustment should be identified, removed from service, and thoroughly investigated for the cause of the loss fluctuations.

5.02 The method of determining the cause will vary greatly depending upon test facilities available, manpower available, and suspected trouble conditions. Each case must be diligently pursued and corrected.

6. CONTROLLING POSSIBLE SOURCES OF MEASURED LOSS DEVIATIONS

6.01 Measured trunk losses can vary from design values for several reasons:

- (a) Failure to meet the design requirement exactly at the beginning of service
- (b) Variations in test power sources and accuracies of measuring sets
- (c) Effects of environmental changes such as temperature and humidity
- (d) Aging and deterioration of components
- (e) Workman caused errors
- (f) Automatic switching of amplifiers, radio channels, etc.

6.02 Many loss fluctuations can be traced to poorly controlled maintenance activity. Equipment is often switched or patched for routine maintenance or service restoration. Trunk cables are half-tapped, loaded or rearranged. Pads are erroneously changed, SF units adjusted, etc. It is important to control both the frequency and manner of conduct of those activities. Spare equipment

should be maintained in proper adjustment. Proper records should be kept and transmission levels should be checked after any temporary or permanent change in equipment.

6.03 Trunk loss deviations should be properly sectionalized before correction. A CORRECTLY ALIGNED SECTION OF A TRUNK SHOULD NEVER BE ADJUSTED TO CORRECT FOR ANOTHER MISALIGNED SECTION. Such erroneous correction can impair the noise performance of the trunk and can create difficult-to-trace maintenance problems later on, especially if the trunk is rearranged.

6.04 The maintenance of milliwatt supplies, measuring equipment, and transmission test lines is absolutely essential to maintain minimum trunk loss variations. When these equipments are incorrectly adjusted, the loss index is equally incorrect. Adjustments of circuit losses, based on measurements with incorrectly adjusted equipment, obviously compounds the problem.

6.05 Certain fluctuations of loss can be attributed to the design of the facility. In every investigation of trouble, it is the responsibility of plant forces to actively attempt to correct the

condition. However, when it becomes reasonably apparent that trouble lies in the design of the trunk or carrier system, a recommendation for replacement or redesign should be transmitted through channels to the Engineering Department.

7. SUMMARY

7.01 In summary:

- (a) Proper network performance on built-up connections requires that trunk losses be held close to their design values.
- (b) Trunk losses should be set precisely at circuit order time and monitored at regular intervals thereafter.
- (c) Trunks with loss deviations larger than ± 3.7 dB should be removed from service immediately for corrective action.
- (d) Trunks with deviations less than this amount should be corrected according to an office-determined schedule designed to meet loss index objectives with reasonable use of the available work force.